RULES
OF THE
ST. CLAIR COUNTY
DRAIN COMMISSIONER

Procedures and Design Criteria
For Stormwater Drainage in Development Plans

Established Pursuant to:

The Land Division Act
Public Act No. 288 of 1967, as amended;
M.C.L. §§ 560.101 – 560.293
&
the Mobile Home Commission Act
Public Act No. 96 of 1987, as amended;
M.C.L. §§ 125.2301 – 125.2350
&
The Condominium Act
Public Act No. 59 of 1978, as amended;
M.C.L. §§ 559.101 – 559.276
&
The Michigan Drain Code
Public Act No. 40 of 1956, as amended
M.C.L. §§ 280.1 – 280.630

October 1, 2018

Robert Wiley
St. Clair County Drain Commissioner

Order of Adoption of Amendments
To the Rules of the St. Clair County Drain Commissioner

Whereas, the Land Division Act (Act 288 of 1967, as amended), M.C.L. §§ 560.101 – 560.293, and the Mobile Home Commission Act (Act 96 of 1987), M.C.L. §§ 125.2301 – 125.2350, provide for the adoption and publication of rules and standards by the County Drain Commissioner to govern outlet drainage and storm water facilities in developments; and

Whereas, the Michigan Drain Code (Act 40 of 1956, as amended), M.C.L. §§ 280.1 – 280.630, provides the general authority of Drain Commissioners and for other standards and permitting requirements; and

Whereas, the Rules of the St. Clair County Drain Commissioner were originally adopted and published by Drain Commissioner Thomas Donohue effective January 1, 1995, and amended July 14, 2000, October 1, 2004, and October 1, 2013, effective upon re-publication; and

Whereas, it has become necessary to further amend and to clarify certain of those rules;

Now, Therefore, It Is Hereby Ordered, that the Rules of the St. Clair County Drain Commissioner are amended to read as follows and such amended rules shall take effect immediately upon publication on the St. Clair County website, October 1, 2018.

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1.0 INTRODUCTION

These Rules of the St. Clair County Drain Commissioner are adopted pursuant to the general authority granted under the Michigan Drain Code of 1956, Public Act No. 40 of 1956, as amended, M.C.L. §§ 280.1 – 280.630 (hereinafter "Drain Code") and other applicable laws, to protect the public health, safety, and welfare in regarding drainage matters over which the Drain Commissioner has jurisdiction. These Rules are meant to assist in maintaining the County's stormwater drainage systems, waterways and watersheds, focusing on the legally established drainage districts and drains within St. Clair County. Specifically, these Rules are designed to provide guidance in order for project design to minimize flood damage; to preserve farm drainage; to promote best management practices relating to drainage; to protect the quality of surface and ground waters; to protect St. Clair County residents' natural flow rights under common law; and to manage the County's drains, drainage resources, and drainage districts for multiple purposes including drainage, sustainable development, recreation, scenic beauty, and fish and wildlife habitats. These Rules are applicable to all developments subject to review and approval of the Drain Commissioner and over which the Drain Commissioner has jurisdiction. These Rules provide minimum standards for developments covered under the Rules, provided, however, that the Drain Commissioner reserves the right to deviate from the specific design standards set forth in the Rules when, on a case-by-case basis, such deviation is appropriate or necessary in order to accommodate the goals and purposes underlying these Rules. These rules and their implementation are designed to promote low impact designs such as rain gardens or other site control of stormwater. The Drain Commissioner is committed to working with those developing projects or applying for permits to use alternate drainage methods which help meet local landscape ordinance requirements and improve the quality of water in our environment.

The following discussion outlines basic ideas and principals of stormwater management, and provides a conceptual foundation for the design standards contained in this document.

1.1 Impacts of Development on Water Quantity

The hydrology of a watershed changes in response to site clearing and development of the natural landscape. A site's existing stormwater storage capacity can be lost as vegetation is removed, natural depressions are graded and both topsoil and wetlands are eliminated. As the soil is compacted and resurfaced with impervious materials, rainfall may no longer penetrate into the ground and runs off of the land. These modifications, along with the installation of drainage facilities, alter natural drainage patterns within the area drained.

1.1.1 Examples of Changes in Watershed Hydrology and Stream Morphology

- Increases in volume of runoff raise the flood stage and the frequency of severe flood events.
- Bankfull floods fill the stream channel to the top of its banks, but do not spill over into the floodplain. Increased bankfull flooding subjects the stream channel to continual disturbance and scour.
- Increases in flow velocities are caused by the combined effect of greater discharges, shorter times of concentration, and smoother hydraulic surfaces.

- Stream flow fluctuations increase dramatically as runoff is concentrated into more quickly rising, higher peaks with equally abrupt returns to pre-storm level discharges. Increased flow fluctuations may disrupt habitats and reduce the diversity of aquatic species regardless of water quality.
- If infiltration into the underlying water table is reduced, there is often a lowering of the level of surface waterbodies that are dependent on groundwater to maintain base flows during dry periods.
- Channel widening and down-cutting contribute to increased runoff rates and flow fluctuations.
- Streambank erosion accelerates as channels are disturbed by undercutting, tree-falls and bank slumping.
- Sediment loads increase with streambank erosion and construction site runoff. These sediments settle out and form shifting bars that often accelerate the erosion process by deflecting runoff into sensitive bank areas.
- Increased sedimentation and channel widening affect aquatic habitats. Stream structure changes as the gradient of the stream adjusts to accommodate frequent floods. Sediment deposition damages invertebrate habitat as well as fish spawning areas.

1.2 Impacts of Development on Water Quality

As development occurs, changes in land use may contribute new or additional pollutants to storm-water runoff. In addition, some accompanying impervious surfaces may provide efficient delivery of these pollutants into receiving waterways. Leaves, litter, animal droppings, exposed soil from construction sites, fertilizer and pesticides are all washed off of the land. Vehicles and deteriorating urban surfaces deposit trace metals, oil, and grease onto streets and parking lots. These and other toxic substances may be carried by stormwater and conveyed through creeks, ditches and storm drains into our rivers and lakes.

In short, the ecology of drains and waterways may be re-shaped by the shifts in hydrology, morphology and water quality that can accompany the development process. The stresses that these changes place on the environment are often gradual and invisible, yet they may produce significant effects over time: The Michigan Department of Environmental Quality (MDEQ) has identified streams in the urban and urbanizing areas as requiring special initiatives to restore degraded habitats, and to improve water quality.

To mitigate drainage impacts, it is necessary to evaluate the way that stormwater and land development are managed. The following discussion provides a framework for this evaluation, which encompasses the entire development process from land use planning and zoning to site design and construction.

1.3 Framework for the Design of Stormwater Management Systems

Thoughtful site planning can substantially reduce environmental and drainage impacts associated with development. Towards this end, communities, regulatory agencies, and designers must evaluate the impact of each individual development project over the long term, and on a watershed scale. Such an approach requires consideration of Best Management Practices (BMPs) that function together as a system to ensure that the volume, rate, timing and pollutant

load of runoff remains stable and sustainable. A "BMP" is a practice or combination of practices that prevent or reduce stormwater runoff and/or associated pollutants. This can be achieved through a coordinated network of structural and nonstructural methods. In such a system, each BMP by itself may not provide major benefits, but becomes very effective when combined with others.

1.3.1 Source Controls

Source controls reduce the volume of runoff generated on-site, and eliminate initial opportunities for pollutants to enter the drainage system. By working to prevent problems, source controls are the best option for controlling stormwater, and include the following key practices:

- Preservation of existing natural features that perform stormwater management functions, such as depressions, wetlands, and woodland and vegetative buffers along streambanks.
- The minimization of impervious surface area through site planning that makes efficient use of paved, developed areas and maximizes open space. Encouraging flexible street and parking standards and the use of permeable ground cover materials can also reduce impervious surfaces.
- Direction of stormwater discharges to open grassed areas such as swales and lawns rather than allowing stormwater to run off from impervious areas directly into the stormwater conveyance system.
- Careful design and installation of erosion control mechanisms and rigorous maintenance throughout the construction period. Effective erosion control measures include minimizing the area and length of time that a site is cleared and graded, and the timely vegetative stabilization of disturbed areas.

1.3.2 Site Controls

Site controls are the subject of this document. After the implementation of source controls, site controls are then required to convey, pre-treat, and treat (e.g., detain, retain or infiltrate) the stormwater runoff generated by development. The range of engineering and design techniques available to achieve these objectives is to some degree dictated by site configuration, soil type, and the receiving waterway. For example, flat or extremely steep topography may preclude the use of grassed swales, which are otherwise preferable to curb and gutter systems. But while each site will be unique, some universal guidelines for controlling stormwater quality and quantity can be stated.

1.3.3 "Drain" and "Drainage District" Defined

The term "Drain" as used in these Rules shall have the meaning as proscribed in Section 3 of the Drain Code as follows:

> The word 'drain', whenever used in this act, shall include the main stream or trunk and all tributaries or branches of any creek or river, any watercourse or ditch, either open or closed, any covered drain, any sanitary or any combined sanitary and storm sewer or storm sewer or conduit composed of tile, brick, concrete, or other

material, any structures or mechanical devices, that will properly purify the flow of such drains, any pumping equipment necessary to assist or relieve the flow of such drains and any levee, dike, barrier, or a combination of any or all of same constructed, or proposed to be constructed, for the purpose of drainage or for the purification of the flow of such drains, but shall not include any dam and flowage rights used in connection therewith which is used for the generation of power by a public utility subject to regulation by the public service commission.

The term "Drainage District" as used in these Rules shall have the following meaning:

> A Drainage District is any county or inter-county drainage district legally established pursuant to applicable provisions of the Drain Code. Drain Code Section 5 provides that each such drainage district is a body corporate with the power to contract, to sue and be sued, and to hold, manage, and dispose of real property, in addition to any other powers conferred by law. Generally, a drainage district is comprised of all lands which drain to a legally established Drain.

1.4 Purpose of These Rules

It is the purpose of these site development rules to establish minimum stormwater management requirements to meet the following objectives:

- Ensure that stormwater drainage systems and BMPs are adequate to address stormwater management needs within a proposed development and protect the drainage, property and water rights of landowners outside of the proposed development.
- Reduce artificially induced flood damage.
- Minimize the degradation of existing watercourses.
- Prevent an increase in non-point source pollution.
- Maintain site hydrology to avoid detrimental changes in the balance between stormwater runoff, groundwater recharge and evapo-transpiration.

Further documentation of the impacts of development on land and water resources and the importance of stormwater management can be found in Chapter 2 of the Low Impact Development Manual for Michigan (SEMCOG, 2008).

Low Impact Development Manual for Michigan, A Design Guide for Implementers & Reviewers
https://www.semcog.org/Reports/LID/files/assets/basic-html/page-1.html

2. 0 DEVELOPMENTS REQUIRING REVIEW and SUBMISSION REQUIREMENTS

Pursuant to state law, all residential or industrial subdivisions and all manufactured housing communities or mobile home parks must conform to these Rules and design standards adopted by the Drain Commissioner. Additionally, these Rules and design standards will be applied to, and a permit from the Drain Commissioner (see Appendix C) may be required for, all other developments and construction activities that affect drainage conditions or drainage patterns for which one or more of the following conditions[1] applies:

Condition I
The proposed development is located within an established drainage district and the proposed development will impact a drain, for example, by contributing flow into the drain or depositing sediment or contaminants into the drain.

Condition II
The proposed development alters drainage flow to an established drainage district.

Condition III
County or local ordinances or other legal authority require the Drain Commissioner's evaluation. Additionally, the Drain Commissioner may apply these standards if requested by a local municipality or county.

Condition IV
The site development is in the defined Port Huron Urbanized Area and disturbs one or more acres, including projects less than an acre that are part of a larger common plan of development or sale, and discharges into an MS4 owned by or under the jurisdiction of the SCCDO or a municipality which has adopted these Rules.

These conditions will also apply to projects of the SCCDO and St. Clair County as long as there is no conflict with PA 40 of 1956 (Drain Code).

Outlined below are examples of types of developments and construction activities that may be within the jurisdiction of the Drain Commissioner that are expressly addressed in the referenced subsections of this Section of the Rule and which may generally require a Drainage Permit from the Drain Commissioner:

2.1 Platted Subdivisions

2.2 Condominium Developments

2.3 Private Road or Land Split Developments

2.4 Manufactured Housing Communities / Mobile Home Parks

2.5 Commercial or Industrial Developments

[1] Minor development or construction activities, such as those associated with a typical single-family residence, that are not part of a larger common plan or development may be exempt from the Drainage Permit requirement.

2.6 Direct or Indirect Discharges to an Established Drain

2.7 Drain Crossings, Culverts, Tiling and/or Enclosing an Established Drain

2.8 Drain Widening, Deepening or Relocation

2.9 Adding or Subtracting Land to/from a Drainage District and/or Construction of a Drain for Ascription as an Established Drain.

The types of plans to be submitted are listed for each development type. Some of the legal sources of the Drain Commissioner's authority are also cited. Details regarding the requirements for plats and plans can be found in the following section, Section 3.0 Plat/Plan Requirements and Procedures.

2.1 Platted Subdivisions

Pursuant to Land Division Act, PA 288 of 1967, as amended, M.C.L. §§ 560.101 – 560.293, and the general authority of Drain Commissioners under the Drain Code

2.1.1 Pre-Preliminary Plats

Section 107 of the Land Division Act, M.C.L. § 560.107, states that a proprietor may submit a pre-preliminary plat to a governing body for their information and review. The pre-preliminary plat will be reviewed by the Drain Commissioner per the same standards as a preliminary plat. Comments on the pre-preliminary plat will be provided for the proprietor's consideration, but approval from the Drain Commissioner is not required to proceed with submission of the preliminary plat. For review of a pre-preliminary plat, the Drain Commissioner may charge the same review fees that would be applicable to a preliminary plat.

2.1.2 Preliminary Plats

Section 105 of the Land Division Act, § 560.105, states that the approval of a preliminary plat shall be conditioned upon compliance with any published rules of a county Drain Commissioner. A checklist of requirements for preliminary plats can be found in Appendix F. Additional requirements for preliminary plats can be found in Section 3.1 Preliminary Plat/Plan Requirements & Procedures. Review fees for preliminary plat apply as outlined in Appendix B. Approval of a preliminary plat does not constitute approval of construction or engineering plans for the proposed subdivision. Construction and engineering plans must be approved prior to the beginning of construction and prior to final approval.

2.1.3 Construction Plans

Construction plans will be reviewed for their compliance with the requirements described in Section 3.2 and the design standards listed in Section 4.0 Design Standards for Stormwater Systems. The plans must be approved by the Drain Commissioner prior to any on-site construction or grading. Additionally, a Drainage Permit must be obtained from the Drain Commissioner if one or more of the conditions in Section 2.0 apply. The initiation of grading or building activities before plan approvals and/or permits from the Drain Commissioner is the basis for issuance of a Stop Work Order. In addition, the completion of projects that do not

conform to approved plan specifications will not be tolerated by the Drain Commissioner and may entail legal enforcement and/or withholding of approval of any final plats until outstanding issues are resolved.

2.1.4 Final Plats

Section 192 of the Land Division Act, M.C.L. § 560.192, states that the Drain Commissioner shall require that the proprietor provide for adequate stormwater facilities within the lands proposed for platting and outlets thereto. If the stormwater facilities are not installed before approval of the final plat, some form of surety must be posted with the Drain Commissioner. Section 192 also allows the Drain Commissioner to require the proprietor to provide adequate stormwater retention/detention systems and an arrangement for the future maintenance of the stormwater facilities. All these requirements must be addressed before the final plat is submitted for review. Additional details regarding the requirements for final plat approval can be found in Section 3.3 Final Plat Requirements & Procedures. Section 146 of the Land Division Act, M.C.L. § 560.146, states that a certificate shall be signed and dated by the Drain Commissioner signifying that the provisions of Section 192 have been met and that the final plat meets the Drain Commissioner's approval.

2.2 Condominium Developments

Pursuant to the Condominium Act, PA 59 of 1978, as amended, M.C.L. §§ 559.101 – 559.276, and the general authority of Drain Commissioners under the Drain Code

Section 71 of the Condominium Act, M.C.L. **§** 559.171, requires that written notice be provided to the Drain Commissioner prior to taking reservations under a preliminary reservation agreement, recording a master deed for the property, or beginning construction for a condominium project. The Drain Commissioner will review plans and offer comments/approval as may be within his jurisdiction. Generally, the Drain Commissioner will review and approve condominium plans using the same criteria that apply to subdivisions. Such review shall be completed prior to the recording of the master deed for the condominium.

2.2.1 Preliminary Plans

Preliminary plans for condominium sites will be reviewed by the Drain Commissioner as per preliminary plats. A checklist of requirements for preliminary plats/plans can be found in Appendix F. Requirements for preliminary plans can be found in Section 3.1 Preliminary Plat/Plan Requirements & Procedures. Approval of a preliminary plat does not constitute approval of construction or engineering plans for proposed subdivisions, and construction and engineering plans must be approved prior to the beginning of any construction and prior to the final plat approval.

2.2.2 Construction Plans

Condominium construction plans must be reviewed by, and a Drainage Permit obtained from, the Drain Commissioner if one or more of the Conditions in Section 2.0 apply. Construction plans will be reviewed for their compliance with the requirements described in Section 3.2 and the

design standards listed in Section 4.0 Design Standards for Stormwater Systems. The plans must be approved by the Drain Commissioner prior to any on-site construction or grading. Only upon their approval will permits required from the Drain Commissioner be issued. The initiation of grading or building activities before obtaining plan approvals and/or permits from the Drain Commissioner is the basis for issuance of a Stop Work Order. Condominium master deeds shall contain a legally binding plan for long-term maintenance of the stormwater facilities. Such plans shall be reflective of/similar to subdivision stormwater management deed restrictions. Examples of such stormwater facility maintenance agreements can be found in Appendix H. A copy of the stormwater maintenance plan will be submitted to the Drain Commissioner as part of the review process. All review fees and expenses will be paid before final approval is given to proceed with construction activities.

2.3 Private Road or Land Split Developments

The Drain Commissioner may have jurisdiction over private road developments or land split developments depending on how the property will be used and whether the use of the property impacts a Drain. The jurisdictional criteria are set forth in Section 2.0 above. The Drain Commissioner strongly recommends that plans for private road developments or land split developments be submitted for review so as to avoid the risk that a project could be delayed because approval was required but not obtained.

2.3.1 Preliminary Plans

If preliminary plans are submitted, preliminary plans for private road and land split developments will be reviewed by the Drain Commissioner as per preliminary plats. A checklist of requirements for preliminary plats/plans can be found in Appendix F. Requirements for preliminary plans can be found in Section 3.1 Preliminary Plat/Plan Requirements & Procedures. Preliminary plans will be approved by the Drain Commissioner contingent upon review of detailed engineering and construction plans.

2.3.2 Construction Plans

Private road and land split development construction plans must be reviewed by, and a Drainage Permit obtained from, the Drain Commissioner if one or more of the Conditions in Section 2.0 apply. Construction plans will be reviewed for their compliance with the requirements described in Section 3.2 and the design standards listed in Section 4.0 Design Standards for Stormwater Systems. The plans must be approved by the Drain Commissioner prior to any on-site construction or grading. Only upon their approval will a permit be issued for discharge to an established drain and/or for work in a drain right-of-way. The initiation of grading or building activities before obtaining plan approvals and/or permits from the Drain Commissioner is the basis for issuance of a Stop Work Order. Stormwater facility maintenance must be ensured through a deed restriction or an equivalent legally binding agreement. Examples of such stormwater facility maintenance agreements can be found in Appendix H. A copy of the stormwater maintenance plan must be submitted to the Drain Commissioner as part of the review process. All review fees and expenses must be paid before final approval is given to proceed with construction activities.

2.4 Manufactured Housing Communities / Mobile Home Parks

Pursuant to the Mobile Home Commission Act, Act No. 96 of 1987, as amended, M.C.L. §§ 125.2301 – 125.2350, and the general authority of Drain Commissioners under the Drain Code

Section 11 of the Mobile Home Commission Act, M.C.L. **§** 125.2311, states that a person who desires to develop a mobile home park shall submit a preliminary plan to the county Drain Commissioner for preliminary approval. It also states that the preliminary plan shall not include detailed construction plans. Subsection 3 states that the Drain Commissioner shall review and may approve the outlet drainage, and that the Drain Commissioner shall adopt and publish standards to implement the subsection. These standards are as published in Section 4.0 Design Standards for Stormwater Systems. Mobile home interior drainage may be reviewed to the extent necessary to determine that the outlet drainage meets these standards, since inadequate interior drainage may result in overflows to the receiving watercourse.

2.4.1 Preliminary Plans

Preliminary plans will include the location, layout, general design, and general description of the mobile home park. A checklist of requirements for preliminary plans can be found in Appendix F. Requirements for preliminary plats can be found in Section 3.1 Preliminary Plat/Plan Requirements & Procedures. Preliminary plan approval will be contingent upon a review of the engineering and construction plans and all details related to and affecting outlet drainage

2.4.2 Construction Plans

Construction plans for mobile home parks must be reviewed by the Drain Commissioner to determine that the adequacy of the outlet drainage has been considered. Additional aspects of the plans for mobile home parks must also be reviewed by, and a Drainage Permit obtained from, the Drain Commissioner if one or more of the Conditions in Section 2.0 apply. Construction plans will be reviewed for their compliance with the requirements described in Section 3.2 and the design standards listed in Section 4.0 Design Standards for Stormwater Systems. The plans must be approved by the Drain Commissioner prior to any on-site construction or grading. Only upon their approval will any permits from the Drain Commissioner be issued. The initiation of grading or building activities before obtaining plan approvals and/or permits from the Drain Commissioner may result in issuance of a Stop Work Order. Stormwater facility maintenance must be ensured through a deed restriction or an equivalent legally binding agreement. Examples of such stormwater facility maintenance agreements can be found in Appendix H. A copy of the stormwater maintenance plan must be submitted to the Drain Commissioner as part of the review process. All review fees and expenses must be paid before final approval is given to proceed with construction activities.

Communication with the Drain Commissioner is strongly encouraged regarding all proposed developments.

2.5 Commercial or Industrial Developments

Pursuant to the jurisdiction of the Drain Commissioner under the Drain Code as set forth in Section 2 above and to the extent local ordinances require a permit.

Proposed commercial/industrial developments (e.g. shopping malls, apartments, schools, general retail and wholesale establishments, factories, industrial complexes, etc.) or additions/ modifications to such existing developments must be reviewed by and a Drainage Permit obtained from the Drain Commissioner if one or more of the Conditions in Section 2.0 apply or if required by a local ordinance.

2.5.1 Preliminary Plans

If preliminary plans for proposed commercial/industrial construction activities are submitted, they will be reviewed by the Drain Commissioner as per preliminary plats. A checklist of requirements for preliminary plats/plans can be found in Appendix F. Requirements for preliminary plans can be found in Section 3.1 Preliminary Plat/Plan Requirements & Procedures. Submission of preliminary plans is encouraged, but not required. Approval of preliminary plans by the Drain Commissioner is not required to proceed with submission of construction plans.

2.5.2 Construction Plans

Construction plans must be submitted to and a Drainage Permit obtained from the Drain Commissioner if one or more of the Conditions in Section 2.0 apply. Construction plans will be reviewed for their compliance with the requirements described in Section 3.2 and the design standards listed in Section 4.0 Design Standards for Stormwater Systems. The plans must be approved by the Drain Commissioner prior to any on-site construction or grading. Only upon their approval will any permits from the Drain Commissioner be issued. The initiation of grading or building activities before obtaining plan approvals and/or permits from the Drain Commissioner is the basis for issuance of a Stop Work Order. A copy of the stormwater maintenance plan will be submitted to the Drain Commissioner as part of the review process. All review fees and expenses must be paid before final approval is given to proceed with construction activities.

2.6 Direct or Indirect Discharge to an Established Drain

If point source or sheet flow drainage from any proposed development or any construction activities are to be directed toward and/or empty into an established drain or to any watercourse under the jurisdiction of the Drain Commissioner, compliance with these Rules and a Drainage Permit and fees shall be required. This permit may be required in addition to approval of plats and/or plans. Please refer to Appendix C for a Drainage Permit application: "Application and Permit Authorizing Development or Construction Activities Affecting Drainage." Unrestricted discharge of stormwater from developments to an established drain or other watercourse within the jurisdiction of the Drain Commissioner is unacceptable.

Before commencing to do any work on the site, the proprietor shall notify the Drain Commissioner at least 48 hours in advance to provide for the inspection of the project by the Drain Commissioner if required. The proprietor shall also notify the Drain Commissioner at the completion of the project to provide for a final inspection by the Drain Commissioner if required.

Inspections by the Drain Commissioner shall not relieve the proprietor of his obligations. Only upon the satisfactory completion of the project and final inspection will the Drain Commissioner issue the Drainage Permit.

Pursuant to Section 423 of the Drain Code, no sewage or waste matter shall be discharged into an established drain, which is capable of producing in the drain, detrimental deposits, objectionable odor nuisance, injury to drainage conduits or structures, or capable of producing such pollution of the waters of the state receiving the flow from the drains as to injure livestock, destroy fish life, or be injurious to public health.

Pursuant to Section 423 of the Drain Code, non-storm water discharges to water courses under the jurisdiction of the Drain Commissioner are prohibited. This may include illicit discharges, direct dumping, disposal of materials, and/or illicit connections to water courses. The following categories of non-storm water discharges are excluded from this prohibition unless they have been identified as significant sources of pollutants to these water courses.

