DEVELOPING PRACTICAL GUIDELINES FOR WATERSHED IMPROVEMENT

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REFERENCE: Proceedings of the 1999 Georgia Water Resources Conference, held March 30-31, 1999, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, the University of Georgia, Athens, Georgia.

Abstract. Although information on best management practices (BMPs) for stormwater and watershed protection abounds, there is far less information on practical methods for setting performance guidelines for the combination of BMPs in any watershed protection plan. Furthermore the typical yardstick for measuring the health of streams, water quality standards, do not provide useful information for measuring practical watershed conditions. In Gwinnett County, a combination of biological (benthos and fish), habitat, and water quality information is being used in an integrated manner to provide a rational basis for setting watershed improvement guidelines. These guidelines, based on statistical correlations between the parameters and professional judgement, allow utilities, governments, and stakeholders to make pragmatic decisions about what is achievable and desirable in their streams. This paper describes the development of watershed improvement guidelines in Gwinnett County as part of the county-wide watershed assessment and modeling project.

INTRODUCTION AND BACKGROUND

Gwinnett County

Gwinnett County lies on the northeastern edge of metropolitan Atlanta. It has a population of over 450,000, and is ranked as one of the strongest county economies in the nation. It lies in the Piedmont geologic region, which means the topography is hilly and underlain by rock with no significant aquifers underneath. The County is also bisected by the subcontinental divide, with water to the west of the divide flowing to the Chattahoochee River and thence to the Gulf of Mexico, and water to the east of the divide flowing eventually to the Atlantic Ocean. All of Gwinnett County's water is taken from Lake Lanier upstream on the Chattahoochee River, the most heavily recreated Corps of Engineers (COE) lake in the country. All but one of the County's existing water reclamation facilities (WRFs) are located in the southern and eastern portion of the County and release into the Atlantic subbasin. A new WRF in the Chattahoochee basin is scheduled to begin operation in August 2000. The area receives almost 50 inches of rainfall per year on average.

Watershed Assessment

Gwinnett County began a comprehensive watershed assessment project over the entire county in 1998. The project is designed to meet regulatory requirements for discharge permitting, NPDES stormwater modeling and monitoring, and drinking water supply protection. The effort is composed of the following major tasks:

- Public Involvement
- Watershed Characterization
- Watershed Modeling
- Watershed Protection

Public involvement is a critical component to raise awareness about watershed issues, and to involve key stakeholders in the development of comprehensive strategies to protect watersheds.

Watershed characterization is basically determining the health of the watersheds. In addition to collection of existing data, it also includes monitoring of habitat, biology, and water quality in streams. The habitat and biology are assessed using standard protocols and indices (Plafkin et. al 1989 and 1996; CH2M HILL 1998a). The locations of the monitoring points are carefully selected to reflect various land uses, impacts of point source, jurisdictional boundaries, and other issues. The results of the monitoring help pinpoint existing problem areas and causes. The results, in conjunction with modeling information, also provide the opportunity to develop and use relationships between loading rates and biological indices to help size BMPs.

Watershed modeling simulates the hydrologic and water quality characteristics of the watershed. In the case of the Gwinnett County project, the BASINS modeling framework was used. The key benefit of modeling is the ability to simulate future land use and BMP conditions. The watershed model is also being used to develop pollutant loads required by the county's NPDES storm water permit.

Watershed protection uses the information developed in the other tasks to develop watershed protection scenarios that meet the water quality, habitat, and biological objectives defined while balancing stakeholder issues and concerns. The resulting plan meets not only EPD's requirements for discharge permitting, but also water supply watershed protection requirements.

Improvement Guidelines

Impacts Assessments for previous studies (CH2M HILL 1998b) demonstrate that urban and suburban streams are impacted to varying degrees by hydraulic factors and land activities that degrade stream habitat, dry weather flow contributions (spills, leaks, dumping), and storm water contributions. The dominant impacts are driven by wet weather events in the urbanized area with a high percentage of impervious surface. The impacts generated by these wet weather events are habitat degradation (sedimentation and erosion) and transient pollutant loads. The Impacts Assessments confirm the impact of imperviousness in the watershed on habitat in the stream, as observed in numerous other studies (including Schueler, 1994).

