FINANCING STORMWATER MANAGEMENT:

THE UTILITY APPROACH

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1.0 INTRODUCTION

Urban stormwater runoff is a major source of pollution in the Chesapeake Bay.[1] To achieve targeted reductions in nutrient loadings to the Bay, stormwater management must be improved.[2] Because laws mandating stormwater management are relatively new, most local governments have not yet developed comprehensive programs. Few stormwater programs are well financed [3], and one-third or more of all stormwater management facilities are inadequately maintained [4,5,6]. It is clear that expenditures for stormwater management must increase if water quality goals are to be achieved.

Stormwater management historically has been financed with general revenues from property taxes. Most local officials, however, have considered stormwater management a low priority activity, at least relative to other important local programs. As a result, reliance on property taxes to finance stormwater management has proven inadequate. The best alternative to property taxes appears to be stormwater utility charges, which are "user" charges paid by owners of properties in proportion to some estimate of the amount of runoff from their properties.

The Chesapeake Bay Nutrient Reduction Program (Draft) recognizes that costs to implement urban stormwater controls will increase and that new funding sources will be needed. It proposes a stormwater utilities program.[7]

This guide has been written for local officials so that they can make informed decisions about creating utilities. This guide focuses on the financial, or revenue-generating aspects of utilities. Several of the many political, legal, administrative, and managerial aspects also are addressed, but only in a general way.

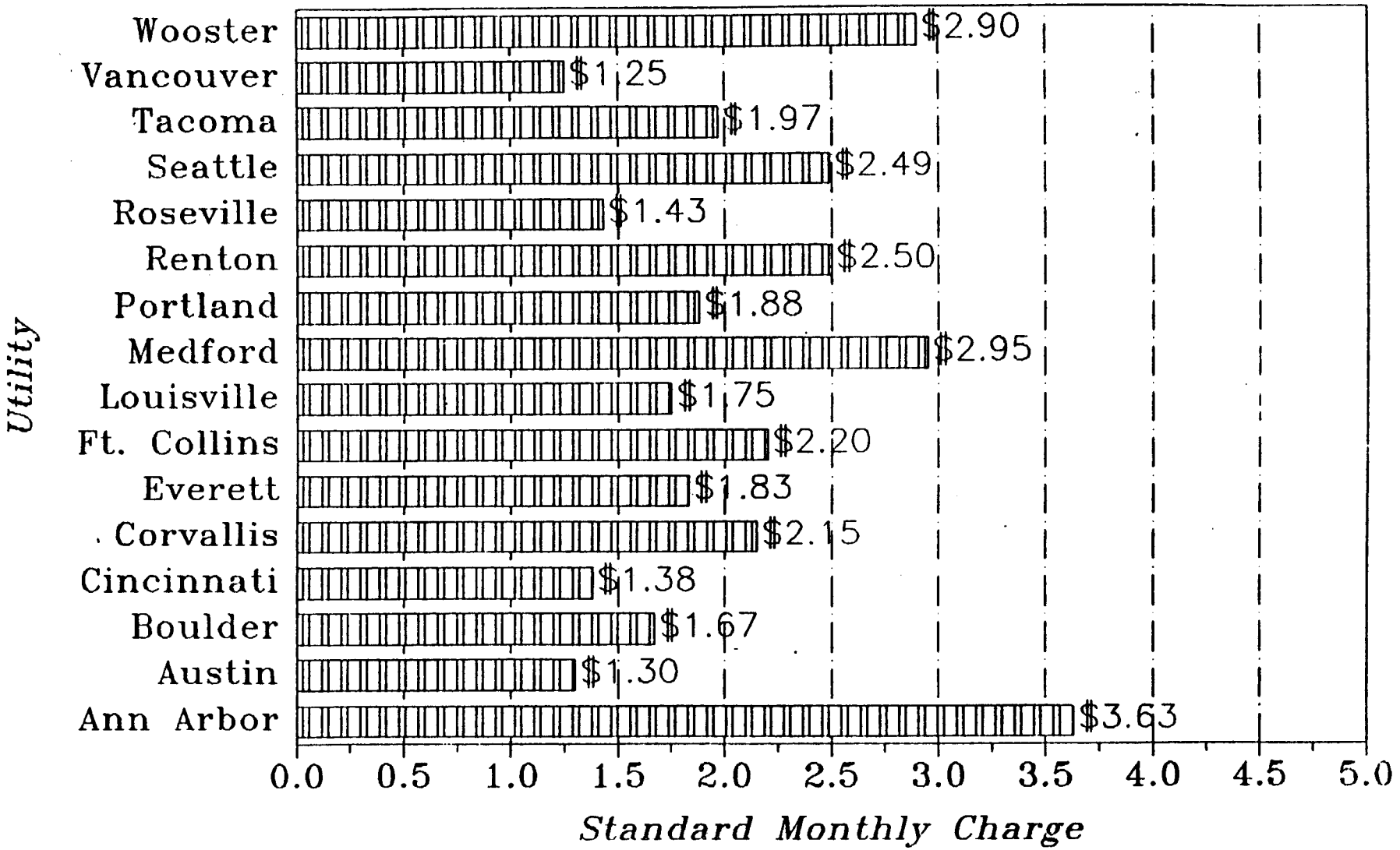
In the following section, stormwater utilities are defined, and their potential for revenue-generation is summarized. Subsequent sections concern the rationale behind the utility approach, general considerations in planning utilities, and details of establishing rate structures and estimating user charges.

This guide is based on the results of a survey of utilities by the Sediment and Stormwater Administration (SSA) [8], on articles published by officials and consultants involved with stormwater utilities, and on various technical reports. The survey, (A Survey of Stormwater Utilities), as well as many of the references, also may be of interest to individuals. Questions concerning the material herein should be addressed to the Sediment and Stormwater Administration, Maryland Department of the Environment.

Table 2.1 Examples of Utility Charges and Revenues [10].

Utility	Service Area Population	Monthly SFR Charge (1987)	Total Revenues from Charges (all categories)	Annual Revenue/ Capita	SFR Charges as % of all Charges	Developed Acreage	Annual Revenue/ Developed Acre	Total Acreage	Annual Revenue/ Gross Acre
Ann Arbor, MI	108,000	$3.63	NA	NA	NA	NA	NA	NA	NA
Auburn, WA	30,000	NA	$818,000	$27.27	NA	NA	NA	NA	NA
Austin, TX	450,000	$1.30	$4,440,000	$9.87	62%	88,000	$50.45	160,000	$27.75
Billings, MT	85,000	NA	$804,831	$9.47	NA	NA	NA	NA	NA
Boulder, CO	90,000	$1.67	$859,453	$9.55	37%	11,401	$75.38	16,762	$51.27
Cincinnati, OH	385,000	$1.38	$3,990,000	$10.36	32%	35,450	$112.55	49,920	$79.93
Corvallis, OR	42,000	$2.15	$546,000	NA	40%	NA	NA	NA	NA
Everett, WA	150,000	$1.83	$1,100,000	$7.33	NA	NA	NA	NA	NA
Ft. Collins, CO	80,000	$2.20	$1,078,219	$13.48	NA	NA	NA	NA	NA
Kent, WA	31,000	NA	NA	NA	NA	NA	NA	NA	NA
Louisville/ Jefferson County, KY	684,565	$1.75	$8,200,000	$11.98	NA	97,344	$84.24	242,079	$33.87
Medford, OR	45,000	$2.95	$850,000	$18.89	NA	NA	NA	NA	NA
Portland, OR	400,000	$1.88	NA	NA	24%	NA	NA	NA	NA
Renton, WA	34,460	$2.50	NA	NA	NA	NA	NA	NA	NA
Roseville, MN	36,000	$1.43	$530,000	$14.72	NA	5,540	$95.67	8,724	$60.75
Seattle/ King Co., WA	NA	$2.49	$7,424,926	NA	51%	NA	NA	NA	NA
Tacoma, WA	160,000	$1.97	$1,821,287	$11.38	40%	14,921	$122.06	23,663	$76.97
Vancouver/ Clark Co., WA	52,000	$1.25	$425,111	$8.18	62%	NA	NA	NA	NA
Wooster, OH	20,000	$2.90	NA	NA	32%	NA	NA	NA	NA

FIGURE 2.1 MONTHLY RESIDENTIAL CHARGES



Data available for 16 utilities.

generating potential for a stormwater utility in Prince George's County range from $4.9 to $23 million (Table 2.2). In this example, both of the estimates of revenues per acre are higher than the per capita estimate. This result occurs because most of the data on which the estimates are based are for municipalities, not counties. By estimating the charges on a county-wide basis, the acreage to be charged increases more, proportionately, than does the population. As a result, the estimated revenues per acre are greater than the estimated revenues per capita.

Prince George's County presently has one of the most comprehensive flood control and stormwater management programs in Maryland. The County's annual expenditures for these purposes are approximately $11,000,000. [13] Thus, current expenditures are near the mean of the crude per capita estimates, and near the low end of the estimates per acre. Assuming that the amount of revenues raised by other utilities are indicative of the amount that could be raised in Maryland, it appears that Prince George's County could raise additional revenues by establishing a utility. Flood control and stormwater programs in Prince George's County are financed by a dedicated property tax of 13.5 cents per $100 assessed valuation. [14] No other local governments in Maryland spend as much or have such a large funding source. It is likely, therefore, that the relative gain from creating utilities would be greater in other jurisdictions.

Like any governmental entity, the ability of a stormwater utility to generate revenues is governed ultimately by the willingness of people to pay for stormwater management. Revenues generated by existing utilities elsewhere are indicative of people's willingness to pay, but these amounts should not be regarded as absolute bounds. In any given situation, residents may be willing to pay more or less than the amounts cited here. A method for preparing more accurate estimates of the revenue generating potential of a utility, including typical user charges, is described in Section 5.

Table 2.2 Hypothetical Estimates of Stormwater Utility Revenues in Prince George's County.

Units	Range of Total Annual Revenues
Per Capita	$4.9 - 18.1 Million
Per Developed Acre	$9.0 - 21.7 Million
Per Acre	$8.0 - 23.0 Million
From Residences	$2.2 - 7.8 Million

3.0 THE RATIONALE FOR THE UTILITY APPROACH

Many people find it rather strange to be asked to pay user fees to a utility for the stormwater that runs off their property. This is because they are used to thinking about runoff (if they think about it at all) as something that occurs naturally, not something that is at least partially the result of people's decisions. Similarly, most people view stormwater management as a government service to solve a public problem, not a service that they use to manage runoff that they themselves generate. The utility approach thus involves a redefinition of the way in which people think about runoff and stormwater management. The basic perspective is that runoff is a man-made problem, and that owners of property are responsible for it.