- Discharges or flows from firefighting activities
- Water line flushing and discharges from potable water sources
- Landscape irrigation runoff, lawn watering runoff, and irrigation waters
- Diverted stream flows and flows from riparian habitats and wetlands
- Rising groundwater and springs
- Uncontaminated groundwater infiltration and seepage
- Uncontaminated pumped groundwater, except for groundwater cleanups specifically authorized by NPDES permits
- Foundation drains, water from crawl space pumps, footing drains, and basement sump pumps
- Air conditioning condensation
- Waters from noncommercial car washing
- Street wash water
- Dechlorinated swimming pool water from single, two, or three family residences.

The SCC Drain Commissioner may inspect, investigate, and monitor suspected illicit discharges into watercourses under his/her jurisdiction, and require and enforce the elimination of these discharges. To the maximum extent practicable, illicit discharges shall be eliminated from water courses under the SCC Drain Commissioner's jurisdiction within 120 days of its presence being confirmed by the SCC Drain Commissioner or his/her staff.

2.7 Drain Crossings, Culverts, Tiling and/or Enclosing an Established Drain

A Drainage Permit from the Drain Commissioner is required for any and all culverts, bridges, enclosures, and utility crossings of established drains. Section 425 of the Drain Code, M.C.L. § 280.425, states that a land owner may make a written request to the Drain Commissioner for permission to tile or enclose an open drain at his/her own expense. The Drain Commissioner may grant the request, via a Drainage Permit, but in so doing shall prescribe the size of the enclosure to be used. In accordance with Section 421 of the Drain Code, M.C.L. § 280.421, a permit shall not be issued to enclose a drain if the enclosure would obstruct the established drain.

2.8 Drain Widening, Deepening or Relocation

If the proprietor desires to perform construction activities within an existing drain right-of-way, including, widening, deepening, or relocation of a drain, application for a Drainage Permit will be filed with the office of the Drain Commissioner. This application will be accompanied by the necessary release of right-of-way, in recordable form, accomplished by all owners of interest. Preliminary and/or construction plans may be required for review as appropriate. Requirements and procedures for preliminary plans and construction plans are described in Section 3.0.

2.9 Adding or Subtracting Land to/from a Drainage District, and/or Construction of a Drain for Ascription as an Established Drain

If a proprietor desires to add or subtract land to/from a drainage district, and to construct a drain for designation as an established drain, the Drain Commissioner's approval must be obtained prior to construction. Section 433 of the Drain Code, M.C.L. § 280.433, requires that the proprietor enter into an agreement with the Drain Commissioner. The agreement would obligate the proprietor to pay (or put on deposit) all costs associated with the new drain(s). The agreement would require that a registered professional engineer prepare and certify all necessary documents, including but not limited to:

- An updated map of the drainage district showing the district boundary
- A document indicating the total area (in acres) of the drainage district, the area of the lands serviced by the new branches and/or extensions, and the total length (in miles and fractions thereof) of all drains, branches, and/or new extensions within the district.
- A current listing of all parcels partially or totally within district boundary.
- Legal descriptions for each parcel partially or totally within district boundary.
- For each parcel partially within district, a general description of the portion of parcel within district and the area (in acres) of that portion.
- Right-of-way documents dedicating to the drainage district all necessary easements and right-of-ways for the new branches and/or extensions. Said documents must be in a recordable form satisfactory to the Drain Commissioner and the County Register of Deeds.
- Covenants or Restrictions attaching to each new lot in the subdivision clearly stating that said lot is in the drainage district and subject to periodic special assessments for drain maintenance.
- Updated special assessment roll reflecting all parcels within the district subject to drain special assessments.

Subsequent to Drain Commissioner approval, the documents must be recorded, with the originals returned to the Office of the Drain Commissioner.

Before commencing to do any work on the site, the proprietor shall make satisfactory arrangements with the Commissioner to provide for the inspection of the project by the Drain Commissioner. These arrangements shall include, among other things, the submission of three sets of approved drainage plans, satisfactory evidence of insurance coverage, and a copy of the signed contract between the proprietor and his Contractor covering the work to be performed. Inspections by the Drain Commissioner shall not relieve the proprietor of his obligations. Spot

inspections by the Drain Commissioner's inspector are to verify the proper construction of the drains in their various stages of completion. If it is necessary to retain a natural watercourse because this watercourse serves land outside the proposed development, then recordable releases for said watercourse will be submitted. The contract shall show in addition to the name of the Contractor, the items of work involved, the total cost of the project, and the proposed completion date. At the time this information is supplied to the Drain Commissioner, inspection deposits shall be computed and payment of same shall be made to the Commissioner prior to commencing work. The proprietor will be held responsible for the actual inspection costs incurred by the Drain Commissioner. Before work commences, an inspector must be assigned to the project. The inspector may, at his discretion, request that a pre-construction meeting of all involved parties be held.

3.0 PLAT/PLAN REQUIREMENTS and PROCEDURES

Listed below are requirements and procedures for preliminary plats and plans, construction plans, and final plats.

All submissions for review by the Drain Commissioner must be accompanied by an Application for Drain Commissioner Review, which can be found in Appendix A. The application must indicate the type of plat/plans being submitted and be signed and dated by the proprietor or the proprietor's legal agent. The application grants permission for the Drain Commissioner or an assigned representative to enter and inspect the site. A check, or equivalent, for the initial review must accompany the application. Initial review fees are presented in Appendix B. These fees are predicated upon the size of the proposed development. Plats/plans shall not be considered "received" for review until the Application for Drain Commissioner Review is completed, signed, and filed along with payment of initial review fees. Proprietors may be responsible for additional fees if additional review time is necessary to perform a satisfactory review of the plat/plans.

3.1 Preliminary Plat/Plan Requirements & Procedures

A preliminary plat is required for proposed residential and industrial subdivisions prior to submission of construction plans. Preliminary plans are required for Manufactured Housing Communities / Mobile Home Parks. Submission of preliminary plans is optional, but may be required, for all other types of developments subject to review and approval of the Drain Commissioner. If preliminary plans are submitted, they will be reviewed according to the same requirements and standards as preliminary plats. All preliminary plat or plan approvals are contingent upon approval of construction plans and other applicable provisions of the Rules.

With the submission of a preliminary plat or preliminary plans, the proprietor or assigned agent must simultaneously submit to the Drain Commissioner:

- five copies of the preliminary plat/plans
- a letter of transmittal
- the Application for Drain Commissioner Review (See Appendix A)
- payment for initial review (See Appendix B)
- the completed Preliminary Plat/Plan Checklist (See Appendix F)

Preliminary plats/plans shall conform to the following requirements:

A. A preliminary plat or preliminary plans shall show the layout of the area intended to be platted or developed. The plat or plans shall be prepared under the direction of a registered engineer or a registered land surveyor, and shall be drawn to a scale not smaller than 1 inch equal to 100 ft.

B. The preliminary plat or preliminary plans shall give the location of the proposed subdivision/development with reference to the section and part of section in which the parcel is situated and the name of the township, city, or village. The plat/plans shall show the proposed street and alley layout, lot and plat/site dimensions, all pertinent

factors such as adjoining roads and subdivisions, rivers, railroads, high tension tower lines or underground transmission lines, cemeteries, parks, natural watercourses, established drains, sewers, easements, or any other feature, the existence, location, or description of which might be of value in determining the overall requirements for the subdivision/development. If the proposed plat/development is a part of or an addition to an established county or inter-county drainage district, this fact shall be clearly stated and the district boundaries shall be shown on the watershed map.

C. Easements for the public utilities shall be shown with the tentative layout. Inasmuch as improper utility easement location can result in a change in plat/site layout, the proprietor is advised to consult with the respective utility companies before presenting the tentative layout for approval. Contour information shall be shown with a minimum of a 2-ft. contour interval.

D. In the case where the proprietor wishes to develop a given area, but wishes to begin with only a portion of the total area, the original plat/plans shall include the proposed general layout for the entire area. The part that is proposed to be developed first shall be clearly superimposed upon the overall plan in order to illustrate clearly the method of development that the proprietor intends to follow. Each subsequent plat or set of preliminary plans shall follow the same procedure until the entire area controlled by the proprietor is subdivided. The final acceptance of a subdivision/development that is a partial development of a larger general layout does not automatically ensure the final acceptance of the overall layout. Each phase of the development will be required to have adequate stormwater drainage and detention. Drainage plans for a phase of development must not be dependent upon work planned to be performed in a future phase.

E. The names of the proprietor and engineering and/or surveying firm, with mailing addresses and telephone numbers for each, shall be included.

F. If an established drain is involved, preliminary plats/plans shall include a note indicating that "All work performed in the right-of-way of an established drain shall require a permit from the Drain Commissioner."

G. Accompanying each copy of the preliminary plat/plans shall be a copy of the site report furnished to the Department of Health under their rule.

H. All wetlands and floodplains shall be delineated on preliminary plats or plans.

I. The seasonal high groundwater table elevation and basement floor elevations (if applicable) shall be indicated on the preliminary plat or plans. Basement floors shall be at least two feet above the seasonal high water table or a permanently controlled groundwater level associated with a permanent gravity groundwater depression system.

J. The receiving watercourse to serve as the outlet for each proposed detention facility shall be identified on the preliminary plat/plans. If the receiving watercourse identified is not suitable to serve as the outlet, the proprietor may be required to improve the watercourse to conditions approvable by the Drain Commissioner.

K. Careful consideration should be given to the design of detention and/or retention basins during preparation of the preliminary plat/plans. Although design calculations for the volume and size of detention or retention basins are evaluated as part of the construction plan review, unidentified problems could result in significant modifications to the design and/or site layout. Frequently overlooked problems include:

- Failure to provide adequate space for detention or retention basins, since unrestricted discharge is not an acceptable option;
- Off-site areas contributing runoff onto a subject property affecting detention or retention pond volume requirements;
- Intrusive floodplain elevations;
- Depth to groundwater as a constraint to a detention/retention basin's depth; and
- Insufficient elevation change between a detention basin and its receiving watercourse.

L. If the preliminary plat/plans have been revised and are being re-submitted, the letter of transmittal shall indicate how the plat/plans have been revised and how each comment from the Drain Commissioner's previous review letter has been addressed.

M. When concentrated stormwater is proposed to be discharged over, onto, or across property other than that owned by the proprietor, an easement or agreement between the property owners must be executed and submitted to the Drain Commissioner in a form acceptable to the Drain Commissioner.

N. If either the proprietor or the Drain Commissioner finds it advantageous to make changes to a preliminary plat before the final plat is presented to the Commissioner for signature, such changes can be made, provided that a new preliminary plat is submitted for with each change in the layout. The proprietor is reminded that approval of a proposed subdivision by the local governing body is also required under the Subdivision Control Act. Changes made to obtain approval by the local governing body must be incorporated into the layout and a new preliminary plat resubmitted even though the original layout may have already been approved by the Drain Commissioner. If the proprietor does not present his final plat to the Commissioner for approval within a period of two years after receiving approval of the preliminary plat, it may be necessary that he resubmit the preliminary plat for review in the light of new information that may have become available during the interim.

3.2 Construction Plan Requirements and Procedures

Construction plans shall be reviewed subsequent to preliminary plat/plan reviews, if applicable. With the submission of construction plans, the proprietor or assigned agent must simultaneously submit the following to the Drain Commissioner:

- two copies of the construction plans
- a letter of transmittal
- the Application for Drain Commissioner Review (See Appendix A)
- payment for initial review (See Appendix B)
- the completed Construction Plan Checklist (See Appendix G)

- an agreement for maintenance of the stormwater management facilities (See Appendix H)
- any needed applications for permits to discharge to an established drain (Drainage Permit) or appeals for inclusion within a drainage district (Section 433 Agreement)
- an agreement between land owners if concentrated stormwater is to be discharged onto private property other than that owned by the proprietor
- a permit from the Michigan Department of Environmental Quality, if any construction activities are proposed within regulated wetlands

Construction plans must meet the following requirements:

A. For developments required to submit a preliminary plat, the approved preliminary plat or plans shall be incorporated into the constructions plans. For developments not required to submit a preliminary plat, the construction plans shall conform to the requirements and standards identified for preliminary plats/plans, items A-M in Section 3.1.

B. Construction plans must conform to the design standards presented in Section 4.0 Design Standards for Stormwater Systems.

C. Except for developments that will ultimately be owned by a single proprietor (e.g. commercial developments, mobile home parks, municipal developments), construction plans will not be granted approval by the Drain Commissioner until a satisfactory agreement has been submitted regarding long-term maintenance of the stormwater management facilities, including the detention and/or retention basins. Examples of acceptable maintenance agreements include:

   - ***Resolution of Acceptance*** from the municipality (e.g. township, city, or village) or other governmental agency with taxing powers indicating that the municipality or governmental agency is willing to accept, maintain, and operate the proposed stormwater management facilities on a permanent basis.
   - ***Deed Restrictions*** for a subdivision indicating that the homeowners' association will accept, maintain, and operate the proposed stormwater management facilities on a permanent basis.
   - ***Master Deed*** for a condominium development indicating the condominium association will accept, maintain, and operate the proposed stormwater management facilities on a permanent basis.

   Examples of such maintenance agreements can be found in Appendix H.

D. When concentrated stormwater is proposed to be discharged over, onto, or across private property other than that owned by the proprietor, an agreement between the land owners must be executed relieving the Drain Commissioner and municipality of any and all responsibility for damage that might occur. Such an agreement shall be submitted to the Drain Commissioner and municipality prior to construction.

3.3 Final Plat Requirements and Procedures

Final plats are required to be submitted for residential and industrial subdivision developments only; all other types of developments are considered approved by the Drain Commissioner upon approval of the construction plans. The Drain Commissioner's evaluation of final plats will occur subsequent to construction plan approvals.

Five copies of the final plat shall be submitted to the Drain Commissioner. If approved, the Drain Commissioner's signature will be affixed to the plats for execution. Six copies may be submitted if the proprietor requests the return of a copy with the Drain Commissioner's signature.

The following requirements must be satisfied prior to final plat approval:

A. The final plat must strictly adhere to the construction plans as approved by the Drain Commissioner.

B. The proprietor must submit a copy of the concerned municipality's approval of the preliminary plat. The municipality's approval shall be considered valid for two years from the date of their approval.

C. The proprietor must submit a notarized letter in which the proprietor or assigned agent attests to the fact that all necessary permits (e.g. Wetland, Floodplain, Inland Lakes and Streams, Erosion Control, etc.) and required governmental approvals (e.g. Michigan Department of Environmental Quality (MDEQ) Compliance Analysis determination of adequacy, MDEQ Baseline Environmental Assessment determination of adequacy, MDEQ risk assessment determination of adequacy, etc.) have been granted.

D. The proprietor's engineer shall furnish a certificate bearing a clear statement that all of the drainage facilities within the subject plat have been constructed in accordance with the approved construction plans and specifications (See Section 3.3.1 below), or, if the construction has not been completed at the time of final plat submittal, the proprietor must enter into an agreement with the Drain Commissioner and post surety for faithful performance of the agreement (See Section 3.3.2 below).

3.3.1 Procedure for the Construction of Drainage Systems Prior to Final Plat Approval

If a drainage system is to be completed before submission of the final plat, the proprietor must request the Drain Commissioner's inspection of the project. The Commissioner must receive an Inspection Request Letter proposing an available time and date for inspection. Requested inspection dates must be no less than 15 working days from the Drain Commissioner's receipt of the request.

Approval of the final plat shall be contingent upon strict adherence to the construction plans as approved in writing by the Drain Commissioner. The proprietor shall be responsible for cleaning all sewers, manholes, catch basins, or other structures affected by the operations in the development before final plat approval. The proprietor should take whatever precautions he deems necessary in direct relations with his contractor in order to assure the work performed by

the contractor meets the approval of the Drain Commissioner. The proprietor shall be held totally responsible for the fulfillment of his obligations to the Drain Commissioner notwithstanding that his contractor or consulting engineer may be at fault. The proprietor may be required to post a nominal bond with the Drain Commissioner to guarantee repairs of any defects, which may show up as a result of poor workmanship or defective materials within one year after completion of the improvements. Should no defects occur within this period of one year and should no adjustments be required, this bond will be returned to the proprietor in its entirety.

3.3.2 Procedure for Drainage Systems Constructed Subsequent to Final Plat Approval

As required under Section 192(b) of the Land Division Act, as amended; M.C.L. § 560.192(b), if adequate stormwater facilities within the land proposed for platting are not installed before approval of the final plat, the proprietor shall enter into an agreement with the governing body or county drain commissioner and shall post a cash deposit, certified check or irrevocable bank letter of credit whichever the proprietor selects, or a surety bond acceptable to the approving authority, in an amount sufficient for the faithful performance of the agreement. A rebate shall be made to the proprietor, as the work progresses, of amounts of any cash deposits equal to the ratio of the work completed to the entire project.

Prior to the final release of surety money, the proprietor's engineer shall submit a complete set of as-built drawings showing all of the approved field changes. The as-built drawings will be kept on file with Drain Commissioner for permanent public record.

3.4 Other Permits & Requirements

3.4.1 Soil Erosion and Sedimentation Control Permit

The development may require a Soil Erosion and Sedimentation Control (SESC) Permit from the County Enforcing Agency (St. Clair County Health Department) for Part 91, Soil Erosion & Sedimentation Control, of the Natural Resources Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended.

SESC permit applications can be obtained from the St. Clair County Health Department:

St. Clair County Health Department
3415 28th Street
Port Huron, MI 48060
http://www.stclaircounty.org/Offices/health/SoilErosion.aspx

3.4.2 NPDES Permit-by-Rule

The development may require a National Pollutant Discharge Elimination System (NPDES) Permit-by-Rule from the Michigan Department of Environmental Quality (MDEQ). The (NPDES) Permit Program is the Construction Storm Water Coverage under Permit-by-Rule under Part 31, Water Resources Protection of the Natural Resources and Environmental

Protection Act (NREPA), Public Act 451 of 1994, as amended and the Federal Water Pollution Control Act, 33 U.S.C. 1251, et seq. (Clean Water Act)

NPDES permit applications for projects within St. Clair County should be submitted to the following MDEQ local district office:

Southeast Michigan District Office
27700 Donald Court
Warren, MI 48092
(586) 753-3700

3.4.3 Other Requirements

In any case where construction will occur within a County Drain Right of Way, the following conditions also apply:

The facility shall be constructed at the location, elevation, and manner shown in the construction drawings. All underground lines must be buried a minimum of 5 feet below the existing bottom and side slopes of the drain unless a written agreement is reached between both parties stating otherwise.

All work done in connection with the construction and the drain facility will be documented to have been restored substantially to the working condition as designed.

Drainage shall be maintained and left unobstructed during construction so as to prevent the backing up of water which would cause flooding of adjacent land.

The Developer assumes all liability for any loss or damage sustained by any person or property as a result of operations performed by him and will repair any damage which it causes. Documentation of the final condition will be provided to the St. Clair County Drain Commissioner.

The Developer will notify the St. Clair County Drain Commissioner 48 hours prior to the commencement of work and an inspector will be present while the work is in progress. Fees for inspection by the St. Clair County Drain Commissioner will be the responsibility of the Developer and the Developer agrees to pay the necessary expense of the Drain Commissioner's inspector. The cost of the Inspector shall be reflected in the budget for construction.

At the discretion of the St. Clair County Drain Commissioner, progress meetings may be required for any work done within County Drain Right of Way. The Developer will prepare agendas and publish minutes of the progress meetings to accurately record the proceedings.

An accurate record of facility construction in the form of scale drawings will be submitted to the St. Clair County Drain Commissioner within 6 months of the completion of construction.

3.5 Procedures for Appeal of Decision of Drain Commissioner

If a proprietor, or other person aggrieved by a decision made by the Drain Commissioner pursuant to these Rules, wishes to appeal the decision of the Drain Commissioner, such appeal shall be made in writing to the St. Clair County Drain Commissioner within 20 calendar days of the decision. Examples of decisions subject to these appeal procedures include, but are not limited to, approvals or denials relating to plats, condominium developments, mobile home developments, or other construction and development activities subject to 425 permits. The written appeal shall identify which aspects of the decision of the Drain Commissioner are the subject of the appeal, and should specify in detail the basis and rationale for the appeal. The appellant may rely on the documentation previously presented to the Drain Commissioner or may include any additional information or documentation to be considered by the Drain Commissioner as part of the appeal. Additionally, the appellant may request an informal hearing with the Drain Commissioner. If an informal hearing is requested, the Drain Commissioner will schedule the hearing within 10 calendar days from the date of having received the appeal.

At the appeal hearing, the proprietor and/or its representatives shall be allowed an opportunity to submit additional information or re-emphasize previously submitted data supporting positions taken in their appeal; to further explain the nature and basis for the appeal; and/or to present an alternative disposition for the decision appealed. Following the Drain Commissioner's review of the information presented during the appeal process, the Drain Commissioner shall make a final decision on the appeal within 20 days of the appeal if no hearing is requested. If a hearing is requested and held, the final decision shall be made within 20 days of the hearing. The final decision of the Drain Commissioner shall be mailed to the proprietor by first class mail.

Undertaking an administrative appeal pursuant to these rules shall be a prerequisite to seeking relief by way of filing court proceedings regarding the subject of the appeal, unless different procedures are expressly provided under the Drain Code pertaining to decisions of the Drain Commissioner or Drain Board or other applicable state laws.

4.0 DESIGN STANDARDS for STORMWATER SYSTEMS

Unless otherwise noted, the following design standards and requirements apply to construction plans submitted for review by the St. Clair County Drain Commissioner for all types of developments or drain-related construction activities.

4.1 General Requirements

The following general stormwater management requirements apply to all new developments and redevelopments in St. Clair County.

A. The design process shall begin by identifying sensitive areas located on the site and laying out the site to protect the sensitive areas.

B. Best Management Practices (BMPs) that reduce the amount of stormwater runoff and improve water quality are required and shall be designed on a site specific basis. Rate and volume reduction BMPs shall be used to protect open channel storm drains. All BMPs shall be included on the plans and will be subject to review and approval by the SCCDO and MDEQ as necessary for permits. BMP usage shall be monitored and recorded in the weekly SESC reports. Areas with potential for significant pollutant loading, as determined by the SCCDO, will require BMPs which address regulation of the specific hazard.

   The Developer/Owner shall include a long-term operation and maintenance schedule for all permanent BMPs. A maintenance agreement between the SCCDO and the owners, lessees, or operators is necessary for permanent BMPs which shall include but not be limited to: inspection of structural or vegetative BMPs, performance of maintenance and corrective actions when BMPs are neglected by the owner, and deed restrictions. This document must be signed and have an email address so the SCCDO can follow up as needed to ensure maintenance is being completed. There must also be a statement that the owner will notify the SCCDO of any sale or transfer of ownership on the property. This can also be done by the use of deed restriction language for subdivisions or through residential and industrial condominium project documents.

C. Onsite management of stormwater is required first and foremost, unless site constraints preclude this approach.

D. Stormwater shall be managed using four standards: stream protection, flood control, water quality and pre-treatment to protect both water resources and real property.

E. Stream protection (channel protection/bankfull flood) shall be provided for surface water discharges to natural water courses (directly or through pipes or ditches) by retaining onsite the difference in stormwater runoff volume between pre-development

and post-development conditions for the 2-year, 24 hour storm (2.29 inches of rain). Stream protection for redevelopments shall be provided through retention of the difference in the 2-year 24-hour stormwater runoff volume between existing and post-development conditions. If extended detention is considered, refer to section 1.3.1 for Source Controls. The design engineer must consider incorporation of green infrastructure elements and keep in mind that if extended detention is to be used, then additional BMPs likely will be needed to maintain pre-development volume and peak flow rate levels for all storms up to the 2-year 24 hour event. The discharge rate from the proposed site cannot exceed 0.15 cfs/acre. The developer will need to provide extended detention for the portion of runoff from the 2-year 24-hour storm that cannot be removed on site and discharge at the runoff rate of 0.15 cfs/acre. Examples of BMPs include but are not limited to green roofs, rain gardens, bio retention, bio swales, removal of impervious area, or use of trees and various shrubs.

F. Flood control shall be provided for all sites through retention or detention. One inch of runoff from disturbed pervious and impervious areas should be detained for treatment and flood control. The maximum allowable detention release rate is equal to the presettlement runoff rate for all storms up to the 100 year storm event using the Runoff Curve Number Method to determine presettlement runoff. The maximum allowable release rate shall be 0.15 cfs per acre. Onsite flood control may be waived for direct discharges to large lakes and rivers if the Developer demonstrates no negative impacts, or if provided in a regional facility with adequate upstream infrastructure.

G. Overland flow routes and the extent of high water levels for the 100-year storm shall be identified for all sites.

H. Water quality treatment shall be provided for all sites. A minimum treatment volume equal to one inch of runoff from the directly contributing impervious area is required. A minimum volume of 900 cubic feet per acre is required for directly connected disturbed pervious areas (i.e. lawns). BMP's shall be designed to reduce post development solids loadings by 80% or to not exceed solids loadings of 80 milligrams per liter.

I. Pre-treatment is required for infiltration, filtration and detention BMPs for ease of maintenance and to protect BMP integrity and preserve longevity.

J. Stormwater discharges from activities with a high risk for an accidental spill of pollutants (stormwater hot spots) shall provide spill containment.

K. Stormwater discharges to cold water streams shall employ management strategies to reduce stormwater runoff temperature and promote groundwater recharge.

L. The design maximum release rate, volume or concentration of stormwater discharged from a site shall not exceed the capacity of existing infrastructure or cause impairment to the offsite receiving area. Evaluation of the existing outlet must be performed and an adequate outlet must be provided.

