



Stormwater 101 – MS4 Program Overview

November 16, 2017



Southwestern Pennsylvania Commission




The Southwestern Pennsylvania Commission is the cooperative forum for regional collaboration, planning, and public decision-making. Operating with public involvement and trust, the Commission develops plans and programs for public investments; fulfills federal and state requirements for transportation, economic development, and local government assistance programs.

The SPC Water Resource Center

In 2013 SPC formed the Water Resource Center (WRC) to address various water issues within [the region](#). WRC's Mission is to promote regional collaboration on water topics; be a leader in facilitating coordination and education; and provide technical assistance to its member governments. Specifically, the WRC has four major tasks to undertake for its members:

- Provide needed technical assistance
- Provide educational resources
- Serve as a regional information clearinghouse
- Provide a forum for regional coordination of water issues






BH's experienced civil engineering group provides safe and sustainable planning and designs to address utility, stormwater, site access, recreation, and circulation system needs for a wide range of communities.

- MS4 and Industrial stormwater permitting
- Modeling and design for urban, suburban, and rural environments
- Grading and drainage design
- Green Infrastructure
- Stream restoration/bank stabilization
- Erosion & Sediment Control and Best Management Practices (BMP)
- Flood Control Studies and Modeling




Presenting Today:

- **Tom Jackson** – PE, PhD, Hydrologist and lead SWM engineer
- **Tom Allison** – GIS Specialist at BH, Previous MS4 Coordinator at Silver Spring Township, PA
- **Todd Colley** – USDA Extension Specialist



AGENDA

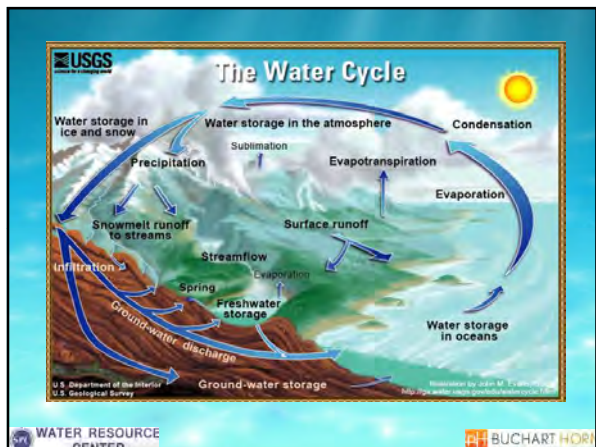
- Hydrologic Basics
- Clean Water Act & Act 167
- MS4 Program Overview
- Minimum Control Measures
- Pollutant Control Measures and Pollutant Reduction Plans
- USDA Rural Development



Hydrologic Basics

It's *not* all Greek!

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What is a watershed?

A watershed is the area of land contributing to stream flow at a given point:

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Fayette County

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Fayette County – Dunlap Creek

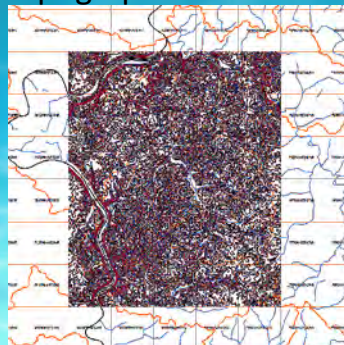
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Topographic Map Grid



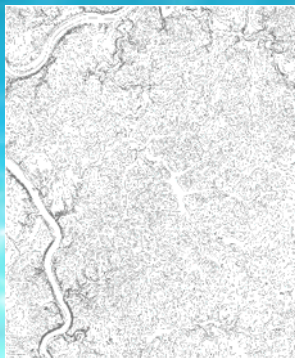
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Topographic Contour Lines



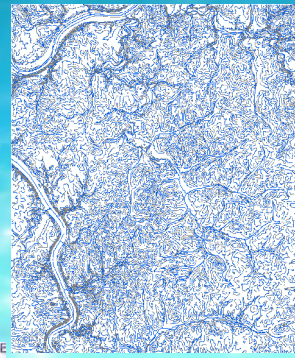
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50 Foot Contour Lines



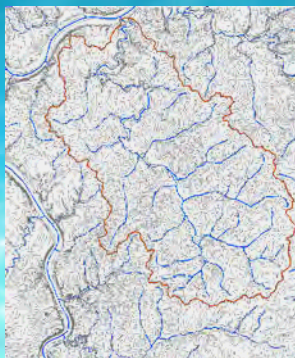
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Contours and Streams



