WAYNE COUNTY MICHIGAN
EXECUTIVE
WARREN C. EVANS
SERVING 43 COMMUNITIES

WAYNE COUNTY
Stormwater Control Program
Adopted September 2021

Stormwater Control Standards

Stormwater Control Ordinance

Stormwater Administrative Rules

ACKNOWLEDGEMENTS

The Wayne County Stormwater Ordinance, Administrative Rules, and Standards Manual (collectively referred to as the Wayne County Stormwater Program) originally were developed during 1998-2000 in collaboration among Wayne County, local communities, engineering firms, developers, and other interested parties. Wayne County gratefully appreciates the perspective on and suggestions to the proposed program brought by the over 70 people who attended the two original workshops or otherwise provided comments on the program.

Subsequent to the adoption of the regulations in October 2000, additional comments and suggestions have been made by a variety of interested parties. Numerous suggestions were made by the over 100 individuals who have attended the Wayne County Stormwater Summits in 2005, 2007, 2016 and 2019. All of these comments and suggestions have been very helpful in crafting and implementing a realistic, workable stormwater management program which is critical to our mutual efforts to protect and restore our water resources and reduce flood hazards.

The current versions of the Wayne County Stormwater Ordinance, Administrative Rules, and Standards Manual were prepared by a Wayne County workgroup that also oversees implementation. These items are collectively referred to as the 'Wayne County Stormwater Program,' because they are to be read together for a complete understanding of the County's requirements and best practices for stormwater management. The workgroup consists of staff from the Department of Corporation Counsel, Department of Public Services (Engineering, Parks and Environmental Services), and OHM Advisors. The workgroup gratefully acknowledges the significant contributions (financial and through suggested changes) made to the regulations and Standards Manual by the Alliance of Downriver Watersheds (ADW) through its SAW grant program.

Wayne County also wishes to acknowledge the efforts of the Regional Stormwater Standards Coordination Committee (RSSCC), a regional collaboration that included Wayne, Oakland, Macomb, and Livingston Counties. It was through this process that the four counties were able to develop rules that were largely consistent across the region, thereby leveling the playing field for development and redevelopment through most of southeast Michigan.

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CHAPTER 1: INTRODUCTIONS

The standards manual supplements the Wayne County Stormwater Management Ordinance, Chapter 95 (Stormwater Management) of the Code of Ordinances of the Charter County of Wayne, as amended (Enrolled Ordinance No. 2021-526a, adopted August 19, 2021); and the Wayne County Stormwater Management Administrative Rules, as amended (Resolution No. 2021-526b, adopted August 19, 2021). For ease of reference in this manual, the Wayne County Stormwater Ordinance, Administrative Rules, and this manual are collectively referred to as the "Stormwater Program."

The purpose of this manual is to outline key elements of the Ordinance and Rules and to assist with their implementation. The manual describes stormwater control requirements that apply to development projects within Wayne County's jurisdiction. Specifically, the manual describes:

- Performance standards for stormwater control systems. The County established the performance standards in order to reduce the magnitude and frequency of urban flooding, control the volume of stormwater runoff where practical, and reduce the concentration of pollutants in stormwater runoff that can result from property development.
- Design criteria for the various components of stormwater control systems. Applicants for stormwater construction approval select various components to meet the performance standards.
- Design and maintenance information for various Best Management Practices (BMPs).

Many development and construction projects that require Wayne County review and approval must conform to the Standards. In general, the types of projects that are subject to the Standards include:

- Multi-unit residential development, commercial, and industrial subdivisions
- mobile and manufactured home parks
- projects that impact stormwater runoff into or around new or existing
  - Wayne County Road rights-of-way;
  - County Road drainage facilities;
  - Storm sewer systems owned, operated, or controlled by the County; and
  - Projects that impact stormwater runoff into or around Wayne County Drains
- projects that impact stormwater into, on, or through properties owned by Wayne County (e.g., County parks)
- projects developed, designed or constructed by Wayne County
- projects that occur within and impact or may impact water quality or water resources in watersheds or sub-watersheds included in the County's Permit for municipal stormwater discharges ("Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s) Subject to Watershed Plan Requirements," Permit No. MI0060059.

If a proposed development presents unique flood control or water resources protection issues at a development site, on adjacent properties, or downstream of a development site, more stringent performance standards and design criteria than those described in the Standards may be imposed.

The obligation to enact and implement stormwater design standards related to frequent hydrologic events (2-year recurrence interval storm and smaller) was imposed upon the County, local governments, and other public agencies by Phase II of the federal National Pollutant Discharge Elimination System (NPDES) stormwater regulations. These obligations include the development, implementation, and

enforcement of programs to manage stormwater quality and runoff volume from development and redevelopment projects. These obligations also require the County to establish protocols for addressing the perpetual operation and maintenance of all stormwater BMPs. Managing stormwater will help to minimize flooding problems, erosion, improve water quality, and protect against the loss of natural resources.

Chapter 4 describes how to obtain Wayne County stormwater construction approval for a project that is subject to the Wayne County Standards. Developers work with the Construction Permit Office, Wayne County Department of Public Services, to obtain a stormwater construction permit and implement the requirements of the Wayne County Standards. Key links to the County's website are listed below:

Permit Application Kit, Application Form, Plan Checklists, Cost Schedule:
Construction Permit Office | Public Services (waynecounty.com)
or
https://www.waynecounty.com/departments/publicservices/engineering/construction-permit.aspx

Stormwater Management Resources
Storm Water Management | Environmental Services (waynecounty.com)
or
https://www.waynecounty.com/departments/environmental/waterquality/storm-water-management.aspx

Wayne County Drains
County Drains | Environmental Services (waynecounty.com)
or
https://www.waynecounty.com/departments/environmental/facilities/county-drains.aspx

CHAPTER 2: BACKGROUND

The entire land area that drains to a given waterbody (such as a lake or stream) is referred to as a watershed. Wayne County lies within portions of the following watersheds and subwatersheds:

- Lake St. Clair Direct Drainage
- Detroit River North
- Rouge River (includes Rouge Middle 1, Upper Rouge, Rouge Lower 1, Rouge Main 3-4, Rouge Lower 2, and Rouge Middle 3 subwatersheds)
- Ecorse Creek
- Combined Downriver (includes Frank and Poet Drain, Blakely Drain, and Detroit River South watersheds)
- Huron River (includes Middle Lower Huron River and Lower Huron River subwatersheds)
- Swan Creek

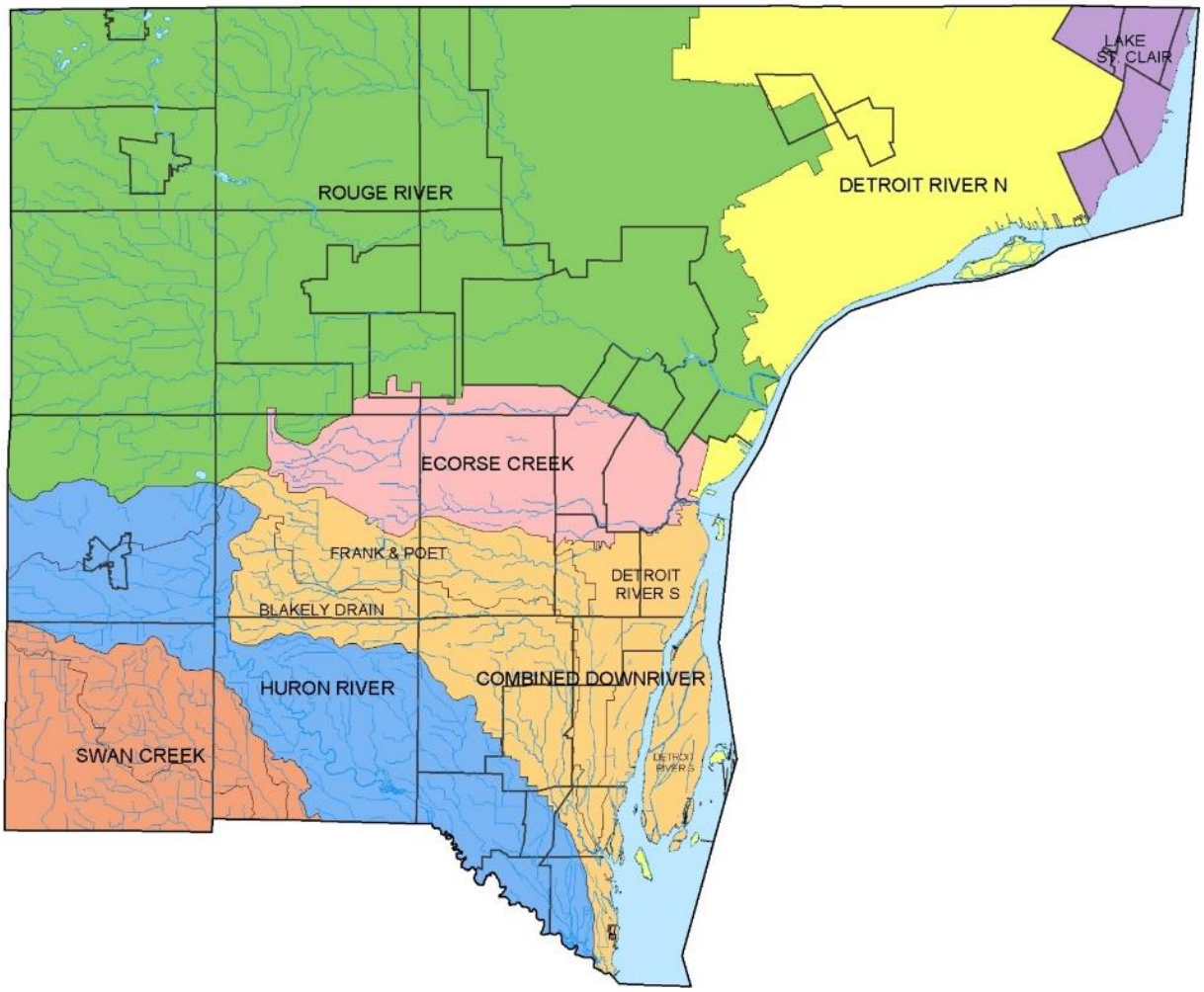


Figure 2-1 Major Hydrologic Watersheds located in Wayne County

All of the watersheds within Wayne County ultimately discharge to the Detroit River and/or Lake Erie.

To protect and improve receiving stream water quality and minimize flooding, Wayne County is obligated to implement a program to manage stormwater runoff from development projects that occur within the portions of these watersheds that lie within Wayne County (see Figure 2-1).

2.1 Stormwater Management Trends

New development creates buildings and other paved areas (called impervious surfaces) that increase the amount of rain water and snowmelt that runs off the areas onto other properties or into nearby rivers and streams. Traditional stormwater management has involved controlling and managing the increased runoff from the developed areas, either by altering the downstream watercourse to increase its capacity for conveying flow (e.g. enclosing, paving, or straightening a drain), or by reducing the flood flow rates using a detention basin.

Current stormwater management philosophy recognizes not only flood control but also the water resource impacts of stormwater runoff. Stormwater runoff is a major source of pollution and degradation of our waterways. As rainwater or snowmelt flows across the land, the runoff picks up pollutants that accumulate on the surface (such as fertilizers and pesticides from lawns, oil and grease from parking lots and roads, animal waste, and household hazardous waste) and conveys the pollutants into the waterways. Stormwater also picks up bacteria from septic systems, toxins from abandoned dumps, and sanitary sewage from illicit sewer connections.

Figure 2-2: Wayne County Parks Strategic Master Plan, May 2017

Reauthorizations of the Clean Water Act have reaffirmed the commitment to control stormwater runoff as a source of water pollution. Just as the quantity of stormwater is controlled to protect downstream interests, modern stormwater management addresses pollutants to prevent degradation of downstream water quality and to protect aquatic life and habitat. A brief history of the regulatory changes that have expanded requirements for controlling the pollutants in stormwater is listed below:

- Beginning in 1991, the federal Clean Water Act required communities with populations over 100,000 that were served by separate storm sewer systems to obtain National Pollutant Discharge Elimination System (NPDES) permits. Phase I of the federal NDPES stormwater regulations required communities to obtain NPDES permits in order to discharge stormwater to creeks, streams and rivers. Construction sites greater than 5 acres in area and certain categories of industry also were required to obtain stormwater discharge permits.

- Beginning in 1999, Phase II of the federal NPDES stormwater regulations was implemented. Phase II requires communities in urbanized areas with populations *under* 100,000 to obtain NPDES discharge permits. To obtain a permit, the Phase II regulations required municipal permit holders to reduce the discharge of pollutants in stormwater runoff to the "maximum extent practicable" by

developing and implementing programs to address a variety of stormwater issues, including "post construction stormwater control." In accordance with this requirement, municipal permit holders must require developers to construct permanent stormwater control measures as part of their development projects. Communities and other public authorities subject to Phase II of the federal NPDES stormwater regulations are required to apply, and re-apply, for permits to discharge stormwater to Michigan's surface waters, roughly every five (5) years. Phase II of the program also required stormwater permits for construction sites greater than 1 acre in area and additional categories of industry.

- The Michigan Department of Environment, Great Lakes and Energy (EGLE), formerly called the MDEQ, issues stormwater discharge permits in Michigan. Beginning in 2013, EGLE places additional requirements on stormwater management for land development, including specific controls for Total Suspended Solids (TSS) for the first 1.0 inch of rainfall, peak flow control for the 2-year, 24-hour storm, as well as runoff volume controls which typically require infiltration BMPs. Wayne County and virtually all communities in Wayne County are subject to the NPDES Phase II permit requirements.

Additional information about the federal NPDES program and its implementation in Michigan and in Wayne County is provided in Chapter 3.

2.2 Wayne County's Commitment

Wayne County, working with its partner citizens, businesses, communities, and agencies, is committed to improving and protecting streams, rivers, and lakes for enhanced environmental quality and recreational opportunities, and for the protection of the public health and quality of life. This commitment includes flood control and water resource protection through stormwater management.

Figure 2-3: Wayne County Fishing Derby (source: Wayne County Parks and Recreation)

Wayne County has been a leader in flood control and water resources protection through several ongoing and new initiatives. For example:

- For many years, Wayne County's Rouge River National Wet Weather Demonstration Project has received national attention for its evaluation of different pollution control and river restoration techniques.

- Since 1987, the County's illicit discharge elimination program has identified and eliminated failing septic systems and improper sanitary sewer connections, which contribute bacteria and pollutants to stormwater runoff.

- In 1999, well in advance of the March 2003 federal deadline, Wayne County obtained a certificate of coverage under the voluntary, watershed-based Michigan General Stormwater Permit. Wayne County developed and implemented a wide range of stormwater pollution prevention measures throughout the County under this voluntary permit.

- In March 2003, Wayne County applied for coverage under the re-issued, mandatory watershed-based General Permit (Permit No. MIG619000). Wayne County's certificate of coverage under the general permit was MIG6190040.

- In 2008, changes were made to the Stormwater Management Manual to address the Engineer's Certificate of Construction and to update forms and policies for long term maintenance of stormwater control systems, as well as updates to requirements for easements, detention basins, underground detention systems, and manufactured treatment systems.

- In July 2015, Wayne County modified the Stormwater Management Manual, specifically, Chapter 6: General Design Standards, Chapter 8: Best Management Practices and Chapter 11: Sample Calculations.

- In April 2016, Wayne County applied for coverage under the mandatory individual Municipal Separation Stormwater System (MS4) permit.

- Since 2018, Wayne County has been an active participant in the Regional Stormwater Standards Coordination Committee (RSSCC) to develop regional stormwater standards with Oakland, Macomb, and Livingston counties.

- In September 2020, EGLE issued Wayne County's MS4 permit number MI0060059.

The Wayne County Stormwater Control Program is a critical component of the County's stormwater management efforts and are required under the County's Individual MS4 Permit. Under their own stormwater permits, all Wayne County communities are required to implement stormwater management programs to control stormwater runoff from development projects. Application of similar standards to development projects across Wayne County under both the County's program and local programs will maximize the effectiveness of stormwater management within the County.

CHAPTER 3: ADMINISTRATION & REGULATIONS

The Wayne County Stormwater Program are administered by the Wayne County Department of Public Services (WCDPS). In addition to Wayne County, other agencies are involved with stormwater management and may have jurisdiction over the design, construction and maintenance of stormwater control systems. The stormwater management authority of various agencies, including Wayne County, is summarized in this Chapter.

3.1 Wayne County

Drain Code, Act 40 of 1956, as amended

The Drain Code of 1956, as amended (Drain Code) governs the construction, maintenance and improvement of established drains. Under the Drain Code, a drain can include sanitary sewers, pumping equipment, and other structures and mechanical devices that are required to purify the flow of water, as well as detention and retention basins. The Drain Code authorizes the levying and collection of special assessments in certain circumstances and prescribes penalties for violations of the code.

The Wayne County Drain Commissioner is an appointed position by the Chief Executive Officer and is responsible for implementing and administering the Drain Code.

Subdivision Control Act, Act 288 of 1967, as amended

This state law requires County Drain Commissioners to ensure that the drainage within platted subdivisions is adequate to address stormwater management needs within the proposed subdivision and protects downstream landowners from flooding. Through the subdivision review process, Drain Commissioners are authorized to impose obligations upon developers to ensure that drains and natural watercourses, both inside and outside the plat, are improved to the Drain Commissioners' standards when necessary for the proper drainage of a proposed subdivision.

The Subdivision Control Act also requires County Drain Commissioners to ensure that stormwater control systems necessary for proposed subdivisions are maintained in perpetuity by an appropriate governmental unit. Alternatively, Drain Commissioners must ensure that a governmental unit will oversee the performance of maintenance by a private entity, such as a property owner's association. Drain Commissioners may acquire jurisdiction over the drainage systems within subdivisions as deemed necessary for adequate operation and maintenance.

In Wayne County, the functions of the Drain Commissioner under the subdivision control act have been assigned to the WCDPS Construction Permit Office.

Mobile Home Commission Act, Act 96 of 1987

This state law requires County Drain Commissioners to review and approve outlet drainage for proposed manufactured or mobile home parks. Proprietors are required to submit preliminary site plans for purposes of this review.

In Wayne County, the functions of the County Drain Commissioner under the Mobile Home Commission Act have been assigned to the WCDPS Construction Permit Office.

Parks and Airports, Act 90 of 1913, as amended

This state law authorizes the County to purchase and own real estate to use as public parks and airports. Under Act 90, Wayne County is responsible for the care and control of park and airport property. As a corollary to this responsibility, the County may make reasonable rules and regulations respecting the use of the park and airport property by the public. These regulations include requirements and standards pertaining to the use of park or airport property for the control of stormwater drainage from neighboring properties.

County Road Law, Act 283 of 1909, as amended

The County Road Law authorizes county Road Commissioners to grade, drain, construct, surface, and otherwise maintain roads under their control. In addition, the law requires persons who desire to construct or perform any work within county road rights-of-way to obtain a permit from the county.

In Wayne County, the executive powers and duties of the County Road Commission are vested in the Roads and Engineering Divisions of WCDPS.

Riparian Rights

Owners of land that are adjacent to natural watercourses have "riparian rights" associated with the ownership of water frontage. These rights include the right to hold the land up to the water's edge secure against the unauthorized use of the property or riparian waters by non-riparian landowners. Wayne County is a riparian landowner by virtue of owning park lands and other property adjacent to natural watercourses within county watersheds. As such, the County may reasonably restrict the use of these County lands for stormwater drainage from neighboring properties.

Wayne County Certificate of Coverage, EGLE Stormwater General Permit

As discussed in Chapter 2, the County's certificate of coverage and the Michigan Individual Permit obligated the County to develop and implement the post construction stormwater control standards contained in this Manual. The County's compliance with the Individual Permit is coordinated by the Environmental Services Division of WCDPS.

Wayne County Soil Erosion and Sedimentation Control Ordinance

Wayne County adopted the Soil Erosion and Sedimentation Control Ordinance, Chapter 94 of the Code of Ordinances of Wayne County (1998) (the "SESC Ordinance"), in October 2001. The County is an Enforcing Agency responsible for administration and enforcement of Part 91 (Soil Erosion and Sedimentation Control) of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, as amended. Pursuant to the SESC Ordinance, Wayne County Environmental Services Division reviews soil erosion and sedimentation control plans and issues permits for earth changes subject to the Ordinance. The SESC Ordinance incorporates the administrative rules promulgated by the State of Michigan under Part 91, and provides for:

- penalties and civil fines as provided under Part 91;
- consent agreements;
- municipal civil infraction citations and notices; and
- a schedule of civil fines authorized under the Wayne County Municipal Civil Infractions Ordinance, Chapter 2 of the Code of Ordinances of Wayne County (2000).

In numerous communities within Wayne County, the Environmental Services Division administers the Michigan Soil Erosion and Sedimentation Control Act pursuant to the SESC Ordinance.

Wayne County Solid Waste Ordinance

Wayne County adopted amendments to the Solid Waste Ordinance, chapter 104 of the Wayne County Code of Ordinances (1998) (the "SW Ordinance"), in September 2004. Under the SW Ordinance, all new solid waste disposal areas that require a construction permit under state law must apply to Wayne County for stormwater construction approval. Existing sanitary landfills must use a combination of retention basins, swales, and/or ditches to manage runoff from landfill areas. The SW Ordinance is administered and implemented by the Environmental Services Division of WCDPS.

Wayne County Sewer Use Ordinance

The County adopted the Sewer Use Ordinance, chapter 101 of the Wayne County Code of Ordinances (1998), in 1995 and amended the ordinance in 1998. The sewer use ordinance requires permits for connections or alterations to county-owned stormwater facilities or public stormwater facilities connected directly or indirectly to County facilities, including sewers and the County interceptor system. The ordinance governs design, construction, alteration and use of County sewer facilities, imposing discharge rate limitations, right-of way requirements for County Drains and natural watercourses, design flow calculation methodology, sewer pipe specifications and construction requirements.

Wayne County Stormwater Management Ordinance and Administrative Rules

Wayne County enacted the Wayne County Stormwater Ordinance and Administrative Rules in 2000 and most recently amended the Ordinance and Administrative Rules on MONTH, DAY, 2020. This manual was revised in 2020 to conform to the amendments. The ordinance and rules, along with this manual, are collectively referred to as the "Stormwater Control Program."

3.2 Local Municipalities

The municipality or municipalities in which a proposed project is located may have local stormwater control standards for design, construction and maintenance. Construction activities within the municipality may be subject to these local standards. The Wayne County Stormwater Control Program does not limit the authority of municipalities within the County to develop and implement their own stormwater control standards that are equal to or more stringent than the County Standards.

3.3 State of Michigan

3.3.1 Michigan Department of Transportation (MDOT)

MDOT is involved with all drainage facilities associated with any MDOT road right-of-way. A permit is required for any work within the right-of-way of any MDOT route. Contact MDOT or see the MDOT website (http://www.michigan.gov/mdot) for information about MDOT routes in Wayne County.

3.3.2 Michigan Department of Environment, Great Lakes, and Energy (EGLE)

Subdivision Control Act, Act 288 of 1967, as amended

Under this Act, subdivisions that include a watercourse that drains an area of two square miles must meet prescribed standards for residential purposes and occupancy within a flood plain. These standards refer to such items as minimum lot area, street access, lowest finish floor elevation, and basement openings above the flood plain.

Michigan Natural Resource & Environmental Protection Act (NREPA), Act 451 of 1994, as amended

Part 31 - Water Resources Protection

Stormwater Management

EGLE regulates stormwater discharges pursuant the National Pollutant Discharge Elimination System (NPDES) permit program authorized by the federal Clean Water Act and enforced at the federal level by the United States Environmental Protection Agency (USEPA).

The current phase of the NPDES stormwater permit program (Phase II) has been in place since 2003. This program covers communities and public institutions within the U.S. Census-defined Urbanized Area, which includes virtually all of Wayne County. EGLE has enforced this program on behalf of the US EPA and has made changes to the permit program multiple times. This revision of the Stormwater Program reflects the latest regulatory requirements for stormwater controls as defined by EGLE.

A summary of the Michigan's requirements for discharges from construction sites, industrial sites, and municipal separate storm sewer systems is presented below.

Construction Sites.

Michigan landowners responsible for construction activities disturbing 5 acres or more with a point source discharge to waters of the state may obtain permit coverage for their stormwater discharges under the "Permit-by-Rule" developed by EGLE. To obtain coverage under the Permit-by-Rule, an applicant first must obtain a Soil Erosion and Sedimentation Control (SESC) permit. An SESC permit may be obtained from WCDPS or from a local community that is a "Municipal Enforcement Agency" under Part 91 of NREPA.

After obtaining a SESC permit, the applicant submits a completed Notice of Coverage (NOC) form, with an application fee, to EGLE. After EGLE receives the NOC and application fee, the permittee is deemed to be covered under the NPDES program. The permit requires, among other things, that the permittee appoint a stormwater operator responsible for the supervision and inspection of the soil erosion control measures. The stormwater operator must be certified by EGLE.

For construction activities disturbing between 1 and 5 acres, the landowner is required to obtain a SESC permit and comply with the provisions of the EGLE Permit-by-Rule. Developers of such smaller sites need not submit a Notice of Coverage application to EGLE.

Industrial Sites.

Industrial facilities in Michigan that are subject to the NPDES program may obtain stormwater discharge authorization by obtaining one of three types of permits: a generic baseline general permit, a generic general permit with monitoring requirements, or a site-specific individual permit. Approximately 4,000 industrial facilities in Michigan have obtained stormwater discharge authorization under one of these permit programs.

Permitted industrial facilities must designate an individual at the facility who is responsible for exercising supervision and control over the control structures at the facility, eliminating any unauthorized non-stormwater discharges, and developing and implementing a stormwater pollution prevention plan for the facility, including structural and nonstructural control measures. The individual must be certified by EGLE as a stormwater operator.

Municipal Separate Storm Sewer Systems (MS4s).

All areas within the U.S. Census Bureau-defined Urbanized Area are subject to to the MS4 permit rules. The vast majority of Wayne County is within the Urbanized Area and is therefore subject to the EGLE regulations described above. Wayne County and the cities/villages/townships within the County have MS4 permits; each permit requires post-construction runoff controls and maintenance of stormwater controls.

Flood Plains

Part 31 also controls flood plain occupancy. Under Part 31, a permit must be obtained from EGLE to fill or otherwise occupy a flood plain. The purpose of this control is to assure that watercourses, and the portion of the flood plains that are floodways, are not inhabited and are kept free and clear of interference or obstruction which would cause any undue restriction of floodway capacity. Part 31 also ensures that adequate provisions are proposed so that no flood damage will occur from proposed alterations.

Part 91 - Soil Erosion and Sedimentation Control

Part 91 of NREPA is designed to protect the waters of the State from sedimentation caused by soil erosion. Part 91 requires persons intending to cause earth changes to prepare soil erosion and sedimentation control plans. In addition, permits are required for earth changes that disturb one or more acres of land or that are within 500 feet of a lake or stream. Permits are issued by counties or local governments with programs approved by EGLE. In Wayne County, these permits are issued by Environmental Services Division unless the project is located in a community that is a Municipal Enforcing Agency. For a listing of the communities in which SESC permits are issued by Wayne County, please see the Wayne County website (www.waynecounty.com/DPS/land).

Part 301 - Inland Lakes and Streams

Part 301 of NREPA controls the construction of channel modifications and utilities crossing streams, rivers, creeks and other watercourses in the State. Under Part 301, a permit must be obtained from EGLE to alter or modify any watercourse. This program regulates unlawful encroachment of these watercourses and specifies construction techniques for alterations and modifications.

Part 303 - Wetland Protection

Part 303 of NREPA provides for the preservation, management, protection, and use of wetlands. A permit is required for construction through, or alteration or use of, a wetland. The Act applies to wetlands that have a ground or surface water connection to a lake, pond, river, or stream; to any isolated wetlands that are greater than five acres in size; and in counties having a population of 100,000 or more, to any wetland determined to be essential to the preservation of the natural resources of the State from pollution, impairment, or destruction.

3.4 Federal Agencies

3.4.1 Federal Emergency Management Agency (FEMA)

The National Flood Insurance Program (NFIP), which was created by an act of Congress in 1968, was designed to reduce flood losses through local flood plain management and to provide protection for property owners against potential losses through flood insurance. Some years later, FEMA was created and NFIP became a part of FEMA. FEMA collects data concerning flood hazards and is responsible for revising NFIP maps to conform to the data. Flood insurance maps are available from the local community or MDEQ. An application must be submitted to FEMA if any work will alter the existing floodplain.

3.4.2 U.S. Army Corps of Engineers (USACE)

State and federal law requires a joint permit from MDEQ and the USACE for certain activities in navigable waters or the waters of the United States.

Rivers and Harbors Act of 1899, Section 10

This Act requires USACE approval before commencing any work in or over navigable waters of the United States or that affects the course, location, condition or capacity of such waters. Typical activities requiring Section 10 permits include:

- Construction of piers, wharves, bulkheads, dolphins, marinas, ramps, floats, intake structure, and cable or pipeline crossings
- Dredging and excavation

Navigable waters are defined as waters that have been used in the past, are now used, or are susceptible to use as a means to transport interstate or foreign commerce up to the head of navigation. Further information on navigable waters in Wayne County can be obtained from the USACE.

Federal Clean Water Act, Section 404

Section 404 of the Clean Water Act requires USACE approval before discharging dredged or fill material into the waters of the United States. Waters of the United States includes essentially all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. Typical activities requiring Section 404 permits include:

- depositing of fill or dredged material in waters of the U.S. or adjacent wetlands;
- site development fill for residential, commercial, or recreational developments;
- construction of revetments, groins, breakwaters, levees, dams, dikes, and weirs; and
- placement of riprap and road fills.

Joint EGLE/USACE Permit Application

EGLE and the United States Army Corps of Engineers (USACE) have prepared a joint permit application to facilitate permit applications for projects under the jurisdiction of both of these agencies. The EGLE/USACE "Joint Permit Application" package covers permit requirements pursuant to state and federal rules and regulations for construction activities where the land meets the water (including wetlands), often referred to as the land/water interface. It is intended to prevent duplication of state and federal requirements. The application covers activities on or for the following parts of the (NREPA):

- Part 301, Inland Lakes and Streams, of the NREPA;
- Part 303, Wetlands Protection, of the NREPA;
- Part 325, Great Lakes Submerged Lands, of the NREPA;
- Floodplain Regulatory Authority found in Part 31, Water Resources Protection, of the NREPA;
- Part 353, Sand Dune Protection and Management, of the NREPA;
- Part 323, Shorelands Protection and Management, of the NREPA; and
- Part 315, Dam Safety, of the NREPA.

Contact EGLE or visit the EGLE website (www.michigan.gov/egle) for more information on the joint permit.

3.5 Responsibilities

The WCDPS Construction Permit Office reviews the design of stormwater control systems; the suitability of the materials proposed, work performed, and manner of performance; and the rate of work progress related to stormwater control systems subject to the Stormwater Ordinance, Administrative Rules and Standards Manual.

Stormwater control systems that are not within the jurisdiction of Wayne County's Stormwater Program are reviewed by the local community.

It is the responsibility of the property owner to pay all appropriate fees and obtain approval from the appropriate jurisdictions to construct and maintain a stormwater control system.

CHAPTER 4: OBTAINING STORMWATER CONSTRUCTION APPROVAL

This chapter provides a brief description of the requirements and procedures for obtaining stormwater construction approval from Wayne County.

4.1 General Information

The types of projects which must obtain stormwater construction approvals under the County's Stormwater Control Program include the following.

- Certain projects that require permits or approvals from Wayne County under other programs. Example projects include:
    - Work within a County road right-of-way or impacting any County road drainage facility.
    - Work that crosses, alters, or outlets into a County Drain.
    - Construction activities within, or in some cases, affecting Wayne County properties (such as Parks).

  These types of projects require permits from the WCDPS Construction Permit Office and must comply with the Wayne County Stormwater Control Program.

- Any greenfield development or brownfield (i.e. redevelopment) project with a land disturbance area of 1.0 acre or larger OR creates or replaces 0.5 acres of impervious surface. Land disturbance is defined in *Chapter 10, Definitions*. Should the applicant plan to construct a project in phases, the land disturbance and impervious surface areas to be considered shall reflect the entire proposed improvement area (inclusive of all planned phases). For instance, if a 0.99-acre parking lot is proposed to be rebuilt as part of two separate projects (0.49 acres each), the total area must be considered, and the development will be subject to these rules as the total impervious surface (0.99 acre) exceeds the 0.5-acre threshold.

- Subdivisions. WCDPS reviews and approves preliminary plats for platted subdivisions in Wayne County. Final plats are reviewed by WCDPS and approved by the Director of Environment Services or his or her designee. Subdivisions must include stormwater control systems that comply with the County's Stormwater Control Program.

- Multi-unit residential developments (e.g. condominiums). WCDPS reviews construction permit applications for multi-unit developments. Multi-unit residential developments must include stormwater control systems that comply with the County's Stormwater Control Program.

- To a certain extent, manufactured and mobile home parks. WCDPS reviews and approves preliminary site plans for manufactured and mobile home parks in Wayne County. Certain aspects of drainage and stormwater management from manufactured and mobile home parks must comply with the Wayne County's Stormwater Control Program.

- Construction activities that occur within and impacts or may negatively impact water quality or water resources in watersheds or sub-watersheds that are included in the County's MS4 Permit. Compliance with County's stormwater standards is required by the County's stormwater ordinance

- Projects that require Soil Erosion and Sedimentation Control (SESC) permits from the County. SESC permits generally are required for earth changes that disturb one or more acres of land or are within 500 feet of a lake or stream. Permittees are required to prepare soil erosion and sedimentation control plans. WCDPS – Environmental Services Division (ESD) reviews and

approves of these plans and issues soil erosion control permits in communities that are not authorized to administer and enforce the SESC program.

Accordingly, Wayne County reviews various submittals for compliance with the Stormwater Control Program. These include:

- Requests for approval of preliminary site plans for manufactured and mobile home parks;
- Requests for approval of preliminary plats for subdivisions;
- Construction permit applications for subdivisions, multi-unit residential developments, manufactured and mobile home parks, and projects which impact County roads, parks, and drains (including taps, relocation, enclosing, etc.);
- Requests for approval of final plats for subdivisions; and
- Soil Erosion and Sedimentation Control (SESC) permit applications.

Applications for stormwater construction approval associated with these types of projects, with supporting documentation, must be submitted to the Wayne County Construction Permit Office. The Permit Office reviews development projects for compliance with:

- Wayne County Stormwater Control Program;
- Wayne County Standards and Specifications (and good construction practices) for work within a Wayne County road right-of-way, County Drain or County park; and
- Wayne County Subdivision Rules and Regulations and standards (for subdivided property).

A development project may require additional permits or approvals from different departments of Wayne County. Such additional permits may include:

- SESC permits;
- Sanitary sewer extension permits;
- Permits for wells and private sewage disposal systems (septic systems); and
- Approval to modify a County Drain or drainage district.

Depending on the type of approvals required from other agencies or Wayne County departments, the WCDPS Construction Permit Office may require proof of other approvals before issuing a stormwater construction approval.

Before submitting an application for stormwater construction approval, applicants should confirm that they have the latest information regarding the Wayne County Stormwater Control Program. An applicant can obtain the Wayne County Stormwater Management Ordinance, Administrative Rules, and the Stormwater Control Program from the Wayne County website.

4.2 Application Requirements

The application for stormwater construction approval generally must include, at a minimum, the following documents and information:

- Completed application form or transmittal. See Figure 4-1 for a copy of the application form. The form or transmittal must include general information needed to process the application, such as:
  - project name,
  - project location,
  - major cross roads in project vicinity,
  - city or township where project is located,

- type of proposed work,
- name of applicant,
- contact person, telephone number and mailing address for both the owner and the engineer,
- description of the work and any unique characteristics of the development, and
- any other relevant information.

- Construction plans developed in accordance with the Wayne County Stormwater Control Program and other applicable Wayne County requirements (see Section 4.3 below for the basic requirements for plans).
- GIS shapefiles with the following information:
  - Boundary of site development area (polygon)
  - Location(s) of site discharge (point(s))
  - GIS data for the stormwater collection system and key stormwater control features; the following items shall be provided (use the naming convention listed below):
    - Dry detention ponds (GIS ID = DPOND-1, DPOND-2, DPOND-X, etc.) – ***polygons***
    - Wet detention ponds (GIS ID = WPOND-1, WPOND-2, WPOND-X, etc.) – ***polygons***
    - Sediment forebays (GIS ID = FOREBAY-1, FOREBAY-2, etc.) – ***polygons***
    - Mechanical separators (GIS ID = MS-1, MS-2, MS-X, etc.) – ***points***
    - Bioretention cells (GIS ID = BR-1, BR-2, BR-X, etc.) – ***polygons***
    - Bioswales (GIS ID = BS-1, BS-2, BS-X, etc.) – ***polygons***
    - Pervious pavement areas (GIS ID = PP-1, PP-2, PP-X, etc.) – ***polygons***
    - Inlets or catch basins *with a sump* (GIS ID = CB-1, CB-2, CB-X, etc.) – ***points***
    - Storm sewer collection system (include all sewer pipes and junctions/manholes; naming convention as determined by the applicant) - ***shapefile***
- Long-term maintenance plan for stormwater control system, including legally binding instrument assuring maintenance of system in perpetuity. (See Exhibit B to Appendix B of this manual for a sample long-term maintenance plan).
- Payment of any applicable fees. As described in Section 4.4, applicants may be required to pay additional fees and provide financial assurances during the review process.

4.3 Requirements for Plans

Plans submitted with each application for construction approval should comply with the following general requirements:

- Portable Document Format (PDF) is acceptable for all submittal components, including plans, details, reports, and applicable application forms. PDF is the desired submittal format at Wayne County.
  - Paper copies are an acceptable alternative. If submitting hard (paper) copies, a minimum of three (3) sets of plans must be submitted for review. Maximum paper size is 24-inch x 36-inch.
- The scale of the drawings should be of a standard engineering scale. Plans should not be difficult to read. Typically a scale of 1 inch = 20 feet or 1 inch = 30 feet is used.
- The plans must be signed and sealed by a Professional Engineer (PE) registered in the State of Michigan.
- The title sheet should include the legal description of the site and a location map. Include major cross streets for reference.
- Include any symbols and line type legend.

The cover sheet ***must*** include the following table, describing the key land cover characteristics and the key volumes that address stormwater quality. This table is essential for Wayne County to comply with MS4 reporting guidelines established by EGLE. ***If this table is not completed and included on the cover sheet, Wayne County will return the unapproved site plan to the applicant.***

Table 4-1: Land Use Summary Example for a Site Plan

Land Use Summary

must be included on the COVER SHEET for all site plans

	Characteristic	Existing Conditions	Proposed Conditions
Pervious Area Land Use Data	Total Development Area (ac)		
	Impervious Area (ac)		
	Total Pervious Area (ac)		
	Pervious Area Breakdown by Cover Type		
	Meadow/fallow/natural areas (non-cultivated)	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	Improved areas (turf grass, landscape, row crops)	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	Wooded Areas	x.xx acres	x.xx acres
	Predominant NRCS Soil Type (A, B, C, or D)		
	Calculated CPVC Volume (cubic feet)		
	CPVC Volume ***Provided*** (cubic feet)		
	CPRC Volume Provided (cubic feet)		

The Professional Engineer who signs and seals this site plan certifies that the values in this table reflect the Wayne County stormwater calculations required for this development and that geotechnical investigations were performed that provide conclusive documentation that demonstrates whether infiltration (i.e., CPVC Volume Control) is practicable.

Notes:

- *The Professional Engineer Certification Statement (see above) must be included with the Land Use Summary Table.*
- *Areas to be shown to the nearest 0.01 acre*
- *'Predominant' soil type shall the soil type with the largest percentage coverage over the designated land use (e.g., 70% Soil Type B and 30% Soil Type C shall be listed in the table as "Soil Type B")*
- *USDA soil types cannot be used to determine site suitability for infiltration and meeting the CPVC volume standard; direct infiltration testing will be required to determine site suitability for infiltration*
- *If CPVC requirement is waived, enter ZERO for the 'CPVC Volume Provided'*
- *When more than one soil type exists in one area, assign the predominant soil type for that area*
- *Use NRCS/USDA Online Soil Survey Map to determine soil type (A, B, C, or D): https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm*

For most projects, some or all the following sheets should be included in the plan sets submitted:

- Title sheet
- Cover sheet
- Existing topographical information (including existing utility information)

- Removal/ demolition sheet
- Typical sections and other details
- Site plan sheets
- Road profiles
- Utility plans
- Miscellaneous details (if any)
- Storm sewer profiles (including hydraulic grade lines)
- Storm sewer calculations table
- Stormwater control system plan view, cross sections, calculations, details, and exhibits to the long-term maintenance plan
- Landscape plan
- Traffic/signing plan
- Drain easements (if required)
- Documentation of required approvals (if any) from other agencies

4.4 The Review Process

The review process begins when an applicant submits an application, payment for any relevant fees, and a PDF of all submittal components (preferred), or three (3) sets of plans, along with supporting documentation, to the Permit Office. A review number and a DPS Engineer are assigned to each project. The Review Engineer performs an in-depth review of the project.

The review process may require more than one submittal of plans for the project to fulfill the County's approval requirements. Applicants should take this into account when applying for construction approval.

Once the plans and all other required documentation have been approved by the DPS Engineer, the Permit Office issues a stormwater construction approval to the applicant. Upon receipt of the approval letter, the applicant must contact the Permit Office contact identified in the approval letter for the exact amounts of the required fees and financial assurance. Financial assurance generally can be provided through use of a performance bond, a cash deposit, or letter of credit in an amount equal to the current estimate of the cost of completing the construction. See Chapter 9 of the Wayne County Stormwater Administrative Rules for additional information regarding financial assurance. **All fees must be paid in full and proof of financial assurance provided prior to permit issuance.** Once all requirements have been met, the Permit Office issues a permit to construct to the applicant.

Wayne County requires the township, city or village in which a project is located, or another public corporation or entity (e.g. drainage district) approved by the County, to assume long-term maintenance responsibility for all stormwater control systems through a legally-binding instrument such as an ordinance, resolution, contract or equivalent instrument approved by the County. See Chapter 9 of this manual for further details.

A detailed outline of the process to obtain stormwater construction approval and a permit to construct is shown in Figure 4-2 "Procedure for Obtaining a Construction Permit".

4.5 Project-specific Requirements

The Wayne County Stormwater Control Program requires that stormwater control systems for development projects be sized to manage the entire upstream land area which drains to that location. This means that the drainage area to a stormwater control system may include:

- offsite drainage areas
- areas within the project site which are already developed (if project involves expansion of existing facilities)

For projects proposing to utilize a stormwater control system designed prior to the current version of the County's Stormwater Control Program, the original system, and in particular its ability to manage (additional) runoff from the development project, will be reviewed for compliance with the Wayne County Stormwater Control Program.

If the County determines that an existing system can manage the additional flow from the proposed project and maintain compliance with the County's current Stormwater Control Program, the applicant may be permitted to use the existing system for managing stormwater from the proposed project. The applicant must demonstrate that it has a legal right to utilize the existing system for stormwater management.

If the County determines that an existing system does not comply with the County's current program, or that the existing system cannot manage the additional runoff in compliance with the Stormwater Control Program, the applicant may not utilize the existing system for the proposed project unless:

- the applicant brings the existing system into compliance with the Stormwater Control Program; and
- the applicant demonstrates that it has a legal right to utilize the existing system for stormwater management.

Applicants that propose to utilize an established County Drain or an established drainage district (with or without modifications) for stormwater management may be subject to additional requirements. The Permit Office will not issue a stormwater construction approval until all applicable requirements of the Wayne County Drain Commissioner have been satisfied. Note that County drain easements established prior to 1956 were not required by statute to be recorded immediately. It may be necessary to check the permanent records of the Wayne County Drain Commissioner (located within the Environmental Services Division) or the Wayne County Register of Deeds to see if a drain easement exists on the subject property.

Additional requirements may apply to condominium developments. For example, condominium lot lines must be shown on the plans. Buffer strips required by the Wayne County Stormwater Control Program must be shown to lie outside of the condominium lot lines.

For Wayne County to ensure stormwater control systems serving subdivisions are constructed in compliance with the Stormwater Control Program, the stormwater control system must be designed and included in the submission for preliminary plat approval.

Similarly, the stormwater control system for mobile home parks must be designed and included in the submission for preliminary plat approval.

4.6 Modifications of Approved Plans

The permit holder is required to construct the project according to the permit to construct and the approved plans. If any modifications to the plans are desired after approval, a written request to modify the plans must be submitted to the Permit Office. The request must include the appropriate sheets from the plans with the proposed modification(s) clearly identified. It should be noted that proposals to change construction materials or manufacturers constitute plan modifications and must be submitted to the Permit Office for approval.

Failure to obtain prior approval of plan modifications is a violation of the Wayne County Stormwater Control Program and may subject the permit holder to penalties in accordance with Chapter 9 of the Wayne County Stormwater Management Ordinance. Additionally, unless modifications are pre-approved, the permit holder may be unable to obtain a certification from a registered PE that the project has been constructed in accordance with approved plans and the permit to construct. Applicants must obtain a PE certification upon completion of the project before Wayne County will release the permit (see Section 4.7).

4.7 Inspections and Permit Release

After permit issuance, Wayne County periodically inspects the project during construction to ensure that construction proceeds in accordance with the approved plans and the permit to construct.

After construction of the stormwater control system has been completed, a registered PE must certify that the stormwater control system has been constructed in accordance with the approved plans and the permit to construct (see Appendix A). Wayne County performs a final inspection of the completed project after receiving the engineer's certification.

As described in Chapter 9, a permit for long-term maintenance of the stormwater control system is issued contingent upon release of the permit to construct. A sample long-term maintenance permit is presented in Appendix B.
Once the stormwater control system has been constructed, inspected, and has been determined to be operating properly, the permit is released and any remaining financial assurances are returned to the permit holder.

4.8 Extensions of Approvals and Permits

Stormwater construction approvals and construction plan approvals by the Permit Office are valid for one year. Permits to construct are valid for up to 2 years. If an extension beyond these periods is needed, the permit holder must submit a written request to the Permit Office for an extension. **Requests for extensions must be made to the Permit Office at least ten (10) working days before permit expiration.**

The Permit Office may grant extensions of up to one year for a permit to construct for a stormwater control system. Updated plans, additional information, further review, additional permit and inspection fees, and additional financial assurance may be required to extend the permit. Please note that failure to obtain any necessary extensions of construction approvals or permits is a violation of the Wayne County Stormwater Program and may subject the permit holder to penalties as described in the Chapter 9 of the Wayne County Stormwater Ordinance.

FIGURE 4-1

STORMWATER CONSTRUCTION APPROVAL
APPLICATION FORM

SUBMIT THIS FORM WITH APPLICABLE FEE PAYMENT AND INFORMATION TO

Wayne County Permit Office
33809 Michigan Avenue,
Wayne, MI
734-595-6504

Warren C. Evans
County Executive

APPLICATION FOR A "C" PERMIT

C Permits are required for:

- **Construction within a Wayne County Road Right-of-Way, County Drain, or County Park**
- **Stormwater construction approval**

Date _____

Project Name _____

Project Location _____

Major Cross Roads _____

City or Township _____

Type of Proposed Work _____

Name of Applicant _____

Owner Contact Information:

Name _____

Mailing Address _____

City, State, Zip _____

Telephone _____Fax _____

Email_____

Engineer Contact Information:

Name _____

Mailing Address _____

City, State, Zip _____

Telephone _____Fax _____

Email_____

Description of Work, including any unique characteristics of the development and any other relevant information

_____

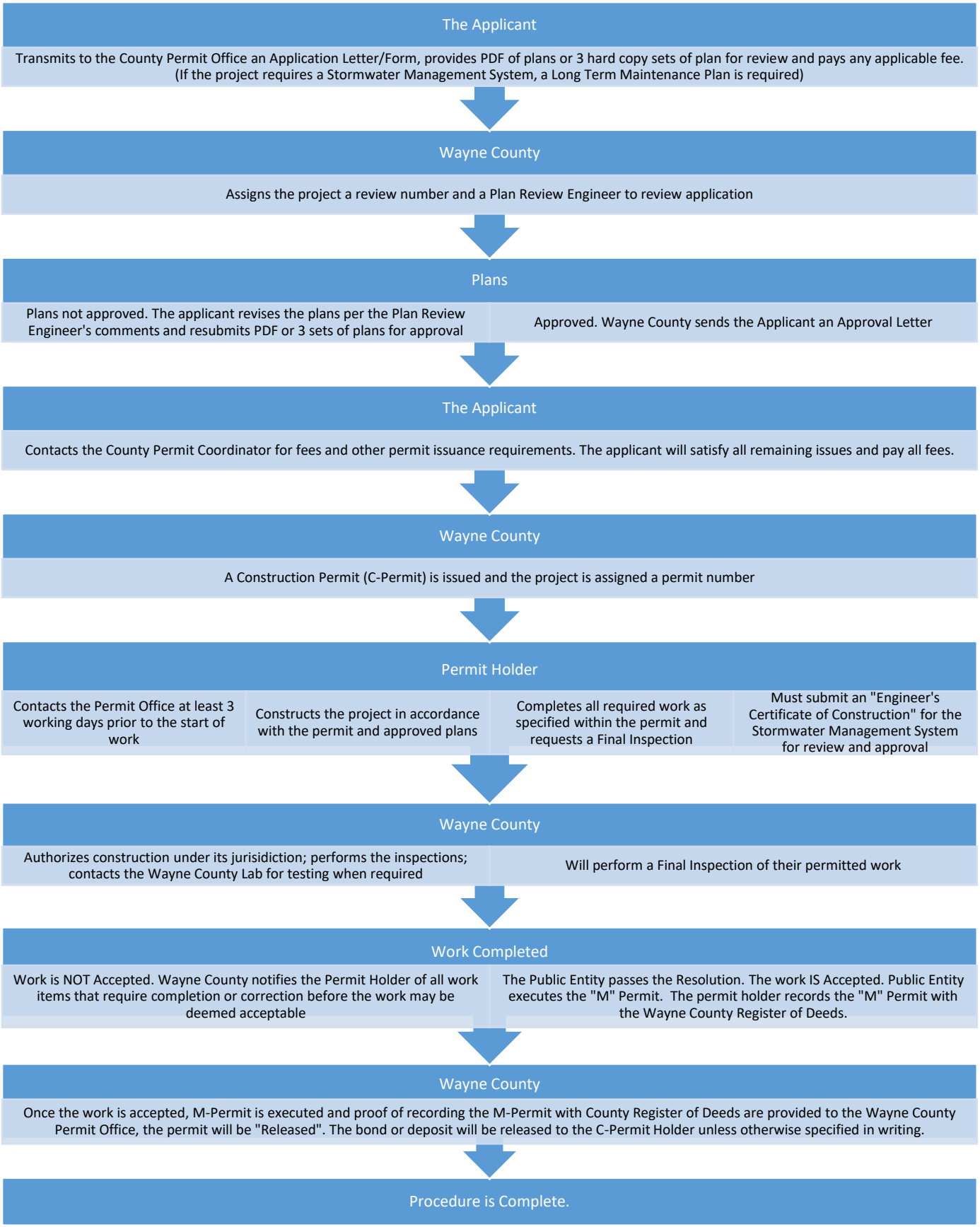
REQUIRED INFORMATION TO BE ATTACHED TO THIS FORM:

- Payment of application fees

- For stormwater construction approvals:
  - Long term maintenance plan for stormwater control system, including legally binding instrument assuring maintenance of system in perpetuity
  - Documentation of compliance with any other Wayne County requirements

FIGURE 4-2

PROCEDURE FOR OBTAINING A CONSTRUCTION PERMIT


The Applicant
Transmits to the County Permit Office an Application Letter/Form, provides PDF of plans or 3 hard copy sets of plan for review and pays any applicable fee. (If the project requires a Stormwater Management System, a Long Term Maintenance Plan is required)
Wayne County
Assigns the project a review number and a Plan Review Engineer to review application
Plans
Plans not approved. The applicant revises the plans per the Plan Review Engineer's comments and resubmits PDF or 3 sets of plans for approval
Approved. Wayne County sends the Applicant an Approval Letter
The Applicant
Contacts the County Permit Coordinator for fees and other permit issuance requirements. The applicant will satisfy all remaining issues and pay all fees.
Wayne County
A Construction Permit (C-Permit) is issued and the project is assigned a permit number
Permit Holder
Contacts the Permit Office at least 3 working days prior to the start of work
Constructs the project in accordance with the permit and approved plans
Completes all required work as specified within the permit and requests a Final Inspection
Must submit an "Engineer's Certificate of Construction" for the Stormwater Management System for review and approval
Wayne County
Authorizes construction under its jurisidiction; performs the inspections; contacts the Wayne County Lab for testing when required
Will perform a Final Inspection of their permitted work
Work Completed
Work is NOT Accepted. Wayne County notifies the Permit Holder of all work items that require completion or correction before the work may be deemed acceptable
The Public Entity passes the Resolution. The work IS Accepted. Public Entity executes the "M" Permit. The permit holder records the "M" Permit with the Wayne County Register of Deeds.
Wayne County
Once the work is accepted, M-Permit is executed and proof of recording the M-Permit with County Register of Deeds are provided to the Wayne County Permit Office, the permit will be "Released". The bond or deposit will be released to the C-Permit Holder unless otherwise specified in writing.
Procedure is Complete.

CHAPTER 5: PERFORMANCE STANDARDS

Under the Wayne County Stormwater Control Program, stormwater control systems must be selected and designed with the following objectives:

- Flood Control
- Water Resources Protection
    - Pollution control
    - Runoff volume reduction
    - Channel protection

This chapter presents the performance standards that Wayne County has adopted to meet these objectives.

In addition to adopting performance standards, Wayne County has established design standards for certain components of stormwater control systems. These standards help ensure that each component is designed, operated and maintained such that the performance standards are met. A summary of the performance standards and design standards under the Wayne County Stormwater Control Program is shown in the attached table. Chapters 6, 7, and 8 of this manual provide detailed information about standards and guidance for designing stormwater control system components to satisfy the performance standards.

Applicants for stormwater construction approval may select any combination of stormwater management components to satisfy the performance and design standards provided that the selection: (1) complies with other requirements of the Wayne County Stormwater Control Program; (2) complies with other local, county, state or federal requirements; and (3) does not conflict with existing local stormwater management plans or design standards.

The performance standards described in this chapter pertain to permanent stormwater control systems. Certain temporary stormwater management measures are also required for some development projects which involve earth change activities. These temporary measures are described in Chapter 7, Section 7.7.

5.1 Flood Control

The design of a stormwater control system must incorporate elements for protecting against the effects of flooding. To control flooding, Wayne County has adopted the following **minimum performance standards** for stormwater runoff from development projects.

- For stormwater control systems with drainage areas greater than or equal to 100 acres, the peak flow rate of stormwater runoff leaving the development site must not exceed 0.15 cfs/acre for a 100-year recurrence interval storm.
- For stormwater control systems with drainage areas less than 100 acres, the peak flow rate of stormwater runoff leaving the development will be determined based on a variable release rate curve for the 100-year recurrence interval storm, equal to 0.15 cfs/acre for 100-acre developments, gradually increasing to 1.0 cfs/acre for developments 2 acres and smaller. See Chapter 6 for the equation for the variable release rate curve.

5.2 Water Resources Protection

Designing a stormwater control system to address water resources protection requires an understanding of the type of pollutants expected to be generated from the site during and after construction. With that understanding, the system and the maintenance plan that accompanies it must incorporate appropriate Best Management Practices (BMPs).

Wayne County has adopted the following **minimum performance standard** to address stormwater runoff volume, pollutant control, and channel protection:

- Stormwater control systems must be designed and constructed to remove 80 percent or more of the total suspended solids (TSS) load from the development site or limit the peak TSS concentration to 80 mg/L for the first one (1) inch of rainfall (First Flush Treatment/Water Quality Control, WQC).
- Stormwater control systems must be designed, where soil/groundwater conditions permit, to infiltrate the first one (1) inch of rainfall over the site development (Channel Protection Volume Control, CPVC)
- Stormwater control systems must be designed and constructed to store and release the volume generated by a 1.9-inch storm event for a minimum discharge duration of 48 hours (Channel Protection Rate Control, CPRC)

Figure 5-1: Conceptual BMP location in Auburn Hills (source: OHM Advisors)

WAYNE COUNTY STORMWATER PROGRAM

Summary of Performance and Design Standards

Performance Standard*	General Design Standards	Additional Design Standards
Rule 501: Flood Control Maximum peak flow rate leaving development site: Rule 501(B)	Determination of peak flow rate: Rule 601 SWMS must include detention system with flow restrictor or retention basin: Rule 602(B) Detention Systems: Rule 602(B)(1) Sizing for flood control storage volume Outlet / flow restrictor sizing Retention Basins: Rule 602(B)(2) Sizing for flood control storage volume SWMS must have adequate outlet, except that outlet not required for retention basins: Rule 602(C) SWMS are prohibited in floodplain unless specific additional requirements satisfied: 602(D) Additional requirements: Rule 602(E) SWMS must follow natural drainage pattern SWMS that include surface waters cannot be located within pre-existing surface water.	Detention Systems/Retention Basins Rule 701: Open Detention Basins Rule 702: Retention Basins Rule 703: Underground Detention Systems Rule 704: Reserved Rule 705: Reserved
Rule 502: Water Resources Protection (WQC) 80% average annual TSS removal: Rule 502(B)	SWMS must include pretreatment system at the inlet to each detention system and/or retention basin. Rule 603(B). Pretreatment system must either Be designed such that the SWMS achieves adequate TSS removal, Rule 603(B)(1); or Be sized to capture and gradually release the first flush volume: Rule 603(B)(2) SWMS must capture and gradually release bank full flood, except retention basins not required to satisfy bank full flood requirements: Rule 603(C) Additional requirements: Rule 603(D) Buffer strip required for SWMS with surface waters (except bioretention areas and vegetated swales) Landscape plan required for SWMS with surface waters	Pretreatment Systems Rule 706: Forebays Rule 707: Bioretention Areas Rule 708: Manufactured Treatment Systems Rule 709: Reserved Rule 710: Reserved Rule 711: Conveyances Rule 801: Wetlands Rule 802: County Parks Rule 803: County Roads

*Information presented in this table is referenced to the Administrative Rules of the Wayne County Stormwater Control Program.

CHAPTER 6 : GENERAL DESIGN STANDARDS

Figure 6-1: Parking lot bioretention (source: US EPA)

Designing stormwater control systems to meet the Wayne County performance standards is the responsibility of the applicant or its designee. Wayne County maintains the right to require applicants to modify stormwater control system designs to ensure that the performance standards are satisfied. Applicants must demonstrate that the land development activity will address the needs and limitations of the local drainage system. Taking these factors into account, the following sections describe general design standards for stormwater control systems.

Additional design standards for specific stormwater control systems may be found in Chapters 7 and 8.

6.1 Determination of Peak Flow Rate

6.1.1 Rational Method

The Rational Method for calculating stormwater runoff is generally acceptable for calculating peak flow rate at a particular location within a stormwater control system. Alternative methods may be required when the County determines that another method is necessary to satisfy the requirements of the Standards (see Section 6.1.2).

To calculate peak flow rate using the Rational Method, an applicant must use the following Rational Method Formula:

Q = C x I x A

where: Q = peak flow rate (cfs)
C = runoff coefficient
I = rainfall intensity (in/hr), see equations below
A = drainage area (acres)

Key rainfall intensities to be used for site design in Wayne County are listed below: these are based on rainfall intensities as published in NOAA Atlas 14:

- 10-year storm: $I_{10} = \frac{63}{(12.33 + \mathrm{T})^{0.84}}$

- 100-year storm: $I_{100} = \frac{101}{(12.33 + \mathrm{T})^{0.84}}$

where:
I = peak rainfall intensity (in/hr)
T = time of concentration (minutes)

The peak flow rate for each component of a stormwater control system must be calculated using a composite runoff coefficient, the entire tributary drainage area, and a design rainfall intensity adjusted based on time of concentration. Values for the various terms used in the Rational Method Formula in determining peak flow at a particular location must be determined as follows:

- Drainage area (A) means the entire upstream land area that drains to that location, including any off-site contributing drainage area. Offsite flows should bypass the proposed stormwater control system, unless clearly demonstrated by the applicant that this bypass is infeasible.

