City of Bridgeport

Connecticut

Department of Public Facilities

Storm Water Management Manual

Adopted April 6, 2009
Revised October 11, 2016

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EXHIBITS
(In map pocket)

Exhibit 8-1: Combined Sewer System Areas of Concern from *Facility Plan 2000 Report*

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The Bridgeport City Council approved Public Ordinance Chapter 15.48, Storm Water Management Manual on April 6, 2009.

The Ordinance allows for the creation of a comprehensive storm water management program in Bridgeport. The Ordinance places the responsibility for citywide storm water management under the supervision of the Engineering Department. The Ordinance requires the Engineering Department to develop this storm Water Management Manual. The manual presents the framework of the storm water management program, including its mission, goals, program elements and implementation phases.

1. **DEFINITIONS**

Applicant: Any person, company, or agency that applies for a permit through the City of Bridgeport.

Bioretention Facility: A facility that utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff. Examples of bioretention facilities in this manual can include vegetated swales, flow-through and infiltration planters, vegetated filters, and vegetated infiltration basins.

Buffer: The area of land immediately adjacent to any surface water body measured perpendicular to and horizontally from the top-of-bank on both sides of a stream that must remain or be restored with native plants, trees, and shrubs.

Capacity: The capacity of a storm water drainage system is the volume or rate that a facility (e.g., pipe, pond, vault, swale, ditch, drywell, etc.) is designed to safely contain, receive, convey, reduce pollutants from or infiltrate storm water to meet a specific performance standard. There are different performance standards for pollution reduction, flow control, conveyance, and destination/ disposal, depending on location.

Catch Basin: A structural facility located substantially below the ground surface, used to collect storm water runoff for conveyance purposes. Generally located in streets and parking lots, catch basins have grated tops, allowing storm water from the surface to pass through for collection. Catch basins also include a 2 foot sumped bottom.

Catch Basin – Hooded: Catch basins also include a submerged outlet pipe (downturned 90 degree elbow, hood, or baffle board) to trap floatables, and gases when discharging to a combined sewer when sealed.

City – City of Bridgeport

Combined (or Combination) Sewers*:* Pipes that convey both sanitary sewage and storm water.

CSO (Combined Sewer Overflow): A discharge of a mixture of sanitary sewage and storm water at a point in the combination sewer system designed to relieve surcharging flows.

Department: City of Bridgeport, Department of Public Facilities.

Design Professional: A licensed professional engineer registered in the State of Connecticut.

Design Storm: The magnitude and temporal (temporary) distribution of precipitation from a storm event measured in probability of occurrence (e.g., five-year storm) and duration (e.g., 24 hours), used in the design and evaluation of storm water management systems.

Detention Facility: A facility designed to receive and hold storm water and release it at a slower rate, usually over a number of hours. The full volume of storm water that enters the facility is eventually released.

Developer: Any landowner, agent of such landowner, or tenant with the permission of such landowner, who makes or causes to be made a subdivision of land or land development project.

Development Footprint: To area of the building footprint, hardscape, access roads and parking.

Development Project: Any human-induced change to improved or unimproved real estate, whether public or private, including but not limited to land development, construction, installation, or expansion of a building or other structure, land division, street construction, and site alteration such as embankments, dredging, grubbing, grading, paving, parking or storage facilities, excavation, filling, stockpiling, or clearing. As used in these regulations, development encompasses both new development and redevelopment. It includes the entire development site, even when the project is performed in stages or only on a limited portion of the site.

Development Site: The specific tract of land where any earth disturbance activities are planned, conducted, or maintained by a developer.

Directly Connected Impervious Area (DCIA): An impervious or impermeable surface, which is directly connected to the drainage system.

Drywell Systems: Facilities which utilize subsurface storage and/or percolation for storm water runoff.

Easement: An acquired right to cross or use another's property for a specific defined purpose, noted and recorded on City land records.

Earth Disturbance: Any human activity which moves or changes the surface of land, including, but not limited to, clearing and grubbing, grading, excavation, embankments, land development, agricultural plowing or tilling, road maintenance activities, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials.

Ecoroof: A lightweight low-maintenance vegetated roof system used in place of a conventional roof. Ecoroofs provide storm water management by capturing, filtering, and evaporating rainfall.

Erosion and Sediment Control Plan: A plan for a project site that identifies storm water detention and retention structures that will minimize accelerated erosion and sedimentation during the construction phase, and is in accordance with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control.

Existing Conditions: Physical conditions on the site including land use, impervious surface, topography, vegetation, soils, and hydrology that exist on the site on the date the Developer starts the development process.

Extended Wet Detention Pond*:* A surface vegetated basin with a permanent pool of water and additional storage volume, used to provide pollution reduction and flow control for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out. During large storm events, storm water temporarily fills the additional storage volume by as much as three feet and return gradually to pre-storm elevations within 24 hours of the storm event.

Flood Prone Areas: Areas in the City where flooding may be caused by inadequate sewer capacity or stream bank overflow.

Groundwater Recharge: The replenishment of existing natural underground water supplies without degrading groundwater quality.

Hotspots: Areas where land use or activities have contaminated the soil underlying the site such that infiltration of storm water would likely cause groundwater contamination through leaching of the soil's contaminants.

Impervious Surface: A surface that prevents the infiltration of water into the ground. Examples of impervious surface include roofs, streets, sidewalks, and parking or driveway areas that are covered with impervious paving materials such as asphalt or concrete.

Infiltration: The percolation of water into the ground.

Level Spreader: Storm water outlet control that spreads out concentrated flow and releases it as a low velocity, non-erosive diffused flow.