Stormwater management historically has been provided by government and financed by property taxes. The rationale for government involvement is that there is a public benefit to the managing runoff. The rationale for the financing mechanism, taxes, is either (1) that higher-valued properties benefit more or (2) that owners of higher-valued properties are able to pay more for a public good, the benefits of which are available to everyone and cannot be quantified.

With the utility approach, the benefits of stormwater management are deemphasized, and emphasis is placed on the cause of the problem. Individual property owners are viewed as generators, and the role of government is to control the discharges. To finance the government's activities, property owners pay user charges in amounts proportionate to their discharges. The rationale for the utility approach, therefore, is the "polluter pays" principle. Neither property values and ability to pay nor perceived benefits and willingness to pay generally are considered.

Three definitions follow from this discussion [15]:

* Users are properties that add runoff to a system;

* Beneficiaries are people or properties that gain from stormwater management (e.g., are protected from flood damage or benefit from improved water quality);

* User charges are dedicated fees paid by generators of stormwater based on the amount of runoff that leaves their property.

The utility approach consists of practical application of these definitions. Care must be taken in the formation of utilities, particularly their rate structures, because utilities frequently are subject to controversy. Four of 19

utilities surveyed by the Administration reported legal challenges; in each case, the rate structure was questioned. Courts, however, have upheld creation of stormwater utilities and user fee systems. Cyre (1986) has summarized the legal standard that has evolved [16]:

> Charges must be fair and reasonable and bear a substantial relationship to the cost of service and facilities.

This standard is important. It says that local jurisdictions must have rational bases for making estimates of runoff and determining charges, but that runoff from parcels need not be measured precisely. Reasonably accurate estimates will suffice. Equally important, the standard does not mention benefits or beneficiaries. Utility rate systems may be based on costs, not benefits. In fact, the user charges imposed by most utilities are cost based and do not take benefits into consideration.

There is a consensus among public works officials that the utility approach is the best way to finance stormwater management. [17] The main reason for their preference is obvious: utilities are a stable, secure source of funds. Another important factor, however, is that many officials believe that the utility approach is more equitable. Many people think that user charges based on one's contribution to the problem are more fair than property taxes. The American Public Works Association (APWA) has concluded [18]:

> The user charge and the utility concept are the most dependable and equitable approaches available to local governments for financing stormwater management.

Planning for a stormwater utility involves determining the best way to apply the concepts discussed above in a particular locale. Various steps in the planning process are discussed in the following section.

4.0 PLANNING STORMWATER UTILITIES

The formation of a stormwater utility involves systematic consideration of a series of political, managerial, financial, and technical issues. These include:

* determination of the best administrative structure for stormwater management;

* estimation of revenue requirements;

* identification of potential sources of revenues and allocation of revenue requirements among sources;

* development of a billing system;

* adoption of a stormwater utility ordinance; and

* implementation of a public information program.

Each of these issues is addressed briefly in this section. The financial aspects of utility planning, including a general approach to estimating user charges, are discussed in detail in the following section.

4.1 Administrative and Managerial Considerations

Stormwater management historically has been inadequate, in part because responsibility for various activities has not been defined clearly. Therefore, planning for a utility often begins with what is sometimes referred to as a "functional requirements study." [19] Such a study involves determination of the scope of activities necessary to manage stormwater and identification of the administrative departments best suited to perform each activity. Functions typically performed by utilities include administration, planning, design and engineering, operations and maintenance, regulation and enforcement, construction, and, sometimes, water quality management. Clear specification of responsibilities for these activities will help solve management problems caused by fragmentation. It also will help a utility meet requirements for fiscal accountability.

Information on institutional structures for 19 utilities is included in the SSA publication, A Survey of Stormwater Utilities. Utilities generally are operated by or within Departments of Public Works, although this is not always the case. In some communities, a variety of Departments are involved, including the Departments of Finance, Utilities, Environmental Regulation, and Planning and Zoning. A common arrangement is for an agency such as the Department of Public Works to have responsibility for planning, design and

engineering, and operations and maintenance, and for the Department of Finance to have responsibility for billing.

At least two jurisdictions in Maryland recently have completed studies to determine how best to organize stormwater management. Prince George's County prepared an analysis when planning how to assume responsibilities for stormwater management from the Washington Suburban Sanitary Commission. [20] Anne Arundel County studied various administrative arrangements for stormwater management as part of a study to determine how best to organize watershed management programs. [21] Although these studies were not prepared as part of efforts to establish utilities, they are good examples of functional analyses. The Prince George's County study is particularly useful because of the tables and figures used to illustrate and evaluate institutional alternatives.

An issue that merits special consideration in a functional analysis is whether stormwater management facilities should be maintained by the public or private sector. A strong argument in favor of private maintenance is that maintenance by the private sector limits the direct public costs of stormwater management. However, recent surveys indicate that private stormwater management facilities are not being maintained as well as public facilities. [22,23] The APWA suggests that maintenance activities are best carried out by the entities with the "greatest interest in the specific benefits associated with each maintenance operation." [24] APWA also has identified factors to be considered in deciding whether detention facilities are to be privately or publicly owned, and notes that [25]:

> there appears to be a preference for and a trend towards public ownership ..... Generally, unless basins are maintained by public agencies, long term adequate maintenance can not be assured.

The Sediment and Stormwater Administration generally agrees with this conclusion.

4.2 Estimating Revenue Requirements

Determination of revenue requirements, or the total costs of stormwater management, is an important step in utility planning and is the first step in preparing the utility financial plan. Cyre (1987) has published ball-park estimates of costs for stormwater management. He reports that in most cities, basic stormwater administration, engineering, and reactive maintenance costs $15 to $25 per gross acre. [26] He also projects that comprehensive management, including drainage master plans, preventive maintenance, and major capital improvements may cost $100 or more per gross acre. Only two

of the six utilities that provided this information to the Administration currently spend more than $100 per developed acre. [27]

Accurate estimation of the costs of comprehensive stormwater management is complicated and time-consuming. Estimates of costs (i.e., revenue requirements) should be developed for all the functions of the utility. In practice, the range of activities financed by utilities varies greatly. Some utilities (e.g., Fort Collins, Colorado) fund both O&M and capital projects with utility revenues. [28] Others (e.g., Austin, Texas) use utility revenues only for planning and O&M and finance capital improvements by issuing general obligation bonds that are repaid with property tax revenues.

Sources of the information necessary to estimate total costs include historic records, old drainage and watershed plans, public works personnel, and unit costs for specific activities that are published in the literature. For example, Grigg (1986) reports costs for mowing, debris removal, and other routine activities. [29]

A current master drainage plan is essential for projecting costs of stormwater management, particularly costs of capital improvements. Accurate identification of capital improvements is necessary because maintenance costs often are projected as a percentage of capital improvements. Master plans are helpful for another reason: contested utilities are more likely to be upheld if charges are based on a master plan that specifies costs associated with a comprehensive stormwater program.

Frequently, maintenance costs are projected as a percentage of debt for capital improvements. King County, Washington, estimates that cost for maintenance of all facilities is 0.43% of total debt. [30] Schueler (1987) estimates that maintenance costs for best management practices range from 3% to 10%, although he notes that few reliable data for estimating costs exist. [31]

4.3 Identification and Allocation of Revenue Sources

Identification of potential sources of revenues and allocation of revenue requirements among sources comprises the remainder of the utility financial plan. Financing methods for each of the utility's functions and the amount to be raised by each should be specified. Table 4.1, in which financing options are grouped according to the purpose for which the funds typically are used, provides a general framework for this process. [32] As is shown, taxes and user charges are the only options for financing capital improvements and operations and maintenance, which are the most

Table 4.1. Financing Methods for Stormwater Management (after Cyre 1982 and 1983 [32]).

Use of Revenues	Source of Revenues	Developer/ User Pays	Taxpayer Pays	Other Pays
Operations & Maintenance				
	General Fund (property tax)		X	
	Utility Fee or Service Charge	X		
	Interfund Loans (for transition to utility)		X	
Major Capital Improvements				
Redevelopment or New Development				
	General Obligation Bonds		X	
	Revenue Bonds	X		
	Taxes on other utilities			X
	Grants (federal or state; e.g., Community Development Block Grants)			X
	Pay-as-you-go Sinking Fund		X	
	Tax Increment Financing		X	
Primarily New Development				
	Subdivision Exactions	X		
	Developer Incentives	X		
	Impact Fees	X		
	System Development Charges	X		
	General Facilities Charge	X		
	In-lieu of Construction Charges	X		
	Latecomer Fees for Extensions	X		
Regulatory Services				
	Plan Review & Inspection Fees	X		
	On-site Facility Inspection Fees	X		
	Penalties and Fines	X		
Special Services & Projects				
	Local Improvement Districts		X	
	Utility Local Improvement Districts		X	
	Area of Special Benefit Financing		X	
	Special Purpose Taxing Districts		X	
	Homeowners' Associations			X
	Voluntary Gifts			X

costly aspects of stormwater management. While other methods of financing exist (e.g., development fees), these are used primarily for financing stormwater management activities associated with new development. Based on survey results, these sources usually account for less than 10% of a utility's revenues. Given the inadequacy of property taxes as a revenue source, it is clear that the major task in this part of the planning process is selection of a utility rate structure and estimation of user charges.

When implementing a utility, planners must decide who will be charged, how they will be charged, and whether there will be any exemptions. Generally, in planning studies, estimates of user charges are developed from basic land use information; it is not necessary to have detailed data concerning the amount of impervious area on individual properties. For implementation, however, most utilities need this information. To obtain the data, it usually is necessary to digitize aerial photos or tax maps. The task of measuring parcels, if undertaken, is done during development of the billing system. It is one of the most time-consuming and expensive tasks in the creation of a utility.

4.4 Billing Considerations

Options for billing systems include:

1. Adding stormwater charges to other utility bills (e.g., water and sewer bills);

2. Adding stormwater charges to property tax bills;

3. Creating a new, separate billing system.

Advantages and disadvantages of alternative methods are presented in Table 4.2.

