

Stormwater Infiltration and Groundwater Recharge Requirements
npsinfo thread 12/08

Original Post:

Folks,

I'm trying to find as many examples as possible of state or local stormwater rules that require infiltration, groundwater recharge or some other form of runoff volume reduction. If you are aware of such requirements in your state or region, please send me the info off-list (jay.dorsey@dnr.state.oh.us), including any web links to the rules or guidance. I'll compile responses for those who are interested. (Has anyone already compiled this information?)

The only example I'm aware of from Ohio is the TMDL-driven NPDES Construction Stormwater Permit for the Darby Creek Watershed:

Groundwater Recharge Requirements. The SWP3 shall ensure that the overall site post-development groundwater recharge equals or exceeds the pre-development groundwater recharge. The SWP3 shall describe the conservation development strategies, BMPs and other practices deemed necessary by the permittee to maintain or improve pre-development rates of groundwater recharge.

(details at:

http://www.epa.state.oh.us/dsw/permits/GP_ConstructionSiteStormWater_Darby.html)

Thanks

Jay

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Jay-

Massachusetts has a groundwater recharge requirement for wetland filings. See their stormwater handbook:

<http://www.mass.gov/dep/water/laws/policies.htm#storm>

The standards were included as part of the wetland regs:

<http://www.mass.gov/dep/water/laws/regulati.htm#wl>

Good luck!

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Jay,

Here are some guidelines for Iowa. In Dickinson County Iowa we have created basic ordinances that give definition and then for design, sizing and construction you must follow the Iowa Storm Water Management Manual.

<http://www.ctre.iastate.edu/PUBS/stormwater/index.cfm>

Steve Anderson

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Hi Jay,

The state of Maryland is in the process of updating its Stormwater Management Act and has included infiltration requirements. You can see the draft regulation at:

<http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/swm2007.asp>

Good luck,

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Jay:

I'm attaching a draft (underscore DRAFT) document where we've been trying to document these kinds of approaches. This isn't really quite ready for prime time, but perhaps you'll find it useful. It's our intention to circulate it to NPDES programs sometime soon anyway, it just hasn't gotten through internal review, etc. yet.

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Jay -

Maryland has a recharge requirement. You'll find their stormwater requirements at :
http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp
Look at Chapter 2 for the calculation of Rev

Virginia is just now revising their stormwater requirements to include runoff reduction (which includes infiltration). You can find their proposed requirements and methods at: <http://www.dcr.virginia.gov/lr2f.shtml> . They're being developed by the State through a Technical Committee that has the Center for Watershed Protection under contract - and with the help of Tom Schueler at the Chesapeake Stormwater Network. I don't have the contact information for those folks just at hand - and I'm running out to retrieve some stormwater samples - but if you need their contact information let me know and I'll get it to you later today or over the weekend.

Regards,
Rick

Jay - There are quite a few examples in the Twin Cities metro (the following are located in Washington County, MN):

The Middle St. Croix Watershed Management Organization requires retention of the first 1/2 inch of runoff for impervious surfaces and 1/4 inch for compacted soils:
http://www.mscwmo.org/documents/watershed_plan_body.pdf (see Section 5.1.4).

Brown's Creek Watershed District requires no increase in volume from pre-settlement conditions:
http://www.bcwd.org/BCWD_rules_07.pdf (see Section 2.0).

Rice Creek Watershed District requires retention of the 2-year storm event:
http://www.ricecreek.org/content/documents/permit/forms/RCWD_Rules.pdf (see Rule C #5).

South Washington Watershed District requires no increase in volume from pre-development conditions:
<http://www.swwdmn.org/pdf/SWWDrules.pdf> (see Subd. 3 Part D).

Valley Branch Watershed District requires volume control based on location:
<http://www.vbwd.org/RulesRegs/Rules%2012%20Adopted.pdf> (see Standards, Section 6 - starts on page 15).

Ramsey-Washington Metro Watershed District requires retention of 1" over impervious areas:
<http://www.rwmwd.org/vertical/Sites/%7BAB493DE7-F6CB-4A58-AFE0-56D80D38CD24%7D/uploads/%7B95689C7A-C072-429B-9771-6C396622DFB1%7D.PDF> (see Rule C #3 c).