Maximum Extent Practical: A goal for Developers to utilize all storm management design practices available and feasible on the project site.

National Flood Insurance Program (NFIP): A federal program to make flood insurance to businesses and residents available within communities adhering to minimum state and federal floodplain management standards. The NFIP is administered by the Federal Emergency Management Agency (FEMA)

Open Channel*:* A fluid passageway which allows part of the fluid to be exposed to the atmosphere (i.e. U-shaped channel).

Owner: Any person, landowner, corporation or other legal entity recognized by the State of Connecticut who holds legal title to property.

Peak Flow: The peak flow, sometimes called the peak discharge, is the maximum rate of flow of water passing a given point as a result of a rainfall event or the maximum discharge on a runoff hydrograph.

Pervious Pavement*:* Types of pavement systems that allow storm water to percolate through them and into subsurface drainage systems or the ground.

Post-Developed Condition*:* A site's ground cover and grading after development.

Predevelopment Condition: The predevelopment condition shall be the existing condition of the site immediately prior to implementation of the approved development plan. For redevelopment, predevelopment shall be defined according to the procedures found in Section 5.B.

Rainwater Harvesting*:* The practice of collecting and using storm water for purposes such as irrigation and toilet flushing.

Redevelopment: Any development on a site that requires demolition or removal of existing structures or impervious surfaces and replacement with new impervious surfaces. Maintenance activities such

as top-layer grinding and re-paving are not considered redevelopment. Interior remodeling projects are also not considered redevelopment.

Retention Facilities: A facility that permanently retains storm water on-site, where it infiltrates and recharges the groundwater aquifer, or in the case of surface retention facilities, evaporates or is absorbed and used by surrounding vegetation. In this way, retention facilities reduce the total volume of water released downstream. Examples of retention facilities include surface treatments (such as eco-roofs or pervious pavements) that cover or replace traditional impervious surfaces. Other examples include vegetated facilities such as swales, filters, ponds, and planter boxes.

Roof Garden (a.k.a. Green Roof): A heavyweight roof system of waterproofing material with a thick soil and vegetation cover. Roof gardens provide storm water management by capturing, filtering, and evaporating rainfall.

Runoff: storm water that flows across the ground surface during and after a rainfall event.

Site Design Credits: Credits that act as an incentive to developers to implement better site design and low impact development techniques that can reduce the volume of storm water runoff, preserve natural areas, and minimize the pollutant loads from the site. These credits allow developers to reduce or eliminate design requirements for water quantity, water quality, channel protection and flood control.

Storm water: Water that originates as precipitation on a particular site, basin, or watershed.

Storm water management: The overall combination of techniques used to reduce pollutants from, detain and/or retain, and provide a destination for storm water to best preserve or mimic the natural hydrologic cycle, to accomplish goals of reducing and controlling storm water runoff, or to fit within the capacity of existing infrastructure.

Water Quality Volume: The amount of storm water runoff from any given storm that should be captured and treated in order to remove a majority of storm water pollutants as specified in the CT DEP SWQM, Chapter 7.

Watercourse: A channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. Watercourses may be either natural or man-made.

Wet Pond: A vegetated basin with a permanent pool of water, used to provide pollution reduction for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out.

Wetland: An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and areas mapped by a licensed Connecticut Soil Scientist. Specific wetland designations shall be made according to both State of Connecticut and US Army Corps of Engineers requirements.

2. **ABBREVIATIONS & ACRONYMS**

BMP – Best Management Practices
CSO – Combined Sewer Overflow
CTDEP – Connecticut Department of Environmental Protection
CTDEPSWQM – CTDEP Storm water Quality Manual
CTDOT – Connecticut Department of Transportation
CTDOTDM – CTDOT 2000 Drainage Manual
CTGSESC – CTDEP 2002 Connecticut Guidelines for Soil Erosion and Sediment Control
DCIA – Directly Connected Impervious Area
DPF – Department of Public Facilities, City of Bridgeport
E & S – Erosion and Sediment
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FIS – Flood Insurance Study
GIS – Geographic Information System
NPDES – National Pollutant Discharge Elimination System
NRCS – National Resources Conservation Service (formerly SCS)
SCS – Soil Conservation Service (now referred to as the NRCS)
SWCIP – Storm water Capital Improvement Plan
USDA United States Department of Agriculture
USACOE – United State Army Corps of Engineers
WPCA – Water Pollution Control Authority
WQV – Water Quality Volume

3. **RELATED DOCUMENTS AND WEBSITES**

State of Connecticut Department of Transportation

1. Standards Specification for Roads, Bridges and Incidental Construction, Form 816, or as amended. http://www.ct.gov/dot/cwp/view.asp?a=1385&q=305506

2. 2000 Drainage Manual, as amended.
http://www.ct.gov/dot/cwp/view.asp?a=1385&Q=260116&dotPNavCtr=|#40139

3. Standard Details shall be incorporated into this manual, except as revised and modified herein. http://www.ct.gov/dot/cwp/view.asp?a=2288&q=259352

4. Qualified product list. http://www.ct.gov/dot/lib/dot/documents/dresearch/conndot_qpl.pdf

State of Connecticut Department of Environmental Protection

1. 2004 Connecticut Storm Water Quality Manual, as amended.
http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325704&depNav_GID=1654

2. 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, as amended
http://www.ct.gov/dep/cwp/view.asp?a=2720&q=325660&depNav_GID=1654

University of Connecticut (UCONN)

1. NEMO (**Nonpoint Education for Municipal Officials**) is a University of Connecticut program for local land use officials addressing the relationship of land use to natural resource protection.
http://nemo.uconn.edu/index.htm

