TRUMBULL COUNTY ENGINEERS DRAINAGE DESIGN AND STORM WATER MANAGEMENT AND TRUMBULL COUNTY SOIL & WATER CONSERVATION DISTRICT STORM WATER POLLUTION PREVENTION PLAN MANUAL

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Executive Summary

The U.S. Environmental Protection Agency (EPA) and the Ohio EPA have mandated portions of Trumbull County to comply with the National Pollution Discharge Elimination System (NPDES) Phase II Storm Water Program. Development of the Storm Water Management Program represents Trumbull County's commitment to preserving, protecting and improving water resources within the county. The program tasked the County Engineer, with assistance from the Trumbull County Soil and Water Conservation District, to implement portions of Minimum Control Measure 5, Post-Construction Runoff Control. As part of the County Engineer's effort to improve water quality in Trumbull County, this manual was developed to document the stormwater requirements and as a tool to guide drainage design, erosion and sedimentation runoff control, post-construction runoff control and storm water management for construction and development within the unincorporated areas of Trumbull County. This is an update to the manual adopted October 24, 2012 by the Trumbull County Commissioners in Commissioners Journal Volume 138 at Page 17058.

Due to the Ohio EPA's updated stormwater regulatory requirements for municipal stormwater discharges (Small MS4 Discharge Storm Water NPDES General Permit) and construction stormwater discharges (Stormwater Discharges from Small and Large Construction Activities NPDES General Permit), the Trumbull County Engineer's office and the Trumbull County Soil and Water Conservation District are updating this manual.

The objectives of this manual are to provide engineering guidance to:

- Local communities and personnel responsible for implementing storm water management practices, programs, policies and operation/maintenance activities within Trumbull County.
- Engineers responsible for design of storm water conveyance structures, storm water management plans, drainage systems, and infrastructure in support of development.
- Individuals and other professionals associated with storm water management at varying levels may find the manual useful as a technical reference to illustrate storm water engineering design principals and techniques.

The intent of this drainage manual is to minimize impacts to:

- Human health and public safety
- Existing drainage infrastructure
- Flooding events and property damage
- Stream channel degradation

The County Engineer will provide updates and revisions to this manual periodically based on reviews of actual manual concepts implemented in the field and manual user suggestions and feedback on improving manual content and applicability with cooperation of the Trumbull County Soil and Water Conservation District. The County Engineer reserves the right to review drainage designs and construction plans submitted as a result of using this guidance manual. The County Engineer shall not be held liable as a result of information presented in this guidance manual. The manual as developed primarily is a "tool" to guide developers, engineers, builders and contractors through the county's drainage design process and procedures. The County Engineer does not consider this as an all-inclusive comprehensive design document or manual.

1.0 Introduction

This manual serves as a guide for drainage design and stormwater management within Trumbull County, Ohio. It is designed to assist developers, engineers, and landowners in complying with local, state, and federal regulations governing stormwater runoff quantity and quality. The manual supplements the Phase II requirements set forth by the U.S. Environmental Protection Agency (EPA) under the Clean Water Act and is adopted by the Trumbull County Commissioners.

1.1 Purpose

Experience has shown that most of the serious flooding, erosion, and water quality problems are "created." Usually this occurs from conveying more stormwater to a given area than can be carried away effectively. Ever increasing drainage problems emerge unless well-conceived, cooperative stormwater drainage and flood control programs are undertaken throughout the entire watershed. The stormwater management goals of Trumbull County, Ohio, are to prevent flooding, streambank erosion, and water quality degradation that may result from stormwater runoff from development and redevelopment projects.

The purpose of the Manual is to protect existing natural stormwater resources, convey and control stormwater in a safe and responsible manner, and meet water quality goals. The Manual is intended to provide information to the public on the stormwater policies and design practices, as well as assist developers, engineers, and staff in the preparation, review and approval of the Stormwater Management Report and Construction Drawings that must accompany private and public development proposals. This document is organized to facilitate specific design and submittal activities related to stormwater management infrastructure.

The Manual is intended to facilitate collaboration of storm water management regulations, specifically between the Trumbull County Erosion and Sediment Control Rules, Subdivision Regulations, Flood Damage Reduction Regulations and other community specific riparian setback, floodplain and storm water management regulations.

Storm water management, particularly storm water quality management, is an evolving science. The goal of the County is to be responsive to changes in storm water policy and design brought forth by the natural progression of the industry. As such, the Manual will be updated as necessary to reflect accepted standard practice in stormwater management.

The County also recognizes that there may be instances where alternative storm water standards may apply to protect sensitive ecological areas or to meet the goals of Total Maximum Daily Loads established by Ohio EPA. Where alternative standards conflict with the requirements of the Manual, the more stringent criteria shall apply.

1.2 Manual Organization

The manual has been divided into the following technical sections.

- Section 1: INTRODUCTION
- Section 2: DRAINAGE HYDROLOGY
- Section 3: DRAINAGE DESIGN AND STORM WATER MANAGEMENT
- Section 4: STORM WATER POLLUTION PREVENTION PLAN
- Section 5: FLOOD PLAIN REGULATIONS
- Section 6: ADMINISTRATION
- Section 7: APPENDICES

Each section is subdivided to provide supporting details and example calculations to present a step by step process for implementing the drainage criteria in this manual. Application of concepts, methods and engineering practices addressed in this manual should contribute toward effective and economic solutions for:

- Storm water management
- Sound planning, engineering and design of drainage and storm water infrastructure systems
- Permitting and promoting development while decreasing downstream flooding
- Urban and rural erosion and sedimentation control

- Reducing negative impacts to receiving watercourses
- Local drainage and flooding issues

Sections 1, 2, and 3 shall be used to prepare constructions drawings and a storm water management report which shall be submitted to the Trumbull County Engineer's Office for review, comment, and ultimate approval or disapproval. Section 4 shall be used to prepare a storm water pollution prevention plan and an erosion and sediment control plan which shall be submitted to the Trumbull County Soil & Water Conservation District for review, comment, and ultimate approval or disapproval. Alternate engineering design methods, other than those identified in this manual, may be used with approval of the County Engineer. If the alternative is specific to design of the water quality structure, the County Engineer will request the Administrator of the Trumbull County Soil and Water Conservation District to review and comment on the design prior to approval. Complete supporting documentation, including calculations, shall be required at the request of the County Engineer for approval of these alternative methods. An application for submittal to the County Engineers office is provided in the Appendix.

1.3 Using the Manual

The Manual has been developed with the ability to distribute sections independently or as a complete document. The primary objective of the manual is to provide a consistent approach to drainage design and storm water management within Trumbull County. The following list provides recommendations on the use of this Manual for drainage design, construction projects, storm water management and compliance within Trumbull County.

- Review current pre-developed site conditions.
- Consider incorporation of natural site conditions, contouring and setbacks where practical.
- Review and select appropriate drainage methodology presented in manual. Refer to examples provided in manual as guidance during design.
- Drainage methodology selected shall include review and incorporation of both quantity and quality runoff controls, temporary erosion and sediment controls and post-construction control best management practices.
- Determine requirements to complete a Storm Water Pollution Prevention Plan.
- Completed subdivision and construction plans shall be submitted to the County Engineer and the Trumbull County Soil and Water Conservation District as appropriate.
- Complete Notice of Intent and submit to OEPA online via https://ebiz.epa.ohio.gov
- Provide County Engineer and the Trumbull County Soil and Water Conservation District with approved copy of NOI.

Project planners, developers and engineers should address both on-site and off-site runoff, downstream potential impact issues, local requirements and known flooding areas when developing project site plans for addressing project drainage and runoff.

1.4 Drainage Policy

The Trumbull County Engineer shall ensure that sound engineering practices, concepts, and methods are incorporated into planning and design of drainage infrastructure and conveyance systems within Trumbull County. Emphasis shall be placed on protecting and managing the following:

- Public safety
- Historic flooding areas
- Protecting stream channels and property
- Current drainage infrastructure

The Manual specifically supports the policy of preservation and protection of lakes, rivers, streams, riparian setback zones, floodplains, flood hazard areas and wetlands. The following elements are the basis for Trumbull County's drainage criteria.

Minor System – The drainage system provided to accommodate the appropriate return period storm event. This includes pavement, curbs, gutters, ditches, inlets, catch basins, pipes, open channels, and water quality and quantity management facilities or approved outfall. The minor system is designed to convey the 10yr storm full and the 25yr storm for hydraulic grade.

Major System – The route followed by runoff when the capacity of the minor drainage system is exceeded. The major drainage system consists of the roadway surface, oversized conduits, drainage swales, channels or roadside ditches. This system shall convey the 100yr storm event to the storm water management facility or approved outfall.

Storm Water Management Facilities – Intent is to ensure storm water run-off is properly conveyed, detained, or managed to meet the water quality and quantity requirements. Elements include, but are not limited to detention/retention, outlet controls, quantity volume controls, and minimization of downstream quantity and erosive impacts.

The three elements are explained in detail with supporting example calculations in the following sections of this manual. Criteria and requirements set forth in this manual are intended to be used as tools in combination with sound hydraulic/engineering practices for both public and private projects. The County Engineer requires that all designs, permits, supporting drawings, state and local storm water runoff requirements be reviewed and stamped by a professional engineer registered in the State of Ohio, unless specified differently within this Manual.

1.5 Planning

Locating permanent post-construction runoff controls and associated level of maintenance practices with regards to these controls are examples to be considered during initial project planning. The Trumbull County Engineer recommends that at a minimum, the following should be considered and incorporated prior to submitting project construction plans:

- Has the project design incorporated naturally occurring site features such as stream buffers, natural site contours, green space where applicable, setbacks, natural drainage features, etc.? Do these incorporated features meet local requirements?
- Has the project design accounted for both-off-site runoff and protection of streams and adjacent properties?
- Will the project drainage design minimize operation and maintenance activities?
- Has the project incorporated local storm water Best Management Practices (BMP's)?
- Does the project design allow for construction of BMP's capable of functioning prior to major earthwork activities?

1.6 Applicability Limitations

The Manual is being adopted as a rule of Trumbull County pursuant to the authority provided in the Ohio Revised Code Section 307.79. The rules adopted under this Section require persons to file plans governing erosion control, sediment control, and water management before clearing, grading, excavating, filling, or otherwise wholly or partially disturbing one or more contiguous acres of land owned by one person or operated as one development unit for the construction of nonfarm buildings. Unless otherwise exempted, the Manual shall be used for all public and private projects within the unincorporated areas of Trumbull County. Projects that have an Earth Disturbed Area of one or more acres shall comply with this Manual in its entirety. Projects that have an Earth Disturbed Area less than one acre shall submit a Drainage Site Plan to the County Engineers office and the Trumbull County Soil & Water Conservation District for review and comment. The Drainage Site Plan will be reviewed for possible impacts to neighboring properties and the downstream drainage facilities and may require stormwater management.

The Manual is not applicable to the expansion, construction, or reconstruction of one single-family dwelling or one two-family or three-family dwelling on a single parcel; however, construction of this type may still fall within the jurisdiction of the Trumbull County Erosion and Sediment Control Rules (the Rules) implemented by the Trumbull County Soil and Water Conservation District and the Ohio EPA NPDES General Construction Permit.

This manual will be effective thirty (30) days after adoption by the County. Any development that occurs after this date must comply with the Manual, unless a variance has been obtained as described in the manual.

The manual establishes uniform design criteria for storm water design and management practices within the unincorporated areas of Trumbull County. The manual does not replace the need for sound engineering judgement, nor does it preclude the use of information that may subsequently become available. The manual is not intended to

be a comprehensive document. The objective is to provide a guidance manual which establishes uniform criteria for consistency in design of drainage and storm water runoff controls.

The Trumbull County Engineer and the Trumbull County Soil and Water Conservation District, in its review of submitted project plans, reserves the right to return and/or request additional supporting documentation as necessary to ensure the above project elements have been addressed to the maximum extent practicable. The Trumbull County Engineer and the Trumbull County Soil and Water Conservation District recognizes that this manual is not all inclusive or comprehensive and will require updates periodically.

Anything not composed entirely of storm water is considered an illicit discharge. The Trumbull County Engineer and the Trumbull County Soil and Water Conservation District shall prohibit all non-storm water discharges except those shown in Table 1.1:

TABLE 1-1: Allowable County, Non-Storm Water Discharges

Footing Drains	Foundation Drains	Landscape Irrigation	Lawn Watering
Dechlorinated/Desalinated Swimming Pool Discharges	Uncontaminated Ground Water Infiltration	Discharges from Portable Water Sources	Uncontaminated Pumped Groundwater
Street Wash Water with Dry Cleanup Methods and No Detergents	Air Conditioning Condensate	Individual Residential Car Washing	Water from Crawl Space Pumps
Discharges from non-planned Fire Fighting Activities	Flows from Riparian Habitats and Wetlands	Natural Springs	Water Line Flushing
Diverted Stream Flows	Irrigation Water	Rising Groundwater	

Source: OEPA Small MS4 Discharge Storm Water NPDES General Permit *Current Edition*

By completing and submitting construction plans and Notice of Intent (NOI), you agree to comply with the requirements of the OEPA Storm Water Discharges from Small and Large Construction Activities - General Permit (OEPA CGP) and to limit the discharge of storm water runoff from the project site to the Maximum Extent Practicable (MEP). MEP represents the highest level of performance achievable considering cost, technology and project constraints.

Manual Updating

The County Engineer, with input and review from other Trumbull County Agencies, will review regulatory requirements, best management practices, design criteria, and other supporting materials to provide necessary updates to the manual as required or necessary. The County Engineer will take under advisement, any design requirement suggestions or other manual revisions which will not conflict with the intent and purpose of this manual.

1.7 Contact Information

For specific questions regarding this manual:

For Sections 1,2, and 3 contact:
Trumbull County Engineer
650 North River Road
Warren, OH 44483
330-675-2640
Website – https://www.co.trumbull.oh.us/engineer/index.html

For Section 4 contact:
Trumbull County Soil & Water Conservation District
520 W. Main Street, Suite 3
Cortland, OH 44410
330-637-2056
Website - http://swcd.co.trumbull.oh.us/index.html

1.8 Design and Construction Criteria

The following criteria will be used for the design and construction and all storm water conveyance, drainage and storage facilities:

- Design and installation of all storm water conveyance systems, storm sewers, and storm water post-construction BMPs (Public and Private) shall comply with all applicable federal, state and local laws. Special attention shall be given to Storm Water Pollution Prevention Plan requirements addressed in Section 4 of this manual and the Trumbull County Erosion and Sediment Control Rules implemented by the Soil and Water Conservation District.

- In no case shall a structure be located within the impoundment area of any storm water (retention) storage facility or over any storm water drainage or sewer line.

- Roadway "Sags" and parking areas which also serve as temporary impoundments of runoff shall not exceed an impounded depth of 10 inches.

- Maintenance of all detention/retention facilities will be responsibility of the property owner(s).

- Project downstream impacts shall not be allowed. Project storm water runoff shall be managed and maintained on site.

1.9 Compliance with Local, State and Federal Regulations

Addressing only the requirements associated with the Construction General Permit or the Trumbull County Soil and Water Conservation District regulations does not relieve the applicant of responsibility for obtaining all subsequent permits and/or approvals from the Ohio Environmental Protection Agency (OEPA), the United States Army Corps of Engineers (USACE) or any other federal, state and/or county agencies. Should the requirements vary, the more restrictive requirements will govern. Additional permits may include but are not limited to those listed below. The Trumbull County Engineer shall require proof of compliance with these local, state and federal regulations prior to plan approval.

1. OEPA – Authorization of Storm Water Discharges Associated with Construction Activity General Permit– Proof of compliance will consist of an OEPA approved Notice of Intent (NOI) including NPDES project permit number.

2. All proposed development sites must be checked for the existence of wetlands by a qualified professional. If no wetlands are on the site, a letter from the qualified professional stating that shall be included with the submittal of the project construction plan packet. If wetlands are found to be on the site one or all the following may be required based on the determined extent of the impact:

    a. Jurisdictional Determination – Proof of compliance shall be a copy of the Jurisdictional Determination from the USACE, confirming the findings of a qualified professionals survey and report.
    b. Section 404 of Clean Water Act – Proof of compliance shall be a copy of the USACE Individual Permit Application. Should an individual permit be required, public notification and meetings will be held. Should an individual permit not be required,

proof of compliance shall be a copy of the USACE Nationwide Permit including a site plan indicating proposed fill areas in proximity to waters of the U.S.

3. Should a Section 404 Permit or Jurisdictional Determination not be necessary, the site owner shall submit a letter certifying that a qualified professional has surveyed the site and no waters of the United States were identified.

4. OEPA-Isolated Wetland Permit – Proof of compliance will consist of a copy of the OEPA's Isolated Permit Application, public notice or project approval or a letter from the site owner certifying that a qualified professional has surveyed the site and no waters of the state were identified.

5. Section 401 of Clean Water Act – Proof of compliance will consist of a copy of the OEPA's Water Quality Certification Application, public notice, project approval or a letter from the site owner certifying that a qualified professional has surveyed the site and no waters of the United States were identified.

6. Ohio Dam Safety Law – Proof of compliance will consist of a copy of the ODNR's – Division of Water Permit application or a copy of the project approval letter for ODNR.

7. Federal Emergency Management Agency (FEMA) – Proof of compliance will consist of a copy of the project site showing the regulatory floodplain and floodway as defined by FEMA on the effective Flood Insurance Rate Map (FIRM) and corrected by Letter(s) of Map Change, as applicable. When FEMA has provided regulatory base flood elevations for the watercourse, the regulatory floodplain shall be delineated on the project site plan by elevation, not by scaling from the FEMA map. All project site plans shall identify the vertical datum used in the project and the translation equation between the project vertical datum and the vertical datum used by local FEMA mapping. Copies of the local FEMA mapping and Letter(s) of Map Change affecting the study area shall be submitted with the project site plan.

8. Notice of Intent (NOI)/Notice of Termination (NOT) – Copies of the approved NOI shall accompany the construction plans. NOTs shall be applied for in a timely manner and a copy forwarded to the Trumbull County Engineer's office as documentation of project close out.

The permitting process may require extensive coordination, including project start time based on the receipt of permit approval, construction sequencing and seasonal limitations. The Trumbull County Engineer recommends attention be given to "up-front" planning and consideration of alternatives before moving forward with potential time-consuming permitting procedures and project design. To assist with the permitting and review process the Trumbull County Engineer and the Soil and Water Conservation District recommend a pre-application meeting(s) to discuss, provide comments and/or review of potential designs prior to submittal. The Trumbull County Engineer acknowledges that there will be times when multiple permits are required, necessary and unavoidable. The following table is a summary of current permits being used on projects within Trumbull County:

The following table is intended to be a summary of permits, submittals and project related issues:

Table 1-2: Permit Summary Table

Submittal Type	Requirement Drivers	Agency	Comments
Drainage Design and Storm Water Management Plan	Earth Disturbed Area equal to or greater than one acre. Trumbull County Drainage Design and Storm Water Management Manual	Trumbull County Engineer's Office	Construction Plans and Storm Water Management Report
Storm Water Pollution Prevention Plan and Erosion and Sediment Control Plan OEPA - NOI OEPA - NOT	Earth Disturbed Area equal to or greater than one acre. Trumbull County Drainage Design and Storm Water Management Manual and SWPP and ESCP Manual	Ohio Environmental Protection Agency (OEPA) – Surface Water Division, Northeast District Office Trumbull County Soil & Water Conservation District Office	TCSWCD requires that the Erosion and Sedimentation Control Plan be submitted in conjunction w/ the SWP3 plan.
401/404 Nationwide General Permit: • 401-Water Quality Certification • 404-Nationwide General Permit Note: Associated with activities in and around waters of US.	Maintenance Activity – 200 feet maximum. Bank Stabilization – 500 feet maximum. Drainage Ditch Reshaping – 500 feet maximum (Waters of US). Storm Water Management Facilities – 300 feet maximum streambed loss due to discharge (Intermittent streams only, not allowed for perennial streams). Include maintenance plan.	U.S Army Corp. of Engineers (USACE) (404) Ohio EPA (401)	USACE – 45 Day permit turn around period upon receipt of complete permit package. 30 days to review and provide notification of missing submittal components (Pre-Construction Notification (PCN)). Trumbull County Engineer – Recommends that these types of activities/permits be minimized and alternatives considered prior to implementing this process and that permit copies should be supplied.
Floodplain Activities: • Letter of Map Revision (LOMR) • Conditional Letter of Map Revision – (CLOMR) • Trumbull County Flooding regulations	Associated with structures within floodplain/floodway. Requirement condition is no back water effect and no more than 0.5-foot of rise of water final surface elevation.	(1) Federal Emergency Management Agency (FEMA) (2) USACE (3) Trumbull County Planning Commission/ Trumbull County Floodplain Coordinator	FEMA – 45 Day permit application review period upon receipt of required information. Trumbull County Engineer – Recommends that any activities associated with structures within floodplain of floodway be minimized or implemented should no other alternatives be practical.
Drainage Site Plan	Earth Disturbed Area less than one acre.	Trumbull County Engineer's Office/ Trumbull County Soil & Water Conservation District Office	For review and comment

1.10 Definitions and Acronyms

For these regulations certain rules or word usage apply to the text as follows:

A) Words used in the present tense include the future tense, and the singular includes the plural, unless the context clearly indicates the contrary.

B) The term "shall" is always mandatory and not discretionary; the word "may" is permissive. The term "should" is permissive but indicates strong suggestion.

C) The word or term not interpreted or defined by this Section shall be construed according to the rules of grammar and common usage to give these regulations their most reasonable application.

MANUAL DEFINITIONS:

ACRE: A measurement of area equaling 43,560 square feet.

BASE FLOOD: The flood having a one percent chance of being equaled or exceeded in any given year. The base flood may also be referred to as the 1% chance annual flood or one hundred (100) year flood.

BASE (100-YEAR) FLOOD ELEVATION (BFE): The water surface elevation of the base flood in relation to a specified datum, usually the National Geodetic Vertical Datum of 1929 or the North American Vertical Datum of 1988 and usually expressed in Feet Mean Sea Level (MSL). In Zone AO areas, the base flood elevation is the natural grade elevation plus the depth number (from 1 to 3 feet).