When developing watershed protection and improvement strategies, a combination of pragmatism, rule-of-thumb, and load reductions for some basic parameter are typically used. However this approach is limited in its effectiveness and defensibility, and lacks a corresponding link to biotic integrity. In Gwinnett County, and in prior studies (CH2M HILL 1998b and 1998c), a new approach was used to set a target biotic integrity for a watershed and develop a management plan to make that aquatic integrity attainable.

METHODS

In order to develop the watershed improvement guidelines, a correlation analysis is performed on the paired data by monitoring location for habitat, benthos, and fish scores, as well as pollutant loading rates for various pollutants of interest. An example of a correlation matrix is shown in Table 1 (CH2M HILL 1998b).

A desired level of aquatic integrity is then set, typically working with a stakeholder group and using visual examples that are public-friendly. Examples of planning level cost estimates are used to provide a feel for the cost of reaching a desired level of aquatic integrity.

Once this level of aquatic integrity is determined, the corresponding levels of the other factors influencing aquatic integrity (habitat, pollutant loads, imperviousness, etc.) are estimated. These estimates are based on regression analysis of the data used in the correlation analysis.

The results are then reviewed for each parameter, for both benthos and fish, and a guideline is selected based on professional judgement and the results. An example of these results is summarized in Table 2 (CH2M HILL 1998b).

CONCLUSIONS

Gwinnett County is assessing its watersheds in a comprehensive manner to protect and improve water quality. In the process, the county is committed to protecting aquatic integrity as a tangible benefit of watershed protection measures.

Stakeholders are key to successful implementation of watershed protection measures. These aquatic integrity guidelines provide a rational, easily understood means of explaining the importance and effects of watershed protection measures.

Although this approach appears to be working well, additional research is needed. In particular, long-term monitoring associated with implementation of watershed protection measures should be compared to the expected results using this method. Also the increasing amount of practical research on the effectiveness and performance of BMPs will improve the planning process for watershed protection, resulting in more effective and efficient plans.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support and cooperation of the Gwinnett County Department of

Table 1. City of Atlanta Correlation Analysis for Impacts Assessment.

Units in kg/ha/yr unless otherwise noted	Imperviousness (percent)	BOD	TSS	NH_3-N	Total P	Cd	Cu	Pb	Zn	Habitat	Benthic Raw Score	Fish Raw Score
Imperviousness (percent)	1.000											
BOD	0.800	1.000										
TSS	0.862	0.784	1.000									
NH_3-N	0.651	0.888	0.691	1.000								
Total P	0.751	0.939	0.689	0.832	1.000							
Cadmium	0.782	0.372	0.755	0.234	0.325	1.000						
Copper	0.815	0.956	0.857	0.848	0.935	0.487	1.000					
Lead	0.850	0.929	0.875	0.808	0.909	0.562	0.985	1.000				
Zinc	0.854	0.907	0.919	0.837	0.830	0.538	0.931	0.938	1.000			
Habitat Raw Score	-0.555	-0.529	-0.596	-0.436	-0.528	-0.447	-0.599	-0.584	-0.582	1.000		
Benthic Raw Score	-0.704	-0.696	-0.726	-0.581	-0.630	-0.579	-0.708	-0.701	-0.667	0.627	1.000	
Fish Raw Score	-0.790	-0.864	-0.785	-0.681	-0.901	-0.737	-0.852	-0.814	-0.748	0.546	0.835	1.000

Table 2. City of Atlanta Guidelines.

Parameter	Units	Guidelines Based on Benthic Relationships	Guidelines Based on Fish Relationships	Overall Guidelines
Habitat	NA	130	150	120
TSS	lb/ac/yr	320	200	300
Cadmium	lb/ac/yr	0.006	0.002	0.003
Copper	lb/ac/yr	0.038	0.005	0.025
Lead	lb/ac/yr	0.035	0.005	0.02
Zinc	lb/ac/yr	0.21	0.12	0.15
BOD	lb/ac/yr	NA	17	20
Ammonia	lb/ac/yr	0.8	0.6	0.8
Total Phosphorus	lb/ac/yr	NA	0.5	0.6
Effective Imperviousness	%	15	5	12

Public Utilities and the Gwinnett County Board of Commissioners.

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