2. The Map and Geographic Information Center (MAGIC), is the University of Connecticut's Map Library. Collect maps, atlases, gazetteers, aerial photographs, and digital geospatial data, as well as resources on the history and current state of mapping.
http://magic.lib.uconn.edu/

City/State/Federal Government

1. City of Bridgeport
http://ci.bridgeport.ct.us/

2. Bridgeport Enterprise GIS System
www.ci.bridgeport.ct.us/gis

3. State of Connecticut
http://www.ct.gov/

4. FEMA Map Service Center to purchase or view flood studies and maps.
http://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1

5. USDA Natural Resource Conservation Commission Web Soil Survey
http://websoilsurvey.nrcs.usda.gov/app/

6. Facility Plan 2000 Report Water Pollution Control Authority of Bridgeport, Connnecticut.

7. Storm Water Improvements and Flood Control Report

4. **INTRODUCTION**

The purpose of this design manual is to provide standards to be used to prepare plans that will be reviewed within the Subdivision Regulations, Zoning Regulations and the Inland Wetland-Watercourse Regulations.

The standards found herein are requirements that are to be used to reach the application and permit stage. Every site has its own unique characteristics and must be prepared and dealt with on its own merits and there can be no substitute for an exchange of information with City staff to insure all concerns have been addressed.

The manual gives design minimums and maximums, formulas, details, procedures and other information. In the event a situation occurs that is not covered within this manual, the designer is advised to first receive approval from the City Engineer concerning the acceptance of a particular procedure, formula or design.

5. **OVERVIEW OF THE REGULATIONS**

All projects including new construction, projects adding more than 200 square feet of impervious surfaces, and which generate earth disturbance of 20,000 square feet or more (5,000 sq ft or more in flood prone areas) must comply to the greatest extent practical with the requirements of the Storm Water Management Regulations. There are four major elements to the Bridgeport Storm Water Regulations: Water Quality, Water Quantity, Channel Protection, and Flood Control Requirements. Water Quantity & Quality shall adhere to the maximum extent practicable treatment standards.

Maximum Extent Practicable (MEP) as defined by Environmental Protection Agency (EPA) is "to reduce and/or eliminate to the extent achievable using control measures that are technologically available and economically practicable and achievable in light of best industry practices."

The flood insurance study for the City of Bridgeport has designated areas as Zone A, areas inundated by a 100-year flood and Zone V, areas of 100-year coastal flood with velocity (wave action).

A. Water Quality Requirements

The Water Quality Requirement concerns the first one inch of precipitation over Directly Connected Impervious Areas from each storm and is established to: (1) recharge the groundwater table and increase stream base flows; and (2) reduce contaminated runoff from sites as well as to improve water quality discharge into Long Island Sound.

1) The management technique required is infiltration unless infiltration is determined to be physically impossible (due to contamination, high groundwater table, shallow bed rock, poor infiltration rates) or where it can be shown that doing so would cause property or environmental damage.

2) Where infiltration is not feasible for the entire inch, any remaining portion of the initial inch of precipitation from a storm that cannot be infiltrated must be treated for water quality using the secondary treatment practices found in the CTDEPSWQM.

B. Water Quantity Requirements

The City of Bridgeport's goal is to protect existing and new development by minimizing the increase of storm water runoff volume beyond that experienced under predevelopment conditions and by reducing peak storm water flows.

At a minimum, flow control (detention) shall be sufficient to reduce runoff volume and peak flow rates to 10% less than their pre-development levels for required storm frequencies, 24-hour runoff events. Note that for redevelopment projects, pre-development condition is determined as follows:

Redevelopment projects have two options in determining impervious area under pre-development conditions:

1. Use the Existing Conditions, which are the conditions on the site on the day that the Developer starts the development process.
2. Determine historical imperviousness for site by conducting a review of aerial photos and other acceptable methods of interpreting impervious coverage as far back as 1970. The greatest percent impervious coverage since 1970 may be used for the pre-development condition when calculating flood controls. The developer is responsible for providing the City with legible and acceptable documentation historical site impervious coverage used in the project design.

C. Channel Protection Requirements

The Channel Protection Requirement is established to: (1) protect the quality of stream channels and banks, fish habitat, and man-made infrastructure from the influences of high stream velocity erosive forces and (2) prevent filling of embankments and promote widening of existing channels to historical widths. The requirement applies equally to natural and man-made watercourses, and also to sites discharging to drainage ditches, natural or man-made ponds, direct discharge and storm lines if those systems ultimately discharge to previously listed receiving waters. However, the Channel Protection Requirement does not apply to sites directly discharging to tidal waters.

All developments and redevelopments, subject to these regulations, shall provide the City's Department of Public Facilities, with a "Right of Access" or access easement where deemed necessary by the Department. An access easement shall be a minimum of 15 feet beyond the top of bank on both sides of the watercourse or as defined by the Engineering Department in lieu of defined bearings and distances.

D. Flood Control Requirement in Flood Prone Areas

The Flood Control Requirement is established to: (1) reduce or prevent the occurrence of flooding in areas noted on Exhibit 8-2, as may be caused by inadequate storm line capacity or stream bank overflow and (2) to reduce the frequency, duration and quantity of overflows in combined sewer sheds.

The Flood Control Requirement is based upon ongoing watershed wide planning studies determining flood management districts for controlling peak rates of runoff. As a minimum, a development project is required to reduce runoff volume and peak flow rates of the post-development by 10% in comparison to pre-development conditions for storm frequencies noted in Section 7. As planning programs are completed for Bridgeport's watersheds, new Flood Control Districts will be listed in the manual which will more accurately reflect the level of flood protection needed in localized settings.