BEST MANAGEMENT PRACTICES (BMP'S): Structural or nonstructural facilities or activities that control soil erosion and/or storm water runoff at a development site. This includes treatment requirements, operating and maintenance procedures, and other practices to control site runoff, leaks, or waste disposal.

CHANNEL: A natural bed that conveys water; a ditch excavated for the flow of water.

CHANNEL PROTECTION AND WATER QUALITY VOLUME (CPWQv): Volume of storm water runoff that must be captured and treated before discharge from the developed site after construction is complete. CPWQv is based on the expected runoff generated by the mean storm precipitation volume from post-construction site conditions at which rapidly diminishing returns in the number of runoff events captured begins to occur.

CONSTRUCTION GENERAL PERMIT (CGP): Ohio EPA General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System NPDES. General Permit No. OHC000006.

CRITICAL STORM: That storm which is calculated using the post-construction percentage increase in volume of runoff from a proposed development. The critical storm is used to calculate the maximum allowable storm water discharge rate from a developed site.

DETENTION STRUCTURE: A permanent storm water management facility for the temporary storage of runoff and is designed so as not to create a permanent pool of water.

DEVELOPMENT AREA: A lot or contiguous lots owned by one person or persons, or operated as one development unit, and used or being developed for commercial, industrial, residential, institutional, or other non-farm construction or alternative that changes runoff characteristics, upon which soil-disturbing activities occur.

DEVELOPMENT DRAINAGE AREA: A combination of each of the hydraulically unique drainage areas with individual outlet points on the development area.

DITCH: An open channel, either dug or natural, for the purpose of drainage or irrigation with intermittent flow.

DRAINAGE: The removal of excess surface water or groundwater from land by surface or subsurface drains.

DRAINAGE IMPROVEMENT: As defined in Ohio Revised Code (ORC). 6131.01 (C), and/or conservation works of improvement, ORC. 1511 and 1515.

DUMPING: Grading, Pushing, Piling, Throwing, Unloading, or Placing.

EARTH DISTURBED AREA: An area where clearing, grading, excavating, filling or other alteration of land surface where natural or man-made cover is destroyed in a manner that exposes soils.

ENGINEER: A Professional Engineer registered in the State of Ohio.

EROSION: The process by which the land surface is worn away by the action of wind, water, ice, gravity, or any combination of those forces.

EROSION AND SEDIMENT CONTROL (ESC): The control of soil material, both mineral and organic, to minimize the removal of soil material from the land surface and to prevent its transport out of a disturbed area by means of wind, water, ice, gravity, or any combination of those forces.

EROSION AND SEDIMENT(ATION) CONTROL (ESC) PLAN: For the purposes of the Manual an ESC Plan shall consist of an existing and proposed site conditions, a Site Drainage Plan and the ESC location plan with supporting details and calculations.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA): The agency with the overall responsibility for administering the National Flood Insurance Program.

FINAL STABILIZATION: All soil disturbing activities at the site have been completed and a uniform perennial vegetative cover with a density of at least 80% cover for the area has been established or equivalent stabilization measures, such as the use of mulches, geotextiles, have been employed to the satisfaction of the County Engineer.

FLOOD OR FLOODING: A general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, and/or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD HAZARD BOUNDARY MAP (FHBM): Usually the initial map, produced by the Federal Emergency Management Agency, or U.S. Department of Housing and Urban Development, for a community depicting approximate special flood hazard areas.

FLOOD INSURANCE RATE MAP (FIRM): An official map on which the Federal Emergency Management Agency or the U.S. Department of Housing and Urban Development has delineated the areas of special flood hazard.

FLOOD INSURANCE RISK ZONES: Zone designations on FHBMs and FIRMs that indicate the magnitude of the flood hazard in specific areas of a community. Following are the zone definitions:

Zone A:
Special flood hazard areas inundated by the 100-year flood; base flood elevations are not determined.
Zones A1-30 and Zone AE:
Special flood hazard areas inundated by the 100-year flood; base flood elevations are determined.
Zone AO:
Special flood hazard areas inundated by the 100-year flood; with flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths are determined.
Zone AH:
Special flood hazard areas inundated by the 100-year flood; flood depths of 1 to 3 feet U (usually areas of ponding); base flood elevations are determined.

Zone A99:
Special flood hazard areas inundated by the 100-year flood with average depths of less than 1 foot or with contributing drainage area less than 1 square mile; and areas protected by levees from the base flood.
Zone B and Zone X (shaded):
Areas of 500-year flood; areas subject to the 100-year flood with average depths of less than 1 foot or with contributing drainage area less than 1 square mile; and areas protected by levees from the base flood.
Zone C and Zone X (unshaded):
Areas determined to be outside the 500-year floodplain.

FLOOD INSURANCE STUDY (FIS): The official report in which the Federal Emergency Management Agency or the U.S. Department of Housing and Urban Development has provided flood profiles, floodway boundaries (sometimes shown on Flood Boundary and Floodway Maps), and the water surface elevations of the base flood.

FLOODWAY: A floodway is the channel of a river or other watercourse and the adjacent land areas that have been reserved in order to pass the base flood discharge. A floodway is typically determined through a hydraulic and hydrologic engineering analysis such that the cumulative increase in the water surface elevation of the base flood discharge is no more than a designated height. In no case shall the designated height be more than one foot at any point within the community.

FREEBOARD: A factor of safety usually expressed in feet above a flood level for the purpose of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, obstructed bridge openings, debris and ice jams, and the hydrologic effect of urbanization in a watershed.

GRASSED WATERWAY: A broad or shallow natural watercourse or constructed channel, covered with erosion-resistant grasses or similar vegetative cover, used to convey surface water.

HYDRIC SOILS: Soils that are saturated, flooded, or ponded for a long enough time period during the growing season that anaerobic conditions develop in the upper part of the soil. Soils that are considered “wetland” soils.

HYDROGRAPH: Time distribution of runoff from a watershed.

HYDROLOGIC AND HYDRAULIC ENGINEERING ANALYSIS: An analysis performed by a professional engineer, registered in the State of Ohio, in accordance with standard engineering practices as accepted by FEMA, used to determine flood elevations and/or floodway boundaries.

HYDROPHYTIC VEGETATION: Plants that are found in wetland areas. These plants have been classified by their frequency of occurrence in wetlands.

IMPERVIOUS: Not allowing infiltration which means any paved, hardened or structural surface regardless of its composition including (but not limited to) buildings, roads, driveways, parking lots, loading/unloading spaces, decks, patios, and swimming pools.

INTERMITTENT STREAM: Stream which conveys flow periodically throughout the year. No permanent or consistent flow of water.

LANDSCAPE ARCHITECT: A Professional Landscape Architect registered in the State of Ohio.

LARGER COMMON PLAN OF DEVELOPMENT: A contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan.

LETTER OF MAP CHANGE (LOMC): A Letter of Map Change is an official FEMA determination, by letter, to amend or revise effective Flood Insurance Rate Maps, Flood Boundary and Floodway Maps, and Flood Insurance Studies. LOMC’s are broken down into the following categories:

Letter of Map Amendment (LOMA): A revision based on technical data showing that a property was incorrectly included in a designated special flood hazard area. A LOMA amends the current effective Flood Insurance Rate Map and establishes that a specific property is not located in a special flood hazard area.

Letter of Map Revision (LOMR): A revision based on technical data that, usually due to manmade changes, shows changes to flood zones, flood elevations, floodplain and floodway delineations, and planimetric features. One common type of LOMR, a LOMR-F, is a determination concerning whether a structure or parcel has been elevated by fill above the base flood elevation and is, therefore, excluded from the special flood hazard area.

Conditional Letter of Map Revision (CLOMR): A formal review and comment by FEMA as to whether a proposed project complies with the minimum National Flood Insurance Program floodplain management criteria. A CLOMR does not amend or revise effective Flood Insurance Rate Maps, Flood Boundary and Floodway Maps, or Flood Insurance Studies.

LOT: A tract of land occupied or intended to be occupied by a use, building, or group of buildings and their accessory uses and buildings as a unit, together with such open spaces and driveways as are provided and required. A lot may contain more than one contiguous lot.

MAXIMUM EXTENT PRACTICABLE: The level of pollutant reduction that site owners of small municipal separate storm sewer systems regulated under 50 C.F.R. Parts 9, 122, 123, and 124, referred to as NPDES Storm Water Phase II, must meet.

MS4 GP: Ohio EPA Authorization for Small Municipal Separate Storm Sewer Systems to Discharge Storm Water Under the National Pollutant Discharge Elimination System NPDES. General Permit No. OHQ00004.

MULTI-FAMILY DEVELOPMENT: Apartments, condominiums, townhouses, duplexes, or other similar buildings housing more than one family.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP): The NFIP is a federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the Federal government that states if a community will adopt and enforce floodplain management regulations to reduce future flood risks to all development in special flood hazard areas, the Federal government will make flood insurance available within the community as a financial protection against flood loss.

NPDES: National Pollutant Discharge Elimination System, a regulatory program in the Federal Clean Water Act that prohibits the discharge of pollutants into surface water of the United States without a permit.

NOTICE OF INTENT (NOI): Notice of Intent obtained from the Ohio EPA under the NPDES Phase 2 Program.

NOTICE OF TERMINATION (NOT): Notice of Termination obtained from the Ohio EPA under NPDES Phase 2 Program.

OHIO EPA: Ohio Environmental Protection Agency
ODNR-DSWC: Ohio Department of Natural Resources, Division of Soil and Water Conservation.

PERENNIAL STREAM: A stream that maintains water in its channel throughout the year.

PERMANENT STABILIZATION: The establishment of permanent vegetation, decorative landscape mulching, matting, sod, riprap and landscaping techniques to provide permanent erosion control on areas where construction operations are complete or where no further disturbance is expected for at least one year.

PERSON: Any individual, corporation, firm, trust, commission, board, public or private partnership, joint venture, agency, unincorporated association, municipal corporation, county or state agency, the federal government, other legal entity, or an agent of combination thereof.

PHASING: Clearing/grubbing/excavating a parcel of land in distinct sections, with the stabilization of each section occurring before clearing the next.

RAINWATER AND LAND DEVELOPMENT MANUAL: Ohio's standards for storm water management, land development, and urban watercourse protection. The most current edition of these standards shall be used with this Manual.

RETENTION STRUCTURE: A permanent storm water management facility that provides for the storage of runoff by means of a permanent pool of water.

RIPARIAN: Contiguous tract of land in contact with a stream and within the same watershed as the stream.

RUNOFF: The portion of rainfall melted snow, or irrigation water that flows across the ground surface and is eventually returned to water resources, watercourses, or wetlands.

SEDIMENT: Soils or other surface materials that are or have been transported or deposited by the action of wind, water, ice, gravity, or any combination of those forces, as a product of erosion.

SEDIMENTATION: The deposition or settling of sediment.

SEDIMENT BASIN: A barrier or other suitable retention structure built across an area of water flow to intercept runoff and allow transported sediment to settle and be retained, prior to discharge into Water of the State.

SEDIMENT POLLUTION: Degradation of waters of the state by sediment as a result of failure to apply management or conservation practices to abate wind or water soil erosion, specifically in conjunction with soil-disturbing activities on land used or being developed for commercial, institutional, industrial, residential, or other non-farm purposes.

SETBACK: A designated transition area around water resources or wetlands that is left in a natural, usually vegetated, state to protect the water resources or wetlands from runoff pollution. Construction activities in this area are restricted or prohibited as required in this regulation.

SOIL AND WATER CONSERVATION DISTRICT: An entity organized under Chapter 1515 of the Ohio Revised Code; referring either to the Soil and Water Conservation District, Board, or its designated employee(s), hereinafter referred to as the Trumbull SWCD.

SOIL DISTURBING ACTIVITY: Clearing, grubbing, grading, excavating, filling, or other alteration on the earth's surface where natural or human-made ground cover is destroyed and which may result in, or contribute to erosion and sediment pollution. This may also include construction of non-farm buildings, structures, utilities, roadways, parking areas, and septic systems that will involve soil disturbance or altering of the existing ground cover.

SPECIAL FLOOD HAZARD AREA: Also known as "Areas of Special Flood Hazard", it is the land in the floodplain subject to a one percent or greater chance of flooding in any given year. Special flood hazard areas are designated by the Federal Emergency Management Agency on Flood Insurance Rate Maps, Flood Insurance Studies, Flood Boundary and Floodway Maps and Flood Hazard Boundary Maps as Zones A, AE, AH, AO, A1-30, and A99. Special flood hazard areas may also refer to areas that are flood prone and designated from other federal state or local sources of data including but not limited to historical flood information reflecting high water marks, previous flood inundation areas, and flood prone soils associated with a watercourse.

STABILIZATION: The use of Best Management Practices, such as seeding and mulching, that reduce or prevent soil erosion by water, wind, ice, gravity, or a combination of those forces.

STORM FREQUENCY: The average period within which a storm of a given duration and intensity can be expected to be equaled or exceeded.

STORM WATER: Water runoff from rain events, snowmelt, surface runoff, and drainage.

STORM WATER MANAGEMENT: Runoff water safely conveyed or temporarily stored and released to an allowable rate to minimize erosion and flooding.

STORM WATER POLLUTION PREVENTION PLAN (SWP3): For the purpose of the Manual a SWP3 shall consist of a Site Drainage Plan, Erosion and Sedimentation Control Plan, Post-Construction Design Plan and Post-Construction Operation and Maintenance Plan with supporting details and calculations as defined and required by the Ohio EPA.

STRUCTURE: A walled and roofed building, manufactured home, or gas or liquid storage tank that is principally above ground.

SUBSOIL: That portion of the soil below the topsoil or plow layer, typically beginning 6-12" below the surface, but can also extend to 48" or deeper in the case of prime farmland soils, down to bedrock parent material.

TEMPORARY SOIL STABILIZATION: Establishment of temporary vegetation, mulching, geotextiles, preservation of existing vegetation and other techniques capable of quickly establishing cover over disturbed areas to provide erosion control between construction operations.

TOPSOIL: The upper layer of soil that is usually darker in color and richer in organic matter and nutrients than the subsoil.

USDA-NRCS: United States Department of Agriculture, Natural Resources Conservation Service.

WATERCOURSE: A definite channel with defined bed and banks within which concentrated water flows, either continuously or intermittently, (e.g. brooks, channels, creeks, rivers, or streams).

WATER RESOURCE: Any public or private body of water including lakes and ponds, as well as streams, gullies, ditches, swales, or ravines that have banks, a defined bed, and a definite direction of course, either continuously or intermittently flowing.

WATERSHED: The total drainage area contributing runoff to a single point.

WETLAND: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and contain a predominance of hydric soils, and that under normal circumstances do support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and similar areas (40 CFR 232, as amended).

1.11 Severability

If any provision of this manual is held invalid, the remainder of the manual and the application of such provisions shall remain in effect.

2.0 DRAINAGE HYDROLOGY

2.1 Hydrologic Design Policies

A design storm is the defined precipitation pattern used in hydraulic system design. The design storm is not an actual storm of record. Rather, it is a fabricated storm compiled from average characteristics of previous storm events and therefore is used to predict future storm events.

There are various hydrologic techniques to estimate the design storm. These include, but are not limited to:

- The Rational Method
- The SCS Graphical Peak Discharge Method
- The SCS Unit Hydrograph Method

Each of these methods has limitations and their results vary.

Usage Limitations for Hydrologic Methodologies

Method	Minor Systems (Storm Sewers)	Major Systems (Culverts and Streams)	Critical Storm Determination	Pond Routing
Rational Method	YES	NO	NO	NO
SCS Graphical Peak Discharge	NO	YES	NO	NO
SCS Unit Hydrograph	NO	YES	YES	YES

The following sections describe in detail the methodology and resources for each method.

2.2 Rational Method

The rational method is a formula for estimation of peak flow rates for small drainage areas. Its formula is a ratio between runoff and rainfall rates. It should be used primarily when designing the storm system (minor) in urban or rural areas. It shall not be used for the overland system (major) when the drainage area is greater than 20 acres. The Rational Method is explicitly prohibited from use in volumetric calculations, including critical storm determination and storage routing calculations for runoff quantity control.

Rational Formula:

$Q = FCIA$

Where: Q = rate of runoff (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr)
A = drainage area (acres)
F = correction factor (footnote 7 from Table 2-1)

- The runoff coefficient, C, is a dimensionless decimal value that estimates the percentage of rainfall that becomes runoff. It incorporates most of the hydrological abstractions, soil types, antecedent conditions, etc. Values of typical C coefficients are listed in Table 2-1.

  Where small watersheds have various land use or ground covers, a Weighted "C" value shall be used. The following example illustrates how a Weighted "C" value is calculated:

Example

Area	Land Use	"C"	"CA"
5	Roof	0.95	4.75
15	Lawn	0.35	5.25
20	Summation		10.0

Weighted "C" (Cw) = CA/Area = 10/20 = 0.50

TABLE 2-1: Runoff Coefficients "C" for Typical Land Uses

Cover Type and Hydrologic Condition	Average percent impervious area (5)	Runoff Coefficient for Hydrologic Soil Group (7) A	B	C	D
Fully developed urban areas (vegetation established) (1)					
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding unpaved right-of-way)		0.94	0.94	0.94	0.94
Open space (lawns, parks, golf courses, cemeteries, etc.)					
Poor condition (grass cover, 50%)		0.29	0.48	0.63	0.70
Fair condition (grass cover 50% to 75%)		0.07	0.30	0.48	0.58
Good condition (grass cover>75%)		NA	0.19	0.39	0.50
Commercial and business (TND – TC) (6)	85	0.70	0.77	0.83	0.85
Industrial	72	0.52	0.67	0.75	0.80
Residential Districts by Average Lot Size (6):					
Multi-family (TND – NC)	80	0.63	0.75	0.80	0.83
1/12 to 1/6 acre lots (TND – NG)	75	0.56	0.70	0.77	0.83
1/8 acre (TND – NE)	65	0.44	0.60	0.72	0.77
¼ acre	38	0.19	0.40	0.56	0.65
½ acre	25	0.11	0.32	0.50	0.60
1 acre	20	0.08	0.29	0.48	0.58
Undeveloped or agricultural lands (1)					
Cultivated Land:					
Without conservation treatment		0.35	0.52	0.67	0.75
With conservation treatment		0.21	0.34	0.46	0.52
Pasture, grassland, or range – continuous forage for grazing. (2)	Hydrologic condition:				
	Poor	0.29	0.48	0.63	0.70
	Fair	0.07	0.30	0.48	0.58
	Good	NA	0.19	0.39	0.50
Meadow – continuous grass, protected from grazing and generally mowed for hay	--	NA	0.16	0.34	0.46
Brush – brush-weed-grass mixture with brush the major element (3)	Poor	0.06	0.27	0.44	0.56
	Fair	NA	0.13	0.32	0.44
	Good	NA	0.06	0.25	0.37
Woods (4)	Poor	0.04	0.26	0.44	0.56
	Fair	NA	0.18	0.37	0.48
	Good	NA	0.12	0.32	0.44
Farmsteads – buildings, lanes, driveways, and surrounding lots.	--	0.17	0.39	0.54	0.63

Notes:
NA – Method to derive value is not applicable for curve number values less than 40.

(1) Average runoff condition, and Ia=0.2s.
(2) Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.
(3) Poor: <50% ground cover.
Fair: 50 to 75%
Good: >75% ground cover.
(4) Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.
(5) The average percent impervious area shown was used to develop the composite CN's which were then used to derive runoff coefficient values. Other assumptions are as follows: impervious areas have a runoff coefficient of 0.94 (or CN of 98), and pervious areas are considered equivalent to open space in good hydrologic condition.
(6) Acronyms for zoning of residential districts are as follows:
TND – TC: Traditional Neighborhood Development – Town Center
TND – NC: Traditional Neighborhood Development – Neighborhood Center
TND – NG: Traditional Neighborhood Development – Neighborhood General
TND – NE: Traditional Neighborhood Development – Neighborhood Edge
(7) These runoff coefficients were calculated from CN's drawn from the NRCS (SCS) Peak Discharge Method from TR-55 assuming a 10-year, 24-hour storm. For larger design storms, the runoff coefficients should be increased using the following C value correction factors:
1.0 for the 10-year design storm and less
1.1 for the 25-year design storm
1.2 for the 50-year design form
1.3 for the 100-year design storm

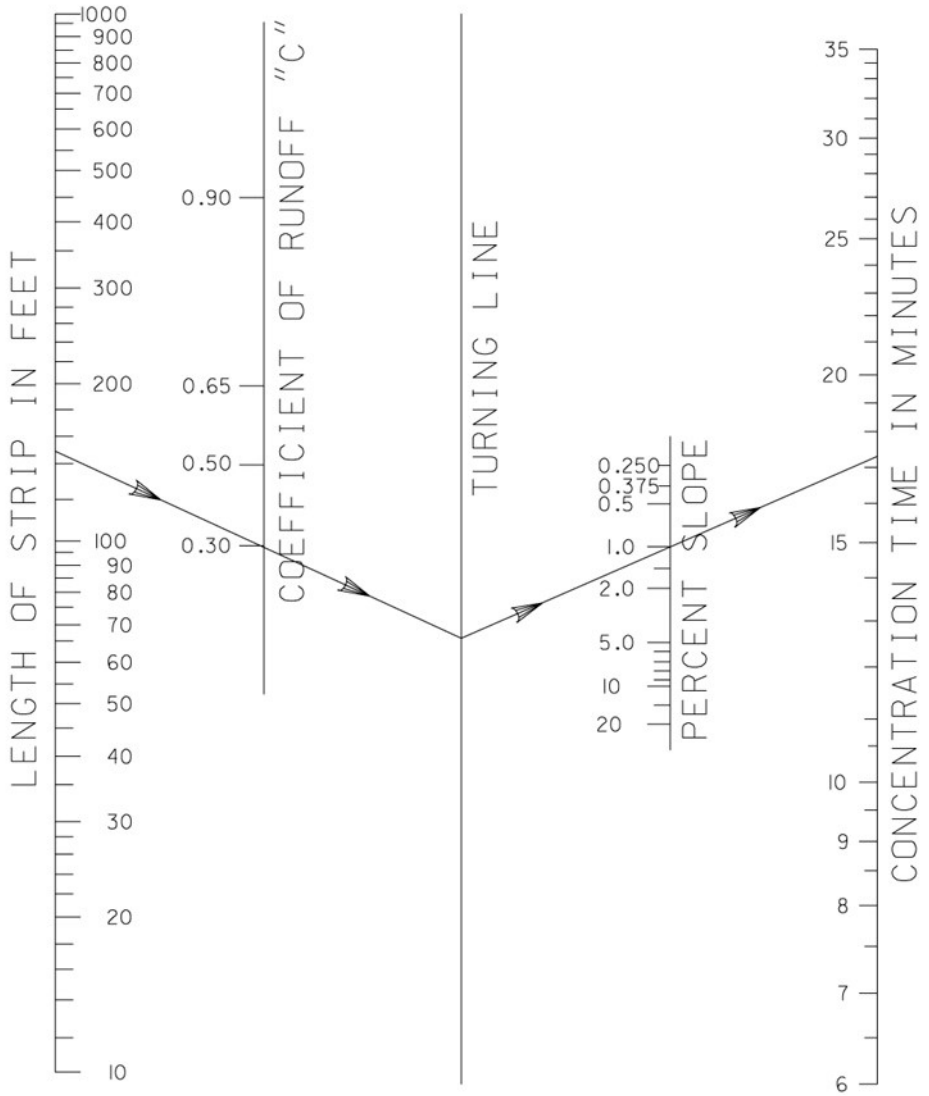
- The rational method assumes that the rainfall intensity, i, is uniform over the entire watershed during the entire storm duration. The maximum runoff rate occurs when the rainfall lasts as long, or longer, than the time of concentration. Refer to Table 2-2 for rainfall intensities in Trumbull County.