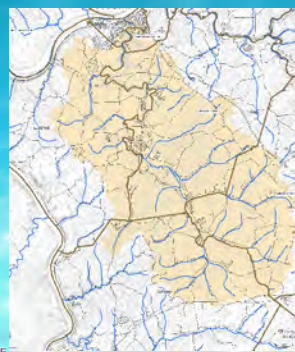
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Dunlap Creek Watershed Boundary



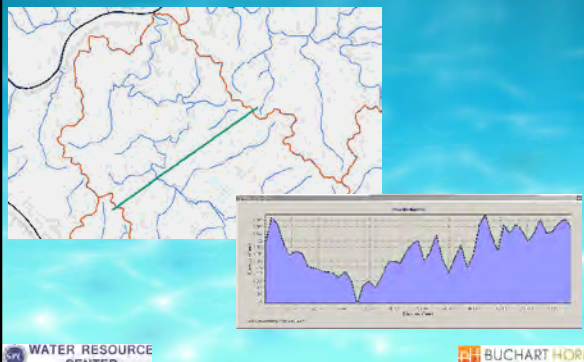
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Roads and Municipalities



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Elevation Profile



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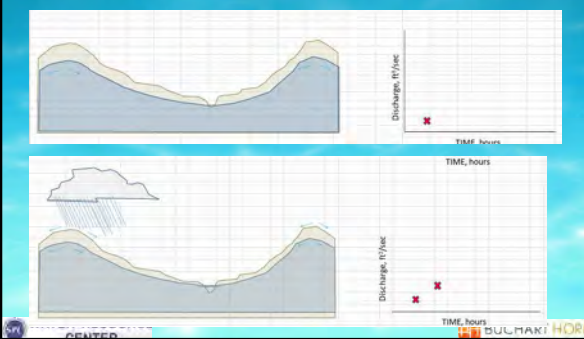
What is a Runoff Hydrograph?

The variation in flow over time at a specific point in a watershed is represented in graphical form as a Runoff Hydrograph.

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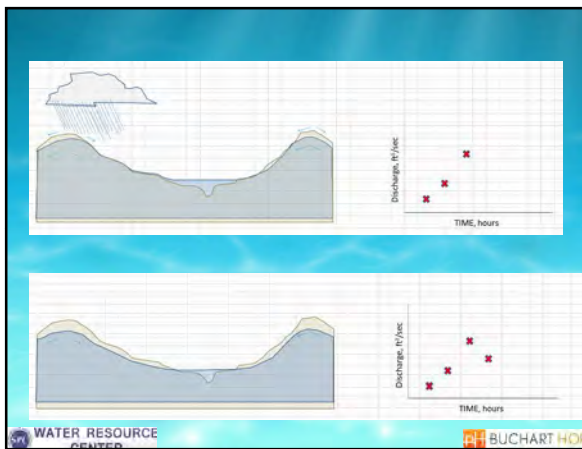
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Runoff over time



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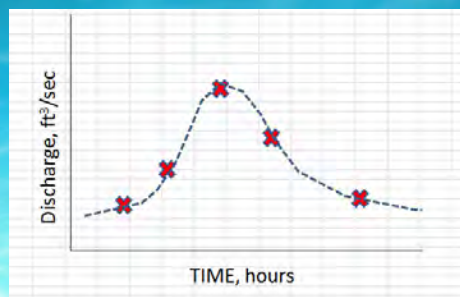
End of the rainfall event – back to “normal stream flow”



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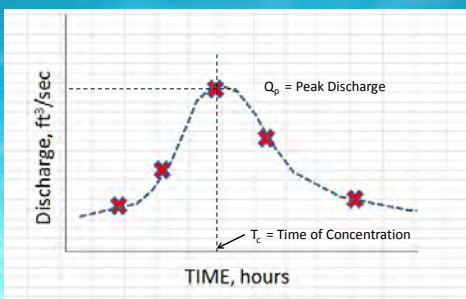
Runoff Hydrograph, Q(t)



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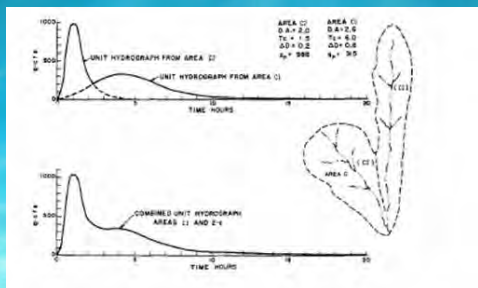
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Runoff Hydrograph, $Q(t)$