6. **WATER QUALITY CONTROLS**

All storm water management practices shall be designed according to the Best Management Practices (BMP) to capture and treat storm water runoff. The Best Management Practices should be selected according to the specifications outlined in CTDEP 2004 Connecticut Storm Water Quality Manual to meet the maximum extent practicable treatment standards.

In order to achieve the maximum extent practicable treatment standards all storm water management practices shall be designed and selected to be the most effective at treating pollutants and reducing flow velocities.

Some of the BMP measures shall include but not be limited to:

1. Maximizing flow paths from inflow points to outflow points of basins, pools and ponds.
2. Protection of inlet and outfall structures.
3. Elimination of erosive flow velocities.

The basic design concept for flow control (detention and retention) is simple: water from developed areas is managed with a variety of flow control techniques and released to downstream conveyance systems at a slower rate (detention) and lower volume (retention). Managing flows in this way attempts to mimic the site's natural rainfall runoff response prior to development.

A. Overflow Requirement Criteria

Flow control is intended to protect downstream properties, infrastructure, and natural resources from the increases in storm water runoff peak flow rates and volumes resulting from development.
Storm water runoff from almost all the developed areas of the City, whether served by separate storm water sewers or combined sewers, is causing impairment to the aquatic and riparian habitats of streams and rivers in Bridgeport. These water bodies are suffering from streambank and channel erosion resulting in the exposure of sewer infrastructure and decreased stream baseflow due to reduced groundwater recharge. The streams do not support healthy aquatic communities, do not meet uses designated by the State, do not serve as amenities to the community, and occasionally cause property damage due to flooding.

The City's policy is to ensure that runoff leaving the post-development site:

- Does not exceed the capacity of the receiving conveyance facility or water body.
- Does not increase the potential for stream bank and stream channel erosion.
- Does not add significant volume to an existing closed depression, such as Lake Forest or other similar geologic features found throughout the City.
- Does not create or increase any upstream or downstream flooding problems.
- Does not create or increase the occurrence of CSOs or basement sewer backups.

In order to achieve the City's Policy, connection of the overflow pipe from the infiltration facility to the city's storm sewer pipe or combined sewer will only be allowed under extenuating circumstances. The City's approval will be required. After the City's approval, the developer shall submit calculations adhering to the submittal requirements and verifying that there will be no upstream & downstream flooding & no combined sewer surcharge or backup onto the street or into basements.

B. Flow Control Requirements for Projects Adding more than 200 square feet of Impervious Surfaces

- No storm water from addition shall drain to adjacent properties or over public sidewalk.
- Storm Water disconnection is recommended by either diverting the runoff to low impact development features like grass swales, rain garden or by installing best management practices (BMP) like drywells, pervious pavement.
- A zero peak run off and volume for design year storm events shall be met.

  Best Management practices and Low Impact Development features shall be implemented to help mitigate the effects of site disturbance and new impervious area. The use of non-structural best management practices is encouraged in order to minimize the reliance on structural practices.

C. NPDES Combined Sewer Permits and Regulations

Storm sewers discharging to surface waters in Bridgeport are regulated under the NPDES. Measures required under NPDES storm water permits include storm water management during construction and storm water management on the developed site after construction.

Sections of Bridgeport's land area is served by sewers that carry sanitary sewage and storm water in a single pipe. During dry weather, all this flow is treated at water pollution control plants before discharge to receiving waters. During wet weather, total flow exceeds the capacity of the sewer system and a portion of the flow (combined sewer overflow) is discharged untreated to receiving waters.

Storm water management is an integral part of Bridgeport's approach to CSO management. United States Environmental Protection Agency's (USEPA) CSO Control Policy, published in 1994, promotes effective storm water management on a watershed basis.

All site designs shall establish storm water management practices to control the peak flow rates of storm water discharge associated with specified design storms and reduce the generation of storm water. The most effective practices increase infiltration and evaporation at the site level and reduce the amount of wet weather flow in the sewer system. These practices should seek to utilize pervious areas for storm water treatment and to infiltrate storm water runoff from driveways, sidewalks, rooftops, parking lots, and landscaped areas to the maximum extent practical to provide treatment for both water quality and quantity. Other practices detain storm water and release it to the sewer system at a slower rate, taking advantage of sewer system capacity over a longer period of time. These techniques are most effective during small storms. Techniques designed to limit streambank erosion and flood damage during large storms work equally well in areas of combined sewers and separate storm sewers.

D. Reduced Site Disturbance and Storm Water Management

Item reserved for future implementation.

7. HYDROLOGIC DESIGN CRITERIA

The design procedures outlined in the CTDOTDM shall be followed. Design procedures other than what is outlined by the CTDOT must be approved by the City Engineer.

Peak discharge for the design of wet and dry detention systems may be derived from the SCS Graphical Peak Discharge Method - Technical Release 55 (TR-55). Use of this method shall be limited to watersheds less than 20 square miles having a 24-hour duration and a storm pattern with a Type III distribution. 24-hour rainfall-frequency relationships for Fairfield County are provided in the CTDOTDM.

Watershed Area: Boundaries of the watershed shall be established from field survey and/or City topographic maps. The City's topographic maps are available through the Bridgeport Enterprise GIS System.

Time of Concentration: The amount of time needed for runoff to flow from the most remote point in the drainage basin to the point of analysis. Time of concentration shall be derived for all storm systems constructed. The minimum time of concentration to be used shall be ten minutes. An acceptable measure for time of concentration in a residential area is as follows: ten (10) minutes to gutter plus time to flow in gutter to first inlet plus time in the storm drains equals time of concentration. Other calculations of Tc shall follow CTDOTDM.

