New Jersey Geological Survey
Technical Memorandum 99-1

Basin Factor Calibration for Ground-Water Recharge Estimation

by Jeffrey L. Hoffman

(Supplement to GSR 32: *A method for evaluating ground-water-recharge areas in New Jersey*)

The New Jersey Geological Survey's methodology for estimating ground-water recharge on parcels of land five acres or larger (Charles and others, 1993) contains a calibration constant referred to as the "basin factor." As part of the method's development, recharge over the test area (in Morris County) was compared to an estimate of stream baseflow from the same area. The report states:

> "Calibration of calculated volumetric recharge to estimated stream baseflows for test basins indicated the need to modify recharge. The basin factor was added to the recharge equation to meet this goal. Baseflow is a measure of ground-water discharge to streams, and, over the long term, a viable estimate of ground-water recharge.
>
> "The calibration process indicated that a constant of 1.3 resulted in basin-wide recharge volumes in line with observed stream baseflows. More detailed analyses may show that different basins may require different basin factors. The accuracy of this adjustment depends on the exact relationship between stream baseflows and the distribution of ground-water recharge."

For the initial calibration, baseflow was estimated using the sliding-interval method (Pettyjohn and Henning, 1979). This method was also used to estimate baseflows for New Jersey's current statewide water-supply plan (CH2M Hill and others, 1992). The NJ Geological Survey has determined that the sliding interval method may overestimate long-term ground-water baseflow to streams (J. Boyle, NJ Geological Survey, oral commun., 1999). A more appropriate baseflow estimate comes from a method developed by Posten (1984) and results in values about a third lower than those from the sliding-interval method.

The NJ Geological Survey has recently mapped ground-water recharge rates for several areas in New Jersey. This work allows for a comparsion of baseflow and recharge calculations. Table 1 lists baseflow from the sliding-interval and Posten methods at three gaging stations: the Whippany River at Morristown, the Rockaway River above the Boonton Reservoir, and the Manasquan River at Squankum. Table 2 shows estimated net ground-water recharge over the basins assuming different basin factors. It is clear that using a basin factor of 1.3 overestimates the Posten values of stream baseflow. A basin factor of 1.0 results in a better match.

Based on this research, and in the absence of local baseflow information, the NJ Geological Survey now recommends applying a basin factor of 1.0 when using the methodology developed by Charles and others (1993). If additional research establishes that a different baseflow estimation technology is more appropriate, then use of another basin factor may be necessary. Additionally, watersheds of varying size, geology or land use may require different basin factors to match net ground-water recharge with baseflow.

References:

Charles, E.G., Behroozi, Cyrus, Schooley, Jack and Hoffman, J.L., 1993, A method for evaluating ground-water-recharge areas in New Jersey: NJ Geological Survey Report GSR 32, 95p.

CH2M Hill, Metcalf & Eddy, Inc., and New Jersey First, Inc., 1992, New Jersey statewide water supply master plan, task 2 report, water supply baseline data development and analysis: Consultant's report prepared for the N.J. Department of Environmental Protection, variously paginated.

Pettyjohn, W.A. and Henning, R.J., 1979, Preliminary estimate of regional effective ground-water recharge rates in Ohio: Ohio State University Water Resources Center, Columbus, 241p.

Posten, S.E., 1984, Estimation of mean groundwater runoff in hard-rock aquifers of New Jersey: Columbia University seminar series on pollution and water resources, v. 16, Halasi-Kun, G.J., editor, Pergamon Press, NY, p.109-154.

Table 1. Estimated baseflow from streamflow measurements (inches/year)

Methodology	Gaging Station/Watershed Geology		
	Whippany River at Morristown/ primarily unglaciated Highlands	Rockaway River above Boonton Reservoir/ primarily glaciated Highlands	Manasquan River at Squankum/ outer Coastal Plain
Sliding interval	18.1	19.3	16.1
Posten	13.4	15.1	13.7

Table 2. Estimated baseflow from ground-water recharge methodology using different basin factors (inches/year)

Basin factor	Gaging Station/Watershed Geology		
	Whippany River at Morristown/ primarily unglaciated Highlands	Rockaway River above Boonton Reservoir/ primarily glaciated Highlands	Manasquan River at Squankum/ outer Coastal Plain
1.0	14.4	13.4	14.3
1.1	16.8	15.3	15.7
1.2	19.2	17.1	17.2
1.3	21.7	18.9	18.6
1.4	24.1	20.7	20

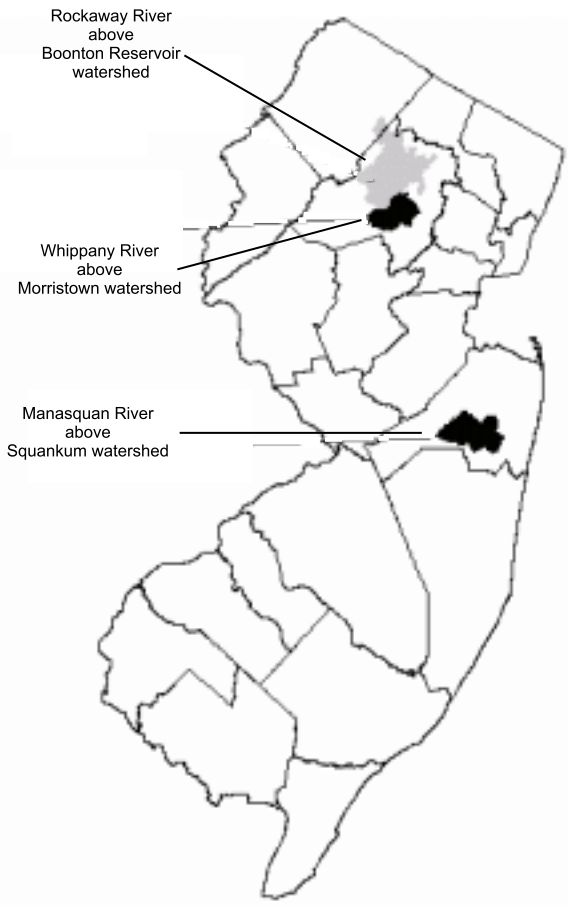

Figure 1. Location of calibration watersheds in New Jersey

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