In practice, most utilities modify existing billing systems, adding new components as necessary to accommodate information needs or to include users not already on existing systems. Only four of 19 utilities surveyed by the Administration created entirely new billing systems. [33] Two of these were utilities that serve multiple jurisdictions. Most utilities use information from tax files and water accounts to construct billing systems; less than half of those surveyed digitized photos during implementation. Most utilities bill users monthly; some bill classes of users (e.g., commercial, industrial) with different frequencies.

In Maryland, if utilities were established, they most likely would be on a county-wide basis that would serve, at least nominally, multiple jurisdictions. Depending on the

Table 4.2. Options for Developing a Stormwater Utility Billing System.

Option	Frequency	Advantages	Disadvantages
Add to existing utility bill	usually quarterly or bimonthly	account structure is basically in place	existing system may not include all parcels to be charged
		may minimize cost of new system	may not have control over billing system
		benefits from local experience and expertise	existing system may not include parcel size or land use data
		minimizes problem of adjusting to turnovers	costs could be high if cost of meter reading is not factored out of cost-sharing equation
		more frequent billing may improve cash flow	more frequent billing may cost more
		reinforces idea that charge is a service fee and not a tax	people may confuse sewer charge and stormwater charge
Add to property tax bill	usually annually, may be semiannually	tax assessor's files usually include parcel size and land use	may not be legal
		annual billing may minimize cost of billing	data in tax assessor's file may not be accurate enough for computation of charges
		most parcels to be charged will be in system	annual billing results in poor cash flow
		may minimize cost of new system	people may confuse stormwater charge with property tax
			complicates problems associated with turnover on parcels
Create new system	as determined	complete flexibility in designing system to meet needs	probably highest cost to develop and maintain
		complete control over modifications to the system	costs of billing are not shared
			data for development of system may be more difficult to obtain

current scope of county services and existing billing systems, it is likely that new systems would have to be created.

A useful document for understanding aspects of creating a billing system is the publication by URS Corporation, Surface Water Management, The Utility Approach: Drainage Utility Service Charge, Customer Account Development Process. [34] The development of a billing system consists of the preparation of a master account file, a billing file, and, in some cases, a transactions file. The MAF is a complete list of all properties (users) to be charged and includes information necessary to calculate the charge (e.g., parcel address, land use code, exemption code, impervious area, relevant map numbers). The billing file contains data used to prepare bills, including owner name, address, account number, billing dates, and current balance. Programs may be written so that certain information needed in the billing file is "looked up" in the MAF.

Cyre (1987) reports that the costs to develop and implement the MAF, billing file, and support systems can range from $50,000 to $150,000 for professional services plus $3 to $10 per account. [35] His data are somewhat higher than data collected by the SSA indicate: utilities reported costs to develop billing systems ranging from $0.05 to $7.82 per account. [36] The 19 stormwater utilities surveyed by the Administration report annual billing costs per account ranging from $1.00 to $8.64. The data show that the cost of billing can account for anywhere from 1.4% to 16.3% of total revenues from charges. The cost of billing apparently accounts for more than 5% of total revenues for seven of the 11 utilities for which these data are available. Estimates of the percentage of delinquent accounts range from approximately 0.2% to 10%. Nine of the 10 utilities reporting this information have delinquency rates less than five percent.

4.5 Stormwater Utility Ordinances

Prior to implementation of a utility, local governments must adopt legislation (ordinances or resolutions) that specifies the scope of the utility's activities, its rate structure, details of billing, and other items. This usually involves modification of existing ordinances. In Maryland, most local stormwater ordinances are patterned after a model ordinance written by the SSA. [37] The model ordinance, however, contains no references to stormwater utilities. The SSA, therefore, has prepared a supplemental publication, "Sample Stormwater Utility Ordinance," as a guide for local officials interested in establishing utilities. [38] It is based on a review of utility ordinances adopted by 19 local governments, and is available on request from the SSA.

4.6 Public Information Programs

Sixteen of the 19 utilities surveyed by the SSA reported that public information programs were undertaken prior to implementation. [39] Most local officials stated that public information program were helpful and, in some cases, critical to successful implementation, although some utilities apparently have been established without informational programs. Public information programs typically include public meetings, slide shows, and mailings of informational brochures to residents. Some governments enlist the support of established citizen's organization, create formal citizen's advisory committees, and mail sample bills to residents. Details concerning the public information programs conducted by various utilities are included in A Survey of Stormwater Utilities. Examples of informational materials developed by various utilities also are available from the SSA.

4.7 General Considerations

Most utilities have been formed to fund operations and maintenance and flood control programs; funding of water quality programs has not been as important. Nearly one-third of the utilities surveyed were formed in response to severe flooding. [40] Only two cited concern over poor water quality.

Creation of a utility typically requires a substantial amount of time. Utility representatives report planning periods prior to authorization ranging from seven to 12 months to more than 2.5 years. [41] The planning period reported most frequently was 1.5 to 2.0 years. Implementation generally proceeds rapidly. Most (75%) of the utilities surveyed were implemented within six months after authorization; one required between two and two and one half years.

Eleven utilities report that consultants were retained to assist in the development of the utility. Most retained engineering firms; some used management or financial consultants. Consultants typically performed tasks such as the development of billing systems and the preparation of master plans.

5.0 ESTIMATING USER CHARGES

This section presents a methodology for estimating typical stormwater user charges based on data readily available in Maryland. The approach suggested here, which involves estimating charges based on general land use data, should provide accurate enough information about potential revenues for local officials to determine whether a utility should be created. However, because the approach does not involve estimation of the actual amount of impervious area on individual parcels, it is not sufficient for implementation.

5.1 Data Needed to Estimate Charges

Information needed to determine typical charges includes:

1. Land use data;

2. Rate factors derived from runoff coefficients for all land uses;

3. Revenue requirements for stormwater management.

Land Use Data

The land use data needed to estimate charges include land use categories (not zoning information), total acreage in each category, the total number of parcels in each category, and parcel area data (average parcel area is sufficient for initial planning studies).

In Maryland, these data are available from the Department of Assessments and Taxations, which maintains a uniform parcel file for 19 of the State's major jurisdictions. Data for five other jurisdictions also are available, but in a different format. The Department of State Planning has analyzed the taxation parcel files and summarized its findings in the Development Planning Series -- '85, Report 2: Residential Land Use in Maryland, 1985, An Analysis Based on Assessments and Taxation Parcel Files. [42] This report includes average parcel size data for improved and unimproved parcels for all jurisdictions except Baltimore City. Updated data based on 1987 tax files are available for individual counties from the Department of State Planning. [43]

Tables 5.1 and 5.2 are excerpts from the 1985 report that show how the data are presented for the standard land use categories. Table 5.3 is a condensation of Table 5.2 in which residential acreage categories have been re-grouped to correspond to residential acreage categories for which rate factors are available.

Table 5.1. Land Use Data for Prince George's County [42].

GEOGRAPHY: PRINCE GEORGE'S COUNTY-SUMMARY TAPE DATE APR 85

	IMPROVED					UNIMPROVED					TOTAL	
LAND USE	NO. OF PARCELS ACRES SPEC.	ACRES	AVERAGE ACRES	NO. OF PARCELS ACRES NOT SPEC	TOTAL ACRES	NO. OF PARCELS ACRES SPEC.	ACRES	AVERAGE ACRES	NO. OF PARCELS ACRES NOT SPEC	TOTAL ACRES	PARCELS	ACRES
RESIDENTIAL	141136	55436	.4	0	55436	29051	33743	1.2	55	33810	170262	91446
COOPERATIVE	0	0	.0	0	0	0	0	.0	0	0	0	0
APARTMENT	2139	3745	1.7	34	3833	972	1518	1.6	0	1523	3175	5358
CONDOMINIUM	8940	444	.0	0	444	16	9	.6	0	9	8956	453
MOBILE	11	218	19.8	0	218	1	23	23.0	0	23	12	241
GROUP QUAR	148	231	1.6	0	231	6	39	6.5	0	39	154	270
HOTEL	53	274	5.2	0	274	4	3	.8	0	3	57	277
INDUSTRIAL	278	2605	9.4	0	2605	1239	4887	3.9	0	4887	1517	7492
EXEMPT	1190	27751	23.3	0	27751	6449	23861	3.7	0	23861	7639	51612
COMMERCIAL	4418	10074	2.3	2	10078	2171	8931	4.1	17	8959	6608	19037
AGRICULTURAL	1389	69106	49.8	0	69106	1835	20807	11.3	0	20807	3224	89913
OTHER	146	7179	49.2	16	7219	1190	14469	12.2	0	14469	1352	21688
DISTRICT TOTAL	159808	177265		54	177397	42934	110290		80	110390	202956	287787

Table 5.2. Residential Land Use Data for Prince George's County [42].

GEOGRAPHY: PRINCE GEORGE'S COUNTY-SUMMARY — TAPE DATE APR 85
LAND USE CODE: RESIDENTIAL

IMPROVED PARCELS(ACRES SPECIFIED)

ACREAGE INTERVALS	NUMBER OF PARCELS	PERCENT OF TOTAL PARCELS	CUMULATIVE NUMBER OF PARCELS	CUMULATIVE % OF TOTAL PARCELS	NUMBER OF ACRES	PERCENT OF TOTAL ACRES	CUMULATIVE NUMBER OF ACRES	CUMULATIVE % OF TOTAL ACRES	AVERAGE ACREAGE	CUMULATIVE AVERAGE ACREAGE
0 - .5	128882	91.30	128882	91.30	26372	47.46	26372	47.40	.20	.20
>.5 - 1.0	7216	5.11	136098	96.42	5249	9.43	31621	56.84	.73	.23
>1.0 - 1.5	1390	.98	137488	97.40	1687	3.03	33308	59.87	1.21	.24
>1.5 - 2.0	950	.67	138438	98.07	1750	3.15	35058	63.01	1.84	.25
>2.0 - 3.0	855	.61	139293	98.68	2114	3.80	37172	66.81	2.47	.27
>3.0 - 5.0	812	.58	140105	99.26	3304	5.94	40478	72.76	4.07	.29
>5.0 - 10.0	735	.52	140840	99.78	4791	8.61	45269	81.37	6.52	.32
>10.0 - 15.0	140	.10	140980	99.88	1678	3.02	46947	84.38	11.99	.33
>15.0 - 20.0	58	.04	141038	99.91	881	1.58	47828	85.97	17.62	.34
>20.0 - 30.0	53	.04	141083	99.95	1248	2.28	49096	88.25	23.92	.35
>30.0 - 40.0	19	.01	141102	99.96	658	1.18	49754	89.43	34.63	.35
>40.0 - 50.0	11	.01	141113	99.97	493	.89	50247	90.31	44.82	.36
>50.0 - 75.0	18	.01	141131	99.98	1107	1.99	51354	92.30	61.50	.36
>75.0 - 100.0	8	.01	141139	99.99	696	1.25	52050	93.55	87.00	.37
>100.0 - 150.0	7	.00	141146	99.99	887	1.59	52937	95.15	126.71	.38
>150.0 - 200.0	7	.00	141153	100.00	1410	2.53	54347	97.68	201.43	.39
>200.0 - 300.0	0	.00	141153	100.00	0	.00	54347	97.68	.00	.39
>300.0 - 500.0	3	.00	141156	100.00	1289	2.32	55636	100.00	429.67	.39
>500.0 - 750.0	0	.00	141156	100.00	0	.00	55636	100.00	.00	.39
>750.0 - 1000.0	0	.00	141156	100.00	0	.00	55636	100.00	.00	.39
>1000.0 - 10,000	0	.00	141156	100.00	0	.00	55636	100.00	.00	.39
>10,000	0	.00	141156	100.00	0	.00	55636	100.00	.00	.39

