

# Effects of Urban Sprawl on the Water Resources of Northern Virginia

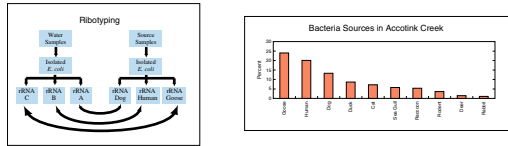
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## Water Quality – Accotink Creek, Fairfax County

Accotink Creek, which flows through heavily developed areas in Fairfax County, violates the Virginia standard for fecal coliform bacteria.

USGS is determining the dominant sources of fecal coliform bacteria in Accotink Creek using ribotyping. This technique uses genetic "fingerprints"—consisting of the section of DNA coded for ribosomal RNA production that is unique to each warm-blooded animal species—to positively identify the bacteria sources in streamwater.



Many pesticides were detected in water samples collected from Accotink Creek from 1992 to 1996 (Ator and others, 1998). These pesticides are used on rights-of-way, turf, golf courses, and as additives to asphalt and other building materials.

### Pesticides detected in Accotink Creek

atrazine	MCPA <sup>2</sup>
carbaryl	metolachlor
chlorpyrifos	oryzalin <sup>2</sup>
diazinon <sup>1</sup>	prometon
malathion <sup>1</sup>	simazine <sup>3</sup>

<sup>1</sup>detected at the highest concentration measured in the Potomac River Basin

<sup>2</sup>detected at the highest concentration measured nationwide

<sup>3</sup>detected at the highest frequency and at the highest concentrations in the basin, occasionally exceeding the maximum contaminant level of 4 µg/L.

## Water Quality – Lake Anne in Reston, Fairfax County

This "real-estate lake" is located in a densely populated watershed, and the lake shoreline is surrounded by dwellings. Lake outflow drains to the Potomac River.

USGS hydrologist Karen Rice compared concentrations of arsenic and copper in samples of precipitation and streamwater collected from Bear Branch, a forested watershed on Catoctin Mountain, Md. (Church and others, 1998), to samples from the Lake Anne watershed (Rice, in preparation).

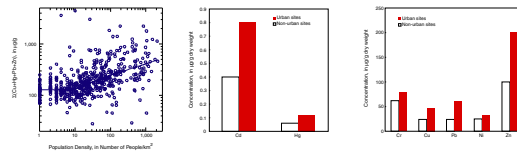
- While precipitation loadings of arsenic at Lake Anne were similar to those at Bear Branch, loadings of copper were 1.5-fold higher at Lake Anne.
- Fluxes of total arsenic were up to 5,800 times higher and fluxes of total copper were up to 10,000 times higher in Lake Anne streams compared to Bear Branch.
- The source of the copper in the Lake Anne watershed is primarily brake linings on motor vehicles while much of the arsenic is leached from pressure-treated lumber used as building material.
- Both arsenic and copper are on the list of 126 Priority Pollutants and are considered very toxic and relatively accessible in the environment. Arsenic is classified as a carcinogen, and the USEPA's drinking water standard was recently lowered from 50 µg/L to 5 µg/L.



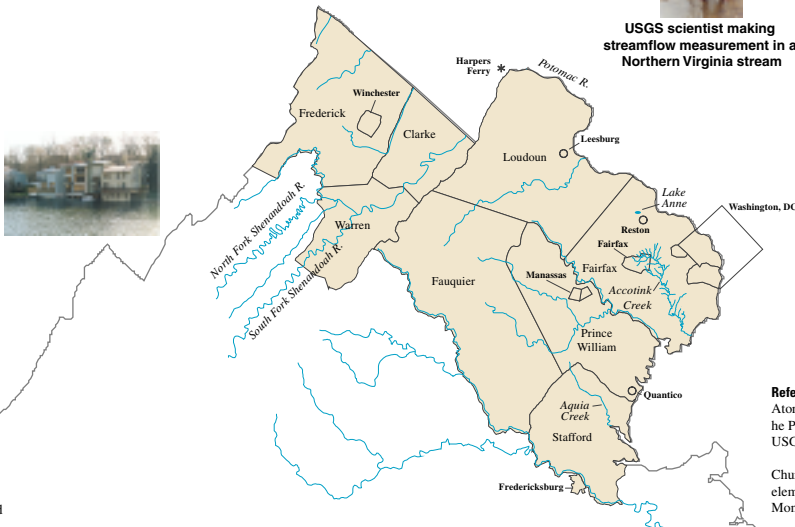
## Effect of Urbanization on Sediment Quality – Results of a Nationwide USGS Study