- Peak flow rate (Q) must be calculated with the assumption that off-site drainage areas (upstream of the development) are developed consistent with any applicable master land use plan, stormwater standards and storm water master plan enacted by the local community in which the stormwater control system is located, and the Wayne County Stormwater Control Program. When calculating upstream (off-site) peak flows, the ***higher*** of the following peak flow calculations must be used: 1) existing conditions peak flow rate, or 2) future conditions peak flow with assumed peak flow controls.

MINIMUM ACCEPTABLE RUNOFF COEFFICIENTS

Type of Surface	Runoff Coefficient (C)
Water Surfaces	1.00
Roofs	0.95
Asphalt or concrete pavements	0.95
Gravel, brick, or macadam surfaces	0.95
Semi-pervious: lawns, parks, playgrounds:	
Hydrologic Soil Group A	0.15
Hydrologic Soil Group B	0.20
Hydrologic Soil Group C	0.25
Hydrologic Soil Group D	0.30

- The composite runoff coefficient (C) must be based on the percentage of surface types in the drainage area upstream of that location. Surface types to be used are shown in the following table.

- Rainfall intensities must be calculated using the Intensity-Duration-Frequency (IDF) curves listed in this chapter. These IDF equations are based on the most recently-available point precipitation duration/frequency tables (currently NOAA Atlas 14). The calculation of intensity is dependent on the time of concentration (t_c), which is the time duration (in minutes) that is required for runoff from the most remote point of the drainage area to reach the stormwater control system component being designed.

- For developments larger than two (2) acres, the time of concentration (t_c) must be calculated using the EGLE equations in their publication Computing Flood Discharges for Small Ungaged Watersheds (rev. 2010). Velocities are calculated for up to three different flow types (smaller sites may have fewer flow types):

  - Velocity (V) = K * $S^{0.5}$
    - V = flow velocity (feet per second)
    - K = coefficient depending on the type of flow (see values below)
    - S = slope of flow path in percent (i.e. 1% = 1)
  - Flow Coefficients are as follows:
    - Sheet flow, K = 0.48 (max length = 300 ft)
    - Waterway, K = 1.2 (valley, swale, or shallow drainage course)
    - Small tributary, K = 2.1 (ditch)

  For sewer pipes and drainage channels, calculate velocities using Manning's equation.

- The velocity (V) must be calculated for each of the selected flow components, allowing for additional segments when changes in slope occur. Using the total length of each flow component, calculate the time of concentration (t_c):

  - t_c = L / (V * 60)
    - V = velocity (feet per second) as calculated using the equation above
    - L = length (in feet)
    - t = time of concentration (minutes)

- Add the travel time for each flow component; this is the time of concentration to be used for peak flow calculations. If the time of concentration is calculated as less than 5 minutes, use 5 minutes as a minimum time of concentration.

TIME OF CONCENTRATION GUIDELINES

For sites that are 2 acres and smaller, the applicant can default to a t_c of ***10 minutes*** for the flood control volume calculations. For larger sites, use the equations on this page to calculate an exact t_c (*to the nearest minute is accurate enough*)

6.1.2 Alternative Methods

The Rational Method Formula may not be an adequate design tool for calculating stormwater runoff from large drainage systems; especially those larger than 100 acres. Alternative runoff hydrograph prediction methods are widely available and may be required by the Permit Office

for sizing the drainage systems on large sites and/or smaller sites that present unique flood control or water resources protection issues. Acceptable alternative methods are:

- US Army Corps of Engineers HEC-HMS
- Soil Conservation Service, WinTR-55 or WinTR-20
- U.S. EPA's Stormwater Management Model (SWMM), or proprietary equivalent
- HydroCAD, StormCAD, or approved equivalent

These methods must be based on the SCS Type II, 24-hour rainfall distribution. When curve numbers are used, they must be based on Antecedent Moisture Condition II (AMC II).

6.2 General Design Standards for Flood Control

Stormwater control systems designed to satisfy the flood control performance standards described in Section 5.1 must include a detention system and/or retention basin that is designed and constructed in accordance with this Section.

6.2.1 Detention Systems

Open detention basins are excavated areas designed to temporarily detain stormwater runoff to control peak flow rates and provide for pollutant removal through settling and plant uptake. All detention ponds have an outlet structure that discharges to a receiving drainage system. The following types of open detention basins can be used in Wayne County:

- Traditional detention basins, which detain stormwater runoff for an extended period in a permanent pool and remove sediment and other pollutants via settling. The permanent pool in a traditional detention basin must be a minimum of 4 feet deep.
- Constructed wetlands, where over 50% of the surface area typically is covered by wetland vegetation. Permanent wetland pool depths vary between 0.5 and 3.0 feet depending on vegetation type.
- Dry detention basins, which are designed to completely drain after a storm event; they have no permanent pool and are sloped along the bottom to provide positive drainage towards the outlet.
- Underground detention systems consist of one or more underground pipes or structures designed to provide the required storage volumes for a development project. Just as with any aboveground means of stormwater detention, underground detention systems must have a restricted outlet that limits outflow for the designated storm events.

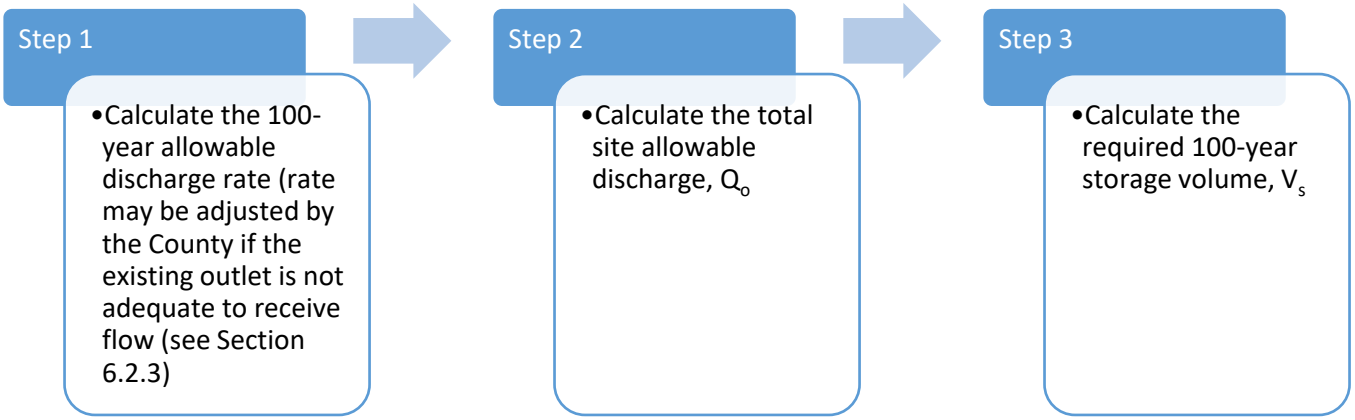
Figure 6-2: Surface Detention (source: OHM Advisors)

Dry detention basins and underground detention systems require upstream pretreatment (TSS reduction). See water quality requirements later in this chapter.

Additional design standards for open detention basins and underground detention systems are presented in Chapter 8. Retention basins (no outlet) are described later in this chapter.

Flood Control Storage Volume

Detention systems that are designed to meet the flood control performance standards described in Section 5.1 must provide enough flood control storage volume so as not to exceed the maximum allowable runoff rate for the site. Equations used to determine the required storage volume are shown below:



Step 1

Calculate the 100-year allowable discharge rate (rate may be adjusted by the County if the existing outlet is not adequate to receive flow (see Section 6.2.3)

- For site developments equal to or larger than 100 acres:

  Q_{allow} = 0.15 cfs/acre

- For site developments smaller than 100 acres:

  Q_{allow} = 1.1055 - 0.207ln(A)

where:

Q_{allow} = 100-yr allowable peak flow rate (cfs/acre)

A = total site drainage area (ac)

For all sites smaller than 2 acres, Q_{allow} shall be set at 1.0 cfs/acre

Step 2

Calculate the total site allowable discharge, Q_o:

- $Q_o = Q_{allow} \times A$

  where:

  Q_o = 100-yr allowable peak flow (cfs)

  Q_{allow} = 100-yr allowable peak flow rate (cfs/acre)

  A = total site drainage area (ac)

Step 3

Calculate the required 100-year storage volume, V_s:

- $V_s = V_r \times [\ 0.206 - 0.15\ln(Q_o/Q_i)\ ]$

  where:

  V_s = required 100-yr storage volume (ft^3)

  V_r = total 100-year developed site runoff volume (ft^3) → ($V_r = A \times C \times 18{,}900$)

  Q_o = 100-yr allowable peak flow (cfs)

  Q_i = 100-yr developed site peak inflow into pond ($Q_i = C \times I \times A$)

  To calculate Qi, use the most recent 100-yr Intensity-Duration-Frequency (IDF) equation for Wayne County (NOAA Atlas 14); alternatively, the following equation can be used for the 100-year peak intensity (I):

$$I_{100} = \frac{101}{(12.33 + \mathrm{T})^{0.84}}$$

  where T = time of concentration in minutes

6.2.2 Retention Basins

Figure 6-3: Retention Basin Example (source: OHM Advisors)

Retention basins are excavated areas designed to store stormwater runoff and provide gravity settling of pollutants. They are used only in cases where no outlet is available. ***Wayne County discourages the use of retention basins and will permit their use only in cases where the applicant has clearly demonstrated that constructing a gravity outlet is infeasible and in areas where adequate soil infiltration rates have been demonstrated via geotechnical analysis.***

Retention basins infiltrate stormwater into the soil rather than discharging it to a surface water or closed conduit. This requires adequate infiltration capacity and regular maintenance of the pond bottom to remove sediment that may seal off access to underlying soils.

Retention basins cannot be constructed underground; all retention basins must be aboveground stormwater storage.

Additional design standards for retention basins, including minimum infiltration rates, maximum storage depths, and pre-treatment requirements, are presented in Chapter 8.

Flood Control Storage Volume

Retention basins that are designed to meet the flood control performance standards described in Section 5.1 must provide enough flood control storage volume to retain the volume of stormwater equal to the runoff from two consecutive 100-year storm events.

If a retention basin is used for a site design, the first flush (1-inch rainfall) treatment must occur separately and upstream of the retention basin. This may be accomplished with a mechanical separator, infiltration BMP, or other approved method. This prevents clogging or choking of the pond bottom due to siltation.

The equation used to determine the required retention pond storage volume is shown in the box below.

Retention Basins:
Flood Control Storage Volume Requirements

Retention basins are required to retain the volume of stormwater equal to the runoff from two consecutive 100-year storm events. Volume required should be based on the following relationship:

$$V_s = 2 \times 18{,}900 \times A \times C$$

Where:

V_s = Flood control storage volume of retention basin (ft^3)
A = Drainage area (acres)
C = Runoff coefficient

6.2.3 Adequate Outlet

Stormwater control systems must have an adequate stormwater outlet. At a minimum, the capacity of the outlet must not exceed the site development's pro rata share of the maximum capacity of the downstream closed conduit or watercourse, as determined by the County.

If the County determines that a site development does not have an adequate outlet, the applicant may be required to design and construct improvements to the downstream County Drain, watercourse, or closed conduit. The County will determine the extent to which downstream improvements are required. Alternatively, the site development's peak discharge rate may be reduced to a value less than the allowable release rates listed in this document, as determined by the County, to a level that meets the available capacity in the receiving drainage system.

6.2.4 Floodplain Restrictions

Stormwater control systems may not be constructed within a 100-year floodplain unless the stormwater control system satisfies the requirements listed below. Construction within a 100-year floodplain must be approved by EGLE as well as the County.

- The stormwater control system must not diminish the net storage capacity of the floodplain. Compensatory storage is required for any reduction in floodplain storage capacity.

- The stormwater control system must not negatively alter the conveyance of the watercourse.

- During the 100-year recurrence interval storm event, the storage capacity of the stormwater control system must remain available for detention of stormwater runoff from the development site. This means that the elevation of the detention basin must be above the influence of the floodplain and that the floodplain conditions will not adversely impact the hydraulic characteristics of the detention basin before, during, or after the peak flood elevations of the receiving drain, stream, river, or channel.

- The stormwater control system must minimize disruption to the riparian habitat of the floodplain by developing and implementing a plan for minimizing disturbance that is acceptable to the County.

6.2.5 Additional Requirements

To the fullest extent possible, stormwater control systems must follow the natural drainage patterns within the development site and within the watershed in which it is located.

6.3 General Design Standards for Water Resources Protection

Stormwater control systems must address water quality and channel protection. This can be achieved through a set of stormwater controls that focus on removing Total Suspended Solids (TSS), reducing runoff volume, and allowing for extended detention for more frequent storm events.

There are three (3) primary requirements in this section:

First Flush Treatment	Channel Protection Volume Control (CPVC)	Channel Protection Rate Control (CPRC)
• Provide treatment for the first one (1) inch rainfall to limit the peak TSS concentration to 80 mg/L ***or*** reduce the TSS concentration by 80%. This requirement is automatically met if the Channel Protection Volume Control requirement is met or the site runoff is controlled in a detention basin with a permanent pool. Typical methods to address TSS are as follows: ○ Bioretention cells (infiltration, where applicable) ○ Sediment forebay ○ Wet detention pond ○ Mechanical separator	• Infiltrate the first one (1) inch of rainfall over the site development. This can be accomplished using infiltration BMPs or water storage/reuse as defined in this manual. This requirement shall be provided to the Maximum Extent Practicable (MEP) and will be enforced in all cases except the following: ○ In-situ soil infiltration rate is less than 0.10 inches/hour ○ Prevailing groundwater exists within two (2) vertical feet of the bottom of the infiltration BMP ○ Contaminated soils exist on or immediately adjacent to the targeted infiltration BMP	• Store and release the volume generated by a 1.9-inch storm event for a discharge duration of 48 hours

6.3.1 First Flush Treatment

Provide water quality control for the first one (1) inch of rainfall. This treatment can occur in any configuration, provided that the following water quality treatment is obtained:

- Limit the TSS concentration at the site development discharge point to 80 mg/L

or

- Reduce TSS loading at the site development discharge point by 80%

The First Flush Treatment requirement is automatically met if the CPVC control is achieved through infiltration or the site runoff is controlled in a detention basin with a permanent pool.

If the First Flush Treatment requirement requires a separate stormwater control other than infiltration, it can be achieved using a sediment forebay or mechanical separation device.

If a sediment forebay is used (in cases where the CPVC is not achievable due to inadequate infiltration capacity and a manufactured treatment system is not used to achieve first flush treatment), the storage volume shall be 15% of the CPVC volume. The sediment forebay storage volume shall be calculated as follows:

$$V_{ff} = 545 \times A \times C$$

where:

V_{ff} = **first flush (sediment forebay) storage volume (ft^3)**

A = drainage area tributary to inlet (acres)

C = runoff coefficient

The sediment forebay must have a flow restrictor designed to gradually release the stored volume over a period of twenty-four (24) hours. The 24-hour average allowable release rate must be determined in accordance with the following relationship:

$$Q_{avg\ ff} = V_{ff} / 86{,}400$$

where:

$Q_{avg\ ff}$ = **24-hour average allowable outflow rate (cfs)**

V_{ff} = **first flush (sediment forebay) storage volume (ft^3)**

If one or more forebays are used as pretreatment system(s), the volume of the forebays above any permanent pool may be used to satisfy a portion of the flood control storage volume (described in Section 6.2.1) and the Channel Protection Rate Control Volume (CPRC, or extended detention volume, described in Section 6.3.3). If a permanent pool is provided, the volume of the permanent pool may not be used to satisfy these other storage volume requirements.

If a mechanical separation device is used, it shall be located upstream of the detention pond and designed to treat the peak flow rate resulting from a 1-year recurrence interval storm. See Section 8.2.4 for peak flow calculation guidelines and minimum/maximum values for peak rainfall intensities. Any additional flows shall bypass the treatment unit and discharge directly to the detention/retention pond. Approved vendors, certifications, and methods for TSS removal efficiencies are described in Section 8.2.4.

Stormwater control systems must include a pretreatment system at each inlet to each detention system and /or retention basin. The pretreatment system must either:

- Be designed and constructed such that the stormwater control system achieves the required first flush pollutant removal rate

  or

- Be designed and constructed to capture the first flush and release it gradually to the detention/retention pond over a period of twenty-four (24) hours, with adequate volume provided below the outlet to provide for sediment storage

6.3.2 Channel Protection Volume Control (CPVC)

The CPVC is required to the MEP to control total runoff volume from a site development. The CPVC volume is determined by calculating the total runoff volume generated over impervious surfaces during a 1-inch rainfall and is calculated as follows:

$V_{CPVC} = A * C * 3{,}630$

where:
V_{CPVC} = required CPVC volume (ft^3)
A = total site drainage area (acres)

Total volume includes the surface storage, soil void storage, and active infiltration over a six-hour period. See *Section 8.2.2: Bioretention* for additional information on infiltration BMP volume calculations and other design criteria.

The CPVC control requirement is waived only when the applicant can clearly demonstrate that site conditions will not accommodate infiltration BMPs. The following conditions will result in a CPVC waiver:

- Infiltration rate of existing (in-situ) soils is less than 0.24 inches/hour (applicant may seek to avoid a waiver where the in-situ infiltration rate is less than 0.24 inches/hour, but in no case will infiltration BMPs be permissible when the in-situ infiltration rate is less than 0.10 inches/hour)
- Prevailing groundwater levels within 2 vertical feet of the bottom of the infiltration BMP
- Presence of contaminated soils in the vicinity of the proposed BMP

The request for a CPVC waiver must be accompanied by a written verification by a Professional Engineer registered in the State of Michigan. Soil and groundwater characteristics must be verified using geotechnical investigations (test pits or soil borings). USDA/NRCS soils maps and/or anecdotal/assumed information on area soil characteristics will ***not*** be adequate to seek a CPVC waiver.

6.3.3 Channel Protection Rate Control (CPRC)

Soil erosion from stream banks and channels is of special concern in Wayne County. As development activity increases impervious surface area, the frequency and duration of bank full flow conditions increases. As a result, streams naturally attempt to become wider and deeper to convey the increased flows. This process can lead to channel and bank erosion and the destruction of aquatic habitat.

To address this concern, each stormwater control system must include a storage area that captures runoff from a 1.9-inch rainfall event and release it gradually over a period of forty-eight (48) hours. The storage volume necessary to capture and treat this event must be calculated based on the following equation:

$$V_{CPRC} = A * C * 6{,}897$$

where:

V_{CPRC} = required CPRC storage volume (ft^3)
A = drainage area (acres)
C = runoff coefficient

Additionally, the CPRC volume shall be discharged using a flow restrictor designed to gradually release this volume over a period of forty-eight (48) hours. The 48-hour average allowable release rate must be determined in accordance with the following relationship:

$$Q_{avg\ CPRC} = V_{CPRC} / 172{,}800$$

where:

Q_{CPRC} = 48-hour average allowable outflow rate (cfs)
V_{CPRC} = Channel Protection Rate Control storage volume (ft^3)

The orifice size shall be calculated using the $Q_{avg\ CPRC}$ and an assumed average head equal to ½ the total depth of the CPRC storage volume.

The minimum permissible orifice size for this requirement is 1-inch diameter. If the calculations above result in an orifice smaller than 1 inch, the orifice size shall default to 1-inch diameter. This is necessary to avoid chronic blockage at the outlet.

For detention systems that are intended to meet both the flood control and Channel Protection Rate Control (CPRC) standard, the lower portion of the flood control storage volume can also be used to capture and release the 1.9-inch rainfall. With this approach, the total detention pond volume required is equal to the flood control storage volume, not the sum of the flood control and CPRC volumes.

The CPVC volume, if provided, can be credited against the flood control storage volume, as the infiltrated volume will not reach the detention pond. If the CPVC volume is greater than the difference between the flood control volume and the CPRC volume, then the CPVC volume can also be used as a credit against the remaining portion of the CPRC volume. However, in no case shall the flood control volume (net of the CPVC credit) be less than the CPRC volume.

Example:

CPVC volume: 10,000 cubic feet
CPRC volume: 19,000 cubic feet
Flood control volume: 28,000 cubic feet

Calculate the adjusted flood control volume with CPVC credit):
28,000 – 10,000 = 18,000 cubic feet

Is the adjusted flood control volume less than the CPRC? Yes.
Required flood control volume = 19,000 cubic feet

Since the flood control volume is equal to the CPRC volume, the entire pond volume can be treated as the CPRC volume and discharged over a 48-hour period. Any volume above 19,000 cubic feet will overflow to the receiving system.

The volume of the permanent pool within an open detention system does not satisfy any of the flood control or CPRC storage volume requirements.

6.3.4 Additional Requirements

To protect water resources, Wayne County has adopted the following additional requirements to minimize pollutants in stormwater runoff from development projects.

Buffer Strip

A buffer strip is a zone that is used for filtering direct stormwater runoff into a stormwater control system and for providing maintenance access to a stormwater control system. The buffer strip varies in size dependent of the development. For a site that is less than 5 acres, a buffer strip of 15 feet wide must be established and/or preserved along the edge of any surface water in the development site (except for bioretention areas and vegetated swales). For a site greater than 5 acres, a minimum of 25 feet wide buffer strip must be established and/or preserved along the edge of any surface water in the development site (except for bioretention areas and vegetated swales

- Along watercourses, the width of a buffer strip must be measured from the top of bank of the watercourse. Around other surface waters, the width of the buffer strip must be measured from the minimum freeboard elevation of the surface water. Additional requirements for buffer strips associated with open detention basins and retention basins are described in Section 8.1.
- The ground slope of a buffer strip should not be steeper than 1:6.
- Construction activities, paving, and chemical application, except for construction activities needed to create or establish the buffer strip, are prohibited in the buffer strip.

Landscape Plan

Because vegetation is an important part of many components of stormwater control systems, a landscaping plan must be submitted to the County.

- The plan must depict landscaping elements that function as part of the stormwater control system, including the buffer strip.
- The landscape plan must include (at a minimum) specifications for the soils and plant materials that the applicant proposes to include in the landscape; and a description of the methods and planting techniques that the applicant proposes to utilize during landscape installation.
- The installation and maintenance of the landscaping described in the landscape plan is included as regulated construction activity for which the County may require financial assurance.

Guidance and requirements for landscaping plans are described in Chapter 8.

Other

Healthy streams have natural temperatures that are cooler than that of stormwater runoff. Applicants should consider incorporating landscaping or other features to minimize the temperature of stormwater runoff, and the adverse effect that high water temperatures may have on the receiving water quality. For example:

- Provide trees or other means to shade open detention basins and certain other stormwater control components.
- Provide an outlet structure for open detention basins which draws water from the (cooler) bottom of the basin. This outlet configuration typically requires a permanent pool depth of at least 6-8 feet.

CHAPTER 7: ADDITIONAL REQUIREMENTS

This chapter presents additional requirements that may apply to stormwater control systems in Wayne County.

7.1 Stormwater Conveyances

Stormwater control systems may use watercourses or structures such as closed conduits, culverts, or bridges as a means of conveying stormwater runoff. Watercourses and closed conduits must be designed to standards described in this section, or, if local standards are more stringent (i.e. higher level of service than required by the County), then the design must conform to the stricter standard. Stormwater runoff conveyed within or under County Roads must also meet the additional requirements described in Section 7.3.

7.1.1 Watercourses

Natural watercourses should be preserved whenever possible. The Permit Office will not approve modifications to natural watercourses (e.g., installing a concrete channel or enclosure) unless the modification is necessary to address a demonstrated public safety, health or welfare issue. When such modifications are deemed necessary, the appropriate governmental agencies must be contacted for review and approval.

The flow capacity of each reach of a watercourse that is part of an approved stormwater control system must be, at a minimum, equal to or greater than the peak flow rate for a minimum of 10-year recurrence interval, 24-hour duration storm event (100-year design requirement applies when the contributing drainage area is larger than 640 acres) . Any component of a watercourse that has been intended to provide a higher level of service shall be designed accordingly. For example, if a watercourse through a development or road project is associated with a FEMA floodplain, then the design standard for that watercourse must be, at a minimum, a 100-year recurrence interval, 24-hour duration storm event. Similarly, if a development design incorporates a local watercourse (or a pipe, culvert, or bridge along that watercourse) that has been designated by a local community, through a stormwater master planning process, as requiring a higher level of service, the design standard for the development must be modified to meet that higher designated level of service. The flow capacity of a watercourse must be calculated in accordance with the "Manning Formula" as follows:

$$Q = \frac{1.486 * A * R^{2/3} * S^{1/2}}{n}$$

where:

Q = flow capacity (cfs)
A = cross sectional flow area (ft^2)
n = Manning's coefficient of roughness
P = wetted perimeter (feet)
R = hydraulic radius = (A/P, in feet)
S = hydraulic gradient (ft/ft)

Modeling software that incorporates the Manning Formula, including (but not limited to) HEC-RAS, SWMM, and similar programs, can also be used to demonstrate watercourse hydraulic capacity.

Manning "n" values for various surfaces should be based on those listed in the MDOT Drainage Manual, latest edition.

7.1.2 Closed Conduits

The flow capacity of each reach of a closed conduit that is part of a stormwater control system must be equal to or greater than the peak flow rate for a 10-year recurrence interval storm, calculated using either a 24-hour SCS Type II rainfall distribution or the Rational Method using the intensity equation in Chapter 6. Higher levels of service may be required when the conduit is designated, by the County or local jurisdiction, for a larger storm The Manning Formula (shown above), or any modeling software that uses the same formula, must be used to determine the flow capacity of a closed conduit.

Figure 7-1: Concrete Closed Conduit Pipes (source: Primera)

The invert elevation of each closed conduit entering a forebay with a permanent pool must be equal to or greater than the permanent pool elevation.

The hydraulic grade lines (HGLs) of closed conduits must meet both of the following requirements:

- The hydraulic grade line must be calculated based on 10-year storm flows, starting with the crown elevation at the outlet. This gradient must not be higher than 1.0 feet below the rim elevation at any upstream manhole, inlet, or catch basin location. However, exceptions may be granted in special circumstances such as for managing stormwater in and around truck docks or in systems that are constrained due to abnormally adverse downstream conditions, per County discretion.
    - For systems with forebays: The HGL starts at the crown of the pipe entering the forebay.
    - For systems with underground detention systems: The HGL starts at the crown of the pipe entering the manufactured treatment structure.
- The rim elevation at any manhole location along the closed conduit upstream of a detention/retention pond must be at least one (1) foot above the design high water level of the detention/retention pond.

The minimum and maximum allowable closed conduit flow velocities are 2.5 and 8.0 feet per second, respectively. The maximum allowable velocity within the conduit may only be exceeded where special provisions have been made to dissipate energy.

The maximum distance between manholes, catch basins, and inlets may not exceed 300 feet plus 100 additional feet for every 1 foot of diameter for closed conduits over 36 inches in diameter.

Manholes or junction chambers must be constructed at all closed conduit junctions and angle points and at all changes in conduit size and/or slope.

The inlets and outlets for all closed conduits require an end treatment and soil stabilization measures, and some closed conduits may also require a grate to prevent entry into the conduit by children and animals. Grates for animal protection are only used for enclosures larger than 24 inches in diameter. Grates should comply with MDOT Standard Plan Series R-92-C. Inlets and outlets should be inspected periodically for blockage, signs of soil erosion, and structural damage.

End Treatments

All stormwater enclosure inlets/outlets in a roadside ditch or adjacent to County Roads must have a flared end section type of end treatment for road safety purposes. The following requirements apply to stormwater enclosure inlets/outlets which are not in a roadside ditch or adjacent to a roadway.

- For inlets/outlets on County park property, end treatments may be either the "reverse wingwall" headwall with a splash pan shown in the detail provided in Appendix D of this manual, or the standard headwall described below.

- For enclosures 36 inches in diameter or smaller, the inlet/outlet treatment should be a flared end section (MDOT Standard Plan Series R-86-D (concrete) or R-88-D (steel)) or an outlet headwall (Standard Plan Series R-85).

- For enclosures larger than 36 inches in diameter, the inlet/outlet treatment should be either a site-specific designed concrete headwall or, if approved by the Permit Office for the specific location and under 84 inches in diameter, a flared end section (MDOT Standard Plan Series R-86-D (concrete) or R-88-D (steel)).

Soil Stabilization

Soil stabilization measures should be provided around each end treatment to prevent any soil erosion around the end treatment or in the flow path leading to or from the end treatment. Storm sewer outlets located across from the cutting side of a watercourse also should include soil stabilization measures for the opposite embankment.

Soil stabilization measures may include riprap with geotextile fabric, revetment mattresses, cobbles, stone, crushed rock, precast blocks, gabions. Crushed/broken concrete is not an acceptable substitute for riprap. Soil stabilization measures should be put in place immediately after final grading and before the inlet or outlet receives flow. Filter fabric should be per MDOT specifications. Riprap placement and sizing should follow the specifications provided in Appendix D of this manual.

Outlet Elevations

In general, the invert elevation of a closed conduit which outlets to a watercourse should be at or below the low water level of the watercourse. Special provisions may be required if the outlet is located on the cutting bank of a bend in the watercourse. To minimize the possibility of backflow from a watercourse into an open detention basin, the permanent pool water level in the detention basin should be at least 1 foot above the low water level in the watercourse.

7.1.3 Vegetated Swales

Vegetated swales are broad, shallow channels lined with vegetation that slow and filter stormwater runoff and promote infiltration. Vegetated swales can serve as stormwater control conveyance and may also be used to achieve a degree of stormwater treatment. Vegetated swales are best suited for relatively small drainage areas such as areas of sheet drainage up to 2 acres (e.g. along roadways, around parking lots, and as buffers between properties). They may count both as part of the required stormwater control system and toward local landscape and/or green space requirements.

Common applications include:

- Stormwater conveyance within a development site. Vegetated swales can replace curbs, gutters, and storm sewer systems along roads or and/or parking areas where local community standards and site conditions permit.
- Stormwater management retrofit and redevelopment situations. The addition of grassed swales will provide some improvement in the amount of runoff and in water quality.

Design Criteria

- A maximum 150-foot distance of sheet drainage to the swale is recommended, with varying grades up to a maximum of 3%.
- If a storm sewer discharges into a swale, energy dissipation should be used at the point of inlet.
- The flow capacity of vegetated swales used as conveyance in stormwater control systems must equal or exceed the peak flow rate for the 10-year, 24-hour storm.
- To reduce the possibility of erosion, swales should be designed with peak flows that do not exceed 5 cfs.
- Flow velocities in vegetated swales should range between a minimum of 2 ft/sec and a maximum of 5 ft/sec.
- Check dams may be used to reduce velocities, promote infiltration, increase storage and enhance water quality. Earthen check dams are not recommended because of their potential to erode. Toe protection is recommended for all check dams.
- The minimum acceptable longitudinal slope of a vegetated swale is 1.5% unless other techniques such as infiltration devices are employed.
- The maximum longitudinal slope of a vegetated swale should not exceed 3%, unless check dams are used.
- Swale length should be a minimum of 200 feet wherever possible, to increase the contact time of stormwater.
- A parabolic or trapezoidal shape is recommended, with side slopes no steeper than 3:1. Soil conditions, vegetative cover and maintenance ability should be considered when designing the side slopes.
- A minimum freeboard of 6 inches below the top of bank is recommended.
- The maximum recommended water depth for temporary pooling of water is 6 inches. A maximum of 3 inches to 4 inches is preferred for areas that receive high hydraulic loading or have soils with low infiltration rates. This should be done in combination with a smaller drainage area.
- Clearance between the swale invert and underground utilities should be addressed as part of the design process. A minimum clearance of 5 feet between swale invert and underground utilities is recommended unless special provisions are employed.
- There may be additional design criteria for vegetated swales adjacent to roads, particularly those under the jurisdiction of another agency (e.g., MDOT).
- Grading plans for the development project should clearly identify the location of vegetative swales in relation to the topography and physical location. The grading plans should clearly identify the routing of construction traffic such that it does not traverse the swale locations.
- Swales should follow the natural, pre-development drainage path when possible.

Vegetation Specifications

Applicants that propose to use vegetated swales as part of a stormwater control system must submit a landscaping plan with the application for stormwater construction approval. The landscaping plan is required because vegetation is essential to the proper functioning of the swale. Landscaping is part of the regulated construction activity for which financial assurance must be provided.

Vegetation should be uniform and should consist of fine, turf-forming water-resistant grasses. Deep-rooted native wetland and upland grasses are preferred for infiltration and reduced maintenance. For more information about vegetation see Section 8.3 and the SEMCOG LID Manual.

Figure 7-2: Swales can be used along roadsides and parking lots to collect and treat stormwater runoff (source: OHM Advisors)

Maintenance

Maintenance of vegetated swales should be focused on keeping a dense, healthy vegetated cover and keeping up the hydraulic and removal efficiency of the channel. Maintenance activities related to the vegetated cover include mowing (with grass never cut shorter than the design flow depth), weed control, and re-planting/seeding of bare areas. "River friendly" lawn and garden practices (see References below) should be followed in the maintenance of vegetated swales.

Vegetated swales should periodically be cleared of debris and blockages. Periodic sediment cleanout should be done manually to avoid the transport of resuspended sediments in periods of low flow and to prevent a damming effect from sediment buildup. Damaged areas (e.g., ruts or holes) within a channel should be repaired utilizing a suitable soil that is properly tamped and seeded.

7.1.4 County Road Culverts and Bridges

Under separate requirements administered by the Wayne County Permit Office, special provisions apply to culverts and bridges that convey a watercourse under a County Road, whether the culvert or bridge will be newly constructed or will be constructed to replace an existing culvert or bridge. If the watercourse is a County Drain, see Sections 7.4 and 7.5 for additional requirements that may apply.

The hydraulic capacities of culverts and bridges must be calculated using a method approved by the County. All bridges and culverts also must be designed with adequate soil erosion protection.

Bridges that convey a watercourse under a County Road must be designed to pass the peak flow rate for a 100-year storm with no harmful increase in backwater elevations. The 100-year storm elevation upstream of a bridge also must be at least one (1) foot below the lowest elevation of either the bridge deck or the approach pavements to the structure. Exceptions may be made where the downstream (tailwater) conditions are adverse and make it infeasible to locate the bridge structure above the floodplain.

Culverts that convey a watercourse under a County Road with a drainage area less than 640 acres (1 square mile) must be designed to convey at least the peak flow rate for a 10-year recurrence interval storm, as determined using the methods described in Section 6.1.1. Culverts that convey a watercourse under a County Road with a drainage area larger than 640 acres (1 square mile) must be designed to convey at least the peak flow rate for a 100-year recurrence interval storm. Culverts that will be inundated by storms larger than the design storm established by the MDOT or EGLE must be designed with soil erosion protection that is adequate for the inundated condition.

Culverts that are located in a FEMA mapped floodplain shall be designed to convey at least the peak flow from a 100-year recurrence interval event with no adverse impact to the 100-year flood profile. In cases where the official floodplain is shown to be significantly changed as a result of the development or road project, the County may require that a Conditional Letter of Map Revision (CLOMR) or a Letter of Map Revision (LOMR) application be submitted to and approved by FEMA prior to approval of a development plan.

7.2 Downstream Improvements

If the County determines that a proposed stormwater control system does not include an adequate stormwater outlet, the Applicant may be required to design and construct improvements to the downstream drain, watercourse or closed conduit. The County determines the extent to which downstream improvements may be required to provide an adequate stormwater outlet.

7.2.1 Streambank Stabilization

Streambank stabilization may be required if the County does not believe there is an adequate capacity downstream of the improvements. The best way to identify specific areas where streambank stabilization controls are needed is to look at the entire watershed. Three techniques are used depending on the area conditions and stabilization needs, engineered, bioengineered and biotechnical techniques.

Technique	Description	Examples
Engineered	Technology used when streambank slopes can't be stabilized by vegetation alone	Riprap, gabions, revetments, retaining walls
Bioengineered	Embedded live plants to provide a barrier for earth movement, soil reinforcement, and hydraulic drains	Live stakes, woody plant cuttings, brush mattress
Biotechnical	Integrated plants and inert structural components to stabilize channel slopes and provide a natural appearance	Vegetated riprap, cellular grids, grass systems

For specific streambank stabilization planning and design guidelines, refer to the USDA/NRCS Stream Restoration Design manual (Part 654, National Engineering Handbook).

Figure 7-3: Streambank Stabilization During Construction (source: OHM Advisors)

Figure 7-4: Streambank Stabilization after Construction (source: OHM Advisors)

7.3 Easements

Easement documentation for drains and watercourse established under the Drain Code are on file with the Wayne County Drain Commissioner. Wayne County generally requires the following minimum easement widths for established County Drains and other watercourses.

1. An open County Drain or watercourse must have a constant width easement centered on the centerline of the drain or watercourse. The minimum width of easement shall be equal to the extreme (widest section of the drain or watercourse) plus 30 feet.
2. Enclosed County Drains must have a minimum easement width of 20 feet centered on the centerline of the enclosure. However, the minimum easement width may vary based on the diameter and depth of the enclosed County Drain. Please see table below.

Minimum Easement Width

Pipe Diameter (in)	Cover (ft)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Over 20'
12	20	20	20	20	20	20	25	25	25	30	30	35	35	35	40	40	45	45	45	50	TBD
15	20	20	20	20	20	20	25	25	25	30	30	35	35	35	40	40	45	45	45	50	TBD
18	20	20	20	20	20	25	25	25	30	30	35	35	35	40	40	45	45	45	50	50	TBD
24	20	20	20	20	20	25	25	30	30	30	35	35	40	40	40	45	45	50	50	50	TBD
30	20	20	20	20	25	25	30	30	30	35	35	40	40	40	45	45	50	50	50	55	TBD
36	20	20	20	25	25	30	30	30	35	35	40	40	40	45	45	50	50	50	55	55	TBD
42	20	20	25	25	30	30	30	35	35	40	40	40	45	45	50	50	50	55	55	60	TBD
48	20	25	25	25	30	30	35	35	35	40	40	45	45	45	50	50	55	55	55	60	TBD
54	25	25	25	30	30	35	35	35	40	40	45	45	45	50	50	55	55	55	60	60	TBD
60	25	25	30	30	35	35	35	40	40	45	45	45	50	50	55	55	55	60	60	65	TBD
66	25	30	30	35	35	35	40	40	45	45	45	50	50	55	55	55	60	60	65	65	TBD
72	30	30	30	35	35	40	40	40	45	45	50	50	50	55	55	60	60	60	65	65	TBD
78	30	30	35	35	40	40	40	45	45	50	50	50	55	55	60	60	60	65	65	70	TBD
84	30	35	35	40	40	40	45	45	50	50	50	55	55	60	60	60	65	65	70	70	TBD
90	35	35	40	40	40	45	45	50	50	50	55	55	60	60	60	65	65	70	70	70	TBD
96	35	35	40	40	45	45	45	50	50	55	55	55	60	60	65	65	65	70	70	75	TBD
102	35	40	40	45	45	45	50	50	55	55	55	60	60	65	65	65	70	70	75	75	TBD
108	40	40	45	45	45	50	50	55	55	55	60	60	65	65	65	70	70	75	75	75	TBD
114	40	45	45	45	50	50	55	55	55	60	60	65	65	65	70	70	75	75	75	80	TBD
120	40	45	45	50	50	50	55	55	60	60	60	65	65	70	70	70	75	75	80	80	TBD
132	45	50	50	50	55	55	60	60	60	65	65	70	70	70	75	75	80	80	80	85	TBD
144	50	50	55	55	55	60	60	65	65	65	70	70	75	75	75	80	80	85	85	85	TBD
Over 144"	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Figure 7-5: Minimum Easement Width based on Pipe Diameter

The easement widths described above govern generally. The County may require an alternative width if the County determines that additional space is required for proper construction, or because of special circumstances, such as sewer depth or soil types. Note that Wayne County DPS does not allow any buffer strips required under the Stormwater Control Program to overlap with County Drain easements. Exceptions to the easement requirements described above are within the County's sole discretion.

7.4 County Drains

Applicants who propose projects that would modify an established County Drain or an established drainage district may be subject to additional requirements as determined by the Drain Commissioner.

7.5 County Park Property

The County may establish additional or alternative requirements for stormwater control systems in County park property or which outlet within County park property. For example, special provisions apply to inlets/outlets on County park property as described in Section 8.3.1 and Appendix D.

7.6 Wetlands

The natural drainage pattern of the land within a development site must not be altered in any way that may cause adverse impacts to existing wetland areas. Untreated stormwater will not be permitted to outlet directly into a natural or mitigation wetland area. The level of treatment required to discharge stormwater runoff to a natural or mitigation wetland area is determined by EGLE. However, at a minimum, stormwater discharged into a natural or mitigation wetland must pass through a pretreatment system. The pretreatment system must be designed in accordance with the requirements described in Section 6.3.1.

In addition to Wayne County approval of the stormwater control system for a development project, the design of any wetland created for mitigation must also be approved by MDEQ.

Figure 7-6: Crosswinds Marsh Interpretive Preserve

7.7 Temporary Measures during Construction

As described in Chapter 3, projects that involve earth change activities may need to implement temporary stormwater control measures to comply with additional federal NPDES requirements that apply to construction activity that disturbs one or more acres of land. More information about the NPDES requirements is available from EGLE's Water Resources Division.

Projects that involve earth change activities also may need to implement temporary stormwater control measures under the state Soil Erosion and Sedimentation Control (SESC) program and Wayne County's Soil Erosion and Sedimentation Control Ordinance, Chapter 94 of the Code of Ordinances of Wayne County (2001). More information about these programs and the types of projects that require a permit under these programs is available in Chapter 3.

Projects within Wayne County that must obtain a SESC permit from WCDPS, ESD must comply with the measures described in this section. An overview of the permit process is shown in Figure 7-1. Additional information about Wayne County's SESC program, and a

downloadable copy of the permit application package, is available from the County's website (https://www.waynecounty.com/departments/environmental/landresources/soil-erosion.aspx).

7.7.1 General Earth Change Requirements

In conformance with the state SESC program and the SESC Ordinance, Wayne County generally requires the following temporary measures during construction:

- The proposed work shall be carried out in accordance with approved earth change plans and in compliance with all requirements of the permit and state laws and regulations.
- Earth changes must be conducted in a manner that effectively reduces accelerated soil erosion and resulting sedimentation.
- Persons engaged in earth change activities must, in conformance with state law, implement and maintain acceptable soil erosion and sedimentation control measures that effectively reduce accelerated soil erosion.
- Earth changes must be scheduled and completed in a manner that will limit the exposed area of any disturbed land for the shortest possible period of time, as determined by WCDPS.
- Sediment caused by accelerated soil erosion must be removed from runoff water before it leaves the site of the earth change.
- Temporary or permanent facilities designed and constructed for the conveyance of water around, through or from the earth change area must be designed to limit the water flow to a non-erosive velocity.
- Temporary soil erosion control measures must be maintained until permanent soil erosion measures are installed and approved. Permanent soil erosion control measures must be maintained for a minimum of one year after the project passes WCDPS's completion inspection.
- Permanent soil erosion control measures for all slopes, channels, ditches, or any other disturbed land area must be completed within five calendar days after final grading or earth moving activity has been completed.
- Soil tracked, spilled, dumped or deposited onto public streets, highways, sidewalks, or other public thoroughfares must be removed promptly.
- Permittees shall notify the WCDPS as to when the project completion inspection can be made.

7.7.2 General Plan Requirements

Three sets of earth change plans must be submitted before regulated earth changes may commence. The plans must be sealed by a Professional Engineer or Landscape Architect registered in the State of Michigan.

Each set of earth change plans must include drawings of the earth change at a scale not more than 100 feet to the inch, including a legal description; a site location map which includes the proximity of any proposed earth change to lakes, streams or wetlands; existing structures; existing contour intervals which clearly show the character of the land; proposed contour intervals which clearly show the future character of the land; and a description of the existing vegetation on the site.

Each set of earth change plans must also include details for the proposed earth changes, including:

- Location of the physical limits of each proposed earth change including the location of temporary soil stockpile areas. If soil is to be removed from the site, the location of the offsite disposal area must be identified.

- A description and location of all existing and proposed on-site drainage facilities, including detailed storm sewer plans, drainage arrows for surface drainage, and the ultimate drainage outlet for the site.

- Time and sequence of each proposed earth change with approximate dates for major grading activities, including site stripping, rough grading and cut and fill; construction of detention basin, roads and underground utilities, digging basements and backfilling lots; final grading, landscaping paving. This sequence must include a description of temporary erosion control measures to prevent sediment from leaving the project site during each of the proposed earth change activities. A description and location of all proposed temporary and permanent soil erosion control measures.

- Approved standard details of all temporary and permanent soil erosion control measures.

7.7.3 Wayne County Plan Requirements

Wayne County imposes additional requirements for earth change plans. In addition to the general plan requirements discussed above, the following design and maintenance features must be shown on the plan and included in the construction sequence:

- A perforated riser pipe with stone filter must be installed on all open detention basins and sediment basins on projects five acres or more in size.

- A temporary crushed rock tracking pad must be installed at the construction entrance and exit. This tracking pad must be maintained with fresh stone periodically. Construction traffic must be limited to designated entrance and exit.

- Street scraping and cleaning (sweeping) must be conducted on a regular schedule. At a minimum, one sweeping must occur each week, and one scraping must occur at the end of each workday.

- Paved storm sewer inlets must be protected by a high flow sack type inlet filter conforming to Siltsack-High Flow by ACF Environmental; or Inlet Pro®-High Flow sediment bag by Hanes Geo Components; Dandy Curb Sack by Dandy Products, Inc.

- Rear yard (beehive-type) storm sewer inlets shall be protected by a SedCage by Sedcatch Environmental Products; or a box filter fabric fence conforming to CSI Geoturf 36-inch MDOT spec silt fence securely fixed to 2" x 2" hardwood stakes spaced no more than 6.5 on center, tied to 4 feet steel posts at all four corners and trenched a minimum of 10-inches into the ground.

- All catch basins and inlets in areas that are determined to be susceptible to flooding must have catch-all type inlet filters.

- All exposed earth must be stabilized with seed and mulch or sod within five days of final grade. Sediment basins must be stabilized with seed and straw mulch blankets. Straw blankets must be staked into the ground five days after the construction of the sediment basin.

- Straw mulch blankets must be used on 3:1 slopes or greater. (Three foot horizontal, one foot vertical)

- Ditches, swales, and other areas that will channel concentrated runoff must be stabilized within five days of construction. Temporary rock check dams must be installed to slow water to non-erosive velocities in areas of concentrated flow.

- Road rights-of way must be stabilized with seed and mulch within five days of completing utility work in the right of way.

- Areas of earth change that are disturbed beyond the fall seeding deadline (November 1) may require dormant seeding and straw mulch securely anchored to the ground.

Figure 7-7: Example of a swale (source: OHM Advisors)

- Single family lots, during construction, must have a silt fence barrier installed across the front and rear lot lines with a temporary crushed rock tracking pad for ingress and egress at each lot.

- A single family residence, prior to receiving a Certificate of Occupancy, must have established lawn; or a temporary silt fence barrier securely trenched a minimum of 8 inches; or annual rye seed mix covered by straw mulch blanket anchored to the ground with hardwood stakes at a minimum of 15 feet from back of curb across the entire front of the lot.

- Rip rap must be immediately installed after construction of outlets and culverts.

7.7.4 Performance Deposit

WCDPS does not issue SESC permits for an earth change unless the permittee first posts with Wayne County a bond, certified check, or irrevocable bank letter of credit in the amount equal to that which would be required for the surety bond. If a bond is used, it must be executed by the permittee and a corporate surety with authority to do business in this state as a surety. The bond must be in the amount of the established total cost of the earth change work authorized by the permit, but in no case may the bond amount be for less than $1,500.00 per acre of earth change.

Each bond must provide assurance for the maintenance of the finished project for a period of one year after the project completion inspection is made. Deposits or bonds shall be submitted to the WCDPS with the permit application. Upon permit issuance, the bond will be posted with the County Clerk by the WCDPS.

No performance deposit is required for a permit classified as a single-family residence.

7.7.5 Inspections and Enforcement

Once an application for a permit is received by WCDPS and before a permit is issued, an initial site investigation is made in the field. After permit issuance, earth change inspections are made periodically to assure compliance with the permit, state law, and the SESC Ordinance. When all grading is complete and all permanent erosion control measures are installed, a project completion inspection is made prior to permit expiration. Finally, one year after the completion inspection, a final inspection is made to ensure that permanent erosion control measures are still functioning effectively.

NOTE: No earth change work (grading, excavation, fill, topsoil, stripping, etc.) within 500 feet of a lake, stream, or drain or that disturbs more than one acre of land may begin until a permit is issued under state law. Such earthwork which begins without a permit is violation of the law and subject to enhanced enforcement.

7.7.6 Extension of Permit

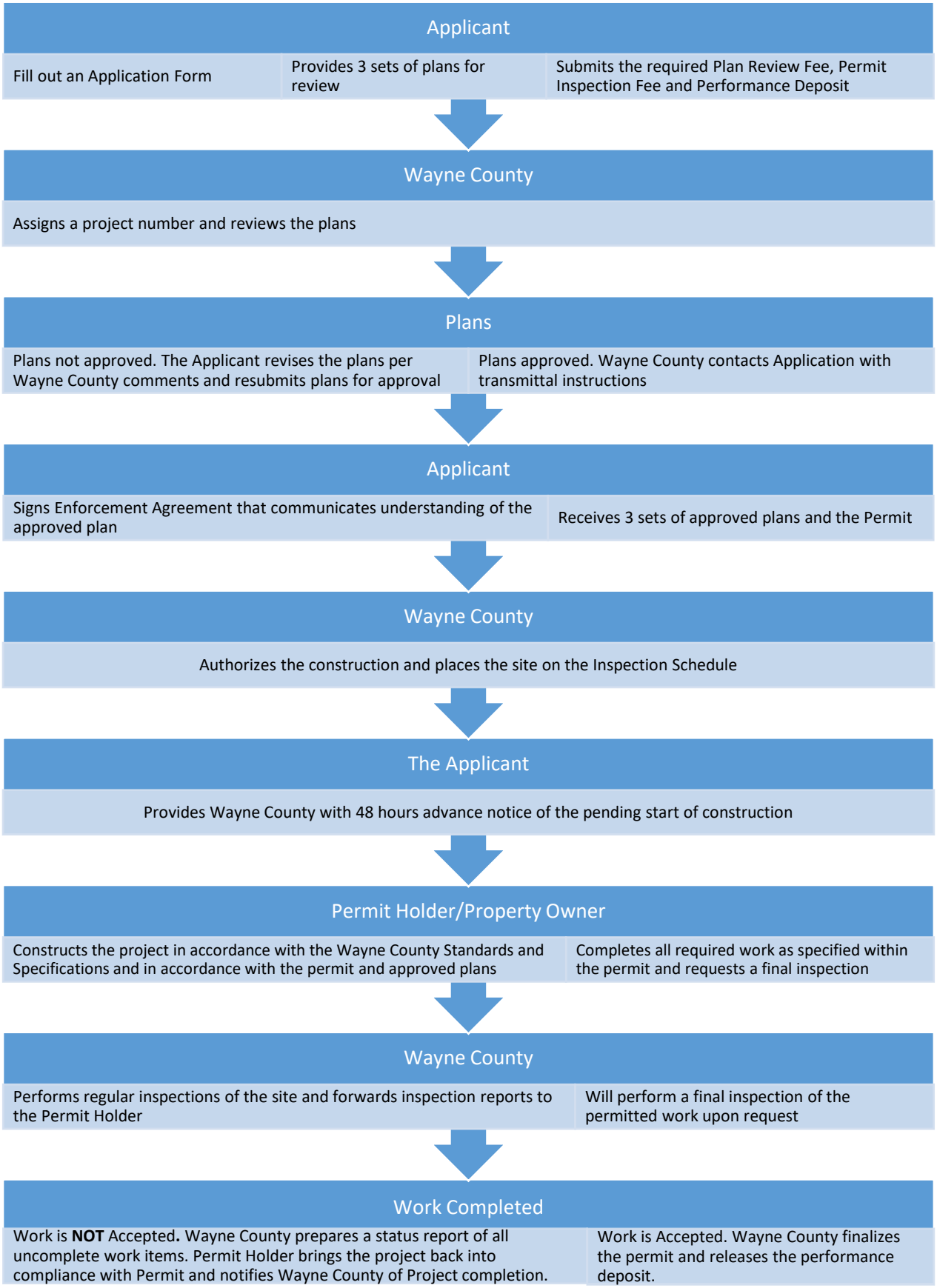
If the permittee is unable to complete the work within the 24-month permit period, he or she must present in writing to the WCDPS, a request for an extension of the permit. Requests for extension shall be made at least ten (10) days before permit expiration. If, in the opinion of the WCDPS, such an extension is warranted, additional time may be granted for the completion of the work. An additional permit and inspection fee are required to extend the permit.

7.7.7 Modifications of Approved Plans

All proposed modifications of the approved earth change plans must be submitted to and approved by the WCDPS. All necessary specifications and related reports shall be submitted with any proposal to modify the approved earth change plan. No earthwork in connection with any proposed modifications is permitted without the approval of the WCDPS.

FIGURE 7-1

PROCEDURE FOR OBTAINING A
SOIL EROSION AND SEDIMENTATION CONTROL PERMIT


Applicant
Fill out an Application Form
Provides 3 sets of plans for review
Submits the required Plan Review Fee, Permit Inspection Fee and Performance Deposit
Wayne County
Assigns a project number and reviews the plans
Plans
Plans not approved. The Applicant revises the plans per Wayne County comments and resubmits plans for approval
Plans approved. Wayne County contacts Application with transmittal instructions
Applicant
Signs Enforcement Agreement that communicates understanding of the approved plan
Receives 3 sets of approved plans and the Permit
Wayne County
Authorizes the construction and places the site on the Inspection Schedule
The Applicant
Provides Wayne County with 48 hours advance notice of the pending start of construction
Permit Holder/Property Owner
Constructs the project in accordance with the Wayne County Standards and Specifications and in accordance with the permit and approved plans
Completes all required work as specified within the permit and requests a final inspection
Wayne County
Performs regular inspections of the site and forwards inspection reports to the Permit Holder
Will perform a final inspection of the permitted work upon request
Work Completed
Work is NOT Accepted. Wayne County prepares a status report of all uncomplete work items. Permit Holder brings the project back into compliance with Permit and notifies Wayne County of Project completion.
Work is Accepted. Wayne County finalizes the permit and releases the performance deposit.

CHAPTER 8: BEST MANAGEMENT PRACTICES

This chapter describes some of the most common Best Management Practices (BMPs) which may be used in designing a stormwater control system. The information provided for each BMP includes a description of the BMP and its purpose along with design criteria and guidelines, specifications and maintenance requirements. The type of applications for the BMPs in this section are summarized in the table below.

Practices	Peak Flow Control	Volume Control	TSS (Water Quality)
Section 8.1 Peak Flow Controls			
Detention	X		
Underground Detention	X		
Retention	X		
Section 8.2 Water Quality/Infiltration Systems			
Forebays		X	X
Bioretention		X	X
Manufactured Treatment Systems		X	X
Permeable Pavement		X	X
Section 8.3 Vegetation			
Vegetation			X

The Detroit Water and Sewerage Department (DWSD) Stormwater Management Design Manual and Southeast Michigan Council of Government (SEMCOG) Low Impact Development (LID) Manual for Michigan (SEMCOG LID Manual) include excellent examples of stormwater BMPs; these documents should be used for design reference materials, along with this chapter, to develop design and operations & maintenance strategies for stormwater BMPs selected for site design. Use the hyperlinks below to access these documents

DWSD Stormwater Management Design Manual

Michigan Low Impact Development Manual

8.1 Peak Flow Controls

Peak flow controls are designed to temporarily store stormwater runoff from a site to prevent downstream flooding by attenuating the peak discharge rate. Examples of peak flow controls are detention basins, retention basins and underground storage. General design, maintenance and vegetation practices for peak flow controls are provided below. For specific information about other systems review Sections 8.1.1 through 8.1.4.

Detention Basin

- Stores stormwater for a period of time, then slowly releases all stored water
- Inlet and Outlet controls
- Manages water quality

Underground Detention

- Stores stormwater in a underground structure used when space is limited
- Inlet and Outlet controls
- Manages water quality

Retention Basin

- Inlet control only
- A wet pond with vegetation

General Design Standards

Peak flow control systems have some common design standards. Those general design standards are listed below. Additionally, referencing of the DWSD Stormwater Management Design Manual is encouraged. Chapter 7 of the DSWD Stormwater Management Design Manual provides detailed design standard information for each peak flow control system.

- A water quality/infiltration system (pretreatment system), such as bioretention, is required at each inlet to the detention or retention basin. Pretreatment systems trap sediment and other floatables before entering the basin, reduce the incoming runoff velocities, and spread runoff evenly over the basin to create sheet flow conditions. Section 8.2 of this manual provides detailed information and design criteria for water quality/infiltration systems.
- All closed conduits entering a detention or retention basin should have an end treatment and adequate soil erosion protection, as described in Section 7.1.2. All enclosures should also be covered with a grate to prevent children and animals from entering the enclosure.
- A minimum of one (1) foot of freeboard is required above the design water level of a detention or retention basin.
- Emergency spillways are required for all detention and retention basin.
- Although use of terraced side slopes generally is discouraged when other alternatives exist, terraced side slopes may be approved for basins in certain, limited circumstances at the discretion of Wayne County. The overall slope of a terraced side of a basin should not be steeper than 1:3 (V:H). An example detail for terraced side slopes is provided in Appendix D.

- A landscaping plan is required for all basins. Plant or grass vegetation, such as along the side slopes of a detention or retention basin, is necessary to control erosion and enhance sediment entrapment. Use of a professional landscape architect with experience in stormwater control system design and native landscaping is encouraged.
- The practice must have a sufficient buffer strip for maintenance purposes (See Chapter 6 for size criteria for buffer strip) . Buffer strips should be sized and located to accommodate access and operation of equipment, spoils, deposition and other activities identified in the development's stormwater management plan.
- Practices should not be constructed in areas with high quality and/or well-draining soils, which are adequate for installing BMPs capable of achieving stormwater infiltration and volume reduction.

General Maintenance

As a general rule, the peak flow control system requires cleaning if its volume is reduced by more than 10 percent due to accumulation of silt and sediment. Additionally, standard maintenance practices are listed below. The maintenance activities must be identified in the operation and maintenance plan that the application must submit with an application for stormwater construction approval. Additionally, provision for maintenance access should be shown on the plan; it is recommended that the maintenance access to the stormwater control system be a minimum of 15-feet wide. The landscape plan should be designed to prevent obstruction of the access of trees and shrubs.

Figure 8-1: Invasive Species: Purple Loosestrife (Source: Plant Conservation Alliance)

- Inspect and clean the stormwater system upstream from the basin (every five years or as needed).
- Inspect for sediment accumulation at the inlet pipes and remove sediment which may be impeding flow (semiannually and after rain events).
- Inspect inlets, catch basins, outlets, and appurtenances (e.g., grates) annually for structural integrity and clogging; clean as necessary.
- Check the outlets regularly for clogging and erosion; clean when necessary, especially after large storm events.
- Inspect the stone around riser-type outlet structures semi-annually and after rain events. If stone has accumulated sediment, vegetation and/or debris to an extent that water is not flowing through the stone and out of the pond as originally designed, then the stone should be replaced.

If the outlet is pumped, then only a licensed electrician or company that provided the pump system should conduct maintenance. Chemicals should not be applied to any aspect of the open detention basin, including the bottom, side slopes or buffer strip.

General Vegetation Specifications

The type of vegetation used for peak flow control systems are dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. The use of native plants and "no mow (or grow) zones" is encouraged. Native plants are adapted to the local climate and conditions and have numerous short-term and long-term advantages. The vegetation requirements at the local level should also be consulted.

A landscaping plan is required, due to the importance of vegetation to the functionality of the entire system. Vegetation should be specified for each zone within the detention basin as follows from the SEMCOG LID Manual. More information about vegetation can be found in Section 8.3 and Appendix C in the SEMCOG LID Manual.

