EPA-841-F-89-100

United States
Environmental Protection
Agency

Office of Water
Nonpoint Source Branch
(WH 585)

Publication U-1
August 1989

EPA

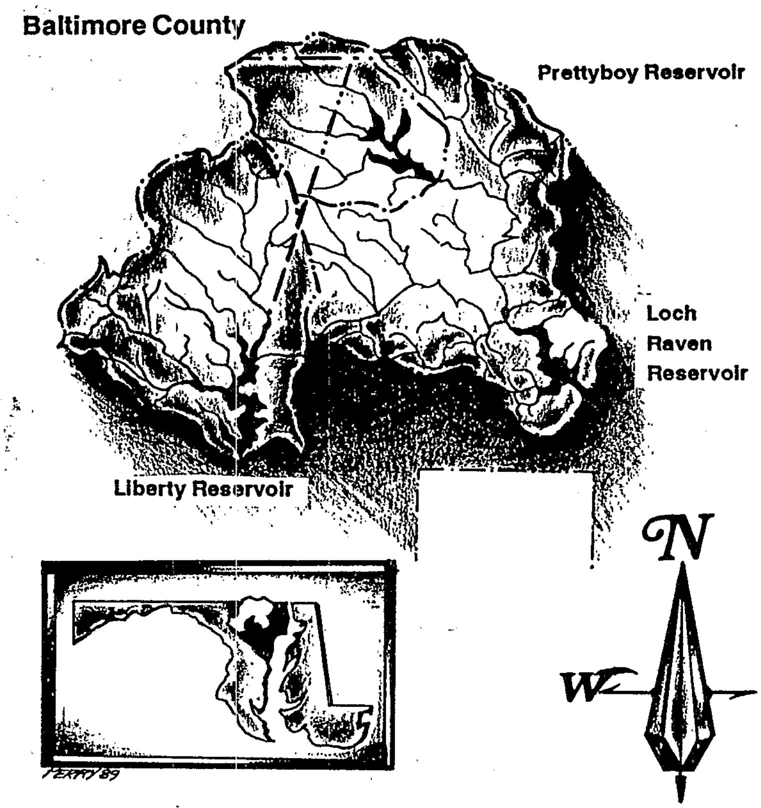
Retrofitting Stormwater Management Basins for Phosphorus Control

The Problem

In the early 1970s, nuisance blue-green algae blooms and low dissolved oxygen problems began to plague the Loch Raven Reservoir, a 21 billion gallon impoundment near Baltimore, Maryland. The cause was an overload of phosphorus generated by agricultural activities and urbanization.

Baltimore County had several phosphorus control programs, but of limited effectiveness. In urban areas, the programs focused mainly on retaining stormwater, primarily through some 36 "dry" ponds that become inundated only during very large storms. Because the hydraulic controls were designed to accommodate only large flows, most storm flows and the sediments they carried passed through the basin unimpeded by a low-flow pipe. Thus, the basins did little to enhance water quality — and, consequently, the reservoir suffered.

To combat this problem, the Water Quality Management Office of the Baltimore City Department of Public Works started a program, funded in part by a Clean Lakes Program grant, to modify these stormwater structures. The goal: change the structures so that they could detain flows from small storms without compromising their ability to control larger storm flows.



Project Design and Construction

Before modification, the 36 structures were able to control the flows from storms that occurred every two years, 10 years, and 100 years. But since most storm events were less intense than even the two-year variety, engineers and planners needed to adjust the structures to accommodate the smaller storms.

To modify the structures, engineers took a two-pronged design approach. First, they needed to needed to know how small the basins could be without restricting their capacity to control the runoff from larger storms. Through computer modelling, it was determined that the basins could be modified to accommodate one-year storms, and that even smaller storms would not be short-circuited.