TABLE 2-2: RAINFALL INTENSITY (i) FOR TRUMBULL COUNTY						
			Storm Event			
TIME OF CONCENTRATION (minutes)	2 YR (in/hr)	5 YR (in/hr)	10YR (in/hr)	25YR (in/hr)	50YR (in/hr)	100YR (in/hr)
5	4.79	5.61	6.22	7.02	7.61	8.17
6	4.51	5.31	5.91	6.69	7.25	7.79
7	4.27	5.05	5.63	6.38	6.93	7.45
8	4.05	4.81	5.38	6.11	6.64	7.15
9	3.86	4.60	5.15	5.86	6.37	6.87
10	3.68	4.41	4.94	5.63	6.13	6.61
11	3.52	4.23	4.75	5.42	5.91	6.38
12	3.38	4.07	4.58	5.23	5.71	6.17
13	3.25	3.92	4.42	5.05	5.52	5.97
14	3.12	3.78	4.27	4.89	5.34	5.78
15	3.01	3.65	4.13	4.74	5.18	5.61
16	2.91	3.53	4.00	4.59	5.03	5.45
17	2.81	3.42	3.88	4.46	4.89	5.30
18	2.72	3.32	3.77	4.34	4.75	5.16
19	2.64	3.22	3.66	4.22	4.63	5.03
20	2.56	3.13	3.56	4.11	4.51	4.90
21	2.49	3.05	3.47	4.00	4.40	4.78
22	2.42	2.96	3.38	3.90	4.29	4.67
23	2.35	2.89	3.29	3.81	4.19	4.57
24	2.29	2.82	3.22	3.72	4.10	4.47
25	2.23	2.75	3.14	3.64	4.01	4.37
26	2.18	2.68	3.07	3.56	3.92	4.28
27	2.13	2.62	3.00	3.48	3.84	4.19
28	2.08	2.56	2.94	3.41	3.76	4.11
29	2.03	2.51	2.87	3.34	3.69	4.03
30	1.99	2.46	2.81	3.27	3.62	3.96
35	1.79	2.22	2.55	2.98	3.30	3.63
40	1.63	2.03	2.34	2.74	3.05	3.35
45	1.50	1.88	2.16	2.54	2.83	3.12
50	1.39	1.74	2.01	2.37	2.65	2.92
55	1.30	1.63	1.88	2.23	2.49	2.75
60	1.22	1.53	1.77	2.10	2.35	2.61
65	1.15	1.44	1.67	1.98	2.23	2.47
70	1.08	1.36	1.59	1.88	2.12	2.36
80	0.98	1.24	1.44	1.71	1.93	2.16
90	0.89	1.13	1.32	1.58	1.78	1.99
100	0.82	1.04	1.22	1.46	1.66	1.86
110	0.76	0.97	1.13	1.36	1.55	1.74
120	0.71	0.90	1.06	1.28	1.45	1.64
140	0.63	0.80	0.94	1.14	1.30	1.47
	From ODOT L&D Manual Volume 2, 1101-2, Area A					

- The time of concentration, Tc, is the time required for the runoff from the most remote part of the watershed to reach the point under design. The Tc for small watersheds (overland travel distance is less than 1,000 feet) can be determined using Figure 2-1. Once the Tc is calculated, the rainfall intensity can be determined using Table 2-2.

Note: Peak runoff rates as determined using the rational method cannot be added together to determine a resultant peak discharge rate from two or more separate watersheds. These are not cumulative runoff values.

FIGURE 2-1 Overland Flow Chart



Source: Ohio Department of Transportation *Location and Design Manual, Volume 2*, Figure 1101-1 (revised October 2020)

2.3 Simplified S.C.S. Graphical Peak Discharge Method

2.3.1 Methodology

Peak Discharge Method is applicable for estimating peak flows from storms of 24 hours in duration, where the drainage area consists of homogenous soil types and land-surface cover. This method shall be used to design storm culverts.

2.3.2 Equations and Concepts

Peak Discharge Equation:

$$Qp = q_u A Q F_p$$

Where: Qp = peak discharge (cfs)
q_u = unit peak discharge (cfs/mi^2/in.)
A = drainage area (mi2)
P = rainfall (in.)
Fp = pond and swamp adjustment factor (Table 2-10)

The input requirements for this method are as follows:

- P = 24-hour design rainfall (See Table 2-3)
- Hydrological Soil Group
- CN = Curve Number (See Table 2-4)
- Tc = time of concentration, hours (See Figure 2-2)
- Rainfall Distribution Type (SCS Type II)
- Storm Frequency

Table 2-3: 24-Hour Cumulative Rainfall, P

Frequency	24-Hour Rainfall (in.)
2-year	2.40
5-year	2.90
10-year	3.40
25-year	4.00
50-year	4.50
100-year	5.00

From NOAA Atlas 14, Vol. 2, Version 3

A. HYDROLOGIC SOIL GROUP CLASSIFICATION

SCS has developed a soil classification system that consists of four groups, identified as A, B, C, and D. Soils are classified into one of these categories based upon their minimum infiltration rate. Soil characteristics associated with each Hydrologic Soil Group are generally described as follows:

Group A: Soils with low runoff potential due to high infiltration rates, even when thoroughly wetted. These soils consist primarily of deep, well to excessively drained sands and gravels with high water transmission rates (0.30 in./hr.). Group A soils include sand, loamy sand, or sandy loam.

Group B: Soils with moderately high runoff potential due to slow infiltration rates when thoroughly wetted. These soils consist primarily of moderately deep to deep, and moderately well to well-drained soils. Group B soils have moderate water transmission rates (0.15-0.30 in./hr.) and include silt loam or loam.

Group C: Soils with moderately high runoff potential due to slow infiltration rates when thoroughly wetted. These soils typically have a layer near the surface that impedes the downward movement of water or soils. Group C soils have low water transmission rates (0.05-0.15 in./hr.) and include sandy clay loam.

Group D: Soils with high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material. Group D soils have very low water transmission rates (0-0.05 in./hr.) and include clay loam, silty clay loam, sandy clay, silty clay, or clay.

Refer to the latest version of the Soil Survey of Trumbull County to determine Soil Type and corresponding Hydrologic Group within project area.

B. RUNOFF CURVE NUMBER, CN

The soil group classification, cover type and the hydrologic condition are used to determine the runoff curve number, CN. The CN indicates the runoff potential of an area when the ground is not frozen. Table 2-4 provides the CN's for various land use types and soil groups.

"Good Condition" shall be used for determining the runoff curve number for pre-development.

The user is referred to TR-55 for additional cover types and general assumptions and limitations.

TABLE 2-4: RUNOFF CURVE NUMBERS

Runoff Curve Numbers, CN (1)					
Runoff curve number for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and Ią – 0.2S)					
LAND USE DESCRIPTION		**HYDROLOGIC SOIL GROUP**			
		A	B	C	D
Cultivated land: without conservation treatment		72	81	88	91
: with conversation treatment (1)		62	71	78	81
Pasture or range land: poor condition		68	79	86	89
: good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or forest land: thin stand, poor cover, no mulch		45	66	77	83
: Good cover (2)		25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc.		39	61	74	80
good condition: grass cover on 75% or more of the area		49	69	79	84
fair condition: grass cover on 50% to 75% of the area (4)					
Commercial and business areas (85% impervious)		89	92	94	95
Industrial districts (72% impervious)		81	88	91	93
Residential (3)					
Average lot size	Average % Impervious				
1/8 acre or less	65	77	85	90	92
¼ acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved parking lots, roofs, driveways, etc.					
Streets and roads:					
paved with curbs and storm sewers (5)		98	98	98	98

[1] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.
[2] Good cover is protected from grazing and litter and brush cover soil.
[3] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.
[4] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.
[5] In some warmer climates of the country a curve number of 95 may be used.

Where watersheds, or sub-watershed areas, have various ground covers and hydrologic groups, a Weighted "CN" value shall be used. The following example illustrates how a Weighted "CN" value is calculated:

$$\text{Weighted Curve Number} = \sum(CxAx)/Atotal$$

C. TIME OF CONCENTRATION, Tc

The time of concentration is the sum of the time increments for each flow segment present in the Tc flow path, such as overland or sheet flow, shallow concentrated flow, and channel flow.

$$Tc = T_{\text{sheet flow}} + T_{\text{shallow concentrated flow}} + T_{\text{channel flow}}$$

These flow types are influenced by surface roughness, channel shape, flow patterns, and slope, and are discussed below:

a. Overland (sheet) flow is shallow flow over plane surfaces. For the purposes of determining time of concentration, overland flow usually exists in the upper reaches of the hydraulic flow path.

The kinematic solution to Manning's equation is used to compute Tc for overland sheet flow:

$$T_{\text{sheet flow}} = Tc = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}S^{0.4}}$$

Where:

n = Manning's (See Table 2-5)
L = flow length in feet (<300 feet) See Note
P_2 = 2 year/24-hour rainfall (inches)
S = average land slope, ft/ft

NOTE: Sheet flow can influence the peak discharge of small watersheds dramatically because the ratio of flow length to flow velocity is usually very high. Surface roughness, soil types, and slope will dictate the distance before sheet flow transitions into shallow concentrated flow. TR-55 stipulates that the maximum length of sheet flow is 300 feet. Many hydrologists and geologists will argue that, based on the definition of sheet flow that 100 to 150 feet is the maximum distance before the combination of quantity and velocity create shallow concentrated flow. In an urban application (usually a relatively small drainage area), the flow time associated with 300 feet of sheet flow will result in a disproportionately large segment of the total time of concentration for the watershed. This will result in a very slow overall Tc and may not be representative of the drainage area as a whole. As stated previously, the designer must be sure that the flow path chosen is not only representative of the drainage area, but also is the flow path for the significant portion of the total peak discharge.

TABLE 2-5: Surface Description – Manning's "n"

Surface Description 'n' Value	
Smooth Surfaces (Concrete, Asphalt, Gravel, or Bare Soil	0.011
Fallow (No Residue)	0.05
Cultivated Soils: Residue Cover < 20% Residue Cover > 20%	 0.06 0.17
Grass: Short Grass Prairie Dense Grasses(2) Bermuda grass	 0.15 0.24 0.41
Range (Natural)	0.13
Woods:(3) Light Underbrush Dense Underbrush	 0.40 0.80
1 The 'n' values are composite of information compiles by Engman(1986). 2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures. 3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow. *From 210-VI-TR-55, Second Edition, June 1986*	

b. Shallow Concentrated Flow usually begins where overland flow converges to form small rills or gullies. Shallow concentrated flow can exist in small manmade drainage ditches (paved and unpaved) and in curb and gutters. Figure 2-2 provides a graphical solution for shallow concentrated flow. The input information needed to solve for this flow segment is the land slope and the surface condition (paved or unpaved).

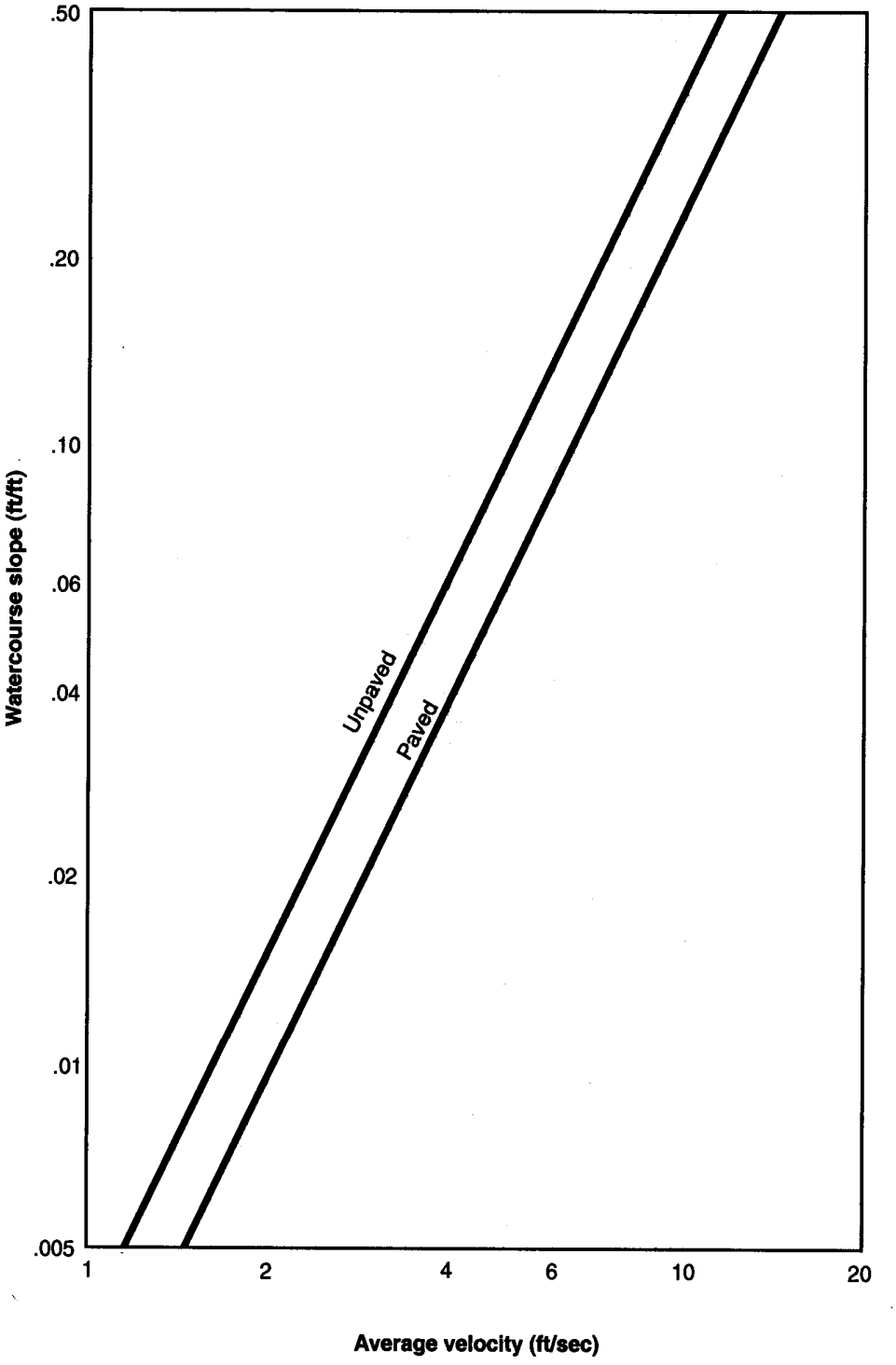
Once the average velocity (V) is determined, the Time of Travel for shallow concentrated flow can be determined using the following equation:

$$T_{\text{shallow concentrated flow}} = Tt = \frac{L}{3600V}$$

Where:

Tt = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours

FIGURE 2-2: AVERAGE VELOCITIES FOR ESTIMATING TRAVEL TIME FOR SHALLOW CONCENTRATED FLOW



Source: 210-VI-TR-55, Second Edition, June 1986

c. Channel flow occurs where flow converges in gullies, ditches or swales, and natural or manmade water conveyances (including storm drainage pipes). Channel flow is assumed to exist in perennial streams or wherever there is a well-defined channel cross-section. The Manning Equation is used for open channel flow and pipe flow, and usually assumes full flow or bank-full velocity. Manning coefficients can be found in Table 2-6a and 2-6b for pipe flow, Table 2-7 for constructed channels, and Table 2-8 for natural streams.

Manning's Equation is:

$$Q = AV = (1.49/n)AR\text{^}(2 / 3)\sqrt{S}$$

$V = (1.49R\text{^}(2 / 3)\sqrt{S})/n$	solved for velocity
$R = ((V\ n)/(1.49\ S\text{^}(1 / 2)\ ))\text{^}(3 / 2)$	solved for hydraulic radius
$S = ((V\ n)/(1.49\ R\text{^}(2 / 3)\ ))\text{^}2$	solved for hydraulic grade line
$\sum n = ((1.49\ R\text{^}(2 / 3)\ \sqrt{S})/V)$	solved for roughness coefficient

Where:

Q = Discharge (ft^3/s)
A = Cross-Sectional Area of Flow (ft^2)
V = average velocity (ft/s)
R = hydraulic radius (ft) and is equal to a/p_w
  a = cross sectional flow area (ft^2)
  p_w = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow

TABLE 2-6a: Manning's "n" – Smooth Lined Pipes

Manning's "n" for Pipe Flow	
Material*	**"n"**
Smooth lined 60" and under	0.015
Smooth lined, larger than 60"	0.013

Source: ODOT L&D Drainage Manual

*Factory values may be used if documentation is submitted.
*The Manning's "n" values in Table 2-6a and 2-6b apply to all smooth lined pipes, including concrete, vitrified clay, PVC or HDPE.

TABLE 2-6b: Manning's "n" – Corrugated Pipes

Manning's "n" for Pipe Flow									
	Annular	Helical							
Corrugations				12"	18"	24"	36"	48"	>60"
1 1/2x1/4									
2 2/3x1/2 in	0.024			0.015	0.015	0.016	0.019	0.020	0.021
3x1 in	0.027							0.023	0.024
6x2 in									0.033

TABLE 2-7: Manning's "n" for Constructed Channels

Lining Material	From	To
Concrete Lined	0.012	0.016
Cement Rubble	0.017	0.025
Earth, Straight and Uniform	0.017	0.022
Rock Cuts, Smooth and Uniform	0.025	0.033
Rock Cuts, Jagged and Irregular	0.035	0.045
Winding, Sluggish Canals	0.022	0.027
Dredged Earth Channels	0.025	0.030
Canals with Rough Stony Beds, Weeds on Earth Banks	0.025	0.035
Earth Bottom, Rubble Sides	0.028	0.033
Small Grass Channels:		
Long Grass – 13"	0.042	
Short Grass – 3"	0.034	

TABLE 2-8: Manning's "n" for Natural Stream Channels

Lining Material	From	To
1. Clean, Straight Bank, Full Stage, No Rifts or Deep Pools	0.025	0.030
2. Same as #1, but Some Weeds and Stones	0.030	0.035
3. Winding, Some Pools and Shoals, Clean	0.033	0.040
4. Same as #3, Lower Stages, More ineffective Slope and Sections	0.040	0.050
5. Same as #3, Some Weeds and Stones	0.035	0.045
6. Same as #4, Stone Sections	0.045	0.055
7. Sluggish River Reaches, Rather Weedy with Very Deep Pools	0.050	0.070
8. Very Weedy Reaches	0.075	0.125

Adapted from Handbook of Hydraulics, Sixth Edition, Brater & King

Once the average velocity (V) is determined, the Time of Travel for channel flow can be determined using the following equation:

$$T_{channel\ flow} = Tt = \frac{L}{3600\ V}$$

The following Worksheet 3 example shows how time of concentration is calculated. A blank Worksheet 3, taken from TR-55, Second Edition, June 1986, is included in the Appendix.