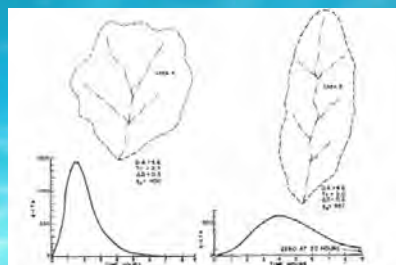


The shape of the watershed has an impact on its hydrologic response (its hydrograph)

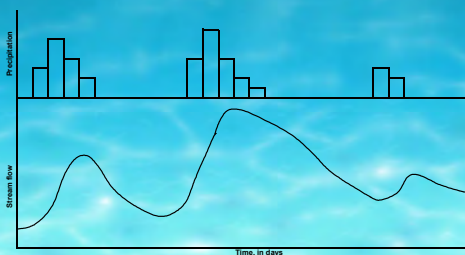
Hydrographs below a tributary are impacted by both branches:



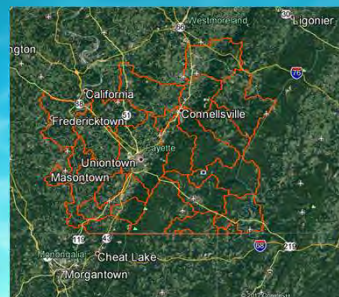
The shape of the upstream watershed will have a pronounced effect on the form of the hydrograph:



Hydrograph response to rainfall



Precipitation Data for Connellsville, PA



Go to NOAA Atlas 14 Point Precipitation Estimates for PA
https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Location information:
 Name: Duran, Pennsylvania, USA
 Station name: CONNELLSVILLE_2
 Site ID: 30-1728
 Latitude: 39.9811°
 Longitude: -79.6313°
 Elevation: 900 ft

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Units of Measurement

- A cubic foot per second (1 ft³/sec) is a volume of water flowing past a given point in one second
- 1 ft³ ≈ 7.5 gallons
- “A pint’s a pound the world round”
- So 1 ft³ of water weighs about 60 pounds
- Actually it weighs about 62.4 pounds, because the old saying isn’t exactly right

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Precipitation Data for Connellsville, PA

Station	Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
30102	1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Precipitation Data for Connellsville, PA

PDS-based depth-duration-frequency (DDF) curves
 Latitude: 39.9811°, Longitude: -79.6313°

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Precipitation Data for Connellsville, PA

Station	Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
30102	1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Return Period & Probability

Return period is measured in years. A two-year return period (T = 2-yr) has a magnitude that will occur on average once in two years.

Another way to say that is: a storm with a return period of 2 years has a 50% probability, p, of occurring in any given year.

$$P = \frac{1}{T}$$

So a rainfall event with a return period of 25 years would have a 4% probability of occurring in any year. For T = 100, p = .01 or 1%

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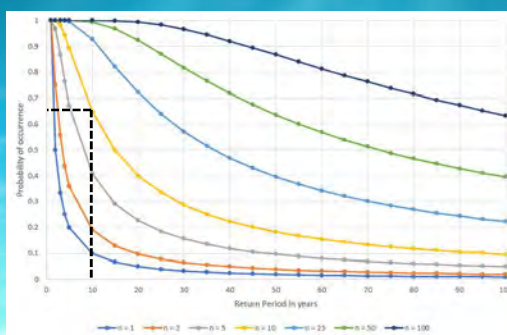
Return Period & Probability

It is NOT true that a storm with a return period T of 10 years will occur exactly once in ten years..

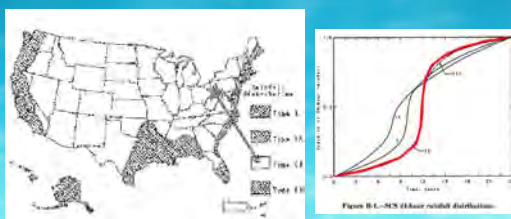
It has a 10% chance of occurring in any year. But over a ten year period, a storm of that intensity or greater has about a 65% chance of occurring. Or in the language of statistical hydrology, it has a probability of failure, P(f) = 0.651.