Design Storm Criteria
An increase in peak storm water flow is not allowed under any circumstances. All projects shall be evaluated for the pre- and post-development peak flows in accordance with the following table.

Table 1
Pre vs. Post Design Storm Frequencies

Project Type	Design Storms
Single Residential	2-, 10-year
Multi Residential	2-, 10-, 25-year
Commercial Districts	2-, 10-, 25-, 50-year
Industrial Parks	2-, 10-, 25-, 50-year

Zero increase in runoff shall be met**. At a minimum, the proposed development for the new construction shall be planned so that there is a 10% decrease in the volume of storm water runoff and post development peak flow rate from the site under the design storm frequencies noted in Table 1.**

City's approval for the overflow connections will be required and shall be sized for 100-yr storm event only to bypass post-development peak runoff in controlled flow velocities without eroding outlets and downstream properties.

8. HYDRAULIC DESIGN CRITERIA

A. Storm Drainage Systems

All public roadway cross culverts, detention basins, channels and ditches, driveway culverts and street drainage shall be designed in conformance with the CTDOTDM, as amended. This requirement may be varied by the City Engineer according to conditions of the land and drainage requirements.

Storm drainage systems constructed under these regulations shall provide the proper drainage of the tributary area to the satisfaction of the City Engineer. The developer shall make provisions for the proper elimination of all stagnant water within the limits of the proposed site or subdivision.

The design of the drainage facilities shall be undertaken with due considerations of the rights of the abutters and the responsibilities of the City. Provisions shall be incorporated to prevent the interruption of natural flows at the limits of the site and to minimize the impacts on the adjacent properties.

Drainage systems shall be constructed to a suitable outlet (i.e. watercourse, City drainage system) and sized to accommodate the design storms listed in Table 2. All storm water runoff generated from new development or redevelopment shall not discharge storm water directly into an inland wetland or watercourse without adequate treatment and appropriate Inland Wetland Commission approval. Storm water shall not discharge into a natural depression without a point of release unless the proper rights for storage and/or provisions for adequate outlets have been secured.

Table 2
Design Storm Frequencies

Drainage System	Design Storm
Storm Drains	25-year
Ditches and Channels	50-year
Detention Basins	2-, 10-, 25, 50-year[1]
Drywells	10 year[2]
Private Driveway Cross Culvert	10-year
Public Roadway Cross Culvert or Watercourse[4] Watershed <1 mi^2 Watershed >1 mi^2	 50-year 100-year
Bridges/Box Culvert	100-year[3]
Pumping Stations	25-year

[1] A 100-year storm shall be routed through the facility to ensure that the embankment will not be damaged or fail during the passage of that storm.
[2] One to three family residences shall be designed for 2 year storm events
[3] Design of any structure located on a watercourse which is included in the Flood Insurance Study for Bridgeport shall be analyzed using the 100 year storm.
[4] State roadway shall conform to CTDOT standards.

Table 3 Installation Criteria	
Storm Water Velocity in Drainage System	Minimum: Three (3) feet per second Maximum: Fifteen (15) feet per second
Catchbasin Spacing	350 feet maximum from high point 300 feet maximum spacing (Note 1)
Manhole Spacing	300 feet maximum
Maximum allowable headwater in structure	One (1) foot below the top of the grate
Minimum grade of storm sewer	One-half (0.5) percent (Note 2)
Minimum amount of cover (Note 3)	Class V RCP – One (1) foot Class IV RCP – Two (2) feet ACCMP – Two (2) feet PVC/HDPE – Per manufacturer's specification
Storm water depth on catchbasin	Three (3) inches maximum in public parking lots One (1) inch below the top of curb on roadway
Storm water spread on catchbasin	Gutter width plus one-half (1/2) of the travel lane located closest to the gutter line
Minimum pipe size	Fifteen (15) inches in City right of way Twelve (12) inches on private developments Six (6) inches for roof leaders/overflow pipe from drywell Four (4) inches for underdrains

Notes:

1. Catchbasin spacing and type shall be determined by gutter flow and ponding analysis as described in the CTDOTDM. A drainage structure or manhole shall be provided at each grade change, change in horizontal direction and at each junction point of two or more storm drains.
2. Variance from this requirement may be granted by the Engineering Department if the storm sewers are designed with a minimum self-cleaning velocity of three (3) feet per second and the proper line and grade of the installation is verified by a licensed land surveyor.
3. Drainage systems within the City's right of way or within proposed right of ways shall be reinforced concrete pipe (RCP). Minimum cover requirements may be increased due to the amount of subjected loading.

B. Flow Control Exemptions

On-site infiltration is required to the **maximum extent practicable** to control storm water volumes and flow rates. Where complete on-site infiltration is not practicable, other on-site retention techniques (such as pervious pavement, green roofs, planters, swales, and other surface vegetated facilities) are required to the maximum extent practicable to reduce runoff volumes, with the following exceptions:

- Wherever space constraints prohibit the construction of on-site retention facilities. Required setbacks from buildings and property lines need to be considered for each facility type.

  If the minimum setback for the infiltration facility is not met then a written statement should be submitted by a professional engineer that the decreased setback will not result in flooding and structural damage to the adjacent foundation or property.

- Wherever the use of surface retention is not practicable or safe because of soil or slope conditions. The City may require an investigation and recommendation of a qualified geotechnical engineer or engineering geologist to demonstrate that this exception applies to a site. It should be noted that some surface retention facilities, such as flow-through planter boxes, are lined and therefore do not infiltrate storm water into surrounding soils.