Again, the total Time of Concentration equals:

$$Tc = T_{sheet\ flow} + T_{shallow\ concentrated\ flow} + T_{channel\ flow}$$

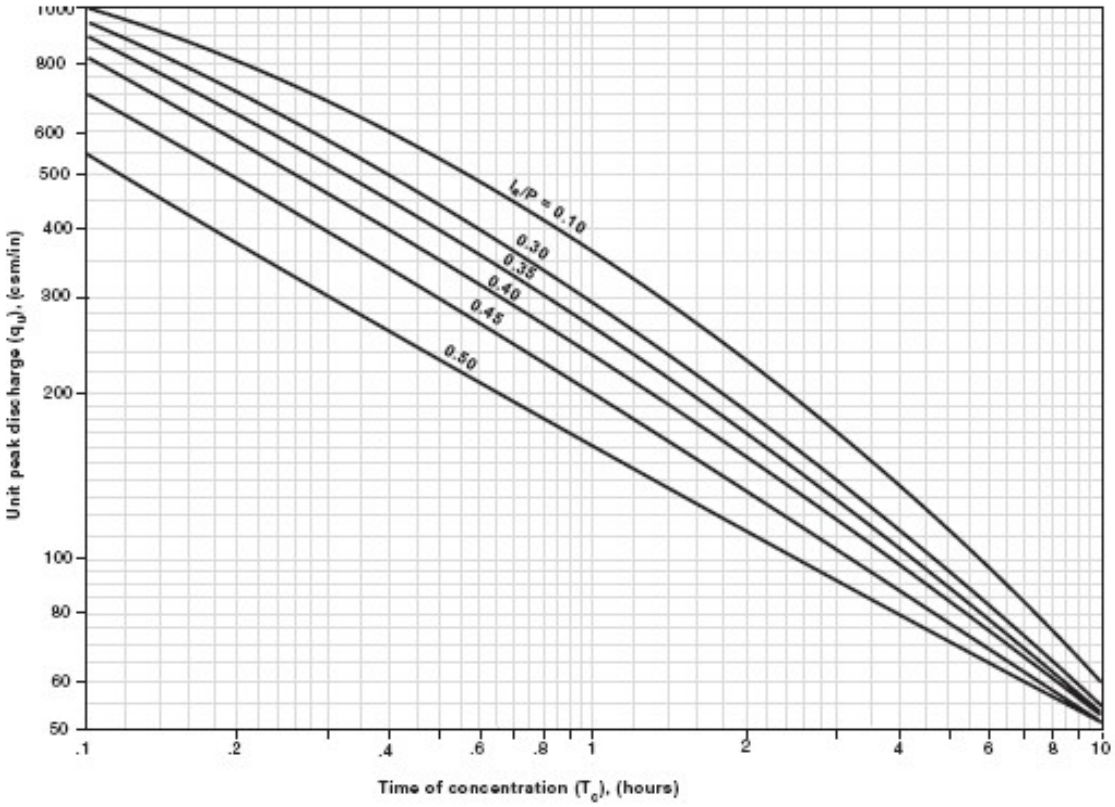
Initial abstraction (Ia) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. The Curve Number (CN) is used to determine the initial abstraction (Ia) from Table 2-9:

TABLE 2-9: Ia Values for Runoff Curve Numbers

Curve Number	Ia (in)		Curve Number	Ia (in)
40	3.000		70	0.857
41	2.878		71	0.817
42	2.762		72	0.778
43	2.651		73	0.740
44	2.545		74	0.703
45	2.444		75	0.667
46	2.348		76	0.632
47	2.255		77	0.597
48	2.167		78	0.564
49	2.082		79	0.532
50	2.000		80	0.500
51	1.922		81	0.469
52	1.846		82	0.439
53	1.774		83	0.410
54	1.704		84	0.381
55	1.636		85	0.353
56	1.571		86	0.326
57	1.509		87	0.299
58	1.448		88	0.273
59	1.390		89	0.247
60	1.333		90	0.222
61	1.279		91	0.198
62	1.226		92	0.174
63	1.175		93	0.151
64	1.125		94	0.128
65	1.077		95	0.105
66	1.030		96	0.083
67	0.985		97	0.062
68	0.941			
69	0.899			

The unit peak discharge, qu, is calculated using Tc and Ia/P with Figure 2-3.

FIGURE 2-3: SCS Type II Unit Peak Discharge Graph



The Fp factor is an adjustment for pond and swamp areas that are spread throughout the watershed. It can only be applied for ponds or swamps that are not in the Tc path.

TABLE 2-10: Adjustment Factors for Pond and Swamp Areas, Fp

Pond & Swamp Areas (%)	Fp
0.0	1.00
0.2	0.97
1.0	0.87
3.0	0.75
5.0	0.72

2.3.3 Design Procedure

Step 1: The 24-hour rainfall depth (P) is determined from Table 2-3 for the selected storm frequency.

Step 2: The runoff curve number (CN) is estimated from Table 2-4.

Step 3: The CN value is used to determine the initial abstraction (Ia) from Table 2-9. The ratio (Ia/P) is then computed.

Step 4: The watershed time of concentration is computed using and is used with the ratio Ia/P to obtain the unit peak discharge (qu) from Figure 2-3.

Step 5: The pond and swamp adjustment factor is estimated from Table 2-10.

Step 6: The peak runoff rate is computed using the Peak Discharge Equation.
Qp = q*u*APFp

The following example shows how the peak runoff rate is calculated.

Example:
Given:
Area (A) = 5 acres = 5/640 = 0.0078 sq mi
Storm Frequency = 10-year
CN = 85
Ia = 0.353
Tc = 0.6 hr.
Pond & Swamp area = 0%

Solution:
Step 1: P=3.40 inches
Step 2: CN=85
Step 3: Ia/P = 0.353/3.60 = 0.098
Step 4: qu = 510
Step 5: F=1.00
Step 6: Qp = 500*0.0078*3.40*1.00 = 13.26 cfs use 13 cfs

2.4 The S.C.S. Unit Hydrograph Method

2.4.1 Methodology

The SCS Unit Hydrograph Method is used to calculate the peak discharge and can be applied to estimate a hydrograph when detention facilities are designed, and pond routing is necessary. It may also be used to design culverts. This method is used to design stormwater management facilities discussed later in this manual. The 24-hour cumulative rainfall amount shown in Table 2-3 shall be used as well as the runoff curve numbers shown in Table 2-4. The Time of Concentration shall be determined as described in 2.3.2 C. This method shall be the basis for the Stormwater Management Report and is also used to calculate the Critical Storm.

2.4.2 Resources

The designer is referred to the procedures outlined by the SCS in Technical Release 55 "Urban Hydrology for Small Watersheds" (TR-55). Hydrologic computer models are made available for download at the USDA Natural Resources Conservation Service (NRCS) website.

http://www.wcc.nrcs.usda.gov/hydro/hydro-tools-models-wintr55.html

Other accepted hydrologic computer models for performing SCS hydrograph calculations include:

- HydroCAD Stormwater Modeling
- TR-20 (February 1992)
- TR-20 Win v. 1.00.002 (January 2005)
- TR-55 (June 1986)
- WinTR-SS v. 1.0.08 (January 2005)
- HEC-1 4.0.1 and up (May 1991)
- HEC-NMS 1.1 and up (March 1998)
- SWMM (Runoff) 4.30 (May 1994) and 4.31 (January 1997)
- SWMM 5 Version 5.0.005 and up (May 2005)
- Pond Pack v. 8 and up (May 2002)
- XP-SWMM 8.52 and up
- XP-Storm 10.0 (May 2006)

List adopted from FEMA Nationally Accepted Models Meeting the Minimum Requirement of the NFIP.

The use of the Rational Method for volume calculations is not allowed.

3.0 STORM DRAINAGE DESIGN AND STORMWATER MANAGEMENT

3.1 Overview

Proposed development sites and existing improvements shall be protected from flood damage and excess ponding of water, springs, and other surface waters. The design and construction of drainage facilities within the proposed development shall be such that runoff passing through the development will be carried through and away from the site without causing flood damage to any structure. Additionally, these waters must not adversely affect the proposed sanitary sewer system or individual sewage systems. Runoff entering the proposed development shall be received and discharged from the site at the locations and, as nearly as possible, in the same manner that existed prior to construction.

The drainage system layout should be made in accordance with the urban drainage objectives, following the natural topography as closely as possible. Design of drainage systems shall not cause runoff to be diverted from one watershed to another. Existing natural drainage paths and watercourses such as streams and creeks should be incorporated into the storm drainage system.

3.1.1 General Provisions

Development shall not:

- Result in any new or additional expense to any person other than the Applicant for flood protection or for lost environmental stream uses and functions; nor
- Increase flood elevations or decrease flood conveyance capacity upstream or downstream of the area under the ownership or control of the Applicant; nor
- Pose any new or additional increase in flood velocity or impairment of the hydrologic and hydraulic functions of streams or floodplains; nor
- Unreasonably or unnecessarily degrade surface or ground water quality; nor
- Violate any provision of this manual either during or after construction

Storm water and erosion and sediment control facilities shall be constructed at the beginning of all construction projects and prior to site grading. Considerations for timing of erosion and sediment control BMP's include the ability to convey, pond and treat on-site sediment laden water discharges prior to major earthwork activities.

100-year flood elevations shall be identified for all drainage paths within the project limits. All usable space in new buildings or added to existing buildings shall be elevated at least one foot above the adjacent base flood elevation to prevent the entry of surface stormwater.

All parcels constructed on fill material in or adjacent to the 100-year inundation area for a drainage path shall be graded in accordance with the recommendations in FEMA Technical Bulletin 10-01.

3.1.2 Drainage Design Criteria

This section will establish the criteria for the design of stormwater conveyance systems for a proposed public street and for commercial and industrial development in the unincorporated areas of Trumbull County. The conveyance system shall include paved surfaces, curbs and gutters, pipes and ditches used to collect and move stormwater to a stormwater management facility and or an approved outlet discharge as applicable. For most projects the conveyance system will discharge into one or more stormwater management facilities that are designed to meet the required detention volume and discharge rates for flood control and water quality volume as required by Ohio EPA. The criteria for the design of stormwater management facilities, also referred to as Post Construction BMPs are presented later in this manual.

The Ohio Department of Transportation Location and Design Manual – Volume 2 shall be used as a reference to design stormwater conveyance systems in Trumbull County. The Location and Design Manual is an extensive reference, and not all the manual is applicable to Trumbull County drainage design. The engineer/designer should become familiar with the entire L&D manual. Certain sections of the L&D manual will be referred to when applicable to specific tasks discussed herein.

3.2 Minor System Design

The minor system shall be designed in accordance with the Ohio Department of Transportation Location and Design Manual – Volume 2 section 1100 Drainage Design Procedures along with the procedures shown in this manual. The conveyance system shall be sized according to section 1104.3 Storm Sewer Design Criteria with the 10-year storm for Just Full Capacity and a 25-year storm for the Hydraulic Grade line. Storm Sewer Calculations shall be provided in the format shown on the STORM SEWER COMPUTATION SHEET provided in this manual. Computer software (CDSS Design Software) is available for these calculations on the OHE Hydraulic Software and Design Resources web page at the following address:
https://www.transportation.ohio.gov/working/engineering/hydraulic/design-resources/cdss

3.2.1 Layout of Storm Sewers

The layout of the storm system for a public street shall place the storm and sanitary sewers on opposite sides of the roadways and within the road right of way where practical. Where opposite side construction is not practical, every effort shall be made to separate the storm and sanitary sewers by six feet (6') barrel to barrel.

The minimum size of all storm sewers, excluding connections and yard drains, shall be 12 inches in diameter. Lateral storm connections to building sites shall be minimum of 6 inches in diameter.

Storm sewers shall have a minimum flowing full velocity of 3 feet per second and a maximum velocity of 12 feet per second.

For sewers sized less than 36 inches in diameter, manholes shall be spaced at not over 400 feet. For sewers 36 inches through 60 inches in diameter, manholes shall be spaced at not over 600 feet. In sewers larger than 60 inches in diameter, manhole spacing shall not exceed 1,000 feet.

Design details must follow ODOT Design Standards as minimum criteria.

All easements for all storm drainage systems shall be 20 feet wide, with the pipe or ditch located in the center of the 30 feet.

3.2.2 Inlet Types and Locations

Storm inlet structures are defined in ODOT CMS and ODOT Standard Details. The location of these structures is as follows:

- Place upstream of all intersections, bridges, pedestrian ramps, commercial drive aprons, intersection return radii, and curb termini.
- Structures should be placed 10' off drive aprons, intersection return radii, pedestrian ramps, or curb termini when practicable.
- Place structure in pavement sags.
- Flank catch basin in sag on both upstream directions at 0.2 feet above the flow line of the inlet of the sag catch basin when practicable.

3.2.3 Storm Sewer Requirements

The design storm frequencies for each type of development are as follows:

- Residential/Subdivisions 10 Year Frequency
- Multifamily 10 Year Frequency
- Schools 10 Year Frequency
- Industrial/Commercial 10 Year Frequency
- Major Urban Business Area 10 Year Frequency

The hydraulic grade line shall be determined for the 25-year storm event. The hydraulic grade line shall be below the grate and/or cover of all structures. Note: The hydraulic grade line should never be below the normal depth of flow in the conduit. If it is, then use the normal depth of flow elevation as the hydraulic grade line elevation.

3.2.4 Storm Sewer Design

A drainage map delineating each sub-basin area and labeled accordingly shall be prepared. The drainage map shall show the proposed improvements, contours and storm sewer system. Post-construction BMP types shall be identified on the map.

The rational method as described in Section 2.2 shall be used to determine the contributing inflow into the system. Use 15 minutes as the minimum Tc to the first structure.

The Storm Sewer Computation Sheet shall be used and completed to correctly size the storm sewers. A blank Storm Sewer Computation Sheet is included in the appendix.

Regardless of the type of smooth-lined pipe the Manning's "n" value shall be as shown in Table 2-6a. Values for Corrugated Metal Pipe (CMP) are shown in Table 2-6b.

The increased values are recommended for sewers to compensate for minor head losses incurred at catch basins, inlets and manholes located in a storm sewer system.

3.2.5 Storm Sewer Computation Sheet – Design Procedures

Column 1: Structure number. Assigned by the designer. Usually numbered from lowest elevation to highest elevation. The main line trunk is numbered first and then the laterals.

Column 2: Station of the structure as referenced from the centerline or baseline.

Column 3: Right, Left or on the Centerline.

Column 4: Drainage area for the referenced structure.

Column 5: Total drainage area. This number is found by summing the ΔA from the current structure to the ΣA directly upstream of it.

Column 6: Time of concentration to the current structure. In some cases, this time may be calculated based upon the length of the conduit and the velocity of the flow if there is no discharge into the next adjacent structure.

Column 7: Total time of concentration. This number is found by summing the individual time of concentration from the current structure (Column 6) to the structure directly upstream of it.

Column 8: The rainfall intensity based upon the design year storm at time equal to ΣT (Column 7).

Column 9: The rainfall intensity based upon the hydraulic grade year storm. This intensity is based upon the greatest time of concentration to the outlet. It is used for the entire upstream storm sewer system. Do not complete until the greatest Tc is known. This intensity is used for the entire storm upstream.

Column 10: The weighted coefficient for the watershed.

Column 11: The multiplication of the drainage area for the structure and the weighted coefficient for the watershed (column 4 x column 10).

Column 12: Summation of the ΔCA value of the current structure added to the upstream ΣCA value.

Column 13: The design discharge found by the multiplication of the ΣCA and the design intensity (column 12 x column 8).

Column 14: The design discharge found by the multiplication of the ΣCA and the hydraulic grade intensity (column 12 x column 9). Do not complete until #9 is determined.

Column 15: The diameter of the conduit.

Column 16: The length of the conduit.

Column 17: The slope of the conduit.

Column 18: The invert of the incoming conduit to the current structure.

Column 19: The invert of the outgoing conduit from the structure.

Column 20: The velocity based upon the Manning's "just full equation". (See notes)

Column 21: The discharge based upon the Manning's "just full equation".

Column 22: The hydraulic friction slope. (Sf)

Column 23: The head loss (H) due to friction in the conduit. H=L*Sf

Column 24: The elevation of the hydraulic grade line. Calculated by adding the head loss to the hydraulic grade elevation of the downstream structure. At the outlet the hydraulic grade elevation is either the water surface, or it is calculated by the (critical depth+diameter)/2, whichever is greater.

Column 25: The elevation of the structure grate or cover.

Column 26: The difference of the structure grate or cover elevation and the hydraulic grade elevation (column 25 – column 24).

Notes:

- The starting elevation for the hydraulic grade line determination is the higher of either: the downstream tailwater channel water surface elevation or (dc+D)/2 at the system outlet as explained in ODOT L&D manual Section 1105.6.1. Use the same intensity (i) in the Rational Equation Q = CiA to determine the check discharge for all sewer runs as that calculated for the last, or downstream run, in a continuous sewer system. The hydraulic grade line must not exceed the following:
  1. 12 inches below the near edge of pavement for sections without curb.
  2. The elevation of a curb opening inlet or grate elevation of a pavement catch basin

A blank Storm Sewer Computation Sheet, taken from the ODOT Location and Design Manual, is included in the Appendix.

3.2.6 Culvert Design

Culverts shall be designed to easily convey the 10-year design storm. As a check, the headwater depth shall not be within 12" of the final pavement (crown) elevation for the 25-year storm. Culverts shall be designed in accordance with the Ohio Department of Transportation Location and Design Manual – Volume 2 section 1105.4.

Hydraulic analysis of all culverts shall be performed per the following report:

Federal Highway Administration, Report No. FHWA-IP-85-15, Hydraulic Design Series No. 5, "Hydraulic Design of Highway Culverts", September 1985.

A copy of the report can be obtained at:

https://rosap.ntl.bts.gov/view/dot/54219

A culvert design form LD-42 will be required for submittal. A blank form is included in the appendix.

Computer programs such as FHWA's "HY-8" or ODOT's "CDDS", "HYDRA", software packages may be used. HY-8 and CDDS can be downloaded at the following websites:

FHWA "HY-8"
https://www.fhwa.dot.gov/engineering/hydraulics/culverthyd/culvert.cfm

ODOT "CDSS"
https://www.transportation.ohio.gov/working/engineering/hydraulic/design-resources/cdss

3.2.7 Major System Design

The major drainage system will come into operation once the minor system's capacity is exceeded during storm events larger than the minor system's design storms. Thus, an overflow system must be planned to ensure that the storm runoff will be directed to the storm water management facility(s). The major drainage system may consist of open channels (including roadway, parking lot, swales, etc.), an over designed storm sewer system, or combinations of both. For the purposes of this manual, the 100-year storm event will serve as the design storm of record for the major drainage systems. A map of the major drainage system shall be included in the submittal of the construction drawings. Calculations to support the major drainage system shall be included in the Stormwater Management Report.

3.3 Storm Water Management Facilities Design

3.3.1 Overview

This section discusses the general design procedures for designing facilities to provide standard detention of storm water runoff to meet both water quality and quantity requirements.

Storm water management facilities can be classified as surface detention, underground detention, extended dry detention or wet retention. Some facilities include one or more types of storage.

The design procedures for all storm water management facilities are the same when they include a permanent pool of water. In that latter case, the permanent pool elevation is taken as the "bottom" of storage and is treated as if it were a solid basin bottom for routing purposes.

A stage-discharge curve defines the relationship between the depth of water and the discharge or outflow from a storage facility. A typical storage facility has three outlets or discharges: a water quality outlet, a principal outlet and an emergency spillway. The purpose of the water quality outlet is to capture and treat the most frequent rainfall events in Ohio for pollutants associated with storm water discharges. Rainfall of approximately 0.90-inches encompasses approximately 85% of all events each year. Water quality outlet design variations and techniques are plentiful but typically incorporate an orifice or perforated outlet designed to release the retained water volume within 24 to 48 hours. The principal outlet is usually designed with a capacity sufficient to convey the design flows without allowing flow to enter the emergency spillway. A pipe culvert, weir, or other appropriate outlet can be used for the principal spillway or outlet.

The emergency spillway provides a bypass for floodwater during a flood that exceeds the design capacity of the principal outlet and as an outlet should the principal outlet become clogged. The stage-discharge curve should consider the discharge characteristics of both the principal spillway and the emergency spillway.

NOTE: The location of structural storm water controls is very important as it relates to the effectiveness of these facilities to control downstream impacts. In addition, multiple storage facilities located in the same drainage basin will affect the timing of the runoff through the conveyance system, which could decrease or increase flood peaks in different downstream locations. Therefore, a downstream peak flow analysis should be performed as part of the storage facility design process. **A Professional Engineer shall certify that the receiving watercourse has adequate capacity to convey the runoff from the project site.**

In multi-purpose multi-stage facilities such as storm water ponds, the design of storage must be integrated with the overall design for water quality treatment objectives. See section 3.4.2 for further guidance and criteria for the design of structural storm water controls.

Storage facilities shall be designed and constructed with the following characteristics:

- Water surface depths one feet above the base flood elevation will not damage the storage facility.
- The storage facilities shall be accessible and easily maintained. All facilities shall have ingress/egress as required for maintenance access.
- All outlets shall function without human intervention or outside power and shall operate with minimum maintenance.
- Outlet works shall have an outlet pipe of minimum 12 inches diameter.
- Control orifices shall incorporate anti-clogging measures when the orifice measures less than 4 inches in the shortest direction.
- Storage facilities shall minimize impacts of stormwater runoff on water quality by incorporating best management practices.

- Storage facilities shall not be located within 1) regulatory floodplain 2) the area inundated by the base flood or other major stormwater systems with tributary drainage area greater than one square mile 3) a stream channel unless authorized by all governing regulatory agencies.

- Developments with storage facilities that have off-site flow tributary to the site shall provide storage sufficient to accommodate runoff from the off-site tributary watershed and the site or shall store the site runoff and convey off-site flows through the site around the storage facility.

- When the ratio of off-site tributary area to onsite tributary area is greater than five, the off-site runoff shall be conveyed through the site and around the storage facility.

3.3.2 Post-Construction Storm Water Quantity Control Method

The increased peak rates and volumes of storm water runoff shall be controlled to reduce sediment laden pollution from entering public waterways and protect watercourses and water bodies from the effects of erosion caused by accelerated storm water runoff from developed or developing areas.

For construction activities that will disturb one or more acres of land or will disturb less than one acre but is part of a larger common plan of development or sale which will disturb one or more acres of land, the post-construction storm water control methods chosen shall meet the following criteria:

1. The peak discharge rate of runoff from the critical storm and all more frequent storms occurring under post-development conditions shall not exceed the peak discharge rate of runoff from a 2-year frequency, 24-hour storm occurring on the same development drainage area under pre-development conditions.

2. Storms of less frequent occurrence (longer return periods) than the critical storm up to the 100-year storm shall have peak runoff discharge rates no greater than the peak runoff rates of the pre-developed 10-year storm.

3. The critical storm for a specific development drainage area is determined as follows:

    a. Use SCS TR-55 or other appropriate and approved hydrologic simulation model to determine the total volume of runoff from a 2-year, 24-hour storm occurring on the development drainage area before and after development. Include in your calculations the assumptions used for full build out of the proposed condition. Curve numbers for pre-developed or improvements or expansion to a developed condition must reflect the average type of land use over the past 10 years and not only the current land use. To account for unknown future cosmetic improvements to a construction site, an assumption of an impervious surface such as asphalt or concrete must be utilized for all parking areas or driveways, even if stone/gravel is to be utilized in construction.