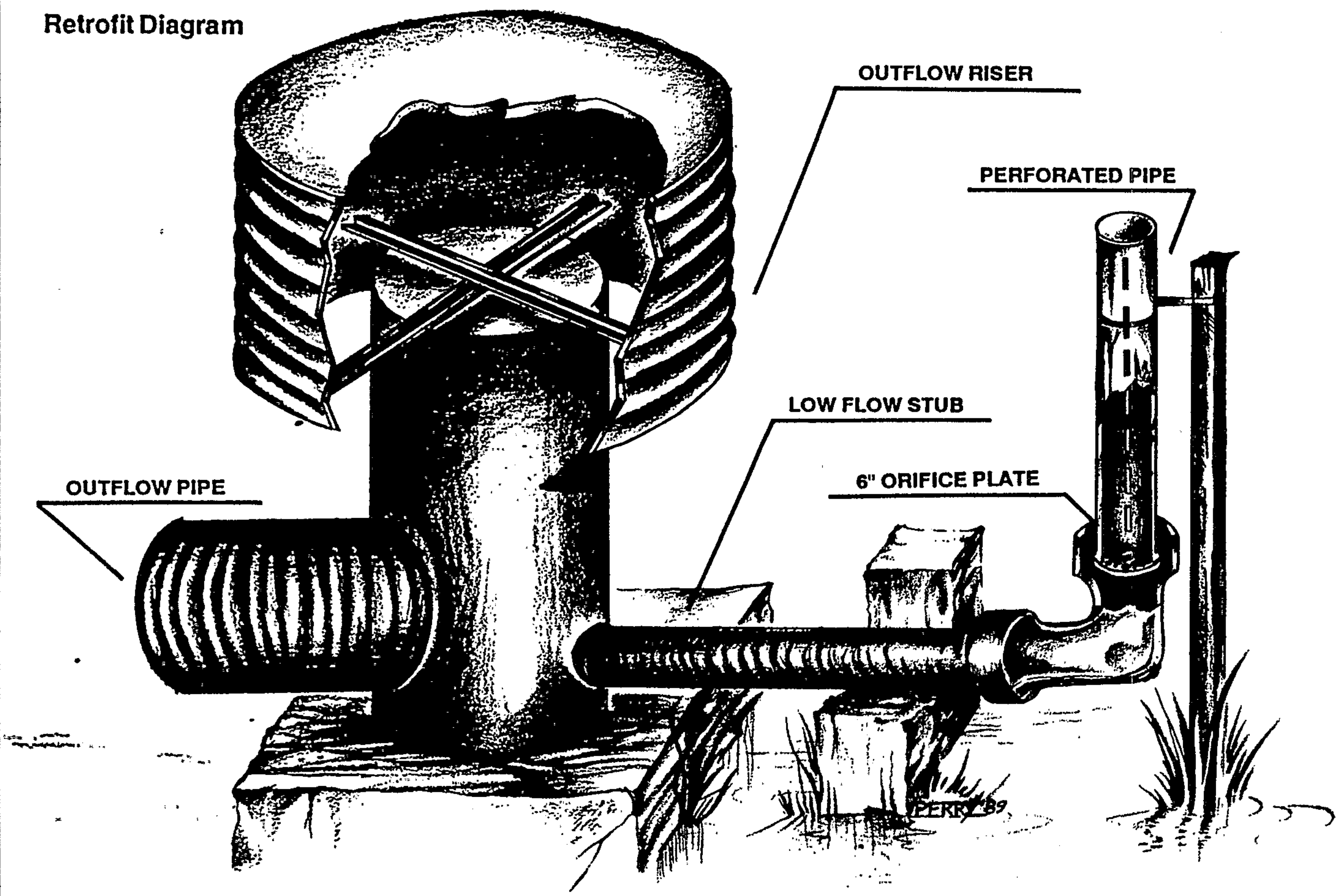
Second, the engineers needed to design the actual retrofits, which would vary the size of the low flow release structure to handle smaller storms. This was accomplished by designing a special attachment and installing a trash debris guard.

So far, five retrofits have been built. The first, Dulaney Gate, was installed during the summer of 1984; the most recent, Huntridge, was completed in March 1988.

Each retrofit was tailored to individual outlet and site conditions. Three of the retrofits were dry ponds and installation took less than three days. Retrofitting the wet pond was more complicated and expensive because the pond had to be pumped and the bottom dredged because the low flow release was covered by sediment.

A schematic of a detention basin that has been retrofitted appears on the last page.

Retrofit Diagram



Costs

The cost of the retrofits ranged from $2,000 to $13,000 per basin. The dry ponds cost approximately $2,000 and the wet pond $13,000. The added cost of dredging bottom sediment and pumping the standing water accounts for the higher cost associated with the wet basin. In addition to the costs, it took an average of one day to install the dry basin and one week for the wet basin.

Maintenance and Liability

Any modification made to an existing pond could increase liability and maintenance. The county government agreed to work with private basin owners and, if necessary, relieve them of these responsibilities. Because of legal and political issues, the county could guarantee maintenance for the retrofit only on ponds already owned by the county, thus limiting the available coverage of this effort.

Water Quality Monitoring and Results

Preliminary results indicate the retrofits remove over 90 percent of all particulate material and between 30 and 40 percent of the total phosphorus. These high removal efficiencies were fairly consistent for all storms. All of the storms successfully monitored had less than a one-year recurrence interval and detention times ranged from 3 to 5 hours.