M. The use of many decentralized Low Impact Development (LID) BMPs is not mandated, but is encouraged on private sites.

N. Construction plans for a phased development shall show the existing and/or proposed drainage systems for all prior phases of the development, unless the drainage system for the current phase is entirely independent of the prior phases. Furthermore, drainage plans for a phase of a development must not be dependent upon work planned to be performed in a future phase.

O. Plans shall include a grading plan showing existing and proposed topographic contour lines and proposed finish floor and basement floor elevations.

P. All existing natural or manmade watercourses shall be shown on the plans. The proposed changes to the site must not interfere with Common Law Natural Flow Rights. Existing watercourses must be preserved or relocated, or the flow otherwise accommodated by the proposed plans. Provisions for the maintenance of the watercourse must be included in the deed restriction or an equivalent legally binding agreement. MDEQ and/or the Army Corp. of Engineers may also require permits for changes made to such watercourses.

Q. No construction activities shall be allowed without approval of the Drain Commissioner in a 100-year floodplain as determined by the Drain Commissioner.

R. The cover sheet of the plans shall include a "Permit Status Table" indicating the status of all permits being obtained. An example of such a table is provided in Appendix E.

S. If an established drain is involved, construction plans shall include a note indicating that "All work performed in the right-of-way of an established drain shall be in accordance with the Drain Commissioner's Rules."

T. The engineer's seal shall be affixed to all sheets of the construction plans.

4.2 Established Drains

A. Plans shall include plans and profiles of all existing and proposed drains within road right-of-way and drainage easements on site. These drawings shall indicate the channel bottom, banks, base flow water elevation, and the location of the outlet from the detention facility, if applicable.

B. Minimum right-of-way widths for proposed drains:

1. Proposed open drains shall have a minimum right-of-way of 40 feet plus top width of channel centered on drain centerline. A consistent right-of-way width shall be maintained along the entire reach of drain on the proposed site. A minimum width of 20 feet must be maintained from the top-of-bank to the edge of the right-of-way to allow for maintenance of the drain.

2. Proposed enclosed drains shall have a minimum right-of-way of 40 feet centered on the centerline of the enclosure.

3. The above minimum widths shall govern generally; however, wider right-of-ways may be required at the discretion of the Commissioner.

C. Where drainage is to be discharged to an established drain, either directly or through secondary routes, the drain shall be improved to standards approved by the Drain Commissioner when necessary for proper drainage of the proposed development. The drain restoration can be performed by and/or at the expense of the Developer (See Section 2.8), or by the Drain Commissioner by means of a petition to clean out the drain.

D. Where drainage is discharged to an established drain, the outlet shall be so designed as to enter the drain at an angle of 90 degrees or less, as determined by the upstream centerline. Preformed end sections, grouted riprap, or specially designed outlet structures will be required.

E. If cutting and/or filling is to be performed within a drain right-of-way, a table shall be provided indicating at one-foot elevation intervals the total cut and fill volumes below each elevation. At each one-foot elevation interval, the total cut volume must equal or exceed the total fill volume. (Note that additional permit(s) may be required from the MDEQ.)

F. Sodding, seeding, and mulching within a drain right-of-way shall be done in accordance with the requirements of the "Soil Erosion and Sedimentation Control, Authorized Public Agency Procedures Manual" of the St. Clair County Drain Commissioner, and performed only after prior approval of the Drain Commissioner as to the time of performance and acceptability of the finished grade. This work must be performed under the inspection of the Drain Commissioner.

4.3 Storm Sewers

A. Plans shall show boundaries and acreages of catchment areas contributing runoff to each proposed or existing catch basin and/or inlet. Runoff from off-site tributary areas must be accommodated in design or rerouted.

B. The required discharge capacity for each reach of sewer shall be determined by the Rational Method.

1. A 10-year design storm shall be used such that rainfall intensity, $I = 175 / (T + 25)$, where T = time of concentration in minutes.

2. The runoff coefficient, C, shall be in conformance will normal design practice. Where a weighted average coefficient is employed, the computations shall be submitted for review.

C. A complete set of storm sewer design calculations shall accompany every set of construction plans submitted for review.

1. Sewer capacities shall be based on the Manning equation.

2. Energy losses from friction shall be based on calculated design storm peak discharges and velocities, not Manning design (i.e. full-pipe) capacities.

3. Energy losses from friction shall be based on typical Manning "n" roughness values as shown in Table J-3.

4. Energy losses through manholes and other appurtenances shall be included in the design calculations OR reflected in friction losses through use of conservative Manning "n" roughness values as shown in Table J-3.

D. The storm sewer pipe shall have a minimum diameter of 12 inches when constructed in a public right-of-way or easement.

E. Storm sewer slopes must not be flatter than the minimum slopes indicated in Table J-2.

F. Minimum allowable pipe velocity shall be 2.5 ft/sec. (except where the minimum diameter requirement makes this unachievable.) Desirable pipe velocity range shall be 4-8 ft/sec. Maximum allowable pipe velocity shall be 10 ft/sec.

G. Hydraulic grade lines shall be calculated and shown as a part of all storm sewer profiles. In no case shall the hydraulic grade line exceed the elevation lying 1 foot below the rim elevation of a manhole, catch basin or inlet. The hydraulic grade line upstream of a detention or retention storage facility shall be calculated assuming the design high water elevation (e.g. full detention basin).

H. The storm sewer plan and profile drawing shall show the following data:

1. Proper identification and numbering of manholes, catch basins and inlets

2. Invert and casting elevations for all structures

3. Pipe length (C/L to C/L to structures)

4. Pipe diameter

5. Pipe slope

6. Pipe class or designation

7. Detail of trench construction and type of backfill material

I. Generally, manholes shall be placed not more than 400 feet apart for sewers less than 30 inches diameter and 600 feet apart for larger sewers.

J. The minimum inside diameter of all manholes, catch basins and inlets shall be 48 inches, with the following exception: Inlet structures from which water will be discharged directly into a catch basin may be 24 inches inside diameter. The depth of such inlets shall be no greater 5.0 feet and no less than 3.5 feet from the top of frame and cover to the invert.

K. Manholes and inlets structures may be constructed of brick, manhole block, precast concrete (ASTM C478) or cast-in-place concrete.

L. All manhole block or brick structures shall be plastered on the outside with 1 to 2.5 mix of portland cement mortar, ½-inch thick. No calcium chloride or other chemical shall be added to lower the freezing point of the mortar, as the strength of the mortar may be lessened.

M. Inlet structures in the public street right-of-way shall be spaced a maximum of 400 feet apart (or a maximum of 400 feet on either side of a high point). The spacing and/or number of inlet structures required to accommodate the design flows in streets and in private drives and parking areas, shall be based on a maximum of 1 cfs per 90 square inches of opening in an inlet or catch basin cover.

N. All storm sewer pipe, manholes, catch basins, and inlets shall meet MDOT specifications.

O. Generally, drops of over 2.0 feet at manholes, from invert of higher pipes to lower pipes, shall be avoided.

P. Joints in concrete pipe having a diameter of 30 inches or larger shall be pointed up on inside with mortar after backfilling has been completed.

Q. Where drainage is discharged to an established drain or natural watercourse, such outlets shall enter the drain or watercourse at an angle of 90 degrees or less, as measured from the upstream centerline. Preformed end sections, riprap or specially designed outlet structures will be required.

R. Unless the storm sewers are to be owned and maintained by a single private entity (i.e. municipal or commercial development, manufactured housing community, etc.), all storm sewers shall be located within an easement. The minimum easement width for a storm sewer shall be 40 feet centered on the sewer centerline.

S. All existing and proposed on-site drainage easements shall be clearly shown.

T. If any utilities are to be located within existing or proposed drainage easements within a development, the proprietor's engineer shall present plans of such utilities to the Commissioner for his approval as to location. If possible, such plans should be presented at the same time as drainage plans so that all details of construction and location may be checked and properly oriented with each other. In order to avoid conflict, it is important that a careful investigation be made where underground utilities are in close proximity to proposed storm sewers, or where they cross each other.

4.4 Open Channels

NOAA Atlas 14, "Precipitation–Frequency Atlas of the United States" (2013) is considered the most current and comprehensive rainfall data available. The National Oceanic & Atmospheric Administration's Atlas 14 data can be accessed at: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

In the recent past, rainfall data compiled by Huff, F.A. and Angel, J.R. was commonly used. See: Rainfall Frequency Atlas of the Midwest, 1992, Bulletin 71 Midwestern Climate Center and Illinois State Water Survey. MCC Research Report 92-03, available for free download at: http://www.sws.uiuc.edu/pubdoc/B/ISWSB-71.pdf

Long-term daily and monthly precipitation data for about 25 stations throughout Michigan is available free from the United States Historical Climatology Network (USHCN) at: http://cdiac.ornl.gov/epubs/ndp/ushcn/ushcn_map_interface.html

A. The peak 10-year flow in each reach of open channel shall remain within the banks of the channel. Off-site tributary area shall be included in the design, or the off-site tributary runoff shall be rerouted around the channel.

B. The values of Manning's "n" shall be no less than 0.040 except where the channel is smooth and paved in which case an "n" value of 0.013 to 0.022 shall be used.

C. The maximum velocity for grass lined channels shall not exceed 5 ft/sec. Where above velocity is exceeded, the channel shall be protected by cobble paving or other means to prevent scour.

D. The minimum acceptable non-siltation velocity should be 1.5 ft/sec.

E. Unless the open channels are to be owned and maintained by a single private entity (i.e. industrial/commercial development, manufactured housing community, etc.), all open channels shall be located within an easement. Open channels shall have a minimum right-of-way of 40 feet plus top width of channel centered on the centerline. A consistent right-of-way width shall be maintained along the entire reach of channel on the proposed site. A minimum width of 20 feet must be maintained from the top-of-bank to the edge of the right-of-way to allow for maintenance. The above minimum width shall govern generally; however, wider right-of-ways may be required at the discretion of the Commissioner.

F. Side slopes of open channels shall normally be no steeper than 1 vertical to 3 horizontal. Where conditions dictate steeper side slopes, consideration should be given to slope paving and fencing. The final decision in such matters rests with the Drain Commissioner.

G. All existing and proposed on-site drainage easements shall be clearly shown on the plans.

4.5 Culverts

A. All culverts should be labeled on the plans as "existing", "proposed", or "to be extended".

B. Plans shall show boundaries and acreages of tributary areas contributing runoff to each proposed or existing culvert on the proposed site.

C. Proposed or extended culverts on established county drains must be approved by the Drain Commissioner. Proposed or extended culverts may also require the approval of the Michigan Department of Environmental Quality (MDEQ), the St. Clair County Road Commission and/or the Michigan Department of Transportation (MDOT). Copies of permits obtained from other agencies must be submitted to the St. Clair County Drain Commissioner.

D. If the tributary area to a culvert is less than 20 acres, the Rational Method shall be used to determine the peak design flow for the culvert. For larger tributary areas, the SCS Method shall be used. The runoff coefficients used should be consistent with those in Table J-1, and selected to reflect the future land use of the tributary area.

E. All culverts shall be designed for inlet and outlet control conditions. Calculations of the 10-year and 100-year headwater elevations shall accompany the final plans (see Appendix N for Example Culvert Design Calculation).

   1. The 10-year headwater elevation of each culvert shall not exceed an elevation one foot below the road or driveway centerline elevation. The backwater shall not extend beyond the limits of the proprietor's property.

   2. The 100-year headwater elevation of each culvert may overtop the road or driveway centerline elevation, but must remain below proposed finish floor elevations of all nearby existing and proposed structures.

   3. The tailwater elevation assumed for each culvert should be estimated as the normal depth of the peak flow in the downstream channel, unless the tailwater is influenced by the headwater of another downstream culvert or the confluence of another watercourse.

F. Wing walls, headwalls, end sections, and all other culvert extremities shall be designed to ensure the stability of the surrounding soil, and to meet the requirements of other governing agencies (e.g. St. Clair County Road Commission, MDOT, MDEQ)

G. Roadways over culverts or bridges may be required to be paved or designed in such a way as to prevent the erosion of road material into the established drain or watercourse.

H. The following data shall be provided for all proposed or extended culverts:
   - Length
   - Diameter

- Invert elevations
- Material type
- Protection for culvert ends

I. Riprap must be provided for all culverts in established drains or significant watercourses. The rip-rap provided for the protection of culvert ends shall:

1. Extend at least one culvert diameter upstream of the culvert inlet and at least four culvert diameters downstream of the culvert outlet;

2. Extend across the bottom of the channel and up the banks of the channel to at least the elevation of the crown of the culvert;

3. Be inlayed such that it does not cause an obstruction in the watercourse; and

4. Have a minimum dimension no smaller than that consistent with HEC-11 Design Guidelines for Rock Riprap and MDOT standards. (A conservative guideline for water depths less than 3 feet would be to use 8-inch diameter riprap for flow velocities up to 6 feet/sec, and 16-inch diameter riprap for flow velocities up to 11 feet/sec.)

J. Minimum diameter for a driveway or crossroad culvert shall be 18 inches or equivalent pipe arch.

K. The pipe used in culverts shall meet MDOT specifications and St. Clair County Road Commission standards.

4.6 Bioretention

A bioretention system consists of a soil bed planted with native vegetation located above an underdrained sand layer. It can be configured as either a bioretention structure or a bioretention swale. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system. Runoff storage depths above the planting bed surface are typically shallow. The adopted TSS removal rate for bioretention systems is 90 percent.

Bioretention systems are used to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff. They can also be used to reduce peak runoff rates and increase stormwater infiltration when designed as a multi-stage, multi-function facility.

4.6.1 Pre-Design Site Evaluation

Each specific site proposed for development or re-development is unique due to soils, land cover, topography, location, land use and many other variables. These unique characteristics make it difficult, if not impossible, to develop one set of uniform storm water standards which can accommodate all variables. Due to this parameter, additional requirements not included in these

standards may be necessary to meet the intent of these rules. Also, waivers and variances from certain provisions of these design standards or rules may be requested when it can be determined that the standard cannot be feasibly accommodated. In these situations, alternatives consistent with the overall intent of these rules may be proposed for consideration and will be subject to the approval of the St. Clair County Drain Commissioner. For example, if there is an underdrain sand filtration system in place to completely filter all runoff from this system, then the first flush treatment criteria can be disregarded. During the review of the final submittal, if the design meets applicable volume and water quality standards and any applicable discharge criteria, it can be approved by the Drain Commissioner's engineer or designee.

Soil borings and/or soil test pits may be required to determine the feasibility of infiltration. Also, the design engineer must research the soils in the area of development/re-development and determine the hydrologic soil groups (HSG - A, B, C, or D) and soil characteristics. The majority of the Urbanized Area of St. Clair County does not have very permeable soils and the soils are mainly type C and D soils. If the site has had previous soils borings and BMPs in place which have functioned well in the past and can currently meet the 0.25 inches per hour infiltration rate, or if the soils map and soil profile show an area which is conducive to infiltration, then new soil borings may not be required. The need for soil borings will be determined by the Drain Commissioner's engineer or designee.

Another aspect to be cognizant of when implementing infiltration practices is the buildings on the perimeter of a site development. The design engineer must consider basements nearby or other buildings which may be adversely impacted by an infiltration practice being implemented in an area with a clay layer just a few feet under the soils which prevents effective infiltration.

The bio-retention filtration collection system with its sand filtration system will slow the discharge rates considerably and will lower the peak discharge rates. The peak discharge rate from these systems cannot exceed the 2-yr 24-hr discharge from the site, so as to meet channel protection standards.

For infiltration trench and structure practices, the following infiltration (K_{SAT}) values shall be used:

- $K_{sat} \geq 0.50$ inches/hour
  Infiltration BMPs shall be constructed to provide the infiltration volume as calculated using the above requirements.

- 0.24 inches/hour $< K_{sat} <$ 0.50 inches/hour
  Install supplemental measures, which may include subsoil amendment, or an underdrain placed at the top of the storage bed layer to ensure dewatering in the event underlying soils fail to provide adequate drawdown/dewatering time. If underdrains are selected, they shall be designed to allow stormwater to percolate through the soils first, with the underdrain serving as a secondary outlet, by placing the underdrain in the upper level of the BMP, with pipe perforations located along the underdrain invert.

- $K_{sat} < 0.24$ inches/hour
  Soils are not suitable for infiltration. Alternative methods to reduce stormwater volume shall be used.

Feasibility testing is to be conducted to screen unsuitable sites, and reduce testing costs. A soil boring is not required at this stage. However, a designer or landowner may opt to engage Concept Design Borings at his discretion, without feasibility testing.

Initial testing involves either one field test per facility, regardless of type or size, or previous testing data, such as the following:

* on-site septic percolation testing, within 200 feet of the proposed BMP location, and on the same contour which can establish initial rate, water table and/or depth to bedrock,

* geotechnical report on the site prepared by a qualified geotechnical consultant, or

* Natural Resources Conservation Service (NRCS) County Soil Mapping showing an unsuitable soil group such as a hydrologic group "D" soil in a low-lying area.

Soil information can be found at this website:

https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

If the results of initial feasibility testing as determined by a qualified professional show that an infiltration rate of greater than 0.24 inches per hour is probable, then the Drain Commissioner's engineer or designee shall make the final decision on implementation.

Once all testing is completed the design engineer must contact the St. Clair County Drain Commissioner's engineer to review the results for the site and determine if the proposed BMP is a feasible practice for the development/re-development.

Technical Infeasibility

For projects where technical infeasibility exists, the design engineer must document and quantify that stormwater strategies, such as infiltration, evapotranspiration, and harvesting and water use have been used to the maximum extent technically feasible (METF) and that implementation of these methods are infeasible due to site constraints. The burden of proof of technical infeasibility lies with the design engineer. Documentation of technical infeasibility should include, but may not be limited to, engineering calculations, geological reports, hydrological analyses and site maps. A determination that the performance design goals cannot be achieved on the site should include analyses that rule out the use of an adequate combination of infiltration, evapotranspiration, and water use measures. Adequate documentation must be submitted to the St. Clair County Drain Office for review and final determination. Examples of site conditions that may prevent the application of stormwater BMP's to the METF include (adapted from EPA Section 438 Technical Guidance, December 2009):

- The conditions on the site preclude the use of infiltration practices due to the presence of shallow bedrock, hard clay horizons, contaminated soils, high ground water or other factors, such as underground facilities, utilities or location of the development within a wellhead protection area.
- The design of the site precludes the use of soil amendments, plantings of vegetation or other designs that can be used to infiltrate and evapotranspirate stormwater runoff.

- Water harvesting and use are not practical or possible because the volume of water used for irrigation, toilet flushing, industrial make-up water, wash-waters, etc. is not significant enough to warrant the design and use of water harvesting and use systems.
- Modifications to an existing building to manage stormwater are not feasible due to structural or plumbing constraints or other factors.
- Site area is too small to accommodate adequate infiltration practices for the impervious area to be served.
- Soils cannot be sufficiently modified to provide reasonable infiltration rates.
- Site use is inconsistent with the capture and use of stormwater or other physical conditions on site that preclude the use of plants for evapotranspiration or bio-infiltration.
- Retention and/or use of stormwater onsite or discharge of stormwater onsite by infiltration would have an adverse effect on the site, the down gradient surface or subsurface water or receiving watershed or water body ecological processes.
- Federal, state, or local requirements or permit conditions prohibit water collection or make it technically infeasible to apply LID practices.

4.6.2 Design Criteria

A. Storage Volume, Depth, and Duration

Bioretention systems shall be designed to treat the runoff volume generated by the stormwater quality design storm (2 year). The maximum water depth during treatment of the stormwater quality design storm shall be 12 inches in a bioretention structure and 18 inches in a bioretention swale. The minimum diameter of any outlet or overflow orifice is 2.5 inches. The bottom of a bioretention system, including any underdrain piping or gravel layer, must be a minimum of 2 feet above the seasonal high groundwater table. The planting soil bed and underdrain system shall be designed to fully drain the stormwater quality design storm runoff volume within 72 hours. The distance from the bottom of the bioretention system to the seasonal high groundwater level is recommended to be four (4) feet. Two feet is allowable, but may reduce the performance of the BMP.

B. Permeability Rates

The design permeability rate through the planting soil bed must be sufficient to fully drain the stormwater quality design storm runoff volume within 72 hours. This permeability rate must be determined by field or laboratory testing. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two shall be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the soil bed material is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the system's stormwater quality design storm drain time.

C. Planting Soil Bed

The planting soil bed provides the environment for water and nutrients to be made available to the vegetation. The soil particles can adsorb some additional pollutants through cation exchange, and voids within the soil particles can store a portion of the stormwater quality design storm runoff volume. The planting soil bed material should

consist of 10 to 15 percent clays, a minimum 65 percent sands, with the balance as silts. The material's pH should range from 5.5 to 6.5. The material shall be placed in 12 to 18 inch lifts. The total depth or thickness of the planting soil bed should be a minimum of 3 feet. As noted above, the design permeability rate of the soil bed material must be sufficient to drain the stormwater quality design storm runoff volume within 72 hours. Filter fabric should be placed along the sides of the planting soil bed to prevent the migration of soil particles from the adjacent soil into the planting soil bed.

D. Vegetation

The vegetation in a bioretention system removes some of the nutrients and other pollutants in the stormwater inflow. The use of native plant material is recommended for bioretention systems wherever possible. The goal of the planting plan should be to simulate a forest-shrub community of primarily upland type. In general, trees should dominate the perimeter zone that is subject to less frequent inundation. Shrubs and herbaceous species that are adapted to moister conditions and expected pollutant loads should be selected for the wetter zones. The number of stems per acre should average 1,000, with tree spacing of 12 feet and shrub spacing of 8 feet.

E. Sand Layer

The sand layer serves as a transition between the planting soil bed and the gravel layer and underdrain pipes. It shall be a minimum thickness of 12 inches and consist of clean medium aggregate sand (AASSHTO M-6/ASTM C-33 or MDOT Class II). To ensure proper system operation, the sand layer must have a permeability rate at least twice as fast as the design permeability rate of the planting soil bed.

F. Underdrain

The underdrain piping must be rigid Schedule 40 PVC pipe. The portion of drain piping beneath the planting soil bed and sand layer must be perforated. All remaining underdrain piping, including cleanouts, must be nonperforated. All joints must be secure and watertight. The underdrain piping must connect to a downstream storm sewer manhole, catch structure, channel, swale, or ground surface at a location that is not subject to blockage by debris or sediment and is readily accessible for inspection and maintenance. Blind connections to downstream storm sewers are prohibited.

G. Overflows

All bioretention systems must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow.

H. Tailwater

The hydraulic design of the underdrain and overflow systems, as well as any stormwater quantity control outlets, must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

Bioretention systems must be constructed off-line from County Drains.

I. Maintenance

The following requirements must be included in the system's maintenance plan.

1. General Maintenance

   All bioretention system components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include bottoms, trash racks, low flow channels, outlet structures, riprap or gabion aprons, and cleanouts.

   Sediment removal should take place when the structure is thoroughly dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

2. Vegetated Areas

   Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the planting soil bed and remaining vegetation.

   When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

   All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health should not compromise the intended purpose of the bioretention system. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

3. Structural Components

   All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

4.7 Infiltration

An infiltration structure is a facility constructed within highly permeable soils that provides temporary storage of stormwater runoff. An infiltration structure does not normally have a structural outlet to discharge runoff from the stormwater quality design storm. Instead, outflow from an infiltration structure is through the surrounding soil. An infiltration structure may also be combined with an extended detention structure to provide additional runoff storage for both stormwater quality and quantity management. The adopted TSS removal rate for infiltration structures is 80 percent.

Infiltration structures are used to remove pollutants and to infiltrate stormwater back into the ground. Such infiltration also helps to reduce increases in both the peak rate and total volume of runoff caused by land development. Pollutant removal is achieved through filtration of the runoff through the soil as well as biological and chemical activity within the soil.

4.7.1 Pre-Design Site Evaluation

Infiltration structures can present some practical design problems. When planning for an infiltration structure that provides stormwater quality treatment, consideration should be given to soil characteristics, depth to the groundwater table, sensitivity of the region, and runoff water quality. Specifically, infiltration structures must not be used in the following locations:

- Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied or pesticides are loaded, unloaded, or stored.

- Areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.

- Areas where infiltration structure use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.

- Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.

- Areas where industrial stormwater runoff is exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing, or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

- Areas where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures. Such adverse impacts must be assessed and avoided by the design engineer.

If any of the above mentioned conditions are present, the SCCDO will coordinate with the MDEQ as appropriate in the matters regarding the site to implement infiltration BMPs to manage stormwater on a site with contaminated soils or similar issues.

Infiltration structures must be configured and located where their construction will not compact the soils below the structure. In addition, an infiltration structure must not be placed into operation until the contributing drainage area is completely stabilized.

General Setback Requirements for Infiltration Structures:

Soil Absorption Systems for Title 5 Systems: 50ft.
Private wells: 100 ft.
Public wells: 150 ft.
Public reservoir, surface water sources for public water systems and their tributaries: 400 ft.
Other surface waters: 50 ft.
Property Lines: 10 feet
Building foundations: >10 to 100 ft, depending upon soil types and Infiltration Structure type

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for the planning and preliminary design of infiltration structures. For final design and construction, soil tests are required at the exact location of a proposed structure in order to confirm its ability to function without failure.
Tests should include:

- determination of the textural classification
- permeability of the subgrade soil at and below the bottom of the proposed infiltration structure

The recommended minimum depth for subgrade soil analysis is 5 feet below the bottom of the structure or to the groundwater table. Soil permeability testing can be conducted in accordance with the Standards for Individual Subsurface Sewage Disposal Systems.