The landscaping plan for peak flow control systems should identify the following items:

- Existing site conditions and vegetation (e.g., trees 6-in caliper and larger) that are affected by the project;
- Plan view of the open detention basin, including one foot grading contours;
- Elevations in the open detention basin, including detention basin bottom elevation, permanent water elevation, channel protection rate control elevation, 100-year storm elevation, and freeboard elevation;
- Area in square feet of each of the planting zones (pond zone, edge zone, and upland zone);

Figure 8-2: Black-eyed Susan (source: Outside Proud Nursery)

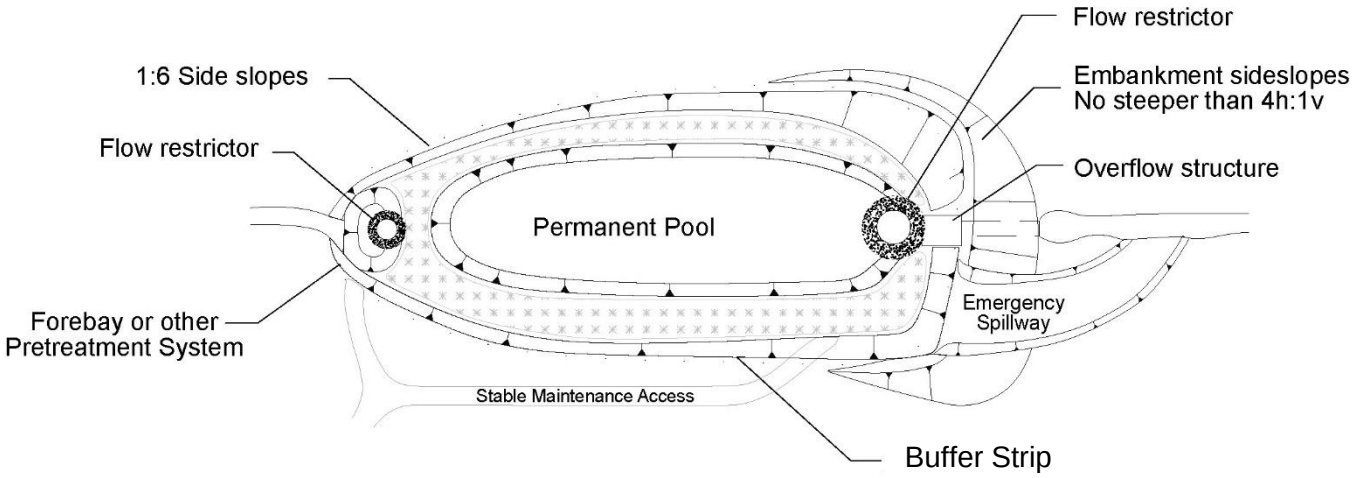
- Seed mixes and wetland plugs/bare root stock in each of the planting zones;
- Plant spacing and applicable depths, based on industry standards; and
- Any above ground mechanical structures necessary for pond operation should be identified on the landscape plan and should be screened with evergreen trees or other trees/shrubs recommended for the appropriate pond zone.

All plant material and planting applications should meet all guidelines set by the SEMCOG LID Manual. All plant stock should be grown by suppliers or nurseries certified by the Michigan Native Plant Producers Association.

References

- Detroit Water and Sewerage Department. “Stormwater Management Design Manual.” https://detroitmi.gov/departments/water-and-sewerage-department/customer-care/stormwater-management-codes-and-ordinances
- Southeast Michigan Council of Government. “Low Impact Development Manual.” https://semcog.org/green-infrastructure

8.1.1 Detention Basins



Conceptual Sketch, Detention Basin
Graphic adapted from Urban Drainage and Flood Control District, Colorado
NOT TO SCALE

Open detention basins are man-made surface waters designed to temporarily detain stormwater runoff to control peak flow rates and provide for pollutant removal through settling and plant uptake. There are two types of open detention basins traditionally used in Wayne County:

- Traditional detention basins, which detain stormwater runoff for an extended period of time in a permanent pool and remove sediment and other pollutants via settling.
- Wet ponds, where over 50% of the surface area typically is covered by wetland vegetation. Permanent wetland pool depths vary between 0.5 and 3.0 feet depending on vegetation type.

Design Standards

Open detention basins must be sized to detain the required storage volumes (both the channel protection rate control and flood control volumes). Design standards specific to detention basins include the following:

- Open detention basins must have a restricted outlet that limits outflow for the channel protection rate control and for the variable allowable release rate from the development site.
- Flow restrictors, overflow structures, and emergency spillways are required for all open detention basins. Flow restrictors must be placed near or within the embankment of the detention basin to provide ready maintenance access.
- Open detention basins may include a minimum four (4) foot deep permanent pool that allows for removal of urban pollutants through settling and biological uptake. Permanent pools are not required for wet ponds except when the County determines that a permanent pool is necessary to satisfy the flood control or water quality performance standards. The volume of the permanent pool does not satisfy any portion of the required flood control storage volume.
- The design water level of an open detention basin must not exceed five (5) feet above the permanent pool water level.
- Providing a safe design is a primary consideration for all stormwater control systems. Side slopes for open detention basins may not be steeper than 1:6 (V:H). Further safety measures (e.g., aquatic benches or safety shelves, vegetative and barrier plantings) may be warranted depending on the type of development.
- Open detention basins may not be located within pre-existing surface waters.

- Plant vegetation is required for all types of open detention basins to control erosion and enhance sediment entrapment. A landscaping plan is required for open detention basins, due to the importance of the vegetation to the function of the entire system. Use of a registered landscape architect with experience in stormwater control system design and native landscaping is encouraged.
- In wet ponds, a diversity of depth zones throughout the basin should be used to meet the unique growing requirements of divergent wetland plants. Use of a qualified professional with specific expertise in hydrology and wetland plant ecology is recommended for design of these systems.
- Detention must have at minimum 15-feet in width buffer strip beyond the freeboard elevation for sites that are less than 5 acres and a minimum of 25-feet in width buffer strip for sites that are greater than 5 acres. The slope of the buffer strip should be 6H:1V or flatter.

Preferred Design Elements

- Open detention basins should be designed to maximize sheet flow across the open water portion of the facility.
- The shape and configuration of open detention basins will vary considerably based on detention type and storage requirements, local topography, land availability, hydraulic considerations, and other site-specific constraints. Generally, a rectangular configuration is preferable, with an approximate length to width ratio of 3:1. Inlet and outlet pipes should be placed at opposite ends.
- If a terraced side slope is approved for use in a detention basin, the materials proposed for use in its construction should be approved by the local community.
- Baffles may be used to increase the flow path and maintain the topography.
- If aerating devices are used as part of a stormwater control system, they should be designed to minimize disturbance of bottom sediments. For example, detention basins may need to have a deeper permanent pool if an aerating device is used. Bubbler systems are the preferred type of aerating device as they have been found to be more efficient at providing aeration. The manufacturer's recommendations should be followed in regards to design and maintenance.
- When discharge is within a watershed where thermal impacts are a primary concern, deep wet ponds with bottom draw or dry ponds may be preferred.

Figure 8-3: Dry Detention Basin (source: OHM Advisors)

Additional design standards and elements can be found in the DWSD Stormwater Management Design Manual, Chapter 7.

Construction

Proper construction techniques, particularly installation of vegetation, are important to the successful functioning of open detention basins, especially for constructed wetland type open detention basins in order to establish a dense and diverse emergent wetland plant community. General guidelines for vegetation installation include:

- If emergent plant stock is proposed in the pond zone, the supplied plug material must have sufficient vegetative growth extending out of the water once planted.
- Seed must be planted above the permanent water elevation.
- All seeded areas should be properly stabilized with a much blanket pegged in place.

- Depending on the type of vegetation, barriers may be required for one year to protect the plantings (e.g., snow fence or netting to deter wildlife, prevent mowing).
- Additional guidance on seed and sod specifications and installation is provided in Section 8.3 of this manual.

For wet ponds, preparation of the wetland bed prior to planting is crucial to success.

Vegetation Specifications

The type of vegetation used is dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. Reference Appendix C in the SEMCOG LID Manual for recommended plants.

Outlets

Outlets from open detention basins convey flow from the detention basin into a surface water or off-site closed conduit. Required outlets from open detention basins include a flow restrictor to convey restricted flow, an overflow structure to discharge when the water level exceeds the design water level, and an emergency spillway to convey unrestricted flow.

Design Elements

Outlets for open detention basins must be designed as follows:

- A flow restrictor is required in each detention basin. Depending on which performance standard(s) the system is being designed to meet, the flow restrictor may be designed to meet the 100-year flood control outflow requirements, the CPRC extended detention requirements, or both.
  - For 100-year flood control, the flow restrictor must be designed such that peak 100-year discharge rate at the 100-year high water level does not exceed the maximum allowable outflow rate for flood control as determined by the equations described in Section 6.2.1.
  - For the CPRC volume, the flow restrictor must be designed to gradually release the channel protection rate control storage volume over a period of forty-eight (48) hours as described in Section 6.3.3.
- Flow restrictors in open detention basins must be placed near or within the embankment of the basin to facilitate maintenance. Flow restrictors must be constructed of materials that minimize future maintenance requirements.
- An overflow structure must be provided to allow discharge when the basin water level exceeds the design water level. The overflow structure and its outlet pipe must be designed to convey the peak flow rate tributary to the detention basin for the 100-year, 24-hour design event.
- An emergency spillway with a defined downstream drainage path must be provided to accommodate the peak flow rate tributary to the detention basin for the 100-year, 24-hour design event. The emergency spillway elevation must be 6 inches below the top of freeboard elevation. The spillway must be armored to prevent erosion of the berm.

Preferred Design Elements and Materials

- Wayne County strongly discourages pumped detention pond outlet systems;
- Wayne County prefers gravity outlets versus pumped outlets from open detention basins. If an open detention basin is designed to include a pumped outlet, the pumps must be located downstream of the detention basin's flow restrictor and the pumping capacity must not exceed the maximum allowable release rate from the flood control storage volume (Q_a).
- Risers and overflow structures shall have a minimum diameter of 36 inches (48-inch diameter preferred for maintenance purposes).
- Riser holes should be 1 inch minimum diameter but no larger in size than the surrounding stone. The holes should be spaced a minimum of 4 inches apart, on center, both vertically and horizontally. If a CMP riser pipe is used, the holes should be pre-drilled prior to galvanizing.
- Any field modifications to risers, overflow structures, or other outlet pipes should be performed in accordance with ASTM A780-01.

- Risers and overflow structures should have a 2-foot deep sump and a concrete base of 6-inch minimum thickness. The concrete base should be constructed of either pre-cast concrete meeting ASTM C478, or cast-in-place concrete with a 28-day strength requirement of 3,500 psi.
- Risers and overflow structures should be securely attached to the base. They may be embedded in concrete or affixed by an approved fastening method.
- The top of risers and overflow structures should be equipped with a steel grate. Openings should be a minimum of 3 inches square and a maximum of 4 inches square.
- Stone filter backfill around risers should consist of 3-inch diameter washed stone, with an outer blanket of MDOT 6A stone. The side slope of the stone blanket is typically 1:4.
- The berm on which an emergency spillway rests should be made of approved material free of debris, organic material and large rocks (over 4 inches in diameter). The approved material should be placed and compacted as roadway embankment per the current MDOT standard specifications for roadway embankment construction.
- Suggested options for armoring spillways include riprap, tri-lock, geoweb with infill material, and reinforced turf.
- The outlet "Tee" should be equipped with a removable cap in the horizontal direction; the vertical leg should serve as an oil separator. The horizontal leg often is used as a clean out.
- The minimum preferred outlet pipe diameter is 4 inches.
- An anti-seepage collar should be provided on each outlet pipe.

8.1.3 Underground Detention

Description

Underground detention systems consist of one or more underground pipes or structures designed to provide the required storage volumes (both the CPRC volume and flood control volume) for a development project. Just as with any aboveground means of stormwater detention, underground detention systems must have a restricted outlet that limits outflow for the CPRC volume and for the 100-year maximum allowable release rate from the development site.

Figure 8-4: StormTrap Underground Detention System, CVS Pharmacy (source: StormTrap)

General Design Elements

Before entering an underground detention system, stormwater runoff must pass through a water quality/infiltration system as described in Section 8.2.

Underground detention systems may be used to satisfy the infiltration requirements (CPVC volume) when adequate soil infiltration characteristics are demonstrated.

If a manufactured treatment system is installed upstream of the underground detention system, the underground detention system should be designed, to the extent possible, such that the flood control design water elevation within the underground detention system is equal to or below the controlling water surface elevation in the manufactured treatment system. This design consideration is necessary to maximize the performance of this type of pretreatment system and to minimize the resuspension of collected sediment.

Materials

Wayne County is authorized to restrict the types of materials that may be used to construct underground detention systems. Generally, underground detention systems should be constructed from pre-cast or cast-in-place concrete, corrugated metal pipe (CMP), polymer-coated corrugated steel pipe, reinforced concrete pipe, or smooth-lined corrugated plastic pipe (CPE). Unless otherwise indicated in this section, materials used for underground detention systems should meet the requirements of the current MDOT specification for their fabrication.

Underground detention systems made of reinforced concrete pipe should conform to ASTM C76. Stormwater detention systems made of pre-cast or cast-in-place reinforced concrete structures should conform to current Wayne County Specifications for Structural Concrete with the wall thickness not less than the minimum thickness necessary to sustain HS20 loading requirements, as determined by a

registered Professional Engineer. Pipe openings should be sized to accept pipes of the specified size(s) and material(s) and should be sealed with hydraulic cement conforming to ASTM C595M.

Circular CMP should conform to AASHTO M36 (ASTM A760) and should be made from aluminum coated sheet conforming to AASHTO M274. The use of the continuous welded seam process in the fabricating of pipe is not permitted.

Polymer coated corrugated steel pipe should conform to AASHTO M246 (ASTM A742) and be made of aluminum coated sheet conforming to AASHTO M275 (ASTM762). The use of the continuous welded seam process in the fabricating of pipe is not permitted. Smooth-lined corrugated plastic pipe should conform to AASHTO M294, Type S and should be limited to a maximum size of 48 inches.

For systems made of pre-cast concrete or pipes, the manufacturer should contact the Wayne County Testing Office (734-326-3936) at least three working days prior to fabrication to schedule inspection during fabrication of the concrete or piping. Wayne County inspects the material fabrication process to ensure that the manufacturer's testing of the product occurs at the applicable AASHTO or ASTM standards. Testing of pipe materials should occur at the following frequencies:

- CMP should be tested at a frequency of one test per 200 pieces per size per day.
- Steel pipe should be tested at a frequency of one test per 200 lineal feet per heat number.
- CPE should be tested at a frequency of one test per 1000 straight length of pipe per diameter per lot number.

Installation

A stable foundation should be provided. For underground detention systems consisting of pipes, a stable foundation is necessary to ensure that the proper line and grade is maintained. Unstable foundations may be undercut and replaced with MDOT Class I granular bedding material placed in 6 inch lifts. Other methods of stabilization can be used if approved by the County. For underground detention systems consisting of CPE, proper haunching provides a major portion of the pipe's strength and stability. Embedment materials should be worked under the haunches by hand for larger pipes (30-inches and above).

When installing underground pipe as part of a underground detention system, backfill should conform to Wayne County Trench "A" backfill and Trench "B" backfill specifications, except when CPE pipe is used. When CPE pipe is used, the dimensions of the trench backfill are the same as Trench "A" and "B"; however, 21AA stone or gravel aggregate shall be used as backfill to a minimum of 6 inches above the top of pipe for both trench details. Additionally, underground pipe detention systems made of CPE should be backfilled to 6 - 12 inches above the pipe to provide protection for the pipe from construction operations during placement of the final backfill.

8.1.2 Retention Basins

Description

Retention basins are excavated areas designed to store **stormwater runoff and provide gravity settling of pollutants. They are used only in cases where no outlet is available.** Wayne County discourages the use of retention basins and will permit their use only in cases where the applicant has clearly demonstrated that constructing a gravity outlet is infeasible and in areas where adequate soil infiltration rates have been demonstrated via geotechnical analysis.

At a minimum, ***each of the following criteria must be met*** before the County will consider approving a retention basin:

1. The infiltration capacity of the underlying (in-situ) soils is 1.0 inch/hour or greater, as confirmed by a registered Professional Engineer as part of a geotechnical report
2. The prevailing groundwater level is at least four (4) feet below the proposed pond bottom elevation
3. The construction of a gravity-based outlet is infeasible, as deemed by Wayne County permit review staff (the applicant must provide a schematic and cost estimate of a gravity-based outlet to demonstrate whether a conventional detention pond is infeasible).

Figure 8-5: Retention Basin (source: OHM Advisors)

Design Standards

Design standards for retention basins include the following:

- The maximum storage depth of a retention pond is six (6) feet.
- A Geotechnical report must be provided that demonstrates the soil and groundwater characteristics, as described above, are sufficient for adequate dewatering.
- Retention basins must be designed to retain the volume of stormwater equal to the runoff from two consecutive 100-year storm events as described in Section 6.2.2.
- Providing a safe design is a primary consideration for all stormwater control basins. Side slopes for retention basins may not be steeper than 1:6 (V:H). Further safety measures (e.g., safety shelves, vegetative and barrier plantings) may be warranted depending on the type of development.
- An emergency spillway is required for all retention basins. The applicant must demonstrate that there exists a defined drainage path downstream from the emergency spillway to allow discharge when flows exceed the design water level. Design criteria for emergency spillways are the same as those for open detention basins.
- Retention basins may not be located within pre-existing surface waters.
- Buffer strip width requirements are the same as those for detention basins.

Preferred Design Elements

- Calculations showing the percolation rate of soils must be based on soil borings. Wayne County requires soil borings to be collected as follows:
  - Minimum four soil borings per retention basin.
  - Borings should be taken every 200 feet within the perimeter of the basin.
  - Borings should be at least 10 feet deep, measured from the bottom elevation of the proposed basin.
- Soil samples collected from borings should be collected every five vertical feet. Soil analysis should include:
  - Sieve analysis
  - Hydrometer reading
  - Soil classification
  - Standard penetration numbers
- The shape and configuration of retention basins may vary, depending on storage requirements, local topography, land availability, hydraulic considerations, and other site-specific constraints.
- Retention basins should be designed to maximize sheet flow across the open water portion of the facility.
- If aerating devices are used as part of a stormwater control system, they should be designed to minimize disturbance of bottom sediments. For example, retention basins may need to have a deeper permanent pool if an aerating device is used. Bubbler systems are the preferred type of aerating device as they have been found to be more efficient at providing aeration. The manufacturer's recommendations should be followed in regards to design and maintenance.
- If a terraced side slope is approved for use in a retention basin, the materials proposed for use in its construction should be approved by the local community.

Vegetation Specifications

The type of vegetation used is dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. Reference Appendix C in the SEMCOG LID Manual for recommended plants.

8.1.4 Detention/Retention Maintenance

All stormwater detention or retention systems should be inspected annually to verify proper operation, and to identify and perform any necessary maintenance. As a general rule, any detention or retention BMP requires cleaning if its volume is reduced by more than 10 percent due to the accumulation of silt and sediment.

The DWSD Stormwater Design Manual has useful checklists and strategies operations and maintenance recommendations for detention basins. ***A maintenance plan for each stormwater detention/retention BMP must be submitted as part of the site plan submittal.***

8.2 Water Quality/Infiltration Systems

Water Quality/Infiltration Systems are designed to remove total suspended soils (TSS) load from the site for the first one (1) inch of rainfall and to infiltrate the first one inch of rainfall over the site development, to the maximum extent practicable (MEP). Examples of water quality/infiltration systems are forebays, bioretention, permeable pavement, manufactured treatment systems, etc. General design, maintenance and vegetation standards are provided below. For specific information about each system review 8.2.1 through 8.2.4.

General Design Standards

Water Quality/Infiltration Systems should be designed and constructed to:

- Remove 80 percent or more of the total suspended solids (TSS) load from the development site or limit the peak TSS concentration to 80 mg/L for the first one (1) inch of rainfall (First Flush Treatment).
- Infiltrate the first one (1) inch of rainfall over the site development (Channel Protection Volume Control, CPVC).
- Water quality/infiltration systems may not be located within pre-existing surface waters.

General Maintenance

Some maintenance activities for water quality/infiltration systems are listed below. The DWSD Stormwater Management Design Manual should be referenced for other activities, such as vegetation maintenance, and frequency. The maintenance activities must be identified in the operation and maintenance plan that the applicant must submit with an application for stormwater construction approval. Additionally, provisions for maintenance access should be shown on the plan; it is recommended that the maintenance access to the stormwater control system be a minimum of 15-feet wide.

- Remove debris from inlet/outlet controls
- Annual inspection of plant material, soil layer and mulch layering

General Vegetation

The type of vegetation used for water quality/infiltration systems is dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. The use of native plants and “no mow zones” is encouraged. Native plants are adapted to the local climate and conditions and have numerous short-term and long-term advantages. The vegetation requirements at the local level should also be consulted.

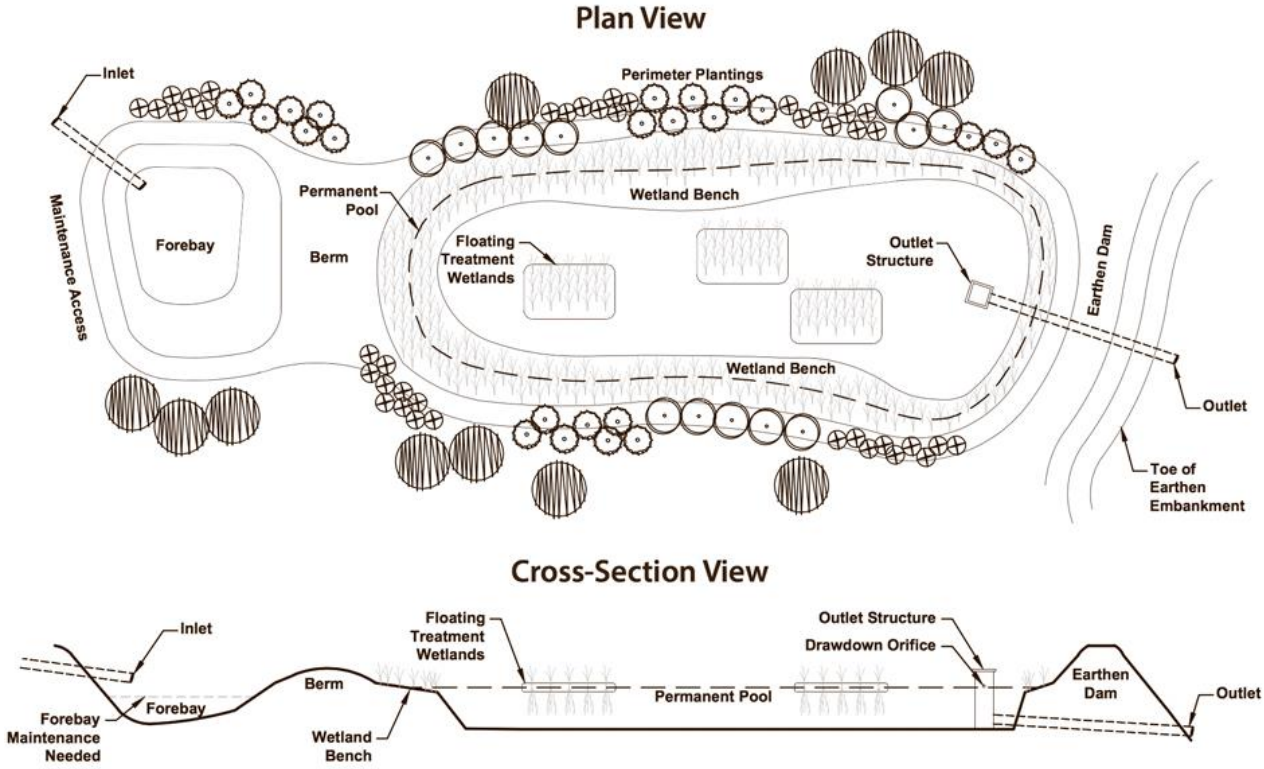
A landscaping plan is required, due to the importance of vegetation to the functionality of the entire system. Vegetation should be specified for each zone within the detention basin as follows from the SEMCOG LID Manual. More information about vegetation can be found in Section 8.3. and Appendix C in the SEMCOG LID Manual.

Figure 8-6: Wild Strawberry (source: Lady Bird Johnson Wildflower Center photographer: Thomas L Muller)

8.2.1 Forebays

Description

Forebays are designed to temporarily store the channel protection volume control (first flush) of runoff from a storm event and provide for pollutant removal through settling. A forebay or other pretreatment system is required at each inlet to a detention system or retention basin.



Design Standards

Forebays must capture the channel protection volume control (first flush) and release it gradually to the detention system and/or retention basin over a period of twenty-four (24) hours. Section 6.3.1 provides detailed information regarding how to calculate the storage volume required to capture the first flush for the area tributary to each forebay, and how to calculate the average allowable release rate from the forebay. Additionally, DWSD's Stormwater Management Design Manual provides detailed information about the design of a forebay, Chapter 7.

Design standards specific to forebays include the following:

- The volume of the forebay above any permanent pool may be used to satisfy a portion of the flood control storage volume (described in Section 6.2.1) and the channel protection rate control volume (described in Section 6.3.3). If a permanent pool is provided, the volume of the permanent pool may not be used to satisfy these other storage volume requirements.
- All closed conduits entering or exiting a forebay should have an end treatment and adequate soil erosion protection. All enclosures should also be covered with a grate to prevent children and animals from entering the enclosure.
- A buffer strip must be provided around all surface waters such as forebays. The buffer strip must be at least 15 feet wide measured from the exterior to the forebay perimeter defined by the top of bank. The slope of the buffer strip should be 1:6 or flatter. These provisions ensure that there is sufficient room to provide access to the forebay for maintenance.
- Plant vegetation, such as along the side slopes of retention basins, is necessary to control erosion and enhance sediment entrapment. Use of a professional landscape architect with experience in stormwater control system design and native landscaping is encouraged.
- Design standards for outlet structures associated with forebays are described in Section 7.1.

Wayne County generally requires forebays to have side slopes no steeper than 1:6. However, earthen berms used as a weir between the forebay and an open detention basin have no minimum side slope requirement.

Vegetation Specifications

The type of vegetation used is dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. Vegetation specifications for forebays are the same as those for open detention basins (see Section 8.3).

Maintenance

Maintenance activities for forebays are the same as those for open detention basins (see Section 8.1). These activities must be identified in the submitted operation and maintenance plan.

Outlet

Description

Forebay outlets convey flow from a forebay into detention systems and retention basins. Forebay outlets must include a flow restrictor, which conveys restricted flow, and a weir, which conveys unrestricted flow.

Design Standards for Forebay Outlets

Outlets for forebays must be designed as follows:

- Flow restrictors in forebays must be placed near or within the embankment of the forebay to provide ready maintenance access and must be constructed of materials that minimize future maintenance requirements.
- Flow restrictors must be designed to gradually release the channel protection volume control (CPVC) volume over a period of twenty-four (24) hours, as described in Section 6.3.2.

Forebays must include a weir to allow discharge from the forebay into the detention system or retention basin when the forebay water level exceeds the top of the forebay storage volume. The weir must be designed to convey the peak flow rate tributary to the forebay for the 100-year design storm.

8.2.2 Bioretention

Description

Bioretention areas are designed to use soil and plant material to mimic natural processes and store, filter and infiltrate stormwater into the ground. Bioretention areas may be used anywhere to address stormwater treatment; the location depends in part on the type of facility employed. Common applications include:

- Address the channel protection volume control (CPVC) requirement.
- Pretreatment system for detention systems and retention basins.
- Within parking lots: bioretention areas are recessed and the pavement is graded to these areas, where stormwater is captured and treated (see figure above). Traditional parking lots typically have curbed, elevated islands of vegetation.

- On new residential subdivision lots or commercial lots, near the source of the runoff generated from impervious surfaces.

Figure 8-7: Bioretention Example (source: OHM Advisors)

- Areas upland from inlets or outfalls that receive sheet flow from graded areas.
- Areas of the site that are planned to be excavated or cut.
- In stormwater management retrofit and redevelopment situations, the addition of bioretention facilities will provide a significant reduction in total runoff volumes and enhancements in water quality.

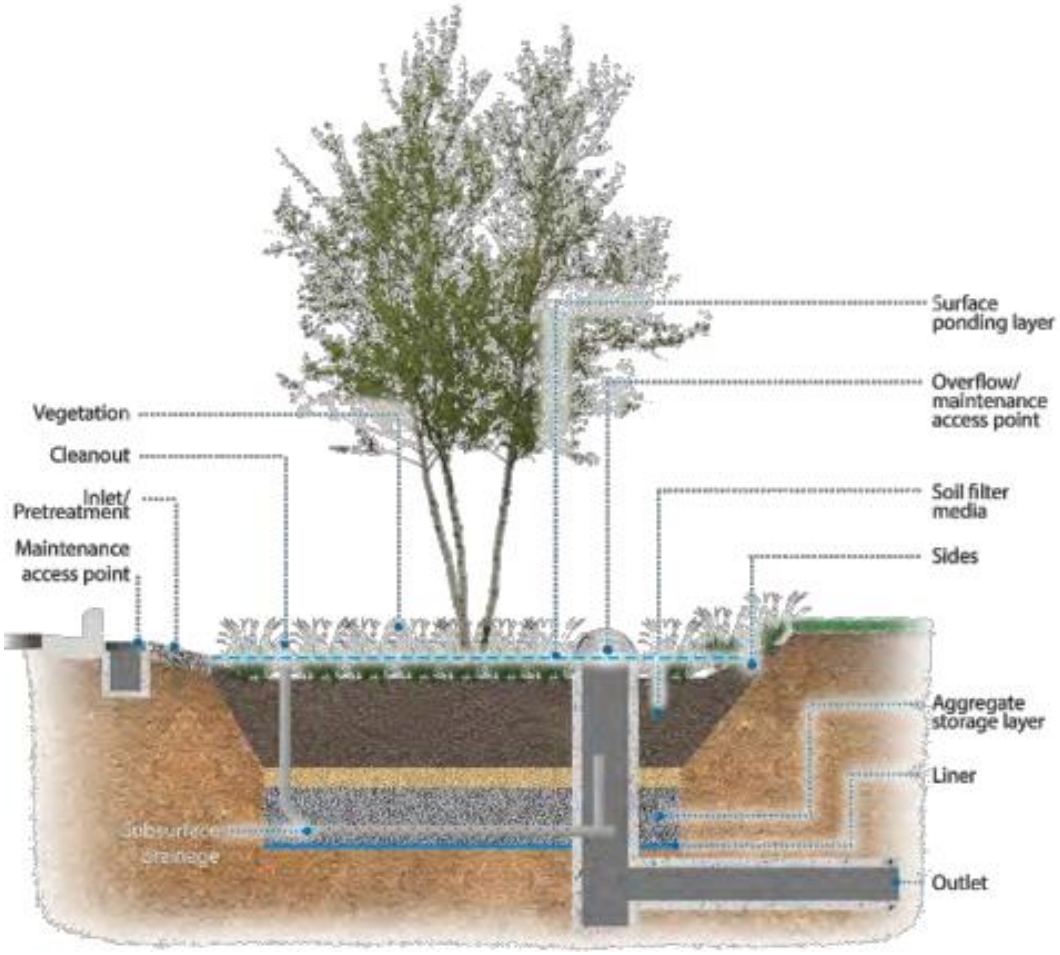


Figure 8-8: Typical Bioretention Detail (source: DWSD Stormwater Management Design Manual)

Design Standards

Bioretention areas must be designed as follows:

- The depth of the ponding area in a bioretention area cannot exceed 12 inches.
- Bioretention areas should include an underdrain, unless the applicant demonstrates that the infiltration rate of soil below the bioretention profile (native soil infiltration capacity) is greater than 0.5 inches/hour. Underdrains must satisfy the following requirements:
    - Underdrains must be sized to allow the surface storage component of the BMP to drain within 24 hours and the engineered soil media to drain within 72 hours of max storage.
    - The underdrain must be perforated along its entire length. The location of the perforations (invert of pipe or elsewhere) depends upon the design of the facility. Typically, the perforations are placed closest to the invert of the pipe to achieve maximum potential for draining the facility. Water below the perforated portion of the underdrain will be temporarily stored in the aggregate storage layer and will slowly be infiltrated based on the in-situ infiltration rate.
    - Underdrains cannot be perforated within 5 feet of where the underdrain system connects to a storm sewer structure.
    - Underdrains must include an adequate outlet into a detention system, retention basin, storm sewer or watercourse to achieve positive flow.
    - The underdrain must be constructed within the aggregate "storage layer" and *not* within the soil media filter layer.
    - The underdrain system must include a cleanout standpipe to provide access for cleaning the system.

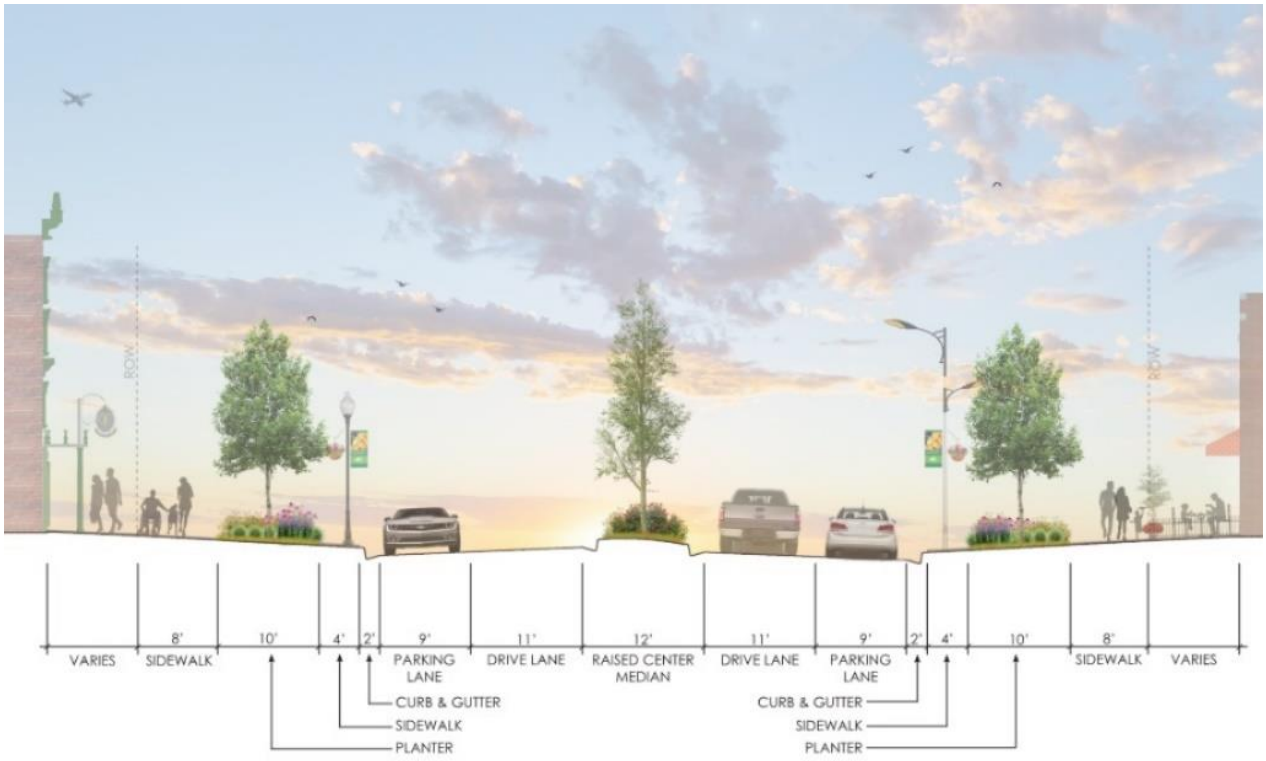


Figure 8-9: Auburn Road Concept (source: OHM Advisors)

The DWSD Stormwater Management Design Manual, Chapter 8: Bioretention, has useful details and examples for bioretention design. Consult this manual for appropriate layout, dimensions, vegetative treatments, and hydraulic components.

BMP Volume Determination

Whether or not an underdrain is used, the entire surface and subsurface volume can be counted towards the required channel protection volume control (CPVC) requirement.

- Surface volume can be calculated using the bioretention contour data, with a maximum allowable surface ponding depth of 12 inches.
- Subsurface volume can be calculated using the total volume of engineered soil filter and aggregate storage media. The soil filter media and coarse aggregate storage layers shall be assigned an effective porosity of 0.30.
- For bioretention scenarios that have no underdrain (where the design in-situ infiltration capacity is at or above 0.50 inches/hour), the active infiltration can be calculated for a six-hour period and counted towards meeting the CPVC requirement:
    - 6 hours of active infiltration during the 1-inch design event:
        - Multiply 6 hours by the design infiltration rate (example: 0.50 inches/hr * 6 hours = 3 inches of infiltration
        - Multiply active infiltration depth by the BMP footprint to determine the active infiltration volume
- Total infiltration volume for a specific bioretention BMP is the sum of the following:
    - Surface storage volume (12-inch max ponding depth)
    - Subsurface storage volume (using referenced porosity values)
    - Active infiltration volume (only applicable if in-situ infiltration rate ≥ 0.50 in/hr)

Grading and Landscape Plans

Applicants that propose to include one or more bioretention areas as components of a stormwater control system must submit a grading plan for the development project. The grading plan must clearly identify bioretention areas in relation to the topography and physical location. In addition, the grading plan must clearly identify routes for construction traffic that direct traffic around the bioretention areas. Allowing construction traffic to traverse a bioretention area may compact the soils or other subsurface media decreasing the functionality of the bioretention system.

Applicants that propose to include one or more bioretention areas as components of a stormwater control system also must submit a landscape plan for the development project. At a minimum, the landscape plan must specify soils and plant materials that the applicant proposes to include in the design and describe the methods and planting techniques that the applicant proposes to utilize.

Preferred Design Elements

- Distributed placement of bioretention areas across a development site results in smaller, more manageable subwatersheds within the development site. Bioretention BMPs are intended to be part of a decentralized design.
- The drainage area to each bioretention area is limited to the following:
    - 2 acres of tributary impervious surface (including commercial, industrial, or high-density residential areas)
    - 5 acres of low- to medium-density residential area
- On new residential subdivision lots or commercial lots, bioretention areas should be located near the source of the runoff generated. Stormwater facilities should be located near the perimeters and edges to maintain typical use of the property. Bioretention areas should not be located near building areas, unless the building design incorporates adequate waterproofing measures, and not near wellheads or septic systems.

- To minimize excess ponding, excess runoff should be diverted away from the bioretention by grading the elevation of maximum surface ponding equivalent to the elevation at which runoff is discharging into the bioretention area or by installing an overflow standpipe within the bioretention area.
- A safe overland flow path for the excess runoff is recommended.
- Bioretention areas should not be built where wooded areas would need to be cleared, to make room for the facility.
- In parking lot applications, bumper blocks or gapped curbing should be used to prevent entry of vehicles into the bioretention area.
- A raised underdrain has the effect of providing a storage area below the invert of the underdrain discharge pipe. The storage area is equal to the void space of the material used.
- Where possible, the sediment should be collected/trapped at the inlet of the bioretention cell. This can be accomplished several ways, although the most effective method is to install a sump structure at the bioretention cell inlet. This collects sand, soil, and other particulate

Figure 8-10: Inlet Sump Structure (source: City of Ann Arbor)

matter and helps prevent more expensive sediment removal along the surface of the bioretention cell (see example below from the City of Ann Arbor, MI). This design element is critical when the tributary area is expected to have higher sediment loads.

Soil Filter Media, Liners, and Vegetation

Specifications for soil filter media, aggregate storage layer, and liners shall be based on Chapter 8 of the DWSD Stormwater Design Manual. Refer to the DWSD Stormwater Management Design Manual for additional information.

The filter media shall consist of an engineered soil mix that is consistent with the DWSD Design Manual, Chapter 8, Section 8.4.4. Recommended soil mixes are included in the table below (Table 8-4 from the DWSD Design Manual). The "SE MI Standard" should be considered the default mix; others may be selected based on local site conditions.

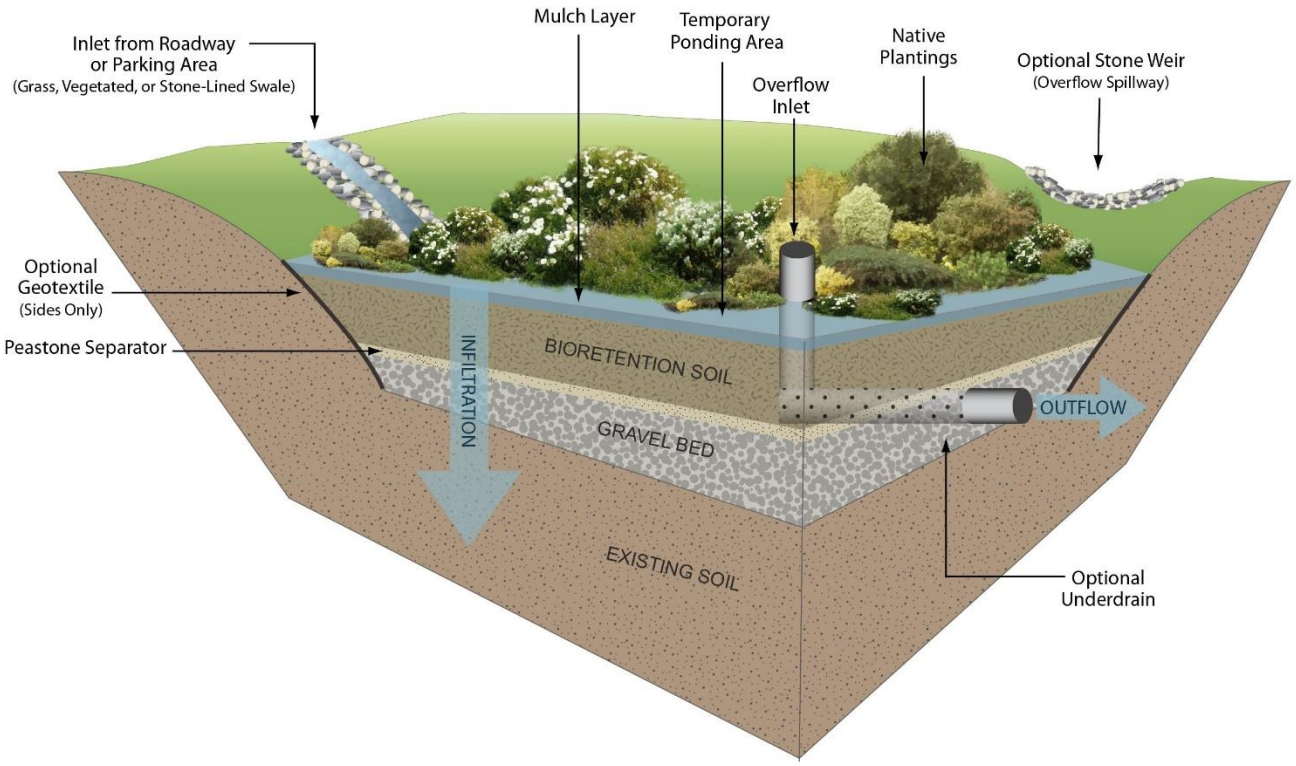


Figure 8-11: Soil layering for a Bioretention System (Source: Massachusetts Department of Environmental Protection)

	SE MI Standard	Tree Mix	Water Quality Mix	Soilless Blend
Clay & Silt Content	<10% clay	<10% clay	25-40% clay & silt Max clay: 15%	<3% clay & silt
Hydraulic Conductivity	Not Specified	Not Specified	1-4 inches/hour	4 – 10 inches/hour
Nutrient Content	Not Specified	Not Specified	Phosphorous (Mehlich 3): 15-30 mg/kg	Total Nitrogen<1000 mg/kg Phosphorous (Mehlich 3) <80 mg/kg
Organic Matter Content	Not Specified	2% - 4%	2% - 5%	4% - 8%
Suggested Mix Ratios (by volume)	20% Compost 50% Sand 30% Topsoil	10% Compost 30 – 40 % Coarse Sand 50 – 60% Topsoil	50-65% Coarse Sand 25-35% Topsoil 10-15% Compost	60-80% Washed Well-Graded Sand 20-40% Fine Compost

Source: DWSD Stormwater Management Design Manual, 2018 (Chapter 8, Section 8.4.4, Table 8-4)

Plant materials used for bioretention cells should consist of native plants. Refer to the following for appropriate vegetation and planting schedules:

SEMCOG LID Manual, Appendix C: http://semcog.org/Reports/LID/index.html

Landscaping for Water Quality: https://www.michigan.gov/documents/deq/wrd-nps-landscape4wq_401217_7.pdf

Plants for Stormwater Design: Species Selection for the Upper Midwest: https://www.pca.state.mn.us/water/plants-stormwater-design

Philadelphia Green Stormwater Infrastructure Landscape Design Guidebook: http://documents.philadelphiawater.org/gsi/GSI_Landscape_Guidebook.pdf

Resources for invasive plants in the Midwest and in Michigan are as follows:

MDNR Michigan Invasive Species List: http://www.michigan.gov/invasives/0,5664,7-324-68002_71240---,00.html

A Field Identification Guide to Invasive Plants in Michigan's Natural Communities: http://mnfi.anr.msu.edu/invasive-species/InvasivePlantsFieldGuide.pdf

Midwest Invasive Species Information Network: http://www.misin.msu.edu/

Construction

Proper construction techniques (including proper grading), adequate landscaping, suitable soil mixtures, and approved materials are critical to the success of bioretention areas.

- The grading plan for the entire development project must clearly identify the bioretention areas. Grading of or construction traffic over those areas should be avoided.
- The area surrounding the bioretention areas should be stabilized prior to construction of the bioretention areas to minimize compaction and contamination of the bioretention site.
- Construction of the bioretention area should be part of the restoration process.
- Placement of the gravel over the underdrain must be done with care. Avoid dropping the gravel high levels from a backhoe or front-end loader bucket. Spill directly over underdrain and spread manually.
- Placement of the planting soil in the bioretention area should be in lifts of 12 to 18 inches and lightly compacted. Minimal compaction effort can be applied to the soil by tamping with a bucket from a dozer or backhoe. Do not use heavy equipment within the bioretention facility. Heavy equipment can be used around the perimeter of the basin to supply soils and sand. Grade bioretention materials with light equipment such as a compact loader or a dozer/loader with marsh tracks.
- Compaction will significantly contribute to design failure. Compaction can be alleviated at the base of the bioretention facility by using a primary tilling operation such as a chisel plow, ripper, or subsoiler. These tilling operations are to re-fracture the soil profile through the 12-inch compaction zone. Rototillers typically do not till deep enough to reduce the effects of compaction from heavy equipment.
- Rototill 3-4 inches of sand into the base of the bioretention facility before back filling the facility and placement of underdrain. Pump any ponded water before preparing (rototilling) base.
- In order to speed up the *natural* compaction process, presoaking the placed soil may be performed. Significant settlement can occur after the first presoak, and additional settlement may occur subsequent to the initial wetting. If time and construction scheduling permits, it is preferable to allow natural settlement to occur with the help of rain events to presoak the soil medium.

Figure 8-12: Construction of Bioretention Cell in Parking Lot, Evansville, IN (source: Indiana Office of Community & Rural Affairs)

Inspection and Maintenance

The DWSD Stormwater Management Design Manual (Chapter 8) offers detailed information on bioretention maintenance practices. Refer to Section 8.11 and Table 8-6 in the DWSD Stormwater Management Design Manual for proper maintenance activities. Table 8-6 from this document is provided for easy reference on the following page.

Task	Frequency	Indicator Maintenance is Needed	Maintenance Notes
Catchment Inspection	Weekly or biweekly with routine property maintenance	Excessive sediment, trash or debris accumulation on the surface of bioretention	Permanently stabilize any exposed soil and remove any accumulated sediment. Adjacent pervious areas might need to be regraded.
Inlet Inspection	Weekly or biweekly with routine property maintenance	Internal erosion or excessive sediment, trash, or debris accumulation	Check for sediment accumulation to ensure that flow into the bioretention is as designed. Remove any accumulated sediment.
Litter and leaf litter removal	Weekly or biweekly with routine property maintenance	Accumulation of litter and leafy debris in the bioretention area	Litter and leaves should be removed to reduce the risk of outlet clogging, reduce nutrient inputs to the bioretention area and to improve facility aesthetics.
Pruning	Prune dead and broken branches annually and deciduous shrubs every 3-5 years	Overgrown vegetation that interferes with access, lines of sight or safety	Nutrients in runoff often cause bioretention vegetation to flourish
Mowing	2-12 times/year	Overgrown vegetation that interferes with access, lines of sight or safety	Frequency depends on location and desired aesthetic appeal
Mulch Removal and Replacement	1 time/2-3 years	Less than 4 inches of mulch remains on the surface	Mulch accumulation reduces available surface water storage volume. Removing decomposed mulch also increases surface infiltration rate of fill soil. Remove decomposed fraction and top off with fresh mulch to a total depth of 4 inches
Temporary Watering	1 time/2-3 days for first 1-2 months, sporadically after establishment	Until established and during severe droughts	Watering after the initial year might be required.
Fertilization	1 time initially	Upon planting	One-time spot fertilization for first year vegetation.
Remove and Replace Dead Plants	1 time/year	Dead plants	Plant die-off tends to be highest during the first year (commonly 10% or greater). Survival rates increase with time.
Outlet Inspection	Monthly	Erosion at outlet	Remove any accumulated mulch or sediment.
Miscellaneous Upkeep	12 times/year	Tasks include trash collection, plant health, spot weeding, removing invasive species, and removing mulch from the overflow device.	

Source: DWSD Stormwater Management Design Manual, 2018 (Chapter 8, Section 8.11, Table 8-6)

Alternatives to Bioretention

Bioretention cells, although the most common design component used to infiltrate stormwater, are only one of numerous options. Other stormwater infiltration BMPs that may be used in Wayne County are:

- Rain Garden
- Planter Box / Tree Box
- Raised Planter Box
- Curb Extension
- Bioswale
- Suspended Pavement

Reference the Useful Resources section below for documents containing design criteria for the above alternatives to bioretention.

Figure 8-13: Curb Extension Example (source: OHM Advisors)

Useful Resources for Infiltration BMP Design

DWSD Stormwater Management Design Manual: https://detroitmi.gov/sites/detroitmi.localhost/files/2018-11/Stormwater%20Management%20Design%20Manual%202018-07-26.pdf

Low Impact Development Manual for Michigan – SEMCOG: https://www.semcog.org/desktopmodules/SEMCOG.Publications/GetFile.ashx?filename=LowImpactDevelopmentManualforMichiganSeptember2008.pdf

Landscaping for Water Quality: https://www.michigan.gov/documents/deq/wrd-nps-landscape4wq_401217_7.pdf

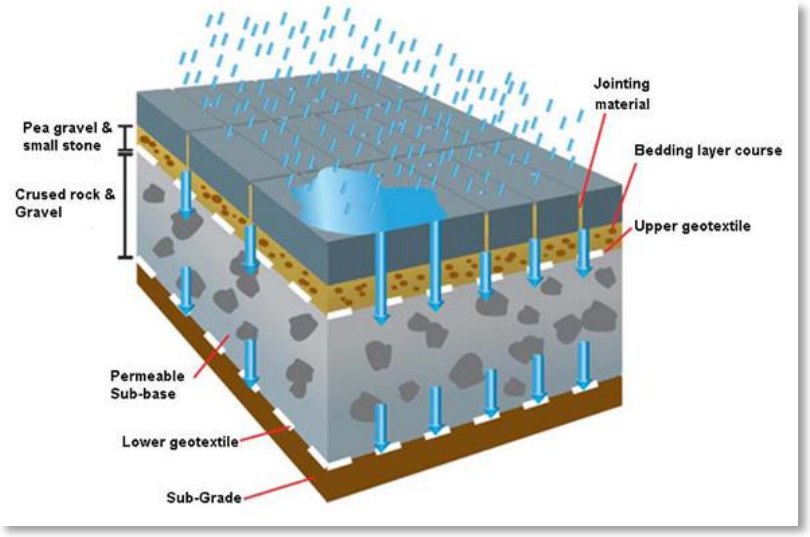
Plants for Stormwater Design: Species Selection for the Upper Midwest: https://www.pca.state.mn.us/water/plants-stormwater-design

Philadelphia Green Stormwater Infrastructure Landscape Design Guidebook: http://documents.philadelphiawater.org/gsi/GSI_Landscape_Guidebook.pdf

8.2.3 Permeable Pavement

Description

Permeable pavement is a type of paving method for driveways, parking lots, walkways and low traffic roads used to treat water quality and water quantity to a lesser degree. This paving method allows for stormwater runoff to infiltrate into the ground, reducing runoff volume, instead of flowing directly into the stormwater collection system like typical paving methods, such as concrete and asphalt. There are multiple types of permeable pavement such as pervious pavers, grid pavement, permeable aggregate, etc. Reference Chapter 10 within the DWSD Stormwater Management Design Manual for detailed information for the design, construction and maintenance of permeable pavement.



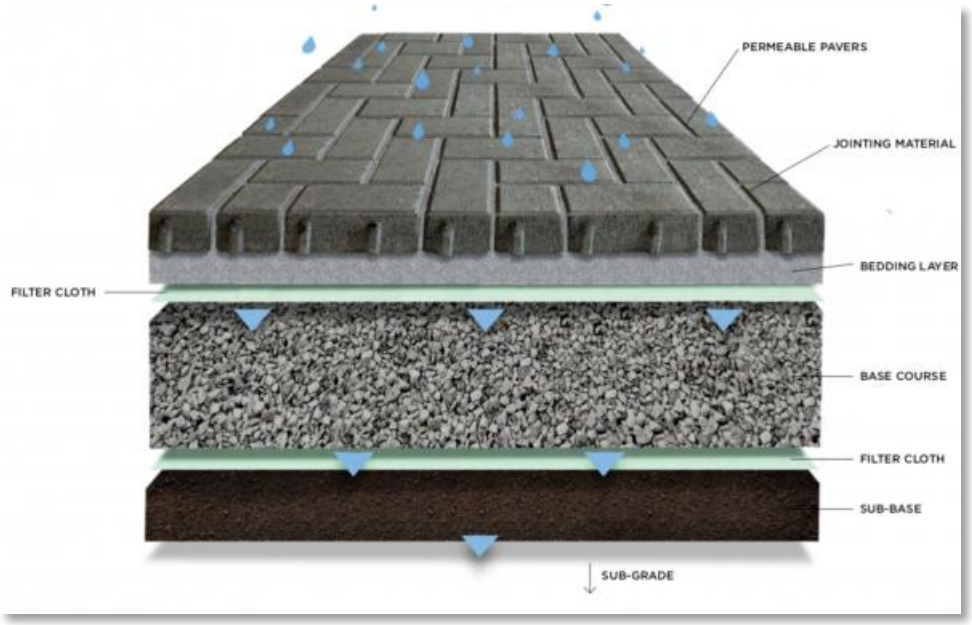


Figure 8-14: Examples of Permeable Pavement Options Source: Permeable Pavement Engineering (top photo) Magazine of the Registered Master Builders Association (bottom photo)

Benefits of Use

- Used in place of traditional pavement methods
- Can be used on almost any site
- Can reduce the amount of salt needed in the winter [University of New Hampshire, Houle and others, 2009]
- The air trapped in the pavement can store heat and release it to the surface, promoting the melting and thawing of snow and ice (Roseen and others, 2012)

Features of Permeable Pavement

Permeabel Pavement Surface

- Pavement surface layering can vary and should be chosen to best fit the design of the development

Aggregate Storage Layer

- Layer should be 1.5 to 3 inch diameter crushed aggregate. Aggregate should follow MDOT standards.

Underdrain pipe

- Should be used unless applicant can demonstrate that the infiltration rate is sufficient.

Permeable liner

- An option layer to prevent materials from mixing but still allows for infiltration

Subgrade

- Native soil layer

Design and Construction Standards

Reference the DWSD Stormwater Management Design Manual for the design and construction of the permeable pavement.

Maintenance

- Vacuum sweeping should be performed at a minimum of twice a year.
- Weeds should not be pulled from permeable pavement but killed by pesticides
- Pavement material should be replaced as needed to keep infiltration system working properly
- For winter maintenance, follow the recommendations set by the manufacturer of the product

Resources

Detroit Water and Sewage Department (DWSD) Stormwater Management Design Manual, DWSD: https://detroitmi.gov/sites/detroitmi.localhost/files/2018-11/Stormwater%20Management%20Design%20Manual%202018-07-26.pdf

Evaluating the Potential Benefits of Permeable Pavement on Quantity and Quality of Stormwater Runoff, United States Geological Survey Government Agency: https://www.usgs.gov/science/evaluating-potential-benefits-permeable-pavement-quantity-and-quality-stormwater-runoff?qt-science_center_objects=0#qt-science_center_objects

Permeable Paving, Massachusetts Department of Environmental Protection: http://prj.geosyntec.com/npsmanual/permeablepaving.aspx

8.2.4 Manufactured Treatment Systems

Description

Manufactured treatment systems are structures that are used to remove sediment and other particulate matter from stormwater runoff. Manufactured treatment systems may be used at the inlets to underground detention systems, open detention basins, or retention basins. By removing settleable materials, pretreatment systems such as a manufactured treatment system, reduce the amount of material that accumulates in detention/retention systems, and the frequency at which accumulated materials must be removed. Manufactured treatment systems are particularly applicable in small development sites for meeting the TSS control standards for Wayne County.

Wayne County periodically evaluates various types of manufactured treatment systems for conformance with the design standards, preferred design elements, and materials specifications presented in this section. Please refer to the "Guideline for Wayne County Review of Manufactured Treatment Systems" document available from the Wayne County website for more information about the review process

https://www.waynecounty.com/documents/environmental/wqmd-mts-guidelines-6-2015.pdf

Alternatively, manufactured treatment systems may be selected based on those that meet the "Basic Treatment" criteria established through the Technology Assessment Protocol – Ecology (TAPE) program through Washington State or those that meet the "Laboratory Verified and NJDEP Certified" criteria established by the New Jersey Corporation for Advanced Technology (NJCAT). Both programs have legitimate field and laboratory testing criteria. Approved technologies are provided in the respective websites for both programs:

TAPE: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

NJCAT: http://www.njcat.org/verification-process/technology-verification-database.html

Please contact the Wayne County Permit Office (734-595-6504) for more information about which types of manufactured treatment systems have been reviewed by Wayne County under this procedure.

Design Standards

- Manufactured treatment systems must include a chamber or other device to accumulate and store settleable solids in a manner and a location that will prevent re-suspension of previously captured particulates.
- The system should be capable of one of the following
    - 80% reduction in TSS concentration
    - Maximum effluent TSS concentration of 80 mg/L
- TSS removal efficiency estimates or models must be based on documented removal efficiency performance from certified full-scale independent studies (see above for Wayne County, TAPE, and NJCAT certifications). In general, the laboratory and field-testing criteria referenced above would provide adequate TSS reduction to meet the 80% / 80 mg/L goals stated above.
- Procedures for submitting a manufactured treatment system to Wayne County for review for compliance with these criteria are documented in "Guideline for Wayne County Review of Manufactured Treatment Systems".
- A water-lock feature must be incorporated into the design of the stormwater treatment system to prevent the introduction of trapped oil and floatable contaminants to the downstream piping during routine maintenance and to ensure that no oil escapes the system during subsequent storm events.
- The installed manufactured treatment system (manufactured unit and surrounding soil structure) must sustain an HS_20 loading as determined by a Professional Engineer licensed in the State of Michigan.
- The minimum cover of backfill material should be recommended by the manufacturer and approved by the Permit Engineer.

Preferred Design Elements

Due to the potential for manufactured treatment systems to malfunction and/or create maintenance problems, Wayne County recommends that manufactured treatment systems incorporate the following design elements:

- Manufactured treatment systems shall be designed for the Water Quality Peak Flow rate calculated using the Rational Method as follows:
    - 1-year recurrence interval peak rainfall intensity using NOAA Atlas 14
    - Maximum peak intensity = 2.0 inches/hour (for sites with time of concentration equal to or less than 15 minutes)
    - Minimum peak intensity = 1.0 inches/hour (for sites with time of concentration equal to or greater than 1 hour)
- Flows that exceed the Water Quality Peak Flow shall bypass the treatment system.
- Manufactured treatment systems should be designed so that they do not re-suspend trapped sediments or re-entrain floating contaminants at flow rates up to or exceeding those for the design storm event.
- The system pump-out volume should be less than ½ of the total system volume.
- The system should not create backwater in the upstream piping network for flows up to and including the design storm event.
- Direct access should be provided to the sediment and floatable contaminant storage chambers to facilitate maintenance. The storage chambers should have no appurtenances or restrictions within them which would prohibit removal of accumulated sediment and debris during maintenance.