$$P(f) = 1 - (1 - p)^n$$

Return Period & Probability



Precipitation Data for Connellsville, PA



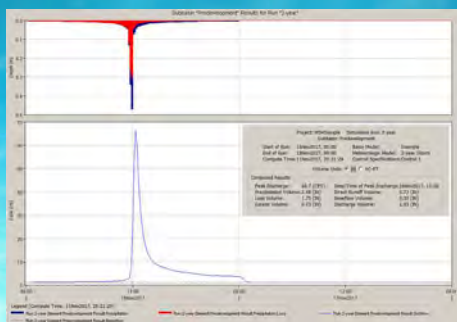
Modeling the impact of development

Consider an undeveloped watershed as follows:

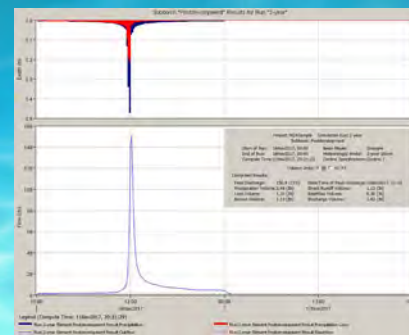
- 160-acre contributing areas, 5% impervious
- Runoff Curve Number of 75
- Time of Concentration = 25 minutes

Look at hydrograph for a 2-year rainfall event:

Predevelopment hydrograph, 2-yr Storm



Post development hydrograph, 2-yr Storm



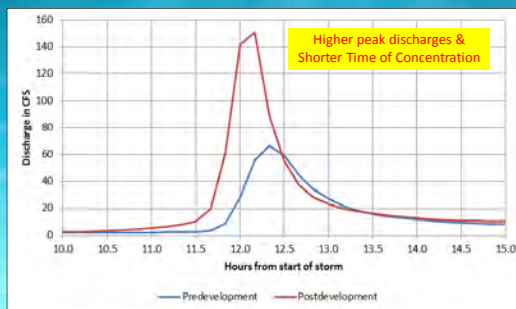
Modeling the impact of development

Consider the watershed after development:

- 160-acre contributing areas, 10% impervious
- Runoff Curve Number of 82
- Time of Concentration = 12 minutes

Look at hydrograph for a 2-year rainfall event:

Modeling the impact of development



Modeling the impact of development

Consider the watershed after development:

- 160-acre contributing areas, 10% impervious
- Runoff Curve Number of 82
- Time of Concentration = 12 minutes

Look at hydrograph for a 2-year rainfall event:

Uncontrolled runoff from development causes higher peak discharges and shorter times of concentration, leading to watershed degradation:

Channel scouring, downstream sedimentation, & stream bank erosion



Higher Flood Levels



Increased Pollutant Loads



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The Clean Water Act & Act 167

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Cuyahoga River (Lake Erie) on fire in 1958!



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Clean Water Act

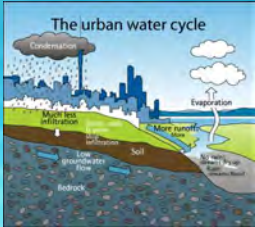
- Established in 1972, with authority for implementation given to the USEPA
- Governs Water Pollution into any 'Waters of the U.S.'
- Introduced the NPDES (National Pollutant Discharge Elimination System), which is a permitting system that governs point source pollution, including MS4 permitting



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Water Cycle In Urbanized Areas


- The traditional water cycle is disrupted by urbanized areas
- This ultimately creates more runoff and pollution
- This leads to more flooding and decreased water quality, in both small and large water bodies



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Act 167: Stormwater Management Act of 1978

- Required that counties develop and adopt a watershed storm water management plan
- For MS4 Municipalities, compliance can be achieved by enacting a storm water ordinance consistent with PA DEP's requirements



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MS4 Program Overview

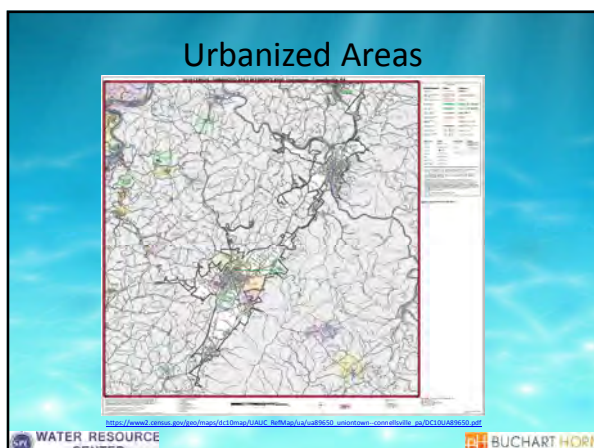
MS4's

- MS4 = "Municipal Separate Storm Sewer Systems"
- An MS4 is a system that:
 - Collects and Conveys Stormwater
 - Discharges to Waters of the U.S.
 - Owned by a public entity (Township, City...)
 - Is not a combined sewer