4.7.2 Design Criteria

A. Storage Volume, Depth, and Duration

An infiltration structure must be designed to treat the total runoff volume generated by the structure's maximum design storm. This may either be the groundwater recharge or stormwater quality design storm, depending upon the structure's proposed use. An infiltration structure must also fully drain this runoff volume within 72 hours. Runoff storage for greater times can render the structure ineffective and may result in anaerobic conditions, odor, and both water quality and mosquito breeding problems. The bottom of the infiltration structure must be at least 2 feet above seasonal high water table or bedrock. For surface structures, this distance must be measured from the bottom of the sand layer. The structure bottom must be as level as possible to uniformly distribute runoff infiltration over the subgrade soils.

To enhance safety by minimizing standing water depths, the vertical distance between the structure bottom and the maximum design storm water surface in surface infiltration structures should be no greater than 2 feet. Construction of an infiltration structure must be done without compacting the structure's subgrade soils. Excavation must be performed by equipment placed outside the structure whenever possible. This requirement should be considered when designing the dimensions and total storage volume of an infiltration structure. It is important to note that the use of infiltration structures is recommended only for the stormwater quality design storm and smaller storm events. Use of infiltration structures for larger storm events and the requirements by which such structures are to be designed, constructed, and maintained should be reviewed and approved by all applicable reviewing agencies.

B. Permeability Rates

The minimum design permeability rate of the soils below an infiltration structure will depend upon the structure's location and maximum design storm. The use of infiltration structures for stormwater quality control is feasible only where soil is sufficiently permeable to allow a reasonable rate of infiltration. Therefore, infiltration structures designed for storms greater than the groundwater recharge storm can be constructed only in areas with Hydrologic Soil Group A and B soils.

Maximum Design Structure Location	Minimum Design Permeability Rate (Inches/Hour)
Groundwater Recharge Subsurface	0.2
Groundwater Recharge Surface	0.5
Stormwater Quality Surface and Subsurface	0.5

In addition to the above, the design permeability rate of the soil must be sufficient to fully drain the infiltration structure's maximum design storm runoff volume within 72 hours. This design permeability rate must be determined by field testing (See Bioretention Pre Design). Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two must be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the soils is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the structure's maximum design storm drain time.

C. Bottom Sand Layer

To help ensure maintenance of the design permeability rate over time, a 6 inch layer of sand must be placed on the bottom of an infiltration structure. This sand layer can intercept silt, sediment, and debris that could otherwise clog the top layer of the soil below the structure. The sand layer will also facilitate silt, sediment, and debris removal from the structure and can be readily restored following removal operations. The sand layer must meet the specifications of MDOT Class II sand. This must be certified by a certified testing lab.

D. Overflows

All infiltration structures must be able to convey overflows to downstream drainage systems in a safe and stable manner. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow.

E. Subsurface Infiltration Structures

A subsurface infiltration structure is located entirely below the ground surface. It may consist of a vault, perforated pipe, and/or stone bed. However, due to the greater difficulty in removing silt, sediment, and debris, all runoff to a subsurface infiltration structure must be pretreated. This pretreatment must remove 80 percent of the TSS in the runoff from the structure's maximum design storm.

Infiltration Structures must be constructed off-line from County Drains.

F. Basis of Design

The design of an infiltration basin is based upon Darcy's Law:

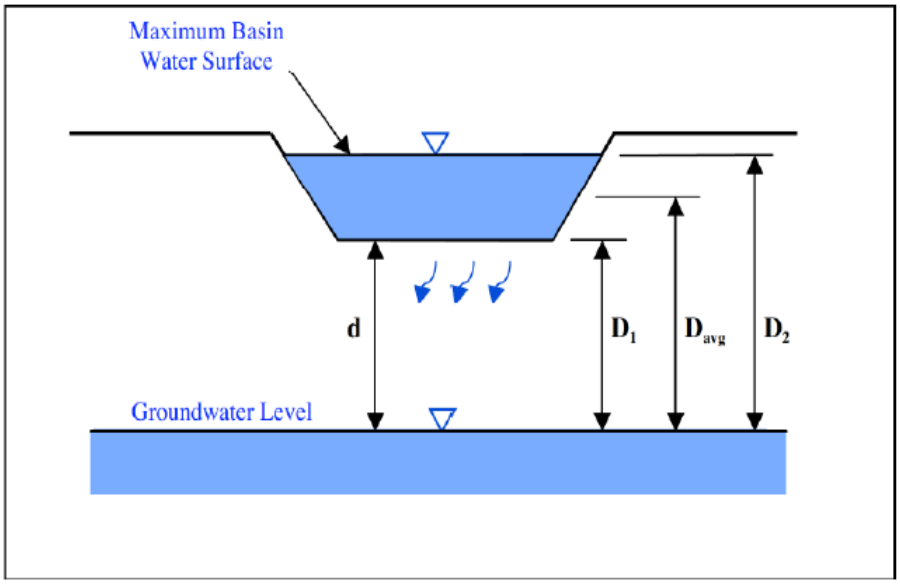
$Q = KIA$

where:

Q = the rate of infiltration in cubic feet per second (cfs)
K = the hydraulic conductivity of the soil in feet per second (fps)
I = the hydraulic gradient
A = the area of infiltration in square feet (sf)

From the variables shown in the Figure below:

Average Hydraulic Gradient = D_{avg} /d
Minimum Hydraulic Gradient = D_1/d
Maximum Hydraulic Gradient = D_2/d



G. Maintenance

The following requirements must be included in the system's maintenance plan.

General Maintenance

All infiltration structure components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include bottoms, riprap or gabion aprons, and inflow points. This applies to both surface and subsurface infiltration structures. Sediment removal should take place when the structure is thoroughly dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

4.8 Detention Storage Facilities

Detention storage facilities are designed to detain runoff for a short period of time and then release it to a watercourse where it returns to the hydrologic cycle. The objective of detention storage is to regulate the released runoff rate and to reduce the impact on downstream drainage systems. Detention storage should not be confused with retention storage (i.e. retention basins), a facility with no engineered outlet (other than an emergency-type outlet) designed to hold runoff for a considerable length of time. The water in a retention basin is not discharged to surface water, although it may infiltrate in to the ground, evaporate, or be consumed by plants.

In keeping with Common Law Natural Flow Rights and the Michigan Drain Code, concentrated discharges of stormwater (such as the outflow from a detention facility) or increased surface water runoff over property owned by others must be pursuant to a valid right-of-way, easement, or other written permission from all property owners affected. The outflow from a detention facility is considered to be such a concentrated discharge of stormwater.

All forms of detention storage shall meet the following criteria:

A. On-site detention (or retention – See Section 4.9 Retention Basins) of stormwater is required of all new developments or redevelopments to maintain the peak outflow to a rate similar to the pre-development runoff rate. The maximum allowable release rate shall be 0.15 cfs per acre, but not to exceed the pre-development runoff rate from the 2-yr / 24 hr storm event, or a discharge rate approved by the St. Clair County Drain Commissioner. In no case shall the outflow from a site exceed the capacity of the receiving watercourse to accept the flow.

B. Detention requirements may be more stringent in certain watersheds according to local ordinances or policies of the drainage district. In the Crapaud Creek watershed, the peak allowable discharge rate is limited to 0.1 cfs/acre.

C. The detention basin volume shall be determined for the 100-year flood volume from all tributary area, including off-site area.

    1. The tributary area shall include all acreage contributing runoff to the detention storage facility, including any off-site tributary area in its existing state, whether developed or undeveloped.

2. The following equations shall be used to determine the 100-year detention volume:

   Q_a = Allowable release rate, cfs

   $Q_o = Q_a / (A\ C)$, where A = Tributary area in acres, C = weighted runoff coefficient

   Detention time in minutes, $T = -25 + \text{sqrt}(10{,}312.5 / Q_o)$

   Storage volume per impervious acre, $V_s = 16{,}500\ T / (T + 25) - 40\ Q_o\ T$

   Required detention volume in cubic feet, $V = V_s \times A \times C$

D. If the site is located near the downstream end of a watercourse or drainage district, the Drain Commissioner may require that the proprietor (or his engineer) generate and submit hydrographs of the outflow from the existing site and from the proposed site (i.e. detention facility) and a hydrograph of the flow in the receiving watercourse to verify that the detained outflow would not result in an increase in the peak flow in the receiving watercourse. If the detained outflow would result in an increase in the peak flow in the receiving watercourse, then stormwater detention is not an acceptable stormwater management option. Retention of stormwater or other stormwater management design approved by the Drain Commissioner must be provided. See Sections 4.6, 4.7 and 4.9 for design requirements. The St. Clair County Drain Commissioner's office may be able to assist in the determination of the required hydrographs, if needed.

E. All developed areas shall drain to detention basins. However, portions of the developing site may be allowed to drain unrestricted (i.e. not through a detention facility) if either of the following conditions are met:

   1. The areas draining unrestricted are not being disturbed or altered by the construction, such that they will maintain their existing drainage characteristics and patterns.

   2. The areas draining unrestricted are being disturbed or altered but will be permanently stabilized to prevent erosion and will not contain any impervious surface post-construction. In this case, the unrestricted flow must be draining to a receiving watercourse with valid rights-of-way, or else written agreement from the affected property owners would have to be obtained per Common Law Natural Flow Rights and the Michigan Drain Code. In addition, the post-construction peak 100-year flow from these areas should be calculated and deducted from the total allowable peak flow from the detention facility (Q_a). The detention outlet(s) should be designed to restrict the basin outflow(s) to this reduced allowable peak flow rate.

F. Where the detention facility is to be equipped with a pump discharge, the St. Clair County Drain Commissioner may require the proprietor to furnish design data on pump(s) and discharge force main so that the capacity of the system can be verified. These data will include system curve calculations, the pump performance curves, and a profile of the system piping. The pumping station should be able to release the first flush volume over approximately 24 hours, the bankfull flood volume over 24-48 hours, and the 100-year flood volume at a rate not to exceed 0.15 cfs/ac of tributary area. A back-up generator will be required to ensure the operation of the pumping station in the event of

power loss. The Drain Commissioner discourages the use of pumped outlets, and will not accept responsibility for damages due to power failure, pump malfunction, or Acts of God that result in storm conditions that exceed the design conditions of the pump station.

G. An agreement for acceptance and maintenance of the detention facility, if executed by the proprietor, shall be submitted to the St. Clair County Drain Commissioner prior to plat approval. The agreement both as form and content shall be subject to the approval of the Drain Commissioner's legal counsel.

H. Under no conditions shall a detention facility be located within the 100-year flood plain of a stream, creek or lake, as determined by the Drain Commissioner.

I. In-line detention (i.e. detention along the drain) will not be permitted unless it can be proven beneficial to the drainage district as a whole.

4.8.1 Detention Basins

A detention basin is a form of detention storage where the stormwater is detained above ground as surface water. An example of a typical detention basin cross section can be found in Appendix M.

In addition to the general requirements indicated above in Section 4.8, detention basins shall meet the following requirements:

J. Detention volume in a gravity-outlet detention basin must be located:

1. Above the invert of the lowest row of orifices in the outlet standpipe,

2. Above the elevation of the dry weather base flow in the receiving watercourse,

3. Above the elevation of the groundwater table. Soil boring data used to determine the groundwater table elevation shall be submitted with the plans.

K. The detention basin outlet shall consist of a vertical standpipe with multi-level orifices. (See example Standpipe Details in Appendix M.)

1. The standpipe shall not be less than 36 inches in diameter.

2. The standpipe shall contain multiple rows of orifices (i.e. holes) to control the release of the first flush runoff volume, the bankfull flood volume, and the 100-year flood volume.
   - First flush orifices shall be located at the elevation of the basin floor (or permanent pool water level, if a wet basin),
   - Additional bankfull flood (stream protection) orifices shall be at the elevation of the first flush volume in the basin, where the first flush volume is calculated as the first one inch of runoff over the site, or

$$V_{ff}\ (cf) = 3630 \times A(acres) \times C, \text{ where C is the runoff coefficient}$$

- Additional 100-year flood control orifices shall be located at the elevation of the bankfull flood (stream protection) volume in the basin, where the bankfull flood volume is calculated as the runoff from a 2-year 24-hr storm event (2.29 inches per NOAA Atlas 14, volume 8, version 2; or 2.26 inches per MDEQ SESC Manual Ch 7 chart on 7-10), or

  V_{bf} (cf) = 8170 x A(acres) x C

  To promote improved filtering of runoff sediment from smaller, more frequent storm events, the bankfull flood and first flush volumes shall be based on the developing tributary site area only, and not include off-site tributary area.

3. Orifices should not be less than 1 inch in diameter or greater than 4 inches in diameter.

4. The top of the standpipe shall consist of a grating at or above the design (high) water level to serve as an overflow mechanism, in addition to the overflow spillway/berm.

5. The standpipe shall be encased in stone extending to the design (high) water level to allow for filtering of the stormwater prior to discharge from the basin. The encasement stone size shall be large enough so as not to plug or pass through the orifices in the standpipe.

6. The standpipe shall contain a sediment sump with a depth of at least one foot.

7. Double standpipes (e.g. a 36-inch diameter inner standpipe within a 48-inch diameter outer standpipe) are encouraged. Double standpipes are believed to be less prone to blockages of the control orifices, and therefore require less maintenance. The inner standpipe should contain the appropriate number and configuration of orifices to provide the controlled release of the first flush volume, the bankfull flood (stream protection) volume, and the 100-year flood volume. The outer standpipe should contain at least several times the orifice area as the inner standpipe over the entire height of the standpipe, such that the head loss across the outer standpipe orifices is negligible. (See example Double Standpipe Details in Appendix M.)

8. The outlet pipe extending from the standpipe to the receiving watercourse shall be sized to convey the calculated 10-year peak inflow to the detention basin.

9. The location of the outlet pipe extending downstream of the standpipe shall be indicated on a profile drawing of the receiving watercourse, whether or not the receiving watercourse is an established drain. The receiving watercourse profile shall extend at least from the upstream end of the site to the downstream end of the site.

L. A sediment sump shall be provided within the basin, below the lowest orifice elevation but above the groundwater table, to provide for sediment accumulation.

1. The volume of the sump shall be equivalent to the first flush volume, or one inch of runoff over the contributing site area. (Sump Volume, cf = V_{ff} = 3630 x A x C)

2. Appropriate precautions shall be taken to protect public safety and to ensure that the sump does not constitute a nuisance.

M. All detention basins must have standpipe overflow grates and spillways in berms for emergency overflow at the high water level.

1. The standpipe overflow grate and spillway must provide adequate capacity to overflow the peak 10-year basin inflow with no more than one foot of head (i.e. water level must not exceed the one foot of freeboard).

2. Downstream of the overflow spillway, the stormwater overflow must be directed (either by overland flow or via a swale or ditch) to the receiving watercourse.

N. A minimum of one-foot freeboard shall be provided above the design high water elevation.

O. The side slopes shall not be steeper than 6 ft. horizontal to 1 ft. vertical unless fenced in accordance with local township or city requirements. Slope protection shall be provided as necessary. Basin side slope elevation contours shall be shown on the plans.

P. Unless the detention basin contains a permanent pool, the bottom of all detention basins shall be graded in such a manner as to provide positive flow to the outlet. A minimum bottom slope of 1% should be provided.

Q. A 12-ft. wide minimum access easement shall be provided for all detention basins, as measured from the top of bank.

R. A 25-ft. wide minimum setback from property lines shall be provided for all detention basins, as measured from the top of bank.

S. Detention basin configurations where stormwater must "back-up" into the basin (i.e. stormwater enters the conveyance system downstream of the basin) will not be permitted.

T. Multiple detention basins serving a single development should function independently. If the outflow from one basin passes through another basin before being discharged to the receiving watercourse, a full hydraulic analysis (i.e. a computer model simulation) will be required to ensure that the system functions satisfactorily.

U. If at any time the detention basin is to function as a sediment basin (for use during the construction phase), an outlet filter shall be provided. Such an outlet filter is to be designed in accordance with criteria established by the St. Clair County Department of Public Health for Soil Erosion and Sedimentation Control. Such use of a detention pond shall be considered a temporary measure only. The proprietor shall be responsible for sediment removal upon completion of construction.

V. Detention basins shall meet all local ordinances and/or requirements for "ponds."

4.8.2 Underground Storage

Underground storage is a form of detention storage where the stormwater is detained in underground pipes. Like a detention basin, the water is released at a controlled rate to a receiving watercourse.

In addition to the general requirements indicated above in Section 4.8, underground detention facilities shall meet the following requirements:

A. Detention volume in an underground detention facility shall be located above the elevation of the dry weather baseflow in the receiving watercourse and above the elevation of the groundwater table. Soil boring data used to determine the groundwater table shall be submitted with the plans.

B. To minimize sedimentation in the downstream drainage district, sediment shall be removed from the stormwater before water enters the underground storage facility (e.g. in first flush forebay or within the catch basins using removable filtration inserts).

C. The pipe material used for the underground storage facility shall have an expected life of at least 50 years.

D. Access manholes shall be provided along the underground storage facility to allow for maintenance.

E. A minimum of one foot of freeboard shall be provided between the design hydraulic grade line in the underground storage facility and the rim elevations of all access manholes.

F. A 25-ft. wide setback from property lines shall be provided for all underground storage facilities.

G. An access easement shall be provided to and above the underground storage facility.

H. No permanent structures shall be constructed above the underground storage facility.

4.9 Retention Basins

A "Retention Basin" is a facility with no engineered outlet (other than an emergency-type outlet) designed to hold runoff for a considerable length of time. The water in a retention basin is not discharged to a natural watercourse, although it may be consumed by plants, evaporate, or infiltrate into the ground. A Retention Basin should not be confused with a "Detention Basin," a facility designed to detain runoff for a short period of time and then release it to a watercourse.

A. On-site retention (or detention – See section 4.8 Detention Storage Facilities) is required of all new developments or redevelopments to prevent an increase in peak flows downstream in the drainage district.

1. Retention basins are an acceptable stormwater management practice on sites where the soil has an infiltration rate of at least 0.52 inches per hour and a clay content of less than 30% (per recommendations in *Guidebook of Best Management Practices for Michigan Watersheds*). The required storage volume of a retention basin is that of the runoff from a 100-year design storm as determined using the SCS Method. On sites with soils having a lower infiltration rate and/or higher clay content (hydrologic soils groups C or D, for example), the Drain Commissioner may allow retention basins with storage volume for the runoff from two consecutive 100-year design storms.

2. Retention basins shall accommodate runoff from off-site areas that drain onto/across the developing site. (An exception to this rule would be if off-site runoff were to be routed around the site to a receiving watercourse, if done in a manner such that runoff from the developing site would not contribute to this off-site flow. If the off-site flow were to be concentrated from overland flow to a point discharge into a receiving watercourse without valid rights-of-way, written agreement from the affected property owners would have to be obtained per Common Law Natural Flow Rights and the Michigan Drain Code.)

B. One foot of freeboard shall be provided above the design high water elevation.

C. Retention volume must be provided above the elevation of the groundwater table. Soil boring data used to determine the groundwater table elevation shall be submitted with the plans.

D. All retention basins must have a spillway for emergency overflow at the high water level.
   1. The spillway must provide adequate capacity to overflow the peak 10-year basin inflow with no more than one foot of head (i.e. water level must not exceed the one foot of freeboard).
   2. The plans must identify where the overflow would be directed to flow or stored in the event of an overflow.

E. The side slopes shall not be steeper than 6 ft. horizontal to 1 ft. vertical unless fenced in accordance with local township or city requirements. Slope protection shall be provided as necessary. Basin side slope elevation contours shall be shown on the plans.

F. A 12-ft. wide access easement shall be provided to and around all retention basins.

G. An agreement for acceptance and maintenance of the retention basin system, if executed by the proprietor, shall be submitted to the St. Clair County Drain Commissioner prior to plat approval. The agreement both as form and content shall be subject to the approval of the Drain Commissioner's legal counsel.

H. If at any time during the construction period the retention basin is to function as a sediment basin, the proprietor shall be responsible for sediment removal prior to completion of construction. (See St. Clair County Department of Public Health for requirements regarding Soil Erosion and Sedimentation Control during construction.)

I. Under no conditions shall a retention basin be located within the flood plain of a stream, creek or lake.

4.10 Wetlands and Low Lying Areas

A. In order to help in analyzing site hydrology and the pre-development runoff rate, soil types, the normal groundwater table, and an accurate delineation of wetlands must be provided as part of preliminary plats/plans. The Drain Commissioner may require confirmation of the absence or presence of regulated wetlands from the Michigan Department of Environmental Quality (MDEQ) through its wetland assessment program. Construction activities to be performed within a regulated wetland may require a permit from the MDEQ and/or local municipalities.

B. Any regulated wetlands or other wetlands that will be part of the drainage system shall be designated as a common area and placed within a conservation easement.

C. If existing wetlands or low lying areas are to be used for stormwater storage, all requirements under either section 4.8 Detention Basins or section 4.9 Retention Basins would apply, depending on whether the wetlands/area would have an outlet.

D. If any disturbed or impervious surfaces will drain into an existing wetland or low lying area, calculations may be required to be submitted indicating that the wetland will accommodate runoff from a 100-year design storm without exceeding the finished grade elevation of any adjacent existing or proposed structure.

E. If a wetland will be used for stormwater storage, a sediment forebay shall be provided upstream of the wetlands to reduce the stormwater velocity and encourage sedimentation. Additionally, a permit from the MDEQ and/or local municipalities may be required.

4.11 Oil Separators

Oil must be removed from stormwater as appropriate prior to discharge to a receiving watercourse. Examples of acceptable Best Management Practices for low oil applications and for high oil applications can be found in Appendix O. The Drain Commissioner will consider other means of oil removal on a case-by-case basis.

4.12 First Flush Basins and Sediment Collection Units

Stand-alone, permanent first flush basins and prefabricated sediment collection units are stormwater Best Management Practices not generally required for developments by the Drain Commissioner. However, when such BMPs are proposed or required for a specific site, the following design standards shall apply:

A. A first flush basin or pre-fabricated sediment collection unit shall contain storage volume for the first one inch of runoff from the on-site impervious tributary area. The storage volume of a first flush basin can be calculated as:

V_{ff} (cf) = A x C x 3630 cf/ac-impervious

B. The outlet of a first flush basin or sediment collection unit shall be designed to release the first flush volume over 24-36 hours. This will achieve the goal of 80% sediment removal or not to exceed 80 mg/L TSS.

C. The outlet of a first flush basin or sediment collection unit shall not be submerged by the receiving watercourse at a 10-year design level.

D. The first flush basin or sediment collection unit shall contain a bypass structure and/or berm to allow the 10-year peak flow to bypass without hydraulic interference.

4.13 Design Reference Material

Additional material regarding stormwater design can be obtained from the sources below.

Low Impact Development Manual for Michigan, A Design Guide for Implementers & Reviewers
https://www.semcog.org/Reports/LID/files/assets/basic-html/page-1.html

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MI
http://hdsc.nws.noaa.gov/hdsc/pfds/

Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act, EPA 841-B-09-001
December 2009
https://www.epa.gov/sites/production/files/2015-08/documents/epa_swm_guidance.pdf

Claytor, R. and T. Schueler. December 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection. Ellicott City, MD.

Livingston, E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Schueler, Thomas R. and Richard A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

APPENDIX A

APPLICATION FOR DRAIN COMMISSIONER REVIEW

Application for Drain Commissioner Review

ST. CLAIR COUNTY DRAIN COMMISSIONER
21 Airport Drive, St. Clair, Michigan 48079

The undersigned hereby requests the St. Clair County Drain Commissioner review plans for:

_____
Name of project

Please indicate the type of development or construction activity for which plans are being submitted for review:

- **Platted Subdivision** (Pursuant to Land Division Act, Act No. 288 of 1967, as amended, M.C.L. §§ 560.101 – 560.293)
  ___ Pre-preliminary Plat
  ___ Preliminary Plat
  ___ Construction Plans
  ___ Final Plat

Is a Drainage Permit required? _____ Yes _____ No (Check one)

- **Condominium Development** (Pursuant to Condominium Act, Act No. 59 of 1978, as amended, M.C.L. §§ 559.101 – 559.276; the general authority of Drain Commissioners under the Drain Code including Drain Code Sections 425 and 433; and Local Ordinances)
  ___ Preliminary Plans
  ___ Master Deed
  ___ Construction Plans

Is a Drainage Permit required? _____ Yes _____ No (Check one)

- **Private Road or Land Split Development** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Michigan Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Preliminary Plans
  ___ Construction Plans

Is a Drainage Permit required? _____ Yes _____ No (Check one)

- **Manufactured Housing Community / Mobile Home Park** (Pursuant to Mobile Home Commission Act, Act No. 96 of 1987, as amended, and the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433)
  ___ Preliminary Plans
  ___ Construction Plans

Is a Drainage Permit required? _____ Yes _____ No (Check one)

- **Commercial or Industrial Development** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Preliminary Plans
  ___ Construction Plans

Is a Drainage Permit required? _____ Yes _____ No (Check one)

- **Direct or Indirect Discharge to an Established Drain** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Application for Drainage Permit

- **Drain Widening, Deepening, or Relocation** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Application for Drainage Permit

- **Drain Crossings, Culverts, Tiling, and/or Enclosing an Established Drain** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Application for Drainage Permit

- **Adding or Subtracting Land to/from a Drainage District and/or Construction of a Drain for Ascription as an Established Drain** (Pursuant to the general authority of Drain Commissioners under the Drain Code, including Drain Code Sections 425 and 433, and Local Ordinances)
  ___ Draft Section 433 Agreement

Attached are initial review fees in the amount of: _____
(See Review & Permit Fees Schedule)

I hereby grant permission to the Drain Commissioner, his employees, agents, or consultants, to enter and inspect the site under review. I am the owner of the property or the owner's agent and am authorized to grant this permission. ***I also understand and agree that I am obligated to and will reimburse the St. Clair County Drain Commissioner for all out-of-pocket consulting, engineering, site inspection, administration, and/or legal expenses incurred by the Commissioner in connection with review of this site and plans.***

_____ _____
Signature Date

_____ _____
Name printed Date

Send copies of reviews to:

_____ _____
Name Name

_____ _____
Address Address

_____ _____

_____ _____

APPENDIX B

REVIEW & PERMIT FEES

ST. CLAIR COUNTY DRAIN COMMISSIONER

REVIEW & PERMIT FEES

Initial Fees Due with Application

Pre-preliminary Plat Review	$ 100
Preliminary Plat or Site Plan Review	$ 550
Construction Plan Review (Stormwater Facilities) Plus $10 for each residential lot, or Plus $50/acre for commercial sites	$ 600
Final Plat Inspection and Review:	$ 200
Re-submittal Review Fees:	50% of Initial Fees
Drainage Permit–Development/Construction Activities, Direct/Indirect Discharge, Widening/Deepening/ Relocation	$250
Drainage Permit–Residential, Agricultural, Utility Crossing, Culverts, Tiling, Enclosing	$175
Inspection Fees:	$ 50/hour

In addition to these fees, there may also be additional costs if the project requires the relocation, clean-out, tiling, extension or establishment of a county drain, pursuant to Sections 425 or 433 of the Michigan Drain Code.