Materials Specifications

Manufactured treatment systems may be constructed from pre-cast or cast-in-place concrete or other materials approved by Wayne County and should meet the following specifications:

- For treatment systems made of cast-in-place or pre-cast concrete:
    - Concrete for pre-cast manufactured treatment systems should conform to ASTM C 857 and C 858.
    - Cement should be Type II Portland cement conforming to ASTM C 150.
    - Treatment systems constructed from pre-cast concrete should be manufactured in accordance with ASTM C 478.
        - Sections should be cured by an approved method and should not be shipped until (1) at least 5 days have passed since fabrication and/or repair, and (2) the concrete has attained a compressive strength of 4,000 psi.
    - Manufactured treatment systems constructed from cast-in-place concrete or reinforced concrete should conform to current Wayne County specifications for structural concrete.
    - Sections should have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C 990.
    - Wall thicknesses should not be less than 6 inches or as otherwise shown on the dimensional drawings
    - Openings should be sized to accept pipes of the specified size(s) and material(s), and should be sealed with hydraulic cement conforming to ASTM C 595M.
    - Internal aluminum plate components should be aluminum alloy 5052-H32 in accordance with ASTM B 209.
      A bitumen sealant in conformance with ASTM C 990 should be utilized in affixing the aluminum swirl chamber to the concrete vault.

- For manufactured treatment systems (including smooth bubble and weir plates) fabricated from high density polyethylene (HDPE):
    - Virgin HDPE material should be used, conforming with the minimum requirements of cell classification 424420C (4-in – 10-in diameter) and 435440C (12- in – 60-in diameter) per ASTM C 3350.
    - The virgin HDPE material should be evaluated using the notched constant ligament-stress (NCLS) test as specified in Section 9.5 and 5.1 of AASHTO M294 and ASTM F2306.
    - Weir and battle plates shall be welded at all interfaces between the plate and water quality unit.
- For manufactured treatment systems fabricated from corrugated polyethylene pipe (CPE):
    - The system and all required fittings should conform to AASHTO M294 Type S.
    - Fittings and couplings must be noncorrugated, solid sleeve fabricated from polyethylene with a gasket on both sides of the joint.
    - Split collar couplers are not allowed.
    - Weir and battle plates shall be welded at all interfaces between the plate and water quality unit.

Testing

The manufacturer of these systems must contact the Wayne County DPS Construction Office (734-595-6504) at least 72 hours prior to fabrication to schedule inspection during fabrication. Wayne County inspects the material fabrication process to ensure that the manufacturer's testing of the product occurs at the applicable AASHTO or ASTM standards.

Installation

Manufactured treatment systems must be constructed to serve the capacity shown on the drawings and as specified in the approved permit plans. The system must be installed at elevations and locations shown on the approved plans, or as otherwise directed by the County.

A Wayne County DPS Permit Engineer must observe the installation of all manufactured treatment systems. Contact the Wayne County Permit Office (734-595-6504) at least 72 hours prior to installation to schedule inspection during installation. Wayne County will not accept any manufactured treatment systems installed when a County Permit Engineer is not present; permits and financial assurances will not be released at the conclusion of construction for such systems.

The following procedures should be followed for installation of manufactured treatment systems:

- For concrete manufactured treatment systems, installation should conform to ASTM specification C 891 "Standard Practice for Installation of Underground Precast Utility Structures." Cast-in-place installation should follow Wayne County specifications for structural concrete. Installation procedures recommended by the manufacturer, if any, should also be consulted.
- For manufactured treatment systems made of materials other than concrete, installation procedures recommended by the manufacturer should be followed. These procedures should be included in the application package submitted to Wayne County for approval of the entire storm water control system for the development project.
- The base unit of the manufactured treatment system should be placed on a subbase consisting of MDOT Class II granular material of a minimum thickness of six inches, or greater after compaction by the "Controlled Density Method" to 95% of the Maximum Unit Weight. The granular subbase should be checked for level prior to setting and the pre-cast base section of the trap should be checked for level at all four corners after it is set. If the slope from any corner to any other corner exceeds 0.5%, the base section should be removed and the granular subbase material re-leveled.
- For pre-cast concrete systems, prior to setting subsequent sections, a bitumen sealant that conforms to ASTM C 990 should be placed along the construction joint in the section that is already in place. Pre-cast sections should be set in a manner that will result in a watertight joint.
- For manufactured treatment systems made of materials other than concrete, prior to setting subsequent sections, a sealant that conforms to the specification recommended by the manufacturer should be placed along the construction joint in the section that is already in place. Sections should be set in a manner that will result in a watertight joint.
- For pre-cast concrete systems, holes made in the concrete sections for handling or other purposes should be plugged with a nonshrink grout or by using grout in combination with concrete plugs.
- For manufactured treatment systems made of materials other than concrete, holes made in the unit for handling or other purposes should be plugged with materials meeting the specification recommended by the manufacturer for such materials.
- For pre-cast concrete systems, where holes must be cut in the pre-cast sections to accommodate pipes, cutting should be completed before the sections are set in place, to prevent any subsequent jarring which may loosen the mortar joints. For manufactured treatment systems made of materials other than concrete, field cutting of the system to accommodate pipes is not allowed.
- Backfill around the manufactured treatment system should consist of:
  - MDOT Class II granular material for systems made of cast-in-place and pre-cast concrete
  - MDOT 6A, 2G, or 34G material for systems made of HDPE or CPE

  - All backfill materials should be placed in a balanced manner and such that there is no more than a 2 lift differential from one side to the other. Balanced lifts should be advanced across the width of the system, evenly along the length of the system throughout the backfilling process.
  - All backfill materials should be placed in lifts of maximum 10-inches in depth.
- For each backfill lift, all materials should be compacted to a minimum of 95% (90% minimum required for backfill consisting of MDOT 6A material) of the backfill material's maximum unit weight at a moisture content not greater than the optimum. The maximum unit weight of the backfill material should be determined by the AASHTO T 180 or Michigan Cone Method. The frequency of the compaction testing should be one or more tests per lift of backfill around the trench of the structure.

Documentation of the following items relative to the installation of manufactured treatment systems is required to be submitted to the Wayne County Permit Engineer before permits and financial assurances are released:

- All backfill materials are from Wayne County tested stock.
- All backfill materials were placed in lifts of maximum 10-inches.
- For each backfill lift, all materials were compacted to a minimum of 95% of the backfill material's maximum unit weight at moisture content not greater than optimum. If MDOT 6A backfill material was used, materials were compacted to 90% of the backfill material's maximum unit weight at moisture content not greater than optimum. The maximum unit weight of the backfill material was determined by the AASHTO T 180 or Michigan Cone Method.
- The compaction was tested a minimum of one test per lift of backfill around the trench of the structure.

Maintenance

Manufactured treatment systems should be maintained in accordance with the manufacturer's recommended schedule.

8.3 Vegetation

Figure 8-15: Butterfly Weed (source: Lady Bird Johnson Wildflower Center photo taken by: Sally and Andy Wasowski)

Description

The type of vegetation used for peak flow control systems and infiltration systems are dependent on site-specific conditions, such as soil types, amount of sunlight, and other factors. The use of native plants and "no mow zones" is encouraged. Native plants are adapted to the local climate and conditions and have numerous short-term and long-term advantages. A riparian buffer is best used between a river and the surrounding land use. The vegetation requirements at the local level should also be consulted.

A landscaping plan is required, due to the importance of the vegetation to the function of the entire system. Proper installation of landscaping is critical to the success of vegetation for water quality/infiltration systems. Many local communities have landscaping requirements; it is recommended that any local landscaping requirements be reviewed prior to designing vegetation for stormwater control systems.

Plant selection and placement should reflect various zones in the area to be landscaped. Some sections may typically have wet, saturated soils while other areas may be drier. Vegetation should be specified for each zone within the site's stormwater applications as follows from Southeast Michigan Council of Government (SEMCOG) Low Impact Development (LID) Manual for Michigan (SEMCOG LID Manual). Below are the planting zone categories from Appendix C of the SEMCOG LID Manual. Each Best Management Practice (BMP) requires plantings; however, not at every zone. For example, bioretention practices or rain gardens require plantings at each zone, unlike a dry detention basin that only has plantings above the water level (Zone C, D and E).

- **Zone A** (2 inches to 4 inches below water level): Vegetation is entirely or partially submerged and should consist of a combination of native plant plugs and bare-root stock.
- **Zone B** (0 inches to 2 inches below water level): Vegetation in the pond zone is entirely or partially submerged and should consist of a combination of native plant plugs and bare-root stock
- **Zone C** (0 inches to 2 inches above water level): Vegetation in the edge zone must withstand periods of inundation and drought. This vegetation also stabilizes the side slopes of the facility.
- **Zone D** (2 inches to 4 inches above water level): Vegetation in the edge zone must withstand periods of inundation and drought. This vegetation also stabilizes the side slopes of the facility.
- **Zone E** (4 inches to 18 inches above water level): Vegetation in the upland zone may have little or no inundation by stormwater and must withstand periods of drought. This vegetation also stabilizes the side slopes of the system. Note that the buffer strip lies within the upland zone.

Benefits

Native Plants

- Typically requires less water and fertilizer than non-native species
- Manu are naturally resistant to pests

- Deep roots help absorb stormwater and help decompose pollutants
- Installation costs for native plants can be as much as 40% less than those of traditional perennial beds
- Long-term maintenance costs can be up to 50% less expensive than turf or other traditional landscapes (less maintenance intensive than traditional landscapes)

Riparian Buffers

- Improves water quality
- Protects wildlife habitats
- Streambank Stabilization
- Protects against property loss due to flooding
- Low Maintenance

Figure 8-16: A healthy riparian buffer (Source: USDA NRCS)

Sodding Specifications

Sod should consist of a dense, well-rooted growth of perennial sod, free from noxious weeds and objectionable grasses. Nursery sod should have been grown in a prepared seedbed, and regularly fertilized and maintained according to established practices for at least two (2) years before cutting. Sod should be cut into rectangular sections with straight cut edges. Pieces may vary in length from 18 inches to 6 feet and should be a uniform width between 10 and 18 inches. Sod should be no less than 1 inch thick if used on flat areas, and 1.5 inches thick if used on slopes. Grass should be mowed to a length of no less than 3 inches before the sod is cut. Broken or damaged sod should not be used. Sod should be taken from a loam soil (rather than from peat, for example) so that the sod will not break, crumble, tear, or otherwise be unavoidably damaged during cutting, transporting, and laying. Local community landscaping specifications may require approval of sod in its original location before cutting operations begin. Staking sod with wooden pegs may be required in certain areas (e.g., sandy soils).

Areas to be sodded should be prepared with topsoil (at least 3 inches deep), all large clods and lumps should be pulverized, and rocks, roots and other foreign matter should be raked out. The area should be graded and made smooth and uniform to conform to the finished grades and cross sections shown on the construction plans. Fertilizers (preferably earth-friendly formulations) should be applied before sod is laid.

Sodding generally should take place in the spring from the time the ground is workable until June 1 and after August 15 until the time the ground becomes unworkable. Sod should not be placed when the temperature is 32 degrees Fahrenhiet or less. Local community

landscaping requirements may place additional restrictions on when sodding may occur. Sodded areas should be watered regularly until permanent growth is established.

Seeding Specifications

Areas to be seeded should be prepared with topsoil (at least 3 inches deep), all large clods and lumps should be pulverized, and rocks, roots and other foreign matter should be raked out. The area should be graded and made smooth and uniform to conform to the finished grades and cross sections shown on the construction plans. Fertilizers (preferably earth-friendly formulations) should be applied just prior to seeding.

Seeding mixtures should be from the previous year's crop, and should be composed of certified seed of the purity, germination and proportions by weight specified for the intended use.

Seeding should take place in the spring from the time the ground is workable until June 1 and during the period September 1 through October 10. Local community landscaping requirements may place additional restrictions on when seeding may occur. Seed should not be sown during periods of high winds. Do not cover seed more than ¼-inch deep.

Recently seeded areas should be mulched using loose mulch (straw in air-dry condition) or turf mulch blankets. The mulch may also need to be anchored using a tackifier or netting. Seeded areas should be watered regularly until permanent growth is established.

Seed Mixtures

Reference the SEMCOG LID Manual for seed mix for native seeding. Local requirements for seed mixtures should also be consulted.

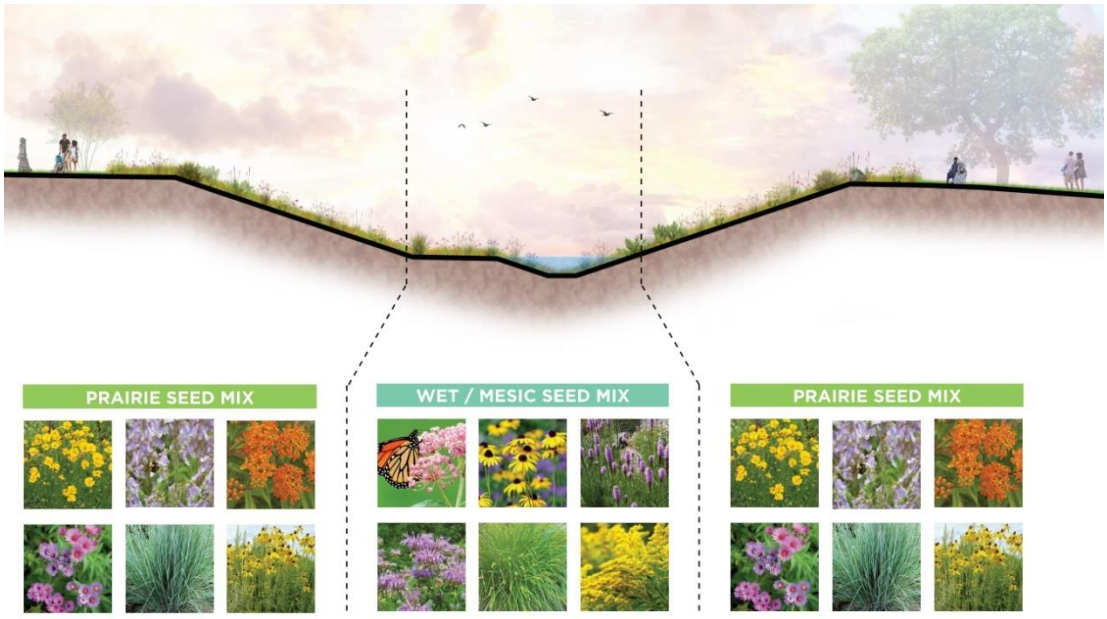


Figure 8-17: Seed Mixture for an Open Channel (source: OHM Advisors)

Adjacent to Wayne County Roads: Refer to Wayne County Department of Public Services specifications for turf establishment. Currently, MDOT seed mixture THM from specification 917 is preferred (Creeping Red Fescue – 50%, Perennial Rye Grass - 20%, Kentucky Bluegrass - 30%), applied at a rate of 200 pounds per acre.
Buffer Strips: Use of native landscaping materials is preferred within buffer strips adjacent to water bodies.

Maintenance

Maintenance activities related to vegetated areas are specific to the type of vegetation established, but all maintenance plans should include provision for re-planting/seeding of bare areas and removal of invasive species (e.g., weeds in turf grass, purple loosestrife in native plantings).

Native Plants

The initial maintenance period (3-5 years post-installation) is the most critical to the success of the project. Maintenance considerations for native landscapes include:

Control of non-native species is required to create healthy native plant communities. Depending on the size of the landscaped area, this can be accomplished through prescribed burns or mowing (large areas) or weeding (small areas).

If any of the plants do not perform well, become diseased or die, they should be replaced.

For trimming and harvesting, the current practice is to leave ornamental grasses and perennial seed heads standing to provide winter interest, wildlife forage, and homes for beneficial insects. Plants should not be cut back until spring when new growth commences, and even then, it is only done for neatness; it does not impact growth. Plants may be pinched, pruned, sheared or deadheaded during the growing season to encourage more flowering, a bushier plant, or a fresh set of leaves. Diseased or damaged plant parts should be pruned as they occur. If a plant is pest-infested, perform cleanup in fall to deny the pest a winter home. Trees and shrubs may be pruned for shape or to maximize fruit production.

The properly designed native landscape should thrive and allow planting materials to expand and propagate, eventually becoming overcrowded. If this occurs, perennial plants should be divided in spring or fall.

Riparian Buffers and No Mow Zones

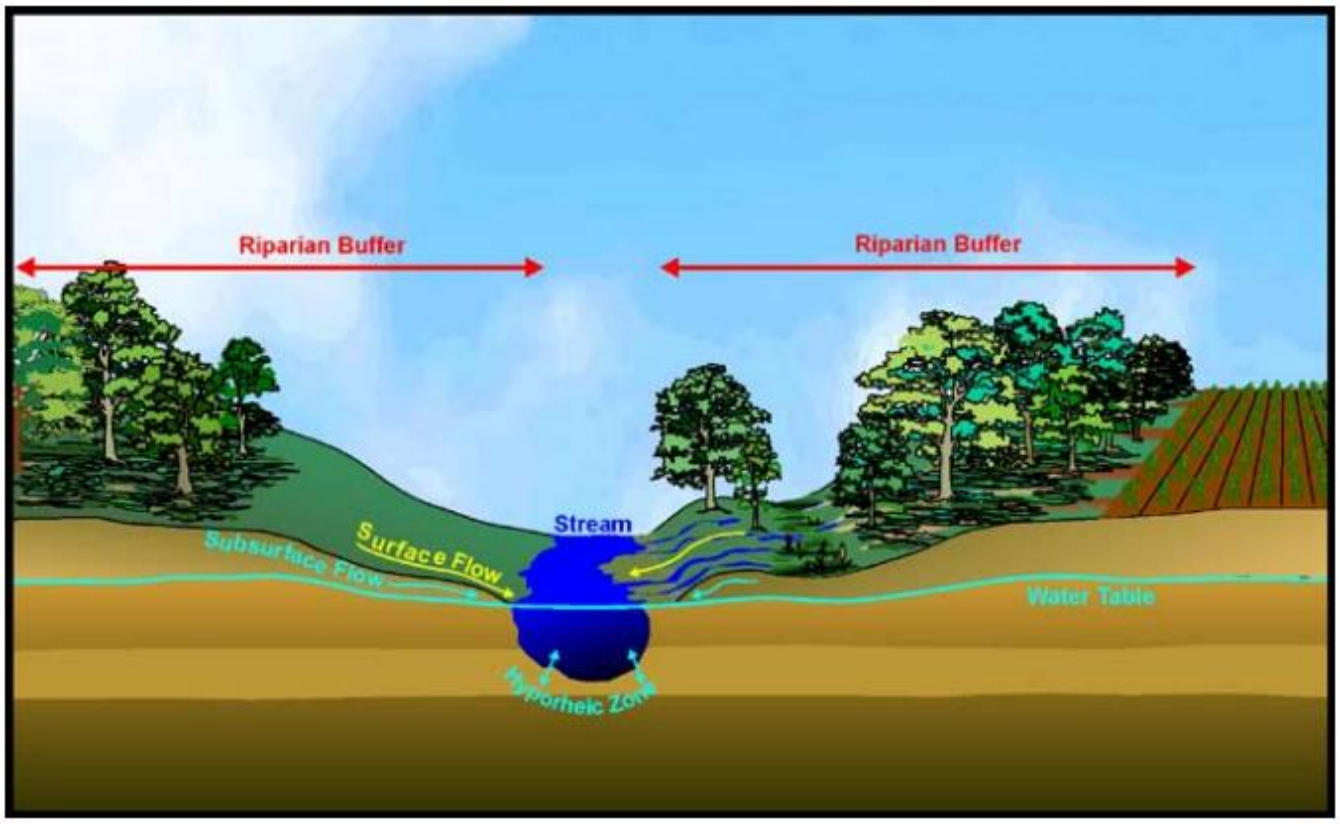


Figure 8-18: Riparian Buffer (Source: EPA Riparian Buffer Width 2005)

Occasional site inspections should be conducted to ensure the vegetative corridor area is intact and stable. Vegetated areas should be checked for removal of undesirable vegetation (invasive species). Site washouts should be repaired immediately. All appropriate government agencies should be contacted, and approval granted prior to beginning any riparian buffer measures.

Plantings

For grassed areas that are mowed, these practices include:

- "Mow high": Proper mowing and use of a mulching mower is important and will not contribute to thatch problems. Proper mowing at the correct heights and frequencies with a sharp blade is very important for lawn health. Mowing at heights between 2 and 3 inches is best to encourage deeper roots, discourage weeds and reduce evaporation.
- Soil compaction and thatch build-up result in shallow roots and reduced water infiltration and air flow. Mechanical soil aeration, vertical mowing (thatch removal) and coring can help loosen compacted soil. It is not unusual for lawns to contain shallow top soil and compaction from frequent vehicle access and foot and animal traffic.
- Thatch is a dense layer of dead grass, stems, and roots that develops between the soil surface and the growing grass. While some thatch is normal and desirable, excessive thatch problems are often a sign of over-watering and improper mowing. Mechanical de-thatching in the early fall is recommended for lawns with more than one inch of thatch build-up.

For fertilizing:

- Consider compost or other organic fertilizer sources as they provide a slow, steady release of nutrients over time.
- Consider fertilizer that contains at least 50% water insoluble nitrogen.

- Recycle lawn clippings. Recent research at the University of Connecticut has shown that fertilizer needs can be reduced by 50% or more when using recycled clippings.
- Most lawns will not need more than 2 lbs. N/1,000 sq. ft. per season. Apply no more than 1 lb. of N/1,000 sq. ft. per application.
- Apply one application in May and another application in September. Do not apply fertilizer after October 15th to reduce pollution risk.
- Proper application methods such as measuring the actual area to be treated and calibrating the spreader is also very important--this ensures that proper amount of fertilizer is applied. Avoid spreading fertilizer on paved areas or near storm drains or drinking water wells. Sweep up these areas with a broom, do not wash with a hose. A drop spreader can allow for more accurate control around critical areas. Compost and other organic fertilizers are still sources of nutrients, so they should be applied at the proper rate and time using sound application methods.

Other practices include:

- Use Integrated Pest Management techniques if pests become a problem.
- Newly planted, sodded or seeded areas should receive the equivalent of 1 inch of water per week, for the first 6 to 8 weeks, either via rainfall or irrigation.
- For seeded areas, do not pull weeds while seed is germinating and seedlings are establishing or desirable plants may be uprooted with the weeds.

References

- Streambank and Shoreline Protection Manual. Lake County Stormwater Management Commission, Lake County Planning, Building and Development Department U.S.D.A. - Natural Resources Conservation Service. January 2002.
- Stream Corridor Restoration: Principles, Processes, and Practices. Federal Interagency Stream Restoration Working Group (FISRWG 15 Federal agencies of the US government) October 1998.
- American Standard of Nursery Stock, American Nursery & Landscape Association, https://www.americanhort.org/education/american-nursery-stock-standards/
- Michigan Department of Transportation Specifications, http://www.michigan.gov/mdot

CHAPTER 9: LONG-TERM MAINTENANCE

The Wayne County Stormwater Program requires stormwater control systems to be maintained in perpetuity to ensure that they function effectively as designed. Long-term maintenance generally begins when construction of the stormwater system is complete and the County releases the permit issued in connection with granting stormwater construction approval. The County issues a long-term maintenance permit for the project that identifies, among other things, the limits of the stormwater system, the party responsible for maintenance, and the activities required to ensure that the system functions effectively. A sample long-term maintenance permit is presented in Appendix B to this manual.

This chapter describes general long-term maintenance and reporting requirements for stormwater control systems approved by Wayne County. This chapter also identifies specific maintenance activities that should be performed for closed conduits and watercourses, and describes situations where stormwater control components may be maintained by others (e.g., closed conduits operated by Wayne County or the Michigan Department of Transportation). Specific maintenance activities for open detention basins, retention basins, forebays, and other components of stormwater control systems are described in Chapter 8 and in Appendix B. The inspection and maintenance checklists is adapted from the DWSD Stormwater Management Design Manual, November 2018.

Figure 9-1: Bioretention Clean Out (source: Stormwater Maintenance Consulting)

This chapter does not describe maintenance activities that are necessary during construction. Temporary measures that must be utilized during construction are described in Chapter 7.

Application Site Plan Review

- Maintenance Plan and Schedule submitted and approved as part of site plan review process
- Maintenance Plan covers all stormwater management components, including detention ponds, sediment forebays, infiltration BMPs, mechanical separators, catch basins, storm sewer pipes, open channels, and related components

Maintenance Agreement

- Maintenance Agreement prepared and signed by Property Owner and Public Entity
- For private development, the Maintenance Agreement shall be signed as follows:
  - City, Village, or Township (signed by the Local Unit of Government (L.U.G.))
  - Schools: signed by local School District

Site Plan Approval (C-Permit)

- Wayne County issues C-Permit, allowing for site construction, after full site plan approval, including approval of Stormwater Exhibits "A" and "B" (exhibits are part of the *Long-Term Maintenance Permit* in Appendix B of this Manual).

Finalize Construction and M- Permit

- Construct site per approved site plan.
- Wayne County will perform a final inspection of all stormwater components.
- Wayne County sends request to L.U.G. to pass a Resolution accepting the perpetual maintainance responsibilities of the stormwater management system and to sign the M-Permit.
- Property owner records the M-Permit, which includes the passed the Maintenance Plan, Maintenance Agreement and Resolution, with the Wayne County Register of Deeds and sends proof of recording to WCDPS Construction Permit Office.

Stormwater Control Database

- GIS data provided by the applicant (per Chapter 4 of Stormwater Manual) will be imported into Wayne County's GIS-based stormwater maintenance database. ***[IN DEVELOPMENT]***
- Wayne County will make the contents of the database available to each L.U.G. to facilitate local enforcement of Maintenance Agreements.
- This database will be used to track ongoing compliance to Maintenance Agreements and to track inspection, maintenance, and enforcement history.

Ongoing Stormwater Inspection/Reporting

- Property owners are responsible for performing annual inspection/maintenance of all stormwater controls (see Appendix C for inspection and maintenance checklists for common stormwater controls)
- Wayne County or L.U.G. may perform independent inspections of stormwater controls
- Inspection frequency may vary and will be determined by Wayne County or L.U.G.
- Property owners will provide inspection records when a deficiency has been identified or if requested by Wayne County or L.U.G.

Notice of Maintenance Deficiencies

- For those stormwater controls that are not adequately maintained (confirmed via Wayne County or L.U.G. inspection), a Notice of Maintenance Deficiency will be sent to the property owner or responsible party (e.g., Homeowners' Association)
- Wayne County or L.U.G. reserves the right to ask for copies of inspection/maintenance records kept by the property owner (***lack of records serves as a violation of the Maintenance Agreement***)
- Wayne County or L.U.G. will provide the property owner with a schedule to remedy the stated deficiency and will inspect the property for compliance at the end of this period.

Emergency Repairs and Assessments

- If the maintenance deficiency has not been addressed within the specified period, Wayne County or the L.U.G. will enter the property, address the maintenanced deficiency, and charge the property owner for labor, materials, and related legal and administrative efforts
- In Townships, Wayne County may, at its discretion, use the Drain Code to assess property owners for necessary maintenance work
- In Villages and Cities, the L.U.G. may use other legal means to seek reimbursement

9.1 Requirements for Long-Term Maintenance Plans

Applications for a stormwater construction approval must be accompanied by a long-term maintenance plan for the stormwater control system. The maintenance plan generally must include the following elements:

- The plan must identify the physical limits of the stormwater control system and the party responsible for maintaining each system component.
- The plan must identify the manner in which the applicant will assure, through a legally binding instrument, that the stormwater control system will be maintained in perpetuity.
- The plan must identify the preventative maintenance activities that are necessary to ensure that the system functions properly.
- The plan must provide for periodic monitoring of the system to determine whether the system is functioning properly.
- The plan must commit the entity responsible for maintenance to performing remedial actions necessary to repair, modify, or reconstruct the system in the event the system does not function properly as designed.
- The plan must set forth a schedule for implementing the activities necessary to ensure the proper functioning of the system.
- The plan must provide the procedure for submitting on an annual basis the maintenance records for the stormwater control system to the local unit of government or other public entity in which the stormwater control system is located and the County.

The remainder of this section provides more information about the elements of an approvable long-term maintenance plan. A sample long-term maintenance plan is included as Exhibit B to the sample long-term maintenance permit presented in Appendix B.

9.1.1 Identifying the Limits of System and Responsible Entities

Long-term maintenance plans must define the physical limits of the stormwater control system associated with the plan and identify the entity that is responsible for maintenance. Buffer strips and routes of access to components of a stormwater control system for maintenance purposes should be identified. Typically, the limits of the system can be shown on a map or drawing that includes a legend that labels each component of the system and identifies the entity responsible for maintaining each component. A sample diagram is included as Exhibit A to the sample long-term maintenance permit presented in Appendix B.

9.1.2 Ensuring Maintenance in Perpetuity

Agreement with Local Unit(s) of Government or County-approved Public Entity

The local unit(s) of government or other public entity approved by the County, must assume long-term maintenance responsibility for stormwater control systems that require a Wayne County stormwater construction approval in accordance with the Ordinance and the Administrative Rules. This maintenance responsibility must be assumed through a resolution, or equivalent instrument approved by the County as a condition of final project construction approval.

The instrument is attached to and made a part of the long-term maintenance permit (M-Permit) issued by the County. (See Appendix B.) Examples of options for establishing maintenance responsibility (e.g., a resolution from a local government accepting maintenance responsibility) are shown in Appendix B to this manual.

For certain types of projects, an applicant may submit a request to the Wayne County Drain Commissioner to establish the stormwater control system as a County drainage district. Through the establishment of a drainage district, Wayne County finances, administers and performs maintenance of the stormwater control system in accordance with the Drain Code. The listing of applicable projects and the process for requesting that the stormwater control system be established as a County Drain are presented in Appendix C to this manual.

Notifying Future Property Owners

Long-term maintenance plans must describe in general terms the method or methods that will be relied on to ensure that maintenance is performed in perpetuity. The M-Permit including the long term maintenance agreement must be recorded with the Wayne County Register of Deeds, and may be required to be included in other documents or instruments associated with a development, such as bylaws, plats, master deed or rules/regulations.

9.1.3 Maintenance, Inspection and Reporting Activities

Typical long-term maintenance plans include a detailed description of the following elements:

- Maintenance activities for all components of the stormwater system, including closed conduits, watercourses, outflow control structures, best management practices, and other related appurtenances. The plan must clearly identify the means of accessing stormwater control components for purposes of maintenance, and identify the location of all access points.
- Debris removal from catch basins, watercourses, manufactured detention systems, manufactured treatment systems, forebays and detention basins.
- Dredging operations for watercourses, including detention basins and forebays. The County generally requires removal of sediment when the forebay volume is reduced by 30%.
- Detailed description of the procedures for both preventative and corrective maintenance activities. Preventative maintenance should include periodic inspections, adjustments, replacements, and record keeping of operations.
- A schedule for routine and non-routine inspection of all components of the system.
- Provision for maintenance of buffer strips.
- A description of ongoing landscape maintenance needs.
- Provision for necessary permits from others.
- Provision for submitting annual reports to the County and local unit of government or other public entity documenting inspections and maintenance.

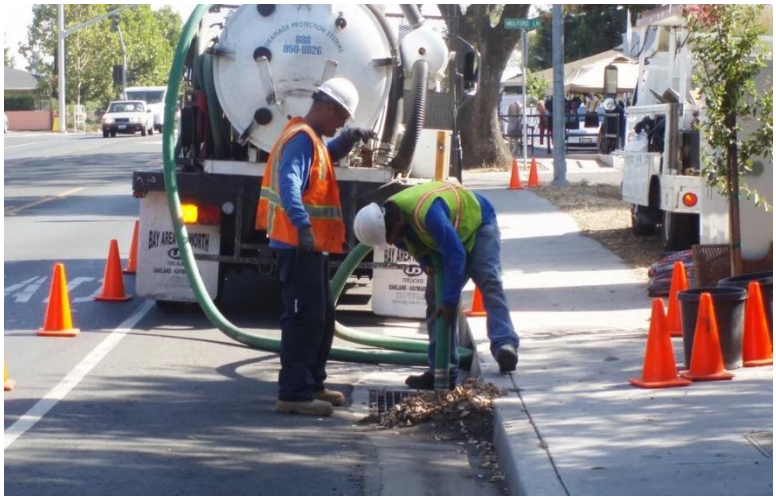
See Table 1 in Exhibit B to the sample long-term maintenance permit presented in Appendix B for an example listing of maintenance activities.

9.2 Closed Conduits

The Michigan Department of Transportation (MDOT) is responsible for maintaining storm sewers within its jurisdiction, such as those within state road rights-of-way. The Wayne County Department of Public Services (WCDPS) Roads Division maintains County-owned storm sewers within County property (for example, County road rights-of-way including those within subdivision developments). WCDPS Environmental Services Division maintains storm sewers that enclose County Drains. In some cases, local governments conduct storm sewer maintenance on behalf of WCDPS through special agreements.

Maintenance Activities

Storm sewer operation is affected by the buildup of sediments and collection of debris such as paper, rags, and small branches. The frequency in which enclosures experience this problem depends on the storm sewer's velocity, the street maintenance program, and the litter collection practices of adjacent development. Storm sewer inlets and outlets should be checked annually for clogging and the system should be cleaned as required. Regular pipe inspection should be made to verify that the piping is not cracked or broken. Grates on inlets, outlets and other storm sewer structures should be cleaned regularly, and sediment should be removed from structures when the accumulation reaches 30% of the structure's volume.



Catch basins should be inspected at least twice a year for debris and sediment buildup. If debris accumulates in the outlet pipe, cleaning the catch basin can become much more time-consuming and expensive.

Figure 9-2: Closed Conduit Maintenance (source: CRH Building Solutions)

9.3 Watercourses

WCDPS Roads Division maintains watercourses in County road rights-of-way that provide drainage for County roads. The WCDPS Environmental Services Division maintains watercourses that are designated as County Drains. The U.S. Army Corps of Engineers (USACE) maintains the lower Rouge River and the Detroit River within Wayne County. Maintenance of watercourses other than those described above is a function sometimes performed by the local municipality or property owners. It should be noted that some watercourse maintenance activities may require a permit from another public agency (e.g., EGLE or USACE). Chapter 3 of this manual provides an overview of select local, state, and federal regulations governing activities in watercourses.

Maintenance Activities

Watercourses generally should be kept open to allow maximum water flow, stormwater transport, and water quality improvements. Buildup of sediment and debris in watercourses can cause low flow problems, flooding problems and degradation of the water quality. Watercourses and the riparian corridor should be maintained according to the riparian corridor management techniques described in Sections 8.4 and 8.5.

CHAPTER 10: DEFINITIONS

NOTE: The definitions in this Chapter are set forth here for convenience and ease of reference, and are not intended to modify, supplant, expand, or replace definitions in the Ordinance or in rules promulgated pursuant to the Ordinance. Any conflict between the definitions in this chapter and the definitions in the Ordinance and/or rules should be resolved in favor of the Ordinance and/or rules.

Applicant - A person responsible for regulated construction activity on a development site who is seeking to obtain stormwater construction approval.

Aquatic Bench or **Safety Shelf** - A bench, usually 4-feet to 5-feet wide, that is constructed around the inside perimeter of a permanent pool and that ranges in depth from zero to 12 inches. Normally vegetated with emergent plants, the bench augments pollutant removal, provides habitat, conceals trash and changes in water level, and enhances safety.
stormwater

Bare-Root Stock – Plants used as a component of vegetation for open detention basins and retention basins that are received with very little, if any, soil around the roots and are generally wrapped in Hessian cloth or plastic to prevent the roots from drying out.

Best Management Practice (BMP) - A practice or combination of practices that have been determined by the County to be the preferred method of preventing, minimizing, or reducing pollution and other effects of stormwater and stormwater runoff.

Bioretention Area – A component of a stormwater management system that is comprised of a depressed land area that contains specific soil, plant materials, and other features and is used as a pretreatment system.

Borings - Cylindrical samples of a soil profile used to determine soil properties.

Bridge - A structure, including supports, built to carry a feature over a surface water or watercourse, with a clear span of more than 20 feet measured along the center of the feature being carried.

Buffer Strip - A zone that is used for filtering direct stormwater and stormwater runoff into a stormwater control system and for providing maintenance access to a stormwater control system.

Catch Basin - A structure designed to collect water from the surface and convey it into a closed conduit.

CFS - Cubic feet per second.

Channel Protection Rate Control (CPRC) – Controlling the stormwater runoff generated by a 1.9-inch rainfall event via extended detention.

Channel Protection Volume Control (CPVC) – Controlling the stormwater generated by a 1-inch rainfall event via infiltration or other means of onsite retention.

Check Dam - A crushed rock or earthen structure used in vegetated swales to reduce water velocities, promote sediment deposition, and enhance infiltration.

Closed Conduit - An enclosed conveyance designed to carry stormwater runoff such that the surface of the water is not exposed to the atmosphere, including without limitation storm sewers, culverts, closed County drains, and pipes.

Constructed Wetland – An open detention basin that uses a variety of water depths and wetland plants to provide pollutant removal.

Construction Activity - A human-made activity, including without limitation, clearing, grading, excavating, construction and paving, that results in an earth change or disturbance in the existing cover or topography of land, including any modification or alteration of a site or the "footprint" of a building that results in an earth change or disturbance in the existing cover or topography of land.

Conveyance - Any structure or other means of safely conveying stormwater and stormwater runoff within a stormwater control system, including without limitation a watercourse, closed conduit, culvert, or bridge.

County - The Charter County of Wayne, Michigan

County Drains -Drains established pursuant to the Michigan Drain Code of 1956, MCL 280.1 et seq., as amended.

County Road –Roads and road rights-of-way within the jurisdiction of the County.

Culvert - A structure, including supports, built to carry a feature over a surface water or watercourse, with a clear span of less than 20 feet measured along the center of the feature being carried.

Design Storm - A rainfall event of specified size and return interval that is used to calculate the water volume and peak flow rate that must be handled by a stormwater control system.

Design Water Level - The peak water surface elevation in a detention system at which the storage volume in the system (above the permanent pool water level, if any) equals the required storage volume.

Detention or **Detain** – The temporary storage of stormwater and stormwater runoff to control peak flow rates and/or provide pollutant removal before discharging the water to a surface water or closed conduit.

Detention System – A component of a stormwater control system, either aboveground or belowground, that detains stormwater and stormwater runoff. Detention systems may include, without limitation, open detention basins and underground detention systems.

Detention Time - The amount of time that a volume of water will be detained in a detention system.

Development – Land disturbance related to the improvement of a portion or all of a single parcel or multiple parcels. This includes new development on non-urban land (i.e. agricultural areas, woodland, pasture, meadow) and development in urbanized areas (i.e. brownfield development or redevelopment).

Development Site - The property on which regulated construction activity will occur, is occurring, or has occurred.

Director - The Director of the Wayne County Department of Public Services or his or her designee.

Drain Commissioner - In Wayne County, the Drain Commissioner is an appointed position within the Department of Public Services.

Drainage Area - The entire upstream land area from which stormwater runoff drains to a particular location, including any off-site drainage area.

Easement - A legal right, granted by a property owner to another person, allowing that person to make limited use of the property involved for a specific purpose.

Edge Zone - The area within an open detention basin or retention basin between the permanent pool water surface elevation and the channel protection rate and volume elevation.

Emergency Spillway - A depression in the embankment of an open detention basin or retention basin that is used to pass flows in excess of the overflow structure capacity.

Fill - Earth or other approvable substances that are added to land to change its contour.

Filter Fabric - Textile of relatively small mesh or pore size that is used 1) to allow water to pass through while keeping sediment out (permeable), or 2) to prevent both runoff and sediment from passing through (impermeable).

First Flush- Stormwater runoff that occurs during the early stages of a storm as a result of the washing effect of stormwater runoff on pollutants that have accumulated on the surface of the drainage area. The first flush at a particular location within a stormwater control system consists of runoff from the 90th percentile annual non-exceedance is the storm where 90 percent of the runoff-producing storm rainfalls are equal to or less than the specified value. This value may change over time; the equations in the Stormwater Control Program will be updated to reflect current rainfall statistics.

Flood Control Storage Volume (Detention System) – The detention system volume necessary to control the 100-year peak flow to the allowable discharge rate while providing adequate freeboard.

Flood Control Storage Volume (Retention System) – The retention system volume necessary to store the volume from two consecutive 100-year storm events while providing adequate freeboard.

Floodplain - For a given flood event, that area of land adjoining a continuous watercourse that has been covered temporarily by water.

Flow Restrictor - A structure, feature, or device in a detention system or pretreatment system that is used to restrict the discharge from the system for specified design storm(s).

Forebay - A component of a stormwater control system that is comprised of a surface water that is used as a pretreatment system.

Freeboard - The vertical distance from the design water level to the top of the embankment of an open detention basin or a retention basin.

Hydrograph - A graph showing variation in the water depth or discharge in a watercourse or closed conduit over time.

Infiltration - The rate of absorption of water into the ground, usually expressed in terms of inches/hour.

Land Disturbance - Any activity which affects the ground surface and/or vegetation (e.g., clearing, grubbing, cut/fill, grading, excavating for foundations, etc.). Pavement milling and resurfacing is ***not*** considered a land disturbance activity; however, full pavement removal (to the aggregate or subgrade layer) ***is*** considered a land disturbance activity.

Manhole - A structure that allows access into a closed conduit or other underground component of a stormwater control system.

Manning's Formula - A technique for estimating the hydraulic capacity of a closed conduit, watercourse, or other means of conveyance of stormwater and stormwater runoff.

Manning's Roughness Coefficient ("n") - A coefficient used in Manning's Formula to describe the resistance to flow due to the roughness of a conveyance.

Manufactured Treatment System - A component of a stormwater control system that is comprised of a manmade device or structure that is used as a pretreatment system.

Open Detention Basin - A component of a stormwater control system that is comprised of a surface water that is used as a detention system.

Ordinance - The Wayne County Stormwater Management Ordinance, as amended.

Outflow Rate - The rate of discharge in volume per unit time.

Overflow Structure - A structure designed to allow unrestricted discharge from a component of a stormwater control system when the water level exceeds the design water level.

Peak Flow Rate - The maximum instantaneous rate of flow at a particular location within a stormwater control system, usually in reference to a specific design storm event.

Permanent Pool - A pool in an open detention system or forebay that provides additional removal of pollutants through settling and biological uptake.

Permit Holder – A person granted stormwater construction approval under the Ordinance.

Permit Office - The Permit Office of the Wayne County Department of Public Services, Engineering Division.

Person - A natural person, trustee, court-appointed representative, syndicate, association, partnership, firm, club, company, corporation, business trust, institution, agency, government corporation, municipal corporation, city, county, municipality, district, or other political subdivision, department, bureau, agency or instrumentality of federal, state, or local government, or other entity recognized by law as the subject of rights and duties.

Plug – Plants used as a component of vegetation for open detention basins and retention basins that are raised as individual plants, each in a small container about the size of an ice cube.

Pollutant - Any substance introduced into the environment that may adversely affect the public health, safety, welfare, or the environment, or the usefulness of a resource.

Pond Zone - The area within an open detention basin or retention basin where the permanent water depths range from 0 to 3 ft deep.

Ponding Area – In bioretention areas, the area where excess stormwater runoff is temporarily stored prior to infiltration into the ground.

Pretreatment System – A structure, feature, or appurtenance, or combination thereof, either aboveground or below ground, that is used as a component of a stormwater control system to remove incoming pollutants from stormwater and stormwater runoff. Pretreatment systems may include, without limitation, forebays, manufactured treatment systems, and bioretention areas.

Rational Method Formula - A technique for estimating peak flow rates at a particular location within a stormwater control system, based on the rainfall intensity, watershed time of concentration, and a runoff coefficient.

Regulated Construction Activity - Construction activity that is subject to the provisions of the Ordinance or a rule promulgated pursuant to the Ordinance.

Regulated Wetland - Any wetland protected by federal, state, or local laws or regulations.

Retention or **Retain** - The storage of stormwater and stormwater runoff to provide gravity settling of pollutants and to promote infiltration into the soil, rather than to discharge the stormwater or stormwater runoff to a surface water or closed conduit.

Retention Basin - A component of a stormwater control system that retains stormwater and stormwater runoff with no outlet to the receiving drainage system. Retention basins discharge via infiltration and evaporation.

Return Interval – The length of time during which a rainfall depth is predicted to be exceeded one time. For instance, a 10-year return interval rainfall depth has a 10 percent chance of being exceeded in any given year. A 100-year return interval rainfall depth as a 1 percent chance of being exceeded in any given year.

Riprap - A combination of large stone, cobbles, and boulders used to line watercourses, stabilize banks, reduce runoff velocities, or filter out sediment.

Runoff Coefficient - The ratio of the volume of stormwater runoff from a given drainage area over a given time period, to the total volume of precipitation that falls on the same drainage area over the same time period.

Safety Shelf – *See* the definition of Aquatic Bench.

Stormwater - Water resulting from precipitation, including without limitation rain, snow, and snowmelt.

Stormwater Construction Approval - An approval issued by the Wayne County Permit Office pursuant to the Ordinance and rules promulgated pursuant to the Ordinance.

Stormwater Management Program - Ordinances, orders, rules, regulations, and other mechanisms that provide for the management of stormwater to prevent flooding and to ensure the restoration and/or protection of surface waters. Wayne County's stormwater management program consists of this Ordinance, rules or regulations promulgated under this Ordinance, the Stormwater Management Standards, and any other activities mandated by the MS4 Permit issued by EGLE, former the MDEQ, to the County.

Stormwater Management System - Any structure, feature or appurtenance subject to the Ordinance or a rule promulgated pursuant to the Ordinance that is designed to collect, detain, retain, treat, or convey stormwater runoff, including without limitation buffer strips, swales, gutters, catch basins, closed conduits, detention systems, pretreatment systems, wetlands, pavement, unpaved surfaces, structures, watercourses, or surface waters.

Stormwater Runoff - The excess portion of precipitation that does not infiltrate the ground, but "runs off" and reaches a conveyance, surface water, or watercourse.

Surface Water - A body of water, including without limitation seasonal and intermittent waters, in which the surface of the water is exposed to the atmosphere, including without limitation lakes, open detention basins, forebays, watercourses, bioretention areas, retention basins, wetlands, and impoundments.

Time of Concentration - The time duration (typically in minutes) that is required for stormwater runoff from the most remote area of the watershed to reach a given location in a stormwater control system.

Total Suspended Solids (TSS) - Particles or other solid material suspended in stormwater or stormwater runoff. TSS is commonly expressed in concentration (milligrams per liter or parts per million).

Underdrain - One or more underground pipes installed beneath bioretention areas, terraced side slopes, or other structures to facilitate conveyance of stormwater runoff from beneath the structure to another part of the stormwater control system.

Underground Detention System - One or more underground pipes and/or other structures that are utilized as a detention system.

Upland Zone – The area within an open detention basin or retention basin between the channel protection rate elevation to the 100-year flood elevation and beyond.

Vegetated Swale – A conveyance, open to the atmosphere, consisting of a broad, shallow channel lined with vegetation to slow and filter stormwater runoff and promote infiltration.

Watercourse - An open conduit, either naturally or artificially created, that periodically or continuously conveys water, including without limitation rivers, streams, vegetated swales, open channels, and open County drains.

Watershed - The complete area or region draining into a watercourse, surface water or closed conduit.

Weir - A structure that extends across the width of a surface water, watercourse or closed conduit and is used to impound or restrict the flow of water.

Wetted Perimeter –The length of the perimeter of a watercourse or closed conduit cross-section that is submerged and thereby causes resistance to flow.

CHAPTER 11: SAMPLE CALCULATIONS

This chapter includes three examples of how to apply these rules to perform the basic calculations necessary to demonstrate compliance with Wayne County stormwater standards. The steps below are related directly to the equations in Chapter 6. ***It is highly recommended that site plans include the equations in the order and format as explained below***; this will help to expedite the review process.

These examples reflect typical site developments in Wayne County and may not be reflective of all development types and design complexities. In some cases, the design engineer will need to use complex modeling to demonstrate compliance; especially for larger (i.e. 20+ acres) developments. The following examples are intended to provide a step-by-step approach for conventional site developments.

The examples provided in this chapter include the following:

1. 16.67-acre single family residential development with good soils (infiltration is feasible without an underdrain)
2. 0.96-acre commercial redevelopment with marginal soils (infiltration is possible with an underdrain)
3. 0.86-acre commercial development with tight soils (infiltration is infeasible)

The following table includes key design variables used in this chapter.

Variable	Units
Area, A	Acres
Runoff Coefficient, C	unitless
100-year Allowable Release Rate, Q_{allow}	Cubic feet per second per acre (cfs/acre)
Channel Protection Volume Control, V_{CPVC}	Cubic feet (cf)
Channel Protection Rate Control, V_{CPRC}	Cubic feet (cf)
100-yr Peak Rainfall Intensity, I_{100}	Inches per hour (in/hr)
100-yr Peak Allowable Discharge, Q_o	Cubic feet per second (cfs)
100-yr Peak Pond Inflow, Q_i	Cubic feet per second (cfs)
Average Flow Rate, Q_{ave}	Cubic feet per second (cfs)
Average head, h_{ave}	Feet
Required 100-yr Storage Volume, V_s	Cubic feet (cf)
100-yr Runoff Volume, V_r	Cubic feet (cf)

Runoff Volume Determination

The runoff coefficient, C, is used to calculate peak flows and key design volumes throughout this manual. The runoff coefficient can be calculated using an area-weighted value by calculating the percentage of pervious and impervious surfaces on a site. The table to the right can be used to assign the runoff coefficient for various surfaces. Impervious surfaces are assigned a c value of 0.95. Pervious surfaces can be assigned a c value based on the soil type.

MINIMUM ACCEPTABLE RUNOFF COEFFICIENTS

Type of Surface	Runoff Coefficient (C)
Water Surfaces	1.00
Roofs	0.95
Asphalt or concrete pavements	0.95
Gravel, brick, or macadam surfaces	0.95
Semi-pervious: lawns, parks, playgrounds:	
Hydrologic Soil Group A	0.15
Hydrologic Soil Group B	0.20
Hydrologic Soil Group C	0.25
Hydrologic Soil Group D	0.30

Rainfall Intensity

Key rainfall intensities to be used for site design in Wayne County are listed below: these are based on rainfall intensities as published in NOAA Atlas 14:

- 10-year storm: $I_{10} = \frac{63}{(12.33 + \mathrm{T})^{0.84}}$
- 100-year storm: $I_{100} = \frac{101}{(12.33 + \mathrm{T})^{0.84}}$

where: I = peak rainfall intensity (in/hr)
T = time of concentration (minutes)

The time of concentration (T) must be calculated using the EGLE equations in their publication Computing Flood Discharges for Small Ungaged Watersheds (rev. 2012). Velocities are calculated for up to three different flow types (smaller sites may have fewer flow types). See Chapter 6 (and Example 1 in this section) for equations and methodology.

Channel Protection Volume Control (CPVC) Volume Calculation

$$\boldsymbol{V_{CPVC} = A * C * 3,630}$$ *[cubic feet]*

Channel Protection Rate Control (CPRC) Volume Calculation

$$\boldsymbol{V_{CPRC} = A * C * 6,897}$$ *[cubic feet]*

100-year Flood Control Volume Calculations

100-yr Allowable Release Rate (Q_{allow}): $\boldsymbol{Q_{allow} = 1.1055 - 0.207 \ln(A)}$ *[cubic feet per second/acre]*
(maximum = 1.0 cfs/acre)

100-yr Peak Allowable Discharge (Q_o): $\boldsymbol{Q_O = Q_{allow} * A}$ *[cubic feet per second (cfs)]*

Calculate 100-year Pond Volume:
100-yr Peak Pond Inflow (Q_i): $\boldsymbol{Q_i = C * I_{100} * A}$ *[cubic feet per second (cfs)]*
100-yr Runoff Volume (V_r): $\boldsymbol{V_r = 18,900 * C * A}$ *[cubic feet]*
Storage Ratio (V_r/V_s): $\frac{V_s}{V_r} = \mathbf{0.206 - 0.15 \ln(\frac{Q_o}{Q_i})}$

100-yr Required Storage Volume (V_s): $V_s = V_r * Storage\ Ratio$ *or* $V_s = V_r * (.206 - 0.15 \ln(\frac{Q_o}{Q_i}))$

Orifice Calculations

Outlet Restrictor Size for CPRC (Extended Detention)

Average Discharge Rate (Q_{ave}): $Q_{ave} = \frac{CPRC\ Volume}{172{,}800}$ [cfs, average discharge rate over a 48-hour period]

Average Head (h_{ave}): $h_{ave} = \frac{h_{ED}}{2}$ [h_{ED} = maximum head, ft, resulting from CPRC storage volume]

Extended Detention Orifice Area (a): $A = \frac{Q_{ave}}{0.62\sqrt{2*g*h_{ave}}}$ [A = orifice area in square feet]

Extended Detention Orifice Diameter (d): $d = 12 * \sqrt{4 * \frac{A}{\pi}}$ *[d = orifice diameter in inches, assuming single orifice]*

Outlet Restrictor Size for Flood Control (100-yr storm)

Step 1: Calculate the 100-year head (h_{max})
Step 2: Using h_{max}, calculate the 100-yr peak flow through the Extended Detention orifice(s)
Step 3: Subtract the flow from Step 2 from the 100-yr Peak Allowable Discharge (Q_o); this is the *residual* peak flow, or Q_{res}
Step 4: Calculate the flood control orifice size*:

$h_{res} = h_{max} - h_{ED}$ [h_{res} = *residual head, ft, from 100-yr peak storage to Extended Detention (CPRC) peak storage]*

$A = \frac{Q_{res}}{0.62\sqrt{2*g*h}}$ [*A = 100-yr orifice area in square feet]*

$d = 12 * \sqrt{4 * \frac{A}{\pi}}$ [*d = 100-yr orifice diameter in inches, assuming single orifice]*

* *If the Extended Detention (CPRC) volume is equal to or greater than the 100-year required storage volume (V_s), the Extended Detention orifices will serve as the outlet control for all storm events (no additional orifices are necessary)*

The minimum permissible orifice size for Extended Detention and Flood Control requirements is 1-inch diameter. If the calculations above result in a single orifice smaller than 1-inch diameter, the orifice size shall default to 1-inch diameter. This is necessary to avoid chronic blockage at the outlet.

Site Plan Examples

Example 1

The site is a new development for a residential subdivision. The total development area is roughly 17 acres. Infiltration tests were conducted on the site, which yielded an observed infiltration rate of 0.40 inches/hour; therefore, it was determined that infiltration is feasible, which will require volume control (CPVC). Because the infiltration rate is below 0.50 inch/hour, an underdrain may be used to dewater the infiltration measures.

Area, A (ac)	16.67
Proposed Impervious Area (ac)	7.62
Proposed Pervious Area (ac)	9.05
Runoff Coefficient, C	0.57
100-yr peak intensity, in/hr	5.4

Land Use Summary

must be included on the COVER SHEET for all site plans

Pervious Area Land Use Data

Characteristic	Existing Conditions	Proposed Conditions
Total Development Area (ac)	16.67	16.67
Impervious Area (ac)	1	7.62
Total Pervious Area (ac)	15	9.05
Pervious Area Breakdown by Cover Type		
Meadow/fallow/natural areas (non-cultivated)	4 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type B	N/A
Improved areas (turf grass, landscape, row crops)	1.67 acres	7.62 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type B	Type B
Wooded Areas	10 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type B	N/A
Calculated CPVC Volume (cubic feet)		34,492
CPVC Volume ***Provided*** (cubic feet)		34,492
CPRC Volume Provided (cubic feet)		65,535

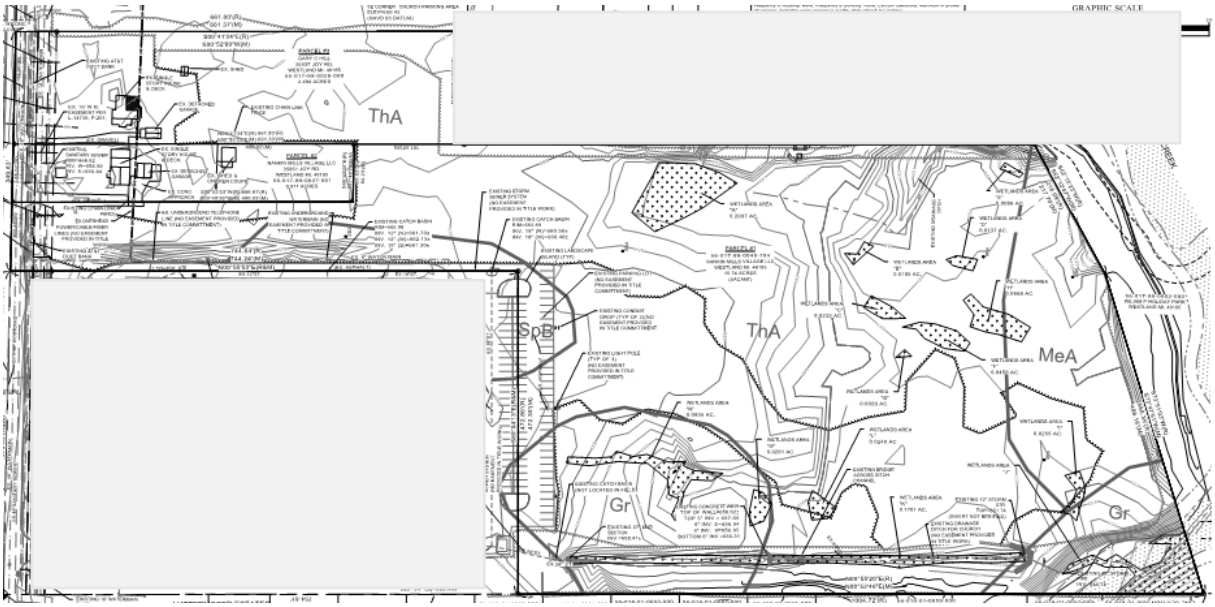


Figure 11-1: Example 1 Residential Development Site

Calculate Runoff Coefficient

$$C = \sum \frac{(A_i * C_i)}{A}$$

$$C = \frac{(7.62*0.95)+(9.02*0.25)}{16.67} = 0.57$$

Calculate 100-year Peak Intensity

$$I_{100} = \frac{101}{(12.33 + T)^{0.84}}$$

T = 20 minutes (see calculations, this page)

$$\boldsymbol{I_{100} = \frac{101}{(12.33 + 20)^{0.84}} = 5.4\ in/hr}$$

Calculate Channel Protection Volume Control (CPVC) Required Volume

$$\boldsymbol{V_{CPVC} = A * C * 3{,}630}\ \textit{[cubic feet]}$$
$$\boldsymbol{V_{CPVC} = 16.67 * 0.57 * 3{,}630 = 34{,}492\ cubic\ feet}$$

TIME OF CONCENTRATION CALCULATIONS

Sheet Flow:
V = K * $S^{0.5}$ (K=0.48 for sheet flow), slope = 1.0%
V = 0.48 * $1.0^{0.5}$
V = 0.48 feet per second
Flow time = L / (V*60) (L = flow length = 125 feet)
Flow time = 25 / (0.48 * 60) = ***4.3 min***

Shallow Flow: (Waterway, a/k/a shallow concentrated flow along roadway or swale, upstream of sewer system)
V = K * $S^{0.5}$ (K=1.2 for waterway flow), slope = 1.3%
V = 1.2 * $1.3^{0.5}$
V = 1.37 feet per second
Flow time = L / (V*60) (L = flow length = 600 feet)
Flow time = 600 / (1.37 * 60) = ***7.3 min***

Sewer Flow:
V = 3.0 feet per second (average velocity from sewer flow calculations), sewer length = 1,500 feet
Flow time = L / (V*60) (L = flow length = 1,500 feet)
Flow time = 1500 / (3.0 * 60) = ***8.3 min***

Time of Concentration = 4.3 min + 7.3 min + 8.3 min = 20 min

Calculate Channel Protection Rate Control (CPRC) Required Volume (a/k/a Extended Detention)

$$\boldsymbol{V_{CPRC} = A * C * 6{,}897}\ \textit{[cubic feet]}$$

$$V_{CPRC} = 16.67 * 0.57 * 6,897 = 65,535\ cubic\ feet$$

Calculate 100-year Detention Volume

100-yr Allowable Release Rate (Q_{allow}): $Q_{allow} = 1.1055 - 0.207 \ln(A)$ *[cfs/acre] (maximum = 1.0 cfs/acre)*
100-yr Allowable Release Rate (Q_{allow}): $Q_{allow} = 1.1055 - 0.207 \ln(16.67) = 0.52\ cfs/acre$

100-yr Peak Allowable Discharge (Q_o): $Q_O = Q_{allow} * A$ *[cfs]*
100-yr Peak Allowable Discharge (Q_o): $Q_O = 0.52 * 16.67 = 8.67\ cubic\ feet\ per\ second$

100-yr Peak Pond Inflow (Q_i): $Q_i = C * I_{100} * A$ *[cfs]*
100-yr Peak Pond Inflow (Q_i): $Q_i = 0.57 * 5.4 * 16.67 = 51.3\ cubic\ feet\ per\ second$

100-yr Runoff Volume (V_r): $V_r = 18,900 * C * A$ *[cubic feet]*
100-yr Runoff Volume (V_r): $V_r = 18,900 * 0.57 * 16.67 = 179,586\ cubic\ feet$

Storage Ratio (V_r/V_s): $\frac{V_s}{V_r} = 0.206 - 0.15 \ln(\frac{Q_o}{Q_i})$
Storage Ratio (V_r/V_s): $\frac{V_s}{V_r} = 0.206 - 0.15 \ln\left(\frac{8.67}{51.3}\right) = 0.473$

100-yr Required Storage Volume (V_s): $V_s = V_r * Storage\ Ratio$
100-yr Required Storage Volume (V_s): $V_s = 179,586 * 0.473 = 84,944\ cubic\ feet$

The Site Plan must be designed to accommodate the following volumes:

- CPVC: 34,492 cubic feet
- CPRC: 65,535 cubic feet
- Flood Control: 84,944 cubic feet – 34,492 cubic feet = 50,452 cubic feet*

* If the volume control requirement is met, the CPVC volume can be subtracted from (credited against) the 100-year flood control volume.