Phase I and Phase II MS4's

- Phase I – 1990 regulation for large cities with populations over 100,000
- Phase II – 1999 regulation for smaller MS4s within the Urbanized Areas
 - Includes some larger universities, hospitals, prisons, and PennDOT
- Majority of MS4 Permits are Phase II



MS4 Permits

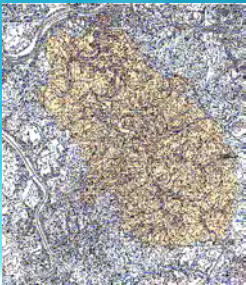
- 5 Year Permit Term
- Permit dictates annual requirements as well as requirements for 5 year term
- Permit Types: General, Individual, and Waiver

MS4 Permits – Fayette County

Permit No.	Permittee Name	Permit Type	Effective Date	Expiration Date	Regulatory Agency	MS4 ID	MS4 Name	MS4 Type	MS4 Category	MS4 Subcategory	MS4 Description	MS4 Status
100001	Fayette County	General	10/1/17	9/30/18	DEP	100001	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100002	Fayette County	General	10/1/17	9/30/18	DEP	100002	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100003	Fayette County	General	10/1/17	9/30/18	DEP	100003	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100004	Fayette County	General	10/1/17	9/30/18	DEP	100004	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100005	Fayette County	General	10/1/17	9/30/18	DEP	100005	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100006	Fayette County	General	10/1/17	9/30/18	DEP	100006	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100007	Fayette County	General	10/1/17	9/30/18	DEP	100007	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100008	Fayette County	General	10/1/17	9/30/18	DEP	100008	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100009	Fayette County	General	10/1/17	9/30/18	DEP	100009	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active
100010	Fayette County	General	10/1/17	9/30/18	DEP	100010	Fayette County	MS4	MS4	MS4	Fayette County MS4	Active


http://www.dopr.com/agencies/state.pa.us/ReportServer/ReportViewer.aspx?774MS/MS4_PermitList_Facilities_MS4

- ### MS4 Permit Elements
- Minimum Control Measures (MCMs)
 - Pollutant Control Measures (PCMs)
 - Pollutant Reduction Plans (PRPs)
 - Other Requirements (waste disposal, etc)

- ### MS4 Permit Elements
- Annual Report to DEP
 - \$500 Annual Fee for General Permits
 - Collaboration on permits and/or plans with other municipalities is encouraged (York County)
- 

MS4 Permit - Minimum Control Measures


- ### Minimum Control Measures
- 
- Applies to all permittees
 - MCM #1 – Public Education and Outreach
 - MCM #2 – Public Involvement and Participation
 - MCM #3 – Illicit Discharge detection and Elimination
 - MCM #4 – Construction Site Stormwater Runoff Control
 - MCM #5 – Post Construction Stormwater Management
 - MCM #6 – Pollution Prevention and Good Housekeeping

- ### MCM #1 – Public Education and Outreach
- BMP #1 – Written Program
 - Plan documenting who the Target Audience Groups are and how to reach them
- 

MCM #1 – Public Education and Outreach

- **BMP #2 – Target Audience Groups**
 - A List (often with contact info)
 - Residents, Businesses, Developers, Schools, Municipal Employees, and more

FOR THE PUBLIC
 From the Department of Environmental Protection
 Environmental Protection Division
 240 State Street
 Hartford, CT 06103
 Telephone: (860) 424-3200
 Fax: (860) 424-3201
 Email: DEP@dep.state.ct.us
 Website: www.deps.state.ct.us



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MCM #1 – Public Education and Outreach

- **BMP #3 – Publishing a Newsletter**
 - Either in print or online
 - Displaying DEP and EPA websites
- **BMP #4 – Other Forms of Outreach**
 - Events, Meetings, Presentations, Posters, Brochures, Giveaways, Advertising, and more

STORMWATER UPDATE
 Providing the public with information about stormwater management and water quality is a key goal of the Department of Environmental Protection. This newsletter provides information on current stormwater programs, projects, and events. It also provides information on how you can help reduce stormwater runoff and improve water quality. For more information, please contact your local DEP office or visit our website at www.deps.state.ct.us.