UNIMPROVED PARCELS (ACRES SPECIFIED)

0 - .5	23920	82.34	23920	82.34	4749	13.34	4749	13.34	.20	.20
>.5 - 1.0	2161	7.44	26081	89.78	1501	4.20	6270	17.54	.69	.24
>1.0 - 1.5	568	1.96	26649	91.73	690	1.93	6960	19.47	1.21	.26
>1.5 - 2.0	370	1.27	27019	93.01	665	1.86	7625	21.33	1.80	.28
>2.0 - 3.0	485	1.67	27504	94.67	1193	3.34	8818	24.67	2.46	.32
>3.0 - 5.0	505	1.74	28009	96.41	2031	5.68	10849	30.35	4.02	.39
>5.0 - 10.0	436	1.57	28445	97.98	3184	8.91	14033	39.26	6.98	.49
>10.0 - 15.0	149	.58	28634	98.56	2081	5.82	16114	45.08	12.31	.56
>15.0 - 20.0	97	.33	28731	98.90	1693	4.74	17807	49.82	17.45	.62
>20.0 - 30.0	126	.43	28857	99.33	3065	8.58	20872	58.39	24.33	.72
>30.0 - 40.0	55	.19	28912	99.52	1925	5.39	22797	63.78	35.00	.79
>40.0 - 50.0	27	.09	28939	99.61	1223	3.42	24020	67.20	45.30	.83
>50.0 - 75.0	48	.17	28987	99.78	2921	8.17	26941	75.37	60.85	.93
>75.0 - 100.0	25	.09	29012	99.87	2093	5.86	29034	81.23	83.72	1.00
>100.0 - 150.0	24	.08	29036	99.95	2751	7.70	31785	88.93	114.62	1.09
>150.0 - 200.0	13	.04	29049	99.99	2623	7.34	34408	96.27	201.77	1.18
>200.0 - 300.0	0	.00	29049	99.99	0	.00	34408	96.27	.00	1.18
>300.0 - 500.0	0	.00	29049	99.99	0	.00	34408	96.27	.00	1.18
>500.0 - 750.0	2	.01	29051	100.00	1335	3.73	35743	100.00	667.50	1.23
>750.0 - 1000.0	0	.00	29051	100.00	0	.00	35743	100.00	.00	1.23
>1000.0 - 10,000	0	.00	29051	100.00	0	.00	35743	100.00	.00	1.23
>10,000	0	.00	29051	100.00	0	.00	35743	100.00	.00	1.23

NO. OF IMP. PARCELS, ACREAGE SPECIFIED 141156 (100.0)
NO. OF IMP. PARCELS, ACREAGE NOT SPEC. 0 (.0)
TOTAL 141156

NO. OF UNIMPROVED PARCELS, ACREAGE SPECIFIED 29051 (99.8)
NO. OF UNIMPROVED PARCELS, ACREAGE NOT SPEC. 55 (.2)
TOTAL 29106

Table 5.3. Acreage Estimates for Residential Land Use, Prince George's County.

Residential Acreage Category	Total Parcels	Total Acres	Average Acreage
0 - 0.5	128,882	26,372	.20
> 0.5 - 1.0	7,216	5,249	.73
> 1.0	5,058	24,015	4.75

As will be illustrated in the following example, these average parcel size data are useful for quickly preparing estimates of charges for typical parcels given different rate structures. The data must be interpreted with caution, however, because of the assumptions in the Department of State Planning's classification system. For example, any parcel with an improvement with a market value of more than $10 was classified as "improved." [44] Thus, parcels in improved and unimproved classifications may not correspond with the categories of developed and undeveloped that typically are used in the calculation of stormwater charges. To actually establish a utility, therefore, the parcel data must be refined.

Similarly, the land use categories that are used in the files are not entirely suitable for determining charges. For example, the "exempt" category in the files includes parcels that are exempt form property tax. These parcels may or may not be exempt from a utility charge. For example, a non-profit, tax-exempt hospital most likely would be liable for a stormwater utility charge, while other tax-exempt uses (e.g., a state forest or park), might not be.

In practice, the actual size of all parcels to be charged must be determined. Most utilities use the exact size of parcels (e.g., acres or square feet) in the billing algorithms. Others (e.g., Cincinnati, OH) assign parcels Area Range Numbers (ARNs) which represent categories that include all parcels with areas in a certain range. [45] The Cincinnati algorithm assigns an ARN of 1 to parcels with areas of 1 to 2000 feet, and ARN of 2 to parcels with areas of 2001 to 4000 feet, and so on, in 2000 square foot increments.

Rate Factors

Rate factors are numbers based on standard runoff coefficients which are assigned to parcels so that charges reflect actual runoff and the respective burden each property places on the stormwater system. Theoretically, to reflect runoff precisely, rate factors should include total area, percentage of impervious area, soil type, slope, and other factors.

However, impervious area is the only factor that usually is used. This is because the calculations necessary to incorporate all relevant factors are not warranted economically.

For planning studies, rate factors generally are based simply on land use categories. Land use categories typically vary by jurisdiction; therefore, matching land use categories with rate factors requires some judgement. Rate factors generally are derived from runoff coefficients in the Rational Method. [46] In practice, the specific rate factors used by utilities vary greatly. Because of the potential for variability, rate factors must be chosen carefully. Analyses by the Administration indicate that estimated charges to users in a given land use category could vary by as much as 60% depending on the rate factors and structure that are used.

For initial planning studies in Maryland, the SSA recommends use of the rate factors presented in Table 5.4. The SSA computed these factors based on estimates of the average amount of impervious area for parcels in different land use categories included in the Soil Conservation Service's publication, "Urban Hydrology for Small Watersheds" [47] and, to a lesser degree, in the Rational Method.

The rate base is defined as all categories of users to be charged. Thirteen standard and five nonstandard land use categories are included in Table 5.4. Under the utility concept, every parcel should pay to the extent it generates runoff. In practice, however, it is common for certain categories of parcels to be exempt by edict rather than because they generate no runoff. Land uses sometimes considered for exemptions include public parcels such as government office complexes and street rights-of-way, tax-exempt parcels such as hospitals and churches, and agricultural and undeveloped land. A useful planning exercise to determine the effect of removing various land use categories from the rate base.

During implementation, when the data used to determine charges must be refined, there are no hard and fast rules for selecting rate factors and choosing the rate base. To derive rate factors, many utilities measure the amount of impervious area on all nonresidential parcels and on a statistically significant sample of residential parcels. Rate bases frequently are determined for political as much as technical reasons. For example, public office complexes and institutional, tax exempt users frequently are large generators of stormwater. The utility approach is attractive in part because these types of uses, which do not generate revenues under a property tax system, often pay stormwater charges. Charging these uses, however, can be very controversial.

Table 5.4. Recommended Rate Factors for Stormwater Utility Planning Studies.

Land Use Category	Average Percent Impervious	Rate Factor
Agriculture	-	.10
Commercial	.85	.82
Commercial Residential	.70	.68
Exempt		.26
Parks	.07	.11
Playgrounds	.13	.17
Schools	.50	.50
Industrial	.72	.70
Apartments	.65	.64
Not Perc	-	.00
Residential		
Acreage $\leq$ 1/8 (town houses)	.65	.40
1/8 < A $\leq$ 1/4	.38	(.40 is average for
1/4 < A $\leq$ 1/3	.30	Acreage < 1/2)
1/3 < A $\leq$ 1/2	.25	
1/2 < A $\leq$ 1	.20	.23
1 < Acreage	.12	.16
Res Agr	-	.16
Res Comm	-	.64
Condominium	-	.64
Condo Comm	-	.68
Marshland	-	.00
Other Nonstandard Categories		
Cooperative	-	.64
Mobile	-	.64
Group Quar	-	.64
Motel	-	.82
Other	-	.50

Note: Estimates of the average percentage of impervious area are from SCS TR-55 or the Rational Method. The estimate of .65 for apartments was taken from the TR-55 estimate for town houses. A "-" in the average impervious column means that no estimate corresponded directly with the land use category. The rate factors were determined by selecting figures for a comparable use (e.g., Res Agr was assigned the same rate factor as Residential [1 < Acreage]).

Hospitals and churches have been involved in suits against utilities, arguing that they should be exempt from any payments to local government. Property owners have argued that charging public properties makes them pay twice: property taxes for the public parcel, and stormwater charges for their own properties.

Similarly, although some utilities charge agriculture and undeveloped land, these practices also are controversial. Owners of undeveloped land have argued successfully in court that they should not be charged since they have not altered natural conditions. In any real case, the issue of the rate base must be resolved by the city council or county board through a public forum.

Revenue Requirements

Section 4 describes considerations in estimating costs or revenue requirements for stormwater management. In practice, the scope of activities funded with utility revenues varies. The rate structure should be designed so that the sum of charges for all parcels is equal to the revenue requirements.

In Maryland, no two jurisdictions will have the same revenue requirements. Costs will have to be estimated from a variety of sources. For example, in Prince George's County, one source of information about revenue requirements is the "transfer" study prepared by the County prior to its assumption of stormwater management activities from the Washington Suburban Sanitary Commission (WSSC). In 1986 the WSSC generated approximately $10.5 million from an ad valorem property tax dedicated for purposes of stormwater management. [48] The County projects that tax revenues will increase gradually through 1991 to $14.2 million. These estimates are sufficient for planning purposes. Any jurisdiction planning a utility must obtain or prepare comparable estimates.