- Wherever contaminated soils limit the use of retention approaches.

- Wherever the development is located in an area of Bridgeport where flow control is not required. See Section 8.E.

Development and redevelopment are exempt from flow control requirements if they discharge storm water runoff directly into the Yellow Mill River, Pequonnock River, or Long Island Sound and have a surface area less than 5% of the watershed area upstream of the developed site. The applicant shall meet with Public Facilities to verify exemption.

IMPORTANT NOTES:
- This exemption is for flow control only; pollution reduction requirements still apply.
- Development must still properly dispose of storm water using approved methods in accordance with this manual.

Where complete on-site infiltration or the use of retention facilities is not practicable, the absolute minimum guidelines for flow control (detention) shall be sufficient to reduce runoff volume and peak flow rates at 10% less their pre-development levels for the noted storm frequencies in Section 7. Note that for redevelopment projects, pre-development condition is determined as noted in Section 5.B.

C. Flow Control Requirements Specific to Developments Discharging to the Combined Sewer System

Substantial storm water volumes in the combined sewer system result in CSOs and basement flooding in many areas served by combined sewers. Storm water that enters the combined sewer system during low-flow periods is treated at the City's wastewater treatment plants, using costly energy and other resources. For these reasons, it is important to limit the quantity of storm water entering the combined sewer system. Development projects in combined sewer areas are subject to the requirement to **infiltrate storm water on-site to the maximum extent practicable**.

For projects that are served by combined sewers but are unable to infiltrate on-site as per Section 8.B., the absolute minimum guidelines for flow control (detention) shall be sufficient to reduce peak flow rates by 10% less than their pre-development levels for the noted storm frequencies in Section 7, Table 1. Note that for redevelopment projects, pre-development condition is determined as noted in Section 4.B.

The WPCA Facility Plan 2000 Report identified 14 sewer shed areas that required significant improvements. These 14 areas are identified on Exhibit 8-1 with the area number matching that included in the report. Flow requirements will be enforced for all projects located within the 14 combined sewer system areas. The applicant shall meet with Public Facilities to verify exemption.

D. Flow Control Requirements Specific to Developments located in Flood Prone Areas

Substantial storm water volumes in portions of the storm sewer system result in surface and basement flooding in many areas. For these reasons, it is important to limit the quantity of storm water entering the drainage system, and development projects in flood prone areas are subject to the requirement to **infiltrate and retain storm water on-site to the maximum extent practicable**.

For developments that are located in flood prone areas but are unable to infiltrate on-site as per Section 8.B., the absolute minimum guidelines for flow control (detention) shall be sufficient to reduce runoff volume and peak flow rates by 10% less than their pre-development levels for the noted storm frequencies in Section 7. Note that for redevelopment projects, pre-development condition is determined as noted in Section 5.B.

As planning programs are completed for Bridgeport's watersheds, new Flood Control Districts will be listed in the manual which will more accurately reflect the level of flood protection needed in localized settings.

Exhibit 8-2 provides the location of the flood prone areas where flow requirements will be enforced. The applicant shall meet with Public Facilities to verify exemption.

E. Dry Detention Basins

(CTDOTDM Chapter 10)

Dry detention basins are utilized for the detention of storm water to reduce the peak discharge and release the stored water at an acceptable and controlled rate. Dry detention basins shall be designed to drain completely within 72 hours.

Detention structures can be categorized as dry basins, underground storage facilities, and multi-use storage areas such as parking lots, roadway shoulder, and other shallow holding areas. Structures for detention of storm water may be considered together since the major control structures functions the same for each. The maximum depth of storm water allowed at any location in a parking lot shall be six (6) inches.

Control structure release rates shall approximate pre-developed peak runoff rates for the two (2), ten (10), and twenty five (25) year storms, with emergency overflow capable of handling the 100-year discharge. Measures should be employed to prevent the clogging of the outlet structure.

A minimum freeboard of one (1) foot above the 100-year water surface elevation shall be provided for all impoundments. The 100-year event shall be routed through the facility to ensure that the embankment will not be damaged or fail during the passage of that storm.

Relief may be granted from the one hundred (100) year storm design requirements for existing sites with the approval of the City Engineer and provided that:

1.) The physical constraints of site will not allow for construction of a basin for the one hundred (100) year storm event.

2.) Any possible increase in runoff will not adversely impact adjacent properties and area upstream and down stream from the project.

Fencing may be required around the detention basin for public safety. An access gate shall be provided for maintenance purposes. The maintenance of all detention basins, which are required, will be the responsibility of the private property owner(s).

Detention basins shall be constructed as part of the first phase work and incorporate sedimentation and erosion controls to minimize the impacts of construction on adjacent watercourses.

Detention basin embankments shall have a minimum top width of eight (8) feet along the access side of the basin. The bottom of the facility shall slope at 0.5% minimum toward the outlet.

The calculations for the detention pond shall provide information on the impacts of the outflow hydrograph from the detention basin on the existing drainage systems and/or watercourse.

Detention basins that discharge to combined sewers may only discharge 90% of the peak rate of the 10-year predevelopment flow. Storage outflows greater than that rate (i.e. 25-, 50-, 100-year) must be detained longer onsite to ensure that the basin discharge does not overload the combined sewer.

F. Catchbasin with Drywell Design

The use of drywells as a method of storm water discharge must only be considered after all other methods (discharge into City system, watercourse) of storm water discharge have been reviewed and found to be unacceptable by the City Engineer. Drywell systems require constant maintenance to keep them effective, the designer shall design a system that will include maintenance reduction items (i.e. pavement sweeping, low plantings, inspection schedule to remove debris, trash, sediment and other waste material).