Quick Links

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- Publications
- Training
- Events
- Services
- Resources
- Links

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MCM #2 – Public Involvement and Participation

- **BMP #1 – Written Plan**
 - Plan documenting the opportunities and methods of communication to the public
- **BMP #2 – Solicit Public Input**
 - On Storm water Management Ordinances and Pollutant Reduction Plans




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MCM #2 – Public Involvement and Participation


- **BMP #3 –Public Involvement and Participation**
 - Public meetings with opportunities for input
 - Document and Report instances of cooperation
 - Creek Cleanups, Trash Cleanups, Rain Barrel Workshops, Tabling at Events





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MCM #3 – Illicit Discharge Detection and Elimination

- **Written Plan**
 - Includes identifying high risk areas, procedures for identifying and dealing with illicit discharges and complaints, and mechanisms for gaining access to private property






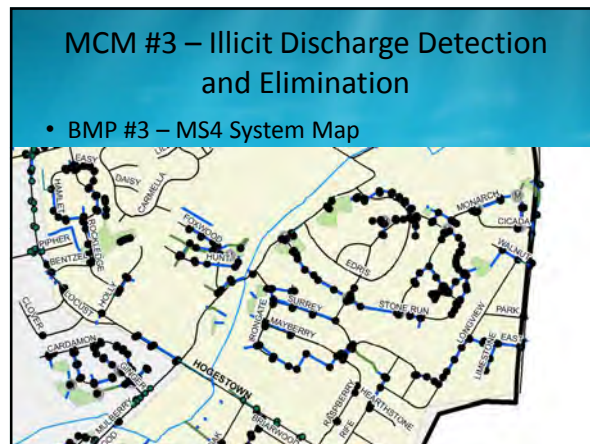
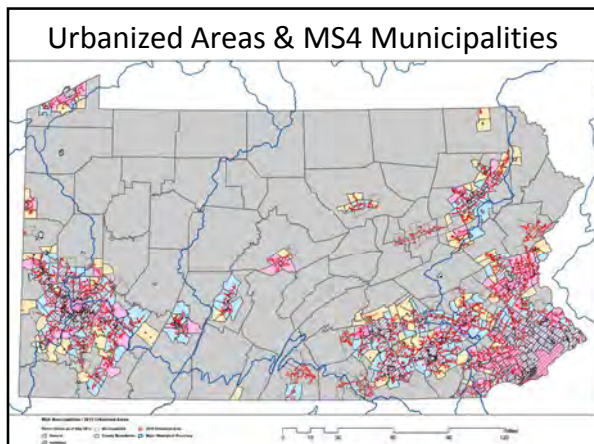
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MCM #3 – Illicit Discharge Detection and Elimination

- **BMP #2 – Outfall Map**
 - Outfalls, Urbanized Areas, Municipal Boundaries, Surface Waters
 - Outfalls are any location where storm water is conveyed through the municipal system and reaches the surface water





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MCM #3 – Illicit Discharge Detection and Elimination

- BMP #3 – MS4 System Map
 - Good opportunity to gather information while mapping on pipe/inlet/basin condition
 - Information that can be used to assess the system as a whole, determine risk of failure, and prioritize repairs – Proactive instead of Reactive

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Asset Management


- The development of MS4 Mapping required for MCM#3 compliance provides a great opportunity for future implementation of an Asset Management Plan
- There are 10's, and potentially 100's of miles of stormwater pipes in a municipality



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Asset Management

- With so many aging pipes in the ground there is always a chance for failure somewhere
- Asset Management can help reduce that risk



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MCM #3 – Illicit Discharge Detection and Elimination

<https://www.youtube.com/watch?v=NTbhyHNA1Vc>

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MCM #3 – Illicit Discharge Detection and Elimination

- **BMP #4 – Dry Weather Outfall Screenings**
 - Once every 5 years to ensure there are no septic/non-permitted connections or dumping
 - Procedures for testing polluted water

The image shows a 'MS4 OUTFALL FIELD SCREENING REPORT' form. It includes sections for 'BACKGROUND INFORMATION' (Project Name, Location, Date, etc.), 'OUTFALL DESCRIPTION' (Type of Outfall, Location, etc.), and 'SCREENING RESULTS' (Flow, Turbidity, etc.). There are checkboxes for various screening criteria and a section for 'COMMENTS'.