Lots of TMDLs are in the works here in the TC metro area. There is quite a bit of state funding available for conservation projects in subwatersheds with completed TMDLs, so that has become a driving force behind a lot of the new TMDL work. Good luck in your search!

Pete Young

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We have been collecting regulations and ordinances in Connecticut that encourage "LID" type stormwater practices such as infiltration, filtration and recharge. We set up a website called "CT LID Regulations" that allows users to query an online database to find regulations that might fit their specific concern. Take a look:

http://clear.uconn.edu/tools/lid_reg/index.htm

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NEMO's New Stormwater Trifecta:

<http://nemo.uconn.edu/tools/>
Low Impact Development
Methods, Examples, Regulations

PA and NJ have such requirements. I think that WI does too. If you are counting percentage of capture on-site, the list is longer. I would think that Jenny Molloy or Robert Goo at US EPA would be your best source.

Stoner, Nancy [nstoner@nrdc.org]

From the MA Stormwater Handbook
<http://www.mass.gov/dep/water/laws/policies.htm#storm>

Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Selected Commentary from the Handbook:

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. Standard 3 requires the restoration of recharge, using infiltration measures and careful site design. Through judicious use of low impact development techniques and other approaches that minimize impervious surfaces and mimic natural conditions, new developments can approximate pre-development recharge for most storms.

The NRCS classifies soils into four hydrologic groups, A thru D, indicative of the minimum infiltration obtained for a soil after prolonged wetting. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. **The required recharge volume, the stormwater volume that must be infiltrated, shall be determined using existing site conditions and the infiltration rates set forth below. (emphasis added)**

Hydrologic Group Volume to Recharge (x Total Impervious Area)	
Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

Fred Civian, MassDEP
Stormwater Coordinator
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<http://mass.gov/dep/water/wastewater/stormwat.htm>

Many Pennsylvania communities require runoff volume reduction and it is included in the PA Stormwater BMP Manual (chapter 3) as well:
<http://www.depweb.state.pa.us/watershedmgmt/cwp/view.asp?a=1437&q=529063&watershedmgmtNavPage=|>

I couldn't quickly find the latest version of the state's model stormwater ordinance but here is one that has been used in the southeast region (section 405 has the groundwater recharge requirements):
http://www.depweb.state.pa.us/southeastro/lib/southeastro/storm_model_ordinance_crumcreekrev.pdf

New Jersey DEP has been requiring groundwater recharge for several years now - the model ordinance from their stormwater manual can be found here:
http://www.njstormwater.org/tier_A/pdf/NJ_SWBMP_D.pdf

Jay - I certainly been interested in whatever you compile.

Thanks,

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Remember to integrate our volume-based considerations into all the spectrum of discharges. Maryland has just published a new volume-based approach. I do not have the web link handy but it will be easy to find. I am in the midst of compiling such information to develop a more coherent volume based approach across the spectrum of flows for some criteria manuals I am working on.

We might be able to divide the impacts of urban development according to: infiltration loss, pollution, channel erosion, nuisance flooding, and floodplain protection/management. Each of these, in turn, requires consideration of an ever larger volume with the preceding volume often nested within it. The most common overall goal is to "mimic" the pre-development hydrology. Future goals might include drinking water conservation, rainwater reuse, and to establish a "compatible hydrograph" with the new or planned land use. Volumes are handled through delay or capture. Delay can involve infiltration and interflow return to the receiving waters as hydrograph recession up through planned detention. Capture involves deeper infiltration/injection, reuse, or evapo-transpiration.

Reese, Andrew J [andrew.reese@amec.com]

It seems that using infiltration as a method of controlling runoff is not always a good thing. Runoff, from a roof for example, generally presents much less risk of introducing pollutants into the groundwater from an infiltration area than runoff from a parking lot or industrial manufacturing area.

It seems that we are just shifting the potential pollutants from surface water to groundwater. I would rather have pollutants on the surface where I can identify them and maybe do something to control them rather than have them in the groundwater where they are difficult to identify and do anything about. It also seems like it would be better to have most pollutants in surface water where there is a chance of some biological treatment and where we can more quickly identify potential problems and we have a better chance of controlling the pollutants. Shifting them to groundwater puts us to much into the "out of site out of mind" mode.