5.2 A General Approach for Planning Studies

A general approach to developing a utility rate structure involves two steps:

1. Estimation of a charge per "equivalent runoff unit";

2. Determination of the charge per individual parcel.

Equivalent runoff units (ERUs) are used to represent runoff from a parcel. They are the units for which stormwater charges are levied, and they are calculated by multiplying a rate factor times a parcel area.

Estimation of Charge per Equivalent Runoff Unit

The charge per equivalent runoff unit (ERU) is determined by:

1. Assigning a rate factor to each general land use category;

2. Determining the total acreage in each category;

3. Multiplying the rate factors times the total acreage in each category to obtain the number of ERUs per category;

4. Selecting categories to be included in the rate base;

5. Summing the ERUs for all categories in the rate base; and

6. Dividing the revenue requirements by the total ERUs.

A general equation for computing the charge per ERU is:

$$C/ERU = R / [\sum (F \times A)] \qquad (a)$$

where

C/ERU = the charge per ERU
R = revenue requirement for the utility stormwater programs
F = the rate factor for each land use category
A = the total acreage for each land use category in the rate base
F x A = the ERUs for a given land use category.

Estimation of Parcel User Charges

Typical parcel user charges can be estimated after a charge per ERU has been determined. To obtain the charge per parcel, the individual parcel area is multiplied times its rate factor and the charge per ERU. Some utilities also add surcharges or provide credits depending on the particular features of the parcel.

A general equation for calculating stormwater user charges is:

$$PC = [PA \times F \times (C/ERU)] \pm CR;SC \qquad (b)$$

where

PC = the charge for a parcel
PA = the area of the parcel
F = the rate factor for the parcel land use
C/ERU = the charge per equivalent runoff unit
CR;SC = a credit or surcharge (e.g., for on-site retention or location in a floodplain).

These equations frequently are referred to as billing algorithms. In practice, the algorithms used in different communities vary.

5.3 Worksheet

The SSA has developed the worksheet presented in Figure 5.1 to assist Maryland counties and cities in evaluating options for stormwater utilities. Use of the worksheet essentially involves application of the two equations presented above. Steps in using the worksheet are explained below in the context of an example for Prince George's County. The data needed to complete the worksheet are an estimate of revenue requirements, land use categories for all parcels, and total area (acreage), average parcel size, and rate factors for each category. The SSA recommends that the worksheet be completed using a spreadsheet software program for a personal computer. Use of a spreadsheet permits planners to analyze the effects of excluding different land use categories from the rate base very efficiently. The example presented below includes this type of sensitivity analysis.

5.4 An Example: Estimating Typical User Charges For Prince George's County

An example of the use of the worksheet will be completed using data for Prince George's County. To complete the worksheet, one must:

1. Obtain Revenue Requirements. Data from the Prince George's County transfer study will be used. It will be assumed that the revenue requirement for the County in 1988 will be $11 million.

2. Select Rate Factors. The rate factors presented in Table 5.4 will be used in this analysis.

3. Obtain Land Use Information. Tables 5.1 and 5.3 present average parcel size and total acreage per category for all land use categories in Prince George's County.

Figure 5.1. Worksheet for Calculation of Stormwater User Charges.

	1	2	3	4	5	6	7	8	9	10	11	12
	Land Use	Rate Factor	Total Acreage	ERU	Revenue Requirement ($)	Cost/ ERU ($)	Average Acre/ Parcel	Annual Charge ($)	Monthly Charge ($)	Number of Parcels	Total Revenues ($)	% of Total Revenues
1	Agriculture											
2	Commercial											
3	Comm Res											
4	Exempt											
5	Park											
6	Playground											
7	School											
8	Industrial											
9	Apartments											
10	Not Perc											
11	Residential											
12	0 - 0.5 Acres											
13	>.5 - 1.0 Acres											
14	> 1.0 Acres											
15	Res Ag											
16	Res Comm											
17	Condominium											
18	Condo Comm											
19	Marshland											
20												
21	Non-standard											
22												
23	Cooperative											
24	Mobile/Trailer											
25	Group Quar											
26	Motel											
27	Forest Cons											
28	Detached S-F											
29	0 - .5 Acre											
30	> .5 - 1 Acre											
31	> 1 Acre											
32	Attached S-F											
33	Garden Apt.											
34	High Rise											
35	Other											
36												
37	Subtotal (Dev.)											
38												
39	Unimproved											
40												
41	Grand Total											

STEPS FOR USING WORKSHEET TO CALCULATE USER CHARGES

1) Enter land use categories to be charged in column 1. (Use data from Dept. of State Planning or local data.)

2) Enter rate factors in column 2. Use factors in Table 5.4 or data consistent with local practices.

3) Enter total acreage in each land use category in column 3. (from Dept. of State Planning or local source)

4) Compute ERUs. Multiply column 2 times colum in column 4. Subtotal ERUs for developed p Sum ERUs for all categories in row 41 (column 4).

5) Enter revenue requirements in column 5, row 41.

6) Compute charge per ERU in column 6, row 41, by dividing column 5, row 41, by column 4, row 41.

7) Enter average parcel sizes in column 7 (from Dept. of State Planning).

8) Compute annual charge for all categories in column 8 by multiplying column 2 times column 7 times charge per ERU (column 6, row 41).

9) Compute monthly charge in column 9 by dividing column 8 by 12. Enter total number of parcels in each category in column 10.

10) Compute total revenues per category by multiplying column 8 times column 10.

11) Compute percentage of total revenues paid by user category in column 12 by dividing values in column 11 by total for column 11.

4. Determine rate base. In this example, sensitivity analyses will be done to evaluate effects of including various land use categories in the rate base. In the initial example, it will be assumed (A) that all categories of land will be charged, including exempt, agricultural, other, and unimproved (i.e., undeveloped). Other scenarios considered are (B) no charges to agriculture or unimproved; (C) no charges to agriculture, unimproved, or exempt; and (D) no charges to agriculture, unimproved, exempt or other.

5. Compute ERUs and Charge Per ERU. The total number of ERUs for each land use category is determined by multiplying each category's total acreage times its rate factor. The charge per ERU is determined by dividing the revenue requirement by the sum of the ERUs for all categories to be charged.

If a spreadsheet is being used, all one need do is enter the land use data, rate factors and the appropriate equations as specified in Figure 5.1. If the example is being completed by hand, equation (a) from above:

$$C/ERU = R / [S (F \times A)]$$

becomes:

$$C/ERU = 11,000,000 / [.40(26,372) + .23(5,249) + .16(24,015) + .64(0) + .64(3,745) + .64(444) + .64(218) + .64(231) + .82(276) + .70(2,605) + .50(27,751) + .82(10,074) + .10(69,106) + .50(7,179) + .10 (110,290)]$$

Solving this equation gives:

$$C/ERU = 190.90$$

The charge per ERU necessary to generate $11 million for stormwater management in Prince George's County would be $190.90, assuming that all parcels would be charged.

6. Determine of Typical Charges Typical charges for an average parcel in each land use category can be computed by multiplying the average parcel size times the rate factor times the charge per ERU. A spreadsheet does this quickly, or, as above, equation (b) could be used and the charges could be determined by hand. Typical charges for average sized parcels in each land use category in Prince George's County are presented in Table 5.5.

Table 5.5. Calculation of Stormwater Utility Charges for Prince George's County: Case A.
(Charges to agriculture, exempt, and unimproved.)

Land Use	Rate Factor	Total Acreage	ERU	Revenue Requirement ($)	Cost/ ERU ($)	Average Acre/ Parcel	Annual Charge ($)	Monthly Charge ($)	Number of Parcels	Total Revenues ($)	% of Total Revenues
Agriculture	0.10	69,106	6,911			50	951	79	1,389	1,320,501	12.0%
Commercial	0.82	10,074	8,261			2	360	30	4,418	1,590,649	14.5%
Comm Res	0.68		0				0	0		0	0.0%
Exempt	0.26	27,751	7,215			23	1,156	96	1,190	1,376,205	12.6%
Park	0.11		0				0	0		0	0.0%
Playground	0.17		0				0	0		0	0.0%
School	0.50		0				0	0		0	0.0%
Industrial	0.70	2,605	1,824			9	1,256	105	278	349,203	3.2%
Apartments	0.64	3,745	2,397			2	208	17	2,159	448,424	4.1%
Not Perc	0.00		0				0	0		0	0.0%
Residential			0				0	0		0	0.0%
0 - 0.5 Acres	0.40	26,372	10,549			0	15	1	128,882	1,968,291	18.0%
>.5 - 1.0 Acres	0.23	5,249	1,207			1	32	3	7,216	231,289	2.1%
> 1.0 Acres	0.16	24,015	3,842			5	145	12	5,058	733,837	6.7%
Res Ag	0.16		0				0	0		0	0.0%
Res Comm	0.64		0				0	0		0	0.0%
Condominium	0.64	444	284			0	6	1	8,940	54,613	0.5%
Condo Comm	0.68		0				0	0		0	0.0%
Marshland	0.00		0				0	0		0	0.0%
			0				0	0		0	0.0%
Non-standard							0	0		0	0.0%
			0				0	0		0	0.0%
Cooperative	0.64	0	0				0	0		0	0.0%
Mobile/Trailer	0.64	218	140			20	2,419	202	11	26,610	0.2%
Group Quar	0.64	231	148			2	195	16	148	28,931	0.3%
Motel	0.82	276	226			5	814	68	53	43,142	0.4%
Forest Cons	0.50		0				0	0		0	0.0%
Detached S-F			0				0	0		0	0.0%
0 - .5 Acre	0.40		0				0	0		0	0.0%
> .5 - 1 Acre	0.23		0				0	0		0	0.0%
> 1 Acre	0.16		0				0	0		0	0.0%
Attached S-F	0.64		0				0	0		0	0.0%
Garden Apt.	0.40		0				0	0		0	0.0%
High Rise	0.64		0				0	0		0	0.0%
Other	0.50	7,179	3,590			49	4,696	391	146	685,638	6.3%
							0	0			
Total (Dev.)		177,265	46,593				0	0	159,888	8,857,332	80.8%
							0	0			
Unimproved	0.10	110,290	11,029			3	49	4	42,934	2,106,403	19.2%
Grand Total		287,555	57,622	11,000,000	190.90				202,822	10,963,735	100.0%

Sensitivity Analysis

Actual charges, of course, would vary with the size of individual parcels and, more importantly, depend on the categories included in the rate base. In Case A (Table 5.5) all parcels are charged. In practice, it is likely that some of these parcels (e.g., agricultural, unimproved, exempt) would not be charged. Tables 5.6, 5.7, and 5.8 present typical charges based on alternate rate bases. In Case B (Table 5.6), agricultural and unimproved parcels are removed from the rate base. In Case C (Table 5.7), agricultural, unimproved, and exempt are removed from the rate base. In Case D (Table 5.8), the "other" land use category, in addition to the agricultural, unimproved, and exempt categories, is removed.

