
STORMWATER UTILITY IMPLEMENTATION USING GIS

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Abstract. In recent years, stormwater utility fees have been identified as a reasonable and effective funding mechanism to address stormwater problems. The fees provide for an equitable assignment of cost that is in proportion to the demand placed on the drainage system by an individual property's runoff. The citizens of DeKalb County are facing an increasingly acute and complex set of storm water infrastructure challenges as the County continues to grow and prosper. An effective storm water management and infrastructure system is required to protect properties from flooding, to preserve and enhance the environmental quality of area watersheds, and to comply with National Pollutant Discharge Elimination System (NPDES) requirements. (NPDES is part of the Clean Water Act enforced by the Georgia Environmental Protection Department.) A stormwater utility fee system must meet the needs of the program expenditures, be dedicated to stormwater utility programs, continue to ensure long-term effective implementation and environmental stewardship and be legally defensible within the state of Georgia. DeKalb County's stormwater utility fee system incorporated data from the County's Geographical Information System (GIS) and the Tax Assessor's database to assign the fees for each parcel within unincorporated DeKalb County. This paper describes in more detail the technical methods for calculating and assigning these fees.

INTRODUCTION

Stormwater management presents a number of challenges for the citizens of DeKalb County. Runoff from significant rainfall events threatens public safety and property and conveys a number of pollutants to receiving streams, impacting water quality. While local governments may have authority and a duty to manage stormwater runoff, it is fundamentally the responsibility of individual property owners to ensure that any adverse consequences resulting from the development of their properties, or activities conducted thereon, are not transferred to downstream or adjacent property

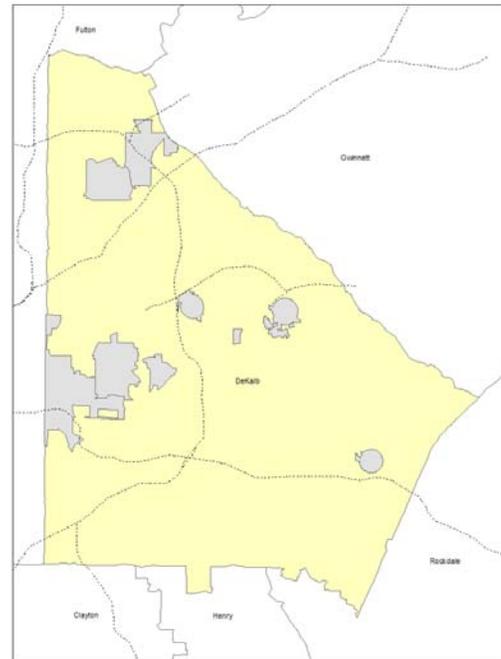


Figure 1: DeKalb County, Georgia

owners. In much the same way that raw sewage disposal, control of foul air emissions, or abatement of noise are responsibilities of those generating such impacts, owners of developed property have a measure of responsibility for flood protection and preservation of the environmental quality of watercourses and riparian corridors. County-delivered stormwater management services, therefore, help fulfill owner responsibilities for mitigating the adverse effects of stormwater runoff.

Property owners receive an array of specific benefits as a result of County-delivered stormwater management services. In particular, as County operations are expanded, existing infrastructure repaired or replaced, and new stormwater management facilities put in place, parcel owners will be subject to reduced incidence of both localized and County-wide flooding, more effective drainage of public rights of

way, and enhanced water quality and riparian ecosystems.

As with other utility services, delivery is subject to a number of regulatory requirements and generally realizes economies of scale. As with rates for water, wastewater, and other utilities, stormwater utility service rates are equitably established based on cost causation.

RATE REVENUE REQUIREMENTS

As is true of other utilities, stormwater utility rates are determined through an iterative financial planning process that identifies total operations and maintenance, capital financing, and other costs, typically for various levels of infrastructure investment or level of service. Other sources of funding, including non-rate revenues (e.g., impact fees) and grants, are deducted from annual requirements to determine revenues to be recovered through rates.

Based on the DeKalb Board of Commissioners' and the general public's acceptance of a \$4 per month per equivalent residential unit fee level, which was recommended in the County's Feasibility Study (December 2001), subsequent financial planning was based on this fee level.

COST ALLOCATION

Cost-of-service ratemaking, across various forms of utilities, is generally characterized by a cost allocation process that defines customer classes and then assigns customer class responsibilities on the basis of cost causation. In DeKalb County, customer classes have been simply defined as follows:

- Single-Family Residential
- Multi-Family Residential
- Non-residential
- Undeveloped
- City – Properties within incorporated cities

For stormwater rate design, DeKalb County has adopted the most basic of rate structures: a flat \$4 per month per 3,000 square feet of impervious area. This simple rate structure fulfills several objectives. First, as there is a well-documented correlation between impervious area and both volume of stormwater run-off and pollutant loading characteristics, this fee structure provides an equitable distribution of cost responsibilities. Parcel owners are charged on the basis of the volume and quality of the stormwater flows emanating from their properties. Second, this rate form limits the County's administrative burden, which is especially important in the initial years of program

implementation. Finally, a flat charge, complemented by an appropriate credit structure, may aid public understanding and acceptance. Publicly articulated messages to the effect that "everyone pays the same amount per unit of impervious area" tend to ring true as eminently fair and understandable.

FEE CALCULATIONS USING GIS

Stormwater utility user fee calculations are based on impervious area measurements because impervious areas (surfaces that do not absorb stormwater, such as rooftops and pavements) have been shown to contribute to increased stormwater runoff and water quality degradation. Basing fees on impervious area ensures that customers pay according to the demand their property places on the County system. Impervious areas are commonly used as the basis for charging stormwater fees.