Design Requirements	Volume (cf)
CPVC	34,492
CPRC	65,535
Flood Control	65,535*

* The minimum flood storage requirement on any site is the CPRC volume. In this case, the CPRC volume is higher than the resultant flood control volume, so the CPRC volume shall dictate the detention storage (flood control) volume.

Orifice Calculations

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{CPRC\ Volume}{172{,}800}}$ *[cfs, average discharge rate over a 48-hour period]*

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{65{,}535}{172{,}800} = 0.38\ cubic\ feet\ per\ second}$

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{h_{ED}}{2}}$ *[h_{ED} = maximum head, ft, resulting from CPRC storage volume]*

Using the designer's pond stage/area table, the peak CPRC storage elevation is calculated at 3.5 feet

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{3.5}{2} = 1.75\ feet}$

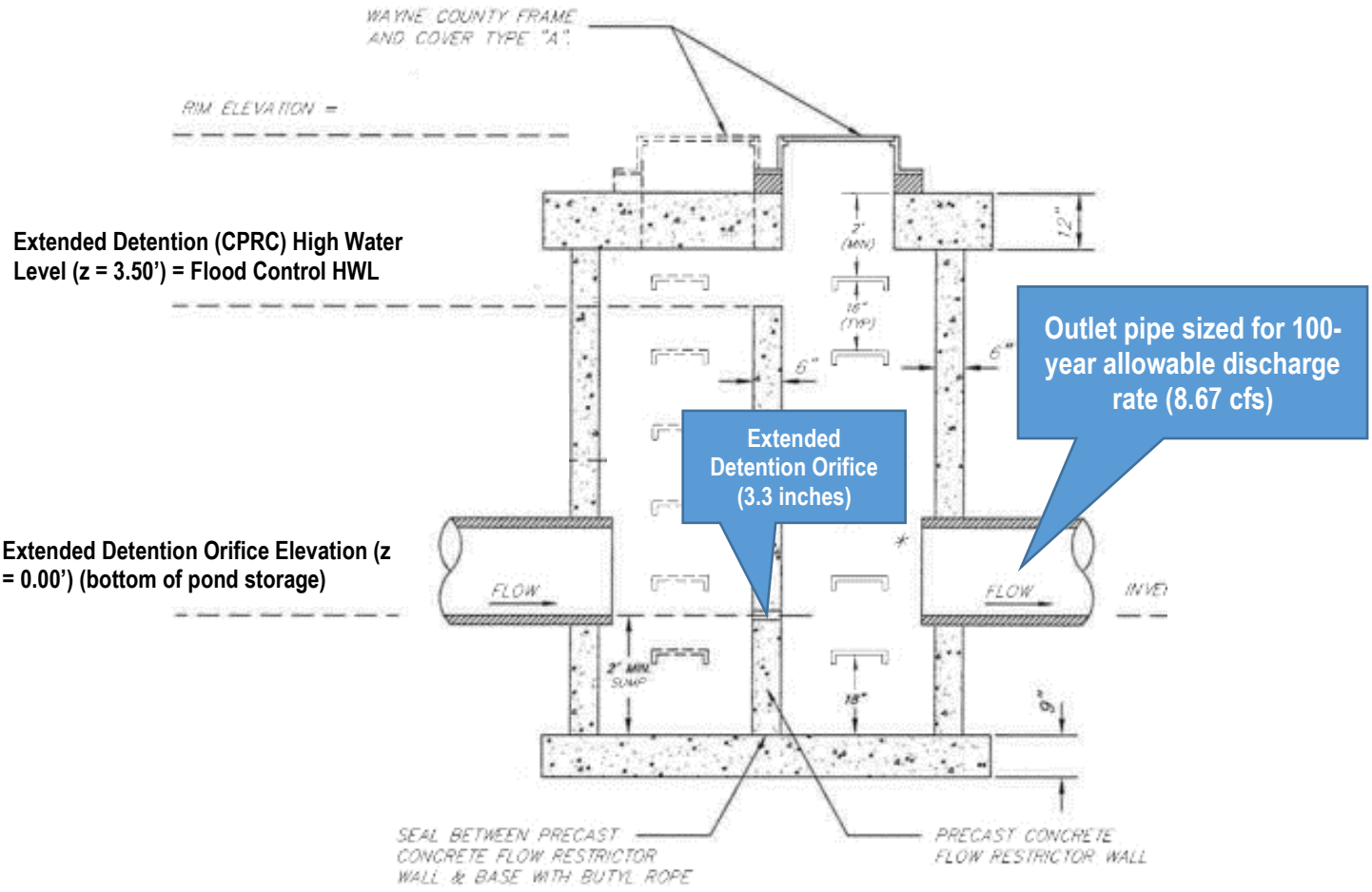
Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{Q_{ave}}{0.62\sqrt{2*g*h_{ave}}}}$ *[A = orifice area in square feet]*

Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{0.38}{0.62\sqrt{64.4*1.75}} = \frac{0.38}{6.58} = 0.058\ square\ feet}$

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{A}{\pi}}}$ *[d = orifice diameter in inches, assuming single orifice]*

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{0.058}{\pi}} = 3.3\ inches}$

Note: If the CPRC volume is at or above the flood control volume, a single control (CPRC) is only needed for the orifice. Volume above the 100-year allowable will be controlled by the outlet pipe (overflow weir). Additionally, for pipe sizing downstream of the detention pond, provide supporting calculations.



EXAMPLE 1 – Detention Pond Outlet Control Structure Detail

Infiltration BMP Calculations

The Channel Protection Volume Control (CPVC) volume will require infiltration BMPs, such as bioretention or pervious pavement. In this development, areas were identified for bioretention cells (See Figure 11-2). As infiltration BMPs are best designed as a ***decentralized*** system, it is necessary to locate the infiltration BMPs at various locations where surface runoff can be easily directed to them. This may include grassed roadway or parking lot medians, rear yard areas, and other common spaces. This residential example has numerous locations where infiltration BMPs are practical.

The volume provided in the infiltration BMPs includes the following components:

- **Surface storage volume (not applicable for pervious pavement):** storage volume above the ground surface; surface volume can be calculated using the bioretention contour areas. This volume can include up to 12 inches of ponded water surface (the maximum allowable ponding depth in a bioretention cell).
- **Subsurface storage volume:** Total volume within the subsurface bioretention soil mix and/or stone media. For all subsurface soils and stone, use an effective porosity of 0.30 to calculate this volume. The area covered is typically represented by the *bottom* contour of the bioretention cell.
- **Active infiltration volume (can only be used if no underdrain is proposed):** active infiltration can be added to the overall storage volume; active infiltration includes the total flow volume infiltrated into the native soils over a ***six-hour period***. This is

measured by multiplying the in-situ infiltration rate by the total footprint of the BMP (for pervious pavement, the footprint equals the area of pervious pavement; for bioretention, the footprint equals the bottom contour of the bioretention cell) and applying that flow rate over a six-hour period.

For this site example, the measured infiltration rate is 0.40 inches/hour; therefore, an underdrain will be used in the design. As such, only the surface and subsurface volumes can be counted. ***The required CPVC volume for this site is 34,492 cubic feet***.

Eleven (11) individual bioretention areas were identified, each with varying sizes and configurations. The surface volume and subsurface volumes must be calculated for each cell; the table below demonstrates that the total design volume meets the CPVC requirement listed above.

- Each bioretention cell is designed with the maximum 12-inch ponding depth.
- Surface volumes for each cell were calculated by taking the average contour area between the bottom and top contour, multiplying that average by one (1) foot, the maximum ponding depth achieved prior to overflow.
- Subsurface volumes for each cell were calculated by taking the bottom contour elevation, applying a 36-inch (3-foot) depth for the engineered bioretention soil and stone, and multiplying the total soil/stone volume by 0.30 (effective porosity).

The bioretention cells meet the water quality (TSS) requirement, as they are sized for a 1-inch storm, so no additional water quality treatment is required for this site.

Bioretention Sizing Summary Table
(see illustration of bioretention cells in Figure 11-2)

Bioretention Cell ID	Bottom Contour Area	Top Contour Area	Surface Storage	Subsurface Storage
1	1,600	1,920	1,760	1,440
2	1,600	1,920	1,760	1,440
3	1,400	1,680	1,540	1,260
4	1,400	1,680	1,540	1,260
5	850	1,020	935	765
6	1,000	1,200	1,100	900
7	850	1,020	935	765
8	1,750	2,100	1,925	1,575
9	2,350	2,820	2,585	2,115
10	1,600	1,920	1,760	1,440
11	2,850	3,420	3,135	2,565
Total Volume Provided		**34,500 cubic feet =**	**18,975 cubic feet**	**+ 15,525 cubic feet**

The total volume provided in the 11 bioretention cells, 34,500 cubic feet, exceeds the minimum required volume of 34,492 cubic feet (CPVC volume). Therefore, the infiltration requirement has been met.

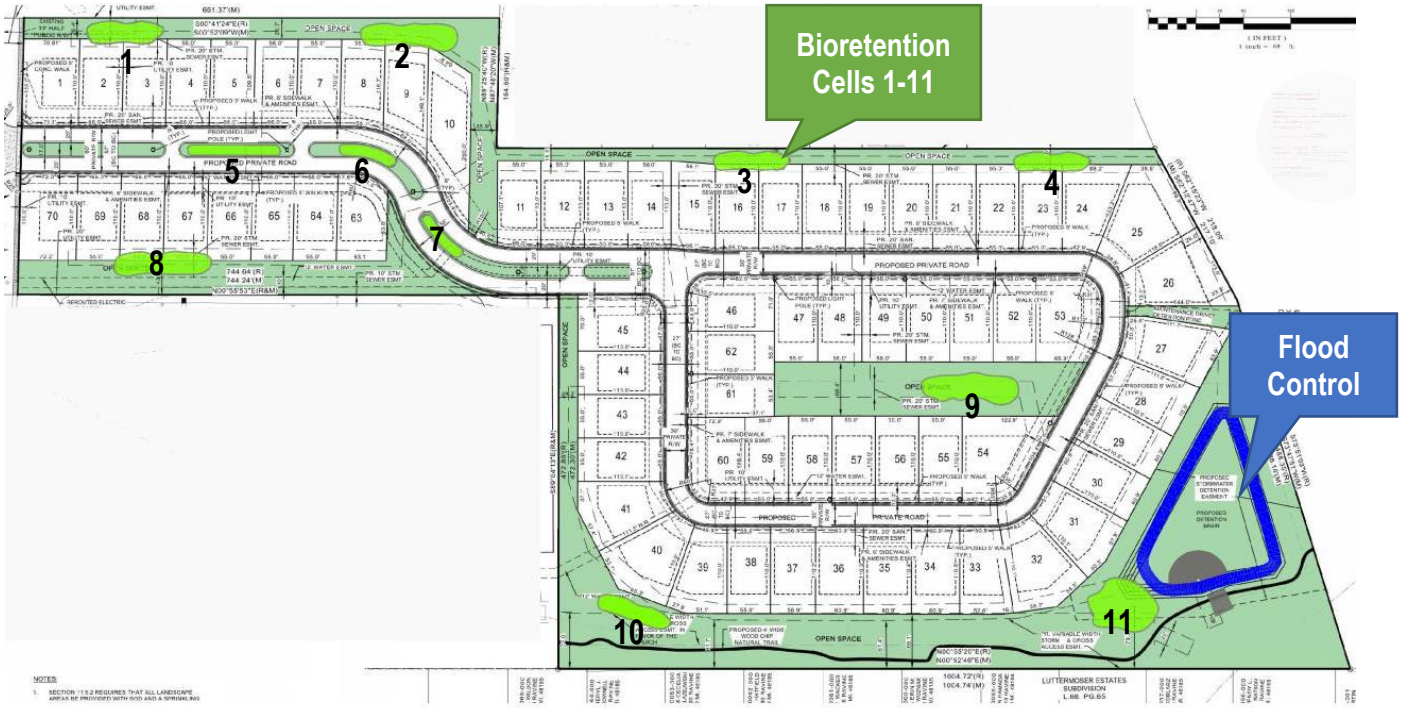


Figure 11-2: Residential Development Stormwater Management illustrated in orange and blue

Example 2

This site plan is a redevelopment of an existing commercial site. The parcel is roughly one (1) acre with disturbance of the entire site. Infiltration tests were conducted on the site, which yielded an observed infiltration rate of 1.20 inches/hour; therefore, it was determined that infiltration is feasible, which will require volume control (CPVC). Furthermore, an underdrain is not necessary for the infiltration measures as the infiltration rate is above 0.50 inch/hour.

Area, A (ac)	0.96
Proposed Impervious Area (ac)	0.64
Proposed Pervious Area (ac)	0.32
Runoff Coefficient, C	0.68
Intensity, in/hr	6

Land Use Summary

must be included on the COVER SHEET for all site plans

Pervious Area Land Use Data

Characteristic	Existing Conditions	Proposed Conditions
Total Development Area (ac)	0.96	0.96
Impervious Area (ac)	0.7	0.64
Total Pervious Area (ac)	0.26	0.32
Pervious Area Breakdown by Cover Type		
Meadow/fallow/natural areas (non-cultivated)	0 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	N/A
Improved areas (turf grass, landscape, row crops)	0.26 acres	0.32 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type B	Type B
Wooded Areas	0 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	N/A
Calculated CPVC Volume (cubic feet)		2,514
CPVC Volume ***Provided*** (cubic feet)		2,514
CPRC Volume Provided (cubic feet)		4,777

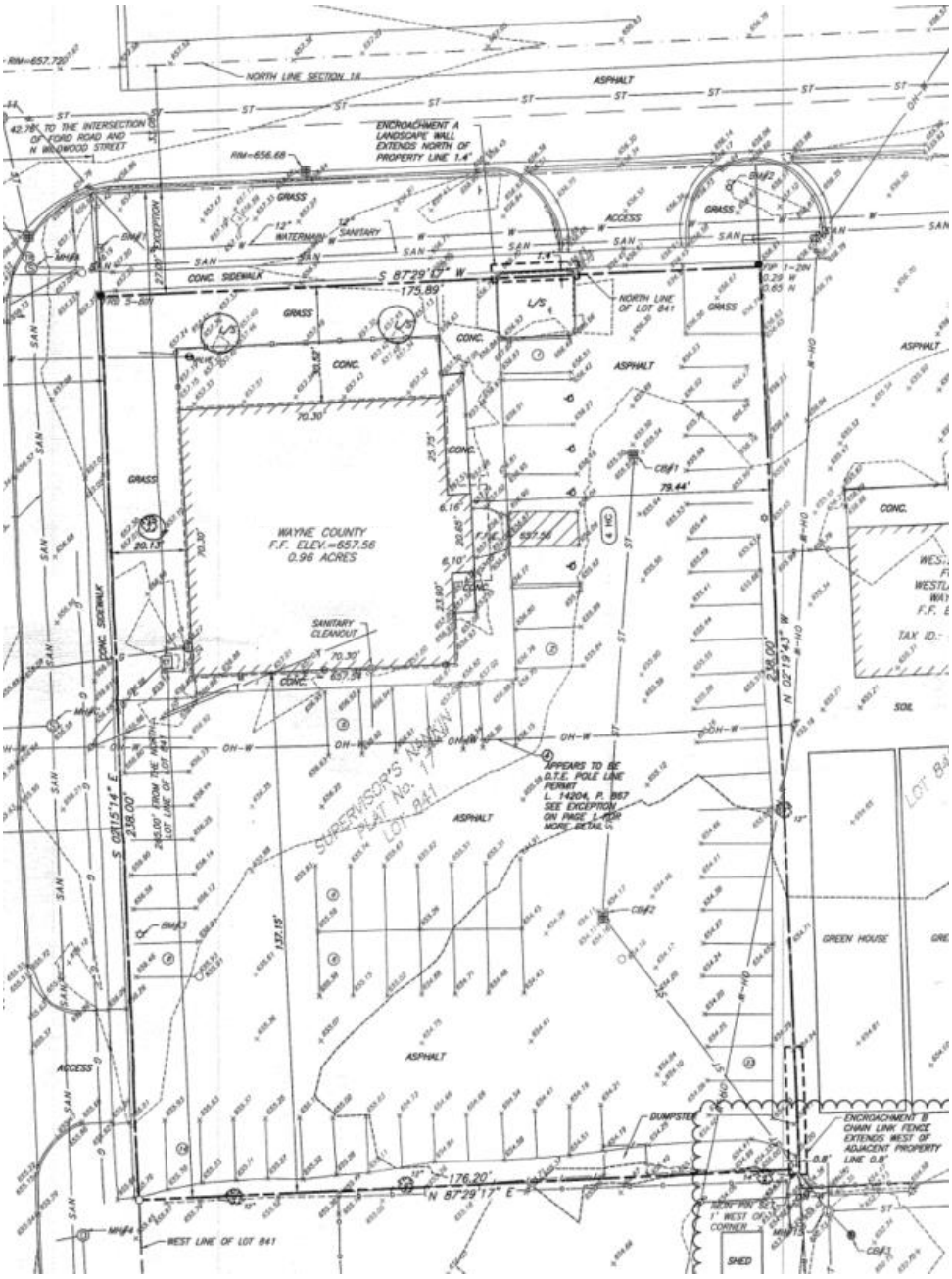


Figure 11-3: Example 2 Commercial Redevelopment Site

Runoff Coefficient

$$C = \sum \frac{(A_i * C_i)}{A}$$

$$C = \frac{(0.32*0.25)+(0.64*0.95)}{0.96} = 0.72$$

Intensity

$$I_{100} = \frac{101}{(12.33 + \mathrm{T})^{0.84}}$$

T = 10 minutes (site is less than 2 acres; use a default time of concentration of 10 minutes)

$$\boldsymbol{I_{100} = \frac{101}{(12.33 + 10)^{0.84}} = 7.4\ in/hr}$$

Calculate Channel Protection Volume Control (CPVC) Required Volume

$\boldsymbol{V_{CPVC} = A * C * 3{,}630}$ *[cubic feet]*
$\boldsymbol{V_{CPVC} = 0.962 * 0.72 * 3{,}630 = 2{,}514\ cubic\ feet}$

Calculate Channel Protection Rate Control (CPRC) Required Volume (a/k/a Extended Detention)

$\boldsymbol{V_{CPRC} = A * C * 6{,}897}$ *[cubic feet]*
$\boldsymbol{V_{CPRC} = 0.962 * 0.72 * 6{,}897 = 4{,}777\ cubic\ feet}$

Calculate 100-year Detention Volume

100-yr Allowable Release Rate (Q_{allow}): $\boldsymbol{Q_{allow} = 1.1055 - 0.207 \ln(A)}$ *[cfs/acre] (maximum = 1.0 cfs/acre)*
100-yr Allowable Release Rate (Q_{allow}): $\boldsymbol{Q_{allow} = 1.1055 - 0.207 \ln(0.962) = 1.11\ cfs/acre}$

However, a site that is less than 2 acres must use a variable release rate of **1 cfs/ac.**

100-yr Peak Allowable Discharge (Q_o): $\boldsymbol{Q_O = Q_{allow} * A}$ *[cfs]*
100-yr Peak Allowable Discharge (Q_o): $\boldsymbol{Q_O = 1 * 0.962 = 0.962\ cubic\ feet\ per\ second}$

100-yr Peak Pond Inflow (Q_i): $\boldsymbol{Q_i = C * I_{100} * A}$ *[cfs]*
100-yr Peak Pond Inflow (Q_i): $\boldsymbol{Q_i = 0.72 * 7.4 * 0.962 = 5.13\ cubic\ feet\ per\ second}$

100-yr Runoff Volume (V_r): $\boldsymbol{V_r = 18{,}900 * C * A}$ *[cubic feet]*
100-yr Runoff Volume (V_r): $\boldsymbol{V_r = 18{,}900 * 0.72 * 0.962 = 13{,}091\ cubic\ feet}$

Storage Ratio (V_r/V_s): $\boldsymbol{\frac{V_s}{V_r} = 0.206 - 0.15 \ln(\frac{Q_o}{Q_i})}$
Storage Ratio (V_r/V_s): $\boldsymbol{\frac{V_s}{V_r} = 0.206 - 0.15 \ln\left(\frac{0.962}{5.13}\right) = 0.457}$

100-yr Required Storage Volume (V_s): $\boldsymbol{V_s = V_r * Storage\ Ratio}$
100-yr Required Storage Volume (V_s): $\boldsymbol{V_s = 13{,}091 * 0.457 = 5{,}982\ cubic\ feet}$

The Site Plan must be designed to accommodate the following volumes:

- CPVC: 2,514 cubic feet
- CPRC: 4,777 cubic feet
- Flood Control: 5,982 cubic feet – 2,514 cubic feet = 3,468 cubic feet*

* If the volume control requirement is met, the CPVC volume can be subtracted from (credited against) the 100-year flood control volume.

Design Requirements	Volume (cf)
CPVC	2,514
CPRC	4,777
Flood Control	4,777*

*The minimum flood storage requirement on any site is the CPRC volume. In this case, the CPRC volume is higher than the resultant flood control volume, so the CPRC volume shall dictate the detention storage (flood control) volume.

Orifice Calculations

Orifice Channel Protection Rate Control (CPRC) Orifice

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{CPRC\ Volume}{172{,}800}}$ *[cfs, average discharge rate over a 48-hour period]*

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{4{,}777}{172{,}800} = 0.028\ cubic\ feet\ per\ second}$

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{h_{ED}}{2}}$ [h_{ED} = *maximum head, ft, resulting from CPRC storage volume]*

Using the designer's detention system stage/area table, the peak CPRC storage elevation is calculated at 5 feet (proposed detention system consists of a network of 60-inch diameter storage pipes)

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{5.0}{2} = 2.5\ feet}$

Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{Q_{ave}}{0.62\sqrt{2*g*h_{ave}}}}$ *[A = orifice area in square feet]*

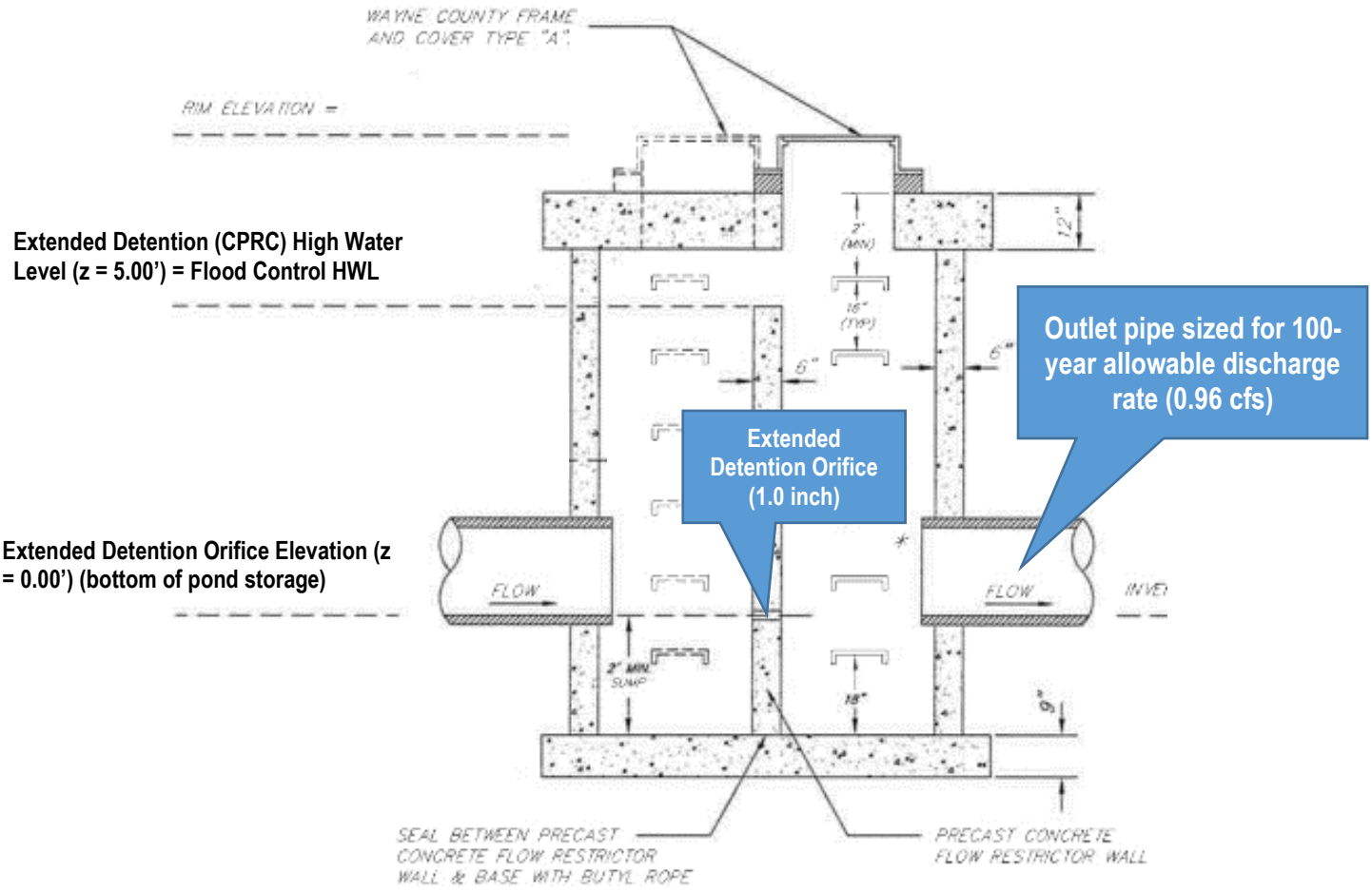
Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{0.028}{0.62\sqrt{64.4*2.5}} = \frac{0.028}{7.87} = 0.0036\ square\ feet}$

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{A}{\pi}}}$ *[d = orifice diameter in inches, assuming single orifice]*

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{0.0036}{\pi}} = 0.81\ inches}$

The calculated orifice size, 0.81 inches, is less than the minimum orifice size of 1 inch. Set the orifice size at 1 inch; this automatically meets the Extended Detention requirement.

Note: If CPRC is at or above the flood control volume, a single control (CPRC) is only needed for the orifice. Volume above the 100-year allowable will be controlled by the outlet pipe (overflow weir). Additionally, for pipe sizing downstream of the detention pond, provide supporting calculations.



EXAMPLE 2 – Detention Pond Outlet Control Structure Detail

Infiltration BMP Calculations

For this site example, the measured infiltration rate is 1.20 inches/hour; therefore, an underdrain is not necessary; the bioretention cells will outlet to the underlying soils. As such, the active infiltration volume can be added to the surface and subsurface volumes. ***The required CPVC volume for this site is 2,514 cubic feet***.

Three individual bioretention areas were identified. The surface volume, subsurface volume, and active infiltration volumes must be calculated for each cell, and the total design volume meets the CPVC requirement listed above.

- Each bioretention cell is designed with the maximum 12-inch ponding depth
- Surface volumes for each cell were calculated by taking the average contour area between the bottom and top contour, multiplying that average by one (1) foot, the maximum ponding depth achieved prior to overflow.
- Subsurface volumes for each cell were calculated by taking the bottom contour elevation, applying a 36-inch (3-foot) depth for the engineered bioretention soil and stone, and multiplying the total soil/stone volume by 0.30 (effective porosity)
- Active infiltration was calculated by multiplying the bottom contour area by 1.2 inches/hour (converting it to 0.1 feet/hour); this provides a flow rate in cubic feet per hour; multiply this value by six (6) to get the active infiltration volume over a six-hour period. For example, bioretention cell #1 has a bottom contour area of 700 square feet:
    - 700 square feet * 0.1 feet/hour = 70 cubic feet per hour

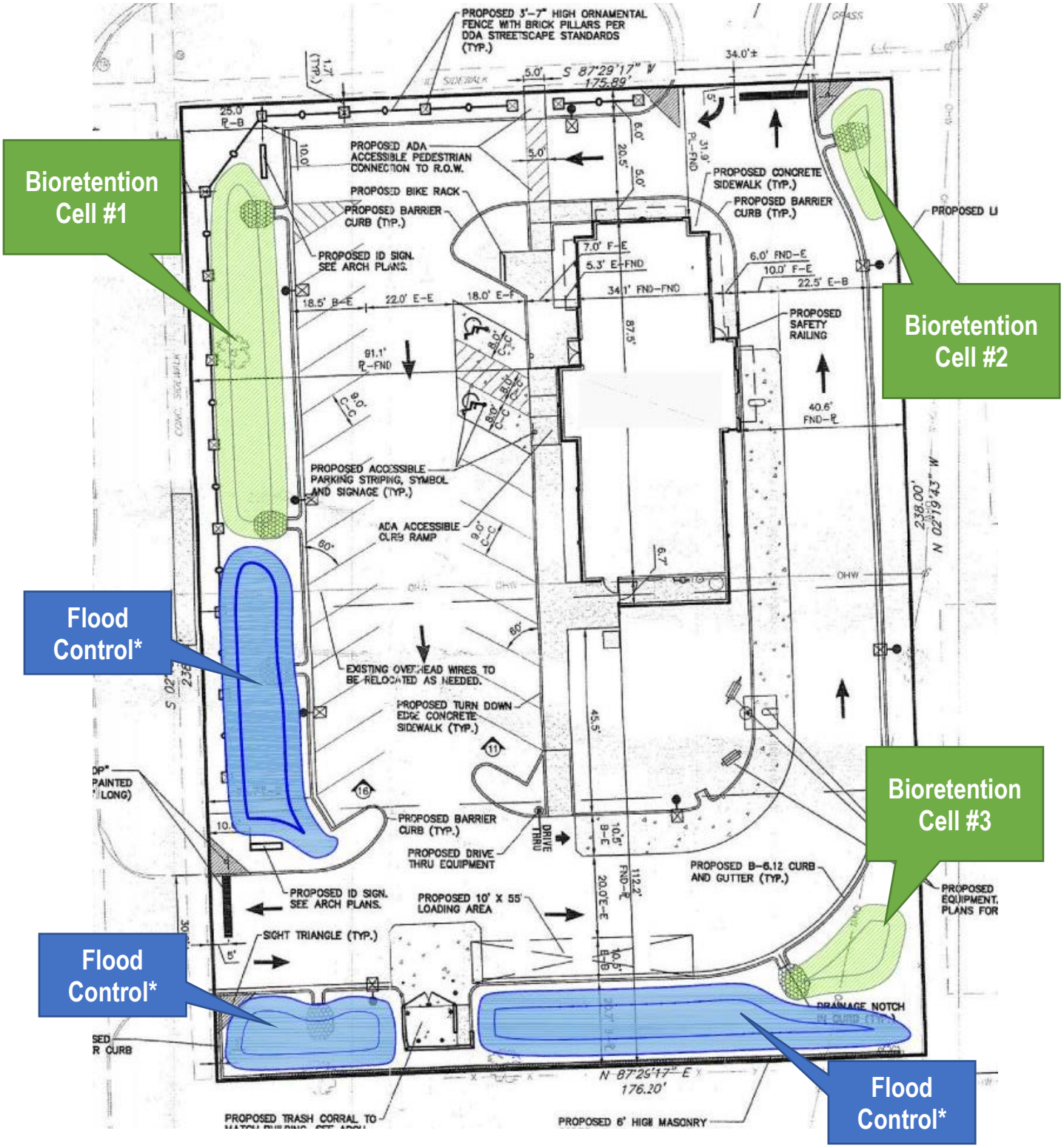
- 70 cubic feet per hour * 6 hours = 420 cubic feet

The bioretention cells meet the water quality (TSS) requirement, as they are sized for a 1-inch storm, so no additional water quality treatment is required for this site.

Bioretention Sizing Summary Table
(see illustration of bioretention cells in Figure 11-4)

Bioretention Cell ID	Bottom Contour Area	Top Contour Area	Surface Storage Volume	Subsurface Storage Volume	Active Infiltration Volume
1	700 square feet	840 square feet	770 cubic feet	630 cubic feet	420 cubic feet
2	120	144	132	108	72
3	150	180	165	149	90
Total Volume Provided	**2,536 cubic feet =**		**1,067 cubic feet + 887 cubic feet + 582 cubic feet**		

The total volume provided in the three bioretention cells, 2,536 cubic feet, exceeds the minimum required volume of 2,514 cubic feet (CPVC volume). Therefore, the infiltration requirement has been met.



** Flood control as illustrated in this scenario consists of shallow basins; to avoid the required buffer around detention ponds, these flood control zones would need to be constructed as bioretention cells with overflow structures. Alternatively, the flood control storage could be constructed underground.*

Figure 11-4: Example 2 Commercial Development Site-Stormwater Management

Example 3

This is a new development site that **CANNOT** infiltrate the first inch of rainfall, due to low infiltration capacity (0.05 in/hr, confirmed in a geotechnical report) and high observed groundwater. For this site, water quality requirements will be met by using a mechanical separator at the upstream end of the stormwater detention system.

Area, A (ac)	0.86
Proposed Impervious Area (ac)	0.53
Proposed Pervious Area (ac)	0.33
Runoff Coefficient, C	0.68
Intensity, in/hr	6

Land Use Summary

must be included on the COVER SHEET for all site plans

Pervious Area Land Use Data

Characteristic	Existing Conditions	Proposed Conditions
Total Development Area (ac)	0.86	0.86
Impervious Area (ac)	0	0.53
Total Pervious Area (ac)	0.86	0.33
Pervious Area Breakdown by Cover Type		
Meadow/fallow/natural areas (non-cultivated)	0 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	N/A
Improved areas (turf grass, landscape, row crops)	0.86 acres	0.33 acres
Predominant NRCS Soil Type (A, B, C, or D)	Type D	Type D
Wooded Areas	0 acres	0 acres
Predominant NRCS Soil Type (A, B, C, or D)	N/A	N/A
Calculated CPVC Volume (cubic feet)		2,123
CPVC Volume ***Provided*** (cubic feet)		0
CPRC Volume Provided (cubic feet)		4,033

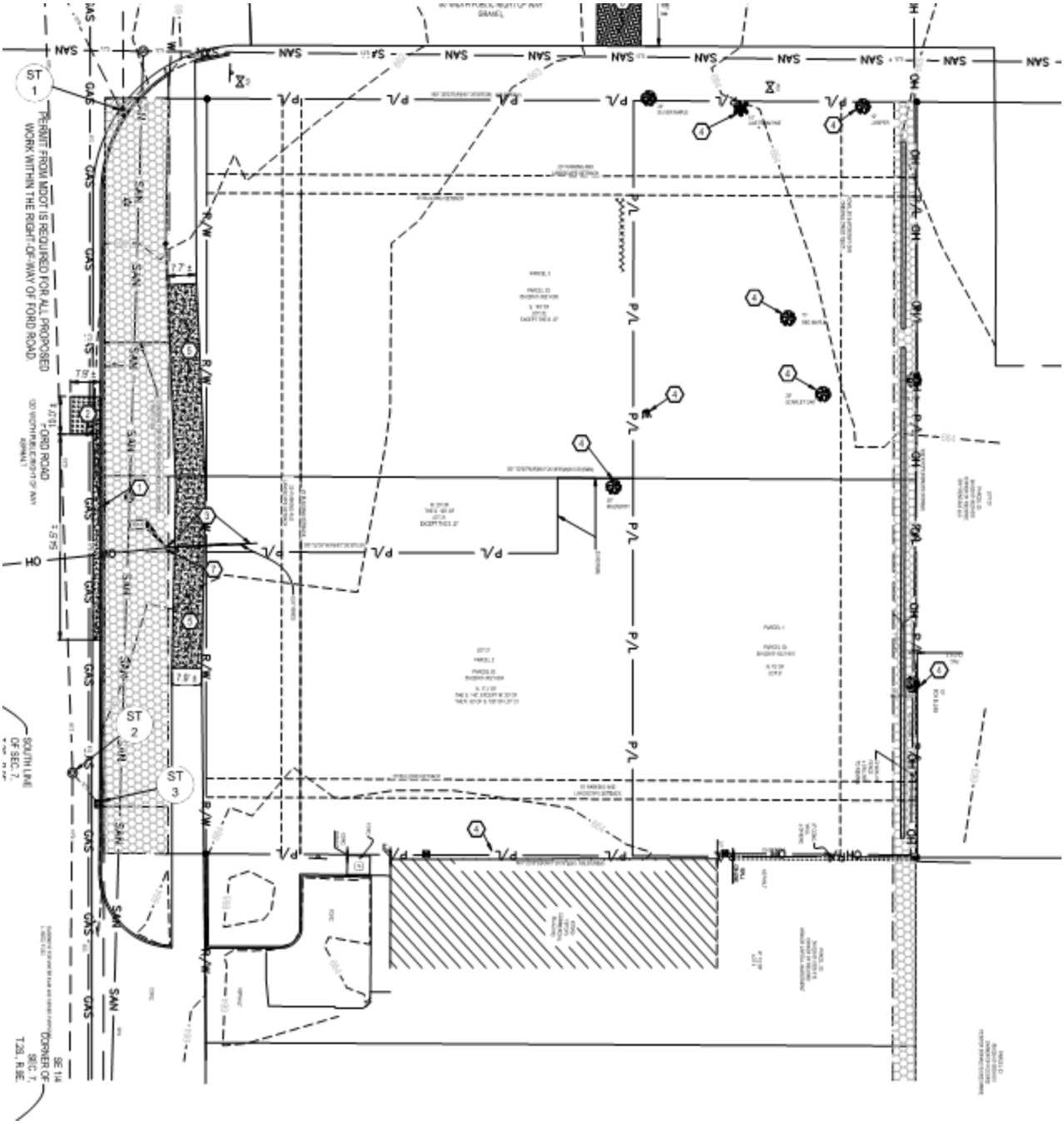


Figure 11-5: Example 3 Undeveloped Commercial Site

Runoff Coefficient

$$C = \sum \frac{(A_i * C_i)}{A}$$

$$C = \frac{(0.33*0.25)+(0.53*0.95)}{0.86} = 0.68$$

Intensity

$$I_{100} = \frac{101}{(12.33 + \mathrm{T})^{0.84}}$$

T = 10 minutes (site is less than 2 acres; use a default time of concentration of 10 minutes)

$$\boldsymbol{I_{100} = \frac{101}{(12.33 + 10)^{0.84}} = 7.4\ in/hr}$$

Calculate Channel Protection Volume Control (CPVC) Required Volume

$\boldsymbol{V_{CPVC} = A * C * 3,630}$ *[cubic feet]*
$\boldsymbol{V_{CPVC} = 0.86 * 0.68 * 3,630 = 2,123\ cubic\ feet}$ (CPVC waived for this site due to poor soils)

Calculate Channel Protection Rate Control (CPRC) Required Volume (a/k/a Extended Detention)

$\boldsymbol{V_{CPRC} = A * C * 6,897}$ *[cubic feet]*
$\boldsymbol{V_{CPRC} = 0.86 * 0.68 * 6,897 = 4,033\ cubic\ feet}$

Calculate 100-year Detention Volume

100-yr Allowable Release Rate (Q_{allow}): $\boldsymbol{Q_{allow} = 1.1055 - 0.207 \ln(A)}$ *[cfs/acre] (maximum = 1.0 cfs/acre)*
100-yr Allowable Release Rate (Q_{allow}): $\boldsymbol{Q_{allow} = 1.1055 - 0.207 \ln(0.86) = 1.14\ cfs/acre}$

However, a site that is less than 2 acres must use a variable release rate of **1 cfs/ac.**

100-yr Peak Allowable Discharge (Q_o): $\boldsymbol{Q_O = Q_{allow} * A}$ *[cfs]*
100-yr Peak Allowable Discharge (Q_o): $\boldsymbol{Q_O = 1 * 0.86 = 0.86\ cubic\ feet\ per\ second}$

100-yr Peak Pond Inflow (Q_i): $\boldsymbol{Q_i = C * I_{100} * A}$ *[cfs]*
100-yr Peak Pond Inflow (Q_i): $\boldsymbol{Q_i = 0.68 * 7.4 * 0.86 = 4.33\ cubic\ feet\ per\ second}$

100-yr Runoff Volume (V_r): $\boldsymbol{V_r = 18,900 * C * A}$ *[cubic feet]*
100-yr Runoff Volume (V_r): $\boldsymbol{V_r = 18,900 * 0.68 * 0.86 = 11,053\ cubic\ feet}$

Storage Ratio (V_r/V_s): $\boldsymbol{\frac{V_s}{V_r} = 0.206 - 0.15 \ln(\frac{Q_o}{Q_i})}$
Storage Ratio (V_r/V_s): $\boldsymbol{\frac{V_s}{V_r} = 0.206 - 0.15 \ln\left(\frac{0.86}{4.33}\right) = 0.448}$

100-yr Required Storage Volume (V_s): $\boldsymbol{V_s = V_r * Storage\ Ratio}$
100-yr Required Storage Volume (V_s): $\boldsymbol{V_s = 11,053 * 0.448 = 4,952\ cubic\ feet}$

The Site Plan must be designed to accommodate the following volumes:

- CPVC: 2,123 cubic feet
- CPRC: 4,033 cubic feet
- Flood Control: 4,952 cubic feet

The Site Plan must be designed for the following volumes:

Design Requirements	Volume (cf)
CPVC	2,123
CPRC	4,033
Flood Control	4,952

Orifice Calculations

Orifice Channel Protection Rate Control (CPRC) Orifice

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{CPRC\ Volume}{172{,}800}}$ *[cfs, average discharge rate over a 48-hour period]*

Average Discharge Rate (Q_{ave}): $\boldsymbol{Q_{ave} = \frac{4{,}033}{172{,}800} = 0.023\ cubic\ feet\ per\ second}$

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{h_{ED}}{2}}$ *[h_{ED} = maximum head, ft, resulting from CPRC storage volume]*

Using the designer's detention system stage/area table, the peak CPRC storage elevation is calculated at 3.5 feet (proposed detention system consists of a network of 54-inch diameter storage pipes)

Average Head (h_{ave}): $\boldsymbol{h_{ave} = \frac{3.5}{2} = 1.75\ feet}$

Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{Q_{ave}}{0.62\sqrt{2*g*h_{ave}}}}$ *[A = orifice area in square feet]*

Extended Detention Orifice Area (a): $\boldsymbol{A = \frac{0.023}{0.62\sqrt{64.4*1.75}} = \frac{0.023}{6.58} = 0.0035\ square\ feet}$

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{A}{\pi}}}$ *[d = orifice diameter in inches, assuming single orifice]*

Extended Detention Orifice Diameter (d): $\boldsymbol{d = 12 * \sqrt{4 * \frac{0.0035}{\pi}} = 0.80\ inches}$

The calculated orifice size, 0.80 inches, is less than the minimum orifice size of 1 inch. Set the orifice size at 1 inch; this automatically meets the Extended Detention requirement.

Flood Control Orifice

100-year Head: $\boldsymbol{h_{res} = h_{max} - h_{ED}}$

[h_{res} = *residual head, ft, from 100-yr peak storage to Extended Detention (CPRC) peak storage]*

The 100-year orifice(s) is(are) located at the CPRC peak storage elevation

Using the designer's detention system stage/area table, the peak flood control storage elevation is calculated at 4.5 feet (proposed detention system consists of a network of 54-inch diameter storage pipes)

100-yr Head: $\boldsymbol{h_{res} = 4.5 - 3.5 = 1.0}$ *[feet, over 100-year orifice(s)]*

100-yr flow through Ext. Det. Orifice: $\boldsymbol{Q_{ED} = a_{ED} * 0.62\sqrt{2 * g * h_{100}} = 0.0055 *\ 0.62\sqrt{64.4 * 4.5}}$

100-yr flow through Ext. Det. Orifice: $Q_{ED} = 0.058$ *[cubic feet per second]*

Remaining flow for 100-yr Orifice: $Q_{res} = Q_o - Q_{ED}$ *[cubic feet per second]*

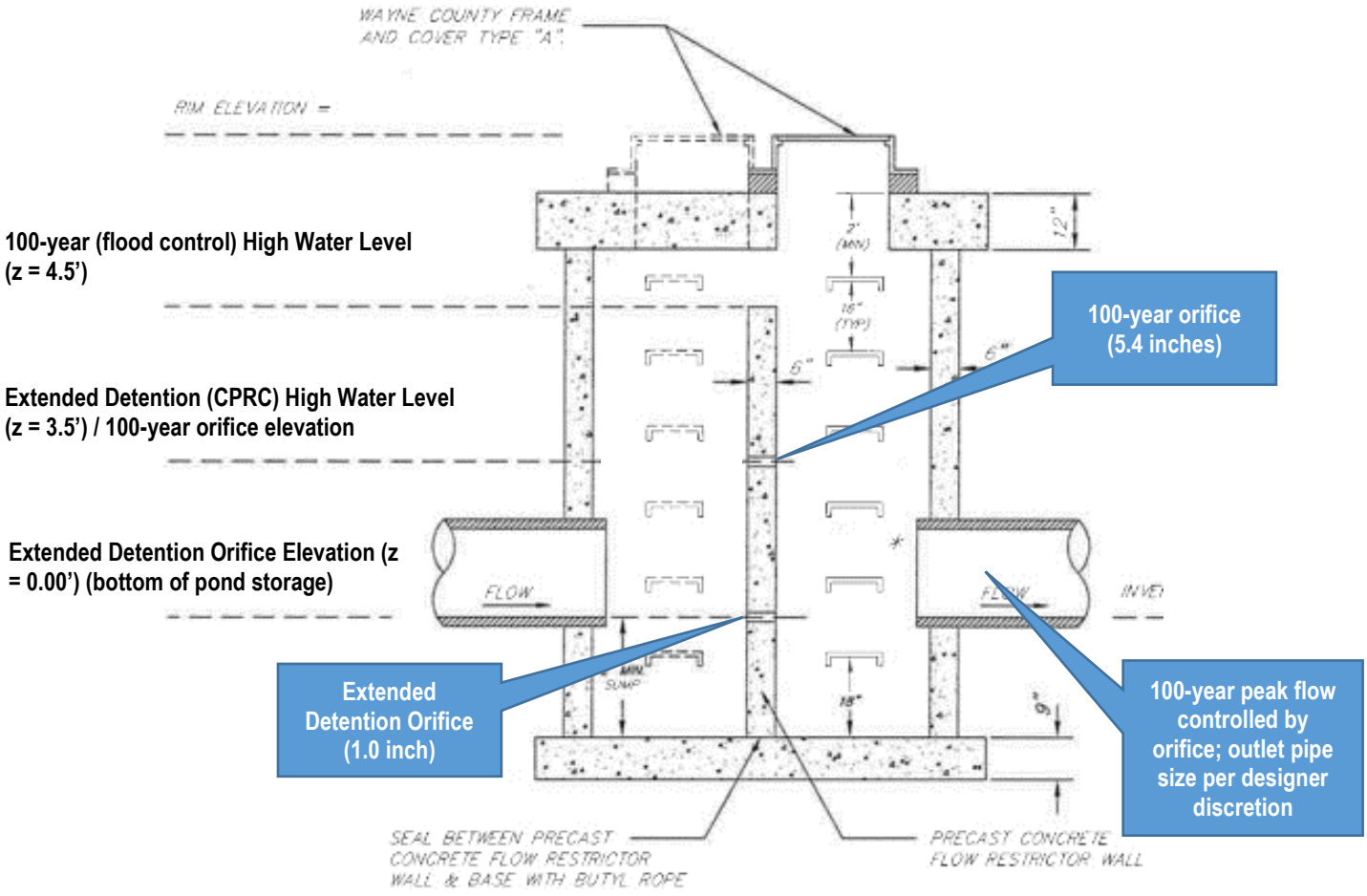
Remaining flow for 100-yr Orifice: $Q_{res} = 0.86 - 0.058 = 0.802$ *cubic feet per second*

Flood Control Orifice Area (a): $A = \frac{Q_{res}}{0.62\sqrt{2*g*h}}$ *[A = 100-yr orifice area in square feet]*

Flood Control Orifice Area (a): $A = \frac{0.802}{0.62\sqrt{64.4*1.0}} = 0.161$ *square feet*

Flood Control Orifice Diameter (d): $d = 12 * \sqrt{4 * \frac{A}{\pi}}$ *[d = 100-yr orifice diam. (inches), assuming single orifice]*

Flood Control Orifice Diameter (d): $d = 12 * \sqrt{4 * \frac{0.161}{\pi}} = 5.4$ *inches*



EXAMPLE 3 – Detention Pond Outlet Control Structure Detail

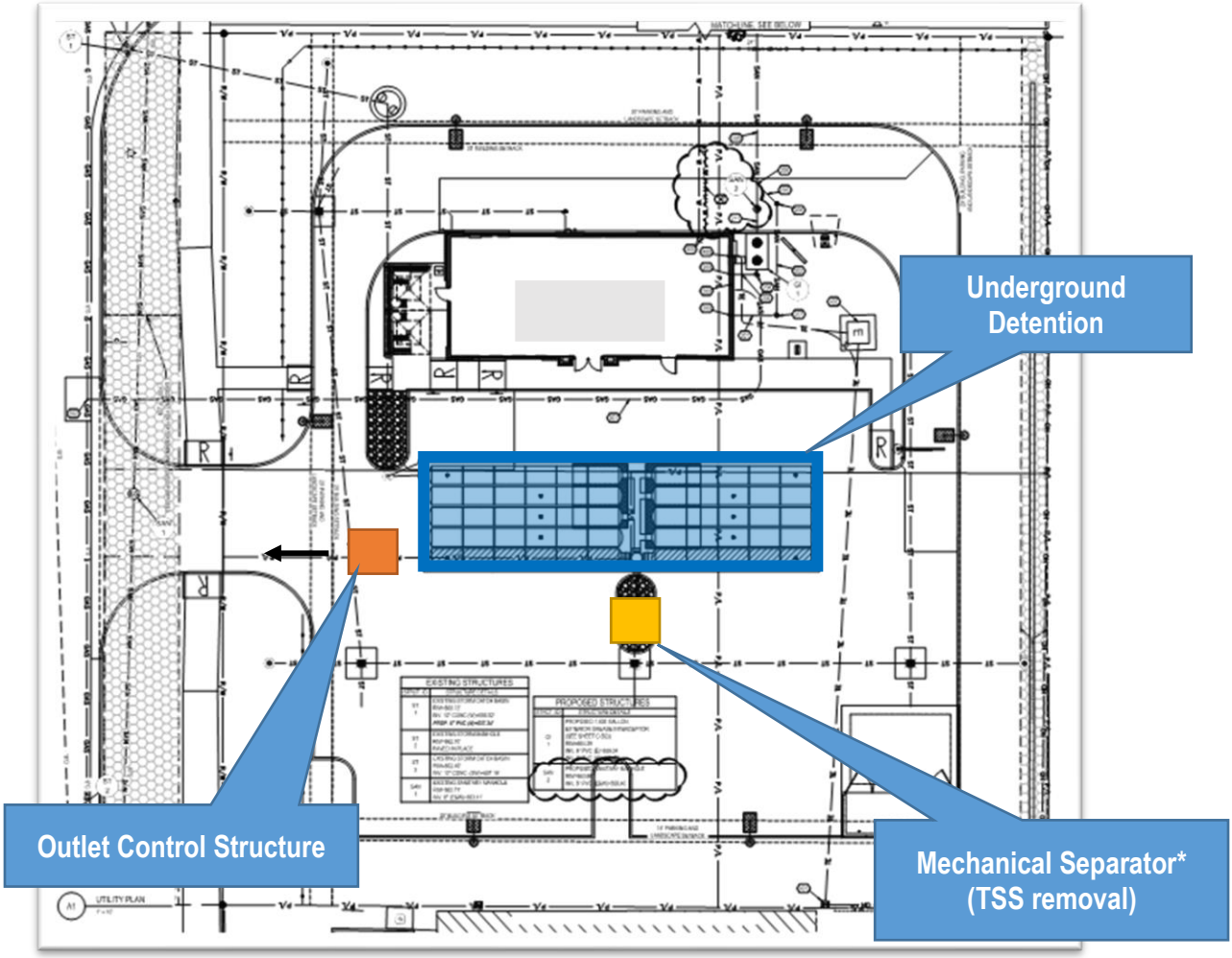


Figure 11-6: Example 3 Developed Commercial Site

* MECHANICAL SEPARATOR

- Mechanical separator must be located ***upstream*** of the detention storage area
- Include vendor certification for unit sizing and configuration
- Check to see that technology is certified by NJCAT or TAPE (see Section 8.2.4)
- Unit size based on calculated ***1-year*** peak flow rate (see Section 8.2.4)
  - Use peak flow intensity of 2.0 inches/hour
  - Q = C * I * A = 0.68 * 2 * 0.86 = 1.2 cfs

APPENDIX A

Engineer's Certification of Construction

Engineer's Certificate of Construction

Wayne County: Construction permit #:_____

Review Number: _____

Project Name: _____

Project Address/Location:_____

City/Township of:_____, Wayne County, Michigan.

I hereby certify that the construction and installation of the Storm Water Management System of the project known as _____is complete as of the date _____. All components of the storm water management system have been constructed and installed in accordance with the construction plans approved by the Wayne County Department of Public Services, Permit Office and comply with the Wayne County Storm Water Management Program.

Signed: _____

Licensed Professional Engineer (Michigan)

NOTE:
This certification must be stamped with the seal of a professional engineer licensed in the State of Michigan. The certificate submitted must be the original.

Please Return Certification to:

Department of Public Services - Permit Office
Attn: Division Permit Construction Manager
33809 Michigan Ave.
Wayne, Michigan 48184

Attachment A to
Engineer's Certificate of Construction

THIS ATTACHMENT MUST BE COMPLETED IF:

1. The storm water management system contains elements where vegetation is critical to the functioning of a storm water management component, including but not limited to: Open Detention Basins, Bioretention Areas, Vegetated Swales, Streambank Stabilization, and Vegetation/Riparian Corridor Management.

AND

2. Plantings incorporated into the system design are not included on plant lists in the Wayne County Storm Water Standards and were instead based on landscaping plans submitted by a Registered Landscape Architect (RLA).

Wayne County: Construction permit #:_____

Review Number: _____

Project Name: _____

Project Address/Location:_____

City/Township of:_____, Wayne County, Michigan.

I hereby certify that the plantings incorporated into the design of the Storm Water Management System for the project known as _____were completely and correctly installed as of the date _____. The plantings were installed in accordance with the construction plans for the landscaping elements approved by the Wayne County Department of Public Services, Permit Office and comply with the Wayne County Storm Water Management Program.

Signed: _____
Registered Landscape Architect (Michigan)

NOTE:
This certification must be stamped with the seal of a landscape architect licensed in the State of Michigan. The certificate submitted must be the original.

Please Return Certification to:

Department of Public Services - Permit Office
Attn: Division Permit Construction Manager
33809 Michigan Ave.
Wayne, Michigan 48184

APPENDIX B

Sample Long-Term Maintenance Permit
"M-Permit"

WAYNE COUNTY
DEPARTMENT OF PUBLIC SERVICES
COUNTY OF WAYNE, MICHIGAN
33809 Michigan Avenue
Wayne, Michigan 48184
(734) 595-6504

72 HOURS PRIOR TO ANY CONSTRUCTION, CALL **(734) 595-6504** FOR INSPECTION
72 HOURS BEFORE YOU DIG DIAL MISS DIG **1-800-482-7161**

PERMIT NO M********		
ISSUE DATE	EXPIRES
REVIEW NO.	WORK ORDER

LONG-TERM MAINTENANCE PERMIT TO CONSTRUCT, OPERATE, USE, AND/OR MAINTAIN

PROJECT NAME**********

LOCATION	CITY/TOWNSHIP**********
PERMIT HOLDER (PROPERTY OWNER) *[Legal Name of Property Owner]* *[Property Owner Address]* *[City/State/Zip Code]* CONTACT PHONE 24 HR PHONE *[Contact Address]* *[City/State/Zip Code]* *[Email Address]*	COMMUNITY/LOCAL UNIT OF GOVERNMENT *[Name of Community]* *[Name of Authorized Community Official]* *[Property Owner Address]* *[City/State/Zip Code]* CONTACT PHONE 24 HR PHONE *[Contact Address]* *[City/State/Zip Code]* *[Email Address]*

DESCRIPTION OF PERMITTED ACTIVITY

Permit to maintain the stormwater control system in accordance with the General Conditions, the drawing attached as Exhibit "A", the terms of the Long-Term Maintenance Plan attached as Exhibit "B", and the Wayne County Stormwater Control Ordinance ("Wayne County Ordinance") and Administrative Rules.

1. The Permit Holder shall be the owner of the property on which the stormwater control system is constructed and to which this M Permit applies.
2. Permit Holder shall ensure that the stormwater control systems function properly as designed and constructed. Permit Holder's responsibilities under this permit shall include, without limitations, (a) any and all monitoring and preventative maintenance activities set forth in the plan; (b) any and all remedial actions necessary to repair, modify or reconstruct the system and (c) any other activities or responsibilities for maintenance of the stormwater control system as may be set forth in the Wayne County Ordinance, Administrative Rules, the plan or this permit.
3. Permit Holder shall perform all monitoring, maintenance, remedial and other responsibilities required by the Wayne County Ordinance, Administrative Rules, the plan and this permit, in perpetuity and at its sole cost expense.
4. Permit Holder shall prepare, execute and (if necessary) record, at its sole cost and expense, any and all agreements, contracts and other documents that may be required to perform its obligations hereunder and ensure maintenance of stormwater control systems at the project in perpetuity.
5. Community, pursuant to Chapter 7 of the Wayne County Ordinance, hereby guarantees to assume jurisdiction over and accepts responsibility for the long-term maintenance of each stormwater control system should the property owner fail to perform.