The effect of removing categories from the rate base is to increase the charges for parcels in other categories. In this instance the charge per ERU doubles from $190.90 to $380.92 when the categories of agriculture, unimproved, exempt, and other are removed. Consequently, the charges for parcels in categories remaining in the rate base (e.g., residential, commercial, industrial) also double (Figure 5.2). For example, residential charges (0 -.5 acres) increase from $15 to $30 dollars annually as the rate base shrinks. The distribution of total revenues from user charges by land use category for these data (Cases A through D) is shown in Figure 5.3. It is clear from these data that decisions about properties to be included in the rate base must be made very carefully.

Observations

The results of this example are useful for decision makers who must weigh the impact of a utility on the public. In this case it was shown, given the limitations of the data, that annual residential charges could vary as much as 100% per year depending on the categories included in the rate base.

It is instructive to compare these estimates of charges to current stormwater tax levies. Presently, parcels in Prince George's County are assessed at a rate of 13.5 cents per $100 assessed valuation. Homes are assessed at 50% of market value. Hence, an owner of a home valued at $50,000 and assessed at $25,000 presently pays $33.75 annually in stormwater taxes. Similarly, the owner of a home valued at $100,000 would pay $67.50 annually. In this case, it appears that replacement of property taxes with user charges as the principal source of revenues would have distributional impacts favorable to residential users.

Table 5.6. Calculation of Stormwater Utility Charges for Prince George's County: Case B.
(No charges to agriculture and unimproved.)

Land Use	Rate Factor	Total Acreage	ERU	Revenue Requirement ($)	Cost/ ERU ($)	Average Acre/ Parcel	Annual Charge ($)	Monthly Charge ($)	Number of Parcels	Total Revenues ($)	% of Total Revenues
Agriculture	0.00	69,106	0			50	0	0	1,389	0	0.0%
Commercial	0.82	10,074	8,261			2	523	44	4,418	2,309,755	21.1%
Comm Res	0.68		0				0	0		0	0.0%
Exempt	0.26	27,751	7,215			23	1,679	140	1,190	1,998,365	18.3%
Park	0.11		0				0	0		0	0.0%
Playground	0.17		0				0	0		0	0.0%
School	0.50		0				0	0		0	0.0%
Industrial	0.70	2,605	1,824			9	1,824	152	278	507,072	4.6%
Apartments	0.64	3,745	2,397			2	302	25	2,159	651,149	5.9%
Not Perc	0.00		0				0	0		0	0.0%
Residential			0				0	0		0	0.0%
0 - 0.5 Acres	0.40	26,372	10,549			0	22	2	128,882	2,858,123	26.1%
>.5 - 1.0 Acres	0.23	5,249	1,207			1	47	4	7,216	335,850	3.1%
> 1.0 Acres	0.16	24,015	3,842			5	211	18	5,058	1,065,592	9.7%
Res Ag	0.16		0				0	0		0	0.0%
Res Comm	0.64		0				0	0		0	0.0%
Condominium	0.64	444	284			0	9	1	8,940	79,302	0.7%
Condo Comm	0.68		0				0	0		0	0.0%
Marshland	0.00		0				0	0		0	0.0%
			0				0	0		0	0.0%
Non-standard							0	0		0	0.0%
			0				0	0		0	0.0%
Cooperative	0.64	0	0				0	0		0	0.0%
Mobile/Trailer	0.64	218	140			20	3,513	293	11	38,640	0.4%
Group Quar	0.64	231	148			2	284	24	148	42,011	0.4%
Motel	0.82	276	226			5	1,182	98	53	62,646	0.6%
Forest Cons	0.50		0				0	0		0	0.0%
Detached S-F			0				0	0		0	0.0%
0 - .5 Acre	0.40		0				0	0		0	0.0%
> .5 - 1 Acre	0.23		0				0	0		0	0.0%
> 1 Acre	0.16		0				0	0		0	0.0%
Attached S-F	0.64		0				0	0		0	0.0%
Garden Apt.	0.40		0				0	0		0	0.0%
High Rise	0.64		0				0	0		0	0.0%
Other	0.50	7,179	3,590			49	6,819	568	146	995,604	9.1%
							0	0			
Total (Dev.)		177,265	39,682				0	0	159,888	10,944,108	100.0%
							0	0			
Unimproved	0.00	110,290	0			3	0	0	42,934	0	0.0%
Grand Total		287,555	39,682	11,000,000	277.20				202,822	10,944,108	100.0%

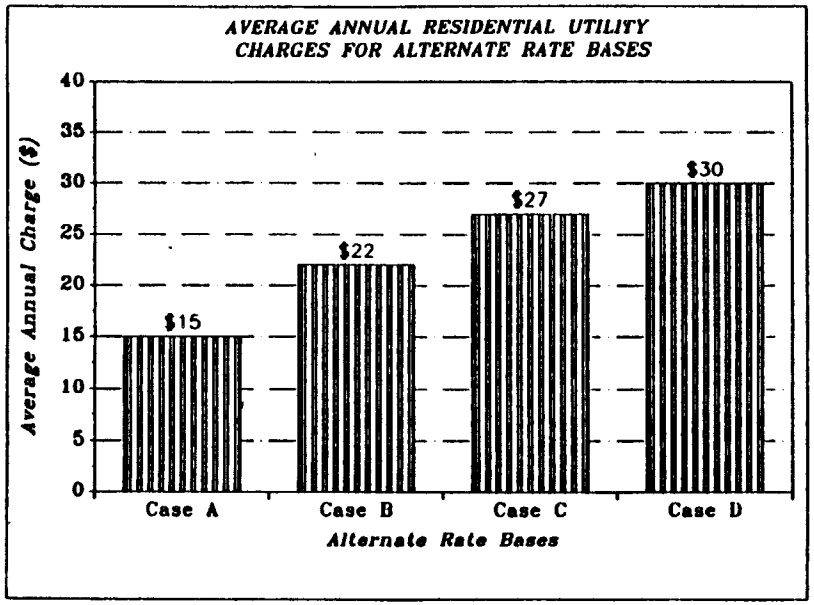
Table 5.7. Calculation of Stormwater Utility Charges for Prince George's County: Case C.
(No charges to agriculture, unimproved, and exempt.)

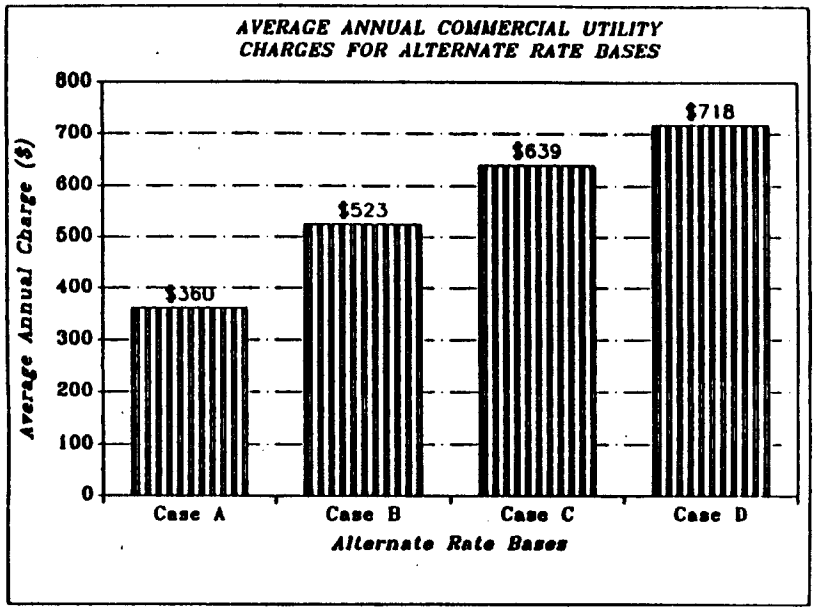
Land Use	Rate Factor	Total Acreage	ERU	Revenue Requirement ($)	Cost/ ERU ($)	Average Acre/ Parcel	Annual Charge ($)	Monthly Charge ($)	Number of Parcels	Total Revenues ($)	% of Total Revenues
Agriculture	0.00	69,106	0			50	0	0	1,389	0	0.0%
Commercial	0.82	10,074	8,261			2	639	53	4,418	2,823,064	25.8%
Comm Res	0.68		0				0	0		0	0.0%
Exempt	0.00	27,751	0			23	0	0	1,190	0	0.0%
Park	0.11		0				0	0		0	0.0%
Playground	0.17		0				0	0		0	0.0%
School	0.50		0				0	0		0	0.0%
Industrial	0.70	2,605	1,824			9	2,229	186	278	619,761	5.7%
Apartments	0.64	3,745	2,397			2	369	31	2,159	795,857	7.3%
Not Perc	0.00		0				0	0		0	0.0%
Residential			0				0	0		0	0.0%
0 - 0.5 Acres	0.40	26,372	10,549			0	27	2	128,882	3,493,298	31.9%
>.5 - 1.0 Acres	0.23	5,249	1,207			1	57	5	7,216	410,488	3.8%
> 1.0 Acres	0.16	24,015	3,842			5	257	21	5,058	1,302,404	11.9%
Res Ag	0.16		0				0	0		0	0.0%
Res Comm	0.64		0				0	0		0	0.0%
Condominium	0.64	444	284			0	11	1	8,940	96,926	0.9%
Condo Comm	0.68		0				0	0		0	0.0%
Marshland	0.00		0				0	0		0	0.0%
			0				0	0		0	0.0%
Non-standard							0	0		0	0.0%
			0				0	0		0	0.0%
Cooperative	0.64	0	0				0	0		0	0.0%
Mobile/Trailer	0.64	218	140			20	4,293	358	11	47,227	0.4%
Group Quar	0.64	231	148			2	347	29	148	51,347	0.5%
Motel	0.82	276	226			5	1,445	120	53	76,568	0.7%
Forest Cons	0.50		0				0	0		0	0.0%
Detached S-F			0				0	0		0	0.0%
0 - .5 Acre	0.40		0				0	0		0	0.0%
> .5 - 1 Acre	0.23		0				0	0		0	0.0%
> 1 Acre	0.16		0				0	0		0	0.0%
Attached S-F	0.64		0				0	0		0	0.0%
Garden Apt.	0.40		0				0	0		0	0.0%
High Rise	0.64		0				0	0		0	0.0%
Other	0.50	7,179	3,590			49	8,335	695	146	1,216,862	11.1%
							0	0			
Total (Dev.)		177,265	32,467				0	0	159,888	10,933,801	100.0%
							0	0			
Unimproved	0.00	110,290	0			3	0	0	42,934	0	0.0%
Grand Total		287,555	32,467	11,000,000	338.81				202,822	10,933,801	100.0%

Table 5.8. Calculation of Stormwater Utility Charges for Prince George's County: Case D.
(No charges to agriculture, unimproved, exempt, and other.)