Soil data must be submitted to ensure that the soil conditions will allow the installation of a drywell system.

The following information shall be provided:

1. Soil Boring
   a) Deep test pits.
   b) Provide information on soil conditions and depths.
   c) Provide information on the ground water elevation.
   d) Provide the elevation of bedrock.
   e) Provide information on the location and the date of the boring(s). The boring(s) shall be in the vicinity of and a minimum of two (2) feet deeper than the proposed drywell system.

2. Drywell Design Criteria
   No credit for storage will be given for any part of the system which is below the mottling (apparent groundwater markings in soil layer) elevation.
   The maximum amount of Storage allowed for the voids within any stone layer placed around the drywell is forty (40) percent of the volume of the area occupied by the stone.
   The drywell and the surrounding stone must be wrapped with geotextile.
   The drywell system shall have measures incorporated which prevent sediment from entering the drywell which will affect the performance and/or life of the drywell.
   A six inch overflow connection to an existing drainage system shall be included except where an exception is granted by the City Engineer.

3. The following information on the drywells must be provided:
   a) Type & size of structure
   b) The loading for which the unit was designed
   c) Invert elevations of all pipes
   d) Elevations
   e) Construction details

The drywell shall be sized by the development of a hydrograph. Rational Method triangular hydrograph is an acceptable method for small sites (less than one acre). A minimum of two times the time of concentration shall be utilized for the back leg of a triangular hydrograph. The drywell system design should not include any credit for percolation. The percolation values are to be considered a factor of safety.

The design of the system will be reviewed and approved by the Engineering Department.

9. GENERAL STORM WATER MANAGEMENT POLICIES

A. Channel Right-of-Ways

A channel or brook access of sufficient width to include a fifteen (15) foot access strip on both sides in addition to the width of the channel or brook from top of bank to top of bank, shall be offered for dedication to the City for access purposes. Channels shall be rip-rapped or appropriately lined when deemed necessary.

B. Drainage Easements

Drainage easements, outside of street lines, shall be a minimum of twenty-five (25) feet wide, fifteen (15) feet on one side and ten (10) feet on opposite side of the storm drain. Easement for the system and the outlet structure shall extend a minimum of ten (10) feet beyond the end of the system or to a suitable existing storm drain or an adequate natural watercourse.

C. Intersection Grading

Where the development streets join existing streets, the developer must provide drainage at the intersections as necessary, or as directed by the City Engineer. During the development of a private site, the design should prevent sheet flow from the drives and parking lots from reaching the streets.

D. Private Drains

Rear yard drains, sump pumps or foundation drains that are connected to the storm drainage system, must be shown on the final approved plan of the drainage system.
The use of yard drains are allowed in grassed areas, with the approval of the City Engineer.

It is unlawful to connect any of these items to a sanitary sewer (private or municipal).

E. Drainage Standard Details

All storm drainage facilities constructed under these Regulations shall conform, wherever possible, to the CTDOT standard details or as approved by Engineering.

F. Minimum WPCA/Engineering Standards

1. All storm main design has to be performed by and certified to by a State of Connecticut licensed professional engineer.
2. A sanitary sewer connection permit is needed before connecting into a combination system. The WPCA has to be notified at least two working days in advance before the connection is made so that it can be inspected.
3. The sanitary service and storm service lines have to be separate and independent to the combined sewer main.
4. A service should have a backwater valve if it discharges groundwater from a basement sump pump. The backwater valve, such as Cleancheck®, must be located on the property, five feet from the building, accessible by a eight inch diameter riser pipe with cover, and has to be maintained by the owner.
5. The connection of a new private drainage system to the City collection system cannot be made at a City catch basin.
6. Any illegal connection to a sanitary or storm sewer system will be treated as theft of services and will be dealt with accordingly.
7. If there is no storm sewer adjacent to the property, a storm sewer line extension may be required of the developer at his/her expense.
8. Proposed grading of any development should not adversely impact any neighboring properties.
9. Pre-construction conditions will be considered those that existed during the sites most recent “use”. Interim phase cleanup would not be considered recent “use”, any illegal construction will not be considered recent “use”.

10. STORM WATER CREDITS

Section reserved for future implementation.

11. STORM WATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS

1. Storm Water Management Report
2. Operation and Maintenance Plans
3. Erosion & Sediment Control Plan for more than one-half (½) acre
4. Landscaping Plan where applicable (detailing the vegetation to be planted after construction is finished)

1. Storm Water Management Report

A. Project Narrative

- Project description & purpose
- Executive summary
- Proposed structural or non-structural BMP's
- Soil Evaluation
- Comparison Table for Pre - & Post Development Peak Flow, Volume & Percent Difference
- Construction Schedule

B. Calculations

Hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms as specified in Section 7, Table 1 shall follow the CT DOT Drainage Manual guidelines.

Such calculations shall include, at a minimum:

1. Calculations shall use TR-55 & TR-20 methodology. Rational method should only be used for pipe sizing.
2. Description of the design storm frequency, intensity and duration used to evaluate the design.
3. The hydraulic formulas used as the basis for the design.
4. The design criteria, procedures, and any pertinent information incorporated into the design.
5. Time of concentration and travel time.
6. Soil Curve Numbers or runoff coefficients.
7. Peak runoff rates and total runoff volumes for each watershed area.
8. Infiltration rates, where applicable, as determined by field testing of hydraulic conductivity.
9. Culvert or pipe capacities.
10. Flow velocities.
11. Data on any increase in rate and volume of runoff for the design storms referenced in the CT DOT Drainage Manual.
12. Reference graphs and/or charts used in the design but not included in the references for this manual.
13. Water surface elevations showing methodologies used and supporting calculations.