USGS analyzed the concentrations of nine trace elements in 541 streambed sediment samples collected by the National Water-Quality Assessment (NAWQA) Program across the country from 1992 through 1996 (Rice, 1999).

- Population density was positively related to the sum of concentrations of copper, mercury, lead and zinc.
- Median concentrations of cadmium, chromium, copper, mercury, lead, nickel, and zinc were significantly greater ( $p = 0.00$ ) at urban sites compared to nonurban sites.
- These trace elements are considered very toxic, are relatively accessible in the environment, and are on the USEPA's list of 126 Priority Pollutants.



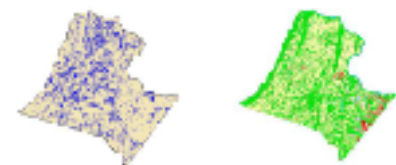
USGS scientist making streamflow measurement in a Northern Virginia stream



## Ground Water – Loudoun County

The population of Loudoun County has increased by about 150% in the past 20 years. This population growth is leading to increased demands for water. Because surface-water supplies are limited, ground water from the fractured rocks of the Piedmont and Blue Ridge Physiographic Provinces will be expected to meet these demands.

In FY 2000, the USGS inventoried existing digital data and produced preliminary maps of the depth of the bedrock and the altitude of the top of the bedrock in Loudoun County. County officials will use this information in an assessment of the sustainability and vulnerability to contamination of the region's ground-water resources.



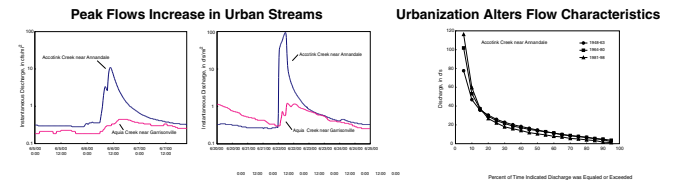
Distribution of Wells in Loudoun County, 1996

Land Use, circa 1995

## Streamflow Characteristics – Urban vs Forested Streams in Northern Virginia

Streamflow data collected by USGS show the effects of impervious areas related to urban development.

- For all storms, the peak flow (per square mile) in Accotink Creek is higher than that of Aquia Creek, which flows through a largely wooded and undeveloped area south of the Quantico U.S. Marine Corps Reservation.
- Flow-duration curves for Accotink Creek divided into three periods—pre-development (1948-63), active development (1964-80), and post-development (1981-98)—indicate that the lowest flows became lower and the highest flows became higher over time, i.e., the "flashiness" of the stream increased as a result of development (Rice, in preparation).



### References

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Church, T.M., Seudlark, J.R., Conko, K.M., Bricker, O.P., and Rice, K.C., 1998. Transmission of atmospherically deposited trace elements through an undeveloped, forested Maryland watershed: Maryland Dept. of Natural Resources, Chesapeake Bay Research and Monitoring Division, 87 p.

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Rice, K.C., in preparation. Historical reconstruction of the deposition of lake sediments and associated arsenic and copper concentrations during land-use change from forested to suburban in a northern Virginia catchment: Ph.D. Dissertation, University of Virginia Department of Environmental Sciences.