Land Use	Rate Factor	Total Acreage	ERU	Revenue Requirement ($)	Cost/ ERU ($)	Average Acre/ Parcel	Annual Charge ($)	Monthly Charge ($)	Number of Parcels	Total Revenues ($)	% of Total Revenues
Agriculture	0.00	69,106	0			50	0	0	1,389	0	0.0%
Commercial	0.82	10,074	8,261			2	718	60	4,418	3,173,976	29.1%
Comm Res	0.68		0				0	0		0	0.0%
Exempt	0.00	27,751	0			23	0	0	1,190	0	0.0%
Park	0.11		0				0	0		0	0.0%
Playground	0.17		0				0	0		0	0.0%
School	0.50		0				0	0		0	0.0%
Industrial	0.70	2,605	1,824			9	2,506	209	278	696,798	6.4%
Apartments	0.64	3,745	2,397			2	414	35	2,159	894,783	8.2%
Not Perc	0.00		0				0	0		0	0.0%
Residential			0				0	0		0	0.0%
0 - 0.5 Acres	0.40	26,372	10,549			0	30	3	128,882	3,927,521	36.0%
>.5 - 1.0 Acres	0.23	5,249	1,207			1	64	5	7,216	461,513	4.2%
> 1.0 Acres	0.16	24,015	3,842			5	290	24	5,058	1,464,295	13.4%
Res Ag	0.16		0				0	0		0	0.0%
Res Comm	0.64		0				0	0		0	0.0%
Condominium	0.64	444	284			0	12	1	8,940	108,974	1.0%
Condo Comm	0.68		0				0	0		0	0.0%
Marshland	0.00		0				0	0		0	0.0%
			0				0	0		0	0.0%
Non-standard							0	0		0	0.0%
			0				0	0		0	0.0%
Cooperative	0.64	0	0				0	0		0	0.0%
Mobile/Trailer	0.64	218	140			20	4,827	402	11	53,098	0.5%
Group Quar	0.64	231	148			2	390	33	148	57,730	0.5%
Motel	0.82	276	226			5	1,624	135	53	86,085	0.8%
Forest Cons	0.50		0				0	0		0	0.0%
Detached S-F			0				0	0		0	0.0%
0 - .5 Acre	0.40		0				0	0		0	0.0%
> .5 - 1 Acre	0.23		0				0	0		0	0.0%
> 1 Acre	0.16		0				0	0		0	0.0%
Attached S-F	0.64		0				0	0		0	0.0%
Garden Apt.	0.40		0				0	0		0	0.0%
High Rise	0.64		0				0	0		0	0.0%
Other	0.00	7,179	0			49	0	0	146	0	0.0%
							0	0			
Total (Dev.)		177,265	28,877				0	0	159,888	10,924,773	100.0%
							0	0			
Unimproved	0.00	110,290	0			3	0	0	42,934	0	0.0%
Grand Total		287,555	28,877	11,000,000	380.92				202,822	10,924,773	100.0%

Figure 5.2. Comparison of Average Annual Utility Charges for Residential, Commercial, and Industrial Users.





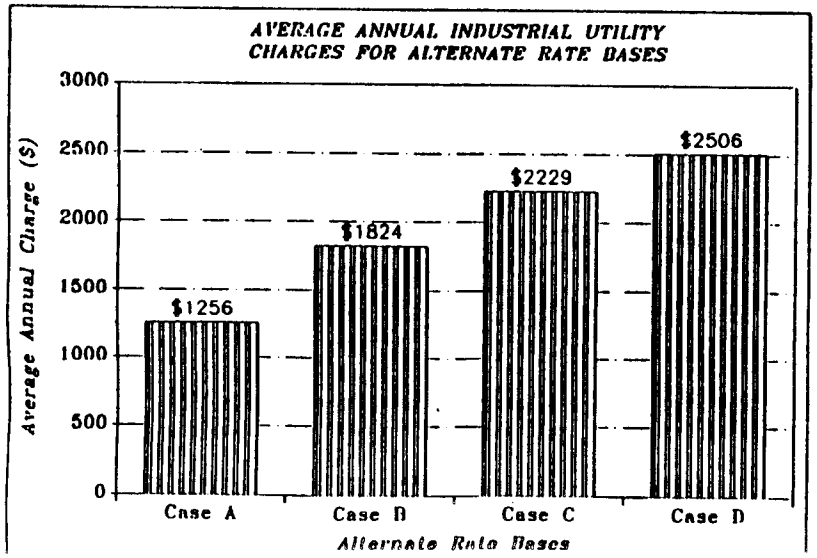
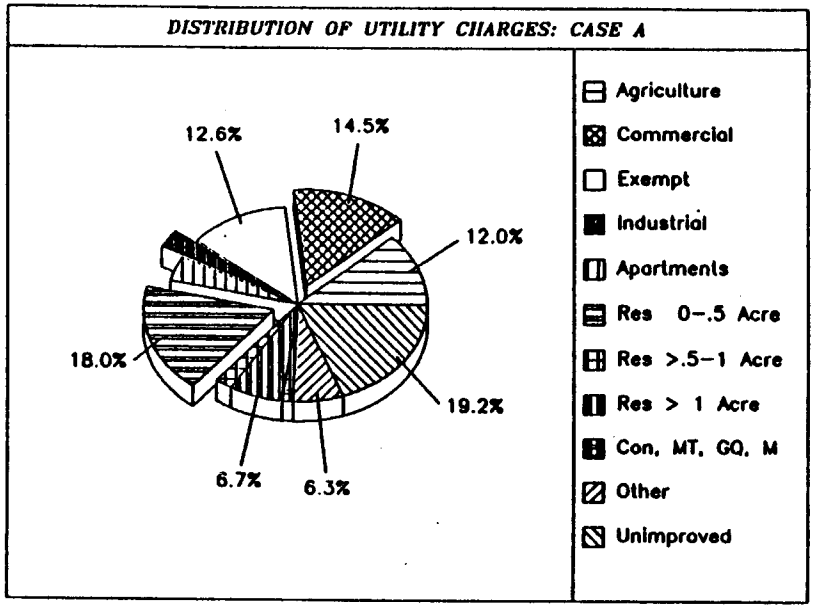
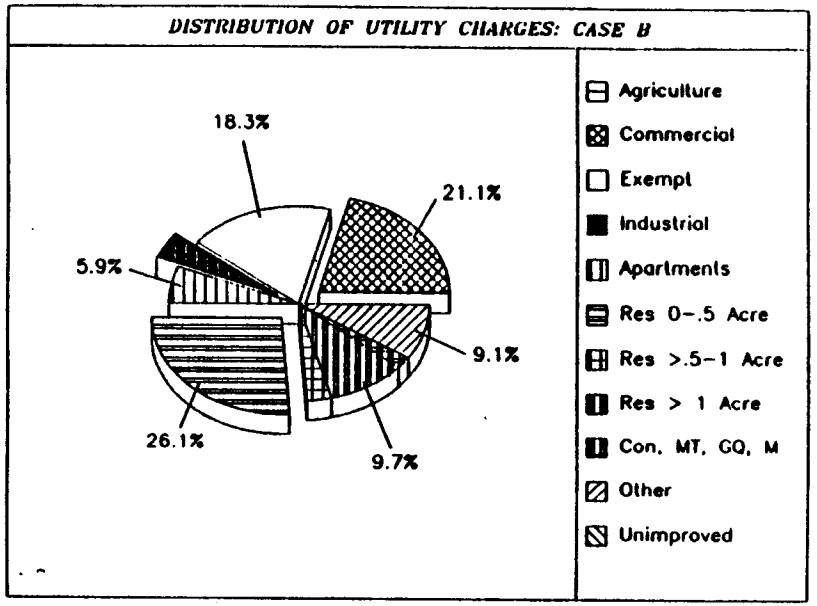
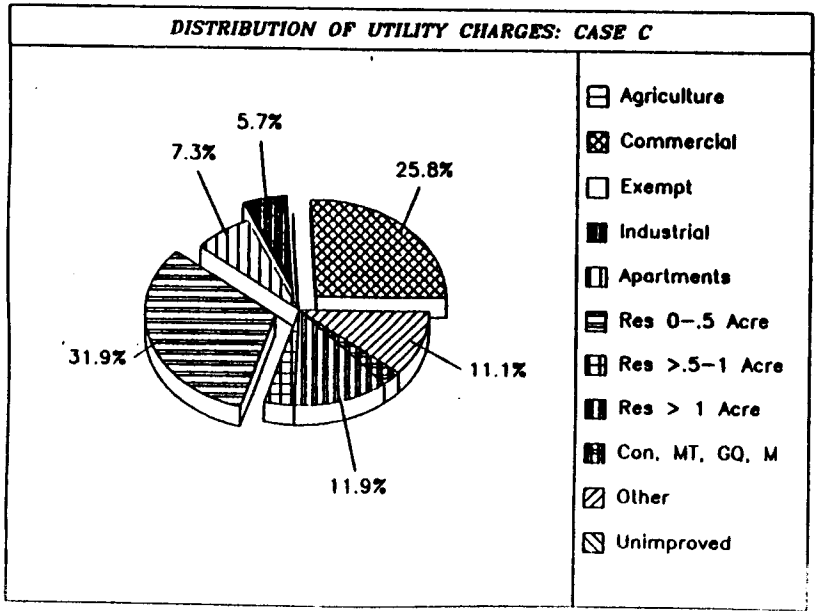
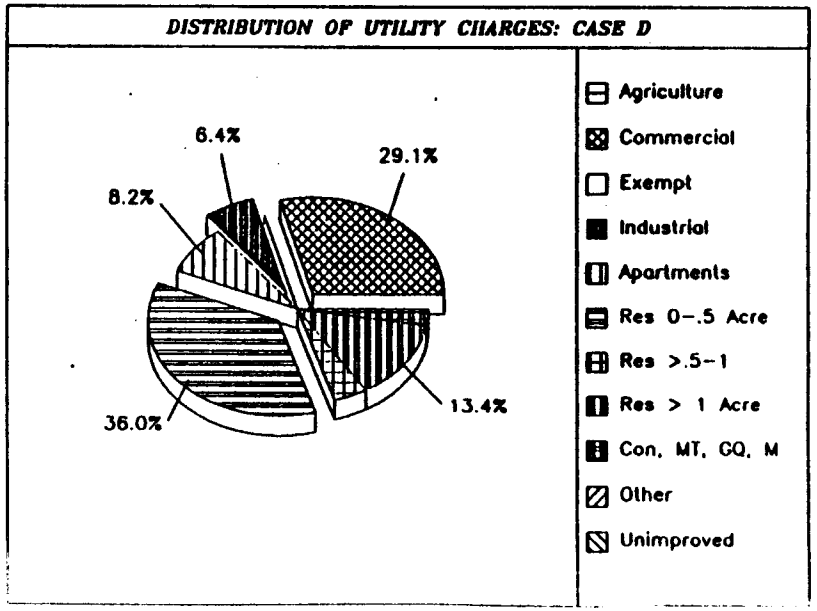