    For sites which are currently developed and are scheduled to be redeveloped, the pre-developed condition shall be defined as 100% of the site as grassland for critical storm and volume storage calculations.

    b. From the volumes determined in (a) above, determine the percent increase in volume of runoff due to development. Using this percentage, select the critical storm from Table 3-1.

TABLE 3-1

Critical Storm Determination Table

IF THE PERCENTAGE OF INCREASE IN VOLUME OF RUNOFF IS:		THE CRITICAL STORM WILL BE:
EQUAL TO OR GREATER THAN:	LESS THAN:	
0	20	2-year
20	50	5-year
50	100	10-year
100	250	25-year
250	500	50-year
500		100-year

For example, if the percent increase between the pre-development and post-development runoff volume for a 2-year storm is 35%, the critical storm is a 5-year storm. The peak discharge rate of runoff for all storms up to this frequency shall be controlled so as not to exceed the peak discharge rate from the 2-year frequency storm under pre-development conditions in the development drainage area. The post-development runoff from all less frequent storms need only be controlled to meet the pre-development peak discharge rate for the 10-year storm.

In no case shall the post developed runoff exceed the pre-developed runoff condition for an equivalent storm event.

3.3.3 Post-Construction Storm Water Quality Control Method

The structural BMP selected shall be sized for protection of watercourses from erosion (quantity) and include water quality volumes for controlling sediment volumes. The following method is taken directly from OEPA's CGP:

- WQv = the volume of storm water runoff which must be captured and treated prior to discharge from the developed site after construction is complete. Equates to the volume of runoff from a 0.90-inch rain event.

- WQv determined according to one of the two following methods:
  - Through a site hydrologic study approved by the Trumbull County Engineers Office that uses continuous hydrologic simulation and local long-term hourly precipitation records or,
  - Using the following equation: $WQv = Rv * P * A / 12$ (Equation 1)

Where:
WQv = water quality volume in acre-feet
Rv = the volumetric runoff coefficient calculated using equation 2

P = 0.90 inch precipitation depth

A = area draining into the BMP in acres

$Rv = 0.05 + 0.9i$ (Equation 2)

where i = fraction of post-construction impervious surface

An additional volume equal to 20 percent of the WQv shall be incorporated into the BMP for sediment storage. Ohio EPA recommends BMPs be designed according to the methodology described in the most current edition of the Rainwater and Land Development manual or in another design manual acceptable for use by Ohio EPA.

- BMP's shall be designed such that the drain time is long enough to provide settlement treatment, but short enough to provide storage available for successive rain events as described in Table 3-2 below.

Table 3-2:

Extended Detention Post-Construction Practices with Minimum Drain Times

Best Management Practice	Minimum Drain Time of WQv
Dry Extended Detention Basin[1,3,4]	48 hours
Wet Extended Detention Basin [1,2,3]	24 hours
Constructed Extended Detention Wetland [1,3]	24 hours
Permeable Pavement- Extended Detention[1]	24 hours
Underground Storage- Extended Detention[1,5]	24 hours
Sand & Other Media Filtration-Extended Detention[1,6]	24 hours

Notes:

1.The outlet structure shall not discharge more than the first half of the WQv in less than one-third of the drain time.

2. Provide a permanent pool with a minimum volume equal to the WQv and an extended detention volume above the permanent pool equal to 1.0 x WQv.

3. An additional volume equal to 20 percent of the WQv shall be incorporated into the BMP for sediment storage.

4. Dry basins must include a forebay and a micro pool each sized at a minimum of 0.1 x WQv and a protected outlet or include acceptable pretreatment and a protected outlet.

5. Underground storage must have pretreatment for removal of suspended sediments included in the design and documented in the SWP3. This pretreatment shall concentrate sediment in a location where it can be readily removed. For non-infiltrating, underground extended detention systems, pretreatment shall be 50% effective at capturing total suspended solids according to the testing protocol established in the Alternative Post Construction BMP Testing Protocol.

6. The WQv ponding area shall be completely empty between 24 and 72 hours

Infiltration Post-Construction Practices with Maximum Drain Times

Infiltration Practices	Maximum Drain Time of WQv
Bioretention Area / Cell [1,2,3]	24 hours
Infiltration Basin[2,3]	24 hours
Infiltration Trench[3,4]	48 hours
Permeable Pavement - Infiltration[3]	48 hours
Underground Storage - Infiltration[3,4,5]	48 hours

Notes:

1. Bioretention soil media shall have a permeability of approximately 1 – 4 in/hr. Meeting the soil media specifications in the Rainwater and Land Development manual is considered compliant with this requirement. Bioretention cells must have underdrains unless in-situ conditions allow for the WQv (surface ponding) plus the bioretention soil (to a depth of 24 inches) to drain completely within 48 hours.

2. Infiltrating practices with the WQv stored aboveground (bioretention, infiltration basin) shall fully drain the WQv within 24 hours to minimize nuisance effects of standing water and to promote vigorous communities of appropriate vegetation.

3. The SWP3 shall demonstrate the design infiltration rate values are derived from site specific measurements obtained thru field tests of the in-situ soil for practices designed to infiltrate the water WQv.

4. Subsurface practices designed to fully infiltrate the WQv (infiltration trench, permeable pavement with infiltration, underground storage with infiltration) shall empty within 48 hours to recover storage for subsequent storm events.

5. Underground storage systems with infiltration must have adequate pretreatment of suspended sediments included in the design and documented in the SWP3 to minimize clogging of the infiltrating surface. Pretreatment shall concentrate sediment in a location where it can be readily removed. Examples include media filters situated upstream of the storage or other suitable alternative approved by Ohio EPA. For infiltrating underground systems, pretreatment shall be 80% effective at capturing total suspended solids according to the testing protocol established in the OEPA Alternative Post Construction BMP Testing Protocol.

Previously Developed Areas

OEPA encourages the redevelopment of untreated impervious areas through a reduction of the WQv treatment requirement. For an untreated previously developed area, one or a combination of the following two conditions shall be met:

- A 20 percent net reduction of the site's volumetric runoff coefficient through impervious area reduction with soil restoration or replacing impervious roof area with green roof area (for these purposes green roofs shall be considered pervious surface or
- Treatment of a portion of the site using a practice meeting Table 3-2 criteria for which the WQv (see Equation 1) equals or exceeds the WQv_R determined with the following equation:

$WQv_R = P*A*[(Rv_1*0.2) + (Rv_2 – Rv_1)]/12$
Where:
WQv_R = Redevelopment Water Quality Volume in acre-feet
P = 0.90 inches
A = disturbed area in acres
Rv_1 = volumetric runoff coefficient for existing (current site) conditions within the disturbed area
Rv_2 = volumetric runoff coefficient for proposed (post-construction site) conditions within the disturbed area

and it is located to treat impervious areas most likely to generate the highest pollutant load, such as parking lots or roadways.

This section does not apply to previous development that was obligated to obtain CGP coverage and provide management of the WQv under previous generations of the OHC000006 permit (i.e., after April 12, 2003).

3.3.4 Recommended Post-Construction Best Management Practices

OEPA has identified structural BMP's to be considered and incorporated into storm water management for site development. The Trumbull County Engineer and Trumbull County Soil and Water Conservation District will also consider non-structural practices in combination with these structural practices in reviewing site plans requiring supporting documentation of non-structural BMP's estimated pollutant removal information, map of BMP locations on-site, description of BMP type, and frequency with which the BMP will be performed or maintained. Examples of non-structural BMP's include: site impervious area sweeping, natural buffers, creative mowing practice, etc. The post-construction structural BMP's (as presented in the CGP) are addressed below:

1. **Infiltration Methods** - General principle is that treatment occurs through the interaction of storm water runoff and a filtering substrate usually soil, sand or gravel. These could be trench or basin type structures. The captured treated storm water is discharged into the ground water rather than surface water. Suggested design considerations include quantity and velocity of runoff, slopes, site locations – these BMP's potentially require high maintenance and could be expensive to operate.

2. **Extended Detention Basins (Dry)** – General principal is that treatment occurs when storm water runoff is captured during rain events and is slowly released over time. These could be above or below ground type structures. Suggested design considerations include size of drainage area in sizing of basin, which may impact site layout considerations. Sizing needs to account for both quantity and quality factors.

   A. A dry detention pond is designed to temporarily detain runoff during storm events. Plans shall be designed for the following parameters and physical constraints:

Design Parameters

- Groundwater
- Two Stage Design
- Extended Detention Control Device (orifice)
- Low Flow Channel
- Shape (Length vs. Width)
- Side Slopes
- Pond Buffer
- Benches
- Freeboard
- Outlet Control Structure
- Emergency Spillway
- Inlet Headwalls
- Earthen Dams/Embankments
- Accessibility/Security
- Maintenance – Sediment Removal
- Maintenance Easements

Physical Constraints

Drainage Area Size
Elevation Difference/Fall
Groundwater Consideration
Soil Types
Local Climate
Precipitation Volume
Land Cost

3. **Retention Basin (Wet)** – The general principal is that treatment occurs in the permanent pool portion of the basin and pollutants settle out during the hold times, then runoff is released over a period of time to allow for settlement. Suggested design considerations include drainage area size, which influences basin size, which in turn could impact site layout. There are also health considerations (i.e. West Nile virus), perimeter protection needs (fencing, maintenance access gates, ingress/egress, easements), and maintenance issues.

4. **Constructed Wetlands** –Engineered wetlands that utilize natural processes involving wetland vegetation, soils, and their associated microbial assemblages to assist, at least

partially, in treating an effluent or other water source. Suggested design considerations can include large surface areas, limiting site layouts, and additional permitting.

5. **Bio-retention** –Bioretention practices are stormwater basins that utilize a soil media, mulch and vegetation to treat runoff and improve water quality for small drainage areas. Bioretention practices provide effective treatment for many runoff quality problems including reduction of total suspended solids, heavy metals, organic compounds, bacteria and nutrients (phosphorous and nitrogen) by promoting settling, adsorption, microbial breakdown, and nutrient assimilation by plants. Suggested design considerations include site locations, maintenance, drainage area size, site slopes and soil infiltration rate.

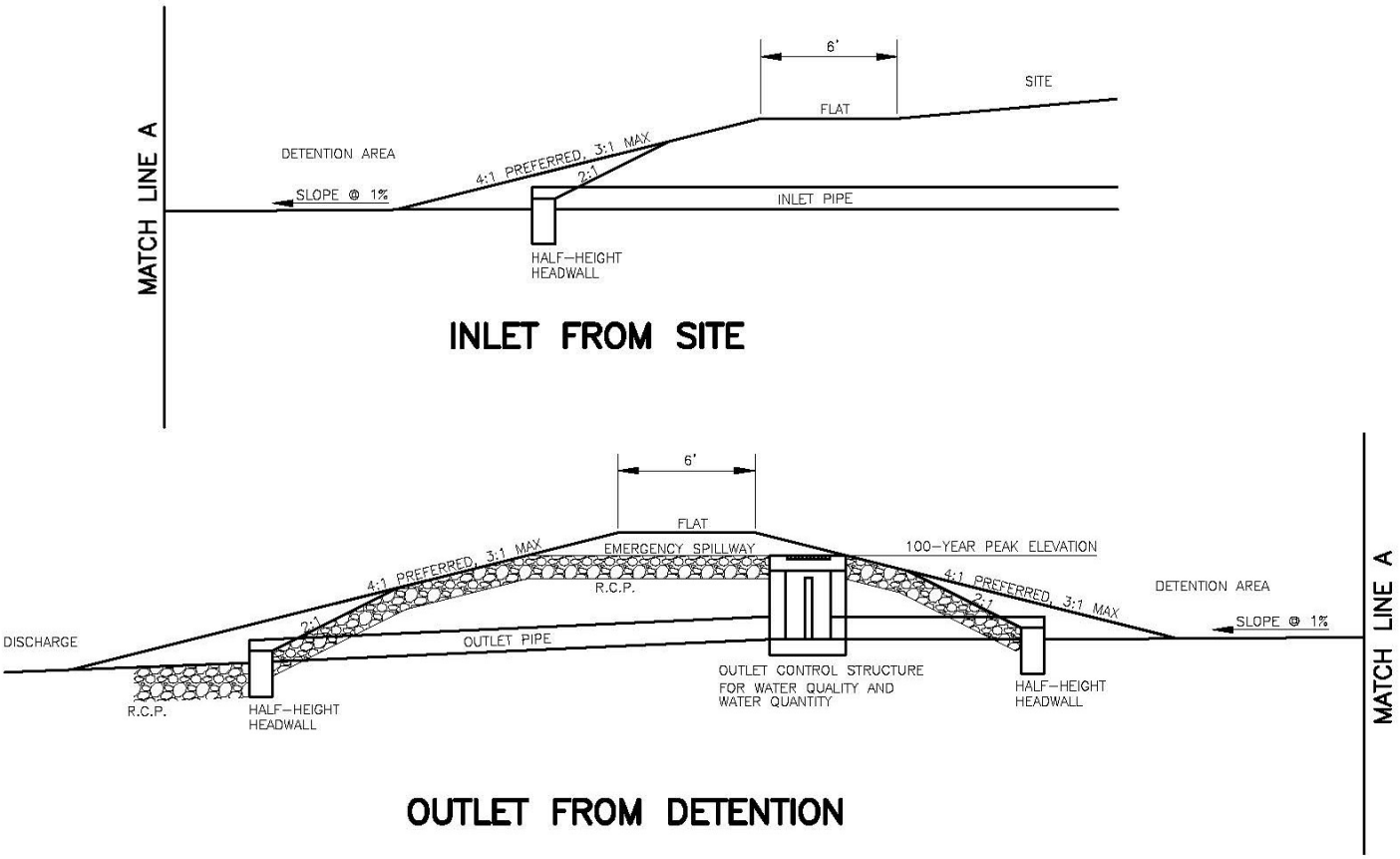
6. **Permeable paving** - A range of materials and techniques for paving roads, cycle-paths, parking lots and sidewalks which allows the movement of water and air around the paving material so storm water can percolate and infiltrate through areas that would traditionally be impervious. Suggested design considerations include weight and speed of vehicles using the surface, soil infiltration rate, the site's contamination risk, slope/grade of land and proximity to water features, including wells.

7. **Sand Filters –** Sand filters utilize a sedimentation chamber and a filtration chamber to treat stormwater. The first chamber (sedimentation) removes larger particles from stormwater by allowing them to settle out of suspension, while the second chamber (filtration) removes finer particles by filtering stormwater through a bed composed of sand or a combination of sand and organic material overlying a drain system. Suggested design considerations include site locations, maintenance, drainage area size, site slopes and soil infiltration rate.

The recommended post-construction BMPs list above is not an endorsement of the Manual that each is suitable throughout Trumbull County. Multiple post-construction BMPs listed above have critical limiting factors present in large portions of Trumbull County. The Professional Engineer should account for possible limiting factors such as soil conditions (fill vs. in-situ), soil type, on-site infiltration rates, perched groundwater tables, seepage considerations, etc. prior to designing a specific BMP.

The County Engineer will consider alternatives to these structural post-construction BMP's after all have been considered during the project development process. Supporting rationale as to why they cannot be implemented, designed or incorporated into the site development must be provided. The County Engineer reserves the right to review and recommend alternatives or accept/reject alternatives based on level of maintenance requirements, public health or safety risks, limited water quality benefits and functionality.

FIGURE 3-1: Typical Detention Pond Section



- Pond Length to width ratios should be 3:1.
- Placement of inlet and outlet should be at maximum distance possible apart.
- Easement access to all facilities must be provided.
- Side slopes of 4:1 are recommended for maintenance, 3:1 is the maximum slope.
- Dry Detention ponds shall be a maximum of 6 feet deep.
- A plan and section of the detention pond shall be submitted along with the construction plans.
- A one foot freeboard shall be provided above the emergency spillway elevation.

3.4 Design Procedures

A general procedure for designing storm water management facilities is presented below:

Step 1: Determine the Water Quality Volume required in accordance with section 3.3.3.

Step 2: Determine the Critical Storm using the method described in section 3.3.2. Compute the Pre-development and Post-development inflow hydrographs for each of the design storms using the hydrologic methods outlined in Section 2.4. Calculate the allowable discharges for each of the design storms. Fill in the known values in the Storm Water Management summary of Discharges table shown in Figure 3-1 below.

Step 3: Perform preliminary calculations to approximate detention storage volume requirements based on the hydrographs from Step 2 and the Water Quality Volume required.

Step 4: Determine the physical dimensions necessary to hold the estimated volume from Step 3, including 1 foot of freeboard. The water quantity volume shall be calculated from the top of the volume required for water quality. Locate and grade the proposed storm water facility using contours. Determine the stage-storage curve using the methods described in Section 3.4.1, or other acceptable method.

Step 5: Select the type of outlet and size the outlet structure based on allowable discharge rates determined from the critical storm method and draw down times associated with water quality requirements. Determine the stage-discharge curve for chosen outlet using the methods described in Section 3.4.2.

Step 6: Perform routing calculations using inflow hydrographs from Step 2 to check the preliminary design using a storage/discharge routing computer model. If the routed Post-development peak discharges exceed the allowable Post-development peak discharges, then revise the available storage volume, outlet device, etc., and return to Step 4. Complete Figure 3-2 below and include it in the Storm Water Management Report.

Step 7: Evaluate the downstream effects of detention outflows to ensure that the routed hydrograph does not cause downstream flooding problems.

Step 8: Evaluate the control structure outlet velocity and provide channel and bank stabilization if the velocity will cause erosion problems downstream.

Figure 3-2

	STORM WATER MANAGEMENT SUMMARY OF DISCHARGES					
RETURN FREQUENCY	PRE-DEVELOPMENT RUNOFF (CFS)	POST- DEV. RUNOFF WITHOUT STORM WATER MANAGEMENT (CFS)	ALLOWABLE DISCHARGE BASED ON CRITICAL STORM (CFS)	PROPOSED DISCHARGE ROUTED THRU OUTLET STRUCTURES (CFS)	STORAGE PROVIDED (CUFT)	PEAK POND ELEVATION (FT)
2-YR STORM						
5-YR STORM						
10-YR STORM						
25-YR STORM						
50-YR STORM						
100-YR STORM						

3.4.1 Stage-Storage Calculations

For retention/detention, basins with vertical sides such as tanks and vaults, the storage volume is simply the bottom surface area times the height. For basins with graded side slopes or an irregular shape, the stored volume can be computed by the following procedure.

Note: Other methods for computing basin volumes are available, such as the Conic Method for Reservoir Volumes, but they are not presented here.

Step 1: Planimeter or otherwise compute the area enclosed by each contour in square feet. The invert of the lowest control orifice represents zero storage. This will correspond to the bottom of the facility for extended-detention or detention facilities, or the permanent pool elevation for retention basins.

Step 2: Calculate the average area between each contour. The average area between two contours is computed by adding the area for the first elevation to the area for the second elevation and then dividing their sum by 2.

Step 3: This procedure is repeated for each measured contour interval. Use this data to prepare a Stage-Storage curve with the contour elevations on the y-axis and the storage volumes on the x-axis.

3.4.2 Stage-Discharge Calculations

A principal outlet structure that controls the rate of discharge from a storm water facility will often use a multi-stage riser.

A multi-stage riser is a structure that incorporates separate openings or devices at different elevations to control the rate of discharge from a storm water basin during multiple design storms. Permanent multi-stage risers are typically constructed of modified pre-cast catch basins or manholes. The geometry of risers will vary from basin to basin.

In a storm water management basin design, the multi-stage riser is of utmost importance since it controls the water surface elevations. In designing the multi-stage riser, many iterative routings are usually required to arrive at a minimum structure size and storage volume that provides proper control. Each iterative routing requires that the facility's size (stage-storage curve) and outlet shape (stage-discharge table or rating curve) be designed and tested for performance.

The most common types of devices to control discharge are discussed below. These include orifice, weir, inlet box and circular culvert (with inlet control).

NOTE: All discharge calculations shall be verified under a full range of expected tailwater conditions.

1. OUTLET STRUCTURE TYPE – ORIFICE

An orifice can be used to provide a discharge to meet the smaller discharges associated with Water Quality and meeting the Critical Storm requirements for frequent storm events.

The equation for a single orifice is:

$$Q = CA\,(64.4H)^{1/2}$$

Where:

A = Area of orifice (ft^2)
H = Head on orifice as measured to the centerline of the orifice (ft)
C = Orifice coefficient

Table 3-3:
Orifice Coefficients

C	Description
0.4	Ragged Edge Orifice Cut by Torch.
0.54	Uniform Orifice Project Into Control Structure

0.61	Uniform Orifice with Thickness Less than Twice Orifice Diameter
0.82	Uniform Orifice with Thickness 2-3 Times Orifice Diameter

Due to the increased probability of blockage, the minimum allowable diameter for any orifice in a control structure is 4". This requirement pertains to the primary spillway of a storm water storage facility only and not to the outlet structure of a water quality pond. This requirement does not relieve the designer from considering all means to prevent blockage of all sized orifices.

2. OUTLET STRUCTURE TYPE – SHARP CRESTED WEIRS

The most common types of sharp crested weirs are:

- Contracted Rectangular
- Suppresed Rectangular
- Cipolletti Contracted
- Contracted Triangular or V-Notch

The equations for each type are described below:

- **Contracted Rectangular Weir**

$$Q = CH^{3/2}(L-0.2H)$$

Where:

Q = discharge in ft^3/s neglecting velocity of approach
L = length of crest (ft)
H = depth of flow above elevation of crest (ft)
C = 3.33

- **Suppressed Rectangular Weir**

$$Q = CLH^{3/2}$$

Where:

Q = discharge, (ft^3/s)
L = length of crest (ft)
H = depth of flow above elevation of crest (ft)
C = 3.33

- **Contracted Cipolletti Weir (trapezoidal)**

$$Q = CLH^{3/2}$$

Where:

Q = discharge, (ft^3/s)
L = length of crest (ft)
H = depth of flow above elevation of crest (ft)
C = 3.367

- **Fully Contracted Standard 90-Degree V-Notch Weir**

$$Q = CH^{2.48}$$

Where: Q = discharge, (ft^3/s)
H = depth of flow above elevation of crest (ft)
C = 2.49

NOTE: The user may choose to use any one of a variety of orifice shapes or geometries. Regardless of the selection, the orifice will initially act as a weir until the top of the orifice is submerged. Therefore, the discharges for the first stages of flow are calculated using the weir equation.