APPENDIX C

DRAINAGE APPLICATION AND PERMIT FORM

St. Clair County Drain Commissioner
21 Airport Drive
St. Clair, Michigan 48079
Phone: (810) 364-5369
Fax: (810) 364-7240

Permit No.: _____

Fee Deposit: _____

DRAINAGE PERMIT
Application and Permit Authorizing Development or Construction Activities Affecting Drainage Pursuant to Section 2.0 Of the Rules of the St. Clair County Drain Commissioner

Pursuant to applicable provisions of the Rules of the St. Clair County Drain Commissioner and the Michigan Drain Code, Public Act No. 40 of 1956, as amended, the undersigned landowner(s) has petitioned the Drain Commissioner (or Drainage Board) for permission to undertake development or construction activities which will affect drainage conditions or drainage patterns within a legally established Drainage District, which would require additional drainage to an established Drain, or which would potentially increase contaminant levels within an established Drain. Such activities include, but are not limited to, tapping into, adding new or additional discharges to, or changing the magnitude, concentration, or frequency of runoff discharges to any established Drain, creek, river, ditch, or other natural watercourse in St. Clair County.

This permit is granted for _____ _____ in accordance with the plans labeled_____ _____ and dated _____, which have been approved by the Drain Commissioner and are hereby made a part of this permit. All underground lines must be buried a minimum of 5 feet below the bottom and side slopes of the drain unless a written agreement is reached between both parties stating otherwise.

The permitted activity will affect drainage to _____ (drain or watercourse) as part of the _____ Drainage District. The proposed drain is located in the municipality(s) of _____.

1. The undersigned landowner(s), their heirs and assigns, agree to construct and maintain the stormwater facilities so that they function as designed in the approved plans and as approved by the Drain Commissioner or Drainage Board on behalf of the Drainage District.

2. The landowner(s) certify that consent in writing has been obtained from all owners of land to be traversed by the proposed drain, and that they have supplied the Drain Commissioner with true copies of that consent.

3. The undersigned contractor agrees to perform construction in a good workman-like manner according to the approved plans and specifications. The county or inter-county drain shall be restored to the same or better condition as existed prior to construction. Drainage shall be maintained and left unobstructed during construction so as to prevent backing up of water which could cause flooding of other lands.

4. The undersigned contractor agrees to notify the Drain Commissioner at least 48 hours prior to the beginning of the construction performed under this permit so that the Drain Commissioner may have an inspector present during construction.

5. The landowner(s) or contractor agree to pay all costs to the Drain Commissioner for review of the plans and issuance of permit, including engineering fees, legal fees, and inspection fees. Inspection fees will be charged at the rate of _____ per hour. An estimate for fees and costs, based on the complexity of the project, shall be deposited with the Drain Commissioner in the amount noted at the top of this form. This deposit is non-refundable if the contractor fails to give notice prior to construction as required above.

6. The landowner(s) and contractor agree to repair any damage they might cause to the county or inter-county drain as a result of this construction. The Drainage District, Drainage Board, Drain Commissioner and St. Clair County shall be kept free and harmless by the landowner and contractor from all loss, cost, or damage sustained by any person or property as a result of operations performed under this permit.

7. This permit does not relieve the landowner(s) or contractor of responsibility to secure any additional local, state, or federal permits required and to meet any other permit requirements of law or other public bodies or agencies.

8. This permit is subject to additional terms and conditions as follows:_____
_____
_____
_____

Signed by:

_____	_____
Landowner or authorized agent signature	Contractor signature
_____	_____
Name printed	Name printed
_____	_____
Address	Address
_____	_____
City	City
_____	_____
Phone number	Phone number
_____	_____
Date	Date

Permit Issued by St. Clair County Drain Commissioner on: _____

_____
Signature

_____
Title

APPENDIX D

SECTION 433 AGREEMENT APPLICATION:
APPLICATION TO ADD/SUBTRACT LAND TO/FROM A DRAINAGE DISTRICT

AGREEMENT TO ADD LANDS TO THE DRAINAGE DISTRICT PURSUANT TO SECTION 433 OF THE MICHIGAN DRAIN CODE

_____ Drain Drainage District, St. Clair County

This instrument made and entered into this ____ day of _____, _____, by and between Bob Wiley, St. Clair County Drain Commissioner (herein "Drain Commissioner"), 2 Airport Drive, St. Clair, Michigan 48079, acting for and on behalf of the _____ Drain Drainage District, a public body corporate (hereinafter "Drainage District") and _____, of _____, landowners and developers, (herein "Developer").

WITNESSETH:

WHEREAS, the Drainage District, pursuant to the Michigan Drain Code (Act 40 of the Public Acts of 1956, as amended), is an established body corporate under the jurisdiction of the Drain Commissioner, in the County of St. Clair and State of Michigan;

WHEREAS, the Developer, pursuant to Section 433 of the Michigan Drain Code wishes to add lands to the Drainage District as part of the _____;

WHEREAS, those lands are described as follows:

(See Exhibits _____ attached)

WHEREAS, stormwater drainage facilities have been constructed to service those lands as part of the _____;

WHEREAS, pursuant to Section 433, the Developer has obtained at his/her own expense a certificate from a registered professional engineer satisfactory to the first party, to the effect that the lands to be added naturally drain into the area served by the existing drain or that the existing drain is the only reasonably available outlet for the drainage from the lands to be added and that there is existing capacity in the existing drain to serve the lands to be added without detriment to or diminution of the drainage service provided or to be provided, in the foreseeable future, to the area in the existing drainage district.

NOW, THEREFORE, the parties agree as follows:

1. The lands described above shall be added to the drainage district and shall be from this date forward liable for their apportioned share of maintenance, inspection and repair assessments for the _____ Drain as well as assessments on any county or intercounty drain providing outlet benefits to the added lands.

2. The Developer shall pay or has paid the cost of the drainage facilities and the cost of engineering, inspection, administration, and legal expenses incurred by the drain commissioner, pursuant to Section 433.

3. This Agreement shall become effective upon its execution by the parties 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.

Witnessed:

_____ _____

By:

_____ Its:

Subscribed and sworn to before me this
_____ day of _____, _____.

_____

Notary Public, St. Clair County, MI
Acting in St. Clair County, Michigan
My commission expires:

_____ Drainage District

Witnessed: Drain Commissioner

_____ _____

By: Bob Wiley, St. Clair County
Drain Commissioner

_____

Subscribed and sworn to before me this
_____ day of _____, _____.

_____

Notary Public, St. Clair County, MI
Acting in St. Clair County, Michigan
My commission expires:

Drafted by and return to: Bob Wiley
St. Clair County Drain Commissioner
21 Airport Drive
St. Clair, MI 48079

APPENDIX E

EXAMPLE PERMIT STATUS TABLE

Example Permit Status Table

Permit	Agency	Reason for Permit	Application Date	Date Issued
Soil Erosion Control Permit	SCC Dept. of Public Health	Soil to be disturbed during construction activities	4/10/18	5/5/18
Road Commission Permit	SCC Road Commission	Public roads proposed	4/15/18	5/10/18
Inland Lakes and Streams Permit	MDEQ/Army Corp.	Proposed culvert has more than 2 square miles tributary area	5/25/18	6/15/18
Wetlands Permit	MDEQ/Army Corp.	Construction of parking lot will disturb existing wetlands	5/25/18	6/15/18
Drainage Permit	SCC Drain Commissioner	Proposed discharge of flow to established drain	4/20/18	
Drainage Permit	SCC Drain Commissioner	Proposed culvert crossing on established drain	4/20/18	
NPDES Phase II Permit	MDEQ	More than 1 acre to be disturbed during construction	4/15/18	
MDOT Permit	MDOT	Proposed driveway construction in MDOT R.O.W.	4/30/18	

APPENDIX F

PRELIMINARY PLAT/PLAN CHECKLIST

DEVELOPMENT NAME: _____ DATE: _____

LOCATION: _____ REVIEWED BY: _____

CHECKLIST FOR PRELIMINARY PLATS/PLANS

The following information shall be included on all Preliminary Plats and Plans submitted for approval by the St. Clair County Drain Commissioner.

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
1.	Plat Name (e.g. Preliminary Plat of "Residential Hills"				
2.	Description of Location (Including Section and fractional portion thereof, Town and Range designation, Township or City of St. Clair County, Michigan)				
3.	Location Map				
4.	Name, Address and Telephone No. of proprietor				
5.	Name, Address and Telephone No. of Engineer/Surveyor				
6.	Scale not smaller than 1"=100'				
7.	Engineer's Seal, all sheets				
8.	Tentative approval of Governing Body				
9.	North Arrow and Scale				
10.	Bar Scale				
11.	USGS Benchmark Description				
12.	Legend				
13.	Typical Road cross-section (Label road as "Public Road" or "Private Road")				
14.	Lot Square Footage (Minimum)				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
15.	Proposed Improvements				
16.	Plat Boundary				
17.	Identification of all adjoining parcels (For subdivisions show Lot Number, Subdivision Name, Liber & Page Numbers. For acreage parcels, show Tax roll number & proprietor name.)				
18.	Existing Buildings (Label those under construction with address)				
19.	Existing Roads (w/Name, R.O.W. width and width and type of surface.)				
20.	Proposed Roads (with Names and R.O.W. widths)				
21.	Property Description Metes & Bounds (w/Ties to government corner.)				
22.	Lot Dimensions				
23.	Lot Numbers				
24.	Building Setback Lines				
25.	Typical Lot Grading Plan Detail or Statement				
26.	Minimum House Grade for Each Lot				
27.	Basement Elevations for Each Lot				
28.	Soil Boring Logs and Locations (to include ground elevation at each boring log and water table information.) Logs from site report prepared for Dept of Health are acceptable.				
29.	Existing Contours				
30.	Easements (w/dimensions, utility and existing drain easements.)				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
31.	Identification of entity to assume ownership of drainage system (including detention facilities)				
32.	Off-site watershed areas and/or drainage district (w/boundaries and acreages to be shown on Location Map)				
33.	All existing drainage courses and structures (w/proper labeling as to type, size, and invert elevations.)				
34.	Flood Plain Contour (Existing or Proposed)				
35.	Boundaries and acreages of tributary areas of all proposed and existing inlets, catch basins and culverts.				
36.	Proposed drainage system (Clearly identify all open and enclosed portions.)				
37.	Proposed Drainage Easements				
38.	Intercepting Swales – Easements				
39.	Established Drains (permit required to tap)				
40.	Off-site Drain Easements/ ROWs				
41.	If established drain involved, note that "All work… in accordance with… Rules."				
42.	Wetlands delineated				
43.	Floodplains				
44.	Proposed stormwater detention/retention basins				
45.	Receiving watercourse(s) identified				

APPENDIX G

CONSTRUCTION PLAN CHECKLIST

DEVELOPMENT NAME: _____ DATE: _____

LOCATION: _____ REVIEWED BY: _____

CHECKLIST FOR CONSTRUCTION PLANS

The following information shall be included on/with all Construction Plans submitted for approval by the St. Clair County Drain Commissioner.

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
1.	Approved Preliminary Plat included OR plans also conform to Preliminary Plat Checklist (submit Preliminary Plat Checklist)				
2.	Agreement re: maintenance of stormwater management facilities (including existing watercourses)				
3.	Drainage systems for prior phases shown				
4.	Grading Plan with existing and proposed contour lines shown				
5.	Proposed minimum finish floor or finish basement elevations				
6.	Existing watercourses shown and preserved, relocated or accommodated				
7.	No construction activities in floodplain				
8.	Permit Status Table shown				
9.	Note: "All work performed in the right-of-way of an established drain shall be in accordance with Drain Commissioner's Rules."				
10.	Engineer's seal on all sheets				
11.	Plans and profiles of established drains in road or drain easements shown, including base flow profile and basin outlets				
12.	Min. open drain easement 40' plus top width, 20' top of bank to easement				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
13.	Min. 20’ easement for enclosed drains				
14.	Drains used as outlet improved if necessary				
15.	Outlet to Drain enters at 90 degrees max.				
16.	Drain easement cut/fill volume table				
17.	Drain re-stabilization in accordance with SESC APA Manual				
18.	Delineated catchment areas for each catch basin/inlet				
19.	Off-site tributary area included in design, or rerouted				
20.	Storm sewers designed per Rational Method				
21.	Storm sewers designed for 10-year peak flow				
22.	Storm sewers designed using standard intensity equation				
23.	Storm sewer design runoff coefficient reasonable				
24.	Sewer capacities based on Manning equation				
25.	Friction losses based on design flows, not pipe capacities				
26.	Sewers designed using appropriate Manning n				
27.	Manhole losses included				
28.	Storm sewer capacities meet/exceed design flows				
29.	Min. 12” pipe diameter				
30.	Sewer slopes meet/exceed minimum slopes				
31.	Storm sewer design velocities acceptable ($2.5 < V < 10$ fps)				
32.	Hydraulic grade line shown on storm sewer profile				
33.	Hydraulic grade line 1 foot min. below rim elevations				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
34.	Hydraulic grade line assumes receiving water elevation (e.g. full detention basin)				
35.	Manholes and CBs labeled				
36.	Sewer lengths, diameters, slopes, pipe class, trench details identified				
37.	Manholes spacing 400 ft max for sewers < 30" (600 ft for larger sewers)				
38.	Drainage structure dia. 48" min, inlet dia. 24" min, inlet depth 3.5' to 5'				
39.	Drainage structures brick, block, precast or cast-in-place				
40.	CB/inlet spacing in street R.O.W. 400 ft. max. or for 1 cfs max.				
41.	Pipe, manholes, catch basins, inlets meet MDOT specs				
42.	No manhole drops over 2 feet				
43.	Joints pointed up with mortar for pipes over 30-inch				
44.	Outlets enter receiving watercourse at <90 degrees				
45.	Storm sewer easements shown, min. 40 ft width				
46.	Existing & proposed drainage easements shown				
47.	Utilities in drain easements not in conflict with sewers				
48.	Open channels designed per Rational Method				
49.	Open channel design runoff coefficient reasonable				
50.	Open channels designed using standard intensity eqn				
51.	Open channels 10-year peak flow is within banks				
52.	Open channel capacities based on Manning equation				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
53.	Open channel designed using appropriate Manning n				
54.	Open channel velocities acceptable (1.5 < V < 5 fps)				
55.	Open channels in easements, 40 ft + top width, 20' top of bank to easement				
56.	Open channel side slopes not steeper than 3:1				
57.	Culverts labeled "existing" "proposed" or "to be extended"				
58.	Culvert design flow calculated w/ correct method				
59.	Inlet and outlet control nomographs/equations used				
60.	Culvert 10-yr headwater is 1 ft min. below roadway/driveway				
61.	Culvert 100-yr headwater does not flood structures				
62.	Reasonable tailwater used				
63.	Culvert end sections / head-walls / wing walls acceptable				
64.	Culvert data provided				
65.	Culvert riprap acceptable				
66.	Culverts 18" minimum dia.				
67.	Culverts meet MDOT specs				
68.	Soils and site are suitable for Bioretention				
69.	Bioretention designed for 2-year, 24 hour storm				
70.	Bioretention water depth 12" max. in swales, 18" max. in structures				
71.	Bioretention outlet/overflow orifice 2.5" min.				
72.	Bioretention 2' min. above seasonal high water table				
73.	Bioretention drains water quality storm within 72 hrs				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
74.	Planting bed permeability safety factor of 2 applied				
75.	Planting soil bed acceptable				
76.	Bioretention Vegetation acceptable				
77.	Bioretention sand layer 12" min.				
78.	Bioretention underdrain is rigid Schedule. 40 PVC				
79.	Bioretention has sufficient overflow capacity				
80.	Tailwater elev. in receiving stream is considered				
81.	Bioretention is off-line from County Drain				
82.	Soils and site are suitable for Infiltration				
83.	Infiltration designed for maximum design storm				
84.	Infiltration fully drains within 72 hrs				
85.	Infiltration structure 2' min. above seasonal high water table				
86.	Surface infiltration water depth = 2' max.				
87.	Infiltration structure subgrade compaction is avoided				
88.	Infiltration permeability safety factor of 2 applied				
89.	6" sand layer included				
90.	Infiltration structure has sufficient overflow capacity				
91.	Subsurface infiltration systems include pretreatment				
92.	Infiltration structures are off-line from County Drain				
93.	Infiltration design based on Darcy's Law				
94.	Detention discharges to valid right-of-way				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
95.	Detention max outflow <0.15 cfs/ac				
96.	Detention volume designed for 100-year storm				
97.	Off-site acreage included in detention volume calc				
98.	Appropriate sizing eqns used				
99.	Detention will not increase downstream peak flow				
100.	Areas draining unrestricted are undisturbed or contain only pervious surface				
101.	Concentrated discharge to valid R.O.W. – or -- agreement with downstream property owners				
102.	Disturbed areas draining unrestricted were deducted from basin outlet design				
103.	If pumped outlet, system curve, pump curves, profile submitted				
104.	If pumped outlet, discharges first flush over 24 hours, bankfull flood over 24-48 hours, and 100-year storm at <0.15 cfs/ac				
105.	Drainage system / basin maintenance agreement				
106.	Detention is not within 100-year floodplain				
107.	Detention is not “in-line”				
108.	Storage volume provided above orifices, receiving watercourse baseflow, and groundwater table				
109.	Standpipe outlet with multilevel orifices proposed				
110.	Standpipe at least 36” dia.				
111.	Basin outlet is multi-stage for first flush, bankfull flood, and 100-year storm				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
112.	Bankfull flood and first flush volumes do not include off-site tributary area				
113.	Orifice size 1" min., 4" max.				
114.	Standpipe has overflow grate at high water level				
115.	Standpipe encased in stone to high water elevation				
116.	Standpipe has sediment sump, 1' min. depth				
117.	If double standpipe used, outer pipe orifices adequate				
118.	Outlet pipe from standpipe sized for 10-year peak flow				
119.	Profile of outlet pipe and receiving watercourse shown				
120.	Detention basin sediment sump sized for first flush vol.				
121.	Standpipe overflow grate and emergency spillway in berm have combined capacity for 10-yr flow				
122.	Emergency spillway overflow directed to receiving watercourse				
123.	Basin has 1' min. freeboard				
124.	Basin side slopes 6:1 or flatter, unless fenced				
125.	Detention basin bottom slope 1% min. or permanent pool				
126.	12-ft access easement to and around detention basin				
127.	25-ft setback from property lines to basin				
128.	Basin is not "back-up" configuration				
129.	Multiple detention basins function independently				
130.	If detention basin used as sediment basin, outlet filter provided				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
131.	Soil boring data submitted for underground storage				
132.	Sediment removed before underground storage				
133.	Underground storage pipe material has 50-year life				
134.	Access manholes provided for underground storage				
135.	Underground storage facility has 1' freeboard				
136.	25-ft setback from property lines to underground storage				
137.	Access easement to and above underground storage				
138.	No permanent structures above underground storage				
139.	Soil infiltration rate for retention > 0.52 in/hr, clay content < 30%				
140.	Retention basin designed for runoff from 100-year storm				
141.	Off-site tributary area included in design, or rerouted				
142.	Rerouted off-site drainage to valid R.O.W. – or -- agreement with downstream property owners				
143.	Basin has 1' min. freeboard				
144.	Retention above groundwater table, soil borings submitted				
145.	Emergency spillway in berm has capacity for 10-yr flow				
146.	Emergency spillway overflow route shown				
147.	Basin side slopes 6:1 or flatter, unless fenced				
148.	12-ft access easement to and around retention basin				
149.	Retention basin maintenance agreement submitted				
150.	If retention basin used as sediment basin, outlet filter provided				

		SHOWN	NOT SHOWN	APPROVED	NOT APPROVED
151.	Retention is not within 100-year floodplain				
152.	Wetlands delineated, in conservation easement				
153.	Drainage into wetland will not raise water surface above structures				
154.	If wetlands to serve as detention/retention, sediment forebay provided				
155.	Oil removal BMP's shown (where required)				
156.	Oil/grit separators meet design standards				
157.	First flush basin or sediment collector (FFB/SC) has storage volume for 1" of runoff				
158.	FFB/SC release time between 24-36 hours				
159.	FFB/SC outlet not submerged by receiving watercourse at 10-year design level				
160.	FFB/SC bypasses 10-year peak flow				

APPENDIX H

MODEL FORMS OF STORMWATER SYSTEM MAINTENANCE AGREEMENTS

DECLARATION OF DRAINAGE EASEMENT
AND DRAINAGE MAINTENANCE AGREEMENT
SUBDIVISIONS

This declaration made this _____ day of _____, 20__, by _____, whose address is _____ (hereinafter "Developer"), and on behalf of _____, a Homeowner's Association to be formed (hereinafter "Association").

WHEREAS, the Developer is the owner of all legal and equitable interest in the following property located in the Township of _____, County of St. Clair, State of Michigan, (hereinafter "Development") described as:

See legal description attached hereto as Exhibit 1.

WHEREAS, the Developer has divided the Development, known as _____ into Lots for the purpose of residential home sites;

WHEREAS, Developer is constructing a public road on the Development for the purpose of providing ingress and egress to the Lots and is also providing drainage for the Lots;

WHEREAS, the purpose of this declaration is to provide for the development and maintenance of easements and other drainage facilities to provide proper drainage for the Development;

NOW THEREFORE, in consideration of the mutual benefits to be derived by the Developer, its successors and assigns, and all purchasers and future owners of the various Lots comprising the Development, the Developer, for itself, its successors and assigns, does hereby publish, declare and make known to all intending purchasers and future Owners of the Lots comprising the Development, that all Lots in the Development will and shall be used, owned, held and/or sold expressly subject to the following covenants, conditions, restrictions, easements, obligations and special assessments for the development and maintenance of Drainage Easements and Facilities as described in this Agreement.

It is further declared that the Drainage Easements and Facilities described in Exhibit _____ attached hereto, together with the drainage maintenance provisions contained herein shall run with the land and be binding on the Developer and purchasers of all Lots in the Development and their heirs, personal representatives, successors and assigns.

1. **DEFINITION OF TERMS**. The words and phrases following used in this Agreement are defined as follows:

   a. "Agreement" shall mean and refer to this Declaration of Drainage Easement and Drainage Maintenance Agreement as recorded in the Office of the St. Clair County Register of Deeds, State of Michigan;

b. "Association" shall mean and refer to _____ Homeowners' Association and its successors and assigns;

c. "Developer" shall mean and refer to _____ and its successors and assigns;

d. "Drain Commissioner" shall mean the St. Clair County Drain Commissioner;

e. "Drainage Easements and Facilities" shall mean those areas of land within the Development (including the improvements thereto) now or hereafter owned by the Association or used by the Association or Owners for the drainage purposes as referenced in this Agreement;

f. "Lot" shall mean and refer to any Lot or parcel of land within the Development;

g. "Member" shall mean and refer to those persons entitled to membership in the Association, as provided in this Agreement;

h. "Owner" shall mean and refer to the record owners, whether one or more persons or entities, of the fee simple title to any Lot which is a part of the Development. When more than one person or entity has an interest in the fee simple title to a Lot, the collective interest of all such persons or entities shall be considered to be that of a single Owner for purposes of this Agreement. If any Lot is sold on a land contract, the land contract purchaser shall be considered the Owner. Those persons having any interest in a Lot merely as security for the performance of an obligation are not considered to be Owners.

