

Using the Q7, 10 as an Indicator of the Affect of Urbanization on Low Flow

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Overview

- Review of terms
- Regulations (MD, PA, NJ) Infiltration
- Data results for 3 gages
 Results for 4 additional gages
- Trends and causes
- Implications -



Base flow

Sustained flow of a stream in the absence of direct runoff.

Natural base flow is sustained largely by ground-water discharges.







Q7-10

• 7-day, 10-year low flow

- 10-year recurrence interval of the lowest mean discharge for 7 consecutive days
 - Or the 7-day low flow with a 10% chance of occurring each year.



HSM

No influence of stormwater runoff



MD Stormwater Design Manual (October 2000)





The impervious surfaces and conveyance systems of developed sites result in an earlier and higher peak discharge rate.

PA Stormwater Best Management Practices Manual

Annual hydrologic cycle for an undisturbed acres in the Pa Piedmont region

Representative altered hydrologic cycle for a developed acres in the Piedmont region.

HSMM

AFCOM



NJ Stormwater Best Management Practices Manual (April 2004)

"Filtration of runoff and removal of pollutants by natural surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into waterways. Increases in impervious area can also decrease opportunities for infiltration and reduce stream base flow and groundwater recharge. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion and adversely impact aquatic organisms and habitats. Reduced base flows can negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on these base flows."



Summary of Stormwater Infiltration/Recharge Regulations

New Jersey

100 percent of the difference between the site's pre- and post-development 2-year runoff volumes be infiltrated.



Maryland

Annual groundwater recharge rates shall be maintained by promoting infiltration through the use of structural and nonstructural methods. At a minimum, the annual recharge from postdevelopment site conditions shall mimic the annual recharge from predevelopment site conditions.



Summary of Stormwater Infiltration/Recharge Regulations (cont.)

Pennsylvania

Volume Control Guidance 1

Do not increase the post-development total runoff volume for all storms equal to or less than the 2-year, 24-hour event.

Existing (pre-development) non-forest pervious areas must be considered meadow (good condition) or its equivalent.

20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

Volume Control Guideline 2

Stormwater facilities shall be sized to capture at least the first 2" of runoff from all contribution impervious surfaces.

At least the first 1" of runoff from new impervious surfaces shall be permanently removed from the runoff flow.

Wherever possible, infiltration facilities should be designed to accommodate infiltration of the entire permanently removed runoff; however, in all cases at least the first ½" of the permanently removed runoff should be infiltrated.



Gage Locations



Monocacy River at Jug Bridge near Frederick



Minimum 7-Day, Average 10-Year Flow, Monocacy River





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Potomac River at Hancock



Youghiogheny River near Oakland









Precipitation?

Consumptive Uses?



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Precipitation



10-Year, Rolling-Average Precipitation



Precipitation data from NOAA, National Climatic Data Center. Climate at a Glance, Annual Precipitation, Maryland http://climvis.ncdc.noaa.gov/cgi-bin/cag3/hr-display3.pl



Overlay of Data



Double Mass Curve

- Method to check the consistency of a record of data
- Plot of the cumulative figures of one variable again the cumulative figures of another variable or against the cumulative computed values of the same variable for a concurrent period of time
- Will plot a straight line as long as the data are proportional
- A break in the slope:
 - A change in the constant of proportionality between the variables
 - The time at which a change occurs in the relation between the two variables

Searcey, J.K. and Hardison, C.H. 1960. Double-Mass Curves: U.S. Geol. Survey Water-Supply Paper 1541-B, P. 31-66

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Double Mass Curves





Youghiogheny River 18,000 Cumulative Average Annual Discharge (cfs) 16,000 14,000 12,000 10,000 8,000 6,000 4.000 y = 0.002x - 2.738 $R^{2} = 1$ 2,000 Ô 0 2,000,000 4.000.000 6,000,000

Cumulative Total Annual Discharge (cfs)

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Additional Gages & WWTP





y = 0.023x - 44.30

 $R^2 = 0.558$

1980

1985

Crabtree Creek near Swanton





Fishing Creek near Lewistown



Savage River near Barton

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y = 0.002x - 4.522

 $R^2 = 0.007$

....

2010

2000

1990



Marsh Run at Grimes

7-Day Minimum Flow, Marsh Run













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