3. OUTLET STRUCTURE TYPE – INLET BOX

This structure is an inlet riser with its opening oriented parallel with the water surface. It is typically made from a modified pre-cast catch basin. During low head flow the perimeter of the structure behaves as a weir. As the head increases, the flow transitions from a weir to horizontal orifice condition. The flow can be calculated using the orifice and suppressed rectangular weir equations as described above for the respective condition.

The transition from weir to orifice flow is not instantaneous; rather it occurs during a "zone" of transition. For the purposes of this manual, the transition height shall be considered the head elevation over the structure when the weir flow equals the orifice flow.

4. OUTLET STRUCTURE TYPE – CULVERT

There are various types of culverts for outlet structures, the circular culvert with inlet control being the most widely used. The user is referred to Section 3.2.6 for culvert design.

Full height concrete headwalls, or wingwalls, shall be installed on the inlet end of all culvert structures. Anti-seep collars shall be designed and installed on the length of the culvert through the embankment (See Section 3.4.6).

Hand routing of hydrographs through storage facilities is very time consuming, especially when several different designs are evaluated. It is encouraged that the designer use one of the many available computer programs to perform hydrograph routing and modeling of storage facilities.

3.4.3 Emergency Spillway Design

An emergency spillway controls the discharge from storms greater than the 100-year storm and shall be sized to be capable of discharging the 100-year storm event should the outlet structure become clogged or fail. The emergency spillway shall be located at the same location as the primary discharge. An emergency spillway typically consists of a wide channel cut over the embankment to provide a controlled flow path. The spillway must be designed and installed to protect against erosion.

Emergency spillways shall be designed as a broad crested weir. The design calculations will be like the calculations for a Contracted Cipolletti Weir presented in Section 3.4.2, except a lower discharge coefficient is used to account for the breadth of the weir. Table 3-4 presents discharge coefficients from the Federal Highway Administration publication HEC-22 "Urban Drainage Design Manual".

Table 3-4
Broad-Crested Weir Discharge Coefficients

Broad-Crested Weir Coefficient C Values as a Function of Weir Crest Breadth and Head (coefficient has units of ft.$^{0.5}$/sec.). (1)											
Head (ft)	Breadth of Crest of Weir (ft)										
	0.50	0.75	1.00	1.5	2.0	2.50	3.00	4.00	5.00	10.00	15.00
0.2	2.80	2.75	2.69	2.62	2.54	2.48	2.44	2.38	2.34	2.49	2.68
0.4	2.92	2.80	2.72	2.64	2.61	2.60	2.58	2.54	2.50	2.56	2.70
0.6	3.08	2.89	2.75	2.64	2.61	2.60	2.68	2.69	2.70	2.70	2.70
0.8	3.30	3.04	2.85	2.68	2.60	2.60	2.67	2.68	2.68	2.69	2.64
1.0	3.32	3.14	2.98	2.75	2.66	2.64	2.65	2.67	2.68	2.68	2.63
1.2	3.32	3.20	3.08	2.86	2.70	2.65	2.64	2.67	2.66	2.69	2.64
1.4	3.32	3.26	3.20	2.92	2.77	2.68	2.64	2.65	2.65	2.67	2.64
1.6	3.32	3.29	3.28	3.07	2.89	2.75	2.68	2.66	2.65	2.64	2.63
1.8	3.32	3.32	3.31	3.07	2.88	2.74	2.68	2.66	2.65	2.64	2.63
2.0	3.32	3.31	3.30	3.03	2.85	2.76	2.72	2.68	2.65	2.64	2.63
2.5	3.32	3.32	3.31	3.28	3.07	2.89	2.81	2.72	2.67	2.64	2.63
3.0	3.32	3.32	3.32	3.32	3.20	3.05	2.92	2.73	2.66	2.64	2.63
3.5	3.32	3.32	3.32	3.32	3.32	3.19	2.97	2.76	2.68	2.64	2.63
4.0	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.70	2.64	2.63
4.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.74	2.64	2.63
5.0	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.64	2.63
5.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.64	2.63

- **Contracted Cipolletti Weir (trapezoidal)**

$$Q = CLH^{3/2}$$

Where:

Q = discharge, (ft^3/s)
L = length of crest (ft)
H = depth of flow above elevation of crest (ft)
C = from Table 3-7

3.4.4 Berm Embankment/Slope Stabilization

- Pond embankments are exempt from the ODNR Dam classification if the following are met: 1) 6 feet or less in height regardless of total storage, 2) less than 10 feet in height with not more than 50 acre-feet of storage, or 3) not more than 15 acre-feet of total storage regardless of height. If the embankment does not meet these criteria, the design is subject to review and approval from ODNR.
  Height of dam is defined as the vertical dimension as measured from the natural streambed at the downstream toe of a dam to the low point along the top of the dam.

- Pond embankments over six (6) feet shall require design by a Geotechnical or Civil Engineer licensed in the State of Ohio. For berm embankments of 6 feet or less (including 1 foot freeboard), minimum top width shall be 6 feet or as recommended by the geotechnical or civil engineer.

- Pond berm embankments must be constructed on native consolidated soil (or adequately compacted and stable fill soils analyzed by a geotechnical report) free of loose surface soil materials, roots and other organic debris.

- Retaining walls greater than 3 feet in height used as pond embankments shall be designed by a Structural engineer licensed in the State of Ohio.

- Exposed earth on the side slopes and bottom should be sodded or seeded with the appropriate seed mixture as soon as is practicable. If necessary, geotextile or matting may be used to stabilize slopes while seeding and sodding become established.

3.4.5 Anti-Seep Collar Design

An anti-seep collar shall be installed on conduits through earth fills. The following criteria apply to anti-seep collars:

Spacing between adjacent collars shall be between 5-14 times the vertical projection of each collar.

Place all collars within the saturation zone.

All anti-seep collars and their connections shall be watertight.

3.4.6 Methodology

The assumed normal saturation zone (phreatic line) shall be determined by projecting a line at a slope of 4:1 from the point where the normal water depth (riser grate) touches the upstream slope of the embankment to a point where this line intersects the invert of the culvert. The area below this projected line is assumed to be within the saturated zone.

The length of the saturated zone (Ls) must first be determined. The nomograph below should then be used to determine the number and size of collars.

$$L_S = y\,(z + 4)\,[1 + (\text{pipe slope}/(0.25 - \text{pipe slope}))]$$

Where: L_S = length of pipe in the saturated zone (ft.)

y = distance in feet from upstream invert of pipe to highest normal water level expected to occur during the life of the structure, usually the top of the riser.

z = slope of upstream embankment as a ratio of z ft. horizontal to 1 ft., vertical.

Pipe slope = slope of pipe in feet per foot.

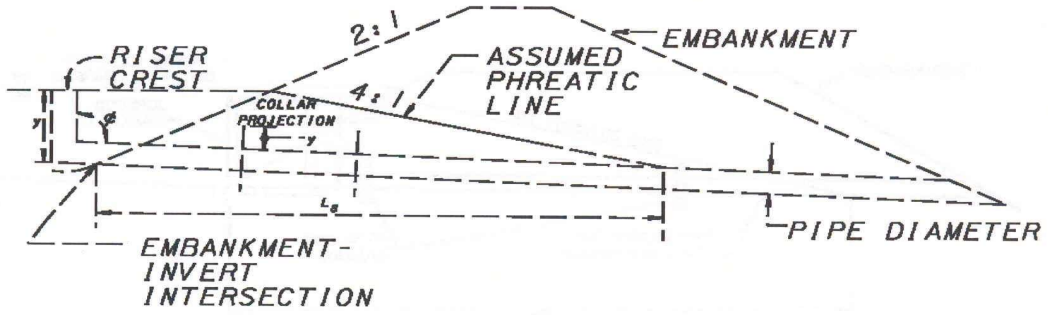


FIGURE 3-4: Anti-Seep Collar Schematic

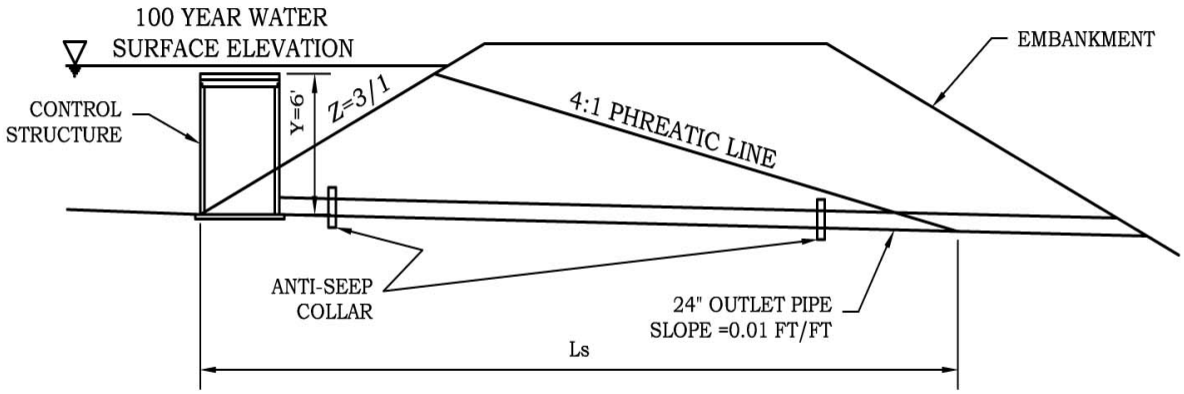


FIGURE 3-5: Anti-Seep Collar Design Example

Step 1: Determine Saturation Length (Ls):

Ls = Y(Z+4)[1+(PIPE SLOPE/(.25-PIPE SLOPE))]

Given: Y = 6'
Z = 3/1
Pipe Slope = 0.01

Ls = 6'(3+4)[1+(0.01/(.25-0.01))]
Ls = 6'(7)[1+0.04166]
Ls = 43.75'

Step 2: Determine Size of Collars:

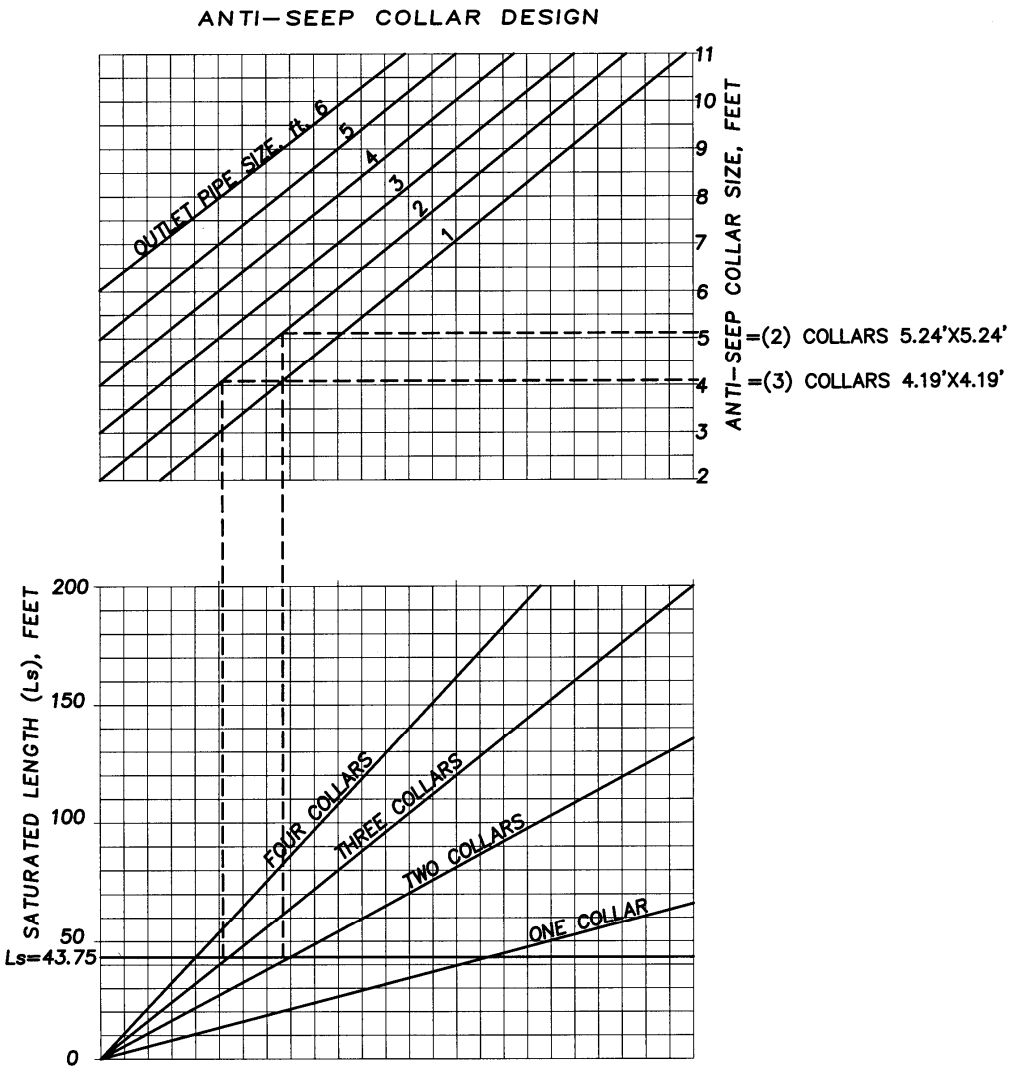
Beginning from the lower graph (see Appendix) with a Ls = 43.75'

1-4 collars may be used, however spacing may limit the amount.

Assuming 2 collars – project up to the 24" pipe at a collar size = 5.24'x5.24'

Assuming 3 collars – project up to the 24" pipe at a collar size = 4.19' x 4.19'

FIGURE 3-6: Anti-Seep Collar Graph



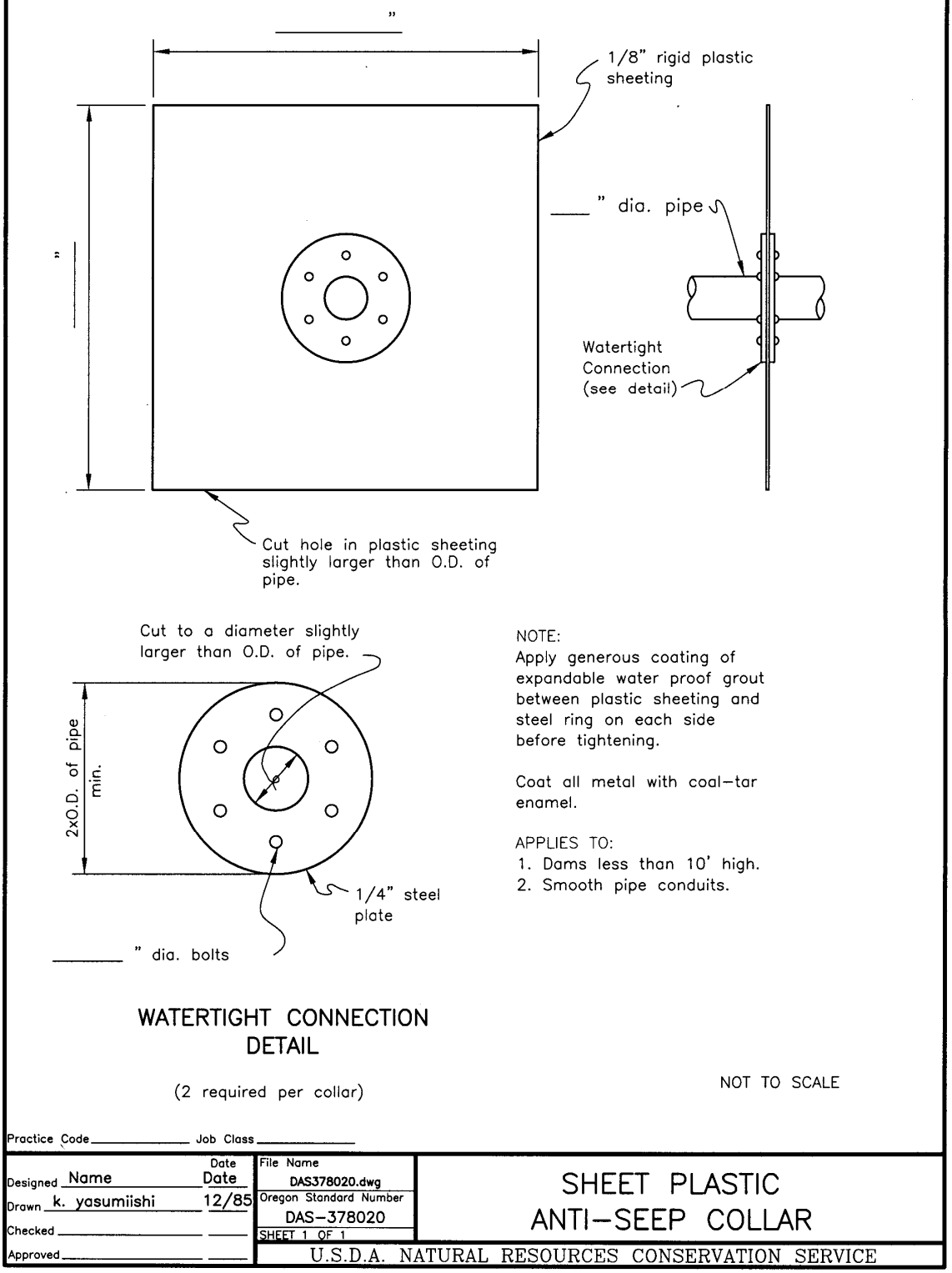
Step 3: Spacing of the Collars:

- Note that the collars must be fully in the saturated zone.
- Spacing can vary from 5-14 times the vertical projection of the collars. The vertical projection is defined as the height of the collars above the outlet pipe.

The 5.24' collars have a vertical projection above the 24" outlet pipe = (5.24'-2')/2 = 1.62'. Therefore, the collars need to be spaced (1.62'*5) up to (1.62'*14) feet apart, or 8.1' to 22.68', respectively.
The 4.19' collars have a vertical projection above the 24" outlet pipe = (4.19'-2')/2 = 1.10'. Therefore, the collars need to be spaced (1.10'*5) up to (1.10'*14) feet apart, or 5.5' to 15.4', respectively.

- The length of the saturation zone may limit the number of collars that can fit based upon their minimum spacing requirements.

FIGURE 3-7: Anti-Seep Collar Detail



3.5 As-Built Drawings

As-built surveys will be required from the Applicant responsible for constructing stormwater facilities and conveyance systems. The purpose of as-built surveys is to demonstrate conclusively that the facilities are constructed to the elevations, slopes, grades, and volumes shown on the approved plans on file with the County. The design engineer shall complete the As-Built Certification Form supplied in the Appendix of the Manual confirming that the facilities are constructed to the elevations, slopes, grades, and volumes shown on the approved plans on file with the County and that adequate storage volume is provided for water quality in accordance with the OHC000006 (or current edition of the OEPA CGP), and for water quantity in accordance with the specifications in this document.

An as-built survey shall be conducted once:

- All structures surrounding lots of stormwater control facility are constructed and final lot grading for each lot is established, and
- The conversion of a temporary sediment basin to a permanent stormwater control facility is complete after the site is built out to the point where the temporary sediment basin is no longer needed. As-built surveys will only be accepted if they are conducted after the sediment in the temporary basin has been removed and regraded, vegetation has been established, and the permanent riser structure(s) is in place.

As-built surveys shall be conducted by a Professional Surveyor registered in the State of Ohio and shall employ standard survey techniques. The Professional Surveyor performing the as-built survey shall be responsible for reduction of notes and any plotting necessary to make the notes interpretable. A final report and original field notes shall be furnished to the County for review and record purposes. A minimum of two benchmarks that are referenced to the same vertical datum as the construction plans shall be provided on the as-built survey drawings. The Applicant, contractor, or other entity constructing the stormwater facilities shall correct the discrepancies necessary to ensure that the stormwater facility will function as designed. The as-built surveys shall be re-performed as necessary to demonstrate plan conformance.

TRUMBULL COUNTY SOIL AND WATER CONSERVATION DISTRICT SECTIONS

4.0 STORM WATER POLLUTION PREVENTION PLANS

4.1 Trumbull County Erosion and Sediment Control (ESC) Rules and Construction General Permit (CGP) Regulatory Framework

This section highlights portions of the Trumbull County Erosion and Sediment Control Rules implemented by the Trumbull County Soil and Water Conservation District and the Ohio Environmental Protection Agency (OEPA) Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System permit no. OHC000006 (or current edition), Ohio Revised Code (ORC) and Ohio Administrative Code (OAC) as they apply to the Construction General Permit.

- Trumbull County Erosion and Sediment Control Rules – Construction activities disturbing one or more acres of total land, or residential sub-lots in a larger plan of development, requires authorization when conducted within unincorporated areas of Trumbull County and municipalities that possess MOUs with Trumbull County Soil and Water Conservation District. The threshold acreage includes the entire area disturbed in the larger common plan of development or sale.

- OEPA – CGP – After March 10, 2003, construction activities disturbing one or more acres of total land are eligible for coverage under this permit. The threshold acreage includes the entire area disturbed in the larger common plan of development or sale.

- Ohio Revised Code (ORC) – Chapter 6111 – Ohio Water Pollution Control Act – Discharges of storm water from sites where construction activity is being conducted, as defined in part 1B of Ohio Environmental Protection Agency (OEPA) permit OHC000006 (or current edition) are authorized to discharge from the outfalls at the sites and to receiving surface waters of the state identified in the Notice of Intent (NOI) application.

- Ohio Administrative Code (OAC) – Rule 3745 - 38-06 – The permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form and written approval of coverage from the director of OEPA in accordance with OAC 3745-38-06.

4.2 Principals of Erosion and Sediment Control

The process of development and urbanization creates conditions of erosion and sedimentation which has the potential to adversely impact large numbers of citizens, property, downstream drainage systems, functions and infrastructure. Excessive erosion and sedimentation can also potentially increase construction cost by requiring additional grading, storm water facility maintenance and sediment cleanup.