2. **DRAINAGE EASEMENTS AND FACILITIES.** The Drainage Easements and Facilities subject to this Agreement are shown and described in Exhibit _____, attached hereto. Each purchaser of the Lots in the Development acquires an indivisible property interest to all the above-described Drainage Easements and Facilities for the purpose of constructing, operating, inspecting, maintaining and repairing such Facilities. The financial responsibility for maintenance of the Drainage Easements and Facilities shall be the Association's and be shared by the Owners of all of the Lots in the Development pursuant to the terms of this Agreement, except that minor maintenance of the drainage areas (such as mowing and landscaping along and around the Drainage Easement and Facilities) shall be performed by the Owners of the Lots where the Drainage Easements and Facilities are located. All Owners are deemed to have consented to entry upon their property necessary to construct, inspect and maintain the Drainage Easements and Drainage Facilities. No buildings or permanent structures may be constructed or maintained over or on any easement area subject to this Agreement. This Agreement shall be perpetual and terminable only upon the occurrence of any one of the following events:

(1) The Drainage Easements and Facilities are no longer necessary to service the Development and are abandoned or replaced with the express written permission of the Association and the Drain Commissioner; or

(2) A Municipality or a Governmental Agency with taxing powers expressly assumes, in writing, the responsibility for the operation and maintenance of the Drainage Easements and Facilities; or

(3) A county or intercounty drainage district is established to operate and maintain the facilities and easements in accordance with Act 40 of the Public Acts of 1956, as amended, and the Rules of the St. Clair County Drain Commissioner.

3. **HOMEOWNERS ASSOCIATION**. There is hereby created an Association, which consists of all the Owners of Lots located within the Development and shall be known as the _____ Homeowner's Association. Membership in the Association is mandatory for each Owner. The Owners of each Lot shall have one (1) vote in the Association (i.e., one vote per Lot, regardless of the number of Owners of the Lot). The Association shall annually elect a president, secretary, and treasurer, which together shall constitute the Board of Directors of the Association (hereafter "the Board"). In the event that such officers are not elected, the existing officers may serve until the new elections take place. In the event that an officer dies, resigns, or is unable or unwilling to carry out his/her duties during the year, the remaining offices may appoint a replacement who shall serve until a new officer is elected. The presence of two (2) members of the Board at a meeting shall constitute a quorum. If only two (2) members of the Board are present at a meeting, the affirmative vote of both is required to take action. Upon majority vote of the Owners of all of the lots in the Development (one vote per lot), the Association may choose to convert the Association to a non-profit corporation or limited liability company which shall carry out the same functions as the Association.

a. **ASSOCIATION MEETINGS**. Each year, during the first week of _____ (or such other date as a majority of the Association member shall designate), the Association members shall meet for the purpose of electing a Board of Directors (the "Board") and officers and approving a maintenance program and budge for the coming year for the Drainage Easements and Facilities. An Owner may vote in person or by proxy authorized in writing signed by the lot Owners (or one of them). For purposes of the annual meeting and setting of the budget, it is not necessary that a majority of Owners be present in person or by proxy in order that a valid meeting is held. Owners or proxies representing at least fifty percent (50%) of the Lots in the Development shall constitute a quorum. Questions shall be approved or disapproved by a majority of Owners present in person or by proxy and voting at the annual meeting or any special meeting called for purposes of this Agreement. Written notice of the time and location of the annual meetings shall be provided to all Owners of record in the Development.

Special meetings may be called with ten (10) days prior written notice to all Owners by the President of the Board or upon request of any three (3) Owners representing (3) separate Lots.

Until such time as all of the Lots in the Development have been sold, by the Developer, or sooner if the Developer so chooses, the Developer shall exercise all the powers and duties of the Association and its Board. However,

all Owners are entitled to attend the annual meeting and give input into the setting of the forthcoming budget. The Developer may from time to time designate an agent for the purpose of maintaining and enforcing the Agreement. Appropriate written notice of such designation, or any other written notice permitted or required by this Agreement, shall be addressed by ordinary mail to each Owner.

The Developer may at any time assign and convey all or part of his rights, powers, privileges and duties, which are reserved to it in this Agreement, to the Association, and upon the execution and filing of the appropriate instruments of assignment, the Association shall thereupon have the right and obligation to exercise all the rights, powers, privileges and duties so assigned by this document to the Developer.

b. **DUTIES: GENERALLY**. The purpose of the Homeowners Association is to manage the Drainage Easements and Facilities in the Development and matters incidental thereto for the benefit of all owners and to enforce these restrictions and any by-laws, rules or regulations the Association may adopt. Adoption of by-laws, rules or regulations shall require the affirmative vote of those owning a majority of the lots in the Development at an annual meeting or a special meeting called for that purpose.

c. **BUDGET**. The Board shall be responsible for drafting a proposed budget for maintenance and repair of Drainage Easements and Facilities for the coming year, if any.

d. **MAINTENANCE AND REPAIR WORK**. The President of the Board shall arrange for such maintenance and repair work as has been approved by the Association. All bills for approved work shall be paid by the treasurer after approval by the officer designated for this purpose by the officers. The budget may include a reserve for future capital expenditures. The Board may authorize above-budget expenditures for emergency maintenance and repairs where the failure to do so would result in a threat to health, human safety, or a risk of financial loss to the Association.

e. **ASSESSMENT**. Each landowner shall pay an annual assessment for the maintenance program required pursuant to Paragraph 3, Subparagraph d. of this Agreement.

f. **ASSESSMENT COLLECTION**. All assessment payments shall be made payable to the Association. Payment is due thirty (30) days after the assessment is mailed by first class ordinary mail. The treasurer shall place all funds collected in the Association account at a federally insured banking institution selected periodically by the Board.

g. **FAILURE TO PAY ASSESSMENT**. If any Owner is in default for any assessment payment of thirty (30) or more days, the Association may bring suit to collect the assessment, together with any costs of collection including

reasonable attorney fees. Additionally, the Association may file a lien against the land in the public records and foreclose the lien in the same manner as the enforcement and foreclosure of mortgages in Michigan. For any Lot in the Development whose dues remain unpaid more than four (4) months after the dues notices are mailed, the delinquent Lot owner shall lose their right to vote as a member of the Association and as a member of the Board until such time as the delinquent dues are paid.

h. **REMEDIES**. By acceptance of title, Owner vests in the Association and/or the Drain Commissioner the right and power to take any legal action which it may deem necessary or advisable to enforce this Agreement or any of its rules or regulations. Upon violation of any restriction or breach of any covenant, the Association and/or the Drain Commissioner may enforce it by a suit for money judgment, by foreclosing of the lien securing payment, or by an action in equity seeking a mandatory injunction. If an Owner is found to be in violation of any of these restrictions, covenants, or any duly adopted rules or regulations of the Associations, the violator agrees to pay the reasonable attorney fees and other costs incurred by the Association and/or the St. Clair County Drain Commissioner in such enforcement action and authorizes the court to enter an order requiring such payment.

In addition to all other remedies, the Association and/or Drain Commissioner may enter upon any land in the Development for purposes of carrying out the provisions of this Agreement and neither the Association nor the Drain Commissioner shall be liable for trespass and shall further be held harmless for any damage or liability occurred thereon as a result of enforcing this Agreement.

The St. Clair County Drain Commissioner shall have the right, but not the obligation, to enforce all provisions of this Agreement and to require appropriate maintenance of and/or improvements to the Drainage Easements and Drainage Facilities referenced in this Agreement if the Developer or the Association fails to adequately maintain the Drainage Easements and Facilities. All costs incurred by the Drain Commissioner, including but not limited to engineering and attorney fees, shall be paid by the Developer, Owners or Association as otherwise provided in this Agreement. Failure of the Drain Commissioner to enforce any covenant or restriction herein contained shall in no event be deemed an estoppel or a waiver of the right to do so thereafter.

4. **HOLD HARMLESS PROVISION**. In addition to the provisions contained above, the Owners of all Lots in the Development agree to hold the St. Clair County Drain Commissioner harmless from any loss, damages or injuries relating to the Drainage Easements and Drainage Facilities in the Development.

5. **SEVERABILITY**. If any section, paragraph, clause or phrase of this Agreement is for any reason held invalid by a court of competent jurisdiction, it is the intent of the undersigned

that such decision should not affect the validity of the remaining provisions of the Agreement, which shall be enforced as if the invalid provision did not exist.

6. **RECORDING**. Upon signing, this Agreement shall be immediately recorded at the St. Clair County Register of Deeds office. A true copy of the Agreement, as recorded, shall be provided to the Drain Commissioner.

7. **AMENDMENT**. This Agreement may not be amended without the express written consent of the St. Clair County Drain Commissioner.

Dated this _____ day of _____, _____.

DEVELOPER:

_____

State of Michigan)
) SS:
County of St. Clair)

On this _____ day of _____, 2013, before me personally appeared _____, to me known to be the person described in and who executed the foregoing instrument and acknowledged that he / she / they had authority to execute the foregoing instrument and executed same as his/ her / their free act and deed.

_____

Notary Public, St. Clair County, MI
Acting in St. Clair County, MI
My Commission Expires: _____

Drafted By:

Timothy J. Lozen, Esq.
901 Huron Ave., Ste. 4
Port Huron, MI 48060

When Recorded Return To:

[Developer]

Example Maintenance Plan and Budget for Development X*

Component	Maintenance Activity	Frequency	Estimated Cost	Annual Budget
Catch Basin Sumps	Inspect for sediment accumulation and debris	Annually	$100	$100
	Remove sediment accumulation and debris	Every 1-3 years	$1000	$500
Storm Sewers	Inspect for sediment accumulation	Annually	$100	$100
	Remove sediment accumulation	Every 5-10 years	$1000	$200
	Inspect structural elements and compare to as-built construction plans	Every 5 years	$200	$200
Detention Basin	Mow	At least 3 times/year	$200	$200
	Inspect for sediment accumulation and debris	Annually	$100	$100
	Remove debris	Annually	$100	$100
	Remove sediment accumulation	Every 5-10 years	$2000	$400
	Replace gravel jacket around outlet structure	Every 3-5 years	$500	$500
	Inspect emergency overflow for erosion	Annually	$100	$100
	Reestablish as-built overflow elevation	As needed	$1000 / 5 years	$200
	Inspect banks for erosion	Annually	$100	$100

	Reestablish vegetation on eroded slopes	As needed	$500 / 5 years	$100
Open Channels	Mow	At least 3 times/year	$200	$200
	Inspect for sediment accumulation and debris	Annually	$100	$100
	Remove debris	Annually	$100	$100
	Remove sediment accumulation	Every 5-10 years	$1000	$200
	Inspect banks for erosion	Annually	$100	$100
	Reestablish vegetation on eroded slopes	As needed	$500 / 5 years	$100
Record Keeping	Record all inspections and maintenance activities	As performed	$100	$100
	Adjust estimated costs for maintenance activities	Every five years	$100 / 5 years	$20
			Total Annual Budget:	**$3800**

** Maintenance schedule and budget are for example only. Frequency of maintenance activities and costs will vary for each development.*

Operation & Maintenance Plan for
STORM DRAINAGE SYSTEMS

<name of site>

<Location>

I. Responsibility for Maintenance:

A. During Construction: <name of site> (contractor) has the responsibility to perform the maintenance

B. Following Construction: <name of site> is responsible to perform the maintenance

C. Routine maintenance of the storm water facilities must be completed on a scheduled basis by the owner or lessee. All catch basins/manholes/rear yard basins, detention basins, flow restrictors, or other stormwater structures must be maintained and inspected on a scheduled basis.

D. If the site is notified by the local DPW, zoning administrator or municipal engineer, either verbally or in writing, action is required within 10 calendar days of this notification, unless other acceptable arrangements are made with the <municipality name>. Emergency maintenance (when there is endangerment to public health, safety or welfare) shall be performed immediately upon receipt of verbal or written notification. If the <name of site> fails to act within these timeframes, the <municipality name> or successors may perform the needed maintenance and assess the cost against the <name of site>, plus an administrative fee.

II. Funding:

A. The <name of site> is required to pay for all continued maintenance activities.

III. Maintenance Tasks and Schedule:

A. During Construction:

1. Properly plug and abandon existing storm sewer to prevent any sediment from entering the existing system

2. Establish and maintain 'BMP's to prevent sediment from leaving the site.

B. Post Construction:

1. Perform scheduled semi-annual inspections and inspections following major storm events to check for floatables and debris within the system, especially where the restrictor is located. Remove floatables and debris as required.

2. Annually inspect for sediment within the catch basin sumps. Removal of sediment is required if it is within 12 inches (or 50% of sump depth) of an inlet or outlet pipe in the structure.

3. Every two (2) years inspect the structural elements of the storm system (restrictor, catch basins, etc.) noting any failures. Correct as needed.

4. If catch basin inserts are in place, inspect every 6 months replace screens, filters, cloth, as necessary for the particular type of insert.

5. Mow detention basins on a regular basis, no cattails, phragmites or other plants can grow unrestricted in these basins.

6. Follow manufacturer recommendations for installed devices and structures.

C. Spills:

1. Identify key spill response personnel and train employees on who they are.
2. Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.
3. Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas).
4. If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
5. If the spill gets into the storm drainage system contact the local DPW staff at _____
6. If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
7. Spills or leaks from vehicles in parking lots such as oils, antifreeze, or fuels should be addressed immediately when noticed by staff working at the site. The spill MUST be cleaned up using adsorbent materials such as Oil Dry or even kitty litter and then swept up and disposed of. DO NOT hose down and wash into the storm drain system, these systems drain directly to rivers in our area and eventually the Great Lakes.
8. Solid materials should be swept up and disposed of properly. DO NOT hose down and wash into storm drain system, these systems drain directly to rivers in our area and eventually to the Great Lakes.

IV. Records:

A. The <name of site> shall keep a written log of both preventive and corrective maintenance activities. At minimum, the log shall contain the date of the inspection, the reason for the inspection, the conditions encountered and the resulting activities. The log shall be available for review at the request of the <name of municipality>. If this site is sold to another, this Operation and Maintenance agreement must be transferred to the new owner and the <name of municipality> must be informed of the change in ownership within 14 days of the sale.

V. Site Access

A. If there is a drainage issue/problem on the site that has to do with the storm drainage system, best management practices, or discharge of too much storm water or water that does not appear to meet water quality standards, the owner shall allow the municipality or designee onto the property to inspect the system.

I have read this document and agree to implement the operation and maintenance procedures listed for this site to protect storm water quality leaving this site.

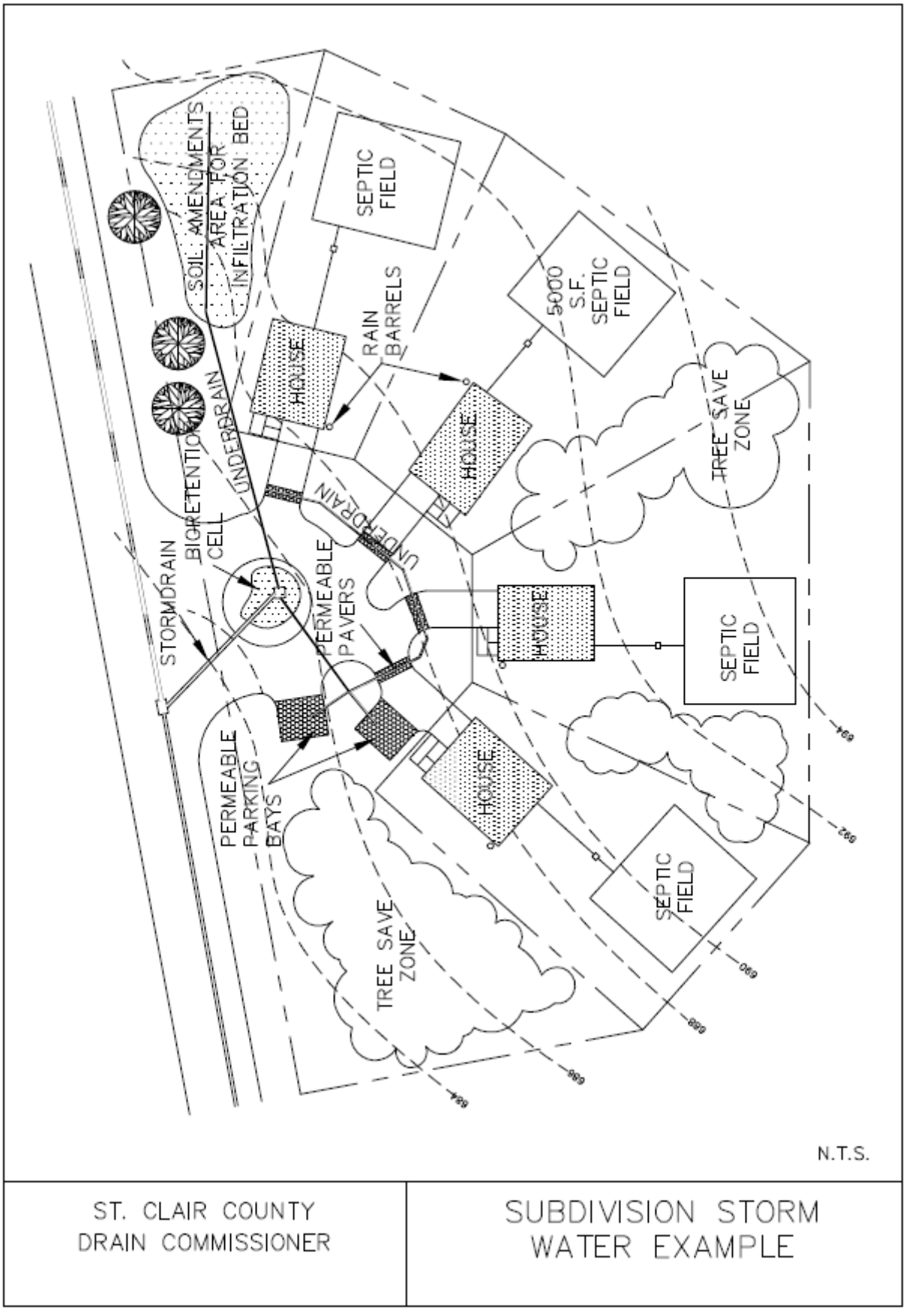
_____ _____

Authorized Signature **Date**

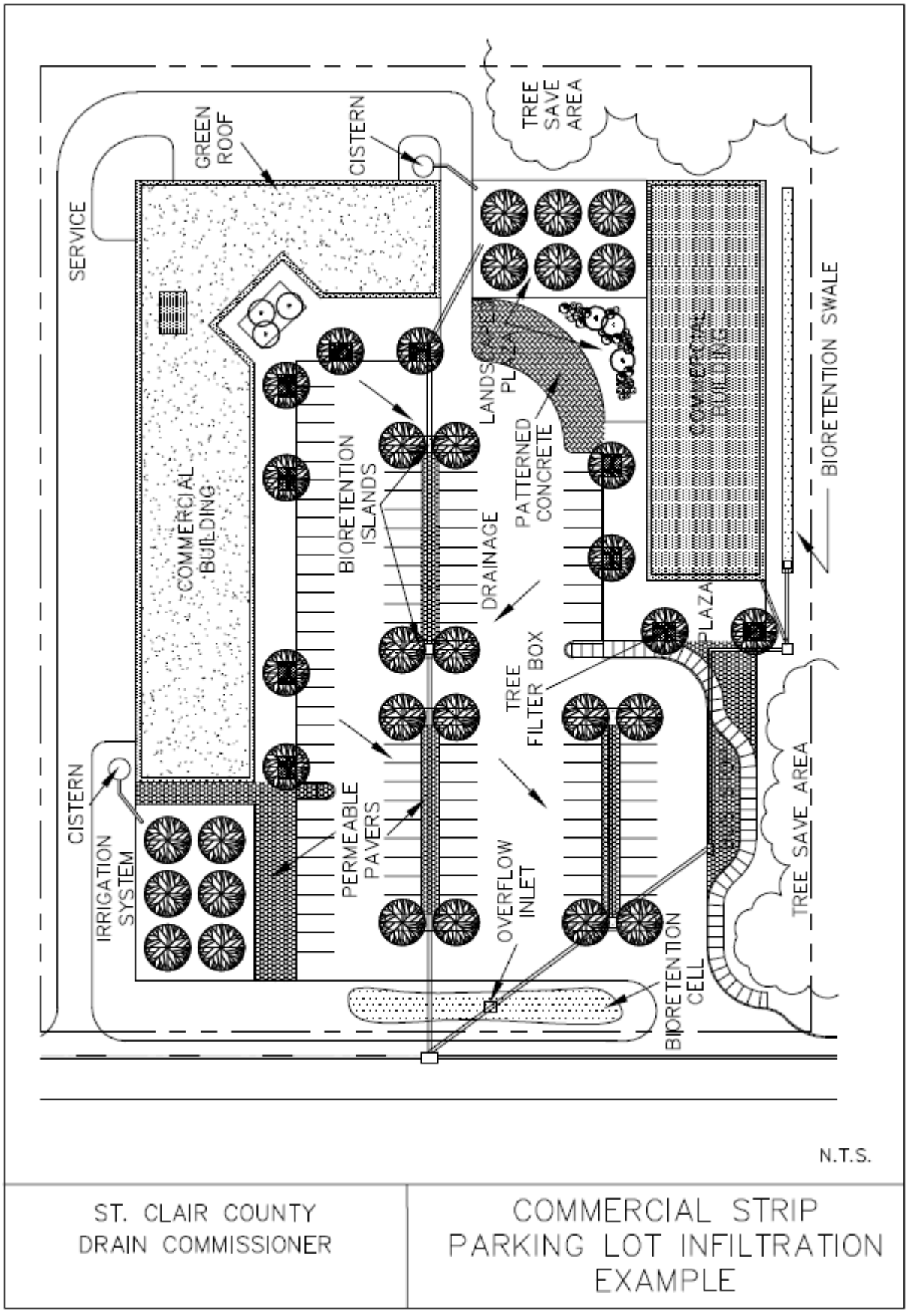
Email address of responsible party: _____

APPENDIX I

EXAMPLE STORMWATER HANDLING STRATEGIES

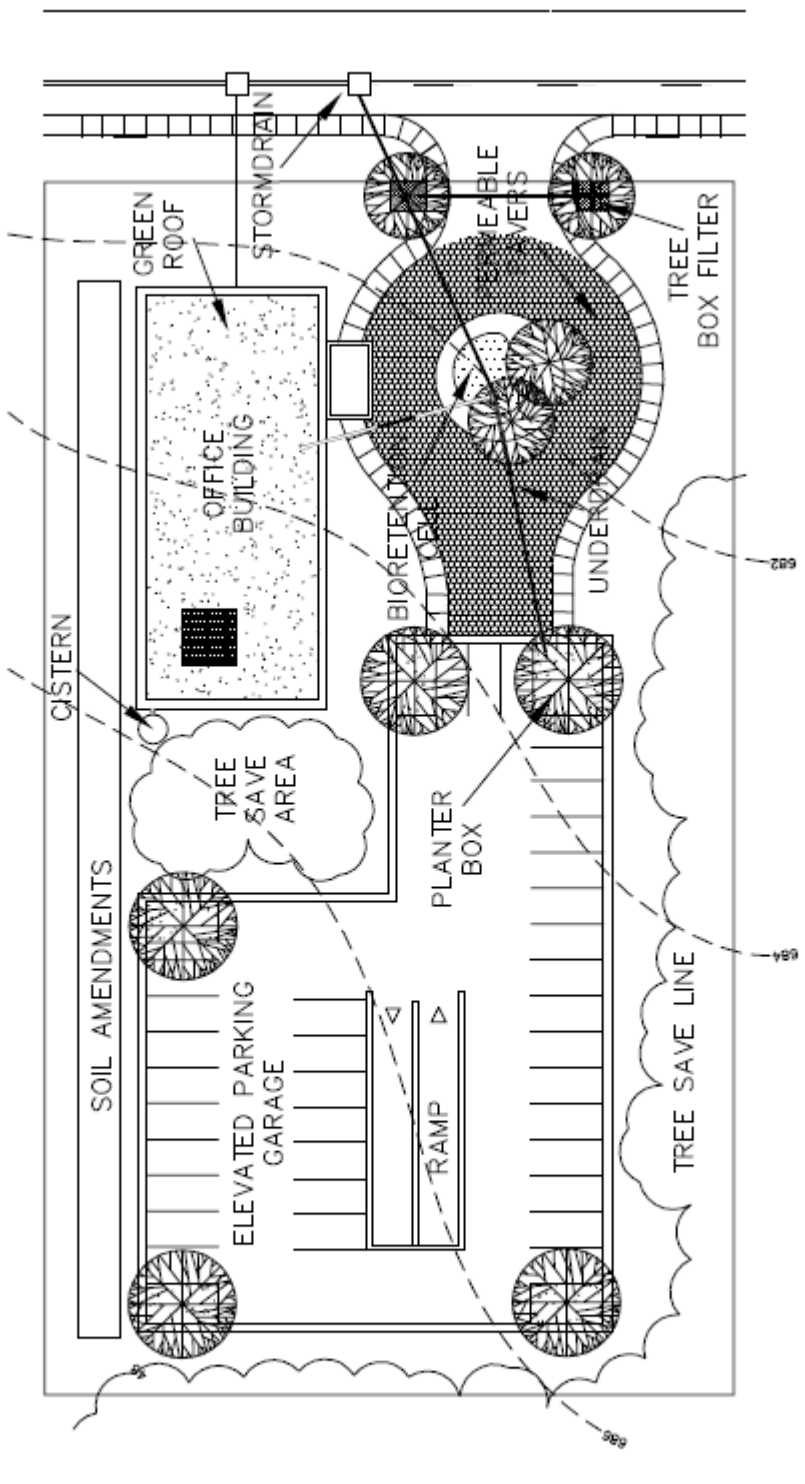


ST. CLAIR COUNTY DRAIN COMMISSIONER	SUBDIVISION STORM WATER EXAMPLE



ST. CLAIR COUNTY
DRAIN COMMISSIONER

COMMERCIAL STRIP PARKING LOT INFILTRATION EXAMPLE



ST. CLAIR COUNTY DRAIN COMMISSIONER	OFFICE & PARKING STORM WATER EXAMPLE

APPENDIX J

REFERENCE TABLES

Table J-1. Rational Method Runoff Coefficients

Surface	Runoff Coefficient (C)
Impervious (roof, pavement)	0.90
Typical ¼-acre lot subdivision	0.35
Mowed grass	0.25
Undeveloped farmland/meadow	0.20
Forested	0.15