If Wayne County finds it necessary to adjust or relocate all or any portion of the permitted stormwater control system, the Permit Holder shall cause this adjustment or relocation to be accomplished at no expense to the County. Prior to any work being performed in the right-of way, a permit shall be secured from the Wayne County Department of Public Services. See construction permit ********* for construction of *******

REQUIRED ATTACHMENTS:

EXHIBIT A: Map Depicting Physical Limits of Stormwater Control System
EXHIBIT B: Long-Term Maintenance Plan
EXHIBIT C: Community Resolution
PERMIT VALID ONLY IF ACCOMPANIED BY ABOVE ATTACHMENTS

[Remainder of Page Left Intentionally Blank; Signatures acknowledgments appear on the following pages]

IN CONSIDERATION OF THE PERMIT HOLDER AND CONTRACTOR AGREEING TO ABIDE BY AND CONFORM WITH ALL TERMS AND CONDITIONS HEREIN, A PERMIT IS HEREBY ISSUED TO THE ABOVE NAMED TO CONSTRUCT, OPERATE, USE AND/OR MAINTAIN WITHIN THE ROAD RIGHT-OF-WAY, COUNTY EASEMENT AND/OR, COUNTY PROPERTY. THE PERMITTED WORK DESCRIBED ABOVE SHALL BE ACCOMPLISHED IN ACCORDANCE WITH APPROVED PLANS, MAPS, SPECIFICATIONS, AND STATEMENTS FILED WITH THIS OFFICE WHICH ARE INTEGRAL TO AND MADE PART OF THIS PERMIT. FURTHERMORE, THE GENERAL CONDITIONS AS WELL AS ANY REQUIRED ATTACHMENTS ARE INCORPORATED AS PART OF THIS PERMIT.

PERMIT HOLDER (PROPERTY OWNER)

X_____ _____

SIGNATURE OF _____ DATE

TITLE:_____

WAYNE COUNTY DEPARTMENT OF PUBLIC SERVICES

_____

PREPARED BY

_____ - _____

VALIDATED BY/FOR WAYNE COUNTY HIGHWAY ENGINEER DATE

State of Michigan)
ss
County of _____)

The foregoing instrument was acknowledged before me in _____ County, Michigan, on _____ by _____, the _____ of _____ on behalf of the company.

Signature of Notary Public: _____
Print Name of Notary Public: _____
Notary Public, State of _____, County of _____
My commission expires: _____
Acting in the County of _____

[Signatures and acknowledgments continue on the following page]

COMMUNITY/LOCAL UNIT OF GOVERNMENT

X_____ _____
[Authorized Community Official] DATE

State of Michigan)
ss
County of _____)

The foregoing instrument was acknowledged before me in _____ County, Michigan, on _____ by _____, the _____ of _____ on behalf of _____[Insert Name of Community].

Signature of Notary Public: _____
Print Name of Notary Public: _____
Notary Public, State of _____, County of _____
My commission expires: _____
Acting in the County of _____

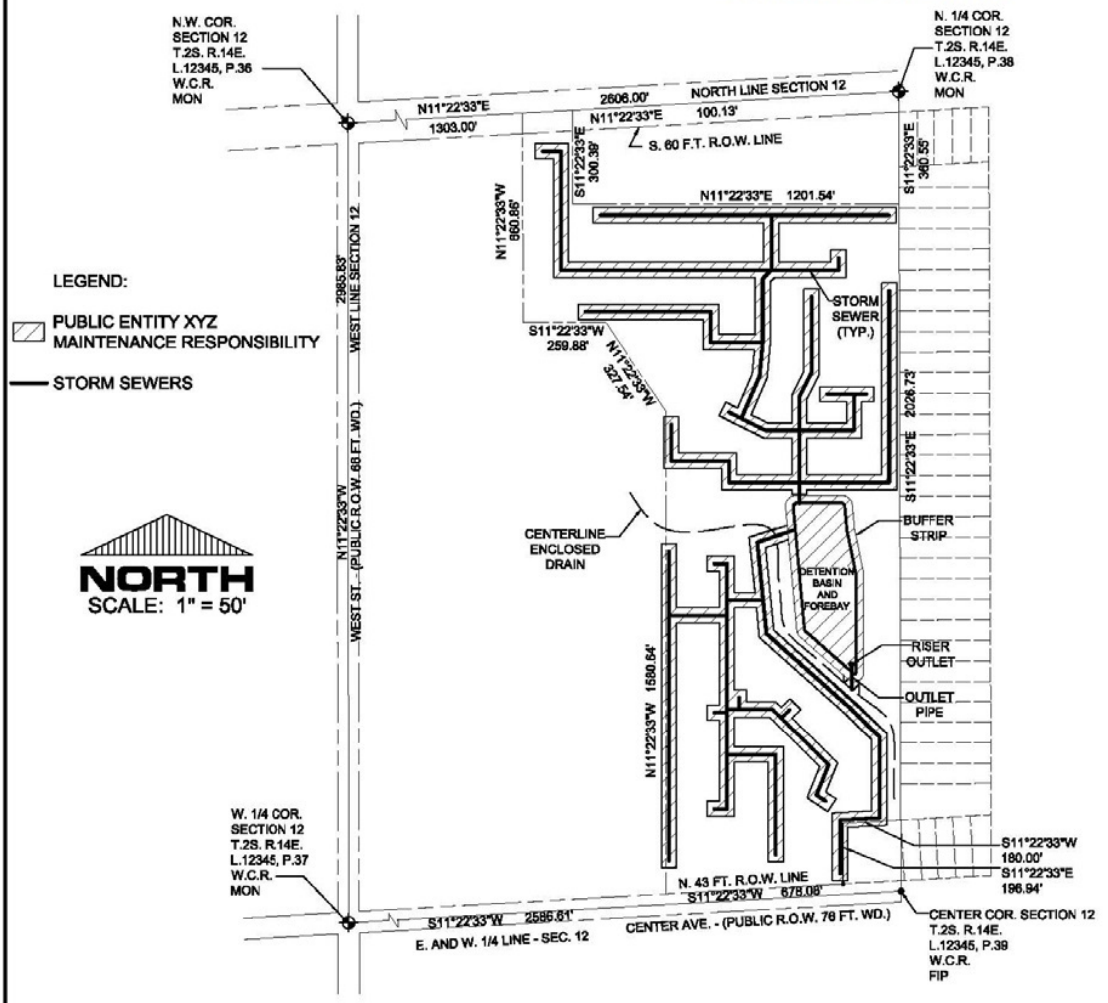
GENERAL CONDITIONS

1. **Specifications.** All work performed under this permit shall be done in accordance with the approved plans, specifications, maps, statements, and special conditions filed with the County and shall comply with the Wayne County Permit Specifications included as an attachment to this permit.
2. **Fees.** The PERMIT HOLDER shall be responsible for all fees incurred by the County in connection with this permit and shall deposit the fees and costs as determined by the County at the time the permit is issued.
3. **Financial Assurance.** The PERMIT HOLDER and/or the CONTRACTOR shall furnish a bond in the form of a performance bond, cashier's check, certified check or by posting an unconditional irrevocable letter of credit in an amount and form acceptable to the County to guarantee performance under the conditions of this permit. The County may use all or any portion of the bond which shall be necessary to cover any expense, including inspection costs, or damage incurred by the County through the granting of this permit. Should the bond be insufficient to cover the expenses and damages incurred by the County, the PERMIT HOLDER shall pay such deficiency upon billing by the County. If the bond amount exceeds the expenses and damages incurred by the County, the excess portion will be returned to the depositor upon completion of all obligations to the full satisfaction of the County. The excess performance bond provided for herein, when it cannot be returned shall be deposited in the County Road Fund and become a part thereof unless claimed by the depositor within one year of the date of satisfactory completion of the construction authorized by this permit unless claimed by the depositor as outlined in the Wayne County Construction Rules.
4. **Insurance.** The PERMIT HOLDER and/or the CONTRACTOR shall furnish proof of liability and property damage insurance in the form and amounts acceptable to the County with Wayne County named as an insured party. The PERMIT HOLDER and/or the CONTRACTOR shall maintain this insurance until the permit is released, revoked, or cancelled by the County.
5. **Indemnification.** The PERMIT HOLDER and the CONTRACTOR shall indemnify, hold harmless and defend Wayne County, the Wayne County Department of Public Services, its officials and employees against any and all claims, suits, and judgments to which the County, the Department, its officials and employees may be subject and for all costs and actual attorney fees which may be incurred on account of injury to persons or damage to property, including property of the County, whether due to negligence of the PERMIT HOLDER or the CONTRACTOR or to the joint negligence of the PERMIT HOLDER and the CONTRACTOR and the County, arising out of any and all work performed under this permit, or in connection with work not authorized by this permit, or resulting from failure to comply with the terms of this permit, or arising out of the continued existence of the work product that is the subject of this permit.
6. **Start and Completion of Work.** This permit shall not become operative until it has been fully executed by the County. The PERMIT HOLDER or the CONTRACTOR shall notify the County at least 72 hours before starting construction and shall notify the County when work is completed. The PERMIT HOLDER or the CONTRACTOR or their representative shall have copies of the executed permit and approved plans in their possession on the job site at all times.
7. **Safety.** The PERMIT HOLDER and the CONTRACTOR agree that all work under this permit shall be performed in a safe manner and to keep the area affected by this permit in a safe condition until the work is completed and accepted by the County and to furnish, install, and maintain all necessary traffic controls and protection in accordance with the Michigan Manual of Uniform Traffic Control Devices.
8. **Underground Utilities.** The PERMIT HOLDER or the CONTRACTOR shall contact all utility owners regarding their facilities prior to starting work and shall comply with all applicable provisions of Public Act 174 of 2013, as amended, or any other similar statute or rule. The presence or absence of utilities is based on the best information available, and the County is not responsible for the accuracy of this information. The PERMIT HOLDER and the CONTRACTOR assume all responsibility for the interruption and damage to underground utilities.
9. **Assignability.** This permit is not transferable and is not assignable without the written consent of the County.
10. **Limitation of Permit.** This permit does not relieve the PERMIT HOLDER and the CONTRACTOR from meeting any and all requirements of law, or of other public bodies or agencies. The PERMIT HOLDER and the CONTRACTOR shall be responsible for securing and shall secure any other permits or permission necessary or required by law from governmental agencies and jurisdictions, corporations, or individuals.
11. **Restoration.** The PERMIT HOLDER and the CONTRACTOR agree to restore the County road, the County road right-of-way, County drain easement or County park property to a condition equal to or better than its condition before work under this permit began.
12. **Acceptance.** Acceptance by the County of work performed does not relieve the PERMIT HOLDER and the CONTRACTOR of full responsibility for other work performed and the presence of the permitted facility. The PERMIT HOLDER acknowledges that the County has no liability for the presence of the PERMIT HOLDER'S facility located within the County road right-of-way, County drain easement, or County park property.
13. **Cost Responsibility.** The design, construction, operation, and maintenance of all work covered by this permit shall be at the PERMIT HOLDER'S expense with the exception that the PERMIT HOLDER will not be responsible for maintaining road widenings or similar facilities which become part of the County roadway.
14. **Compliance and Enforcement.** This permit is subject to the enforcement and compliance sections of the Wayne County Ordinance. If pursuant to the Wayne County Ordinance, this permit is suspended or revoked upon order of the County, the PERMIT HOLDER and the CONTRACTOR shall surrender this permit, cease operations, and remove or relocate, at their expense, the facilities for which the permit was granted and restore the County's property, or the County may remove the facilities and restore the County property at the PERMIT HOLDER'S expense. The PERMIT HOLDER and the CONTRACTOR expressly waive any right to claim damages for compensation resulting from the revocation of the permit. The PERMIT

HOLDER and the CONTRACTOR agree that in the event of a violation of the terms of this permit or in the event the work authorized by this permit is not satisfactorily completed by the permit expiration date or any extension granted by the County, the County may use all or any portion of the performance bond to restore the County road right-of-way, drain easement, wastewater facility or park property as necessary for reasonably safe and efficient operations and maintenance, or to establish extraordinary maintenance procedures as required to assure reasonably safe and efficient operations and maintenance, or to establish extraordinary maintenance procedures as required to assure reasonably safe and efficient operation of the County facility, as outlined in the Wayne County Construction Rules.

15. **Design.** The PERMIT HOLDER is fully responsible for the design of the permitted facility, such design being consistent with applicable County standards, specifications, guidelines and requirements, and good engineering practice.

SAMPLE - EXHIBIT A
PHYSICAL LIMITS OF STORM WATER CONTROL SYSTEM

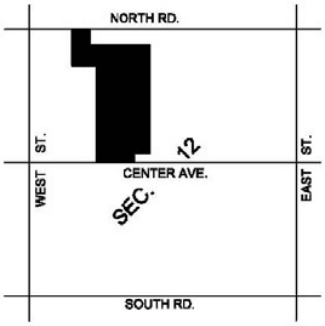


LEGAL DESCRIPTION

LAND IN THE CITY OF XYZ, WAYNE COUNTY, MICHIGAN BEING THAT PART OF THE NORTHWEST CORNER OF SECTION 12, TOWNSHIP 2 SOUTH, RANGE 14 EAST DESCRIBED AS FOLLOWS...

TAX IDENTIFICATION NUMBER (IF SPACE ALLOWS)

VICINITY MAP (N.T.S.)



ENGINEERING OR SURVEYING FIRM NAME & ADDRESS	APPLICANT'S COMPANY NAME & ADDRESS	Date: 3-11-05
		Sheet 1 of 1
		DR. By: ABC / CHK: XYZ
		Job No. 1234

EXHIBIT B

SAMPLE LONG-TERM MAINTENANCE PLAN

Property Information:	ABC Subdivision 123 Example Road City or Town, Michigan 48ZZZ
Applicant:	*[Name of Applicant]* *[Address of Applicant]*
Property Owner:	*[Name of Property Owner]* *[Address of Property Owner]*
Permit Number:	*[Insert Permit Number when available]*

A. Physical Limits of the Stormwater Control System

[This section defines the physical limits of the stormwater control system to be maintained in accordance with this long-term maintenance plan.]

The stormwater control system (SWCS) subject to this Long-Term Maintenance Plan (Plan) is depicted on Exhibit A to the Permit and includes without limitation the storm sewers, swales, manholes, catch basins, stormwater inlets, forebay, detention basin, outlet structure, emergency overflow, buffer strip, and closed conduits and watercourses that convey flow from the detention basin to_____[*ADD other site specific elements (for example, manufactured treatment systems or underground detention) as necessary*].

For purposes of this Plan, this stormwater control system and all of its components as shown on Exhibit A is referred to as_____*[name of SWCS]*.

B. Time Frame for Long-Term Maintenance Responsibility

[This section clearly defines the point at which long-term maintenance responsibility commences, particularly for large development sites.]

[Name of Applicant] is responsible for maintaining the *[name of SWCS]*, including complying with applicable requirements of the local or Wayne County soil erosion and sedimentation control program, until Wayne County releases the construction C-permit. Long-term maintenance responsibility for the *[name of SWCS]* commences when defined by the maintenance permit issued by the County. Long-term maintenance continues in perpetuity.

C. Manner of Ensuring Maintenance Responsibility

[This section identifies the public entity responsible for long-term maintenance if Property Owner fails to perform

[City, Township, or other public entity] has agreed to assume responsibility for long-term maintenance of *[name of SWCS]* if *[Name of Property Owner]* fails to perform. The resolution by which *[City, Township, or other public entity]* has assured maintenance responsibility will be attached to the M-Permit as Exhibit C. *[Name of Property Owner]*, through this maintenance agreement with the *[City, Township, or other public entity],* has committed to perform the maintenance activities required by this Plan. *[City, Township, or other public entity]* retains the right to enter the property and perform the necessary maintenance of the *[name of SWCS]* if *[Property Owner]* fails to perform the required maintenance activities.

Minimum Required Method of Notifying Subsequent Property Owners

To ensure that the *[name of SWCS]* is maintained in perpetuity, the map of the physical limits of the stormwater control system (Exhibit A), this Plan (Exhibit B), the resolution attached as Exhibit C, including the maintenance agreement between the public entity and the Property Owner will be recorded with the Wayne County Register of Deeds. Upon recording, a copy of the recorded document will be provided to the County.

D. Long-Term Maintenance Plan and Schedule

[This section clearly identifies the monitoring, preventative, or remedial activities that will be completed for each element of the stormwater control system. This section also includes a schedule for each activity.]

Table 1 identifies the maintenance activities to be performed, organized by category (monitoring/inspections, preventative maintenance, and remedial actions). Table 1 also identifies site-specific work needed to ensure that the stormwater control system functions properly as designed. The following list supplements Table 1 and provides more information about site specific activities:

[Identify any additional requirements not shown on Table 1 in this section. For example:]

- While performing maintenance, chemicals should not be applied to the forebay, open detention basin, watercourses or anywhere in the 25 foot buffer strip around surface waters and along watercourses unless performed by a State of Michigan licensed pesticide applicator and conducted under a valid aquatic nuisance control permit.

Table 1
Long-Term Maintenance Schedule
ABC Subdivision, 123 Example Road, City or Town, Michigan 48ZZZ

Maintenance Activities	System Component									Frequency
	Catch Basins, Inlets	Channels & Vegetated	Inlets to Pretreatment Systems and Detention/Retenti	Forebays	Open Detention Basins & Retention Basins	Flow Restrictors, Overflow Structures & Outlet Pipes	Emergency	Riprap	Buffer Strip	
Monitoring/Inspection										
• Inspect for sediment accumulation**/clogging of stone filter	X	X	X	X	X	X	X			Annually
• Inspect for floatables, dead vegetation and debris	X	X	X	X	X	X	X		X	Annually and after major
• Inspect for erosion and integrity of banks and berms		X	X	X	X		X	X	X	Annually and after major
• Inspect all components during wet weather and compare to as-built plans	X	X	X	X	X	X	X	X	X	Annually
• Monitor plantings/vegetation		X		X	X		X		X	2 times per year
• Ensure means of access for maintenance remain	X	X	X	X	X	X	X	X	X	Annually
Preventative Maintenance										
• Mowing		X			X		X		X	Up to 2 times/year, select areas
• Remove accumulated sediment	X	X		X	X	X				As needed**
• Remove floatables, dead vegetation and debris	X	X	X	X	X	X	X			As needed
• Replace or wash/reuse stone riser filters						X	X	X		Every 3 years; more frequently as needed***
• Remove invasive plant species		X		X	X				X	Annually
Remedial Actions										
• Repair/stabilize areas of erosion		X	X	X	X		X	X	X	As needed
• Replaced dead plantings, bushes, trees		X		X	X				X	As needed
• Reseed bare areas		X		X	X		X		X	As needed
• Structural repairs	X		X			X	X	X		As needed
• Make adjustments/repairs to ensure proper functioning	X	X	X	X	X	X	X	X	X	As-needed

* Not to exceed the length allowed by local community ordinance.
** Forebays, open detention basins, and retention basins to be cleaned whenever sediment accumulates to a depth of 6-12 inches or if sediment resuspension is observed.
*** Replace stone if it cannot be adequately cleaned.

Table 1 (Continued)
Long-Term Maintenance Schedule
ABC Subdivision, 123 Example Road, City or Town, Michigan 48ZZZ

Maintenance Activities	System Component									Frequency
	Manufactured Treatment	Underground Detention	Bioretention Areas	Porous Pavement	Other Infiltration	Other Features	Other Features	Other Features	Other Features	
Monitoring/Inspection										
• Inspect for sediment accumulation**/clogging	X	X	X	X	X					Annually
• Inspect for floatables, dead vegetation and debris	X	X	X	X	X					Annually and after major events
• Inspect for erosion and integrity of system			X	X	X					Annually and after major events
• Inspect all components during wet weather and compare to as-built plans	X	X	X	X	X					Annually
• Monitor plantings/vegetation			X		X					2 times per year
• Ensure means of access for maintenance remain	X	X	X	X	X					Annually
Preventative Maintenance										
• Remove accumulated sediment	X	X	X		X					As needed**
• Remove floatables, dead vegetation and debris	X	X	X	X	X					As needed
• Re-apply / replace mulch layer			X							Reapply every 6 months. Replace every 2 years.
• Replace subsurface components (e.g., soil, underdrain systems, etc.)			X							Every 5 years or as needed (e.g., when water ponds more than 6 hours)
• Remove invasive plant species			X		X					Annually
• Street sweeping of paved surfaces				X						Semi-annually
• Other: Specify (e.g., recommended by manufacturer)	X			X						
Remedial Actions										
• Repair/stabilize areas of erosion			X		X					As needed
• Replaced dead plantings, bushes, trees			X		X					As needed
• Reseed bare areas			X		X					As needed
• Structural repairs	X	X	X	X	X					As needed
• Make adjustments/repairs to ensure proper functioning	X	X	X	X	X					As-needed

* Not to exceed the length allowed by local community ordinance.

** Manufactured treatment systems and underground detention systems to be cleaned according to manufacturer's recommendations; at a minimum, whenever sediment accumulates to a depth of 6-12 inches or if sediment resuspension is observed.

EXHIBIT C
MODEL COMMUNITY RESOLUTION ACCEPTING
LONG-TERM MAINTENANCE OF STORMWATER SYSTEM

Resolution No: _____

At a Regular Meeting of the _____ *(Name of Community Governing Board)* on _____ *(date)*, the following resolution was offered:

WHEREAS, Chapter 7 of the Wayne County Stormwater Control Ordinance ("Wayne County Ordinance"), requires stormwater control systems to be maintained in perpetuity to ensure that the systems function properly as designed;

WHEREAS, Rule 1001 of the Wayne County Stormwater Control Administrative Rules ("Administrative Rules") requires applicants for stormwater construction approval to submit long-term maintenance plans as part of an application for stormwater construction approval;

WHEREAS, _____ ("Property Owner") has applied to the Wayne County Department of Public Services for a stormwater construction approval with respect to a project named _____ *(Project Name)* ("Project") located at _____ *(Project Location)* in _____ *(City/Village/Township)*;

WHEREAS, Property Owner's application for stormwater construction approval has been assigned permit review number _____ *(insert permit review number)*;

WHEREAS, Property Owner submitted a plan to the County and *(Community)* entitled _____ *(Title, author, and date of Plan)* ("Plan") for long-term maintenance of the stormwater control system(s) at the Project pursuant to Rule 1001, which Plan has been tentatively approved by the County pending issuance of this resolution and acceptance by *(Community)*; and

WHEREAS, pursuant to the Wayne County Ordinance *(Community)* guarantees it will assume jurisdiction and accept responsibility for long-term maintenance of stormwater control system(s) at the Project in perpetuity if the Property Owner fails to do so;

WHEREAS, *[Community]* has designated _____ *[Name of Authorized Community Official]*, the _____ *[Title of Individual]* of *[Community]*, as the person responsible for executing long-term maintenance permits on behalf of *[Community]*;

NOW THEREFORE BE IT RESOLVED, that pursuant to Chapter 7 of the Wayne County Ordinance *(Community)* guarantees it will assume jurisdiction over and accept responsibility for long-term maintenance of stormwater control system(s) at the Project pursuant to the Wayne County Ordinance, the Administrative Rules, the Plan, and the stormwater construction approval issued by Wayne County if the Property Owner fails to do so;

BE IT FURTHER RESOLVED, that approval be and is hereby granted, authorizing *(Authorized Community Official)* to execute, on behalf of *(Community)*, Permit (No. _____) for long-term maintenance of stormwater control system issued by Wayne County for the Project.

[Insert Certification Language of Local Community here]

APPENDIX C

Process to Establish Stormwater Control System as County Drain

Process to Establish Stormwater Control System as County Drain

One option for meeting the requirement of ensuring maintenance of new stormwater control systems in perpetuity is to establish the stormwater control system as a County Drain upon completion of construction. Elements of this process include:

- The landowners transfer funds ($5,000) to the drainage district at its inception to establish a "permanent maintenance fund" for "future maintenance" (provided by Section 433 of Michigan Drain Code).
- Maintenance is performed by the Drain Commissioner's Office (Wayne County Department of Public Services, Environmental Services). Maintenance costs in excess of the initial maintenance fund are assessed to the landowners (based upon the percentage owned by each in the district) as follows:
  - For the collection system and open waterways, $5,000/mile can be assessed annually. If this amount is inadequate, there is provision for special assessments.
  - Costs for maintenance of detention ponds and other features are recovered through special assessments (Section 196 subsection 12).

At the request of a property owner/developer, Wayne County generally will consider an application for establishment of a new stormwater system as a Chapter 18 Drain/drainage district for the following types of projects:

1. Projects where the stormwater system lies on properties owned/operated by multiple parties
   a. Large or regional projects
   b. Subdivisions in townships.
2. Projects that present special circumstances of particular concern to the County, such as
   a. projects contiguous with/that discharge to County property (e.g., Drains, Parks)
   b. projects that have high potential for impacting adjacent or downstream County property (e.g., a County Road) if not maintained.

For applicable projects, a brief overview of the process required to establish a new stormwater control system as a Chapter 18 Drain follows:

A. Landowner(s) submit written request to the Drain Commissioner for establishment of the stormwater control system as a Drain and establishment of the drainage area to the stormwater control system as a Drainage District. An example request is attached as Exhibit A.

B. Landowner(s) submit plans and specifications to Wayne County for review and approval. NOTE: The entire stormwater control system must conform to County standards for materials and specifications.

C. Landowner(s) and County Drain Commissioner sign a written agreement to establish the stormwater control system as a Drain and to establish the drainage area to the stormwater control system as a Drainage District. An example agreement is presented at Exhibit B.

D. Landowner(s) pay costs to establish the Drain (administrative, inspection, permanent maintenance fund).

E. Landowner(s) attach permanent Drain easement to deed. Copies of all recorded easements must be provided to the Wayne County Drain Commissioner.

F. Landowner(s) obtains all necessary permits. Copies of all permits must be provided to the Wayne County Drain Commissioner

G. Landowner(s) construct project with own funds.

H. County performs inspection during construction.
I. Landowner(s) provides As-Built Drawings for the development.
J. County accepts project.

Questions regarding this methodology should be directed to the Wayne County Drain Commissioner at 313-224-3620 or esghelp@waynecounty.com.

Exhibit A

EXAMPLE REQUEST TO
ESTABLISH A COUNTY DRAIN AND DRAINAGE DISTRICT

DATE

NAME
Wayne County Drain Commissioner
Wayne County Department of Public Services
400 Monroe St., Suite 400
Detroit, MI 48226

Reference: Proposed _____
Location _____
WCDPS Plan Review Number _____

Dear Drain Commissioner:

We/I, as the owner/developer of the proposed _____ _____, which will be located in the City/Township of ____ near the intersection of _____ Road and _____ Road (see attached location map), request the following:

1. The establishment of the stormwater control system for this property as a County Drain under the provisions the Michigan Drain Code of 1956 (as amended); and
2. The establishment of the drainage area to the stormwater control system for this property as a Drainage District under the provisions the Michigan Drain Code of 1956 (as amended).

Please contact _____ at (___) _____ as needed regarding this request.

Very truly yours,

_____ _____
Property Owner #1 Property Owner #2

Attachment: Location Map

Cc: Deputy Drain Commissioner, Wayne County Department of Public Services

Exhibit B

SAMPLE

AGREEMENT FOR THE ESTABLISHMENT OF THE _____DRAIN AND THE _____DRAIN DRAINAGE DISTRICT PURSUANT TO SECTION 433 OF ACT NO. 40 OF THE PUBLIC ACTS OF 1956, AS AMENDED

THIS AGREEMENT, made and entered into this _____ day of _____ 20__, by and between the Deputy Director of Wayne County Department of Public Services, and Wayne County Drain Commissioner, whose address is 400 Monroe, Suite 400, Detroit, Michigan 48226, hereinafter referred to as "Drain Commissioner" on behalf of the proposed _____ Drain Drainage District; and _____, a Michigan corporation, whose address is _____ and _____, a Michigan corporation, whose address is _____, a Michigan corporation, whose address is _____, hereinafter referred to as "Landowners".

WITNESSETH:

WHEREAS, Section 433 of Act No. 40 of the Public Acts of 1956, as amended, authorizes the Drain Commissioner to enter into an Agreement with Landowners to establish a drain which was constructed by the Landowners to service an area on lands owned by Landowners as a County Drain; and

WHEREAS, Landowners, pursuant to Sections 425 and 433 of Act No. 40 of the Public Acts of 1956, as amended, wish to provide drainage service to their own lands and have requested same to be established and dedicated as a County Drain under the jurisdiction of the Wayne County Drain Commissioner; and

WHEREAS, Landowners have been advised and understand and agree to assume or have already assumed the total cost of the construction of the Drain to include engineering, inspection, easement acquisition, legal and administrative expenses and the Drain Commissioner's similar costs related or associated with this Agreement; and

WHEREAS, Landowners understand that the Drain constructed, or to be constructed, pursuant to this Agreement, when finally accepted by the Drain Commissioner, will be known as the _____ Drain (See Exhibit A for route and course description) and that the lands owned by _____ described in Exhibit B and the lands owned by _____ described in Exhibit C, etc. will be known and constituted collectively as the _____Drain Drainage District; and

WHEREAS, Landowners further understand that as the owners of the lands included in this Agreement in the Township/City of _____ in which said Drain and the lands to be drained thereby are located, that these above described lands will hereafter be subject to assessments pursuant to the Drain Code for the cost of construction, operation, inspection and maintenance of the Drain; provided, however, such assessment obligation shall be based upon the percentage ownership of the ____ acres of developable land approximately depicted on Exhibit E; and

WHEREAS, Landowners have agreed to assume and pay all costs as set forth herein; and

WHEREAS, Landowners have obtained, at their expense, a certificate from a registered professional engineer satisfactory to the Drain Commissioner to the effect that the existing Drain is the only reasonably available outlet for the proposed Drain and that there is sufficient capacity in the existing outlet for the proposed Drain to serve as an adequate outlet, without detriment to or diminution of the drainage

service which the outlet presently provides. A copy of said certificate is attached hereto as Exhibit F.

NOW, THEREFORE, in consideration of the promises and covenants of each, the parties hereto agree to as follows:

1. The Drain Commissioner agrees to establish the _____Drain as a County Drain, subject to the provisions of this Agreement, upon the satisfactory completion of the construction and inspection of the Drain. The route and course of the Drain is legally described in Exhibit A. The _____Drainage District shall be established and composed of the lands legally described in Exhibits B, C, D and E.

2. Landowners agree that construction of the drainage facilities shall comply with the standards and specifications of the Wayne County Drain Commissioner's Office and consistent with the plans and specifications prepared by _____for _____, Project No. _____, dated _____ and in compliance with all generally accepted construction methods.

3. Landowners agree to assume all costs of the project set forth in the above-mentioned plans, specifications and project designs. This cost shall include all costs set forth in this Agreement, and shall specifically include:

    a. Drain Commissioner's actual attorney fees, recording costs, inspection and engineering costs relative to the drafting and implementation of this Agreement.

    b. The establishment of a permanent maintenance fund pursuant to Section 433 in an amount of 5% of the construction cost but not to exceed $2,500. This payment shall not relieve the subject property from any future assessments levied pursuant to the Drain Code of 1956, as amended.

4. The Landowners shall deposit the Balance Due with the Drainage District, to be used only for the purposes set forth in this agreement.

5. It is agreed that the Landowners shall convey to the Drainage District a map and legal description of the Drainage District as may be necessary to accomplish the purposes set forth and do so without charge. Landowners have granted the necessary easements which consist of the conveyance pipes and detention/retention basins based upon the plans and specifications referenced in paragraph two (2) above. These easements do not include any storage facilities in the parking areas. If any changes are made to the plans or specifications, no alterations will be made to the Drain and the easement areas referenced above, unless approved by the Drain Commissioner which approval shall not be unnecessarily withheld, conditioned or delayed and any necessary easements resulting therefrom are conveyed.

6. The Landowners further agree to provide, without charge, one (1) set of reproducible mylar "Record Drawings" of the Drain as built, which shall include design calculations showing flow rates, imperviousness factors, drainage district and sub-districts, easements and rights-of way locations, and any other data needed by the Drainage District for proper Drain operation and future assessment.

7. The foregoing payment of the cost of the project is agreed and understood as being for the sole benefit of the Drainage District at large or part thereof, and that such payment shall not relieve the subject property from any future assessments levied pursuant to the Michigan Drain Code of 1956, as amended, for construction, improvements and/or maintenance of the Drain arising by virtue of this Agreement or proper and legal petitions, hearings and procedures on such

petitions. Provided, however, such assessment obligations shall be based upon the percentage of ownership of the ____ acres of developable land approximately depicted on Exhibit E.

8. Landowners shall secure all necessary permits or authorizations as may be required by local, state or federal law and provide copies to the Drain Commissioner. The Drain Commissioner shall also be provided copies of all correspondence and reports involving any governmental agency with respect to the Drain.

9. Landowners agree that after the Drain is accepted by the Drain Commissioner that said lands shall hereafter be liable for assessments levied for all costs incurred by the Drainage District (based upon the percentage ownership of the ___ acres of developable land approximately depicted on Exhibit E), including for the operation, maintenance and improvement of the Drain, as provided by this Agreement and by the Drain Code of 1956, as amended.

10. Landowners agree to hold harmless and indemnify the Drain Commissioner and the _____Drainage District for any and all claims, damages, lawsuits, costs and expenses, including attorney fees, arising out of, or incurred as a result of, the construction, operation or maintenance of the Drain occurring prior to the Drain Commissioner's final acceptance of the Drain as an established County Drain. Notwithstanding the foregoing, Landowners' indemnity obligations under this Paragraph 11 shall not extend to any claims, damages, lawsuits, costs and expenses, arising out of the acts or omissions of the Drain Commissioner, its agents, employees and contractors, while on or about the land described in Exhibits B, C and D.

Nothing in this Agreement is to be construed to waive, alter, amend or modify any provision in statute or case law relative to the Drain Commissioner or Drainage District's grant of governmental immunity.

11. Modification, amendments or waivers of any provisions of this Agreement may be made only by the written mutual consent of the parties.

12. This Agreement shall become effective upon its execution by the Landowners and by the Drainage District and shall be binding upon the successors and assigns of each party.

IN WITNESS WHEREOF the parties hereto have caused this agreement to be executed by their duly authorized officers as of the day and year first above written.

_____

NAME
Wayne County Drain Commissioner

LANDOWNER A

_____

By:
Its:

LANDOWNER B

By:
Its:

LANDOWNER C

By:
Its:

STATE OF MICHIGAN)
)ss
COUNTY OF)

On this _____ day of _____, 20__ before me, a Notary Public in and for said County, appeared the Wayne County Drain Commissioner, on behalf of the _____ Drainage District to me personally known to be the person described in and who executed the foregoing instrument and acknowledged the same to be her free act and deed.

_____
, Notary Public
_____ County, Michigan
My Commission Expires:_____

STATE OF MICHIGAN)
)ss
COUNTY OF)

On this _____ day of _____, 20__ before me, a Notary Public in and for said County, appeared _____, of _____, to me personally known to be the person described in and who executed the foregoing instrument and acknowledged the same to be his/her free act and deed.

_____
, Notary Public
_____ County, Michigan
My Commission Expires:_____

STATE OF MICHIGAN)
)ss
COUNTY OF _)

On this _____ day of _____, 20__ before me, a Notary Public in and for said County, appeared _____, of _____, to me personally known to be the person described in and who executed the foregoing instrument and acknowledged the same to be his/her free act and deed.

_____
, Notary Public
_____ County, Michigan
My Commission Expires:_____

Prepared By:
Wayne County Drain Commissioner
400 Monroe St., Suite 400
Detroit, MI 48226
(313) 224-3620

When Recorded Return To:
Wayne County Drain Commissioner
400 Monroe St., Suite 400
Detroit, MI 48226
(313) 224-3620

- Exhibit A: Drain route and course description
- Exhibit B: Legal description of lands in drainage district owned by LANDOWNER A
- Exhibit C: Legal description of lands in drainage district owned by LANDOWNER B
- Exhibit D: Legal description of lands in drainage district owned by LANDOWNER C

  Add additional exhibits for additional landowners as necessary
- Exhibit E: Assessment obligation by landowner (based upon the percentage ownership of the ____ acres of developable land)
- Exhibit F: Certificate from a registered professional engineer specifying that the existing Drain is the only reasonably available outlet for the proposed Drain and that there is sufficient capacity in the existing outlet for the proposed Drain to serve as an adequate outlet.

APPENDIX D

Miscellaneous Design Details

Wayne County Parks – Optional Head Wall Detail for Storm Drain Outlet on River Courses
Riprap Specifications
Example Terraced Side Slope Detail

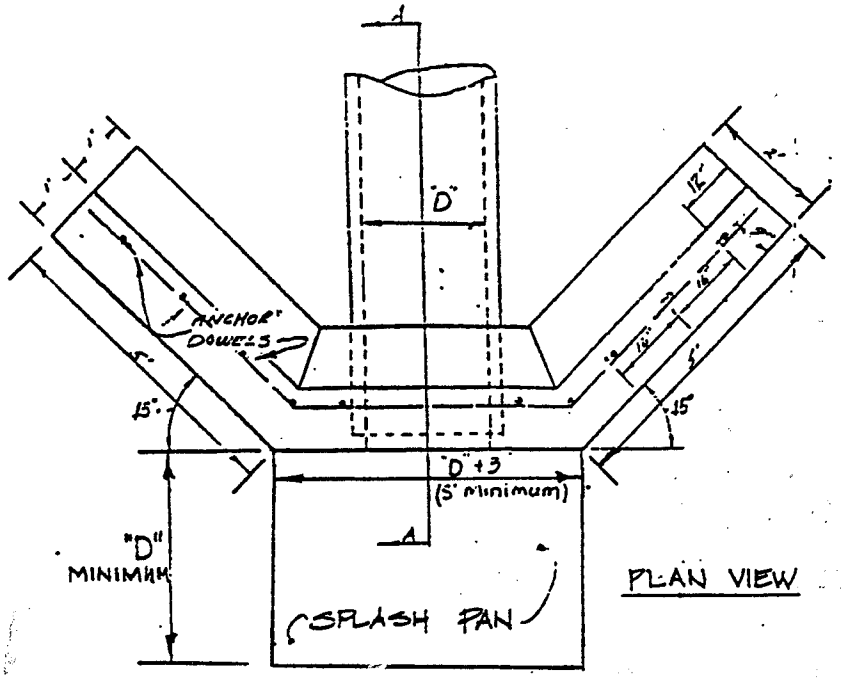
NOTES

FOOTINGS TO BE POURED SEPARATE FROM HEADWALL USING 6 REINFORCING RODS FOR ANCHOR DOWELS.

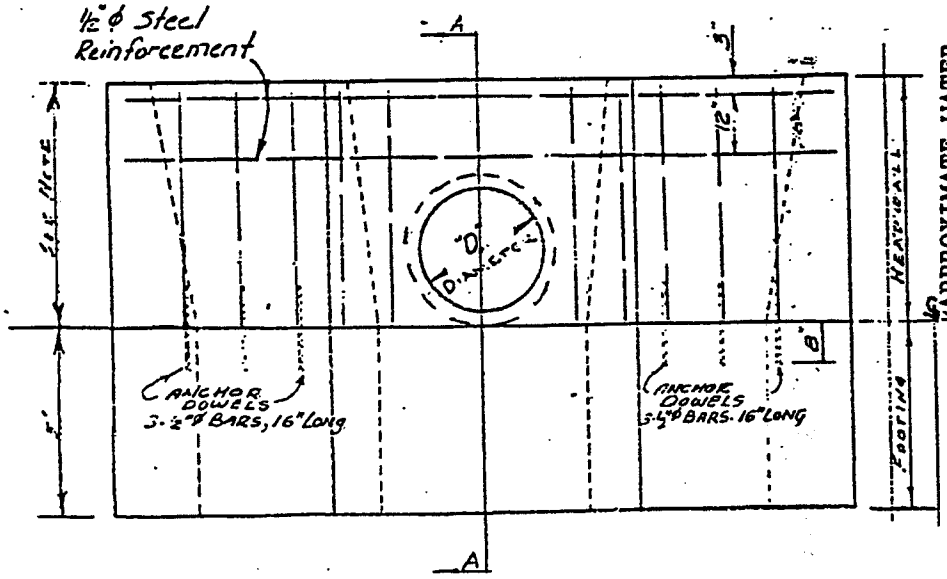
FACE OF HEADWALL SHALL BE LOCATED 1 FT. OUTSIDE THE EDGE OF NORMAL WATER LEVEL.

HEIGHT OF HEADWALL WILL VARY ACCORDING TO THE CHARACTER OF THE BANK AT THE STRUCTURE.

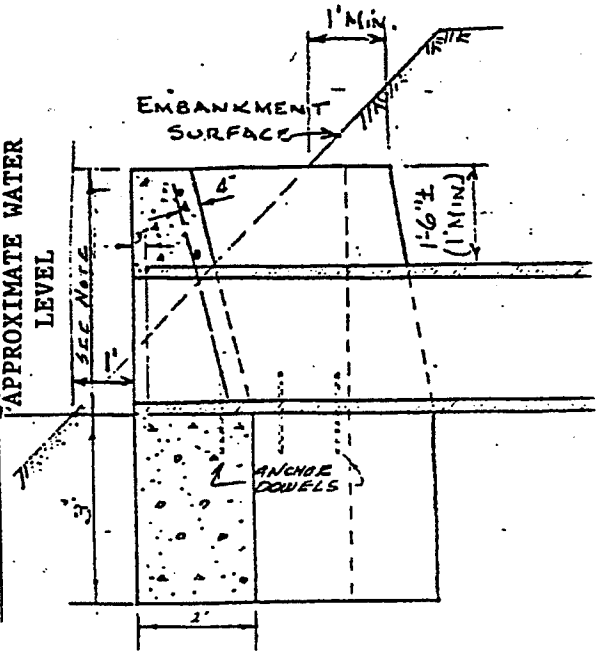
REINFORCE HEADWALL (ABOVE FOOTING) WITH ½" O.C. BARS SPACED AT 16" MAX HORIZONTAL AND VERTICAL, AS SHOWN.



PLAN VIEW



FRONT ELEVATION



SECTION A-A

HEADWALL DETAIL – Storm Drain Outlet on River Courses

WAYNE COUNTY OFFICE OF PUBLIC SERVICE
Department of Parks

Riprap

Updated September, 1997

Definition

Riprap is a permanent cover of rock used to stabilize streambanks, provide in-stream channel stability, and provide a stabilized outlet below concentrated flows.

This BMP addresses using riprap to stabilize streambanks, line channels and provide stable outlets. For purposes of this BMP, "rock" can be used interchangeably with "stone". For information on designing various types of stream liners (including vegetation and riprap), see the Stormwater Conveyance Channel BMP.

All work conducted below the ordinary high water mark of a lake or stream, or in a floodplain or wetland will require permits from the Michigan Department of Environmental Quality, Land and Water Management Division. This includes the placement of riprap. (See Exhibit 1 for a definition of ordinary high water mark).

Other Terms Used to Describe

Armoring
Energy Dissipator

Pollutants Controlled and Impacts

The use of riprap in channels and below concentrated flows protects stream banks and discharge channels from higher erosive flow velocities. This reduces downcutting and lateral cutting, which in turn decreases sediment input to a watercourse.

Application

Land Use
All land uses.

Soil/Topography/Climate
The rock to be used as riprap must be capable of withstanding freezing and thawing and the flow or wave action of the water where it is used. The soil texture on the site and whether seepage is occurring are factors in determining the need and thickness of filters beneath the riprap.

When to Apply
Riprap used at outlets should be in place before the outlet is discharging. Streambank grading should be done when it is most feasible to bring stone to the site. Riprap should be placed as soon after grading as possible.

Where to Apply
Riprap is most often used in streambanks, on slopes, and at outlets.

Relationship With Other BMPs

Riprap is often used in making Stabilized Outlets, in Streambank Stabilization (including bioengineering techniques), and Slope/Shoreline Protection. Filters should be used underneath riprap to

help stabilize the soils.

Specifications

General Considerations:

Riprap structures should be designed by licensed professional engineers or other persons qualified in the design of such structures.

Stone Type

The material used for riprap should be fieldstone or rough unhewn quarry stone. Stone should be hard, angular, and of such quality that it will not disintegrate on exposure to water or weathering. It should also be chemically stable, capable of withstanding freezing and thawing, and suitable in all other respects for the intended use.

Because it is not as aesthetically pleasing as rock, broken concrete is a less favorable riprap alternative. If concrete is used, it should be clean and otherwise meet design criteria. Asphalt should *not* be used as riprap.

Riprap Size

Riprap comes in a variety of sizes. The appropriate size to use primarily depends on the intended use of the structure. For example, the size of riprap used to stabilize streambanks depends on the velocity of the water.

Structural design is usually based on the diameter of stone in the mixture for which a percentage, by weight, will be smaller. For example, D_{50} indicates a mixture of stones in which 50 percent of the stone by size would be larger than the diameter specified, and 50% would be smaller than the stone size specified. In other words, the design is based on the average size of stone in the mixture.

Table 1 lists some typical riprap by weight, spherical diameter and corresponding rectangular dimensions. These stone sizes are based on an assumed specific weight of 165 lbs./ft^3.

Table 1

Size of Typical Riprap Stones

Weight (lbs)	Mean Spherical Diameter (in)	Typical Rectangular Shape Length (in)	Width, Height (in)
50	10	18	6
100	13	21	7
150	14	24	8
300	18	30	10
500	22	36	12
1000	27	45	15
1500	31	52	17
2000	34	57	19
4000	43	72	24
6000	49	83	28
8000	54	90	30

Source: USDA Soil Conservation Service

Gradation

Riprap should be composed of a well-graded mixture down to the one-inch size particle such that 50 percent of the mixture by weight is larger than the D_{50} size as determined from the design procedure. For the purposes of this BMP, a well-graded mixture is defined as a mixture composed primarily of the larger stone sizes but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture should not be more than 1.5 times the D_{50} stone size.

After determining the riprap size that will be stable under the flow conditions, the designer should consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size.

Riprap structures for **streambank stabilization** should be designed to be stable for bank-full flows in the reach of the channel being stabilized.

Thickness

For both streambank stabilization and outlets, the minimum thickness of the riprap layer should be 1.5 times the D_{50} diameter, or 6 inches, whichever is greater. **A geotextile or stone filter must be placed under the riprap to prevent water from removing the underlying soil material through the voids in the riprap.** (Removal of the soil material leaves cavities behind the riprap and failure of the riprap may result). The filter may consist of smaller sized stone (usually 2"), a geotextile material, or a combination of both. Stone filters should be a minimum of 6 inches thick, and greater if the area has high seepage pressures. Follow the specifications below.

Granular (Stone) Filter Blanket. For dumped riprap, a filter ratio of 5 or less between successive layers will result in a stable condition. The filter ratio is defined as the ratio of D_{15} size of the coarser layer to the D_{85} size of the finer layer. An additional requirement for stability is that the ratio of the D_{15} size of the coarse material to the D_{15} size of the fine material should exceed 5 and be less than 40. A further requirement is that the ratio of the D_{50} size of the coarse material to the D_{50} size of the fine material not exceed 40. These requirements can be stated as follows:

$$\frac{D_{15}\text{ (coarser layer)}}{D_{85}\text{ (finer layer)}} < 5 < \frac{D_{15}\text{ (coarser layer)}}{D_{15}\text{ (finer layer)}} < 40$$

$$\frac{D_{50}\text{ (coarser layer)}}{D_{50}\text{ (finer layer)}} < 40$$

The filter requirements apply between the bank material and the filter blanket, between successive layers of filter blanket material if more than one layer is used, and between the filter blanket and the stone cover.

If a single layer of filter material will not satisfy the filter requirements, one or more additional layers of filter material must be used. In addition to the filter requirements, the grain size curves for the various layers should be approximately parallel to minimize the infiltration of the fine material into the coarser material. Not more than 5 percent of the filter material should pass the No. 200 sieve.

The minimum thickness of each layer of granular filter material shall be 6 inches, or 3 times the D_{50} size of the filter, whichever is greater.

Synthetic (Geotextile) Filter Fabric. The Filters BMP includes information on geotextile materials which may be used may be used in place of or in conjunction with granular filters. Always check manufacturer's specifications to ensure that the filter fabric selected meets the tensile strength and

durability requirements for the determined rock size. Some guidance in selecting filter fabric is given below.
The following particle size relationships must exist:

For filter fabric adjacent to granular materials containing 50 percent or less (by weight) of fine particles (less than 0.075 mm):

a) $\frac{D_{85} \text{ base (mm)}}{\text{EOS* filter fabric (mm)}} > 1$

b) Total open area of filter fabric is less than 36 percent.

For filter fabric adjacent to all other soils:

a) EOS less than U.S. Standard Sieve No. 70.

b) Total open area of filter is less than 10 percent.

*Equivalent Opening Size to a US Standard Sieve Size

No filter fabric should be used with less than 4 percent open area or an EOS smaller than U.S. Standard Sieve No. 100.

Stream Bank Protection and Channel Lining

See Exhibit 1 for applications.

General Planning Considerations:

1. Slopes on which riprap is used to stabilize streambanks should be no steeper than 1.5:1.

2. All bare soil on the slope above the riprap should be stabilized with seed and mulch, or sod. See the Vegetative BMPs.

3. When riprap is used in conjunction with other vegetative practices or bioengineering, the riprap should extend 1 foot above the ordinary high water mark. When only riprap is being used for bank stabilization, the top of the riprap should extend 3 feet above the ordinary high water mark. See Exhibit 1 for an explanation of the ordinary high water mark.

4. Determine a means of accessing the site before designing any riprap structure.

5. Determine how the riprap will be placed on the site. If the rock is to be dumped, it must be done in a manner which will not cause separation of the small and large stones. If rock is to be dumped over a bank and placed by hand, it must be done so that it does not create more erosion. Consider using aluminum or wooden shutes to roll rock down a bank to the waters' edge.

6. If riprap placement requires re-configuring banks or slopes, the filter should be placed as soon after the banks are prepared as possible. Placement of riprap should follow immediately after the placement of the filter.

7. The finished surface should not have pockets of finer materials which would flush out and

weaken the structure. Some hand placing should be done to provide a stable surface.

8. Riprap used both at the outlet of storm sewers and to protect an eroding bank, should be designed to accommodate both uses. Riprap used as outlet protection should be constructed before the pipe or channel begins to operate.

Design:

Stone Size Selection for Streambank Stabilization:

The design method described below is adapted from *Design of Stable Channels with Flexible Linings, Hydraulic Engineering Circular No. 15* of the Federal Highway Administration. It is applicable to both straight and curved sections of channel where the flow is not perpendicular to the bank of the channel.

A. Straight Sections of Channel.

This design method determines a stable rock size for straight and curved sections of channels. It is assumed that the shape, depth of flow, and slope of the channel are known. A stone size is chosen for the maximum depth of flow. If the sides of the channel are steeper than 3:1, the stone size must be increased accordingly. The final design size will be stable on both sides of the channel and the bottom.

1. Enter Exhibit 3 with the maximum depth of flow (feet) and channel slope (feet/foot). Where the two lines intersect, choose the d_{50} size of stone.

2. If channel side slopes (z) are steeper than 3:1, continue with step 3, if not, the procedure is complete.

3. Enter Exhibit 4, with the side slope and the base width to maximum depth ratio (B/d). Where the two lines intersect, move horizontally left to K1. Record K1.

4. Determine from Exhibit 5, the angle of repose (Ar) for the d_{50} size of stone. The angle of repose is the angle in which the rocks will lay in relation to the bank. Banks should be designed so that the natural angle of repose of the stone mixture is greater than the slope of the bank being stabilized. (Use Ar=42° for d_{50} greater than 1.0 ft. Do not use riprap on slopes steeper than the angle of repose for the size of stone.)

5. Enter Exhibit 6, with the side slope (z) of the channel and the angle of repose (Ar) for the d_{50} size of stone. Where the two lines intersect, move vertically down to read K2. Record K2.

6. Compute $d'_{50} = d_{50} \times K1/K2$, where d'_{50} is to determine the correct size stone for the bottom and side slopes of straight sections of channel.

B. Curved Sections of Channel

1. Compute the radius of the curve (Ro), measured at the outside edge of the bottom.

2. Compute the ratio of the top width of the water surface (Bs) to the radius of the curve (Ro), Bs/Ro.

3. Enter Exhibit 7, with the ratio Bs/Ro. Move vertically until the curve is intersected.

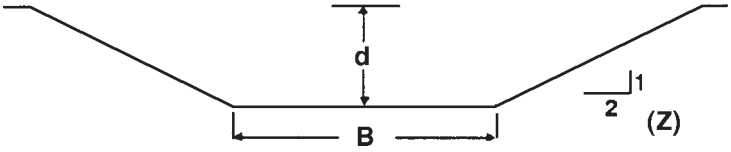
Move horizontally left to read K3.

4. Compute $d_{50c} = d'_{50} \times K3$, where d_{50c} is the correct size stone for bottom and side slopes of curved sections of channel.

C. Design Example Problems:

Problem #1

Given: A trapezoidal channel 3 feet deep (d), with an 8-foot bottom (B), 2:1 side slopes (z), and a 2 percent slope. **Calculate**: A stable riprap size for the bottom (B) and side slopes (z) of the channel.



Solution:

1. From Exhibit 3, for a 3-foot deep channel on a 2 percent grade: $d_{50} = 0.75$ feet or 9 inches.

2. Since the side slopes (z) are steeper than 3:1, continue with Step 3.

3. From Exhibit 4 for B/d = 2.67 and z = 2; K1 = 0.8

4. From Exhibit 5 for d_{50} = 9 inches; Ar = 41°

5. From Exhibit 6 for z = 2 and Ar = 41°; K2 = 0.75

6. $d'_{50} = d_{50} \times K1/K2 = 0.75 \times 0.8/0.75 = 0.8$ feet

   0.8 ft x 12 inches = 9.6 inches

   Use d'_{50} = 10 inches

Problem #2

Given: The preceding channel in Problem #1 has a curved section with a radius of 50 feet at the outside edge of the bottom. **Calculate**: A stable riprap size for the bottom and side slopes of the curved section of channel.

Solution:

1. Radius of curvature, Ro = 50 feet

2. Top width at water surface,

   Bs = 8 +(2 x 3 x 2) = 20 feet

   Bs/Ro = 20/50=0.40

3. From Exhibit 7 for Bs/Ro = 0.40; K3 = 1.1

4. $d_{50c} = d'_{50} \times K3 = 0.84 \times 1.1 = 0.92$ feet

   Use $d_{50c} = 1.0$ ft = 12 inches

Length/Thickness/Height of Streambank Area to be Riprapped
Refer back to page RIP-3 for specifications on the proper thickness.

Length: The appropriate length of channel in which rock should be placed should be at least the entire eroded section that is being protected, plus a minimum of 10 feet upstream and downstream of the eroded area. Be sure that the stone on the upstream and downstream ends are trenched in to prevent dislodging.

Where riprap is used only for slope or bank protection and does not extend across the bottom at the channel, riprap should be "keyed in" as shown in Exhibit 2.

Height: Install riprap to a height of three feet above the ordinary high water mark, or 1 foot above the ordinary high water mark if used in conjunction with bioegineering techniques. All exposed soil above the riprap should be stabilized according to the vegetative BMPs.

Design Example Problem:
A streambank has an ordinary high water mark of 3 feet, an 8 foot bottom width, 2:1 side slopes and a two percent slope. There is a 75 foot long curved bank that is eroding. Determine the proper rock size, appropriate stone gradation, and dimensions of the riprap.

1. Refer to example Problems #2 to solve for the proper stone size. Use a D_{50} stone size of 12 inches.

2. This riprap will be placed to a height of 6 feet (3 feet above the ordinary high water mark). The depth will be 24 inches: [1.5 x (stone size of 12 inches) = 18 inches + 0.5 foot granular stone = total of 24 inches].

3. The length of area covered with riprap will be the eroded area (75 feet) + 10 feet upstream and downstream = 95 feet.

4. A geotextile fabric will be installed beneath the riprap.

Construction:

1. Where grading is required, grade the site according to the grading plan. Grade only when stone is ready to be placed.

2. Compact gravel subgrades according to design. Any fill that is used should be compacted to a density approximating that of the surrounding undisturbed area.

3. Install geotextile filter fabrics according to the manufacturer's specification. Always bury both the upper-most and toe of the geotextile fabric to prevent unravelling. (Basic installa-

tion techniques are discussed in the Filters BMP. Spread granular filters in uniform layers according to the design.

4. Install riprap. If riprap is dumped, hand place any rocks that need to be moved to fit the design.

Maintenance of Riprap on Stream Banks

Inspections should be made of all sites immediately after the first rainfall following installation of riprap. This is particularly important in areas where riprap that is displaced during the storm would impact culverts. Thereafter, riprapped sites should be checked following large storms, especially those which are near or exceed the storm frequency used in the design. Displaced riprap should be removed from its downstream location and new riprap placed according to the specifications above.

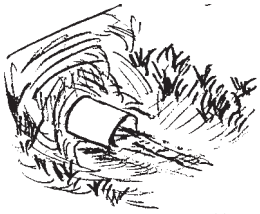
Outlets

General Considerations for Outlets

1. How and when to use a riprapped outlet should be made based on criteria given in the Stabilized Outlets BMP.

2. The outlet structure should be designed in conjunction with the conveyance system (i.e. pipe, outlet of a Sediment Basin, etc.) from which the water is outletted. There should be no overfall from the end of the pipe/outlet to the outlet structure (i.e. the pipe/outlet should not be suspended above the outlet structure).

overfall



no overfall

3. The outlet structure should be in place before water is released from the conveyance system.

4. Additional protection may be required on the opposite bank or downstream to prevent in-stream erosion.

5. There should be no overfall from the end of the apron to the receiving channel streambed.

Stone Size Selection for Outlets

1. The median stone diameter, d_{50}, in feet, shall be determined from the formula:

$$d_{50} = \frac{0.02}{TW}\left(\frac{Q}{D_o}\right)^{4/3}$$

Where TW is tailwater depth above the invert of the culvert in feet,

Q is the pipe discharge in cfs for the conduit design storm, or the 25-year storm, whichever is greater, and

D_o is the maximum inside culvert width in feet.

2. Fifty percent by size of the riprap mixture should be larger than the median size stone designated as d_{50} and 50% should be smaller. The largest stone size in the mixture should be 1.5 times the d_{50} size. The riprap should be reasonably well-graded.

Outlet Dimensions
Refer to Exhibit 8.

1. **Length**: The length of the apron, L, should be determined using the following formula:

$$L_a = \frac{1.7\,Q}{D_o^{3/2}} + 8D_o \quad \text{for culverts flowing up to 1/2 full.}$$

$$L_a = \frac{3.0\,Q}{D_o^{3/2}} \quad \text{for culverts flowing at or above 1/2 full}$$

Where Q and D_o are as described above.

2. **Width**: Where there is a well-defined channel downstream of the apron, the bottom width of the apron should be at least equal to the bottom width of the channel. The structural lining should extend at least one foot above the tailwater elevation, but no lower than two-thirds of the vertical conduit dimension above the conduit invert.

Where there is *no* well-defined channel immediately downstream of the apron (i.e. as may apply to Sediment Basins) width, W, of the outlet end of the apron should be as follows:

For tailwater elevation greater than or equal to the elevation of the center of the pipe:

$$W = 3D_o + 0.4L_a$$

For tailwater elevation less than the elevation of the center of the pipe:

$$W = 3D_o + L_a$$

Where L_a is the length of the apron determined from the formula above and D_o is the culvert width.

The width of the apron at the culvert outlet should be at least three times the culvert width.

3. The side slopes should be 2:1 or flatter.

4. The bottom grade should be level (0.0%).

5. There should be no overfall from the end of the apron to the receiving channel streambed.

6. There should be no overfall at the end of the apron or at the end of the culvert.

7. There should be no bends or curves at the intersection of the conduit and apron.

Stone Size and Gradation

1. The median stone diameter, D_{50}, in feet shall be determined from the formula,

$$D_{50} = \frac{0.02}{TW}\left(\frac{Q}{D_o}\right)^{4/3}$$

Where Q and D_o are as defined under apron dimensions and TW is tailwater depth above the invert of culvert in feet.

2. The largest stone size in the mixture shall be 1.5 times the D_{50} size. The riprap shall be reasonably well graded.

3. Gabions or precast cellular blocks may be substituted for riprap if the D_{50} size calculated above is less than or equal to the thickness of the gabions or concrete revetment blocks. See the Shoreline/Slope Stabilization BMP.

Design Example Problem:

Given: a maximum inside culvert width, D_o of 1.5 ft., a flow (Q) of 14/5 cfs, and a tailwater elevation, TW, of 0.7 feet, determine the appropriate design dimensions of the apron (h_a and W), and the D_{50} stone size.