Not one of the retrofits has clogged, demonstrating the effectiveness of the trash-debris guards. Sediment in-filling of the basins does not appear to be appreciable despite their estimated high trap efficiency. This is most likely due to the fact that all of the retrofits drain stabilized urban areas that characteristically have low sediment export rates. Sediment in-filling is expected to be a concern in areas with construction activity.

Retrofit Design Criteria

Name	Drainage Area (acre)	Retrofit	Detention Times (hours) 1/2 year	1 year
Dulaney Gate	83.6	4"	8.8	20.8
Oakhampton	16.8	2"	2.2	29.1
Mays Chapel	98.3	3"	16.3	2.9
Loveton	41.8	4"	9.8	24.2
Huntridge	20.6	3"	11.5	22.4

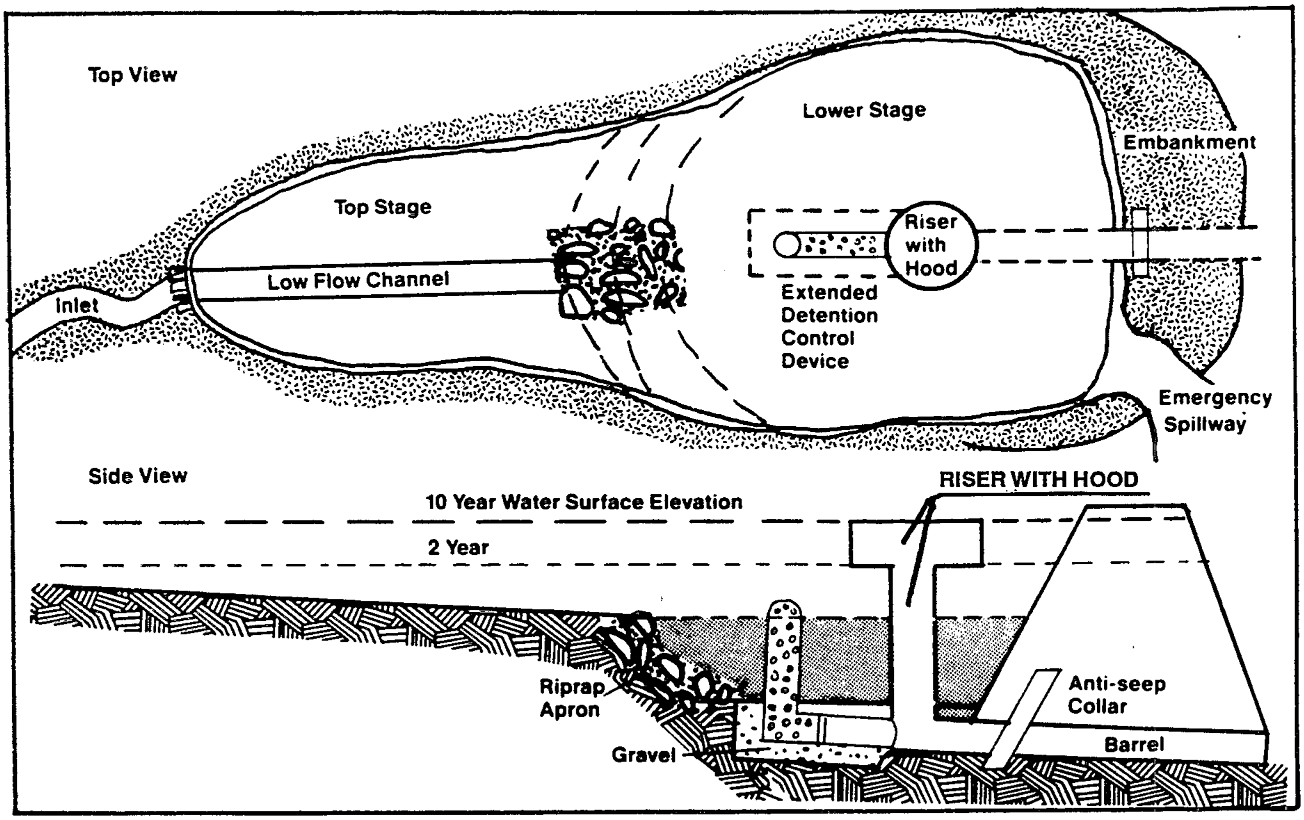


Illustration from *Controlling Urban Runoff: a Practical Manual for Planning and Designing Urban BMPs*, by Thomas R. Schueler, Department of Environmental Programs, Washington Metropolitan Council of Governments; published July 1987.

If you have any questions concerning this project, please contact Randall G. Waite, Clean Water Coordinator, Region III, Philadelphia, PA, (215/597-3425) or William P. Stack, Technical Manager, Baltimore City Water Office, Baltimore, MD (301/396-0732).