Table J-2. Storm Sewer Minimum Slopes

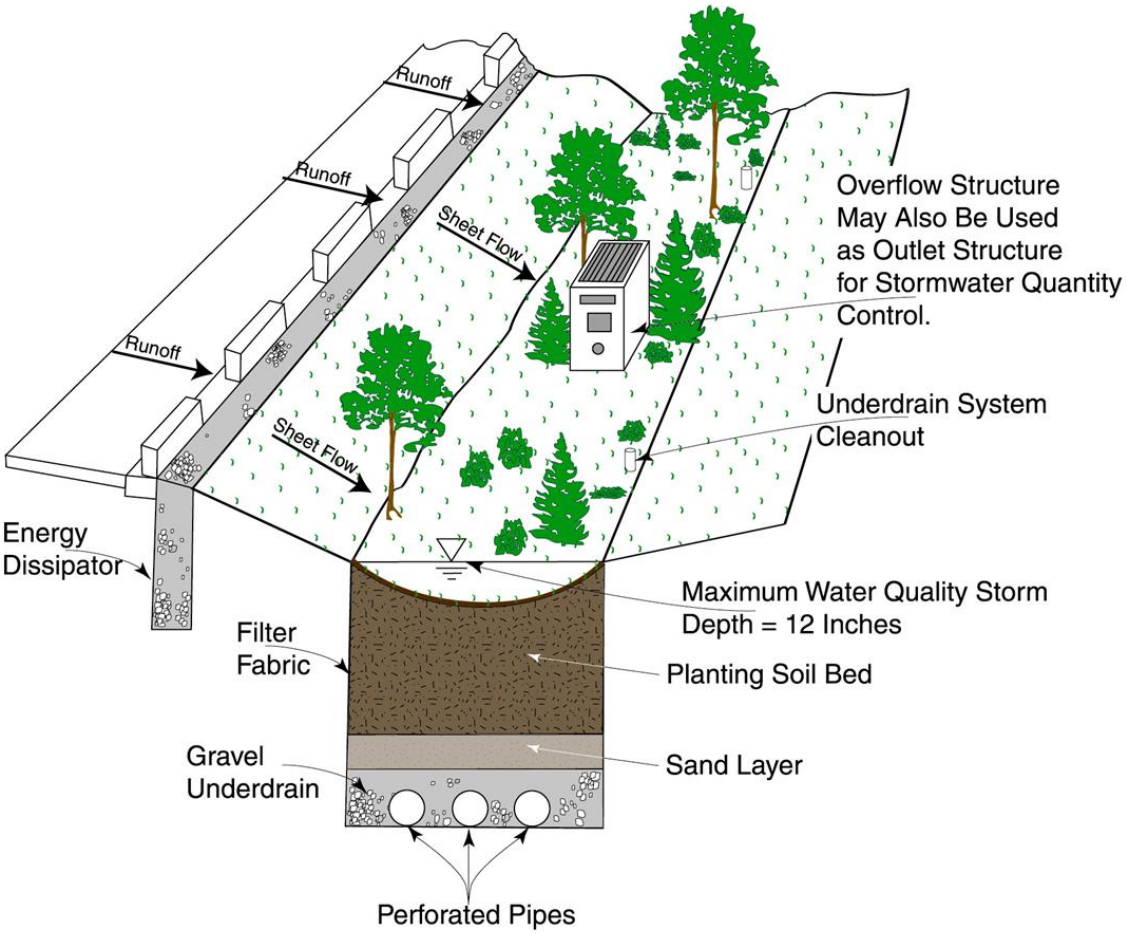
Sewer Diameter (in)	Minimum Slope (%)
8	0.50
10	0.40
12	0.33
15	0.25
18	0.22
20	0.20
24	0.17
27	0.16
30	0.15
36	0.13
42	0.11
48	0.10
54	0.09
60	0.09

Table J-3. Manning "n" Roughness Values

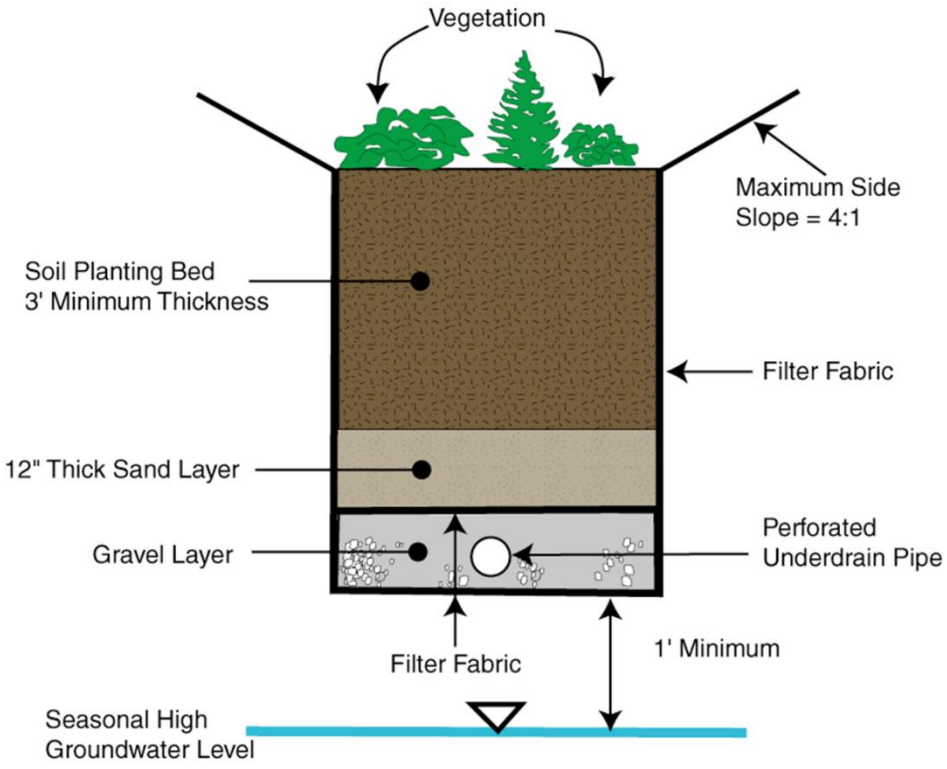
Sewer Material	Typical Manning "n" Roughness Values	Conservative Manning "n" Roughness Values
Concrete, Clay	0.013	0.014
Corrugated metal	0.024	0.026
Plastic (smooth lined)	0.010	0.011

APPENDIX K

EXAMPLE BIORETENTION DETAILS



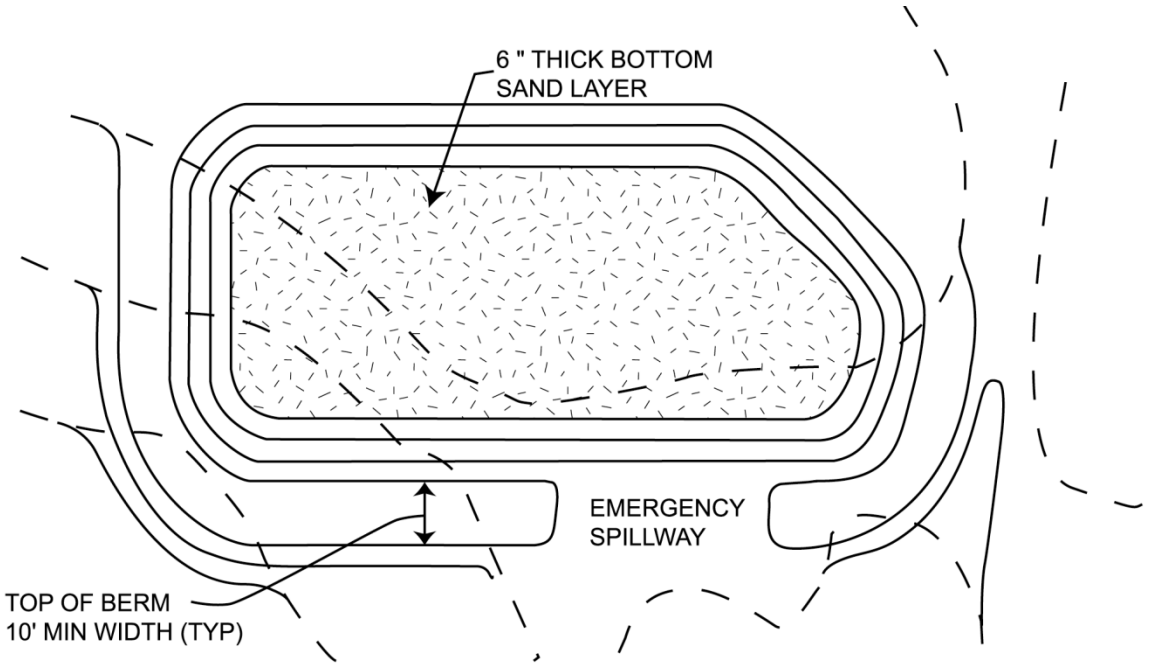
Typical Bioretention System



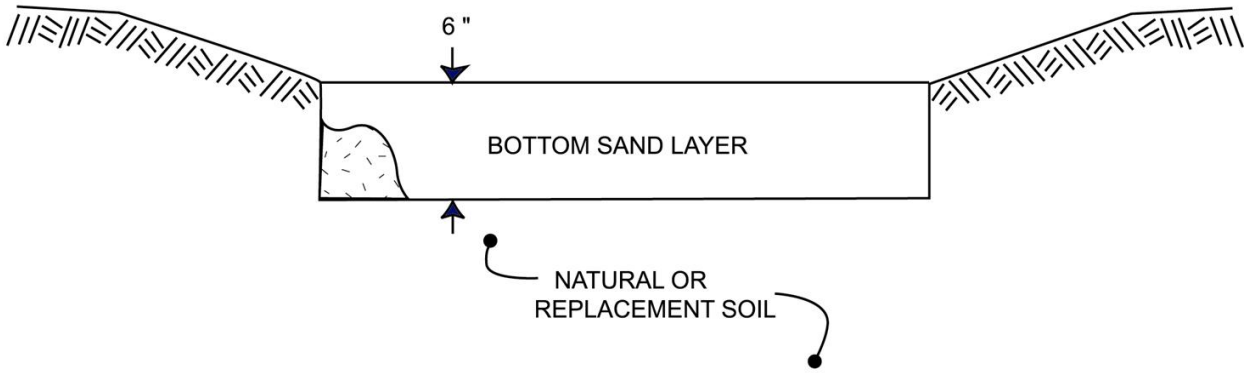
Typical Bioretention Section Detail

APPENDIX L

EXAMPLE INFILTRATION DETAILS



Typical Infiltration Basin



Typical Infiltration Section Detail

APPENDIX M

EXAMPLE DETENTION BASIN DETAILS

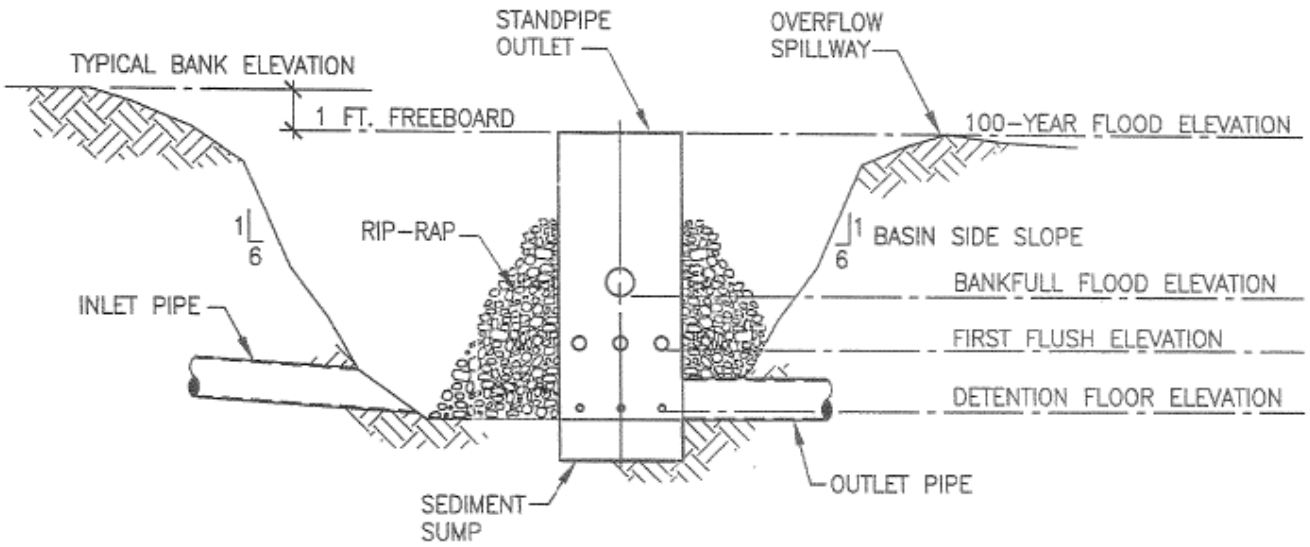
DESIGNED:

DATE: .

TETRA TECH MPS

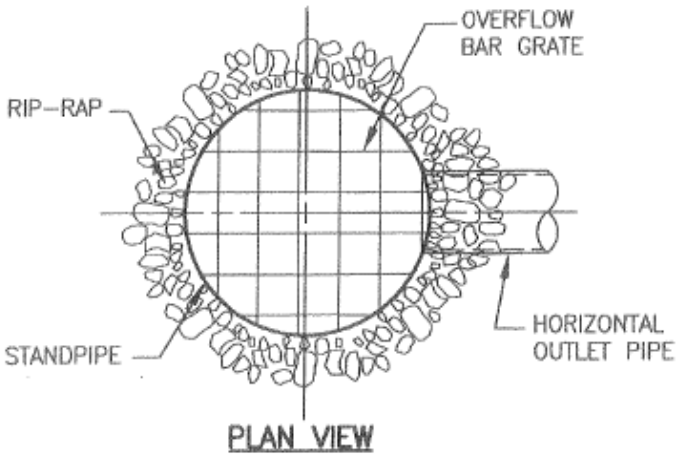
TYPICAL DETENTION BASIN CROSS-SECTION

FIGURE 1

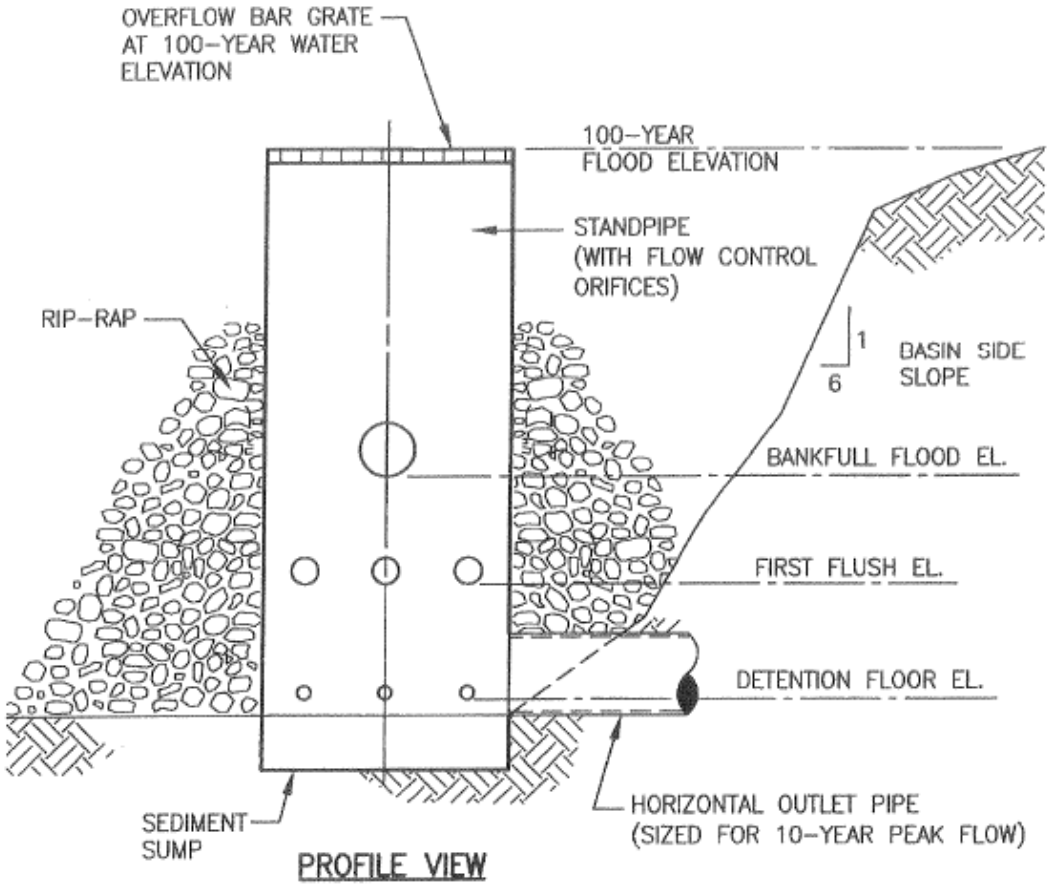


TYP. DETENTION BASIN CROSS-SECTION

NOTE: NOT TO SCALE



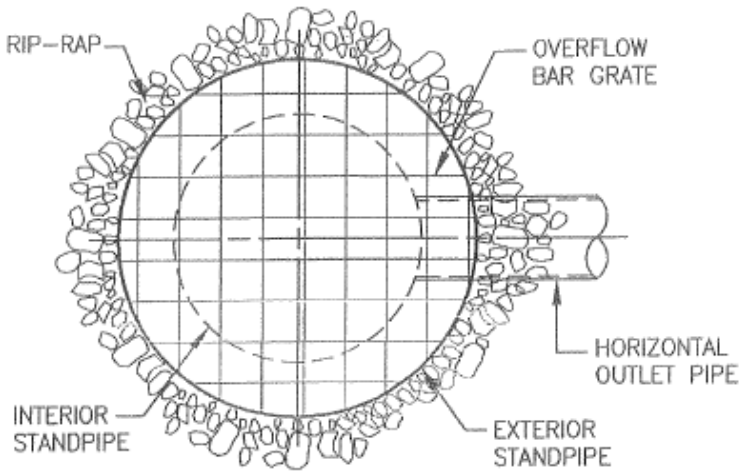
PLAN VIEW



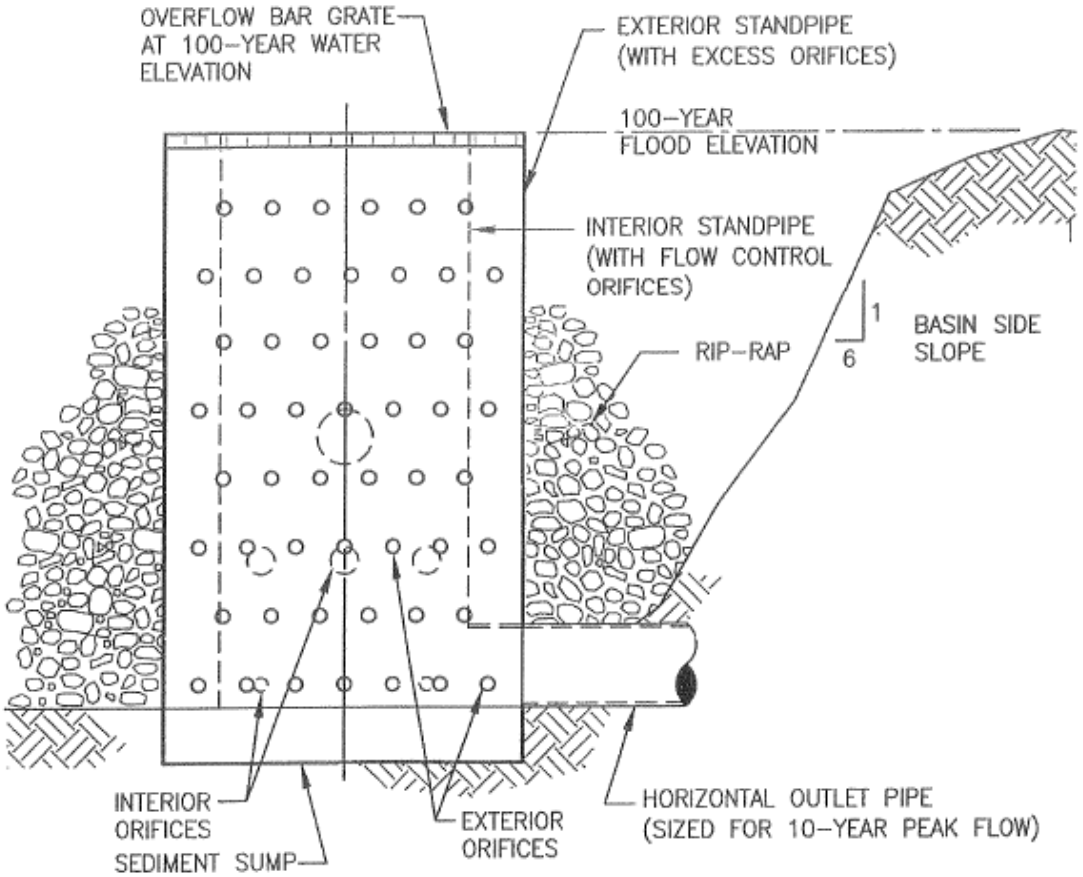
PROFILE VIEW

NOTE: NOT TO SCALE

TETRA TECH MPS	STANDPIPE DETAILS	FIGURE 2
DESIGNED: DATE: .		



PLAN VIEW



PROFILE VIEW

NOTE: NOT TO SCALE

TETRA TECH MPS	DOUBLE STANDPIPE DETAILS	FIGURE 3
DESIGNED: DATE: .		

APPENDIX N

EXAMPLE CALCULATIONS

Example 1: Detention Basin Design

A 10-acre parcel is to be developed into a single-family residential subdivision. A detention basin will be provided to control the release of stormwater runoff to a nearby established drain. No off-site area drains onto or across the developing site.

A hydraulic analysis of the proposed storm sewer indicates that the design water elevation of the basin cannot exceed elevation 585.00 ft to maintain the hydraulic grade line in the storm sewer at least one foot below all catch basin and manhole rim elevations. The bottom of the detention volume in the basin must be at or above the invert of the storm sewer conveying the basin outflow to the receiving watercourse. It must also be above base flow elevation in the drain and above the groundwater table. The receiving watercourse in this case is an existing established drain, which maintains a dry weather base flow with a depth of approximately 6 inches. At the location where the detention basin outlet pipe will tap the drain, the drain bottom is at elevation 580.00 ft. The basin outlet will be located 400 feet away from the drain. The groundwater table was determined by soil borings to be at elevation 578.00 ft.

STEP 1. Size the storm sewer extending from the basin to the drain.

The 10-year peak flow to the basin = Q_{10} = C x I x A

$C_{weighted}$ = 0.34 $C_{weighted}$ = (20% impervious)(0.9) + (80% pervious)(0.2) = 0.34

T = 28 minutes (determined by storm sewer design calculations)

I = 175 / (T + 25) = 3.30 in/hr

A = 10 acres

Q_{10} = C x I x A = (0.34) x (3.30 in/hr) x (10 acres) = 11.2 cfs

At slope of 0.16%, a 27-inch concrete storm sewer would have a capacity of 12.5 cfs.

Therefore, use 27-inch storm sewer at 0.16%.

STEP 2. Set basin floor (or permanent pool) elevation.

Sewer invert at basin outlet = Receiving watercourse bottom elevation + (length of outlet sewer) x (slope of outlet sewer)

Sewer invert at basin outlet = 580.00 + 400 ft x 0.0016 = 580.64 ft

Since the base flow in the drain is at elevation 580.50 ft, and the groundwater table is at elevation 578.00 ft, the sewer invert at the basin outlet (elev. 580.64 ft) will control the minimum elevation of the detention volume in the basin.

Set basin floor (or permanent pool) elevation to at or above 580.64 feet, say 581.00 feet.

STEP 3. Determine the required basin volume for 100-year storm.

A = 10 acres

$Q_{allowable} = Q_a$ = 0.15 cfs/ac x 10 ac = 1.5 cfs

$Q_o = Q_a$ / A C = 1.5 cfs / (10 ac x 0.34) = 0.441 cfs/impervious acre

Storage Time = T = -25 + sqrt(10,312.5 / Q_o) = 127.9 minutes

Volume per impervious acre = V_s = 16,500 T / (T + 25) – 40 Q_o T = 11,546 cf / imp-ac

Required Storage Volume = V_s x A x C = (11,546) x (10 ac) x (0.34) = 39,256 cf

STEP 4. Design the basin outlet standpipe.