Effective erosion and sedimentation control requires first that the soil surface be protected from the erosive forces of wind, rain and run-off and second that eroded soil be captured on-site. The following principals are not complex but are effective. They should be integrated into a system of control measures and management practices to control erosion and prevent off-site sedimentation. The following should be considered when developing plans for the site building footprint, ancillary structures and site drainage:

4.2.1 Fit the Development to the Existing Site Conditions

Review and consider all existing conditions in the initial site selection for the project. Select a site that is suitable rather than force the terrain to conform to the development needs. Ensure that development features follow natural contours. Steep slopes, areas subject to flooding and soils easily eroded severely limit a site use, while level, well – drained areas offer few restrictions.

4.2.2 Minimize the Extent and Duration of Exposure

Sequencing can be a very effective means of reducing the hazards of erosion. Schedule construction activities to minimize the exposed area and duration of exposure, sequencing should account for short term conditions, seasonal changes and stabilization of disturbed areas as soon as possible.

4.2.3 Protect Disturbed Areas from Storm Water Runoff

Use dikes, diversions and watercourses to intercept runoff and divert it away from the cut/fill slopes or other disturbed areas. Sequencing will aid in reducing erosion with these measures installed before clearing and grading.

4.2.4 Stabilize Disturbed Areas

Removing the vegetative cover and compacting the surface alters the soil structure and increases an area's susceptibility to erosion. Apply stabilizing measures as soon as possible after the land is disturbed. Develop and implement plans for temporary and permanent re-vegetation, place mulch or take other protective measures corresponding with construction activities. Protect channels from erosive forces by using linings and the appropriate channel design. Inspect and perform maintenance on a regular basis, once every seven calendar days, or the next calendar day, excluding weekends and holidays unless work is scheduled, after any storm event greater than one-half inch of rain per 24-hour period during construction for these practices.

4.2.5 Keep Runoff Velocities Low

Clearing existing vegetation reduces the surface roughness and infiltration rate and thereby increasing run-off velocities and volumes. Use measures that break the slopes to reduce the problem associated with concentrated flow volumes and runoff velocities. Practical ways to reduce velocities include conveying storm water runoff from steep slopes to stabilized outlets, preserving natural vegetation where possible and vegetating exposed areas immediately after construction.

4.2.6 Retain Sediment on Site

Even with careful planning some erosion is unavoidable. The resulting sediment must be trapped on the site. Determine where sediment deposit will occur and provide maintenance access for sediment removal. Protect low points down grade of disturbed areas by building barriers to reduce sediment loss.

4.2.7 Inspect and Maintain Control Measures

Inspection and maintenance are vital to the performance of erosion and sedimentation control measures. If improperly maintained, control measures may cause more damage than they prevent. Failure of control measures may be hazardous to health and human safety. When deciding which control measure to use, consider the consequences of a control measure failing. Assign responsibility for routine checks to verify the proper functioning of active erosion and sedimentation control measures.

4.2.8 Structural Erosion Control Practices

In general, these are constructed or manufactured controls or systems which assist in managing or controlling construction site storm water runoff (i.e. inlet protection, rock check dams, filter fabric, etc.)

4.2.9 Non-Structural Preservation Methods

Consideration will be given for incorporation of non-structural preservation methods which will preserve natural conditions if these methods do not impede or redirect project storm water runoff off the project site, cause downstream impacts or require increased levels of operation and maintenance effort. Review local community zoning requirements and County Subdivision Regulations for applicability to certain riparian and wetland setback and preservation methods.

4.2.10 Installation of Sediment Controls

Sediment basin and traps, diversion dikes, sediment barriers and other measures intended to trap sediment on-site shall be constructed as a first step in grading and made functional before upslope land disturbance takes place. Centralized sediment traps and basins should be designed along existing contours, facilitate the collection of surface runoff, include minimal embankment construction and be located near the existing surface runoff outflow point(s). Care should be taken to ensure the highest design storage volume elevation will not be greater than the existing inflow grade such that the sediment control feature can collect runoff and function from the onset of earthwork. Traps or basins which are only capable of collecting runoff from proposed storm sewers or raised grade conditions or where constructed above proposed fill will likely require secondary structures for initial site treatment until the permanent sediment control can be installed. Earthen structures whether permanent or temporary such as dams, dikes, sediment basins, storm water basins and diversions shall be seeded and mulched within 7 days after installation is complete.

A combination of structural and non-structural controls is recommended to manage erosion and sedimentation control on construction projects within Trumbull County. These are recommended practices and sound engineering, and design principals shall be applied/incorporated into any submitted plan designs. The plans shall incorporate measures as recommended by the most current edition of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual or an approved equal (Georgia Soil and Water Conservation Commission – Manual for Erosion and Sediment Control in Georgia, Fifth Edition 2000, State of North Carolina, North Carolina Department of Environmental Health and Natural Resources – Erosion and Sediment Control Planning and Design Manual).

4.3 General Applicability Criteria: Storm Water Pollution Prevention Plans and Erosion and Sedimentation Control Plans

These criteria shall cover all new and existing discharges composed entirely of storm water runoff associated with construction activity that enter surface waters of the state or a storm drain leading to surface waters of the state. No person(s) shall allow or cause soil disturbing activities to occur within a project or development area without compliance with the criteria set forth in this manual:

- Storm Water Pollution Prevention Plans (SWP3) must be submitted to the Trumbull County Soil and Water Conservation District for approval of all soil disturbing activities of one (1) acre or more. Projects which require only an Erosion and Sedimentation Control (ESC) Plan and result in no impervious installation(s) must be submitted to Trumbull County Soil and Water Conservation District for approval for all disturbing activities of one (1) acre or more. Excluded from the requirements of the Trumbull County Engineer's Office are soil disturbing activities directly connected to single family residential development on individual lots of less than 5 acres. This statement does not in any way waive the requirements for compliance with all conditions of the Trumbull County Erosion and Sediment Control Rules, the Ohio EPA NPDES Construction General Permit or other local requirements.

- Soil disturbing activities of less than one (1) acre shall not be required to file a SWP3 or an ESC Plan with the Trumbull County Engineer's Office; however, said project shall comply with all other provisions of the Trumbull County Erosion and Sediment Rules and other applicable local requirements. For this reason, submittal of an Erosion and Sedimentation Control Plan is recommended when construction activities disturb less than one acre, including single family residential development on individual lots.

- Compliance with other requirements shall be consistent with applicable state and/or local waste disposal, sanitary sewer or septic system regulations. All discharges regulated under this general permit must comply with the lawful requirements or municipalities, counties and other local agencies regarding discharges of storm water from construction sites. All erosion and sediment control plans and storm water management plans approved by local officials shall be retained with the SWP3 prepared in accordance with all regulatory agencies when the project is located within the jurisdiction of a regulated municipal separate storm sewer system (MS4) the permittee must certify that the SWP3 complies with the requirements of the storm water management program of the MS4 operator.

- Submittal of the SWP3 and/or ESC Plan does not relieve the responsible party from complying with the requirements set forth in the OEPA – Authorization for Storm Water

- Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System permit no. OHC000006 (or current edition), where and when applicable.

- Exceptions of this Manual –

    - Should specific site conditions prohibit implementation of any of the control practices contained in this permit or,
    - Site specific conditions are such that implementation of any erosion and sedimentation control practices contained in this permit will result in no environmental benefit,

- Then the permittee shall provide supporting documentation as justification for non-implementation of each practice due to site specific conditions.

- All practices, designs and controls are to be developed and implemented to the Maximum Extent Practicable.

- Plan Amendments – The construction plan shall be amended whenever there is a change in design, construction, operation or maintenance which has a significant effect on the potential for the discharge of pollutants to surface waters of the state or if the SWP3 and/or ESC Plan proves to be ineffective at achieving objectives of controlling pollutants in storm water discharges associated with construction activity.

- Duty to inform contractors and sub-contractors – Permittee shall inform all contractors and subcontractors who will be involved in the implementation of SWP3 and/or ESC Plan and terms and conditions of this permit. Permittee shall maintain a written document containing signatures of all contractors/sub-contractors who are involved with SWP3 installation and implementation.

4.4 General Construction Plan Submittal Requirements

For the purpose of this manual, the use of Construction Plans includes the following:

- Site Drainage Plan
- Storm Water Pollution Prevention Plan
- Erosion and Sedimentation Control Plan

When referenced in this manual "Construction Plans" will include all three types of plans mentioned above.

The Storm Water Pollution Prevention Plan and Erosion and Sediment Control Plan shall incorporate measures as recommended by the most current edition of the Rainwater and Land Development manual or an approved equivalent. In certain applications the Ohio Department of Transportation (ODOT) Location and Design Manual – Volume 2 should be referenced for roadway projects for recommended erosion and sediment control practices. In addition, ODOT's Location and Design Manual Volume 2 shall be reviewed when selecting Post-Construction Controls for roadway projects. The following represent measures to be integrated into plan design:

A. Certification Requirement – A Registered Professional Engineer shall certify storm water conveyance and post-construction calculations, designs and plan sheets. A Registered Professional Engineer or Landscape Architect or a Certified Professional in Erosion and Sediment Control shall certify erosion and sedimentation control calculations, designs and plan sheets.

B. Permitted Activities and Limitations on Coverage – For the purpose of this manual construction activities include, but are not limited to:

    - Clearing and grubbing operations

- Site grading operations
- Excavating or filling activities
- Trench/Groundwater dewatering – No turbid discharges to surface waters of the state allowed.
- Construction project support activities directly related to the project (Storage yards, batch plants, excavated material disposal areas and borrow areas).

C. Submit a complete and accurate Notice of Intent (NOI) application using Ohio EPA's electronic application form which is available through the Ohio EPA eBusiness Center at: https://ebiz.epa.ohio.gov/. Submission through the Ohio EPA eBusiness Center will require establishing a unique Personal Identification Number (PIN) for final submission of the NOI. Existing eBusiness Center account holders can access the NOI form through their existing account and submit using their existing PIN. Please follow the link for guidance: http://epa.ohio.gov/dsw/ebs.aspx#170669803-streams-guidance. Alternatively, if you are unable to access the NOI form through the agency eBusiness Center due to a demonstrated hardship, the NOI form may be submitted on a paper NOI form provided by Ohio EPA. NOI information shall be typed on the form. Please contact Ohio EPA, Division of Surface Water at (614) 644-2001 if you wish to receive a paper NOI form.

D. Regulatory submittal clarification – All construction plans developed to meet regulatory and manual requirements shall be submitted to the County Engineer and the Trumbull County Soil and Water Conservation District (TCSWCD). Unless requested to do so, construction plans are not required to be submitted to OEPA related to erosion and sediment control or storm water pollution prevention. A Storm Water Pollution Prevention Plan (SWP3) or Erosion and Sedimentation Control Plan must be submitted to Trumbull County Soil and Water Conservation District with appropriate fee for review of plans. The Trumbull County Soil and Water Conservation District fee schedule can be found at www.swcd.co.trumbull.oh.us. Trumbull County Engineers Office Review fees will be based on the County Standard Hourly Rate Table that will be incorporated into a signed agreement with the developer at the time of the document submission.

4.5 Plan Narrative and Site Description Requirements

Operators, developers, general contractors and home builders who intend to obtain initial coverage for storm water discharge associated with construction activity under this general permit shall develop and submit the following:

- Site Type – Residential, Commercial, Industrial, Subdivision, Institutional.
- Construction Phasing or Sequencing Plan.
- OEPA NPDES permit number.
- Location information – Address, City, Village, Township, parcel information if available.
- Watershed Name and Hydrologic Unit Code (HUC) – 11-digit code.
- Total area of site and limits of earth disturbing activity.
- Location and description of any off-site land disturbing activities (borrow/fill areas, Concrete or Asphalt plants).
- Name and location of immediate receiving stream or surface water(s) – Names of subsequent receiving waters, wetlands or special aquatic sites.
- Identify all existing easements on project site (Utility, conservation, public, etc.).
- Storm Water runoff calculations – Pre and post development site conditions, peak discharges and volume of channel protection and water quality information. Include critical storm determination and demonstrate that runoff from upper watershed areas and off-site drainage contributions have been incorporated into site drainage and post-construction control calculations.
- Estimate of impervious surface generated by development/project by area and percentage.
- If available prior site land-use and storm water discharge information.
- Existing soil data.
- Proposed location of concrete truck wash-out areas on site and runoff controls associated w/these areas.
- Proposed site ingress/egress locations and BMP for these locations.

4.6 Storm Water Pollution Prevention Plans and Erosion and Sedimentation Control Plan Requirements

The submitted construction plans shall include drainage, erosion, sediment, and storm water management controls for the site during and after construction. The following is a recommended plan component list and is not intended to be all inclusive:

- Vicinity Map
- Site Plan shall include the following:
    - Soil types.
    - Existing and proposed 2 contours labeled accordingly.
    - Limits of clearing, grading, excavation, off site spoil/borrow areas.
    - Surface water locations within 200' of project site.
    - Existing and planned buildings, roads, parking facilities and other ancillary structures.
    - Location of temporary sediment and storm water management basins. Include settling volume and delineated drainage area sizes.
    - Location of permanent post-construction storm water management practices.
    - Wetland conservation easement buffer fence or barrier locations.
    - Project Wetland Information.
    - Trench dewatering discharge locations and procedures.
    - Designated soil storage/disposal areas.
    - Project ingress/egress areas.
    - Detailed drawings of all permanent and temporary structural storm water management and erosion control methods shall be provided.
    - Proposed project stream crossings.
    - Locations of known 100-year floodplains and known historic flooding areas, identified on construction plans.
    - Description and specifications for project site stabilization including temporary seeding, permanent seeding (include any time-of-year restrictions), mulching, buffer strips, phasing and sequencing of construction operations.

Table 4-1 – Permanent Stabilization

Area Requiring Permanent Stabilization	Time Frame to Apply Erosion Control
Any area that will lie dormant for one year or more	Within 7 days of the most recent disturbance
Any area within 50 feet of a watercourse and at final grade	Within 2 days of achieving final grade
Any other area at final grade	Within 7 days of reaching final grade

Table 4-2 – Temporary Stabilization

Areas Requiring Temporary Stabilization	Time Frame to Apply Erosion Control
Any disturbed area within 50 feet of a watercourse and not at final grade.	Within 2 days of the most recent disturbance if the area will remail idle for more than 21 days
For all construction activities, including stockpiles, that will be dormant for more than 21 days but less than 365 days and not within 50 feet of a watercourse.	Within 7 days of the most recent disturbance For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s)
Exposed areas which will be idle over the winter	Prior to November 1
Note: Where vegetative stabilization techniques will cause structural instability or are otherwise unattainable, alternative stabilization techniques must be implemented.	

- Plan shall consider non-structural BMP's where possible. The Trumbull County Engineer recommends incorporating riparian and buffer areas, phasing construction operations to minimize project land disturbance activities at any given time, identifying and preserving project tree areas to the maximum extent practical, implementing project protective clearing and grubbing practices, and maintaining project natural areas to the maximum extent practical.

- Construction Sequence should clearly identify project erosion, sediment and storm water management control methods, sequence (i.e. when each method will be implemented and the responsible party for implementation of each respective control).

- Pre-Construction Meeting shall be scheduled between Owner/Developer/Operators/Trumbull County Soil and Water Conservation District and Trumbull County Engineer to review the SWP3 no less than 7 days prior to soil disturbing activity.

- **Required Construction Plan General Notes:**

  - Methods, timing and implementation schedule of all temporary and permanent storm water management, erosion and sediment control elements.

  - Owner of Record Contact information (Phone, address and Fax number).

- To the maximum extent practical limit project ingress/egress locations to one entrance.

- Complete all pre-winter site stabilization by no later than September 30.

- Owner of record shall provide required inspections and maintenance for all project erosion and sediment controls. Permanent inspection records are to be kept on site throughout construction. Inspection frequency – once every 7 days and immediately after storm events greater than 0.5 inches of rainfall within a 24-hour period.

- All storm water runoff control facilities and erosion/sediment controls shall be installed and operational during the initial project grading or within 7 days from the start of clearing/grubbing. Upon completion of constructing project sediment ponds, seeding and mulching shall immediately follow to aid in site stabilization and minimization of erosion and sediment transport prior to runoff leaving project site. All erosion and sediment controls shall be maintained and continue to function throughout the active construction portion of the project.

- Runoff Control Practices – Shall incorporate measures which control flow of runoff from disturbed areas to prevent erosion and sediment transport. Practices may include inlet protection, rock check dams, pipe slope drains, diversions to direct flow away from exposed soil areas.

- Inlet Protection – Storm Sewer inlet protection must be provided to minimize sediment laden water from entering storm drain systems, unless the storm drain system discharges to a sediment-settling pond. Individual inlets receiving runoff from drainage areas, whether completely or partially disturbed, of one or more acres will require a sediment-settling pond. Storm sewer inlets and catch basins that are made functional during construction shall be protected from sediment laden runoff. Provisions shall be made for these inlets/catch basins to operate and be maintained before, during and after the final surface is completed. Silt fence alone shall not be utilized as inlet protection. A sturdy frame must be constructed such as 2 x 4 wood to support the silt fence around the inlets. The inlet protection shall encircle the entire inlet and be properly entrenched. Maintenance of these controls shall be preformed on a regular basis.

- Sediment Control Practices – Shall include a description of structural practices that will store runoff allowing for settle and/or divert flows away from exposed soil or limit runoff from exposed areas. Practices may include but are not limited to sediment basins/ponds, silt fences, and/or earthen dikes or channels which direct flow to settlement basins/ponds.

- Sediment Basin requirements:

    - Required for 10 or more acres of disturbance at one time.

    - For areas serving less than 10 acres smaller settlement ponds or sediment traps shall be used.

    - Basin location and sizing criteria:

        Basin location selection and maximization of performance shall consider the following criteria:

        - Maximize Basin Effectiveness – Location selected based on intercepting largest possible amount runoff from project disturbed areas.
        - Undisturbed area runoff shall be diverted from temporary sediment control facilities when ever practical.
        - No basin shall be located within 50 feet of designated floodways.

To maximize trapping and retention of incoming sediment, basins shall be designed with a permanent pool (wet storage) which will protect against sediment re-suspension by promoting extended settlement times. The basin shall also include a dewatering pool (dry storage) which will protect against "short circuiting" of the basin during larger storm events. The standard storage sizing criteria are presented in table 4-3. The following table identifies basin minimums, basin designs shall address project site conditions and maximize length to width

ratios as practical to increase settlement times. Basin designs will not have to include storage volumes for the following:

- Diversion of undisturbed project area runoff,
- Diversion of off-site runoff from outside project area.
- Project stabilized areas.

Should no off-site runoff diversion be implemented, the dry storage component of the basin shall be sized to accommodate both disturbed and undisturbed runoff drainage areas. The wet storage component is based off expected sediment volumes from the disturbed area and does not need to increase with an increased drainage area.

The developer, engineer, builder or contractor shall provide supporting calculations in defense of not implementing the additional storage volumes for the basin. The final decision shall be at the discretion of Trumbull SWCD. Should the project location be located adjacent to streams, creeks or other surface conveyance features, the County Engineer may require the additional storage volume. For all other basins the additional volume shall be required.

Table 4-3 – Standard Temporary Sediment Basin and Modified Permanent Control as Temporary Basin Sizing Criteria

Basin Design Elements	Basin Design Criteria
Basin Wet (Permanent) Storage	37 Cubic Yards (1000 ft^3)/Acre
Basin Dry (Dewatering) Storage	67 cubic Yards (1800 ft^3)/Acre
Maximum Depth	5-feet
Length: Width Ratio	4:1
Minimum Drain Time	48 hours
Maximum Drain Time	7 days

The modified sediment basin is to be used when modifying a permanent storm water control facility for use as a temporary sediment control facility. The Trumbull County Engineer recommends that a 134 cubic yard/drainage acre (including off-site if not diverted) volume be used for sizing the temporary storage control facility or that a series of additional temporary sediment basins be constructed up-gradient of the permanent storm water control facility, one for every inlet pipe discharging into the facility to reduce or eliminate "short circuiting" of the permanent facility during construction. Either method is acceptable. Supporting design calculations for either method are required. Minimum design criteria can be found in table 5-3.

1. Maintenance requirement – Accumulated sediment must be removed when wet (permanent) storage of the basin once it's full of sediment.

2. Spoil material shall be disposed of properly and the County Engineer can request documentation of proper disposal in the form of landfill dumping receipts if considered hazardous. Spoil and borrow areas must be included during preparation of SWP3, ensuring that erosion and sediment control BMP's are designed to minimize impacts and that sediment is not transported to surrounding properties.

3. Basin shall have safety bench designed into basin footprint. The bench shall be designed with a maximum of 2 foot depth.

4. Side slopes from bench to 5-foot depth shall be minimized whenever practical.

5. A length to width ratio of 4:1 is recommended to provide a greater flow treatment distance to increase the efficiency of the sediment basin.

- Silt fence and diversions – Sheet flow runoff from disturbed or denuded areas shall be intercepted by silt fence or alternative diversion practices to protect adjacent properties and water resources from sediment transport contained in sheet-flow runoff.

  Silt Fence shall be placed on a level contour and not placed where concentrated flow is directed toward it. Silt fence shall be pulled tight and trenched 4" to 6" into the ground and backfilled to prevent runoff from cutting underneath and short circuiting the intended use of the fence. Sections of silt fence shall be joined so there are no gaps in the fence. The ends of the fence shall be brought around the ends of the fence. It is recommended to provide structural backing to the silt fencing in the form of chicken wire fence or other similar material to increase the durability of the silt fence and reduce the time and costs associated with maintenance. Silt fence shall not control large drainage areas and placement in parallel series does not increase the maximum drainage area. The estimated maximum drainage to silt fence for a particular slope interval is shown in the table below:

Table 4-4 – Maximum Drainage Area to Silt Fence

Maximum Drainage Area (Acres)/100 linear ft. of silt fence	Interval of slope for a particular drainage Area (Percent)
0.5	<2%
0.25	>2% but <20%
0.125	>20% but <50%

Routine maintenance is required to maintain the silt fence in proper functioning order. The maintenance shall be noted in the weekly inspection logs which are required to be kept updated on the project site.