MCM #3 – Illicit Discharge Detection and Elimination

- **BMP #5 – Stormwater Ordinance**
 - Must prohibit non-stormwater discharges to the MS4
- **BMP #6 – Education Outreach**
 - Outreach focused on illicit discharges
 - A reporting mechanism (phone number, form, etc) to document and correct all issues



MCM #4 – Construction Site Stormwater Runoff Control

- **BMP #1 – NPDES Permit Requirements**
 - No building/zoning permits issued until an NPDES permit is issued if required
- **BMP #2 – CCD Notification if NDPS is needed**
- **BMP #3 – Ordinance Requiring E&S Controls**



MCM #5 – Post Construction Stormwater Management

- **BMP #1 – SW Management Ordinance**
 - Require Post Construction SW Management BMPs
- **BMP #2 – Encourage low Impact Development**



MCM #5 – Post Construction Stormwater Management

- **BMP #3 – Operation and Maintenance of BMPs for larger projects**
 - Develop a BMP inventory from 2003 to present
 - Ensure adequate Operation and Maintenance of those BMPs through some kind of inspection program



Inspection Flowchart (MCM #5)



MCM #6 – Pollution Prevention and Good Housekeeping

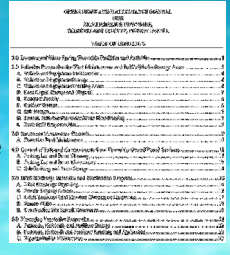
- BMP #1 – Municipal Inventory
 - List all municipal operations that have the potential to pollute: Municipal Buildings, Park Maintenance, Snow Removal, Vehicle Maintenance




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MCM #6 – Pollution Prevention and Good Housekeeping





- BMP #2 – Written Operation and Maintenance Plan
 - Procedures to reduce pollution: Discharges from Floor Drains, Outdoor Storage Areas, Chemical Products, Disposal of Waste, etc
 - DEP and EPA are looking for an all inclusive document



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MCM #6 – Pollution Prevention and Good Housekeeping

- BMP #3 – Employee Training Program
 - Should occur at least annually
 - Encompasses all employees (Police, Fire, Public Works, Administrative, Code Enforcement, etc)

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Pollutant Control Measures and Pollutant Reduction Plans

- New to the 2018 Permit
- Requirements vary for each municipality
 - Identify sources of pollution
 - Reduce pollution percentage for Nitrogen, Phosphorous, and Sediment
 - Plan must include funding sources



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MS4 Permit – Pollutant Control Measures

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Pollutant Control Measures

- May not apply to all permittees
- Aimed at identifying and reducing specific types of pollution
- Appendix A: Surface waters impaired for metals and/or pH associated with Abandoned Mine Drainage

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MS4 Requirements Map

MS4 Requirements

MS4_STREAMS
 - PDES NPDES
 - Unpermitted

MS4_URBAN_AREAS
 - NVC12
 - MCO

<http://www.deppis.state.pa.us/MS4/index.html>

Helpful Links

- EPA's NPDES Website:
 - <https://www.epa.gov/npdes>
- Main PA DEP MS4 Page:
 - <http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/default.aspx>
- DEP's website with MS4 permit documents:
 - <http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-9457>
- DEP's List of Collaborating Municipalities:
 - <http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/Collaboration.aspx>
- Hampden Township's Stormwater Authority Article:
 - http://files.dep.state.pa.us/Water/BNPNSM/StormwaterManagement/MunicipalStormwater/PWEA_Magazine_Article.pdf

<https://www.epa.gov/npdes>

National Pollutant Discharge Elimination System (NPDES)

What is NPDES?
 The NPDES permit program authorizes every polluter to discharge pollutants that do not exceed the pollutant level - the effluent limit - established in the discharge permit issued by EPA or an authorized state.