Solution:

Using $L_a = \frac{1.7Q}{D_o^{3/2}} + 8D_o$

$$= \frac{1.7\,(14.5)}{(1.5)^{3/2}} + 8(1.5)$$

L_a = 25.4 feet, rounded up = 26 feet

Since TW < 0.5 D_o , use $W = 3D_o + L_a$

$$= 3(1.5) + 26$$

W = 30.5 feet, rounded up = 31 feet

Using $D_{50} = \frac{0.02}{TW}\left(\frac{Q}{D_o}\right)^{4/3}$

$$= \frac{0.02}{0.7}\left(\frac{14.5}{1.5}\right)^{4/3}$$

D_{50} = 0.58 feet, converted and rounded = 7 inches

Maintenance

Inspections should be made of all sites immediately after the first rainfall following installation of riprap. This is particularly important in areas where riprap that is displaced during the storm would impact culverts. Thereafter, riprapped sites should be checked following large storms, especially those which are near or exceed the storm frequency used in the design. Displaced riprap should be removed from its downstream location and new riprap placed according to the specifications above.

Exhibits

Formulas included in this BMP were taken from the Rhode Island Soil Erosion and Sediment Control Handbook, Rhode Island Dept. of Env. Mgt., 1989.

Exhibit 1: Streambank stabilization using Riprap. MDNR Construction Project Evaluation Manual, 1987, and Rhode Island Soil Erosion and Sediment Control Handbook, as adopted from Connecticut Guidelines for Soil Erosion and Sediment Control, Connecticut Council on Soil and Water Conservation, 1985.

Exhibit 2: Length and Height of Riprap. MDEQ, Surface Water Quality Division.

Exhibit 3: Maximum depth of Flow for Riprap-lined Channels. "Design of Stable Channels with Flexible Linings", Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975.

Exhibit 4: Distribution of Boundary Shear Around Wetted Perimeter of Trapezoid Channels. "Design of Stable Channels with Flexible Linings", Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975.

Exhibit 5: Angle of Repose for Riprap Stone. Virginia Erosion and Sediment Control Handbook, Virginia Soil and Water Conservation Commission, 1980.

Exhibit 6: Ratio of Critical Shear on Sides to Critical Shears on Bottom. "Design of Stable Channels with Flexible Linings", Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975.

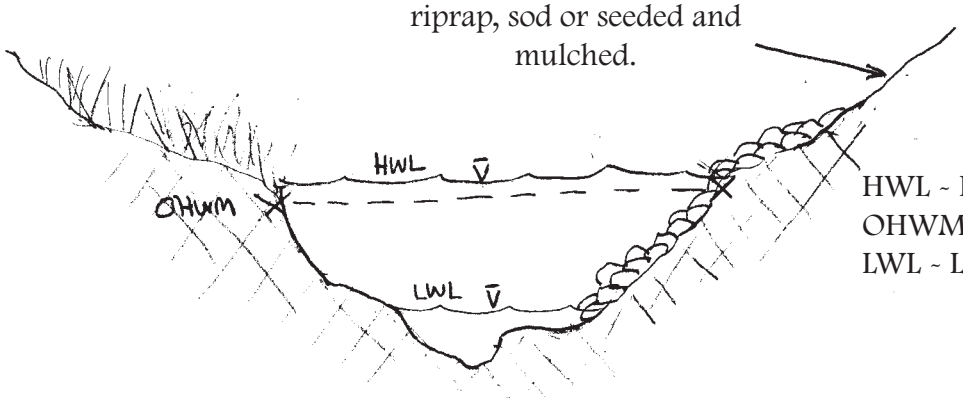
Exhibit 7: Ratio of Maximum Boundary Shear in Bends to Maximum Bottom Shear in Straight Reaches. Virginia Erosion and sediment Control Handbook, Virginia Soil and Water Conservation Commission, 1980.

Exhibit 8: Configuration of Conduit Outlet Protection where there is no well defined channel downstream. Standards for Soil Erosion and Sediment Control in New Jersey, New Jersey Soil Conservation Committee, 1980.

Exhibit 1

Ordinary High Water Mark

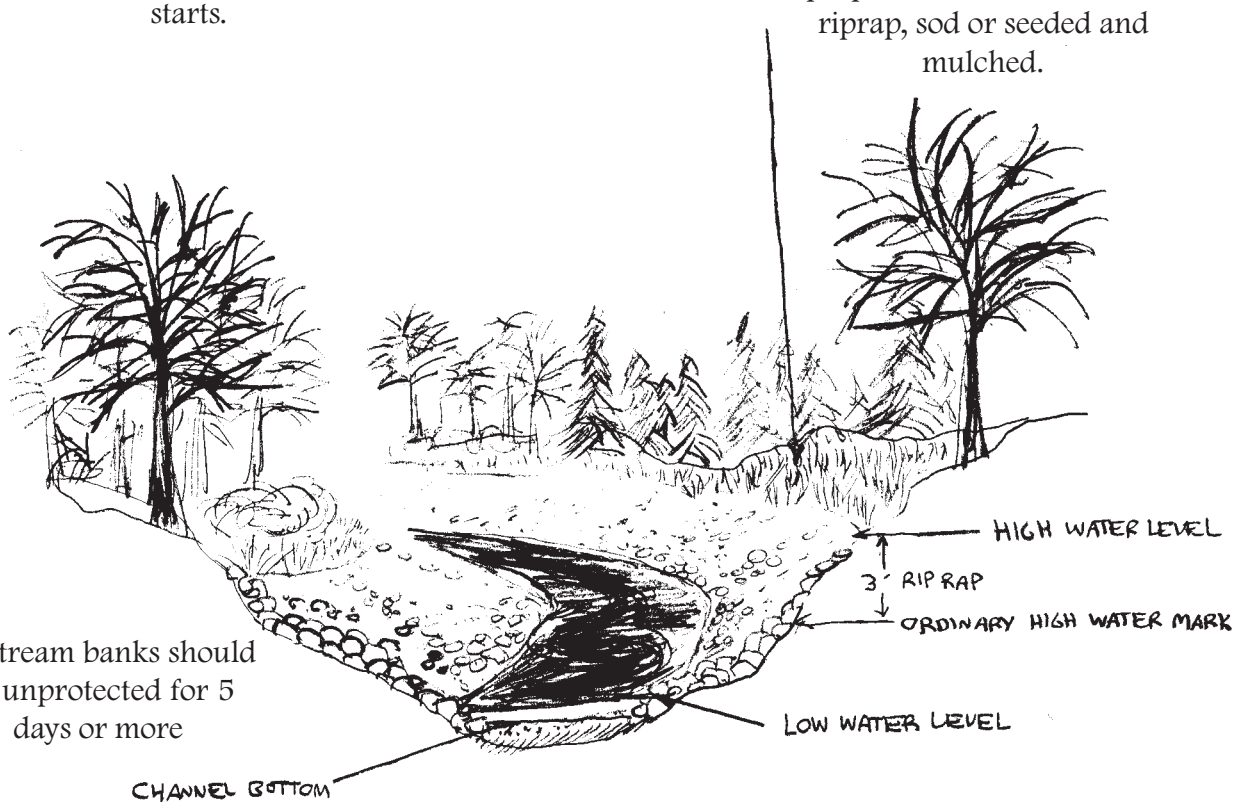
All raw soil above permanent riprap should be covered with riprap, sod or seeded and mulched.



HWL - High Water Level
OHWM - Ordinary High Water Mark
LWL - Low Water Mark

The ordinary high water mark is the normal water level, which on a river is where the grass stops and the bare soil starts.

All raw soil above permanent riprap should be covered with riprap, sod or seeded and mulched.

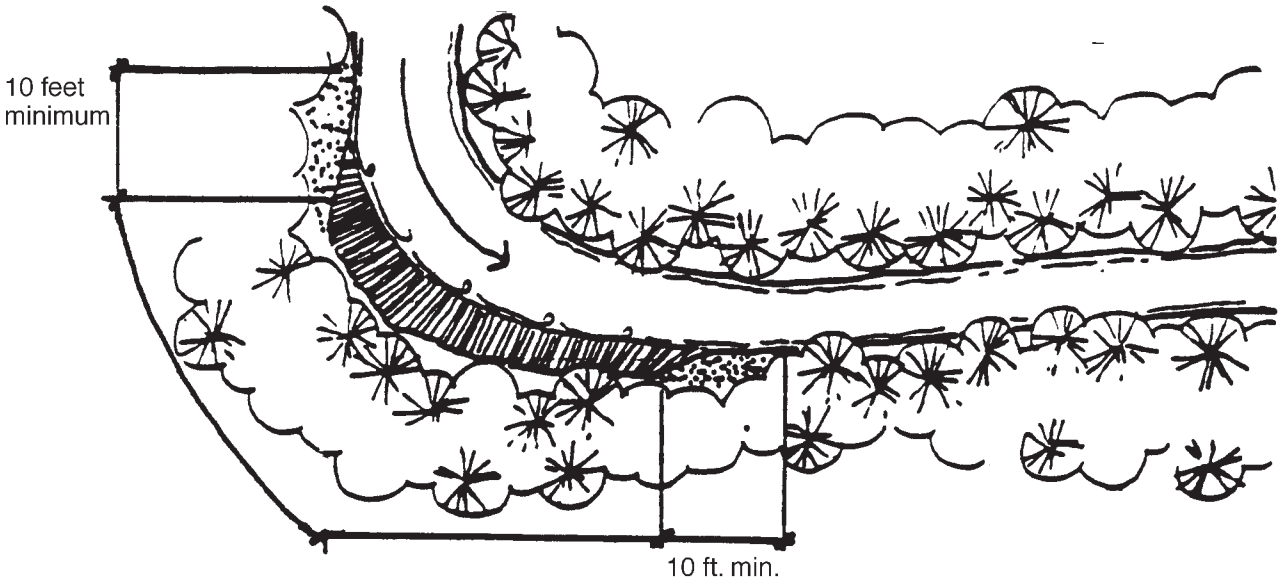


No stream banks should be unprotected for 5 days or more

Source: Michigan Department of Environmental Quality, Land and Water Management Division, 1997.

Exhibit 2

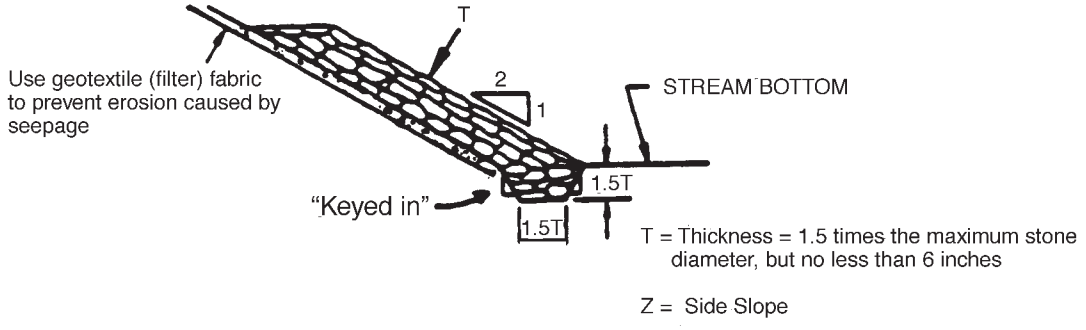
Riprap Placement: Length, Thickness, Height



Length to stabilize: cut bank, plus a minimum of 10 feet on both sides.

Height to stabilize: usually three feet above the Ordinary High Water Mark; can be less on hydrologically stable streams.

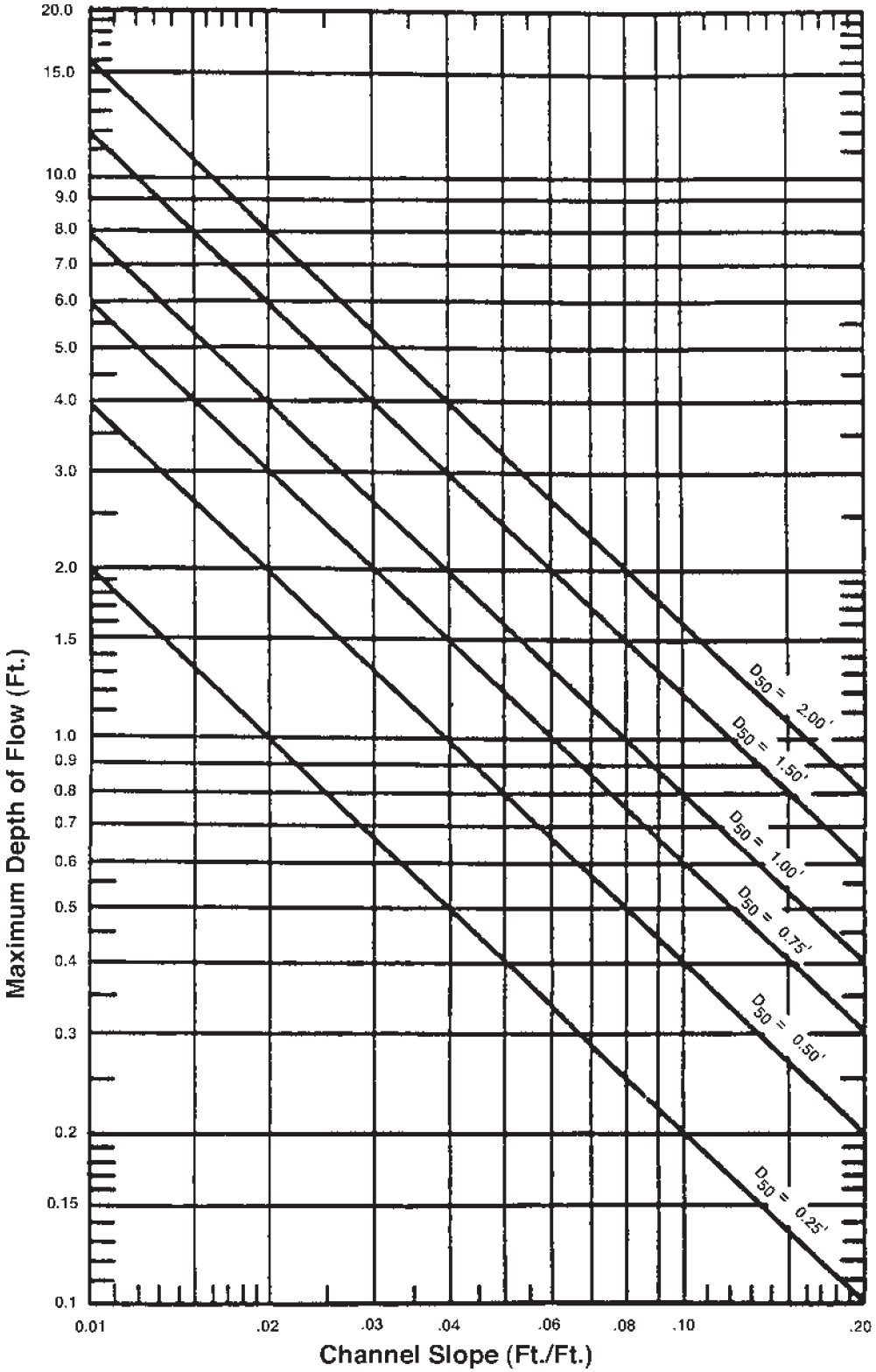
"Keying in"



Sources: Top: Construction Project Evaluation Manual. Michigan Department of Environmental Quality, Land and Water Mangement Division. Redrawn 1997. Bottom: Rhode Island Soil Erosion and Sediment Control Handbook, as adopted from the Connecticut Guidelines for Soil Erosion and Sediment Control, Connecticut Council of Soil and Water Conservation, 1985. Redrawn 1997 by MDEQ.

Exhibit 3

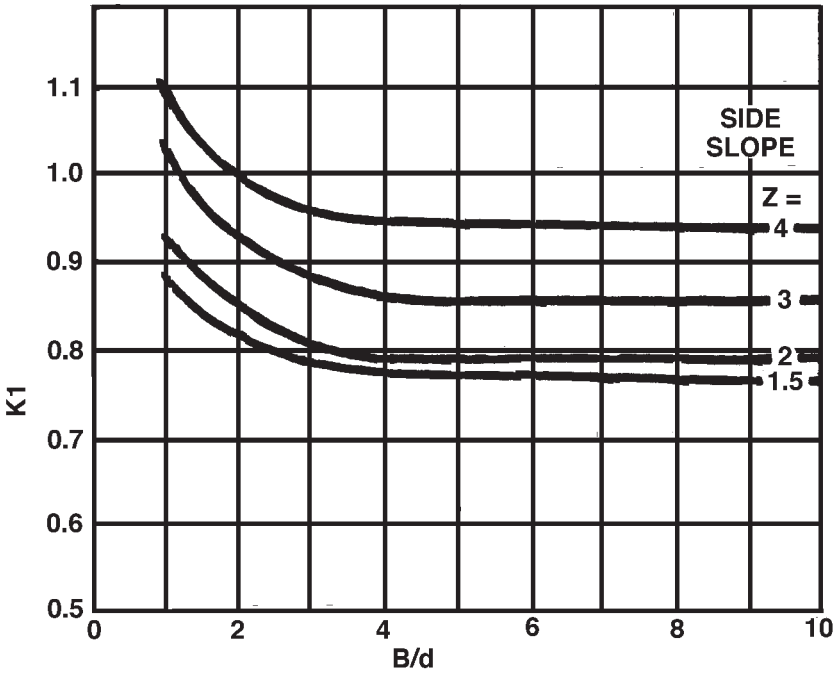
Maximum Depth of Flow for Riprap-Lined Channels



Source: Design of Stable Channels with Flexible Linings, Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.

Exhibit 4

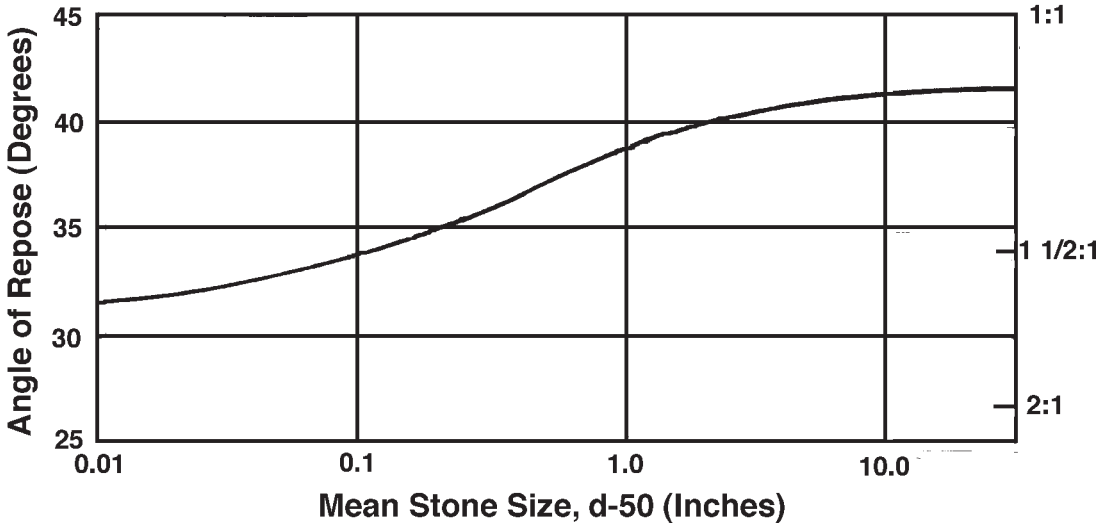
Distribution of Boundary Sheer Around Wetted Perimeter of Trapezoidal Channels



Source: Design of Stable Channels with Flexible Linings, Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.

Exhibit 5

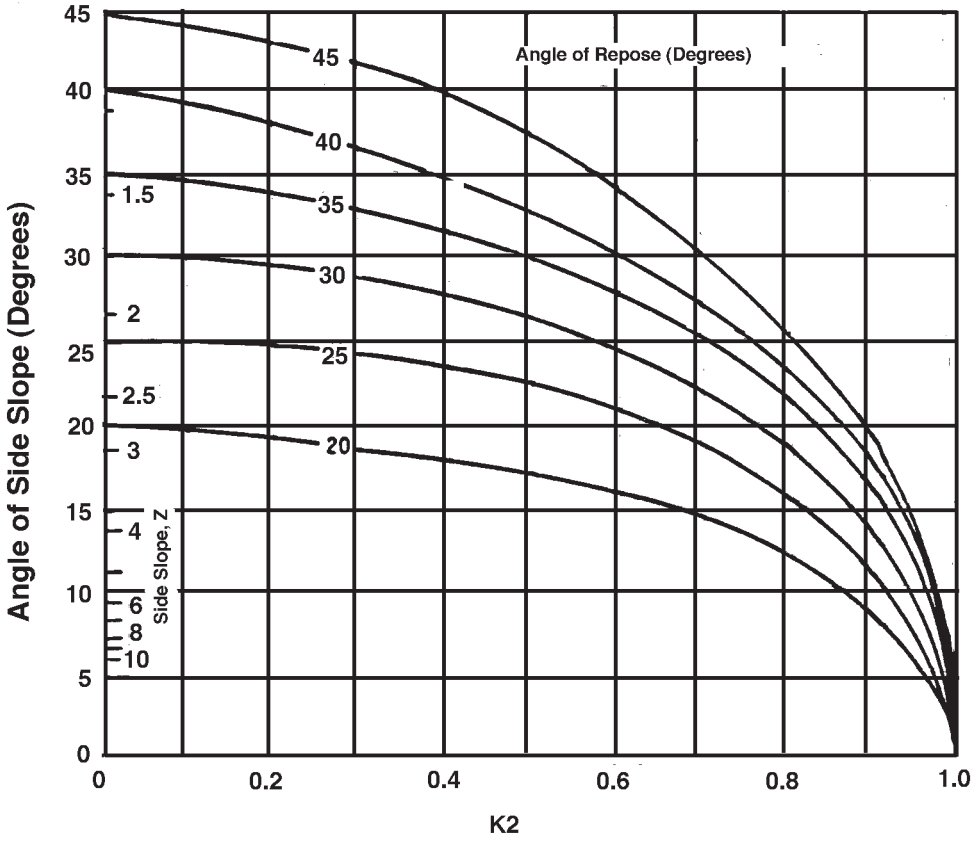
Angle of Repose for Riprap Stones



Source: Virginia Erosion and Sediment Control Handbook, Virginia Soil and Water Conservation Commission, 1980, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.

Exhibit 6

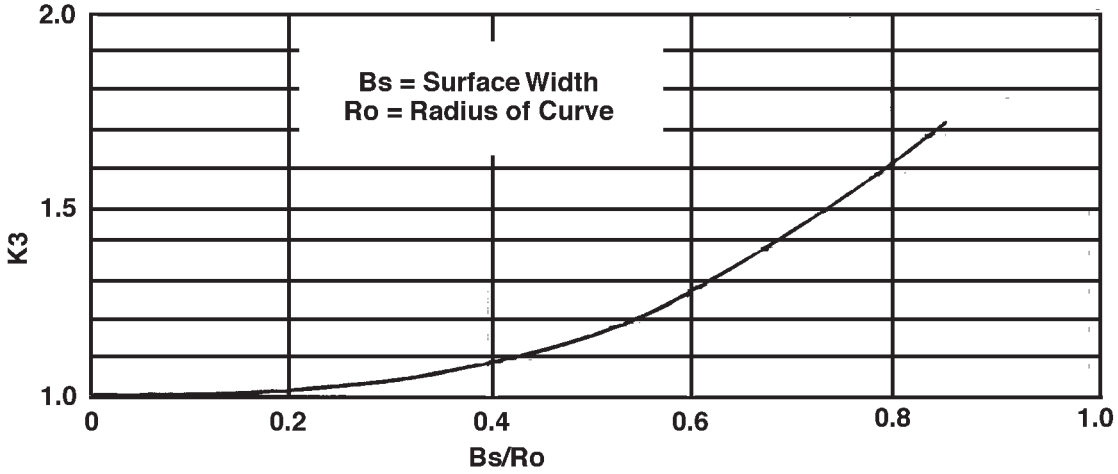
Ratio of Critical Shear on Sides to Critical Shear on Bottom



Source: Design of Stable Channels with Flexible Linings, Hydraulic Engineering Circular No. 15, Federal Highway Administration, 1975, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.

Exhibit 7

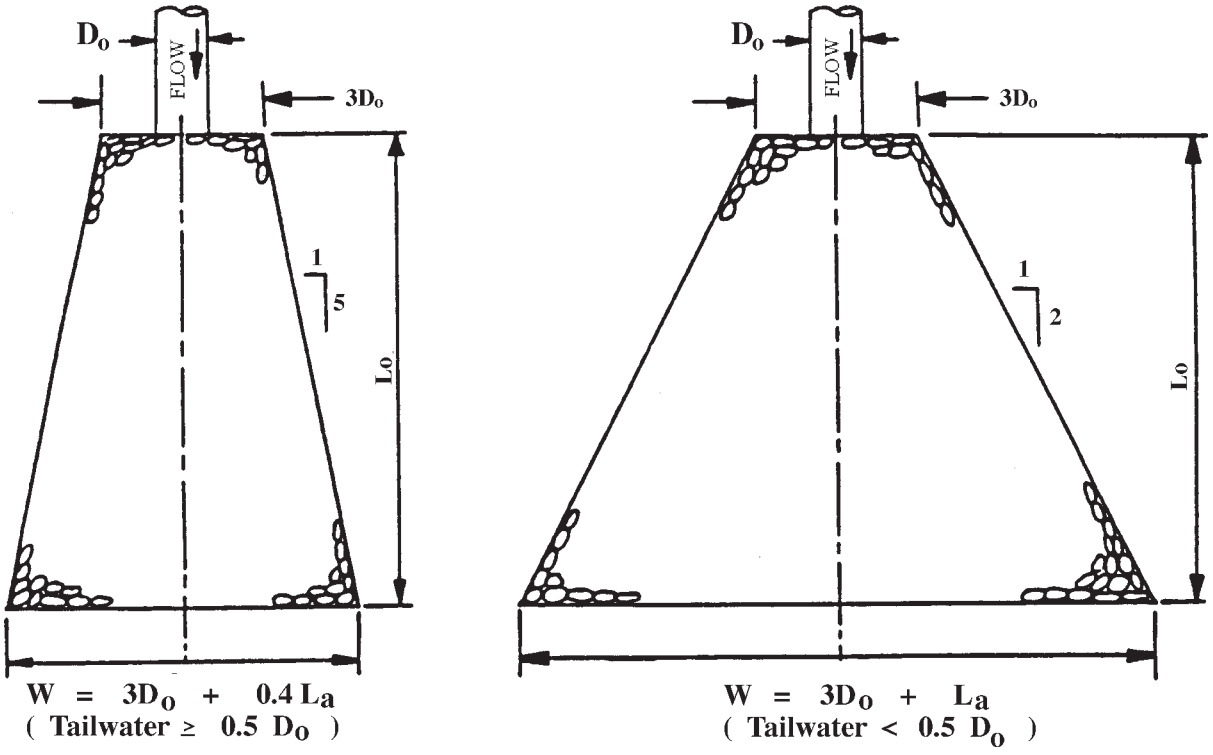
Ratio of Maximum Boundary Shear in Bends to Maximum Bottom Shear in Straight Reaches



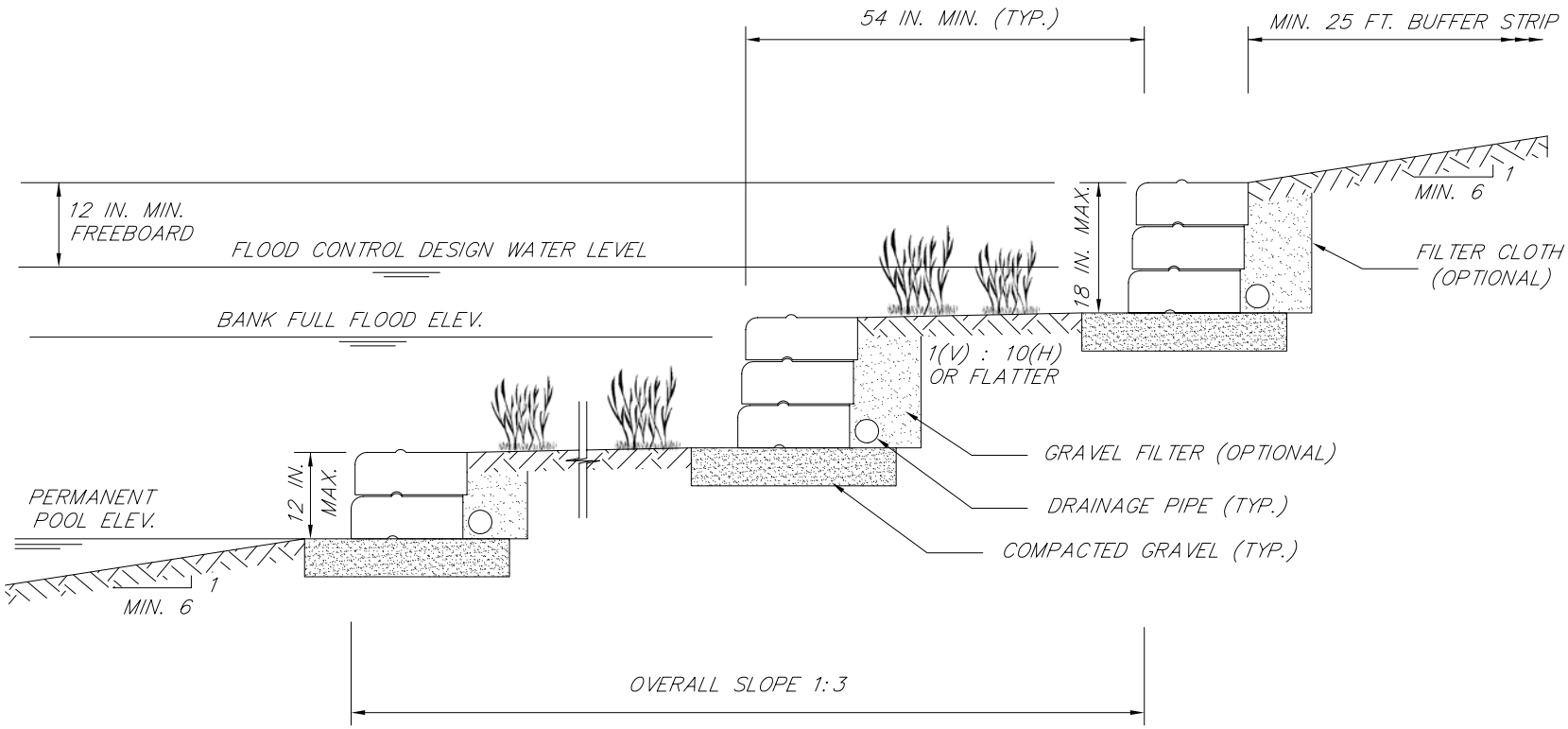
Source: Virginia Erosion and Sediment Control Handbook, Virginia Soil and Water Conservation Commission, 1980, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.

Exhibit 8

Configuration of Conduit Outlet Protection Where There is no Well-Defined Channel Downstream



Source: Standards for Soil Erosion and Sediment Control in New Jersey, New Jersey Soil Conservation Committee, 1980, as copied from the Rhode Island Soil Erosion and Sediment Control Handbook.



ALL TERRACING MATERIALS MUST BE APPROVED BY THE LOCAL COMMUNITY

EXAMPLE OF TERRACING DETAIL

NOT TO SCALE

APPENDIX E

Stormwater Management Ordinance

Wayne County Commission

Alisha R. Bell
Chair

Pamela Lane
Director

CLERK OF THE COMMISSION

August 20, 2021

Honorable Warren C. Evans
Chief Executive Officer
Charter County of Wayne
Suite 3111, Wayne County Building
Detroit, Michigan 48226

Dear Executive Evans:

Transmitted herewith are the resolutions and ordinances that were duly adopted by the Wayne County Commission at the Commission meeting held on Thursday, August 19, 2021.

2021-526a An ordinance by Commissioner Marecki to amend the Wayne County Stormwater Management Ordinance. (2021-70-004)

2021-526b A resolution by Commissioner Marecki to amend the Wayne County Stormwater Management Ordinance Administrative Rules. (2021-70-004)

2021-527 A resolution by Commissioner Marecki to receive and file, the Commission's community parks millage allocations and the Wayne County Parks Millage Capital Plan, pursuant to Enrolled Ordinance No. 2020-561, page 19, item 3. (2021-60-059)

2021-528 A resolution by Commissioner Marecki to receive and file, a copy of the completion status of road repairs pertaining to the Township Paving Program, pursuant to Enrolled Ordinance No. 2020-561, page 18, item 6. (2021-30-062)

2021-529 A resolution by Commissioner Marecki approving a three-year contract, with an option to renew between the Charter County of Wayne and Alfred Benesch & Company (of Detroit) not to exceed $321,285.52 for professional engineering design services to reconstruct the Southfield Road Bridge over Ecorse Creek, Structure No. 12039 in the Cities of Ecorse and Lincoln Park; the term of the contract is from August 19, 2021 through August 18, 2024. (2021-30-059)

2021-530 A resolution by Commissioner Marecki approving a cooperative agreement between the Charter County of Wayne and Leslie Tire Service, Inc. dba CBA Holdings, Inc. (of Harrison Township) not to exceed $600,000, through MiDEAL (DTMB) contract No. 190000000369, for Goodyear tires; the term of the agreement is from December 1, 2021 through March 31, 2024. (2021-17-019)

2021-531 A resolution by Commissioner Marecki approving a three-year contract with a one-year option to renew between the Charter County of Wayne and Alfred Benesch & Company (of Detroit) not to exceed $208,151.23 for as-needed engineering services as a bridge program manager for Wayne County-owned bridges in accordance with the National Bridge Inspection Standards and the State of Michigan Structure Inspection Manual; the term of the contract is from August 19, 2021 through August 18, 2024. (2021-30-060)

2021-532 A resolution by Commissioners Knezek and Marecki approving an intergovernmental agreement between the Charter County of Wayne and the Township of Redford not to exceed $26,306 for improvements to Manning Park and Elliot Tot Lot; the term of the agreement is from August 19, 2021 through September 30, 2023. (2021-60-060)

2021-533 A resolution by Commissioner Varga to receive and file, the Statements of Chargebacks for the period of October 1, 2019 through September 30, 2020. (2021-31-015)

2021-534 An ordinance by Commissioner Varga approving a proposed amendment to the 2020-2021 Appropriations Ordinance (Enrolled Ordinance No. 2020-561) in accordance with Budget Adjustment No. 2021-35-161 reallocating expenditures in the amount of $70,950 in the County Park Fund (208). (2021-35-161)

2021-535 An ordinance by Commissioner Varga approving a proposed amendment to the 2020-2021 Appropriations Ordinance (Enrolled Ordinance No. 2020-561) in accordance with Budget Adjustment No. 2021-35-211 certifying revenue in the amount of $1,148,210 in the Covid 19 Fund (298). (2021-35-211)

2021-536 A resolution by Commissioner Clark-Coleman to receive and file, the Sheriff's Office monthly report on overtime costs, pursuant to Enrolled Ordinance No. 2020-561, page 14, item 8. (2021-69-033)

2021-537 A resolution by Commissioner Clark-Coleman to receive and file, a report on the County-owned vehicles assigned to the Sheriff's Office that are being taken home, used outside Wayne County and the reason why, pursuant to Enrolled Ordinance No. 2020-561, Page 14, Item 5. (2021-69-034)

2021-538 A resolution by Commissioner Clark-Coleman approving Amendment No. 3 to a one-year cooperative agreement between the Charter County of Wayne and Acro Service Corp. (of Livonia) in the amount of $197,558.40, through OMNIA Partners contract No. 16111, extending the term of the agreement to continue to provide maintenance and support for a full range of law enforcement technology platforms at the Sheriff's Office, including support for enterprisewide application systems for the jails and field operations; Amendment No. 3 increases the total agreement amount from $296,337.60 to $493,896; the term of Amendment No. 3 is from October 1, 2021 through September 30, 2023. (2018-71-125M3)

2021-539 A resolution by Commissioner Daub to receive and file, an Emergency Procurement Report for a contract with a one-year option to renew with WorldTech IT, LLC (of Austin, TX) in the amount of $434,852.40 for F5 hardware and services; this contract is critical to support the ongoing and expanding workforce of the County due to the COVID-19 pandemic; the term of the contract is from September 23, 2020 through September 30, 2025. (2020-53-067)

2021-540 A resolution by Commissioner Daub approving the appointment of Robin Dillard-Russaw (of Lathrup Village) to the position of Director of the Indigent Defense Services Department; Ms. Dillard-Russaw will be paid an annual salary of $147,992 and receive paid parking, and all other benefits will be provided in accordance with the Executive Benefit Plan for executive branch employees; the term of the appointment will begin August 19, 2021. (2021-01-024)

2021-541 A resolution by Commissioner Daub approving a settlement in the matter of Michigan AFSCME Wayne County Retiree Sub-Chapter 38 v the County of Wayne (Grievance #8) not to exceed $100,000, subject to approval in Wayne County Circuit Court. (2021-40-044)

2021-542 A resolution by Commissioner Daub approving a prelitigation settlement in the matter of Rodney Clark v County of Wayne not to exceed $150,000. (2021-40-045)

2021-543 A resolution by Commissioner Bell approving the re-appointments of David Katz (of Grosse Pointe), Commissioner Alisha Bell (of Detroit) and Commissioner Terry Marecki (of Livonia) to the Wayne County Zoological Authority Board of Directors, pursuant to Article III, Section 1 of the Zoological Authority Articles of Incorporation and Public Act 49 of 2008 (MCL 123.1161) for a term of August 20, 2021 through August 19, 2022. (2021-66-041)

2021-544 A resolution by Commissioner Bell approving the appointment of Gail Perry-Mason (of Detroit), as nominated by Detroit Mayor Michael E. Duggan, to the Detroit Wayne Integrated Health Network Board of Directors, pursuant

to MCL 330.1212(b) and MCL 330.1222(1); the term of the appointment is from August 19, 2021 through March 31, 2024. (2021-69-035)

2021-545 A resolution by Commissioner Bell approving a cooperative agreement with one, one-year option to renew between the Charter County of Wayne and Guidehouse, Inc. (of Falls Church, VA) not to exceed $4,000,000, through the Michigan Association of Counties-CoPro+ cooperative (no contract number listed), to ensure proper federal reporting for American Rescue Plan Act funds; the term of the agreement is from August 19, 2021 through June 2, 2022. (2021-31-016)

Respectfully submitted,

PAMELA LANE
Acting Clerk of the Commission

ENROLLED ORDINANCE

No. 2021-526a

INTRODUCED BY COMMISSIONER(S): MARECKI

AN ORDINANCE TO AMEND CHAPTER 95 OF THE WAYNE COUNTY CODE OF ORDINANCES, STORMWATER MANAGEMENT, TO AMEND SECTIONS 95-1; 95-2; 95-3; 95-4; 95-5; 95-6; 95-7; 95-9; 95-21; 95-31; 95-32; 95-41; 95-42; 95-43; 95-51; 95-52; 95-61; 95-71; 95-72; 95-81; 95-91; 95-92; 95-93; 95-95; 95-96; 95-97; 95-98; AND 95-111; TO ADD SECTIONS 95-73; 95-74; AND 95-75; AND TO DELETE SECTIONS 95-94 AND 95-112, IN ORDER TO SIMPLIFY AND STREAMLINE THE CONSTRUCTION PERMIT REVIEW, APPROVAL, COMPLIANCE AND APPEAL PROCESS, TO IMPROVE WATER QUALITY AND PREVENT FLOODING, TO ENSURE THAT WAYNE COUNTY'S STORMWATER CONTROL PROGRAM IS REFLECTIVE OF CURRENT CONDITIONS AND TECHNOLOGY, TO GUARANTEE THAT STORMWATER CONTROL SYSTEMS ARE PROPERLY AND PERPETUALLY MAINTAINED AND TO CREATE CONSISTENCY BETWEEN COUNTIES WITHIN SOUTHEASTERN MICHIGAN.

IT IS HEREBY ORDAINED BY THE PEOPLE OF THE CHARTER COUNTY OF WAYNE:

SECTION 1: CODE OF ORDINANCES AMENDED

Chapter 95 of the Wayne County Code of Ordinances is amended to read as follows:

WAYNE COUNTY STORMWATER CONTROL ORDINANCE

Table of ContentsARTICLE I. GENERAL PROVISIONS 4

ARTICLE I. GENERAL PROVISIONS

Sec. 95-1. AUTHORITY

This Ordinance is enacted in accordance with the Federal Water Pollution Control Act of 1972, 33 U.S.C. 1251 et seq., as amended; Part 31 of the Natural Resources and Environmental Protection Act of 1994 ("Part 31"), MCL 324.3101 et seq., as amended; the "Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s)" issued by the Michigan Department of Environment, Great Lakes, and Energy pursuant to Part 31, as amended; Act 288 of 1967 (Subdivision Control Act), MCL 560.101 et seq., as amended by the Land Division Act, MCL 560.101 et seq.; Act 283 of 1909 (County Road Law), MCL 224.1 et seq., as amended; Act 40 of 1956 (Drain Code), MCL 280.1 et seq., as amended; and Act 96 of 1987 (Mobile Home Commission Act), MCL 125.2301 et seq., as amended; the Charter County Law, MCL 45.515 et seq., and the Home Rule Charter of Wayne County, Michigan (1981), as amended.

Sec. 95-2. PURPOSE

Prevention of pollution from stormwater runoff and the protection of the quality of the waters of the state of Michigan is of utmost importance to the People of the Charter County of Wayne. It is the purpose of this Ordinance and any rules promulgated pursuant to this Ordinance:

A. To protect the environment against pollution and other effects from stormwater runoff, and to protect the public health and safety;

B. To provide for the implementation of a stormwater control program in Wayne County to protect public and private property by minimizing and

preventing flooding, streambank erosion, pollution, and other negative impacts from uncontrolled, excess stormwater runoff;

C. To establish standards and criteria for the design and construction of stormwater control systems subject to the requirements of this Ordinance;

D. To establish best management practices for the design, construction, maintenance, and operation of stormwater control systems subject to the requirements of this Ordinance;

E. To provide for the issuance of stormwater construction approvals for construction activities subject to the requirements of this Ordinance;

F. To provide for the long-term preservation and maintenance of stormwater control systems subject to the requirements of the Ordinance;

G. To authorize the inspection of stormwater control systems subject to the requirements of this Ordinance; and

H. To provide for the administration, implementation, and enforcement of this Ordinance.

Sec. 95-3. TITLE

This Ordinance shall be known and may be cited as the “Wayne County Stormwater Control Ordinance.”

Sec. 95-4. ADMINISTRATION

This Ordinance shall be administered by the Wayne County Department of Public Services, or its designee.

Sec. 95-5. EFFECTIVE DATE

The Wayne County Stormwater Control Ordinance, formerly known as the Wayne County Stormwater Management Ordinance, became effective October 23, 2000.

Sec. 95-6. STATE RULES

Unless otherwise specifically provided in this Ordinance, the provisions of this Ordinance shall control over less stringent rules of the Michigan Department of Environment, Great Lakes, and Energy, unless contrary to law.

Sec. 95-7. NO WAIVER OF OTHER OBLIGATIONS

Nothing in this Ordinance or any rule promulgated pursuant to this Ordinance shall be construed to reduce, abate, alter, modify, amend, or affect any duty or obligation to preserve and protect the environment, including the Rouge River, Ecorse Creek, and Huron River watersheds or other waters of the state; to control soil erosion and sedimentation; to protect wetlands; or to prevent air, water, or other pollution.

Sec. 95-8. INCORPORATION BY REFERENCE

Rules, regulations, other regulatory standards or statutory provisions incorporated or adopted by reference in this Ordinance or any rules promulgated pursuant to this Ordinance shall have the same force and effect given to any provision of this Ordinance.

Sec. 95-9. SEVERABILITY AND CONFLICT

The provisions of this Ordinance shall be severable. If any provision of this Ordinance is declared by a Court of competent jurisdiction to be unconstitutional or otherwise invalid, the remaining provisions of this Ordinance shall remain valid and enforceable. To the extent the terms and requirements of this Ordinance conflict with other County rules or regulations concerning stormwater control, the terms and requirements of this Ordinance shall control.

Secs. 95-10 – 95-20. – Reserved.

ARTICLE II. DEFINITIONS

Sec. 95-21. DEFINITIONS

As used in this Ordinance, the following terms have the following meanings, whether capitalized or not herein:

(A) *Applicant* - A property owner, or the property owner's authorized agent or representative, responsible for regulated construction activity on a development site and who is seeking to obtain stormwater construction approval.

(B) *Best management practice*, or *BMP* - A practice or combination of practices that have been determined by the County to be the preferred method of preventing, minimizing, or reducing pollution and other effects of stormwater and stormwater runoff.

(C) *Bioretention area* - A component of a stormwater control system that is comprised of a depressed land area that contains specific soil, plant materials, and other features and is used for channel protection and/or water quality control.

(D) *Bridge* - A structure, including supports, built to carry a feature over surface water or watercourse, with a clear span of more than 20 feet measured along the center of the feature being carried.

(E) *Buffer strip* - A zone that is used for filtering stormwater and to direct stormwater runoff into a stormwater control system and/or for providing maintenance access to a stormwater control system.

(F) *Catch basin* - A structure designed to collect water from the surface and convey it into a closed conduit.

(G) *Closed conduit* - An enclosed conveyance designed to carry stormwater runoff such that the surface of the water is not exposed to the atmosphere, including without limitation storm sewers, culverts, closed County drains, and pipes.

(H) *Construction activity* - A manmade activity, including without limitation, clearing, grading, excavating, construction and paving, that results in an earth change or disturbance in the existing cover or topography of land, including any modification or alteration of a site or the "footprint" of a building that results in an earth change or disturbance in the existing cover or topography of land.

(I) *Construction Permit or "C Permit"* – A construction permit issued by the County after the issuance of a stormwater construction approval in accordance with this Ordinance and the rules promulgated hereunder.

(J) *Conveyance* - Any structure or other means of safely conveying stormwater and stormwater runoff within a stormwater control system, including without limitation a watercourse, closed conduit, culvert, or bridge.

(K) *County* - The Charter County of Wayne, Michigan.

(L) *County drains* - Drains established pursuant to the Michigan Drain Code of 1956, MCL 280.1 et seq., as amended.

(M) *County road* – Shall include roads and road rights-of-way within the jurisdiction of the County.

(N) *Culvert* - A structure, including supports, built to carry a feature (i.e. roadway) over a surface water or watercourse, with a clear span of less than 20 feet measured along the center of the feature being carried.

(O) *Design storm* - A rainfall event of specified size and return interval that is used to calculate the water volume and peak flow rate that must be handled by a stormwater control system.

(P) *Detention* or *Detain* - The temporary storage of stormwater and stormwater runoff to control peak flow rates and/or provide pollutant removal before discharging the water to a surface water or closed conduit.

(Q) *Detention system* - A component of a stormwater control system, either aboveground or belowground, that detains stormwater and stormwater runoff. Detention systems may include, without limitation, open detention basins and underground detention systems.

(R) *Development site* -The property on which regulated construction activity will occur or is occurring or has occurred.

(S) *Director* - The Director of the Wayne County Department of Public Services or his or her designee.

(T) *Drainage area* - The entire upstream land area from which stormwater runoff drains to a particular location, including any off-site drainage area.

(U) *Extended detention* - The storage and gradual release of stormwater from a detention system over a period of not less than 48 hours.

(V) *Flood control* - Methods used to reduce or prevent negative impacts of stormwater runoff.

(W) *Forebay* - A component of a stormwater control system that is comprised of surface water that is used as a pretreatment system.

(X) *Long-Term Maintenance Agreement* – Long-Term Maintenance Permit fully executed by the County, Property Owner and the local unit(s) of government in which the stormwater control system is located or other public entity approved by the County, together with a resolution issued by the local unit(s) of government or other public entity approved by the County.

(Y) *Long-Term Maintenance Permit or "M Permit"* – A Long-Term Maintenance Permit issued by the County, including the long-term maintenance plan approved by the County, pursuant to this Ordinance and the rules promulgated pursuant to this Ordinance.

(Z) *Long-Term Maintenance Plan* - A written document submitted as part of the construction permit (C-Permit) application that identifies all of the stormwater control system components, maintenance responsibilities and schedule, and is included in the Long-Term Maintenance Permit executed by the County, the Property Owner and the local unit(s) of government or other public entity approved by the County.

(AA) *Manufactured treatment system* - A component of a stormwater control system that is comprised of a manmade device or structure that is used as a pretreatment system.

(BB) *MS4* - Municipal Separate Storm Sewer System is a system of drainage (including, but not limited to, roads, storm drains, pipes and ditches) that is publicly owned, not a combined sewer or part of a sewage treatment plant.

During wet weather, pollutants are transported through MS4s to local water bodies.

(CC) *MS4 Permit* - A permit under Section 402 of the Federal Water Pollution Control Act of 1972, as amended, and under Part 31 of the Michigan Natural Resources and Environmental Protection Act of 1994, as amended, that is required by regulated communities with MS4s that discharge to waters of the state.

(DD) *Open detention basin* - A component of a stormwater control system that is comprised of a surface water that is used as a detention system.

(EE) *Ordinance* - The Wayne County Stormwater Control Ordinance.

(FF) *Peak flow rate* - The maximum instantaneous rate of flow at a particular location within a stormwater control system, usually in reference to a specific design storm event.

(GG) *Permit* – A construction permit or long-term maintenance permit, as applicable, issued by the County pursuant to this Ordinance.

(HH) *Permit Office* - The Permit Office of the Wayne County Department of Public Services, Engineering Division.

(II) *Permit Holder* – A person granted a permit pursuant to this Ordinance.

(JJ) *Person* - A natural person, trustee, court-appointed representative, syndicate, association, partnership, firm, club, limited company, limited liability company, s corporation, c corporation, partnership, limited liability partnership, business trust, institution, agency, government corporation, municipal corporation, city, county, municipality, district, or other political

subdivision, department, bureau, agency or instrumentality of federal, state, or local government, or other entity recognized by law as the subject of rights and duties, whether organized in the State of Michigan or another state, country or territory.

(KK) *Pollutant* - Any substance introduced into the environment that may adversely affect the public health, safety, welfare, or the environment, or the usefulness of a resource.

(LL) *Pretreatment system* - A structure, feature, or appurtenance, or combination thereof, either aboveground or belowground, that is used as a component of a stormwater control system to remove incoming pollutants from stormwater and stormwater runoff. Pretreatment systems may include, without limitation, forebays, manufactured treatment systems, and bioretention areas.

(MM) *Property Owner*- A person with legal title to real property on which a stormwater control system is constructed pursuant to this Ordinance.

(NN) *Regulated construction activity* - Construction activity that is subject to the provisions of this Ordinance or a rule promulgated pursuant to this Ordinance.

(OO) *Retention* or *Retain* - The storage of stormwater and stormwater runoff to provide gravity settling of pollutants and to promote infiltration into the soil, rather than to discharge the stormwater or stormwater runoff to a surface water or closed conduit.

(PP) *Retention basin* - A component of a stormwater control system that retains stormwater and stormwater runoff with no outlet to the receiving drainage system. Retention basins discharge via infiltration and evaporation.

(QQ) *Rules* – The Administrative Rules promulgated pursuant to this Ordinance, known as the Wayne County Stormwater Control Administrative Rules.

(RR) *Stormwater* - Water resulting from precipitation, including without limitation rain, snow, and snowmelt.

(SS) *Stormwater construction approval* - An approval issued pursuant to this Ordinance and rules promulgated pursuant to this Ordinance.

(TT) *Stormwater control program* - The ordinances, orders, rules, regulations, and other mechanisms that provide for the control of stormwater and stormwater runoff to prevent and reduce flooding and to ensure the restoration and/or protection of surface waters in Wayne County. With respect to the County, stormwater control program consists of the requirements of this Ordinance and any rules or regulations promulgated under this Ordinance, the Stormwater Standards Manual, and activities mandated by the Wayne County Municipal Separate Storm Sewer System (MS4) Permit as issued by the Michigan Department of Environment, Great Lakes, and Energy to the County.

(UU) *Stormwater control system* - Any structure, feature or appurtenance subject to this Ordinance or a rule promulgated pursuant to this Ordinance that is designed to collect, detain, retain, treat, or convey stormwater or stormwater runoff, including without limitation buffer strips, swales, gutters, catch

basins, closed conduits, detention systems, pretreatment systems, wetlands, pavement, unpaved surfaces, structures, watercourses, or surface waters.

(VV) *Stormwater Standards Manual* – A manual published separately by the Department of Public Services and updated periodically that outlines key elements of this Ordinance and the Rules and assists with their implementation. Specifically, the manual describes: performance standards for stormwater control systems, design criteria for the various components of stormwater control systems, and design and maintenance information for various BMPs.

(WW) *Stormwater runoff* - The excess portion of precipitation that does not infiltrate the ground, but “runs off” and reaches a conveyance, surface water, or watercourse.

(XX) *Surface water* - A body of water, including without limitation seasonal and intermittent waters, in which the surface of the water is exposed to the atmosphere, including without limitation lakes, open detention basins, forebays, watercourses, bioretention areas, retention basins, wetlands, and impoundments.

(YY) *Underground detention system* - One or more underground pipes and/or other structures that are utilized as a detention system.

(ZZ) *Watercourse* - A natural or artificial channel through which water flows, including without limitation rivers, streams, vegetated swales, open channels, and open County Drains.

(AAA) *Watershed* - The complete area or region draining into a watercourse, surface water, or closed conduit.

(BBB) *Wetland* - Land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh.

Secs. 95-22 – 95-30. – Reserved

ARTICLE III. APPLICABILITY

Sec. 95-31. GENERAL

A. This Ordinance and rules promulgated pursuant to this Ordinance shall apply to all of the following:

(i) construction activity that negatively impacts or may negatively impact stormwater runoff into or around new or existing road rights-of-way within the jurisdiction of the County;

(ii) construction activity that negatively impacts or may negatively impact stormwater runoff into or around County drains;

(iii) construction activity that negatively impacts or may negatively impact stormwater runoff in projects that are subject to the requirements of Act 288 of 1967 (Subdivision Control Act), MCL 560.101 et seq., as amended;

(iv) construction activity that negatively impacts or may negatively impact stormwater runoff from projects that are subject to Act 96 of 1987 (Mobile Home Commission Act), MCL 125.2301 et seq., as amended;

(v) construction activity that negatively impacts or may negatively impact stormwater runoff into, on, or through property owned by the County;

(vi) construction activity that negatively impacts or may negatively impact new or existing storm sewer systems owned, operated, or controlled by the County; and

(vii) construction activity that occurs within and negatively impacts or may negatively impact water quality or water resources in watersheds or sub-watersheds impacted by discharges authorized by the Michigan Department of Environment, Great Lakes, and Energy pursuant to the Wayne County Municipal Separate Storm Sewer Systems (MS4) Permit.

Construction activity that negatively impacts or may negatively impact stormwater runoff or water quality includes, without limitation, construction activity that: increases stormwater runoff rates, velocities, or volumes; increases water pollution or transports pollutants; causes erosion and/or sedimentation of waterways; causes a lack of ground infiltration; increases water temperatures; exceeds the safe receiving capacities of storm sewer systems owned, operated, or controlled by the County; or endangers public health or safety.

B. Notwithstanding the foregoing Section 95-31A, this Ordinance shall not apply to emergency repairs within a County right-of-way.

Sec. 95-32. LOCAL REQUIREMENTS

(A) Nothing in this Ordinance, or in any rule promulgated pursuant to this Ordinance, invalidates any rule, regulation, or ordinance enacted by a local unit of government within Wayne County prior to the Effective Date of this Ordinance, or prevents any local unit of government from adopting or enacting a stormwater control program applicable to activities within its jurisdiction.

(B) Nothing in this Ordinance or in any rule promulgated pursuant to this Ordinance shall apply to construction activity that is subject to a stormwater control program enacted by a local unit of government within Wayne County that imposes requirements equal to or more stringent than the minimum applicable requirements of this Ordinance.

(C) The County, in its sole discretion, and to the extent permitted by law, may enter into an agreement with any local unit of government within Wayne County for the purpose of implementing, in whole or in part, this Ordinance and/or any rule promulgated pursuant to this Ordinance, with respect to construction activity within the jurisdiction of the local unit of government.

Secs. 95-33 – 95-40-. – Reserved.

ARTICLE IV. STORMWATER CONSTRUCTION APPROVALS

Sec. 95-41. GENERAL REQUIREMENTS

It shall be a violation of this Ordinance to engage in regulated construction activity except in accordance with this Ordinance and rules promulgated pursuant to this Ordinance, and pursuant to a valid stormwater construction approval and construction permit issued by the County. A stormwater construction approval shall be issued in a form and manner

approved by the County and may be incorporated into a construction permit or other approval issued under or required by another ordinance, statute or regulation.

Sec. 95-42. APPLICATION FOR STORMWATER CONSTRUCTION APPROVAL

(A) Applicants shall submit a written application for a stormwater construction approval to the County. The application shall be made in a form and manner approved by the County and shall include all information and documentation required by the County pursuant to this Ordinance or rules promulgated pursuant to this Ordinance. While an application for stormwater construction approval and a construction permit may be executed by an authorized representative or agent of the property owner on whose land the stormwater control system is or will be located, a long-term maintenance permit (M-Permit) shall be executed by the property owner itself, the County and the local unit(s) of government or other public entity approved by the County.

(B) After issuance of a stormwater construction approval, but prior to commencement of construction activity, the Applicant shall obtain a construction permit (C-Permit) from the County.

(C) All proposed modifications to a stormwater control system shall be submitted to the County in writing, together with all information and all supporting documentation required by the County pursuant to this Ordinance or rules promulgated pursuant to this Ordinance to support the proposed modification. A person shall not commence regulated

construction activity associated with a proposed modification without a stormwater construction approval and construction permit from the County.

(D) All construction permits issued by the Permit Office shall expire not later than two (2) years after the date of issuance, unless extended in writing by the Permit Office for good cause shown by the Permit Holder.

Sec. 95-43. FINANCIAL ASSURANCE FOR REGULATED CONSTRUCTION ACTIVITY

(A) The County may require an Applicant to provide financial assurance for regulated construction activity.

(B) Financial assurance provided pursuant to this section shall be in the form of a performance bond, cashier's or certified check, or unconditional irrevocable letter of credit. The County may accept, with prior approval, an equivalent instrument as financial assurance for regulated construction activity.

(C) The County may establish the form and amount of financial assurance to be provided; the events, circumstances, or occurrences that will cause the County to release the financial assurance; and other requirements for financial assurance to satisfy the purposes of this Ordinance.

(D) The County will only release the construction permit and financial assurance after the County receives a recorded copy of the resolution and fully executed long-term maintenance permit, including the maintenance plan and schedule, pursuant to Article VII of this Ordinance, and all

fees assessed pursuant to this Ordinance have been paid, in accordance with this Ordinance and the rules promulgated pursuant to this Ordinance.

Secs. 95-44 – 95-50. – Reserved.

ARTICLE V. DESIGN AND CONSTRUCTION REQUIREMENTS FOR STORMWATER CONTROL SYSTEMS

Sec. 95-51. GENERAL

(A) Except as provided below, stormwater control systems shall be designed in accordance with the minimum requirements for performance and design that are set forth in this Ordinance and in rules promulgated pursuant to this Ordinance.

(B) The County encourages the development and use of innovative stormwater control system designs and construction techniques, including without limitation the use of non-structural practices to reduce stormwater runoff and/or its water quality impacts, to achieve the flood control and water quality objectives of this Ordinance and the rules promulgated hereunder.

(C) Notwithstanding any provision in this Ordinance or a rule promulgated pursuant to this Ordinance, the County may require stormwater control systems to satisfy performance and/or design standards more stringent than the minimum requirements for performance and design set forth in this Ordinance and in rules promulgated pursuant to this Ordinance when necessary to address unique flood control or water resources protection issues at a development site that negatively impacts or may negatively impact adjacent properties or downstream of a development site.

Sec. 95-52. REQUIREMENTS FOR DESIGN OF STORMWATER CONTROL SYSTEMS

(A) Selecting and designing stormwater control systems to meet the requirements of this Ordinance and the rules promulgated pursuant to this Ordinance shall be the responsibility of the Applicant or its designee, subject to the approval of the County pursuant to this Ordinance and rules promulgated pursuant to this Ordinance. The County may deny a stormwater construction approval for a system design that is not in compliance with these requirements.