Storm water diversion practices shall be used to keep runoff away from disturbed areas and steep slopes where practical. Such diversion devices include dikes and berms which can receive and divert runoff from up to 10 acres.

Stream Protection – During construction activities which disturb areas adjacent to streams, structural practices shall be designed and implemented on site to protect all adjacent streams from sediment transport impacts.

> Ordinary High Water Mark – Ordinary High Water Mark (OHWM) – is an elevation that marks the boundary of a lake, marsh or streambed. An Ordinary High Water Mark is created when the presence and action of water is so persistent that the morphological and natural vegetation is distinctly different from upland areas.

Site stabilization, either temporary or permanent, shall follow table 4-1 and 4-2 as applicable.

Filing a NOT is required for all projects which had a NOI filed and approved.

Disposing of Temporary Measures – All temporary measures shall be disposed of within 30 days after final stabilization of the site is achieved and approved by Trumbull County SWCD.

Trumbull County Soil & Water recommends that all Total Maximum Daily Load (TMDL) stream segments within project boundaries be identified on the general notes plan sheet. Should a TMDL be approved for any waterbody into which the permittee's site discharges and requires specific BMP's for construction, the OEPA director may require the permittee to revise the SWP3.

4.7 Limitations on coverage

The following storm water discharges associated with construction activity are not covered by this manual:

- Storm water discharges that originate from the site after construction activities have been completed, including temporary supporting activity and final site stabilization.

- Storm water discharges associated with construction activity that the OEPA director has shown to be or may reasonably expect to be contributing to a violation of a water quality standard.
- Storm water discharges associated w/other NPDES permits.

4.8 OEPA Permit Waivers

The OEPA CGP allows for 2 different waivers to be considered for sites whose larger common plan of development or sale have at least one, but less than five acres of land disturbance

- Rainfall Erosivity Waiver (REW) – discretion of director.

- Total Maximum Daily Load waiver (TMDLW) – Storm water controls are not needed based on a TMDL approved that addresses the pollutant(s) of concern. Pollutants of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation or Urban storm water runoff) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from project construction activity.

4.9 Submittal and Review

The Storm Water Pollution Prevention Plan (SWP3) and Erosion and Sedimentation Control (ESC) Plan shall be prepared in accordance with sound engineering and/or conservation practices by a professional experienced in the design and implementation of standard erosion and sedimentation controls and storm water management practices addressing all phases of construction. The following are required as part of the SWP3 and/or ESC Plan.

- SWP3 and ESC Plans shall be completed prior to the timely submittal of the NOI.

- Trumbull County Soil and Water Conservation District requires:

  1. Storm Water Pollution Prevention Plans (SWP3) – separate sheet.
  2. Erosion and Sedimentation Control Plan (ESC Plan) – separate sheet.
  3. Post-Construction Controls Plan – separate sheet.
  4. Permanent (Post-Construction) Detention being modified as temporary sediment control basin, or multiple temporary sediment control basins: Provide design calculations for each inlet and discharge pipe – separate sheet.
  5. Long-Term Post-Construction Operation and Maintenance Plan – stand alone document

  Two copies shall be submitted, and one set toTrumbull County Soil and Water Conservation District for review, comment and ultimate approval or disapproval and one set to Trumbull County Engineer for his records.

- For proposed subdivisions the SWP3 and/or ESC Plan shall be submitted to Trumbull County SWCD after acceptance of the preliminary plat by Trumbull County Planning Commission and concurrently with the submittal of site construction drawings to the County Engineer. The review period will commence upon full payment of review fees to the Trumbull County Soil and Water Conservation District . Trumbull County Soil and Water Conservation District will review the SWP3 and/or ESC Plan and provide comments, questions and/or recommendations for revision, or an approval letter, within 30 days. A revised plan shall be submitted to the Trumbull County Soil and Water Conservation District Office and SWCD within 30 days of receipt of notice of deficiencies. The Trumbull County Soil and Water Conservation District shall not allow any land disturbance activities prior to plan approval and proof of compliance with all necessary project permits as outlined in Section 1.10 Compliance with Local, State and Federal Regulations of this manual.

- Within 30 days of receipt of a complete plan, including fees, Trumbull County Soil and Water Conservation District shall indicate the submitted and revised status of compliance or non-

compliance to the owner or appointed representative in cases of after the fact or unauthorized construction. Indication of non-compliance shall include specific deficiencies and procedures for filing a revised plan. Revised plan shall be submitted within 30 days of receipt of notification of deficiencies.

- The Trumbull County Soil and Water Conservation District may impose such special terms and conditions as are appropriate or necessary to ensure compliance with the applicable laws and rules and to protect human health or the environment.

- Incomplete permit applications shall not be considered. Failure to provide a complete application or to respond to requests by the agency for additional information will result in denial of the application.

- The permittee shall make the approved SWP3 and ESC Plan available upon request of the local agency approving sediment and erosion control plans, grading plans, storm water pollution prevention or storm water management plans, to local governmental officials, or to operators of Municipal Separate Storm Sewer Systems (MS4) receiving drainage from the permitted site.

- Submitting an NOT – Compliance with construction permits is required until an NOT form is submitted (a form can be found at the Ohio EPA's website: www.epa.state.oh.us) to Ohio EPA. A copy of the NOT shall be provided to the Trumbull Soil and Water Conservation District which will relieve the permittee of the erosion and sediment control requirements. Permittee's authorization to discharge under this permit terminates at midnight of the day the NOT form is submitted. All permittees must submit an NOT within 45 days of completing all permitted land disturbance activities. Enforcement actions may be taken if a permittee submits an NOT form without meeting one or of the following conditions:

    - Final stabilization has been achieved on all portions of the site. Another operator has assumed control over all areas of the site that have not been finally stabilized. Final stabilization status will be determined by Trumbull SWCD or OEPA. Owner, or appointed representative, may request inspection upon completion of project, prior to submittal of NOT.
    - Temporary stabilization has been completed and the lot has been transferred to homeowner (residential construction only).
    - Individual lots sold by the developer without housing must undergo final stabilization prior to termination of permit coverage (residential construction only).

During site development, layout and planning, consideration shall be given to selection of proper erosion and sediment control practices and designs. Site layout and drainage shall integrate sound erosion and sedimentation practices and should be developed or designed by people experienced in drainage, hydraulics, storm water management or other erosion and sedimentation control techniques.

The following statement shall be included with all submitted erosion and sedimentation control plans and SWP3 plans:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry into the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

4.9.1 Long-Term Operation and Maintenance Agreement

The Long-Term Operation and Maintenance Agreement supplied in the Appendix of this manual shall be completed and submitted along with the plans.

5.0 Flood Plain Regulations

The Trumbull County **Flood Damage Prevention Regulations** provide additional requirements for construction within Trumbull County flood plains. A copy of the effective **Flood Damage Prevention Regulations** can be obtained from the Trumbull County Planning Commission:

Flood Plain Coordinator
c/o Trumbull County Planning Commission

185 East Market Street NE
Suite A – 2nd Floor
Warren, OH 44481
Phone: (330) 675-2480

6.0 ADMINISTRATIVE

6.1 Inspection and Compliance

1. The Trumbull County Soil and Water Conservation District will perform regular inspections of project areas to determine and document compliance with OEPA's Construction General Permit (CGP) requirements and may comment on any other requirement set forth in this manual. Inspection reports will be forwarded to the Trumbull County Engineer, the owner, or appointed representative, and other relevant agencies, regarding site compliance status. Should an apparent violation or deficiency be noted or reported from a third party, the Trumbull County SWCD will investigate the alleged violation and complete a Complaint Inspection Report; the results and recommendations will be forwarded to necessary entities.

   Should a deficiency or non-compliance not be corrected, or plans submitted addressing the situation, deficiency or non-compliance will be forwarded to the Commissioners as a "Notice-of-Violation" containing details of the nature of the violation. If sections of the Ohio Revised Code have been violated, then the Notice of Violation will also be forwarded to the Ohio EPA.

2. In the event that the Trumbull County SWCD determines a deficiency or non-compliance to be causing immediate and significant damage to waters of the State of Ohio, then the Commissioners may be approached for priority consideration without delay.

3. Should the Commissioners determine that a violation does exist, the Prosecuting Attorney for Trumbull County will request in writing an injunction, or other appropriate relief to reduce excessive erosion and sedimentation and secure compliance with the requirements set forth in this manual. In seeking a resolution, the court may order the maintenance or construction of Best Management Practices (BMPs) per the approved SWP3. The court may also require the installation of additional measures if deemed necessary by site conditions.

6.2 Variances to Rules

In the event that a practice, activity or other action is in violation of these Rules, the Trumbull County Board of Commissioners acting through the Administrator of these Rules or other designated agent and after public hearing and notice (as described hereunder) to interested persons including applicant, abutting landowners, the political subdivision wherein the real property subject to the variance is located, and any other person whose property would be substantially affected by the granting of the variance (the determination of the meaning of "substantially affected by" to be the sole decision of the Administrator or other Board designee whose decision is final), may grant a variance to these Rules if all of the following are found to exist:

(a) There are exceptional or extraordinary circumstances or conditions applying to the land;

(b) Owing to special conditions, literal enforcement of the Rules would cause unnecessary hardship and the spirit of these Rules would be observed and substantial justice done;

(c) The exceptional or extraordinary circumstances or conditions and the unnecessary hardship were not the result of any prior actions of the owner (or applicant) of the land;

(d) The variance is necessary for the preservation and enjoyment of substantial property rights of the owner of the land;

(e) The variance will not be a substantial detriment to adjacent land and will not materially impair the purposes of these Rules;

(f) Adverse economic conditions shall not be a valid reason to grant a variance;

(g) A request for a variance shall be in writing and shall be in a form or manner approved by the Administrator/designee and shall state specifically the reasons for the request and shall include all data and information in support of the request. The Administrator/designee shall fix a time and date for the public hearing, give at least a ten (10) day notice in writing to the parties in interest, give notice of such public hearing by publication in a general circulation newspaper in the County at least ten (10) days prior to such hearing. The request shall be reviewed and approved, disapproved or approved with modifications within thirty (30) working days unless extended by the Board for a reasonable time not to exceed an additional thirty (30) days;

(h) Any appeals of the final decision of a variance shall be made to the Board of Supervisors of Trumbull Soil & Water Conservation District;

(i) Variance requests, that involve tasks under the jurisdiction of the local governing engineering entity, whether fully or jointly, must separately obtain approval (if applicable) from said entity prior a variance of these Rules being granted

(j) A variance may not allow applicants to fall below the minimum standards of the Environmental Protection Agency (EPA)

APPENDIX

PLAN SUBMITTAL, REVIEW AND APPROVAL PROCESS FOR DEVELOPMENT IN TRUMBULL COUNTY

1. PRE-SUBMITTAL MEETING WITH THE TRUMBULL COUNTY ENGINEER AND TRUMBULL COUNTY SOIL AND WATER CONSERVATION DISTRICT (RECOMMENDED). TRUMBULL COUNTY ENGINEER SHALL INFORM THE PLANNING COMMISSION OF ANY PROJECTS MEETING THE DEFINITION OF A MAJOR SUBDIVISION AS DEFINED IN THE TRUMBULL COUNTY SUBDIVISION REGULATIONS AND REQUEST A FLOODPLAIN DETERMINATION FROM THE PLANNING COMMISSION FOR ANY ACTIVITIES BEING UNDERTAKEN ON PARCELS CONTAINING SPECIAL FLOOD HAZARD AREAS AS DEFINED BY FEMA

2. CHECK SITE FOR WETLANDS BY A QUAILIFIED PROFESSIONAL AND EITHER PERFORM A WETLAND DELINIATION OR SUBMIT A LETTER FROM SAID PROFESSIONAL STATING THAT NO WETLANDS EXIST ON THE PROPERTY.

3. SUBMIT CONSTRUCTION DRAWINGS AND STORM WATER REPORT ALONG WITH APPLICATION FOR REVIEW AND APPLICATION FEE TO THE TRUMBULL COUNTY ENGINEER FOR REVIEW, COMMENT AND APPROVAL OR DISAPPROVAL.

4. SUBMIT STORM WATER POLLUTION PREVENTION PLAN AND EROSION AND SEDIMENT CONTROL PLANS AND CALCULATION TO THE TRUMBULL COUNTY SOIL AND WATER CONSERVATION DISTRICT FOR REVIEW, COMMENT AND APPROVAL OR DISAPPROVAL. SUBMIT LONG-TERM OPERATION AND MAINTENANCE AGREEMENT. (ATTACHED IN APPENDIX)

5. SUBMIT TO OHIO EPA FOR A NOTICE OF INTENT.

6. SUBMIT PLANS TO THE APPROPRIATE TOWNSHIP ZONING FOR REVIEW, COMMENT AND APPROVAL OR DISAPPROVAL.

7. SUBMIT BUILDING PLANS TO THE TRUMBULL COUNTY BUILDING DEPARTMENT FOR REVIEW, COMMENT AND APPROVAL OR DISAPPROVAL.

DRAINAGE REVIEW APPLICATION
TRUMBULL COUNTY ENGINEERS OFFICE

650 North River Road NW
Warren, OH 44483-2642
330-675-2640

PROJECT NAME _____

ADDRESS _____

TYPE OF PROJECT _____

TOTAL PARCEL ACREAGE _____ EARTH DISTURBED AREA _____

PROJECT OWNER _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____ EMAIL _____

PLANS PREPARED BY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____ EMAIL _____

SUBMITTAL CHECKLIST:

- ☐ PLANS PREPARED BY A REGISTERED ENGINEER
- ☐ STORM WATER MANAGEMENT REPORT
- ☐ APPLICATION FEE OF $500.00
  MAKE CHECK PAYABLE TO "TRUMBULL COUNTY ENGINEER"

A REVIEW FEE OF $100/HOUR WILL BE CHARGED TO COVER THE COSTS OF REVIEWING THE CONSTRUCTION PLANS AND THE STORM WATER MANAGEMENT REPORT. THE ENGINEER'S OFFICE RESERVES THE RIGHT TO RETAIN THE SERVICES OF A PROFESSIONAL ENGINEER, ON A CONSULTING BASIS, RELATIVE TO STORM WATER MANAGEMENT/DRAINAGE PLANS REVIEWS AND ASSESS A REVIEW FEE EQUAL TO THE FEE AMOUNT CHARGED BY THE CONSULTING PROFESSIONAL ENGINEER TO TRUMBULL COUNTY FOR THEIR SERVICES.
THIS REVIEW FEE SHALL BE PAID BEFORE PLANS ARE APPROVED FOR CONSTRUCTION.

BY SIGNING BELOW, YOU AGREE TO PAY THE REVIEW FEE.

_____

PROJECT OWNER'S SIGNATURE DATE PRINT NAME

DRAINAGE REVIEW CHECKLIST
TRUMBULL COUNTY ENGINEER

Reviewed by: _____ Date: _____

3.2 Minor System Design

3.2.1 Layout of Storm Sewers

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.2.4 Storm Sewer Design

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.2.5 Storm Sewer Computations

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.2.6 Culvert Design

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.2.7 Major System Design

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.3 Storm Water Storage Facilities Design

3.3.1 Overview

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.3.2 Critical Storm Determination

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.3.3 Water Quality Control

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4 Design Procedures

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4.1 Stage-Storage Calculations

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4.2 Stage Discharge Calculations

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4.3 Emergency Spillway Design

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4.4 Berm Embankment/Slope Stabilization

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

3.4.5 Anti-Seep Collar Design

- Meets the requirements ☐
- Does not meet the requirements ☐
- Comments:

STORM SEWER COMPUTATION SHEET

SEE SECTION 3.2.5 ON PAGE 39 OF THE MANUAL FOR INSTRUCTIONS

SHT ___ OF ___

PROJECT _____

CALCULATED BY _____

DATE _____

1	2	3	4	5	6	7	8	9*	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
STRUCTURE NO.	STATION	SIDE	DRAINAGE AREA (ACRES)		TIME OF CONCENTRATION (MINUTES)		RAINFALL (IN/HR)		RUNOFF COEF.	COLUMN 4 x 10	SUM OF COL. 11	COL. 8 x 12 DISCHARGE (CFS)	COL. 8 x 12	SIZE OF PIPE (INCHES)	LENGHT OF PIPE (FFET)	SLOPE OF PIPE (FT/FT)	INVERT ELEV. UP	INVERT ELEV. DOWN	MEAN VELOCITY (FPS)	JUST FULL CAPACITY 10-YEAR	FRICTION SLOPE (FT/FT)	HEAD LOSS (FT)	ELEV. OF HYD. GRD. FOR 25-YEAR Q	CRATE OF COVER ELEVATION	GRATE ELV. MINUS HYDR. GRADE ELEV.
NO.			ΔA	ΣA	ΔT	ΣT	i10	i25	C	ΔCA	ΣCA	Q10	Q25	Ø	L	So	ELEV.	ELEV.	Vm	CFS	Sf	H	ELEV.	ELEV.	

* COLUMN 9 SHALL BE THE Tc FOR THE LAST STRUCTURE AND THE SAME FOR ALL ROWS

LONG TERM OPERATION AND MAINTENANCE AGREEMENT FOR POST CONSTRUCTION BMP IN TRUMBULL COUNTY

PROJECT NAME _____

ADDRESS _____

TYPE OF POST CONSTRUCTION BMP _____

LOCATION OF BMP – LATITUDE _____ LONGITUDE _____

TYPICAL TASKS AND SCHEDULE OF MAINTENANCE FOR SWM BASINS*

TASK	SCHEDULE
Remove debris from the banks and bottom of the BMP	Monthly
Clear the water quality orifice	Monthly
Clear the primary out structure	Monthly
Mow grass embankment and stabilize eroded areas	Monthly
Inspect and clean out sediment from the forebay and micropool	Every 5 years
Inspect and remove sediment from rock channel protection	Annually
Remove woody vegetation from the banks and bottom of the BMP	Annually
Remove sediment from the pond bottom	Check annually and remove as needed

*If for a BMP other than a detention basin, attach a list of the tasks and schedules for review.

Certification
As the party responsible, I certify that the BMPs will be implemented, monitored and maintained according to the above tasks and schedule to ensure their continued effectiveness. In the event of a property transfer, the new owner will be notified of the BMPs at this site in writing as part of the sales or lease agreement, which requires the recipient to assume responsibility for the maintenance described above.

Property Owner Name _____

Property Owner Signature _____ Date _____

Notary
State of _____
County of _____
Before me, a notary in and for said county and state, personally appeared _____
Who acknowledged that they are the owner of the project above and that signing of the above was their own free act and deed.
As witness whereof I have hereunto set my hand and affixed my seal this_____day of _____ , 20___.
My commission expires _____

This document shall be recorded to follow the deed when property is transferred.

Recording Information _____

Attach a site plan showing the location of the BMPs in 8.5”x11” format to be recorded with this document

AS-BUILT CERTIFICATION FORM
TRUMBULL COUNTY ENGINEERS OFFICE

650 North River Road NW
Warren, OH 44483-2642
330-675-2640

PROJECT NAME _____

ADDRESS _____

I certify that the facilities are constructed to the elevations, slopes, grades, and volumes shown on the approved plans on file with the County and that adequate storage volume is provided for water quality in accordance with the OHC000006 (or current edition of the OEPA CGP), and for water quantity in accordance with the specifications in the TRUMBULL COUNTY ENGINEERS DRAINAGE DESIGN AND STORM WATER MANAGEMENT AND TRUMBULL COUNTY SOIL & WATER CONSERVATION DISTRICT STORM WATER POLLUTION PREVENTION PLAN MANUAL.

_____

Engineer's Signature Date Engineer's printed name

_____

Engineering Company Name

_____

Address

_____

City State Zip

_____

Phone

_____

Email

TRUMBULL COUNTY COMMISSIONERS

160 HIGH STREET, N.W.
WARREN, OHIO 44481-1093
330-675-2451
Fax: 330-675-2462

February 11, 2026

The following action was taken by the Board of Trumbull County Commissioners on February 11, 2026 and duly recorded in the Journal Volume 161, Page(s) 27801.

* *

RE: ADOPT RESOLUTION 'REVISED' COUNTY ENGINEER'S DRAINAGE AND STORMWATER MANAGEMENT AND COUNTY SOIL & WATER CONSERVATION DISTRICT STORM WATER POLLUTION PREVENTION PLAN MANUAL

MOTION: Made by Mr. Hernandez, seconded by Mr. Malloy, to Adopt a Resolution approving the 'Revised' TRUMBULL COUNTY ENGINEER'S DRAINAGE AND STORMWATER MANAGEMENT AND TRUMBULL COUNTY SOIL & WATER CONSERVATION DISTRICT STORM WATER POLLUTION PREVENTION PLAN MANUAL. The Trumbull County Drainage and Erosion and Sediment Control Manual adopted October 24th, 2012 in Commissioners (JV 138, Page 17058) has been updated to reflect the new Water Quality Volume required by the Ohio EPA and to better define the roles of the County Engineer's office and the Trumbull County Soil and Water Conservation District with respect to the manual and to update methods and procedures; this action per the recommendation of the Trumbull County Soil and Water Conservation District and the Trumbull County Engineer. Documents were reviewed and approved by the Trumbull County Prosecutor's Office.
NOTE: Public Hearings were held by the Board of Trumbull County Commissioners on January 28, 2026 and February 4, 2026 relative to the proposed adoption of the Revised Erosion and Sediment Control Rules and the Drainage and Erosion and Sediment Control Manual.

Yeas: Hernandez, Malloy, Bernard
Nays: None

CERTIFICATION

I, Lisa DeNunzio Blair, Clerk of the Board of County Commissioners, Trumbull County, Ohio, do hereby certify that the foregoing is a true and correct copy of a Resolution adopted by the Board of Trumbull County Commissioners on February 11, 2026, and is duly recorded in their Journal Volume 161, Page(s) 27801.

Lisa DeNunzio Blair

Lisa DeNunzio Blair, Clerk
Board of County Commissioners

/as

cc: Gary Taneri