Available basin depth = 585.00 ft – 581.00 ft = 4.0 ft

Stage-Storage Curve for proposed basin (assume 1:6 side slopes):

Elev (ft)	Area (sf)	Depth (ft)	Volume (cf)	Cumulative Volume (cf)
585.0	15,625	1	14,197	41,668
584.0	12,769	1	11,485	27,471
583.0	10,201	1	9,061	15,986
582.0	7921	1	6,925	6,925
581.0	5929	1	0	0

<u>First Flush</u>

First Flush Storage Volume = 1 in x 10 ac x 0.34 x 43,560 sf/ac x 1 ft/12 in = 12,342 cf

Depth of First Flush Volume in proposed basin:

(15,986 – 12,342 cf) / (15,986 – 6,925 cf) = (583 ft – FF Elev.) / (583 – 582 ft)

FF Elev. = 582.60 ft

Release First Flush Volume over 24 hours:

$Q_{average}$ = 12,342 cf / 24 hrs x 1 hr/3600 s = 0.143 cfs

Average head on orifice outlet:

$H_{average}$ = 2/3 (582.60 – 581.0 ft) = 1.067 ft

Area of First Flush orifices:

A_{ff} = 0.143 cfs / 0.62 sqrt(2 g $H_{average}$) = 0.028 sf

Since a 1-inch orifice has an area of 0.00545 sf, use five 1-inch orifices in 36-inch standpipe at elev. 581.00 ft

Bankfull Flood (Stream Protection)

Bankfull Flood Vol. = 2.29 in x 10 ac x 0.34 x 43,560 sf/ac x 1 ft/12 in = 28,263 cf

Depth of Bankfull Flood Volume in proposed basin:

(41,668 – 28,263 cf) / (41,668 – 27,471) = (585.0 – BF Elev.) / (585.0 – 584.0 ft)

BF Elev. = 584.06 ft

Release Bankfull Flood Volume over 24-48 hours.

Determine discharge rate of Bankfull Flood Volume through First Flush orifices:

$H_{average}$ = 2/3 (584.06 – 581.0 ft) = 2.04 ft

Q_{ff} = 0.62 (5) (0.00545 sf) sqrt(2 g $H_{average}$) = 0.194 cfs

Check detention time for Bankfull Flood Volume:

28,263 cf / 0.194 cfs x 1 hr/3600 s = 40.5 hrs

Since this does not exceed the desired 48-hour maximum detention time, no additional orifices are required at Elev. 582.60 ft

If additional Bankfull Flood orifices were required, the orifice area would be calculated as follows:

Release the Bankfull Flood Volume thorough Bankfull Flood orifices over 24 hours:

Bankfull Flood Volume above Elev. 582.60 ft = 28,263 cf – 12,342 cf = 15,921 cf

$Q_{average}$ = 15,921 cf / 24 hrs x 1 hr/3600 s = 0.184 cfs

Average head on Bankfull Flood orifices:

$H_{average}$ = 2/3 (584.06 – 582.60 ft) = 0.97 ft

Area of Bankfull Flood orifices:

A_{bf} = 0.184 cfs / 0.62 sqrt(2 g H_{avg}) = 0.038 sf

Use seven 1-inch orifices in 36-inch standpipe at elev. 582.60 ft

100-year Flood

Depth of 100-year Flood Volume in proposed basin:

(41,668 – 39,256 cf) / (41,668 – 27,471) = (585.0 – Elev.) / (585.0 – 584.0 ft)

Elev. = 584.83 ft

Determine discharge rate of 100-year Flood Volume through First Flush and Bankfull Flood orifices:

Q_{bf} = 0.62 (7) (0.00545 sf) sqrt(2 g (584.83 – 582.60 ft)) = 0.283 cfs

Q_{ff} = 0.62 (5) (0.00545 sf) sqrt(2 g (584.83 – 581.00 ft)) = 0.265 cfs

Determine discharge rate of 100-year Flood Volume through 100-year Flood orifices:

$Q_a – Q_{bf} – Q_{ff}$ = 1.5 – 0.283 – 0.265 cfs = 0.952 cfs

Average head on 100-year Flood orifices:

$H_{average}$ = 2/3 (584.83 – 584.06 ft) = 0.51 ft

Area of 100-year Flood orifices at Elev. 584.06 ft:

A = 0.952 cfs / (0.62 sqrt(2 g $H_{average}$)) = 0.268 sf

Since a 2-inch orifice has an area of 0.022 sf, use twelve 2-inch orifices at Elev. 584.06 ft

STEP 5. Verify that at least one foot of freeboard is being provided.

Design water elevation = 584.83 ft

Detention basin banks and surrounding ground elevation = 587 ft +/-

Therefore, more than two feet of freeboard are being provided.

STEP 6. Design overflow spillway.

Peak 10-year flow into basin = 11.2 cfs

Since head over weir must be less than 2 feet so as not to exceed the available freeboard,

$Q = C \times L \times H^{1.5}$

$L = Q / (C \times H^{1.5})$

$L = 11.2 \text{ cfs} / (3 \times 2^{1.5})$

$L = 1.32$ ft, say 2 ft

Set length of overflow spillway to at least 2 feet.

Example 2: Retention Basin Design

A 10-acre parcel is to be developed into a single-family residential subdivision. A retention basin will be provided to capture the stormwater runoff from the site. No off-site area drains onto or across the developing site.

A hydraulic analysis of the proposed storm sewer indicates that the design water elevation of the basin cannot exceed elevation 585.00 ft to maintain the hydraulic grade line in the storm sewer at least one foot below all catch basin and manhole rim elevations. The bottom of the retention volume in the basin must be at or above the groundwater table, which was determined by soil borings to be at elevation 578.00 ft.

STEP 1. Determine the soil types in the tributary area (from the United States Department of Agriculture Soil Survey for St. Clair County), and classify these soil types by Hydrologic Soil Group (per Michigan Department of Environmental Quality's "Computing Flood Discharges for Small Ungaged Watersheds" by Sorrell, July 2003).

50% Hydrologic soil group A

50% Hydrologic soil group B

The retention basin will be located in an area that (primarily) consists of soils from hydrologic soil group B.

STEP 2. Determine the weighted Runoff Curve Number for the site (per SCS Method).

For this example, assume initially that the retention basin area will be 10% of the area of the site.

Hydrologic Soil Group	Percent of Total Drainage Area	Land Use	Percent of Soil Group	RCN	Partial RCN
A	59	Single-fam. Res. (1/4-ac)	100	61	36.0
B	41	Single-fam. Res. (1/4-ac)	76	75	23.4
		Retention basin	24	100	9.9
				Composite RCN =	69.3

STEP 3. Determine the 100-year, 24-hour precipitation total for the area, P

Per NOAA Atlas 14 (2013), the 100-year, 24-hour storm consists of 5.28 inches of rainfall (P = 5.28).

STEP 4. Calculate the storage, S (per SCS Method).

S = 1000 / RCN – 10 = 1000 / 69.3 – 10 = 4.43 in

STEP 5. Calculate the stormwater runoff for a 100-year, 24-hour storm, SRO (per SCS Method).
SRO = (P – 0.2S)^2 / (P + 0.8S) = (5.28 – 0.2 x 4.43)^2 / (5.28 + 0.8 x 4.43) = 2.19 in

STEP 6. Determine the runoff volume for a 100-year, 24-hour storm from the site.

Runoff Volume = 2.19 in x 10 acres x 1 ft/12 in x 43,560 sf/1 ac = 79,497 cf

STEP 7. Determine stage-storage curve for proposed retention basin.

The available storage must equal or exceed twice the runoff volume for a 100-year, 24-hour storm: 2 x 79,497 = 158,994

Stage-Storage Curve (assume 1:6 side slopes):

Elev (ft)	Area (sf)	Depth (ft)	Volume (cf)	Cumulative Volume (cf)
586.0	46,208	1	42,704	166,944
585.0	39,200	1	35,984	124,240
584.0	32,768	1	29,840	88,256
583.0	26,912	1	24,272	58,416
582.0	21,632	1	19,280	34,144
581.0	16,928	1	14,864	14,864
580.0	12,800	1	0	0

STEP 8. Determine the design water elevation (DWE) in the retention basin.

(166,944 – 158,994 cf) / (166,944 – 124,240) = (586.0 – DWE) / (586.0 – 585.0 ft)

DWE = 585.81 ft

STEP 9. Check assumption that retention basin area is approximately 10% of total site area.

Design water elevation is 585.81 ft, say 586 ft

Area of basin at elevation 586 feet is 46,208 sf

Basin area is approximately 46,208 sf / 435,600 sf = 10.6% of total area

Assumption that basin area is about 10% of total area is valid.

STEP 10. Verify that at least one foot of freeboard is being provided.

Design water elevation = 585.81 ft

Retention basin banks and surrounding ground elevation = 587 ft +/-

More than one foot of freeboard is being provided.

STEP 11. Design overflow spillway.

Peak 10-year flow into basin, $Q = C \times I \times A$

$Q = 0.35 \times 175 / (T + 25) \times 10$ ac, where T is estimated to be 20 minutes

$Q = 13.6$ cfs

Since head over weir must be less than 1 foot so as not to exceed the available freeboard,

$Q = C \times L \times H^{1.5}$

$L = Q / (C \times H^{1.5})$

$L = 13.6 \text{ cfs} / (3 \times 1^{1.5})$

L = 4.5 ft, say 5 ft

Set length of overflow spillway to at least 5 feet.

Example 3: Culvert Design Calculation

A 12-acre parcel is to be developed into an apartment complex. The entrance driveway to the development will cross an established drain that flows west along the roadside. A 60-ft. culvert is proposed to allow the flow in the drain to cross the entrance driveway. The proposed development drains via overland flow south into the drain. Nine acres of undeveloped land just north of the proposed subdivision drains across the site to the drain. Further upstream in the watershed, another ten acres of single-family residential subdivision and eight acres of undeveloped area also drains into drain. (See figure below.)

STEP 1. Determine the peak design flow to the proposed culvert.

A USGS map indicates that the proposed site and upstream off-site area are tributary to the proposed culvert, as well as a 10-acre residential subdivision and an 8-acre undeveloped parcel. Since less than 2 square miles of area are tributary to the culvert, the culvert will be designed for the 10-year peak flow per county standards, rather than for the 100-year peak flow per state standards.

All the area except the 8-acre undeveloped parcel will pass through detention, so assume a peak flow from this tributary area of 0.15 cfs/acre.

$Q_{detention}$ = (12 + 9 + 10 acres) x 0.15 cfs/acres = 4.7 cfs

Assume that the future use of the undeveloped area is multiple-family residential, but without detention. Use Rational Method to estimate the 10-year peak flow from this area.

$Q_{future\ multiple\text{-}family\ residential}$ = C I A

$Q_{future\ multiple\text{-}family\ residential}$ = 0.5 x (175 / T + 25) x 8 acres Estimate T = 20 min

$Q_{future\ multiple\text{-}family\ residential}$ = 0.5 x 3.89 in/hr x 8 acres

$Q_{future\ multiple\text{-}family\ residential}$ = 15.6 cfs

Add peak flows:

Q_{total} = 15.6 + 4.7 = 20.3 cfs

STEP 2. Estimate tailwater elevation for proposed culvert.

The typical cross-section of the drain is 4 feet deep, with a 1-ft bottom width and 1:3 side slopes. The typical drain slope downstream of the proposed culvert is 0.002 (0.2%). Using Manning's equation, the normal depth of flow for 20.3 cfs in this drain would be

$Q = 1.49\ R_h^{0.67}\ S^{0.5}\ A / n$ where R_h = hydraulic radius of flow
= area / wetted perimeter
S = slope of drain
A = area of flow

n = channel roughness (assume 0.04)

Solving for the normal depth of flow yields:

y_n = 1.88 feet = tailwater elevation for culvert

STEP 3. Size culvert so that the headwater remains at least one foot below driveway and roadway elevations, and the backwater does not extend beyond the limits of the site.

Use a culvert hydraulic analysis program such as the Federal Highway Administration's HY-8, or standard inlet and outlet control nomographs. Assume the proposed culvert is a round, corrugated metal pipe (CMP).

Propose a 30-inch CMP culvert at a slope of 0.2% with upstream and downstream invert elevations: 800.06 ft and 799.94 ft, respectively.

Per FHWA HY-8, Inlet control headwater elev. = 802.61 ft
Outlet control headwater elev. = 803.00 ft

Therefore, the culverts will be under outlet control with a headwater elev. = 803.00 ft

Since the proposed driveway centerline elevation is 804.0 ft, the headwater elevation is more than one foot below the banks.

The elevation of the normal depth of flow at the upstream property line is greater than 804.0 ft. The backwater would not extend onto upstream off-site property.

STEP 4. Verify that 100-year peak flow headwater elevation will remain below adjacent proposed and existing structures.

All the area except the 8-acre undeveloped parcel will pass through detention, so assume a peak flow from this tributary area of 0.15 cfs/acre.

$Q_{detention}$ = (12 + 9 + 10 acres) x 0.15 cfs/acres = 4.7 cfs

Assume that the future use of the undeveloped area is multiple-family residential, but without detention. Use Rational Method to estimate the 100-year peak flow from this area.

$Q_{undeveloped}$ = C I A

$Q_{undeveloped}$ = 0.5 x (275 / T + 25) x 8 acres Estimate T = 20 minutes

$Q_{undeveloped}$ = 0.5 x 6.11 in/hr x 8 acres

$Q_{undeveloped}$ = 24.4 cfs

Add peak flows:

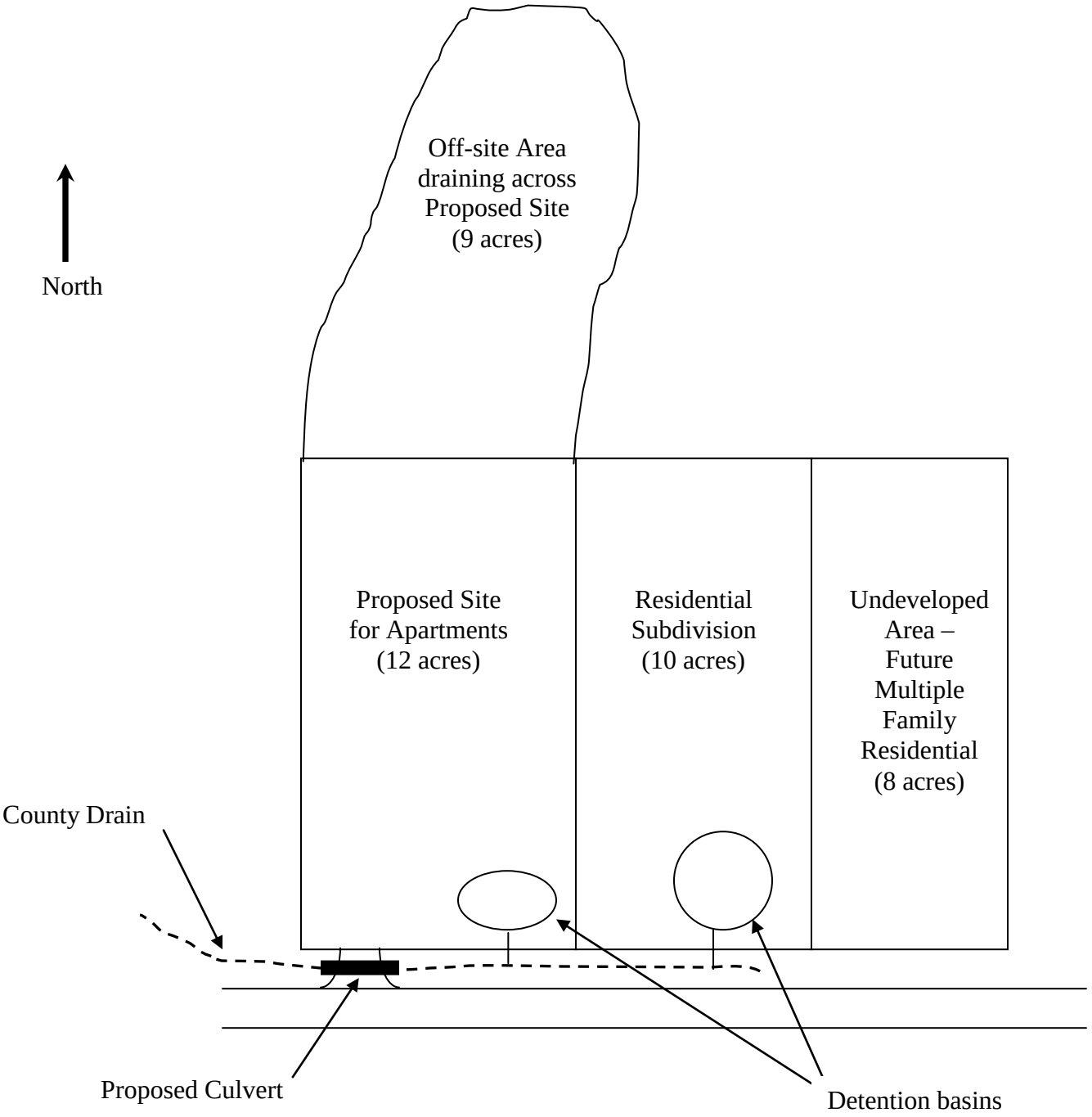
Q_{total} = 24.4 + 4.7 = 29.1 cfs

Using Manning's equation to find the tailwater on the culvert yields

y_n = 2.22 feet = tailwater elevation for culvert

HY-8 (or the culvert nomographs) indicates that the culvert would be under outlet control with a headwater elevation of 804.04 feet.

The lowest nearby structure has a finished floor elevation of 805.0 feet. Therefore, all nearby structures would be above the 100-year headwater elevation for the culvert.



APPENDIX O

EXAMPLE OIL REMOVAL BMP'S (BEST MANAGEMENT PRACTICES)

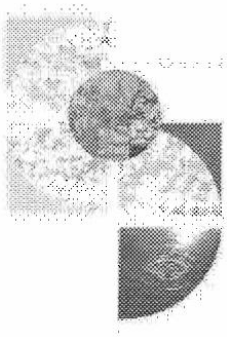
Oil Removal BMP – Low Oil Application

For low oil applications, a typical detention basin outlet may be equipped with an oil skimmer, consisting of a non-leaching absorbent material, connected to the rim of the standpipe with a non-degradable line or rope. A typical standpipe would require one 13-inch x 13-inch packet of absorbent material that converts liquid petroleum hydrocarbons into a manageable solid waste (i.e. not a hazardous waste). An acceptable product would be the "Smart Sponge® Passive Skimmer" or equal. The length of the connecting line should be such that the skimmer, when hanging freely, rests above the crown of the outlet pipe extending from the standpipe. The skimmer shall not cause an obstruction to the flow exiting the standpipe. Additional information on the "Smart Sponge® Passive Skimmer" can be found on the following page.

Oil Removal BMP – High Oil Application

For high oil applications, one or more prefabricated oil/grit separator units may be required. The following design standards shall apply to such units:

- Each oil separator shall serve no more than one acre of (impervious) area.
- The separator shall be designed to pass the ten-year design storm without hydraulic interference.
- Oil separators shall consist of at least three chambers: a sediment chamber, an oil chamber, and a discharge chamber.
- The first two chambers shall provide at least 400 cubic feet of grit storage, with permanent pool depth of at least 4 feet.
- The first and second chambers (sediment chamber and oil chamber) shall be hydraulically connected by two 6-inch orifices protected by a trash rack. The orifices shall be located at least 4 feet above the separator floor.
- The second and third chambers (oil chamber and discharge chamber) shall be hydraulically connected by an inverted elbow at least 18 inches in diameter, 3 feet in length and at least one foot above the oil chamber floor.
- A manhole shall be provided to each chamber for maintenance.
- The outlet from the oil separator shall not be submerged by the receiving watercourse during a 10-year design storm.



AbTech INDUSTRIES

PASSIVE SKIMMER TECHNICAL SPECIFICATION

PASSIVE SKIMMER

CONTENTS

SPECIAL POINTS OF INTEREST:

- Chemically selective to hydrocarbons
- Removes sheen
- Transforms pollutant into a stable solid
- Remains buoyant
- Effective nonpoint source pollution prevention
- Stormwater BMP

DESCRIPTION

The **Passive Skimmer** is designed to absorb and encapsulate hydrocarbons by floating directly on the water in catch basins, sumps, oil/water separators and marine fueling stations. The Passive Skimmers are made of a proprietary blend of polymers, called **Smart Sponge®**, packaged in flexible mesh containers and are available in a variety of sizes. The non-leaching Smart Sponge is chemically selective to hydrocarbons and able to transform liquid petroleum hydrocarbons into a manageable solid waste. Passive Skimmers also remove oil sheen.

This uniquely designed product allows water to flow through the skimmer for extended periods without the sediment-clogging problems associated with other water filters. As debris and larger objects flow into the catch basin, the skimmer folds downward from the weight. This self-clearing action allows the skimmer to return to its original position for continued hydrocarbon absorption. Smart Sponge products will not release absorbed oil, and are tough enough to withstand turbulent environments. As the Passive Skimmer safely "locks up" absorbed hydrocarbons it can remain in place for long periods of time. Passive Skimmers are ideal for use in pollution prevention and long term remediation because they will not deteriorate in water or degrade in sunlight.

INSTALLATION

Installation of Passive Skimmers is a simple process requiring no structural modifications to existing drainage structures or oil/water separators. Simply tie off with a rope through the grommets or through the center handle. Changeout of Passive Skimmers is also quick and easily accomplished by simply pulling the skimmer out and replacing it.

APPENDIX P

GLOSSARY

Glossary

Best Management Practice	Also "BMP". A practice or combination of practices based on current, accepted engineering standards that prevent or reduce stormwater runoff and/or associated pollutants. For example, the *Guidebook of Best Management Practices for Michigan Watersheds*.
Construction Plans	Detailed plans showing the existing and proposed features of a proposed development and engineering calculations supporting the design of the proposed features.
County Drain	A drain which has been designated as an Established Drain wholly within St. Clair County.
Design Storm	A rainfall event of specified return frequency and duration (e.g. a 100-year, 24-hour storm) that is used to calculate peak flows and /or runoff volumes.
Detention Basin	A stormwater management practice that captures stormwater runoff temporarily and releases the stormwater to a surface water body or watercourse
Development	A residential, industrial, municipal, commercial, or other project involving the construction of structures and/or paved surfaces on natural or previously developed land.
Drain	The term "drain" as used in these Rules shall have the meaning as proscribed in Drain Code Section 3 as follows: The word "drain", whenever used in this act, shall include the main stream or trunk and all tributaries or branches of any creek or river, any watercourse or ditch, either open or closed, any covered drain, any sanitary or any combined sanitary and storm sewer or storm sewer or conduit composed of tile, brick, concrete, or other material, any structures or mechanical devices, that will properly purify the flow of such drains, any pumping equipment necessary to assist or relieve the flow of such drains and any levee, dike, barrier, or a combination of any or all of same constructed, or proposed to be constructed, for the purpose of drainage or for the purification of the flow of such drains, but shall not include any dam and flowage rights used in connection therewith which is used for the generation of power by a public utility subject to regulation by the public service commission.
Drain Commissioner	The Drain Commissioner of the County of St. Clair, Michigan.

Drainage District	The term "drainage district" as used in these Rules shall have the meaning as proscribed in Drain Code Section 5 as follows: A Drainage District is any county or inter-county drainage district legally established pursuant to applicable provisions of the Drain Code. Drain Code Section 5 provides that each such drainage district is a body corporate with the power to contract, to sue and be sued, and to hold, manage and dispose of real property, in addition to any other powers conferred by law. Generally, a drainage district is comprised of all lands which drain to a legally established drain.
Easement	Also "Right-of-way". A legal right granted by a property owner to another entity, allowing that entity to make limited use of the property for a specific purpose. The Drain Commissioner secures easements along established drains, detention and retention basins, and other stormwater conveyance systems for the purpose of maintenance access.
Established Drain	An open or enclosed stormwater conveyance system that has been legally established as a county or inter-county drain within St. Clair County pursuant to applicable provisions of the Drain Code.
Final Plat	A map of all or part of a subdivision prepared and certified by the proprietor's Engineer or Land Surveyor in accordance with the requirements of the Subdivision Control Act of 167, Act 288 of the Public Acts of 1967, as amended.
First Flush	During the early stages of a storm, stormwater with a highly concentrated pollutant load, due to the runoff washing away the pollutants that have accumulated on the land.
Freeboard	The vertical distance from the top of an embankment to the design water elevation of a detention basin or retention basin, required as a safety margin.
Headwater	The depth of water at the upstream end of a culvert.
Infiltration	The absorption of water into the ground, often expressed in terms of inches per hour.
Inter-county Drain	A drain traversing two or more counties that has been legally established as an established drain.
Invert	The interior surface of the bottom of a pipe.

Pre-Preliminary Plans	A sketch plan or informal plan drawn to scale and showing the existing features of a site and its surroundings and the general layout of the proposed development.
Pre-Preliminary Plat	A sketch plan or informal plan drawn to scale and showing the existing features of a site and its surroundings and the general layout of the proposed subdivision.
Preliminary Plans	A plan showing the preliminary layout of a development in sufficient detail to allow review by interested agencies.
Preliminary Plat	A plan showing the preliminary layout of a subdivision development in sufficient detail to allow review by interested agencies.
Proprietor	A person, firm, association, partnership, corporation or combination of any of them which may hold ownership in land whether recorded or not. "Proprietor" shall be synonymous with "Developer" or "Land owner".
Retention Basin	A stormwater management practice that captures stormwater runoff and does not discharge to a surface water body or watercourse, but allows the water to evaporate or infiltrate into the ground.
Redevelopment	Additions and/or modifications to an existing development.
Riprap	A combination of large stone, cobbles, and boulders used to line channels, stabilize banks, reduce runoff velocities, or filter out sediment.
Runoff	The excess portion of precipitation that does not infiltration into the ground or is not captured by vegetation, but flows overland to a stream, storm sewer, or water body.
Spillway	A depression in the embankment of a detention basin used to allow overflow of stormwater during storm events in excess of the design storm.
Tailwater	The depth of water at the downstream end of a culvert.
Time of Concentration	The time it takes for surface runoff to travel from the hydraulically farthest portion of a watershed to the design point.