Bob Ressler
Environmental Engineer

Robert Ressler [Robert.Ressler@arlingtontx.gov]

Bob,

The results of the [Water Augmentation Study](#) should allay your fears about groundwater contamination from infiltration. We monitored six sites with BMPs, including two industrial sites, over six storm seasons. We saw no correlation between pollutants in stormwater and groundwater; the study's conclusion is that infiltration is safe. The Phase II Monitoring Report 2008 Update has the complete results.

Using infiltration as a method of controlling runoff is now moving closer to "standard operating procedure" in Los Angeles with the installation of several demonstration sites.

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Nancy,

Sounds like a great study. I would be curious to know the extent to which dissolved pollutant levels were measured, namely phosphorus. For example soluble reactive phosphorus (SRP) is the real "bio-available" portion from what I understand in contributing to health hazards and pollution (algae blooms and cyanobacteria). There are studies out there which indicate that conventional stormwater filtration practices do not adequately address SRP, only the sediment bound portion. Additionally, after limited loading, desorption and the export of phosphorus has been shown to occur (similar to a septic field).

Any comments from your study on this important issue would be appreciated.

Rob Crossman
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I will have to check (I was not the PI) and get back to the list. All of the data are in the reports posted on our website, however.

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Rob,

P sorption in typical soils is generally more than adequate. While there have been P-saturation problems in sandy soils under septic system loads, I have yet to see this reported for stormwater. This is because you have many feet of soil to absorb P in infiltration facilities. Since sorption also occurs in the saturated zone under these systems, the offsite plume would be negligible.

You are dead on when it comes to a couple feet of media, though. P sorption in typical sandy bioretention media is going to get exhausted pretty soon, as I have found. Compost makes it worse, since it competes with P for sorption sites, not to mention leaching considerable quantities under high hydraulic loads as it decays.

Bill

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I am not familiar with the study referenced below. But in general, while it's clearly essential that we recharge groundwater, use infiltration into soils and contact with vegetation (in the root zone) to improve water quality, and do other things to try and maintain and restore pre-development hydrology, I think it's also important to consider the potential for groundwater contamination when using infiltration practices. I have discussed with several people the need for some kind of risk assessment framework to guide decisions about installing infiltration practices. There are clearly locations where protection of groundwater quality should take precedence, and the constituents in the local sources of runoff should be part of this evaluation. There are certain situations where infiltration of stormwater should probably not be implemented. For example, even without deliberate infiltration of stormwater, road salt has contaminated municipal wells in this region, and they've been abandoned as a result.

Simon Gruber [sgruber100@verizon.net]

Simon,

This has already been done. Bob Pitt, among others, has looked into this pretty extensively. See his 1996 book on the topic. With the notable exceptions of salt and nitrate, the jury has come in on Nancy's side. I do want to comment about roofs, though. Shirley Clark's recent work is eye-opening as to both nutrients and metals being much more prevalent than we all think, and sometimes in remarkable concentrations. However, if not directly discharged into surface drainage via an underdrain from media with limited absorbent properties (see previous post), the soil mantle will adsorb most, if not all, pollutants within the first foot or so. Rob Traver showed this in copper profiles in the soil in an infiltration basin after a century's runoff from a copper flashed roof.

As to salt, see previous posts. Rob Roseen is on to something with porous pavement. UNH uses much less on his systems than typical parking lots. If your surficial aquifers are contaminated with salt, I tend to think it would be more due to a sandy setting (outwash or a coastal plain), where infiltration from swales along every road in the area will recharge salt very effectively. I am dubious that it originates solely from

specific infiltration facilities, mainly because there are usually so few compared to the area of swales. Of course, if I am wrong, we should all know.

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Jay - Here are a couple examples from Oregon to add to your list:

The City of Portland's Stormwater Management Manual reflects their city-wide rule and policies focused primarily on in-site water quality treatment and infiltration:
<http://www.portlandonline.com/bes/index.cfm?c=47952&>

The City of Gresham requires on-site infiltration for all new development; the "Green Development Practices for Stormwater Management" is on the web at:
<http://www.greshamoregon.gov/city/city-departments/environmental-services/watershed-management/template.aspx?id=3288>

Since I'm currently working on the latest revision of our own Stormwater Management Manual, I would be interested in seeing the list you compile.