14. Stage-discharge curves, outlet rating curves and inflow and outflow hydrographs for storage facilities (e.g., storm water ponds and wetlands).
15. Hydrologic and hydraulic analysis for all structural components of storm water system (e.g., storm drains, open channels, swales, management practices, etc.) for applicable design storms including final analysis of potential downstream effects of project, where necessary.
16. Documentation of sources for all computation methods and field test results.
17. Soils Information: If a storm water management control measure depends on the hydrologic properties of soils (e.g., infiltration basins), then a soils report must be submitted. The soils report must be based upon on-site boring logs or soil pit profiles. The number and location of required soil borings or soil sites must be determined based on what is needed to determine the suitability and distribution of soil types present at the location of the control measure. If infiltration is to be part of the storm water management plan, then field testing of hydraulic conductivity is required.

The design and planning of all storm water management facilities shall include detailed maintenance and repair procedures to ensure their continued function. These plans will identify the parts or components of a storm water management facility that need to be maintained and the equipment and skills or training necessary.

2. **Operation & Maintenance Plan**

The applicant must submit a plan of operation & maintenance for all storm water Best Management Practices (BMP's) prior to an issuance of the Certificate of Occupancy through Planning & Zoning Department. Operation & maintenance plan must be filed on land records including a notice of declaration of responsibilities and obligations.

At a minimum Maintenance & Operation Plan shall include the following:

1. Plan that is drawn to scale and shows the location of all storm water BMP's along with the discharge point.
2. Storm water management system owners
3. The party or parties responsible for operation and maintenance including the process of notification to the future property owners of the presence of the storm water management system and the requirement for proper operation & maintenance.
4. Storm water Management practices maintenance Declaration Document
5. Description of maintenance tasks with recommended implementation schedule
6. Description of access and safety issues

3. **Maps & Plans**

The applicant must depict the storm water management on the supplemental plans (scale of 1" = 40' or greater detail). Such plans must illustrate at a minimum:

1. Perennial and intermittent streams.
2. Existing and proposed contours (two feet minimum) or elevations.
3. Existing and proposed building or structures
4. Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)
5. Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains with size and elevations.
6. Location of downspouts, roof leaders and storm lateral
7. Easements if required.
8. Each catchment area clearly delineated with label / structure number.
9. Flow paths.
10. Location of floodplain and floodway limits.
11. Location and dimensions of proposed channel modifications, such as bridge or culvert crossings.
12. Location, size, maintenance access, and limits of disturbance of proposed structural storm water management practices.
13. Representative cross-section and profile drawings and details of structural storm water management practices and conveyances (i.e., storm drains, open channels, swales, etc.) which include existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.) and design water surface elevations.
14. Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.

12. DEVELOPMENT AND REDEVELOPMENT WITHIN FLOOD HAZARD ZONES

The following information shall be provided in addition to any requirements in the Zoning Regulations and shall conform to Ordinance 15.44:

1.) Elevation and limits of the one hundred (100) year flood zone (elevations are to be based on the current NGVD datum).
2.) The limits of inland wetlands and buffer zones.
3.) Existing and proposed grading.
4.) Elevation of the lowest floor of any structure. The lowest floor elevation should be at or above the one hundred (100) year flood zone elevation.
5.) Limits of construction.
6.) Quantities of cuts and fills within the flood zone, flood way, or compensation areas.
7.) Provide sections and calculations for excavation within the flood zones.
8.) Provide evidence of receiving all necessary State and Federal permits.

Compensatory storage at the same elevation must be provided for any fill placed within a flood hazard zone. Information shall be provided on the affects of the development on the floodway carrying capacity of the flood zone.

Exhibit 12-1 provides the boundary limits of the 100-year flood event.

13. SOIL EROSION AND SEDIMENT CONTROL PLANS FOR LAND DEVELOPMENT

A soil erosion and sediment control plan consistent with the publication of the Connecticut Council on Soil and Water Conservation in Cooperation with the Connecticut Department of Environmental Protection entitled, 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, shall be submitted with all project applications when the disturbed area of development is more than one-half (½) acre.

All projects to be reviewed and approved by the Engineering Department, City of Bridgeport shall include methods to adequately minimize erosion or sediment contamination to streams, ponds, rivers and reservoirs. The design engineer shall submit with his design plans, the proposed erosion sedimentation control measures consistent with the guidelines referenced.

The Engineering Department, or its duly authorized representative, shall review these plans as submitted and shall take necessary steps to ensure compliance by the developer with these plans as finally approved.

All Plans shall contain the information requested in the E&S checklist provided in the 2002 Guidelines for Soil Erosion and Sediment Control, Chapter 3.

The estimated costs of measures required to control soil erosion and sedimentation, as specified in the certified plan shall be submitted as part of the application. Measures to be taken to control erosion and sedimentation shall be described and provided for on the approved plans and the estimated cost of accomplishing such measures shall be covered in a Bond.

Site development shall not begin unless the soil erosion and sediment control plan is certified and those control measures and facilities in the plan scheduled for installation prior to site development are installed.

Planned soil erosion and sediment control measures and facilities shall be installed prior to construction, where possible, in accordance to the certified plan. All control measures and facilities shall be maintained in effective condition to ensure the compliance of the certified plan.

Land disturbances are to be kept to a minimum. Restabilization is to be scheduled as soon as possible.

At the building permit application stage, a review will be conducted to ensure conformance with the plan as approved.

The Engineering Department, or its duly authorized representative shall make the necessary review and evaluation of methods used and the overall effectiveness of the erosion and sedimentation control program.