Updated NPDES Permit Water Quality Program
 • General NPDES Permit
 • Construction Discharge

About NPDES
 • NPDES General Permit
 • State program information
 • NPDES Discharge
 • NPDES Construction Discharge
 • NPDES Construction Discharge

Program Areas
 • NPDES Discharge
 • NPDES Construction Discharge
 • NPDES Construction Discharge

Technical Resources
 • NPDES Training Manual
 • NPDES Construction Discharge
 • NPDES Construction Discharge
 • NPDES Construction Discharge

New and Notable
 • NPDES Training Manual
 • NPDES Construction Discharge
 • NPDES Construction Discharge

<http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/default.aspx>

MUNICIPAL STORMWATER

WHAT'S NEW

- MS4 PERMITTEES NOW PREPARING POLLUTANT REDUCTION PLANS AND TMDL PLANS
- TMDL Plan Information PCDF published March 2017
- 2017 Permit Applications Due One Hour NPDES
- Guidance "Local Stormwater Management" if NPDES (July/August 2017)
- Guidance NPDES Construction Discharge Permit Application April 2017
- Information about new NPDES Construction Discharge Permit April 2017
- New permit fees
- Construction Discharge Permit (CDP) TMDL is a new page link to this important approach for addressing NPDES TMDLs
- Construction Discharge Permit (CDP) TMDL is a new page link to this important approach for addressing NPDES TMDLs

RELATED INFORMATION

- STANDARDS/CRITERIA
- COLLABORATION
- REPORTING/RECORDS
- PERMITTING/CONSTRUCTION
- INVESTIGATION
- PERMIT FEES AND
- TRAINING/SUPPORT

<http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-9457>

PAG-13 MS4 General Permits
 2013-2014

PLEASE NOTE: The links are direct to the document files for each permit or collection item. Use the "Previous" button to see the list of program items in the form.

Doc No	Doc Title	Doc Type	Doc Date
10	10 MS4 General Permit - Construction	Permit	2013/01/01
11	11 MS4 General Permit - Construction	Permit	2013/01/01
12	12 MS4 General Permit - Construction	Permit	2013/01/01
13	13 MS4 General Permit - Construction	Permit	2013/01/01
14	14 MS4 General Permit - Construction	Permit	2013/01/01
15	15 MS4 General Permit - Construction	Permit	2013/01/01
16	16 MS4 General Permit - Construction	Permit	2013/01/01
17	17 MS4 General Permit - Construction	Permit	2013/01/01
18	18 MS4 General Permit - Construction	Permit	2013/01/01
19	19 MS4 General Permit - Construction	Permit	2013/01/01
20	20 MS4 General Permit - Construction	Permit	2013/01/01
21	21 MS4 General Permit - Construction	Permit	2013/01/01
22	22 MS4 General Permit - Construction	Permit	2013/01/01
23	23 MS4 General Permit - Construction	Permit	2013/01/01
24	24 MS4 General Permit - Construction	Permit	2013/01/01
25	25 MS4 General Permit - Construction	Permit	2013/01/01
26	26 MS4 General Permit - Construction	Permit	2013/01/01
27	27 MS4 General Permit - Construction	Permit	2013/01/01
28	28 MS4 General Permit - Construction	Permit	2013/01/01
29	29 MS4 General Permit - Construction	Permit	2013/01/01
30	30 MS4 General Permit - Construction	Permit	2013/01/01

<http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/Collaboration.aspx>

COLLABORATION

The following is a collection of resources for those seeking more information on collaborating with other MS4 permittees for permit compliance.

DEP does not require that MS4 permittees work together. However, an economy of scale can be achieved by joining resources to achieve permit and best management requirements. Collaboration can be in any form of team effort to fairly share responsibilities - this can include working together on NPDES, designing the permitting/regulatory process, reviewing consistency in their wastewater treatment, and establishing joint permittees.

To make collaboration work, someone or an entity needs to serve as a "glue" - or the "glue" - for that community. Examples include an individual, an MS4 permittee, authority, a county conservation district, and planning commission.

Outside groups like watershed or environmental organizations can be very helpful in providing resources and ideas when they have a goal similar to yours.

MS4 permittees which only do a joint TMDL Plan and/or PDES should include an agreement (written) before the permit. An agreement/collaboration agreement should be in writing.

- Water Pollution Control Authority (WPCA)
- Community Development Authority (CDA)
- County Conservation District (CCD)

You don't have to go it alone. There are other parties out there that can help you with meeting your MS4 requirements.

- Community Development Authority (CDA)
- County Conservation District (CCD)

Links to resources related to DEP's efforts to address nonpoint source pollution.

RELATED INFORMATION

- STANDARDS/CRITERIA
- COLLABORATION
- REPORTING/RECORDS
- PERMITTING/CONSTRUCTION
- INVESTIGATION
- PERMIT FEES AND
- TRAINING/SUPPORT