The stormwater utility user fee calculations are based on three different data sources specific to DeKalb County: the Tax Assessor Master Account Database, parcel boundaries, and impervious ground cover. This information is then utilized in the equivalent residential unit (ERU) analysis and multi-family factor analysis to arrive at realistic assumptions for use in the fee calculations.

A geodatabase containing the impervious surfaces, parcel boundaries and other base map layers such as roads, city boundaries and land lots, stores the spatial data. A separate database stores the Tax Assessor data and the stormwater utility data.

This section further explains the data and the process for arriving at each property owner's fee.

Master Account Database for Assignment of Stormwater Rate Classes

A stormwater rate class (single-family, multi-family, non-residential, city or undeveloped) was assigned to each records in the Master Account Database. This attribute indicates how the fee was determined for that individual account. The stormwater rate class was assigned to each parcel within the County using various fields from the database, including the property class, owner name, total assessed value, year built and total living area. The stormwater rate class determines the method in calculating or assigning the total number of ERUs.

Impervious Ground Cover

A GIS layer of impervious ground cover was developed from DeKalb County's planimetric maps. . The planimetric maps were based on aerial photography from 1995, so recent development is not reflected in the

data. The buildings and pavement lines digitized in the planimetric maps were converted to polygons so that the impervious area could be calculated. This new GIS polygon layer was reviewed and land cover types were assigned: building, street, driveway, or pervious.

Aerial photography coverage dated January 2001 was used to revise the planimetric map data in areas of recent development. For each non-residential parcel, the planimetric data was overlain on the aerial photos and the two data sources were compared. Where a significant amount of impervious ground cover was apparent in the photo but not shown in the planimetric data, additional polygons of impervious area were digitized using GIS techniques. Typical conditions where this was necessary included:

- Small driveways or paved areas not shown on the planimetric maps;
- Development between 1995 and 2000;
- Swimming pools (with decks) and tennis courts not shown in the planimetrics; and
- Compacted pervious surfaces, such as truck parking areas or unpaved driveways.

In addition to the aerial photos, field checks and development plans were reviewed in cases where the Master Account Database indicated development since the effective date of the photography, such as the development near the Stonecrest Mall.

Parcel Boundaries

DeKalb County's GIS department maintains approximately 1,400 CADD files containing the parcel boundary information. Each file covers a land lot or an individual development within a land lot. The parcel boundaries shown on the maps are schematic in nature, not being drawn to a true scale and not georeferenced to a common base map. These CADD files were converted into GIS files and then "rubber-sheeted," or stretched and fitted, to the planimetric base map as well as possible. However, a substantial number of refinements was needed to "clean up" the parcel boundaries. The refinements included assigning a Parcel ID number and relocating individual non-residential parcel boundary lines to align better with the base planimetric information, specifically so the parcel contained the appropriate corresponding impervious features. Where boundary lines remained uncertain, further investigations, including field visits and review of development plans, were used to establish more accurate locations of the parcel boundaries. The GIS layer of parcel boundaries was developed in detail only for non-residential parcels, since they are the only



Figure 2: Sample Non-residential parcel with impervious surfaces

stormwater utility customer class for which measured impervious areas are needed.

Once the non-residential parcels were complete with the parcel number attribute, the parcels were intersected with the impervious surfaces to output a feature class in the geodatabase of impervious surfaces attributed with the parcel number. A summary of the impervious surfaces was performed based on the parcel number, resulting in a square footage of driveways, buildings and parking lots for each non-residential parcel. This summary table was joined to the database containing the Tax Assessor Master Account data table to create the Master Stormwater data table.

Equivalent Residential Unit Analysis

The ERU forms the basis of the billing for the DeKalb County stormwater utility fees. It represents the typical amount of impervious ground cover on a single-family residential property in DeKalb County. Stormwater utility fees for non-residential properties are billed in proportion to the ratio of their total impervious area to that of the typical single-family residential property, represented by the ERU. While stormwater utility fees assessed to single-family residential parcels are at a flat rate for all parcels in the class, impervious areas for non-residential parcels are measured by GIS or other means. The non-residential stormwater utility fee is calculated by dividing that total measured impervious area by the ERU multiplied by the fee per ERU. Available data from the DeKalb County GIS Department were used to determine the

ERU by taking impervious area measurements of a random, statistically valid sampling of single-family residences.

For DeKalb County, it was determined an ERU would equate to 3,000 sq. ft. of impervious surfaces. For each non-residential parcel the total square footage of impervious surfaces calculated in the GIS was divided by 3,000 to produce the number of ERUs.

For multi-family parcels, an analysis was performed to calculate the average amount of impervious surface for each unit. It was determined that multi-family parcels contain approximately 1/2 the amount of impervious area per unit as single-family residential parcels. Therefore, the total number of ERUs assigned to multi-family parcels was calculated as 1/2 the number of units. For example, an apartment complex of 100 units was assigned a total ERU of 50.

The total number of ERUs for each parcel was provided to the Tax Commissioner's office to assign fees.

STATUS OF THE DEKALB COUNTY STORMWATER UTILITY

Stormwater Utility fees were issued on the 2004 property tax bills. To date, over \$15M of the \$16M fees billed have been paid. The majority of the outstanding fees are for properties owned by tax exempt entities.

The GIS data and associated databases have provided the Roads and Drainage staff with the resources to respond to customer inquiries.

CONCLUSIONS

The Stormwater Utility program has proven to be a fair and effective method to provide for DeKalb County's stormwater services. In 2005, data will be updated continuously throughout the year as development changes the stormwater status of properties throughout the county.

LITERATURE CITED

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