Torrey Lindbo
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There are a number of Watershed District and communities with volume control rules in the Twin Cities, Minnesota. These rule generally do not require infiltration for groundwater infiltration. They are designed to reduce the volume of stormwater runoff for water quality improvement and flood control. We do not have combined sewer overflows here that are driving volume reduction efforts in Kansas City and Nashville. Our rules are on our web site www.rwmwd.org.

Cliff

~~~~~  
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Jay, please send what you compile. We are revising a regional stormwater guidance manual and are planning to strongly recommend that runoff reduction practices be included on land development projects with guidance on quantifying detention volume credits. The information that you are seeking would also be useful to Urban Drainage. Here is the website for our project is you are interested - [http://www.udfcd.org/downloads/down\\_critmanual\\_update.htm](http://www.udfcd.org/downloads/down_critmanual_update.htm) You may be interested in the responses to our survey posted on this link - especially question #9.

Regards, Michelle

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Jay,

The Central Coast Water Quality Control Board in California is requiring municipalities in our region to implement low impact development and hydromodification controls as part of their Storm Water Management Programs.

You can the view the implementation process at our website:

[http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/stormwater/muni\\_phase2/ms4enrollment/index.shtml](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/muni_phase2/ms4enrollment/index.shtml)

Use these links for descriptions of our requirements and the municipality's programs . — Low Impact Development Information

- Currently Enrolled MS4s
  - MS4 Enrollment Notification Letter
  - Follow-up to February 15 Enrollment Letter
- and individual MS4s in the "Summary of the Enrollment Process" section.

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Jay,

Similarly we have infiltration requirements for our EOH which is a TMDL watershed. Those are documented in Chapter 10 of our Design Manual at: <http://www.dec.ny.gov/chemical/29072.html>

Briefly, it reads as follows:

Percentage of Impervious area to be directed to a BSD/LID practice or a standard infiltration practice for source control.

| Hydrologic Soil Group | % Impervious area |
|-----------------------|-------------------|
| A                     | 30%               |
| B                     | 20%               |
| C                     | 10%               |
| D                     | 5%                |

I hope this helps. I would also be interested in you compiled information. Thank you.

Shohreh

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Check out the draft West Virginia Phase II permit. Also, the most recent version of the California Construction General Permit provisions for post-construction.

I would be interested in seeing your summary.

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Jay,

The States of NH, MA, and VT all have recharge requirements in their stormwater regulations and the small town ( pop <1800) where I live in in NH has recharge requirements. While not a delegated state, NH has added provisions to the NPDES CGP and MSGP that encourage the use of stormwater infiltration.

I'm not familiar with any state that has specified no increase in volume of runoff leaving a site for some of the larger storm events (say 2 or 10 year storms).

Regarding the subject of P sorption and the long term capacity of soils to sorb and retain P, I tend to wonder if the introduced restrictions in hydraulic capacity (blinding) occur first and necessitate renovation or replacement of the device before adsorption sites are completely occupied by P. I think that there are a couple of people on this list who believe that the end point will be a P and metal specific media that is easily replaced. Once the honeymoon with vegetation and all things organic settle in to its logical place in a treatment train system there will be room for the less sexy engineered soils or medias to complete the treatment process.

Tyler Phillips  
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The county of Los Angeles recently passed an LID ordinance, to take effect Jan. 1, '09, that includes requirements for infiltration. It's at [http://planning.lacounty.gov/doc/green/green-building\\_final-ordinances.pdf](http://planning.lacounty.gov/doc/green/green-building_final-ordinances.pdf). A guidance manual will soon follow.

*Bill DePoto, P. E.*

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Impervious Happens: [www.BMPLA.org](http://www.BMPLA.org)

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The State of West Virginia is requiring it in their next MS4 permit. That's assuming it gets reissued as it is currently written.

You can find the proposed draft permit on this webpage. What you are looking for starts on page 12.

[http://www2.wvdep.org/dwwm/stormwater/MS4\\_docs.htm](http://www2.wvdep.org/dwwm/stormwater/MS4_docs.htm)

Also, I believe the USEPA (headquarters, Wash. D.C.) is in the process of compiling a listing of these kind of stormwater requirements that are found in state permits.

Sherry

*Sherry Wilkins*

