

Aquifer Recharge and Septic System Densities

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New Free Resource . . . A report recently commissioned by Dutchess County's Water and Wastewater Authority provides updated understandings of aquifer recharge. Aquifer recharge rates help you prepare project water budgets and are critical to regional planning studies. It also includes a tool for using recharge rates to determine safe densities for septic systems so aquifers will not become overwhelmed with wastewater discharges.

The approaches described in the report can be used by planners, planning boards, and municipalities to better

understand groundwater supplies and wastewater planning needs, and help prepare groundwater budgets for project or municipal needs. Both the report and an explanatory Powerpoint presentation are available on Dutchess County's website. You can go to <http://www.co.dutchess.ny.us/CountyGov/DeptDepartments.htm> and follow links to the Water & Wastewater Authority homepage

Groundwater Recharge

Rates . . . In much of New York State, evaporation and plant transpiration take up about half of annual pre-

cipitation. The other half becomes either overland runoff, or groundwater recharge. Where soils are clayey and less permeable, runoff is higher and groundwater recharge is restricted. But where soils are open and sandy, runoff rates are low and infiltration can be as high as the full half of annual precipitation.

Stream flows reflect these different soils. Streams in sandy watersheds do not have high storm peak flows since there is little runoff but these streams flow all summer long as infiltrated groundwater seeps downhill to reach the stream months after the

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spring rains have become a distant memory. In watersheds with clay soils and high runoff rates, storm peak flows are much higher but stream flows can be low to dry during summer because there is little recharge available to support the stream once the rain stops.

Recharge rates calculated for Dutchess County are linked to the nationwide system of Hydrologic Soil Groups (A, B, C and D) assigned to soils by the Soil Conservation Service. A and A/D soils are sandy; B, C and C/D soils are progressively more silty. D soils are quite clay-rich. Infiltration and aquifer recharge rates are highest for A and A/D soils and lowest for D soils. Please don't confuse Hydrologic Groups A, B, C and D with the alphabetical slope indicators in the soil guide or with other soil ranking assignments. Hydrologic Soil Groups are listed in all soil guides and many GIS programs, and so are easily available to all communities.

There are two types of groundwater recharge benefiting from infiltration through these Hydrologic Soil Groups. Aquifer recharge consists of the share of precipitation that seeps all the way down into the saturated formations we know as aquifers. Separately, "interflow" is more casual groundwater recharge. It is infiltration that flows along buried clay or bedrock layers, or along root zones, and reaches streams or lakes without ever entering aquifers. Aquifer

recharge is important to wells and summertime septic system wastewater dilution. Aquifer recharge and interflow together support baseflow to lakes and streams.

For this study, we were interested in aquifer recharge rates. We assigned rates to Hydrologic Soil Groups on the basis of local precipitation patterns, baseflow volumes identified from stream flow records, and the distribution of hydrologic soil groups in Dutchess County's three major watersheds. Similar approaches could be used to identify recharge rates throughout New York. Aquifer recharge rates identified for soils in Dutchess County's Wappinger Creek watershed are listed below. Listed below are some Interflow

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Hydrologic Soil Group	Annual Aquifer Recharge (inches per year)	Average Daily Aquifer Recharge (daily gallons per acre)	Annual Interflow (inches per year)	Average Daily Interflow (daily gallons per acre)
A and A/D	18.2	1,354	6.4	476
B	13.3	989	4.6	342
C and C/D	6.8	506	2.4	178
D	3.8	283	1.3	97

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values, based on a separate study conducted in the Wappinger Creek watershed. Interflow in Dutchess County adds about 35 percent more baseflow to streams. During typical drought years, all recharge rates drop by about 30 percent.

There are many planning uses for these kinds of aquifer and interflow recharge rates. Some examples follow:

- Use these rates to estimate how large a groundwater recharge area supplies water to a public water supply well. To do this, you can evaluate Hydrologic Soil Groups near the wells and calculate how many acres are needed to match the well yield.
- Use these rates to estimate how much groundwater (aquifer and interflow together) supports critical wetlands, streams or lakes. Calculate the acreages of upgradient Hydrologic Soil Groups and multiply by the recharge rates to estimate the average baseflow supporting these natural resources.
- Use these rates to determine a water budget for Town planning studies. Calculate the local aquifer recharge rates and compare them to proposed water uses for future Town expansions.

Density for Septic Systems

... It should come as no surprise that when domestic wells and septic systems are placed too close together, ground water quality can suffer. But how close is too close? The Department of Health requires separation distances to ensure adequate filtration for bacteria and most viruses. But this is only part of a necessary planning strategy. Conversations with Department of Health staff confirm that these separation distances were never intended to address or provide adequate dilution for wastewater components

like nitrate, pharmaceutical residues, or the caffeine from our morning cups of coffee.

Therefore, we should continue to use the DOH separation distances, but we should also begin considering the overall regional density of septic systems. This will add a strategy to ensure that compounds addressed best by dilution in aquifers will not overload groundwater resources. The septic system density recommendations have been calculated on the basis of nitrate concentrations in wastewater. Nitrate was used because everyone emits nitrogen (about 10 pounds per person per year), nitrate does not easily break down in aquifers, and, there is a drinking water standard for nitrate (10 milligrams per liter).

The Dutchess County report provides guidance for the closest (most dense) sustainable densities for wells and septic systems. This guidance is only necessary in areas where individual wells and conventional septic systems are in use and are intended to remain in use. The example below shows the recommendations for the Wappinger Creek watershed, assuming an average household occupancy rate of 2.6 persons/septic system, an impervious surface allowance of 0.1 acres per parcel, and a safe nitrate planning target of 5 milligrams per liter since aiming for half the standard better ensures that all outcomes are safely below the standard.

Hydrologic Soil Group	Recommended Minimum Average Septic System Density
A and A/D	1.3 acres per parcel
B	1.8 acres per parcel
C and C/D	3.3 acres per parcel
D	5.9 acres per parcel

Since most of rural New York State is covered by B and C soils, these kinds of calculations show that areas

with no central water or sewer should plan for average parcel sizes of at least 2 to 3 acres. This is not to say that cluster or conservation subdivisions can't be built, but overall average density should meet these guidance values and special care may be needed in cluster subdivisions to consider locations for compensatory recharge to off-set denser areas.

There is another interesting lesson hidden in these density calculations. It is seldom cost-effective to install central water or sewer on parcels larger than about a half acre since the cost of line connections between parcels gets too high. Accordingly, we find that community cores with central water or sewer service seldom have lot sizes larger than 1/2 acre. But this new recharge and septic system analysis indicates that parcels with individual wells and septic systems should usually be on parcels over 2 to 3 acres in size. This means we are now finding that it is unwise to have zoning or planning that promotes parcel sizes between 1/2 acres and 2 acres; these sizes are too far apart to allow cost-effective connection to central water and sewer, but are too close together to assure residents that water quality in individual wells near septic systems will be safe once houses reach full buildout.

So, in closing, this recently-released report is likely to become a benchmark for project design and evaluations in Dutchess County. The recharge rates described can be referenced for approximate use throughout the State, or, for more accurate work communities can examine the approaches and employ them to define more precise local recharge rates. In either case, considering aquifer and interflow recharge rates in planning studies, and in septic density calculations, is smart planning. This report is available to help. ❖