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Cover: Stream gauges established on Poore Creek, Petersburg National Battlefield, make possible a quantitative evaluation of storm runoff from the urbanized watershed (see story page 3).

How Urban Development Near Parks is Affecting Streams

By James D. Gregory, Charles A. Williams, Karl (Chuck) Smith, Chuck Rafkind, Sam Kunkle, and John Karish

Urban development closing in on small park units in densely populated areas can have severe ecological effects on park resources. One example is construction upstream from a park, which can cause erosion, flooding, siltation, and even vegetation die-off in a park. Preliminary observations indicate that Petersburg and Richmond National Battlefields, two NPS sites in central Virginia, are cases in point.

The Petersburg Study

At Petersburg National Battlefield (NB), extensive upstream construction of highways, housing and other developments evidently is causing excessive channel erosion along Poore Creek, a small stream flowing through the heart of the park (Fig. 1). Unusually high volumes of runoff in Poore Creek are now seen during storms. The increased runoff is undercutting the stream banks, causing large trees to uproot and fall into the stream, and has scoured out the channel to its clay base. This is a classic example of the runoff impacts caused by the conversion of forest and fields into asphalt and roofs. Such runoff water also may be of poor quality, which can adversely affect park resources and their use.

In order to stimulate interest in more effective upstream conservation, the park has initiated a study of Poore Creek's urbanization impacts and is working in cooperation with the Department of Forestry at North Carolina State University. The objective of the Petersburg NB study is to evaluate runoff from Poore Creek and its urbanized watershed of 1,230 acres to determine if the runoff from storms is in fact abnormally high and causing the severe channel erosion. In the study, two types of comparisons are being made. First, new runoff data from Poore Creek will be compared to available runoff models and existing case studies from the region. Secondly, runoff comparisons will be made using a control stream, Harrison Creek, which is also in the park and lies adjacent to the Poore Creek watershed. Harrison Creek drains an area of 1,179 acres that exhibits few urbanization impacts but otherwise is similar to the Poore Creek drainage.

Stream gauging and precipitation measuring sites have been established, and field measurements of runoff and water quality are underway (see cover). Park staff are surveying cross-sections along Poore Creek and Harrison Creeks so that long-term cross-sectional measurements can be repeated and erosion quantified with existing park resources beyond the research contract period. An automatic storm-water sampler, which fills up when a stream rises during storm events, is being assembled in the park so that sediment in storm runoff can be monitored. In order to evaluate pollution and erosion impacts, water samples are being collected for analysis of bacterial contamination, suspended sediment, and dissolved solids, and benthic macroinvertebrates are being surveyed in the stream.

Preliminary storm data collected to date at the stream gauging sites indicate that Poore Creek is drastically affected by the urbanization: storm runoff is much higher in Poore Creek than in the control stream. Sewage contamination also has been found. It is too early to pronounce findings on channel erosion, which must be measured over time.

The Richmond Study

At Richmond National Battlefield Park (NBP), urbanization is having a different impact on the riparian environment. Erosion from housing and road construction upstream apparently is sending increased sediment loads downstream into the park's Beaver Dam Creek Unit (Fig. 2). Loss of forest cover upstream also is very likely causing higher peak flows during storms. Because this park unit lies in a lowland area, it serves as a natural deposition site for sediment; preliminary observations at a grid of stakes driven into the ground already are showing that sediment is being deposited. Many of the hardwoods and other vegetation in the unit are showing signs of stress or die-off, apparently a result of the excessive sedimentation. Increased runoff and the sediment deposits also have altered an old mill race that is an important historic feature of the park. Because construction adjacent to the park unit already has led to visible sediment de-



Figure 2. Housing construction can cause erosion, which flows as sediment downstream during storms. This eroded site is only about 100 meters from the park boundary at Richmond National Battlefield Park.

posits in the park after storms, NPS personnel have been working actively with the county, developers, and other groups to effect better conservation practices upstream. In one case, developers of a subdivision near the park already have improved their erosion control measures after park personnel pressed for such action.

Possible Conservation Measures

More effective conservation measures must be implemented by upstream developers in order to protect resources at both Richmond and Petersburg. Developers can take many kinds of conservation actions, such as leaving undeveloped "buffer" strips along streams; using better erosion control and sediment retarding devices; building runoff retention ponds to diminish peak runoff, and incorporating improved development planning. Forcing upstream developers to take conservation actions can be difficult unless a park has some accurate quantitative data to demonstrate beyond a doubt that a problem exists. Therefore, the two parks initiated these studies to evaluate and quantify some of their urbanization-caused impacts.

At Petersburg NB, Dr. James D. Gregory and Research Assistant Charles A. Williams, hydrologists from NCSU, have coordinated the technical work including the data analysis. The park staff responsible for data collection are Rangers Karl (Chuck) Smith and Allan Morris. Sam Kunkle of the NPS Water Resources Division, Fort Collins, Colorado, worked with the park and with John Karish of MARO to develop the original concepts for the project. At Richmond NBP, Chief Ranger Chuck Rafkind has been the primary person involved, with work also carried out by David Shockley, Dan Roddy, and Erv Gasser of the park staff. Gregory and Williams of NCSU also have provided technical advice to Richmond NBP staff on ways to measure sediment deposition.

Questions on techniques being used at these parks can be directed to J.D. Gregory, Department of Forestry, NCSU, Box 8002, Raleigh, NC 27695.

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Figure 1. Upstream urbanization evidently is causing the channel gouging seen here along Poore Creek in Petersburg National Battlefield.