(B) In designing a stormwater control system, the Applicant shall consider all relevant and appropriate factors, including without limitation the following:

(1) the public health, safety, welfare, and the environment;

(2) the inconvenience caused by stormwater runoff on the subject property;

(3) the long-term impact of regulated construction activity on stormwater runoff on, from, and beyond the property;

(4) the natural drainage pattern of the land;

(5) the impact of the regulated construction activity on the affected watershed(s);

(6) the effect of complete upstream development on the subject property as determined by applicable master plans and/or stormwater plans; and;

(7) the extent of downstream improvements necessary for proper stormwater drainage.

Secs. 95-53 – 95-60. – Reserved.

ARTICLE VI. FEES FOR STORMWATER CONSTRUCTION APPROVALS

Sec. 95-61. [Generally]

A County agency may recommend to the County Commission a written schedule to be adopted by the County to establish a fee system for administering and implementing the stormwater control program. The fee system may include fees for application submittal and review, permit issuance, project overview, compliance inspections, and any other task or service performed by the County to administer or implement the requirements of this Ordinance or rules promulgated hereunder. Fees may be refundable or nonrefundable, as determined appropriate by the County, and may include charges for time and materials utilized by the County in implementing and administering the requirements of this Ordinance or rules promulgated pursuant to this Ordinance. The fees described in this Article are separate and distinct from the financial assurance that may be required pursuant to Section 95-43 of this Ordinance. The schedule of fees shall be incorporated into Chapter 129 (Fees) of the Code of Ordinances of the Charter County of Wayne, as amended.

Secs. 95-62 – 95-70. – Reserved.

ARTICLE VII. LONG-TERM MAINTENANCE

Sec. 95-71. DEMONSTRATION OF LONG-TERM MAINTENANCE

The applicant for a stormwater construction approval shall demonstrate to the County in the application or during the application review process, as determined appropriate by the County, that the stormwater control system shall be maintained in perpetuity. This demonstration shall be made in the manner specified in this Ordinance and in rules promulgated pursuant to this Ordinance.

Sec. 95-72. SCOPE OF LONG-TERM MAINTENANCE

For purposes of this Ordinance and rules promulgated pursuant to this Ordinance, long-term maintenance shall include: site monitoring, inspection and preventative maintenance activities necessary to ensure that a stormwater control system functions properly as designed; maintenance of structural and vegetative BMPs installed and implemented to meet the performance standards; remedial actions necessary to repair, modify, or reconstruct the system in the event the system does not function properly as designed at any time; notification to subsequent owners of limitations or restrictions on the property; actions necessary to enforce the terms of restrictive covenants or other instruments applicable to the property pursuant to this Ordinance and rules promulgated pursuant to this Ordinance; and such other actions as may be set forth in rules promulgated hereto, all such actions to be performed in perpetuity.

Sec. 95-73. LONG-TERM MAINTENANCE PERMIT PROCESS

The Permit Holder under the long-term maintenance permit shall be the owner of the property on which the stormwater control system is constructed. The County will issue a long-term maintenance permit for the project pursuant to this Ordinance that identifies, among other things, the limits of the stormwater control system, the party responsible for maintenance, and the activities required to ensure that the system functions effectively. Long-term maintenance shall begin after construction of the stormwater control system has been completed, the County has performed a final inspection of the completed stormwater control system which it approves, and the County has received the engineer’s certificate of construction for the completed stormwater control system. After the County’s approval of the final inspection of the stormwater system and the County receives the engineer’s certificate of construction for the completed

stormwater system and prior to the expiration date of the construction permit, the Property Owner shall obtain a resolution issued by the local unit(s) of government in which the stormwater control system is located or other public entity approved by the County to authorize a community official of the local unit(s) of government to execute the long-term maintenance permit on behalf of the local unit(s) of government or other approved public entity in accordance with this Ordinance and the rules promulgated pursuant to this Ordinance. The County will not release the construction permit and financial assurance until all of the above are completed.

Sec. 95-74. LONG-TERM MAINTENANCE ASSURANCE

The Property Owner is responsible for its long-term maintenance and shall be the Permit Holder under the long-term maintenance permit. The local unit(s) of government in which the stormwater control system is located, or other public entity approved by the County, guarantees it will assume jurisdiction over and accept responsibility for the long-term maintenance of stormwater control systems that require a County stormwater construction approval in accordance with a long-term maintenance plan and schedule approved by the County if the Property Owner fails to maintain the stormwater control system. This perpetual maintenance guarantee by the local unit(s) of government or other approved public entity shall be made by a resolution or equivalent instrument, the form of which resolution or equivalent instrument shall be as provided by the County and issued without change, unless otherwise agreed to and approved by the County.

Sec. 95-75. RECORDING

After the County's approval of the long-term maintenance permit, the long-term maintenance permit together with the resolution shall be recorded at the Wayne County,

Michigan Register of Deeds. No long-term maintenance permit shall be recorded prior to the County's approval. The long-term maintenance permit shall run with the land and be binding on the Property Owner and any successors or assigns.

Secs. 95-76 – 95-80. – Reserved.

ARTICLE VIII. AUTHORITY AND DUTIES OF INSPECTORS

Sec. 95-81. AUTHORITY

Upon presentation of proper credentials and identification, and after stating the authority and purpose of the inspection, County inspectors shall be promptly permitted to enter and inspect a development site. The inspection shall be for the purpose of investigating the development site's stormwater control systems or components of the stormwater control systems, to determine compliance or non-compliance with this Ordinance, rules or regulations promulgated pursuant to this Ordinance, stormwater construction approvals and permits issued pursuant to this Ordinance.

Sec. 95-82. DUTIES OF INSPECTORS

While entering and performing an inspection on private property pursuant to Section 95-81 above, a County inspector shall observe and comply with all safety rules applicable to the premises.

Secs. 95-83 – 95-90. – Reserved.

ARTICLE IX. COMPLIANCE AND ENFORCEMENT

Sec. 95-91. IN GENERAL.

All persons subject to the requirements of this Ordinance shall fully cooperate with the County to ensure that the requirements of this Ordinance, rules promulgated pursuant to this Ordinance, stormwater construction approvals and permits issued hereunder are satisfied. Whenever possible, the County shall attempt to enter into voluntary

agreements to resolve violations of this Ordinance, rules promulgated pursuant to this Ordinance, stormwater construction approvals and permits issued hereunder.

Sec. 95-92. INVESTIGATIONS, NOTICES OF VIOLATION, INFORMAL CONFERENCES, AND VOLUNTARY AGREEMENTS

(A) If the County believes that a violation of this Ordinance, a rule promulgated pursuant to this Ordinance, a stormwater construction approval or permit issued hereunder may have occurred or exists, the County shall, as soon as practicable, initiate an investigation.

(B) Based upon the findings of the investigation, the County shall informally attempt to verbally counsel the Permit Holder or violator on proper methods of remediation.

(C) If, after the investigation and informal attempt at obtaining compliance, the County determines that a violation still exists, the County shall provide written notice of the violation or violations to the Permit Holder or violator, such notice to be given by US mail to the Permit Holder or violator at the address on file with the Permit Office or to the Permit Holder or violator by email to the email address on file with the Permit Office. A written notice of violation shall include a statement of facts upon which the violation is based.

1. Permit Holder or violator shall have fourteen (14) days after notice of violation is given to enter into a Consent Agreement with the County that resolves or corrects the violation to the County’s satisfaction.

2. Within seven (7) days after notice of violation is given, the Permit Holder or violator may request an informal conference be held within the fourteen (14) day period after notice of violation is given.
3. All notices hereunder shall be deemed given on the day of mailing (if by US Mail) or on the day of transmission (if by email).

(D) The County shall provide an opportunity for Permit Holder or violator to enter into a voluntary agreement (Consent Agreement) designed to bring the Permit Holder or violator into compliance. If a Consent Agreement is not entered into, the County shall take appropriate enforcement action pursuant to this Ordinance and other applicable provisions of law.

Sec. 95-93. ADMINISTRATIVE COMPLIANCE ORDERS

(A) If the County determines that a violation of this Ordinance, a rule promulgated pursuant to this Ordinance, a stormwater construction approval or permit issued hereunder has occurred or exists, the County may issue an Administrative Compliance Order pursuant to this Section 95-93.

(B) Except as provided in Section 95-94, the County may issue an Administrative Compliance Order in the following circumstances:

(i) the County determines that a person has violated a Consent Agreement entered into with the County; or

(ii) the County determines that a person has violated or continues to violate this Ordinance, a rule promulgated pursuant to this Ordinance, a stormwater construction approval or permit issued hereunder, and the County has attempted to resolve the violation

pursuant to Section 95-92, but no Consent Agreement has been entered into.

(C) The Administrative Compliance Order shall contain a statement of facts upon which the order is based, a description of the actions that must be taken to correct the non-compliance, a compliance schedule, and other requirements as might be reasonably necessary to address the non-compliance. Administrative Compliance Orders also may contain administrative fines and penalties, and such other monetary relief for the non-compliance, including without limitation, amounts necessary to compensate the County for costs incurred investigating, administering and enforcing this Ordinance or rules promulgated hereto.

(D) Within twenty eight (28) days after the issuance of an Administrative Compliance Order, the person or persons receiving the order may appeal the issuance of the order by providing notice to the Director of Wayne County's Department of Public Services or its designee, such notice specifically identifying the matter being appealed and the basis for the appeal. The Director shall address the appeal within 56 days of receiving the same. The Director shall consider the appeal and make a decision whereby it affirms, rejects or modifies the action being appealed. In considering such appeal, the Director may consider the recommendations of its staff and the comments of other persons having knowledge of the matter. Any person dissatisfied with the Director's decision may exercise his or her appeal rights outlined in Article XI of this Ordinance.

Sec. 95-94. EMERGENCY ADMINISTRATIVE ORDERS

(A) The County may issue an emergency administrative order (Emergency Order) without attempting to resolve a violation by using the enforcement procedures described in Section 95-92 and 95-93 if the County finds that a violation of this Ordinance, a rule promulgated pursuant to this Ordinance, or a stormwater construction approval issued hereunder constitutes or causes, or will constitute or cause, a substantial injury to the public health, safety, welfare, or the environment, and that it would be prejudicial to the interests of the people of the County to delay action.

(B) Emergency Orders issued pursuant to this Section 95-94 shall contain a statement of facts upon which the order is based and notification to the person that it must immediately take action to discontinue, abate, correct, or otherwise address the imminent and substantial injury caused or likely to be caused by the non-compliance.

(C) Within seven (7) days after issuance of an Emergency Order, the County shall provide the person an opportunity to be heard and to present any proof that the non-compliance does not or will not constitute imminent and substantial injury to the public health, safety, welfare or the environment.

(D) An Emergency Order issued pursuant to this Section 95-94 is effective on issuance and shall remain in effect until Permit Holder or violator remedies the condition which required the Emergency Order or until an order of the Wayne County Circuit Court is issued. To the extent the Permit Holder or violator does not remedy the condition, the County has the option of taking

any action deemed necessary, in the County's discretion, to remedy the condition and assess the costs associated with the same against the Permit Holder or violator, as outlined in Section 95-95.

Sec. 95-95. ASSESSMENT OF EXPENSES AND ATTORNEY FEES

To the extent the County is required to expend resources, including but not limited to, expenses, labor, administrative time or attorney fees to enforce this or any other provision of this Ordinance, a rule promulgated pursuant to this Ordinance or a stormwater construction approval, the County shall be entitled to assess the same against the Permit Holder or violator and deduct or assess the same from any bond or other financial assurance.

Sec. 95-96. MUNICIPAL CIVIL INFRACTIONS

(A) Violation; Municipal Civil Infraction

A person who violates any provision of this Ordinance or rules promulgated hereunder, including without limitation any notice, order, stormwater construction approval, agreement, decision, or determination promulgated, issued, made, or entered by the County under this Ordinance or rules promulgated hereunder, is responsible for a municipal civil infraction for which the County may issue a citation, with the violator subject to payment of a civil fine of One Thousand Dollars ($1,000.00) for each infraction, plus costs and other sanctions outlined in this Ordinance or otherwise provided by law. The County may issue such infraction or infractions against individual members, shareholders, directors, managers, officers or other officials of entities, incorporated or not, such as, but not limited to, limited

liability companies, limited companies, s corporations, c corporations, partnerships and limited liability partnerships, whether organized in the State of Michigan or another state or country. Nothing provided for in this section shall impede the County's ability to secure compliance as otherwise outlined in this Article or institute a civil action as provided by Section 95-97 or elsewhere in this Ordinance, rules promulgated pursuant to this Ordinance or as otherwise provided by local or State law.

(B) Repeat Offenses; Increased Fines.

(i) Increased fines may be imposed for repeat offenses. As used in this section, "repeat offense" means a second (or any subsequent) municipal civil infraction violation of the same requirement or provision of this Ordinance or rule promulgated hereunder that is committed by a person within a 12-month period from a prior finding or admission of responsibility.

(ii) The increased fine for a repeat offense under this section shall be as follows:

(a) The fine for any offense that is a first repeat offense shall be not less than $2,500, plus costs.

(b) The fine for any offense that is a second repeat offense or any subsequent repeat offense shall be not less than $5,000, plus costs.

(C) Unpaid Fines and Costs. Any fines and costs assessed pursuant to this section that are not paid in full within twenty eight (28) days after adjudication of the same, the outstanding balance shall double.

(D) Authorized County Officials.

The Director of the Department of Public Services or her or his respective designees and authorized representatives are authorized County Officials for purposes of issuing municipal civil infraction citations (directing alleged violators to appear in district court) for violations of this Ordinance.

(E) Procedures.

Except as otherwise provided by this section, the procedures for municipal civil infraction citation actions shall be as set forth in Chapter 2 (Municipal Civil Infractions) of the Code of Ordinances of the Charter County of Wayne, Enrolled Ordinance 2000-404.

(F) Remedy Not Exclusive.

The County need not exhaust the remedies otherwise outlined in this Ordinance prior to issuing a municipal civil infraction citation, nor must the County exhaust any other remedies prior to issuing a municipal civil infraction.

Sec. 95-97. CIVIL ACTIONS

The County, by and through Corporation Counsel or its designee, may bring a civil action in the name of the County to enforce the provisions of this Ordinance and rules promulgated pursuant to this Ordinance. Nothing in this Ordinance shall preclude the County from instituting an action for appropriate legal and/or equitable relief in Wayne

County Circuit Court to restrain, correct, or abate a violation of this Ordinance, a rule or regulation promulgated pursuant to this Ordinance, or a stormwater construction approval issued hereunder; or to stop an illegal act; or to abate a nuisance; or to prevent pollution or flooding.

Sec. 95-98. CRIMINAL PENALTIES; IMPRISONMENT

Any person who:

(A) Violates this Ordinance, or any notice, order, stormwater construction approval, or decision or determination promulgated, issued or made by the County under this Ordinance; or

(B) Intentionally makes a false statement, representation, or certification in any application for, or form pertaining to, a stormwater construction approval, or in any other correspondence or communication, written or oral, with the County regarding matters regulated by this Ordinance;

shall, upon conviction, be guilty of a misdemeanor punishable by a fine of $500 per violation, per day, or imprisonment for up to 90 days, or both in the discretion of the court.

Sec. 95-99. SEPARATE OFFENSES

Each act of violation, and each day that a violation of this Ordinance, rules or regulations promulgated pursuant to this Ordinance, stormwater construction approval, order, notice, or determination issued, made or entered into under this Ordinance is permitted to exist or occur, constitutes a separate offense and shall be punishable as provided by this Ordinance.

ARTICLE X. [RESERVED]

Secs. 95-100 – 95-110. – Reserved.

ARTICLE XI. APPEAL.

Sec. 95-111. APPEAL.

Any person whose legal rights, duties, or privileges are determined by the County pursuant to this Ordinance or a rule promulgated pursuant to this Ordinance, and who is aggrieved by the County's determination, may file an action at the Wayne County Circuit Court to challenge the same no later than twenty eight (28) days after such determination.

SECTION 2: PREEMPTION

If any section, clause, or provision of this Chapter conflicts with any state law then the section, clause, or provision of state law shall be read to supersede the conflicting provisions of this Chapter to the extent necessary to give the state law full force and effect.

SECTION 3: EFFECTIVE DATE

This Ordinance shall be effective on September 3, 2021.

ADOPTED BY THE WAYNE COUNTY COMMISSION AUGUST 19, 2021.

(2021-526a)

APPENDIX F

Stormwater Administrative Rules

RESOLUTION

No. 2021-526b

By Commissioner Marecki

RESOLVED, Pursuant to Section 5.2 of the Wayne County, Michigan Charter, these Administrative Rules are hereby amended to conform to the amended Stormwater Control Ordinance, Ordinance No. 526A, effective September 3, 2021, in its entirety to read as herein set out. The Administrative Rules were last amended on July 1, 2015 (Resolution No. 2015-345); and be it further

RESOLVED, by the Wayne County Commission this 19th day of August, 2021 that approval be, and is hereby granted authorizing amendments to the Administrative Rules for the Wayne County Stormwater Control Ordinance, as recommended by the Chief Executive Officer.

[Administrative Rules Attached]

(2021-70-004)

WAYNE COUNTY STORMWATER CONTROL ADMINISTRATIVE RULES

Revised August 19, 2021 (Resolution No. 2021-526b)

TABLE OF CONTENTS

Chapter 1 GENERAL PROVISIONS

Rule 101 Purpose

These administrative rules are declared necessary for the protection of the health, safety, and welfare of the citizens of Wayne County and to protect the environment against pollution and other adverse effects from stormwater runoff. The purpose of these rules is to provide for the administration and implementation of a stormwater control program in Wayne County; and to provide performance and design standards for stormwater control systems.

Rule 102 Title

These administrative rules shall be known and may be cited as the “Wayne County Stormwater Control Administrative Rules.”

Rule 103 Effective Date

These administrative rules are effective September 3, 2021.

Chapter 2 DEFINITIONS

Rule 201 General

All terms in these administrative rules shall have the meaning ascribed to them in the Wayne County Stormwater Control Ordinance, unless otherwise specified herein.

Rule 202 Terms

As used in these rules: *Best management practice*, or BMP, means a practice or combination of practices that have been determined by the County to be the preferred method of preventing, minimizing, or reducing pollution and other effects of stormwater and stormwater runoff.

Bioretention area means a component of a stormwater control system that is comprised of a depressed land area that contains specific soil, plant materials, and other features and is used as a pretreatment system.

Bridge means a structure, including supports, built to carry a feature over a surface water or watercourse, with a clear span of more than 20 feet measured along the center of feature being carried.

Buffer strip means a zone that is used for filtering direct stormwater and stormwater runoff into a stormwater control system and for providing maintenance access to a stormwater control system.

Catch basin means a structure designed to collect water from the surface and convey it into a

closed conduit.

CFS means cubic feet per second.

Channel Protection Rate Control means controlling the stormwater runoff generated by a 1.9-inch rainfall event via extended detention.

Channel Protection Volume Control means controlling the stormwater generated by a 1-inch rainfall event via infiltration or other means of onsite retention.

Closed conduit means an enclosed conveyance designed to carry stormwater runoff such that the surface of the water is not exposed to the atmosphere, including without limitation storm sewers, culverts, closed County drains, and pipes.

Constructed wetland means an open detention basin that uses a variety of water depths and wetland plants to provide pollutant removal.

County road shall include roads and road rights-of-way within the jurisdiction of the County.

Culvert means a structure, including supports, built to carry a feature (i.e. roadway) over a surface water or watercourse, with a clear span of less than 20 feet measured along the center of the feature being carried.

Design storm means a rainfall event of specified size and return interval that is used to calculate the water volume and peak flow rate that must be handled by a stormwater control system.

Design water level means the peak water surface elevation in a detention system at which the storage volume in the system (above the permanent pool water level, if any) equals the required storage volume.

Detention or *Detain* means the temporary storage of stormwater and stormwater runoff to control peak flow rates and/or provide pollutant removal before discharging the water to a surface water or closed conduit.

Detention system means a component of a stormwater control system, either aboveground or below ground, that detains stormwater and stormwater runoff. Detention systems may include, without limitation, open detention basins and underground detention systems.

Detention time means the amount of time that a volume of water will be detained in a detention system.

Drainage area means the entire upstream land area from which stormwater runoff drains to a particular location, including any off-site drainage area.

Emergency spillway means a depression in the embankment of an open detention basin or retention basin that is used to pass flows in excess of the overflow structure capacity.

Extended Detention means the storage and gradual release of stormwater from a detention system over a period of not less than 48 hours.

First flush means stormwater runoff that occurs during the early stages of a storm as a result of the washing effect of stormwater runoff on pollutants that have accumulated on the surface of the drainage area. For purposes of these rules, the first flush at a particular location within a stormwater control system consists of runoff from the 90th percentile annual non-exceedance stormover the entire drainage area upstream of that location. The 90th percentile annual non-exceedance storm is the storm where 90 percent of the runoff-producing storm rainfalls are equal to or less than the specified value. This value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

Floodplain means for a given flood event, that area of land adjoining a continuous watercourse that has been covered temporarily by water.

Flood Control Storage Volume (Detention System) means the detention system volume necessary to control the 100-year peak flow to the allowable discharge rate while providing adequatefreeboard.

Flood Control Storage Volume (Retention System) means the retention system volume necessary to store the volume from two consecutive 100-year storm events while providing adequate freeboard.

Flow restrictor means a structure, feature, or device in a detention system or pretreatment system that is used to restrict the discharge from the system for specified design storm(s).

Forebay means a component of a stormwater control system that is comprised of surface water that is used as a pretreatment system.

Freeboard means the vertical distance from the design water level to the top of the embankment of an open detention basin or retention basin.

Manhole means a structure that allows access into a closed conduit or other underground component of a stormwater control system.

Manning's Formula means a technique for estimating the hydraulic capacity of a closed conduit, watercourse, or other means of conveyance of stormwater and stormwater runoff.

Manning's Roughness Coefficient ("n") means a coefficient used in Manning's Formula to describe the resistance to flow due to the roughness of a conveyance.

Manufactured treatment system means a component of a stormwater control system that is comprised of a manmade device or structure that is used as a pretreatment system.

Open detention basin means a component of a stormwater control system that is comprised of a surface water that is used as a detention system.

Ordinance means the Wayne County Stormwater Control Ordinance.

Outflow rate means the rate of discharge in volume per unit time.

Overflow structure means a structure designed to allow unrestricted discharge from a component of a stormwater control system when the water level exceeds the design water level.

Peak flow rate means the maximum instantaneous rate of flow at a particular location within a stormwater control system, usually in reference to a specific design storm event.

Permanent pool means a pool in an open detention system or forebay that provides additional removal of pollutants through settling and biological uptake.

Pollutant means any substance introduced into the environment that may adversely affect the public health, safety, welfare, or the environment, or the usefulness of a resource.

Pretreatment system means a structure, feature, or appurtenance, or combination thereof, either aboveground or belowground, that is used as a component of a stormwater control system to remove incoming pollutants from stormwater and stormwater runoff. Pretreatment systems may include, without limitation, forebays, manufactured treatment systems, and bioretention areas.

Rational Method Formula means a technique for estimating peak flow rates at a particular location within a stormwater control system, based on the rainfall intensity, watershed time of concentration, and a runoff coefficient.

Regulated wetland means any wetland protected by federal, state, or local laws or regulations.

Retention or Retain means the storage of stormwater and stormwater runoff to provide gravity settling of pollutants and to promote infiltration into the soil, rather than to discharge the stormwater or

stormwater runoff to a surface water or closed conduit.

Retention basin means a component of a stormwater control system that retains stormwater and stormwater runoff with no outlet.

Return interval (or *recurrence interval*) means the length of time during which a rainfall depth is predicted to be exceeded one time. For instance, a 10-year return interval rainfall depth has a 10 percent change of being exceeded in any given year. A 100-year return interval rainfall depth as a 1 percent chance of being exceeded in any given year.

Riprap means a combination of large stone, cobbles, and boulders used to line watercourses, stabilize banks, reduce runoff velocities, or filter out sediment.

Runoff coefficient means the ratio of the volume of stormwater runoff from a given drainage area over a given time period, to the total volume of precipitation that falls on the same drainage area over the same time period.

Time of concentration means the time duration that is required for stormwater runoff from the most remote area of the watershed to reach a given location in a stormwater control system.

Total suspended solids ("TSS") means particles or other solid material suspended in stormwater or stormwater runoff. TSS is commonly expressed in concentration (milligrams per liter or parts per million).

Underground detention system means one or more underground pipes and/or other structures that are utilized as a detention system.

Watershed means the complete area or region draining into a watercourse, surface water, or closed conduit.

Weir means a structure that extends across the width of a surface water, watercourse or closed conduit and is used to impound or restrict the flow of water.

Wetted perimeter means the length of the perimeter of a watercourse or closed conduit cross-section that is submerged and thereby causes resistance to flow.

Chapter 3 GENERAL REQUIREMENTS FOR STORMWATER CONTROL SYSTEMS

Rule 301 General

Except as provided in Rule 302, a person who applies for a stormwater construction approval shall:

(A) Incorporate the minimum performance and design standards prescribed by Chapters 5, 6 and 7 of these rules into the selection and design of a stormwater control system;

(B) Demonstrate that the stormwater control system shall be maintained in perpetuity pursuant to Chapter 10 of these rules; and

(C) Incorporate such other requirements as may be deemed necessary by the County to satisfy the requirements of the Ordinance.

Rule 302 Alternative Performance and Design Standards

(A) Notwithstanding any other provision in these rules, the County may approve a stormwater control system that does not satisfy the performance or design standards set forth in Chapters 5, 6 and 7 of these rules if the following conditions are met:

(1) request for approval of a stormwater control system that incorporates alternative performance or design standards is submitted to the County in conjunction with an application for stormwater construction approval;

(2) the applicant demonstrates to the satisfaction of the County that the alternative performance or design standards are adequate to control and prevent flooding, erosion, pollution, and other effects of stormwater runoff, consistent with the Ordinance; and

(3) the alternative performance or design standards are sufficiently described and documented to enable the County to assess their effectiveness.

(B) Notwithstanding any other provision in these rules, when necessary to address unique flood control or water resources protection issues at a development site, on adjacent properties, or downstream of a development site, the County may require additional performance or design standards than set forth in these rules as a condition of granting a stormwater construction approval. Such additional requirements may be required when necessary to satisfy the requirements of the Ordinance or to ensure that stormwater runoff from the development site does not create negative impacts to downstream property owners or water resources.

(C) Approval of a stormwater control system that incorporates alternative performance or design standards pursuant to this rule is within the discretion of the County.

(D) The approval by the County of a stormwater control system that meets alternative

performance or design standards according to the requirements of this rule shall not reduce, abate, alter, modify, amend, or affect the applicant's responsibility to comply with other provisions of the Ordinance, these rules, or an approval issued hereunder.

(E) The County shall approve alternative performance or design standards pursuant to this rule only if the alternative performance or design standards meet or exceed applicable requirements for stormwater control systems that are imposed by the state or a political subdivision within the County.

Rule 303 Best Management Practices and Design Standards

The County may establish best management practices for controlling stormwater runoff and detailed design criteria for stormwater control systems. These practices and criteria shall be established in writing and made available to interested persons. Applicants for stormwater construction approvals shall consider these practices and design criteria when designing stormwater control systems.

Chapter 4 STORMWATER CONSTRUCTION APPROVALS

Rule 401 Application Requirements

(A) Applications for stormwater construction approval, with supporting documentation and all required fees, shall be submitted to the Permit Office. Applications for stormwater construction approval shall be made in a form and manner approved by the County. The County may establish requirements, guidelines, and forms for submitting such applications.

(B) All proposed modifications to the approved stormwater control system shall be submitted to and approved by the County. All supporting documentation shall be submitted with any proposal to modify the stormwater control system. A person shall not commence regulated construction activity associated with a proposed modification without the approval of the County.

Rule 402 Review Procedures

(A) The Permit Office shall approve, deny, or require modification of a stormwater control system proposed in an application for stormwater construction approval. The Permit Office shall notify the applicant of the approval, denial, or request for modification by first class mail or transmitted via email from a County representative. If the application is denied, then the Permit Office shall advise the applicant in writing of its reasons for denial and conditions required for approval.

(B) The Permit Office shall issue a stormwater construction approval only if it determines that

an applicant has satisfied the requirements of the Ordinance and these rules. An approval given to the applicant either in person, by first-class mail or transmitted via email from a County representative constitutes approval of an application for stormwater construction.

Chapter 5 PERFORMANCE STANDARDS FOR STORMWATER CONTROL SYSTEMS

Rule 501 Flood Control

(A) Except as otherwise provided in these rules, stormwater control systems shall be designed and constructed to meet or exceed the minimum performance standards for flood control set forth in this Rule 501. Designing a stormwater control system to meet these minimum performance standards shall be the responsibility of the applicant or its designee, subject to the County's approval.

(B) Flood Control Performance Standards

(1) For stormwater control systems that have drainage areas equal to or greater than one hundred (100) acres, the peak flow rate of stormwater runoff leaving the development site shall not exceed 0.15 cfs/acre for a 100-year storm.

(2) For stormwater control systems that have drainage areas less than 100 acres, the peak flow rate of stormwater runoff leaving the development site shall be determined based on a variable release rate curve for the 100-year recurrence interval storm, equal to 0.15 cfs/acre for 100-acre developments, gradually increasing to 1.0 cfs/acre for developments 2 acres or smaller. See the Wayne County Stormwater Standards Manual for the variable release rate curve equation.

Rule 502 Water Resources Protection

(A) Except as otherwise provided in these rules, stormwater control systems shall be designed and constructed to meet or exceed the performance standard for water resources protection set forth in this Rule 502. Designing a stormwater control system to meet these performance standards shall be the responsibility of the applicant or its designee, subject to the County's approval.

(B) Standard for Water Resources Protection. Stormwater control systems shall be designed and constructed to remove eighty percent (80%) or more of the total suspended solids load from the development site, as determined on an annual average basis or to a discharge concentration less than or

equal to 80 mg/L.

Chapter 6 GENERAL DESIGN STANDARDS

Rule 601 Determination of Peak Flow Rate

(A) Except as provided in Rule 601(B), the peak flow rate at a particular location within stormwater control systems shall be calculated in accordance with the Rational Method Formula. The Rational Method Formula shall be expressed as follows**:**

$$Q = C \times I \times A$$

where Q = peak flow rate (cfs)

C = runoff coefficient

I = rainfall intensity (in/hr)

A = drainage area (acres)

(1) For purposes of calculating peak flow rate at a particular location using the Rational Method Formula, the runoff coefficient *(C)* shall be a weighted average that is based on the percentage of different surface types within the drainage area. Runoff coefficients shall be consistent with those listed in Chapter 6 of the Wayne County Stormwater Standards Manual.

(2) For purposes of calculating peak flow rate at a particular location using the Rational Method Formula, rainfall intensity *(I)* shall be calculated in accordance with the point precipitation/duration frequency tables from NOAA Atlas14 or the intensity equations listed in Chapter 6 of the Wayne County Stormwater Standards Manual.

(3) For purposes of determining rainfall intensity at a given location in accordance with Rule 601(A)(2), the time of concentration *(t)* shall be determined in accordance with the methodology detailed in Chapter 6 of the Wayne County Stormwater Standards Manual..

(B) The County, in its sole discretion, may require the peak flow rate to be calculated in accordance with an alternative runoff hydrograph prediction method when necessary to satisfy the requirements of the Ordinance and these rules. Acceptable alternative methods are: US Army Corps of Engineers HEC-HMS, Soil Conservation Service WinTR-20 or WinTR-55, U.S. EPA's Stormwater

Management Model (SWMM), HydroCAD, StormCAD or approved equivalent. These methods must be based on the SCS Type II 24-hour rainfall distribution with Antecedent Moisture Condition II (AMC II).

(C) For purposes of calculating the peak flow rate for a given development site, it shall be assumed that off-site drainage areas are developed consistent with any applicable master land use plan, stormwater standards and stormwater master plan enacted by the local unit(s) of government in which the stormwater control system is located, and the County's stormwater control program.

Rule 602 General Design Standards for Flood Control

(A) Except as otherwise provided in these rules, stormwater control systems designed and constructed to satisfy the general design standards for flood control set forth in this Rule 602 satisfy the applicable flood control performance standard of Rule 501(B).

(B) The stormwater control system shall include a detention system and/or retention basin that is designed and constructed in accordance with this Rule 602(B).

(1) Detention Systems

(a) Flood Control Storage Volume. The variables in the relationships in this Rule 602(B)(1) shall have the following values:

Q_{allow}	=	maximum allowable peak flow rate from the detention system per acre of development (cfs/acre)
Q_o	=	maximum allowable peak flow rate (cfs)
V_s	=	maximum volume of water stored in the detention system (ft^3)
V_r	=	total 100-year developed site runoff volume (ft^3)
A	=	total site drainage area (acres)
C	=	runoff coefficient
P_{100}	=	current 100-year, 24-hour rainfall depth (in); this value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

(i) The flood control storage volume (V_s) of detention systems that have a drainage area of one hundred (100) acres or less shall be determined based on the following relationships for the 10-year storm:

$$Q_{allow} = 1.1055 - 0.207\ln(A)$$

Q_o = Q_{allow} x A

V_S = V_r x [0.206 - 0.15ln(Q_o/Q_i)]

V_r = A x C x (P_{100} x 3,630)

(ii) The flood control storage volume (V_s) of detention systems that have a drainage area greater than one hundred (100) acres shall be determined based on the following relationships for the 100-year storm:

Q_{allow} = 0.15 cfs/acre

Q_o = Q_{allow} x A

V_S = V_r x [0.206 - 0.15ln(Q_o/Q_i)]

V_r = A x C x (P_{100} x 3,630)

(b) Detention systems shall include a flow restrictor that restricts outflow from the system such that the maximum outflow rate at the design water level will not exceed the maximum allowable outflow rate (Q_o).

(2) Flood Control Storage Volume for Retention Basins. Retention basins shall be designed to retain the volume of stormwater equal to the runoff from two consecutive 100-year storm events (V_r), as determined in accordance with the following relationship:

$$V_s = 2 \times (P_{100} \times 3{,}630) \times A \times C$$

where V_s = flood control storage volume of retention basin (ft^3)

A = drainage area tributary to inlet (acres)

C = runoff coefficient

P_{100} = current 100-year, 24-hour rainfall depth (inches); this value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

(C) Adequate Outlet. Except as provided below, the stormwater control system shall include an adequate stormwater outlet.

(1) At a minimum, a stormwater outlet shall be deemed inadequate if its capacity exceeds its

reasonable share of the maximum capacity of the downstream watercourse or closed conduit, as determined by the County in its sole reasonable discretion.

(2) If the County determines that a proposed detention system does not include an adequate stormwater outlet, the applicant may be required to design and construct improvements to the downstream County drain, watercourse or closed conduit. The County shall determine the extent to which downstream improvements may be required.

(3) Stormwater control systems that include only retention basins for flood control shall not be required to satisfy this Rule 602(C).

(D) Floodplain Restrictions. Stormwater control systems shall not be constructed within a 100-year floodplain unless the stormwater control system satisfies the additional requirements of this Rule 602(D).

(1) The stormwater control systems shall not diminish the net storage capacity of the floodplain. Compensatory storage shall be required for any reduction in floodplain storage capacity.

(2) The stormwater control system shall not negatively alter the conveyance of the watercourse.

(3) During a design storm event, the storage capacity of the stormwater control system shall remain available for detention of stormwater and stormwater runoff from the development site.

(4) The stormwater control system shall minimize disruption to the riparian habitat of the floodplain by developing and implementing a plan for minimizing disturbance that is acceptable to the County.

(E) Additional Requirements

(1) To the fullest extent possible, stormwater control systems shall follow the natural drainage pattern of the land within the development site and within the watershed in which the site is located.

(2) Stormwater control systems that include surface water components shall not be located within pre-existing surface water.

Rule 603 General Design Standards for Water Resources Protection

(A) Except as otherwise provided in these rules, stormwater control systems designed and constructed to satisfy the general design standards for water resources protection set forth in this Rule 603

satisfy the water resources protection performance standard of Rule 502(B).

(B) Pretreatment System. Stormwater control systems shall include a pretreatment system at each inlet to each detention system and/or retention basin. The pretreatment system shall satisfy either or both of the following requirements:

(1) Removal Rate. The pretreatment system(s) shall be designed and constructed such that the stormwater control system achieves the pollutant removal rate required by Rule 502(B).

(2) First Flush

(a) The pretreatment system(s) shall be designed and constructed to provide treatment for the first flush.

(b) If a mechanical separation device is used to satisfy the first flush treatment requirement, refer to the peak flow and vendor certification requirements in Chapters 6 and 8 of the Wayne County Stormwater Standards Manual.

(i) The pretreatment system storage (sediment forebay) volume necessary to capture the first flush shall be determined based on the following relationship:

$$V_{ff} = (545 \times P_{ff}) \times A \times C$$

where V_{ff} = first flush storage volume (ft^3)

A = drainage area tributary to inlet (acres)

C = runoff coefficient

P_{ff} = 90th percentile annual non-exceedance event (inches); this value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

(ii) The pretreatment system(s) shall include a flow restrictor that restricts outflow to gradually release the first flush storage volume over a period of twenty-four (24) hours. The 24-hour average allowable outflow rate shall be determined in accordance with the following relationship:

$$Q_{avg\ ff} = V_{ff} / 86400$$

where $Q_{avg\ ff}$ = 24-hour average allowable outflow rate (cfs)

V_{ff} = first flush storage volume (ft^3)

(C) Channel Protection Volume Control (CPVC). Except as provided below, the stormwater control system shall capture and infiltrate total runoff volume from the channel protection volume to the

maximum extent practicable.

(1) The volume necessary to capture and infiltrate the channel protection volume to satisfy the requirement of this Rule 603(C) shall be determined in accordance with the following relationship:

$$V_{CPVC} = (P_{CPVC} \times 3{,}630) \times A \times C$$

where V_{CPVC} = required CPVC volume (ft^3)

A = total site drainage area (acres)

C = runoff coefficient

P_{CPVC} = 90th percentile annual non-exceedance event (inches); this value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

(2) The CPVC control requirement is waived only when the applicant clearly demonstrates that site conditions will not accommodate infiltration BMPs. Refer to Chapter 6 of the Wayne County Stormwater Standards Manual for conditions that can result in a CPVC infiltration waiver:

(D) Channel Protection Rate Control (CPRC). The stormwater control system shall capture the equivalent to the volume of rainfall retained on a presettlement site with well-drained soils during a 2-year, 24-hour event based on the following equation:

$$V_{CPRC} = (P_{CPRC} \times 3{,}630) \times A \times C$$

where:

V_{CPRC} = required CPRC storage volume (ft^3)

A = total site drainage area (acres)

C = runoff coefficient

P_{CPRC} = 2-year, 24-hour retained rainfall on pre-settlement conditions (inches); this value may change over time; the equations in the Stormwater Standards Manual will be updated to reflect current rainfall statistics.

(3) The stormwater control system shall include a flow restrictor that restricts outflow from the system to gradually release the CPRC volume over a period of forty-eight (48) hours. The 48-hour average allowable outflow rate shall be determined in accordance with the following relationship:

$$Q_{avg\ CPRC} = V_{CPRC} / 172{,}800$$

where Q_{CPRC} = 48-hour average allowable outflow rate (cfs)

V_{CPRC} = channel protection rate control storage volume (ft^3)

(4) Stormwater control systems that include only retention basins for flood control shall not be required to satisfy the requirements of this Rule 603(C).

(D) Additional requirements. Stormwater control systems that include surface waters as components of the system shall satisfy the following additional requirements.

(1) A buffer strip shall be established and/or preserved around each surface water on the development site (except for bioretention areas and vegetated swales).

(a) The minimum width of a buffer strip shall be 25 feet. Along watercourses, the width of a buffer strip shall be measured from the top of bank of the watercourse. Around other surface waters, the width of the buffer strip shall be measured from the minimum freeboard elevation of the surface water.

(b) Construction activities, paving, and chemical application, except for construction activities needed to create or establish the buffer strip, are prohibited in the buffer strip.

(c) The ground slope of a buffer strip shall not be steeper than 1:6.

(d) A buffer strip shall not be required around bioretention areas or vegetated swales.

(2) An applicant for stormwater construction approval shall submit a landscape plan with the application for stormwater construction approval. The plan shall depict landscaping elements that function as part of the stormwater control system, including the buffer strip.

(a) The landscape plan shall include, at a minimum, specifications for the soils and plant materials that the applicant proposes to include in the landscape; and a description of the methods and planting techniques that the applicant proposes to utilize during landscape installation.

(b) The installation and maintenance of the landscaping described in the landscape plan shall be included as regulated construction activity for which the County may require financial assurance.

Chapter 7 SPECIFIC DESIGN STANDARDS

Rule 701 Design Standards for Open Detention Basins

Open detention basins used as components of stormwater control systems shall satisfy the additional requirements of this Rule 701.

(A) Outlets

(1) Flow restrictors in open detention basins shall be placed near or within the embankment of the system to provide ready maintenance access. Flow restrictors shall be constructed of materials that minimize future maintenance requirements.

(2) Open detention basins shall include an overflow structure to allow discharge when the water level in the basin exceeds the design water level. The overflow structure and its outlet pipe shall be designed to convey the peak flow rate tributary to the basin for the 100-year design storm.

(3) Open detention basins shall include an emergency spillway with a defined downstream drainage path to allow discharge when flows exceed the capacity of the overflow structure. The emergency spillway elevation shall be 6 inches below the top of freeboard elevation. The spillway shall be protected with riprap to prevent erosion.

(B) Other Requirements

(1) The design water level of an open detention basin shall not exceed five (5) feet above the permanent pool water level.

(2) The open detention basin may have a minimum four (4) foot deep permanent pool. Permanent pools shall not be required for constructed wetlands except when the County determines that a permanent pool is necessary to satisfy the performance standards of Chapter 5 of these rules. The volume of the permanent pool shall not satisfy any portion of the flood control storage volume required by Rule 602(B).

(3) Side slopes for open detention basins shall not be steeper than 1:6.

(4) A minimum of one (1) foot of freeboard is required above the design water level of an open detention basin.

Rule 702 Design Standards for Retention Basins

Retention basins used as components of stormwater control systems shall satisfy the additional requirements of this Rule 702.

(A) Percolation Rate. Soils beneath the proposed location of the retention basin shall have a minimum in-situ infiltration rate of 1.0 inch/hour, as confirmed by a geotechnical report. Calculations and soil boring results showing the percolation rate of soils shall be submitted to the County with an application for stormwater construction approval and shall be certified by a licensed Professional Engineer.

(B) Prevailing Groundwater. The prevailing groundwater level must be at least four (4) feet below the proposed pond bottom elevation, as confirmed by a geotechnical report. The groundwater level/depth shall be submitted to the County with an application for stormwater construction approval and shall be certified by a licensed Professional Engineer.

(C) Emergency Spillway. Retention basins shall include an emergency spillway with a defined downstream drainage path to allow discharge when flows exceed the design water level. The emergency spillway elevation shall be 6 inches below the top of freeboard elevation. The spillway shall be armored to prevent erosion.

(D) Outlet Feasibility. Prior to County approval of a Retention Basin design, it shall be demonstrated that a gravity-based outlet is infeasible. A schematic and cost estimate of a pond outlet shall be provided to demonstrate whether a conventional detention pond (with a gravity outlet) is feasible. The County reserves the right to accept or reject a proposed Retention Basin based on its review of this information.

(E) Other Requirements

(1) Side slopes for retention basins shall not be steeper than 1:6.

(2) A minimum of one (1) foot of freeboard is required above the design water level of a retention basin.

(3) Maximum storage depth shall be six (6) feet, as measured from the basin bottom to the peak design storage elevation.

Rule 703 Design Standards for Underground Detention Systems

Underground detention systems used as components of stormwater control systems shall satisfy the additional requirements of this Rule 703.

(A) Underground detention systems shall confine stormwater and stormwater runoff to the interior of the detention system, and shall not release the water except through an approved outlet.

(B) The County may restrict the types of materials and methods of construction for underground detention systems. At a minimum, an applicant must demonstrate that materials and construction methods for underground detention systems conform to applicable ASTM standards, AASHTO standards, and local standards adopted by the County.

Rule 704 [Reserved]

Rule 705 [Reserved]

Rule 706 Design Standards for Forebays

Forebays used as a component of a stormwater control system shall satisfy the additional requirements of this Rule 706.

(A) Flow restrictors. Flow restrictors in forebays shall be placed near or within the embankment of the forebay to provide ready maintenance access and shall be constructed of materials that minimize future maintenance requirements.

(B) Weir. The forebay shall include a weir to allow discharge from the forebay into the detention system or retention basin when the forebay water level exceeds the top of the forebay storage volume. The weir shall be designed to convey the peak flow rate tributary to the forebay for the 100-year design storm.

(C) The total forebay storage volume (above the permanent pool, if any) may be used to satisfy both a portion of the flood control storage volume required by Rule 602(B) and the bank full flood storage volume required by Rule 603(C).

Rule 707 Design Standards for Bioretention Areas

Bioretention areas used as components of stormwater control systems shall satisfy the additional requirements of this Rule 707.

(A) Underdrain. The bioretention area design may include an underdrain system to prevent excess pooling of water. Underdrains shall not be required where the applicant demonstrates that the infiltration rate of soil within the bioretention area is sufficient to prevent excess pooling.

(1) The underdrain shall be installed over a gravel layer that consists of at least six (6) inches of gravel.

(2) The underdrain shall include an adequate outlet into a detention system, retention basin, storm sewer, or watercourse.

(3) The hydraulic capacity of the underdrain shall be greater than the infiltration rate of the soil within the bioretention area.

(4) The underdrain shall be perforated along its entire length, except that no perforations shall be permitted within five (5) feet of a connection between the underdrain system and a storm sewer structure.

(5) The underdrain shall include a cleanout well to provide access for cleaning the underdrain system.

(B) Other requirements

(1) The pooling water depth for bioretention areas shall not exceed a depth that results in water accumulating on the surface of the bioretention area for greater than twenty-four (24) hours.

(2) Applicants that propose to include a bioretention area as a component of a stormwater control system shall submit a grading plan for the development site that identifies the location of the bioretention area and the routes for construction and other vehicular traffic to demonstrate that soils and other subsurface media in or around the bioretention area will not be over compacted during construction.

Rule 708 Design Standards for Manufactured Treatment Systems

Manufactured treatments systems used as components of stormwater control systems shall satisfy the additional requirements of this Rule 708.

(A) Manufactured treatment systems shall accumulate and store incoming solids so as to prevent re-suspension of captured solids.

(B) The removal efficiency of manufactured treatment systems shall be based on the documented performance of the system in full-scale independent studies over a range of storm sizes.

(C) Manufactured treatment systems shall incorporate a water-lock feature to prevent the release of trapped oil and floatable contaminants during storm events.

(D) The County may restrict the types of materials and methods of construction for manufactured treatment systems. At a minimum, an applicant must demonstrate that materials and construction methods for manufactured treatment systems conform to applicable ASTM standards, AASHTO standards, and local standards adopted by the County.

Rule 709 [Reserved]

Rule 710 [Reserved]

Rule 711 Design Standards for Stormwater Conveyances

Conveyances used as components of stormwater control systems shall satisfy the minimum requirements of this Rule 711.

(A) Watercourses

(1) Natural watercourses shall be preserved whenever possible. The County shall not approve modifications to natural watercourses unless the modification is required to protect the public health, safety, or welfare, or the environment.

(2) The flow capacity of each reach of a watercourse that is a component of a stormwater control system shall be equal to or greater than the peak flow rate for a 10-year storm, as determined using the method described in Rule 601.

(3) The flow capacity of a watercourse shall be calculated in accordance with the following relationship (the "Manning Formula").

$$Q = (1.486 \times A \times R^{2/3} \times S^{1/2}) / n$$

where Q = flow capacity (cfs)

A = cross-sectional flow area (ft^2)

n = Manning's coefficient of roughness

P = wetted perimeter (feet)

R = hydraulic radius (A/P in feet)

S = hydraulic gradient (ft/ft)

(B) Closed Conduits

(1) The flow capacity of each reach of a closed conduit that is a component of a stormwater control system shall be equal to or greater than the peak flow rate for a 10-year storm, as determined using the method described in Rule 601.

(2) The flow capacity of a closed conduit shall be calculated using the Manning Formula described in Rule 711(A)(3).

(3) The invert elevation of each closed conduit entering a forebay with a permanent pool shall

be equal to or greater than the permanent pool elevation.

(4) Hydraulic gradients for closed conduits shall meet both of the following requirements:

(a) The hydraulic gradient shall be calculated based on 10-year storm flows, starting with the crown elevation at the outlet, and shall be at least 1.0 feet below the rim elevation at any upstream manhole location.

(b) The rim elevation at any manhole location along a closed conduit upstream of a detention/retention system shall be at least one (1) foot above the design water level of the detention/retention system.

(5) The minimum allowable flow velocity in a closed conduit shall be 2.5 feet per second. The maximum allowable flow velocity in a closed conduit shall be 8.0 feet per second. The applicant may design a closed conduit that exceeds the maximum allowable flow velocity only if the applicant demonstrates that special provisions in the design dissipate energy.

(6) The maximum distance between manholes, catch basins, and inlets in a closed conduit shall be in accordance with Table 4.

Table 4: MAXIMUM DISTANCES BETWEEN MANHOLES, CATCH BASINS, AND INLETS

Diameter of closed conduit (inches)	Maximum distance (feet)
36 and smaller	300
greater than 36	300 plus 100 feet for each additional 12 inches in diameter greater than 36 inches

(7) Manholes or junction chambers shall be constructed at all junctions and angle points within closed conduits and at all changes in conduit size or slope.

(8) Closed conduit inlets and outlets shall have an end treatment and soil erosion protection, and may be required to have a grate over the inlet/outlet.

(C) Bridges and Culverts: The following requirements apply to bridges and culverts:

(1) General

(a) The hydraulic capacities of culverts and bridges shall be calculated using a method approved by the County.

(b) All bridges and culverts shall be designed and constructed with adequate soil erosion protection.

(2) Bridges

(a) Bridges that convey a watercourse under a County Road shall be designed and constructed to pass the peak flow rate for a 100-year storm with no harmful increase in backwater elevations.

(b) The 100-year storm elevation upstream of a bridge shall be at least one (1) foot below the lowest elevation of either the bridge deck or the approach pavements to the structure.

(3) Culverts

(a) Culverts that convey a watercourse under a County Road with a drainage area less than 640 acres (1 square mile) shall be designed and constructed to convey at least the peak flow rate for a 10-year storm, as determined using the methods described in Rule 601. Culverts that convey a watercourse under a County Road with a drainage area equal to or greater than 640 acres (1 square mile) shall be designed and constructed to convey at least the peak flow rate for a 100-year storm, as determined using the methods described in Rule 601.

(b) Culverts that will be inundated by storms larger than the design storm established by the Michigan Department of Transportation or Michigan Department of Environment, Great Lakes and Energy shall be designed and constructed with soil erosion protection that is adequate for the inundated condition.

(c) Culverts that are located in a FEMA mapped floodplain shall be designed to convey at least the peak flow from a 100-year recurrence interval event with no adverse impact to the 100-year flood profile. In cases where the official floodplain is shown to be significantly changed as a result of the development or road project, the County may require that a Conditional Letter of Map Revision (CLOMR) or a Letter of Map Revision (LOMR) application be submitted to and approved by FEMA prior to approval of a development plan.

Rule 712 [Reserved]

Chapter 8 ADDITIONAL REQUIREMENTS

Rule 801 Wetlands

The natural drainage pattern of the land within the development site shall not be altered in any way that may cause adverse effects to existing wetland areas. Untreated stormwater shall not be permitted to outlet directly into a natural or mitigation wetland. At a minimum, stormwater discharged into a natural or mitigation wetland shall pass through a pretreatment system designed to satisfy the water resources protection performance standards set forth in Rule 502(B).

Rule 802 County Park Property

The County may establish additional or alternative requirements for stormwater control systems that are located on County park property or that outlet within County park property.

Rule 803 County Roads

(A) The minimum diameter of closed conduits beneath County Roads shall be 12-inches.

(B) Stormwater runoff from improved property abutting a County Road shall not be discharged into the stormwater drainage system for the County Road without the County's prior approval.

(C) The County may establish additional or alternative requirements for stormwater control systems in County Roads.

Chapter 9 FINANCIAL ASSURANCE

Rule 901 General Requirements

(A) Before commencing construction of a stormwater control system, the applicant shall provide financial assurance pursuant to Section 95-43 of the Ordinance. The stormwater construction approval shall include the form and amount of the financial assurance to be provided and, if appropriate, may define temporal limits on the financial assurance. Stormwater construction approval shall not be issued by the County unless and until the applicant provides proof of financial assurance to the County.

(B) If an application for stormwater construction approval is submitted by more than one person, only one (1) person is required to demonstrate financial assurance; however, all parties are liable in the event of noncompliance.

Rule 902 Amount of Financial Assurance

(A) Financial assurance shall be provided in an amount at least equal to the current estimate

of the cost of constructing the stormwater control system to ensure proper construction, oversight and administration of the same and in the form of a deposit, performance bond or letter of credit as outlined herein ("financial assurance mechanism").

(B) When the current estimate of the cost of constructing the stormwater control system increases to an amount more than the amount of the financial assurance mechanism, the applicant, within 28 days after the increase, either shall cause the financial assurance mechanism to be increased to an amount at least equal to the current construction cost estimate and submit evidence of such increase to the County, or shall obtain other financial assurance for the difference. When the current estimate of the cost of constructing the stormwater control system decreases, the amount of financial assurance may be reduced to the amount of the construction cost estimate following written approval of the County.

Rule 903 Deposits or Performance Bonds

(A) Applicants may satisfy the financial assurance requirements of the Ordinance and these rules by: (1) depositing the required funds via cashier's or certified check or (2) posting an unconditional irrevocable letter of credit, each with the County as directed by the Permit Office or (3) obtaining a performance bond that is executed on a form approved by the County and that conforms to the requirements of this rule.

(B) The performance bond shall guarantee that the applicant will construct the stormwater control system in accordance with the Ordinance, these rules, and the stormwater construction approval issued by the County.

(C) Under the terms of the bond, the surety shall become liable on the bond obligation when the Permit Holder fails to perform as guaranteed by the bond when required to do so, and the County provides the Permit Holder (1) notice of the failure, and (2) at least seven (7) days to cure the failure after the date of said notice.

(D) The sum of the bond shall be in an amount at least equal to the current estimate of the cost of constructing the stormwater control system.

(E) Under the terms of the bond, the surety may cancel the bond by sending notice of cancellation, by certified mail, to the Permit Holder and the County at least forty-five (45) days prior to cancellation. Cancellation shall not occur, however, during the ninety (90) days beginning on the date of

receipt of the notice of cancellation by both the applicant and the County, as evidenced by the return receipts. Within thirty (30) days of receipt of a notice of cancellation of the bond from the surety, the Permit Holder shall obtain alternate financial assurance approved by the County.

(F) The Permit Holder may cancel the bond if the County has given prior written consent. The County shall provide such written consent when either of the following occurs: (1) the Permit Holder substitutes alternative financial assurance as specified in these rules; or (2) the County releases the Permit Holder from the financial assurance requirements of these rules pursuant to Rule 905.

(G) The Director or her or his designee may draw on the deposit or bond to correct violations and complete construction after:

(1) Notifying the Permit Holder that the Permit Holder has failed to construct the stormwater control system in accordance with the stormwater construction appro val and other requirements of this Ordinance and these rules when required to do so; and

(2) The expiration of the appeal period outlined in Section 95-111 of the Ordinance.

Rule 904 Letters of Credit

(A) An applicant may satisfy the financial assurance requirements of these rules by obtaining an unconditional irrevocable letter of credit that conforms to the requirements of this rule and that is executed on a form approved by the County. The issuing institution shall be a bank or financial institution that has the authority to issue letters of credit, whose letter of credit operations are regulated and examined by a federal or state agency, and that has an office in Wayne County.

(B) The letter of credit shall be unconditional and irrevocable and shall be issued for a period of at least one (1) year. The letter of credit shall provide that the expiration date will be automatically extended for a period of at least one (l) year unless, not less than 90 days before the current expiration date, the issuing institution notifies both the applicant and the County by certified mail of a decision not to extend the expiration date. Under the terms of the letter of credit, the 90 days shall begin on the date when both the applicant and the County have received the notice, as evidenced by the return receipts.

(C) If the applicant does not establish alternate financial assurance as specified in these rules and obtain written approval of such alternate assurance from the County within 90 days after receipt by both the applicant and the County of a notice from the issuing institution that it has decided not to extend

the letter of credit beyond the current expiration date, the County may draw on the letter of credit. The County may delay the drawing if the issuing institution grants an extension of the term of the credit. During the last 30 days of any such extension, the County shall draw on the letter of credit if the applicant has failed to provide alternate financial assurance as specified in these rules and obtain written approval of such assurance from the County.

(D) The Director may draw on the letter of credit to correct violations and complete construction after doing both of the following:

(1) Notifying the applicant that the applicant has failed to construct the stormwater control system in accordance with the stormwater construction approval and other requirements of this Ordinance and these rules when required to do so; and

(2) Providing the owner or operator with advance notice of at least seven (7) calendar days.

Rule 905 Release of the Financial Assurance Mechanism

(A) The financial assurance for the construction of the stormwater control system shall only be released in accordance with the Ordinance and these rules.

(B) If the County has reason to believe that the stormwater control system has not been constructed in accordance with the Ordinance, these rules, or the stormwater construction approval, the County shall provide the Permit Holder with a detailed written statement of any such reason. The County shall not be required to release the financial assurance mechanism provided by the Permit Holder until the County is satisfied, in its reasonable discretion, that the stormwater control system has been constructed in accordance with the Ordinance, these rules, and the stormwater construction approval.

(C) If the Permit Holder (or another party designated in writing by the Permit Holder to the County to receive the deposit or bond) fails to claim, in writing, his or her deposit or bond within one (1) year after notice from the County that the financial assurance is no longer required, the amount on deposit at that time, less any costs or expenses deducted by the County, shall be forfeited to the County and deposited into the County's road fund by the County.

Rule 906 Recordkeeping

Applicants must maintain evidence of all financial assurance mechanisms used to demonstrate financial responsibility under the Ordinance or these rules until released from the financial responsibility

requirements in accordance with Rule 905. Records maintained at any location other than the development site must be made available upon request of the County.

Chapter 10 LONG-TERM MAINTENANCE

Rule 1001 General Requirement

(A) An applicant shall submit a long-term maintenance plan as part of an application for stormwater construction approval. At a minimum, the long-term maintenance plan shall set forth:

(1) the preventative maintenance activities necessary to ensure that the stormwater control system will function properly as designed;

(2) a schedule describing the frequency with which preventative maintenance activities shall occur;

(3) the manner in which the applicant shall assure, through a legally binding instrument, that the stormwater control system shall be maintained in perpetuity;

(4) the requirement and procedure for submitting on an annual basis the maintenance records for the stormwater control system to the local unit(s) of government in which the stormwater control system is located and the County; and

(5) the physical limits of the stormwater control system and the party responsible for maintaining each system component.

(B) Long-term maintenance shall include site monitoring and inspection to ensure that a stormwater control system is functioning properly as designed; maintenance of structural and vegetative BMPs installed and implemented to meet the performance standards; remedial actions necessary to repair, modify, or reconstruct the system in the event the system does not function properly as designed at any time; notification to subsequent owners of limitations or restrictions on the property; actions necessary to enforce the terms of restrictive covenants or other instrument applicable to the property pursuant to the Ordinance and these rules and such other actions as may be set forth in the Ordinance or these rules promulgated hereto.

(C) As a condition of final approval of the stormwater control system, an applicant for stormwater construction approval shall demonstrate to the County that the stormwater control system shall be maintained in perpetuity.

Rule 1002 Responsibility for Long-Term Maintenance

The M-Permit Holder(s) shall be responsible for its long-term maintenance and shall be the Permit Holder under the Long-Term Maintenance Permit. The local unit(s) of government in which the stormwater control system is located or other public entity approved by the County, shall guarantee the long term maintenance of stormwater control systems that require a County stormwater construction approval in accordance with a long term maintenance plan and schedule approved by the County.

Rule 1003 Long-Term Maintenance Permits and Resolutions

The County may establish requirements for the form and substance of instruments that meet the requirements of this rule.

ADOPTED BY THE WAYNE COUNTY COMMISSION _____