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It seems like there could be more exceptions than just salt and nitrate in highly industrial areas. New Brighton MN and some of the surrounding communities have TCE and other VOCs issues in our municipal wells from past uses of infiltration. We also have pentachloroheanol. Our neighbors to south east are having issues with chemicals from 3M in their municipal wells and some of the private residence well water.

I tend to agree with Simon that there are a few situations where infiltration of stormwater should not be implemented. For example known brownfields areas would not be a good choice. Highly industrial brownfield areas may not be numerous, but they do exist. Or at least the few that we are working to clean up here. Part of our VIC program clean up is to create impervious barriers (geotextiles, buildings or pavement) to prevent infiltration so the contamination does not migrate. For now, it is cheaper to contain than remove the semi deep stuff. Although we did spend over a million to create one safe pond/infiltration area that only treats 10 acres of the 110 acre site we are cleaning up.

I have also heard of problems in southern Minnesota where infiltration has created sink holes in areas with limestone. We do need to be careful that the BMPs selected to treat runoff does not cause damage to the structures the rain is running off of. It would also be wise to have some pretreatment to infiltration areas in wellhead protection areas.

I am concern that there is a push for infiltration as the one bullet solution for a complex problem. Volume of stormwater is being consider a pollutant by some. I understand that point sources did increase volume of clean water to dilute their concentration to meet NPDES permit requirements in the beginning. Stormwater is different. Its flow volume is not uniform. I don't think anyone is creating more volume of runoff with the idea of diluting concentration to meet stormwater concentration requirements. The problem is pollution, NOT WATER. Stormwater runoff is not a wastewater stream and the NPDES permit program needs to adapt to the unique situation.

Yes, reducing volume appears to solve many problems by limiting the transportation of the pollution. Infiltration your average urban runoff in the majority of areas is safe. But do be aware of your local situation.

Kerry Thorne, Civil Engineer  
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Just another cautionary note on infiltration as a BMP. Here at MDOT we were asked to review a design for infiltrating structure runoff into the structure embankment. This could have led to an unstable embankment and the design was therefore not approved.

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I'd like to refer you to the recently released (October 2008) study by the National Research Council on stormwater. It's a very thorough review of, among other things, the critical importance of managing stormwater flows, not just because they carry pollutants, but because of the devastating effects changes in flow (both high and low) have on receiving waters.

[http://www.epa.gov/npdes/pubs/nrc\\_stormwaterreport.pdf](http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf)

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Kerry,

While we obviously agree on the need for consideration of groundwater protection and managing or avoiding infiltration in high risk areas for contamination, there's one part of your email I question. In addition to treatment for water quality, another fundamental benefit of infiltration practices is in fact managing the volume of water flowing to and in streams. Infiltration helps recharge groundwater, which feeds the base flow and thus helps preserve better in-stream flow conditions in dry weather. In wet weather infiltration helps keep downstream flows closer to pre-development conditions by reducing surface runoff (the water reaches the stream much more slowly, as base flow). So, part of the problem is in fact the water. And because these groundwater recharge and stream flow benefits of infiltration are so

important, I think we need to encourage their use but also factor in the water quality protection issues and minimize pollution risks.

Simon Gruber

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Hello:

As part of our green infrastructure efforts here at the Office of Water, we are seeking example language from local jurisdictions that address stormwater design or performance standards including infiltration, evapotranspiration, and reuse requirements. We are especially interested in criteria or standards that are numeric, or otherwise quantified, e.g., % effective imperviousness; volume of stormwater. For example, capturing the runoff volume from the first 0.5 inches of rain over the impervious area of the site (Chicago). We are familiar with criteria from Chicago, Philadelphia, and North Carolina.

Please send your responses to me at [arazan.nancy@epa.gov](mailto:arazan.nancy@epa.gov)

Thank you.

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Have you looked at the PA BMP Manual? Here is a link (Not the same as Philly).

[http://www3.villanova.edu/VUSP/bmp\\_research/Outreach/Pdf/PaBMP.pdf](http://www3.villanova.edu/VUSP/bmp_research/Outreach/Pdf/PaBMP.pdf)

Note They have a CG-1 and CG2 in chapter three. The one entitled CG-2 was originally intended for high impervious sites, but got rewritten politically.

Rob

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Also, check out the MI LID manual:

<http://www.semcog.org/LowImpactDevelopment.aspx>

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