Figure 5.3. Distribution of Utility Charges Under Different Rate Bases.









Strengths and Weaknesses of the Example

The basic strength of the preceding example is that it provides decision makers with a good understanding of the financial implications of establishing a stormwater utility at a minimum cost. The major weaknesses relate to the quality of data that was used in the analysis.

There are three major sources of error in the data:

1. Land uses for parcels may be misclassified (e.g., in this example, the classification of parcels considered improved in the Tax Assessor's files as "developed" may be misleading[1]);

2. The area of the parcels may be inaccurate;

3. The rate factors may be inappropriate.

As long as people understand that this example is a planning exercise meant to show typical charges given average parcel size and general rate factors, these sources of error are not significant. These sources of error could be significant, however, in the actual implementation of a utility.

Another limitation of the data, not the approach, concerns the way in which data are computerized by the Department of State Planning. Generally, the land use data available from Department are for an entire county, including all political jurisdictions within it. In certain counties, some municipalities may have responsibility for their own stormwater programs. In these situations, the potential rate base for the county should exclude land within the municipalities. The Department cannot provide land use data for counties exclusive of municipal data without undertaking additional, expensive computer runs. People planning utilities at the local level must assess the data in specific cases to determine whether this poses a problem.

5.5 Considerations in Implementation

The preceding section raised a number of issues that must be considered during the actual creation of a utility. These and others are reviewed briefly in this section. In general, all the details of the rate structure must be worked out.

[1] In the tax files, any property with an improvement worth more than $10 is classified as "improved". Inspection of files indicates, however, that most (e.g., 95%) improved properties include structures.

Credits and Surcharges

Many utilities issue credits or add surcharges to utility bills depending on special characteristics of a parcel. There is no single, correct rationale for determining credits or surcharges. Some utilities (e.g., Fort. Collins, CO) provide credits for on-site retention of stormwater. Boulder, Colorado imposes surcharges on parcels located in floodplains because these parcels receive additional benefits. On the other hand, the City of Portland, Oregon exempts parcels from stormwater charges if the parcels drain directly to receiving waters. Portland's rationale is that these facilities make no use of storm drainage systems and therefore should not have to pay. As is evident from these examples, parcels granted exemptions in Portland quite possibly would be surcharged in Boulder.

Table 5.9 lists special features that have been included in rate structures of different utilities. Although consideration of credits or surcharges is not critical during initial planning studies, these must be determined during implementation.

Table 5.9. Special Features of Utility Rate Structures.

* Separate charges for capital improvements and operations and maintenance
* Credits for on-site management
* Surcharges for parcels in floodplains
* Exemptions for parcels that drain directly to receiving waters
* Rebates for elderly
* In kind payment by schools that provide education about stormwater management
* Procedures for appealing charges

Considerations in Setting Charges

Most stormwater utilities establish a single charge per ERU that is applied regardless of land use. At least one, however (Denver, Colorado), has devised a progressive rate structure that charges properties which are intensively developed higher unit rates than properties that are less developed. The Denver rates correspond to ranges of impervious area: the greater the percentage of impervious area, the higher the unit rate.

Many utilities assign a uniform charge or flat rate to all single family residential parcels below a certain size. This eliminates the need to determine and use the actual acreage

(and imperviousness) for most residential parcels (which typically account for 60% to 80% of all parcels).

At least eight of the utilities surveyed by the SSA have designed rate structures so that the equivalent runoff units are scaled to represent single-family equivalents (SFEs). [49] SFEs are computed in one of two ways:

1. By adjusting all factors equally so that the product of the average residential area and the residential rate factor is one; or

2. By dividing the amount of impervious area on all non-single family residential parcels by the average amount of impervious area on single family residential parcels.

In either case, the ratios between residential rate factors and factors for other land uses remain the same, as do relative payments.

SFEs have been used mainly because planners believe that people can understand the user charge concept easier when runoff is expressed in terms of the amount generated by a typical single family residence. Also, the use of SFEs rather than ERUs facilitates billing because the base charge is then the single family residence charge. Between 60% and 80% of all parcels are single family residences.

Appeal Procedures

Almost all utilities have some procedure for appealing charges. Appeal procedures are necessary to provide users with opportunities to contest charges that they believe have been calculated inaccurately.

In fact, errors in new billing systems are common. Sources of data (e.g., Tax Assessor's files) commonly used for construction of utility billing files often contain large numbers of errors, both in parcel size and land use classification. Even if parcels have been measured specifically for the creation of the utility billing system, errors should be expected. The sheer volume of information that is processed is a factor in the introduction of error to the system.

5.6 Criteria for Evaluating Rate Structures

This section is a discussion of criteria for the evaluation of rate structures. Eight criteria are presented. The criteria were developed and used by Camp, Dresser, & McKee, Inc. and Priede Sedgwick, Inc. in an evaluation of alternative rate structures for the City of Tampa, Florida. [50]

Two criteria concern sources of error that can affect the calculation of charges. These are:

1. The charge should be based on a reasonably accurate, technically defensible measure of runoff;

2. The data base used to determine charges and prepare the billing system should be accurate.

The use of average rate factors for a land use category rather than measurements of the amount of impervious area on a site ignores the variability that exists among parcels within a given classification. Use of average factors eliminates the need to measure impervious area of parcels, but does so at the cost of a departure from the main principle of the utility, (i.e., that people should pay in relation to their specific contribution) and the associated loss of equity. Decision makers must evaluate this trade-off between equity and efficiency when planning for the utility.

Errors in the data base include errors in the measurement of total parcel area and total impervious area, as well as in land use classification. Sampling of alternative data bases for use in the rate structure can help planners and decision makers determine whether the amount of error is too great and whether corrective measures (e.g., re-measurement of parcels with digitizing equipment) are warranted. Quantitative standards for levels of accuracy can aid in the decisions whether certain databases should be used (e.g., 95% of all parcels in files must be classified and measured correctly).

Additional criteria concern equity:

3. Users in different classes should pay in proportion to the runoff their classes generate relative to others,

4. Users within a class should pay in proportion to their contribution to the total runoff generated by the class.

In general, calculation of a charge per ERU as described above will help ensure equity among classes of users. Use of a progressive rate structure like the one in Denver, however, departs from this criterion.

The use of average rate factors significantly affects equity among users within a given class. CDM suggests use of statistical test for evaluating Criterion 4 (e.g., the contribution of the smallest and largest parcels should be within two standard deviations of the mean; 60% of the parcels should fall within one standard deviation of the mean).

Other criteria are:

5. The structure should be legal and politically acceptable;

6. The structure should be flexible;

7. The structure should generate adequate revenues;

8. The initial costs of implementing the structure should not be exorbitant.

The acceptability of a rate structure depends on the attitude of citizens towards additional charges and the size of the charge. Flexibility refers to whether it is easy to modify the structure to accommodate changes in it (e.g., can the rate for a given class of users be modified without having to reprogram the entire structure). Revenue adequacy is assured if the charge per ERU has been computed in the manner described above. As noted, greater equity can be achieved, for example, if the amount of impervious area on all parcels is measured during implementation. However, costs for this may be excessive.

5.7 Concluding Comments on User Charges

Criterion 5 in the preceding section states that the rate structure should be legal and politically acceptable. While this criterion seems intuitively obvious, the importance of it cannot be stressed too much. The bottom line is that for any utility proposal to be successful, people must be willing to pay the charges. Though the professional journals carry many examples of utility success stories, there are enough examples of failed attempts that officials should not take the decision to create a utility lightly.

Regardless of other considerations, the major factor that seems to influence the response of people to a utility proposal is the size of the proposed charge. Proposals for utilities with fees in the range of $1 to $2 per month for single family residences seem to have been accepted, while proposals for higher fees seem to have been rejected. In Tampa, Florida, for example, a proposal for a utility with monthly residential fees in excess of $4 was stopped by public opposition despite a concerted education program.

Cyre (1986) suggests that users seem to be willing to pay from one-third to one-half as much as they pay for water or sewer bills, whichever is lower, and that there "seems to be a psychological ceiling on stormwater charges of $3 per month for residences." [51] The City of Bellevue, however, which

has increased fees gradually over time, now charges single family residences $4.40 per month. [52]

Eight of the 19 utilities surveyed by the SSA report that they have increased rates. [53] Portland, Oregon, for example, has increased rates eight times. Thus, experience suggests that the best approach to implementing a utility is to begin with relatively low charges and to increase them over time.

6.0 SUMMARY

The State of Maryland has made a commitment to implement new programs to control the quantity and quality of urban stormwater runoff. It is clear that new programs will require new sources of funding. Experts agree that the best way to finance stormwater management is the utility approach, and many communities recently have created stormwater utilities. The rationale for the utility approach is simple: people should pay for the stormwater management in relation to their use of the service. In practice, this means that people pay according to the amount of runoff from their property.

Stormwater utilities throughout the United States are raising substantial amounts of money for stormwater management. Charges to single family residences are relatively modest: they range from $1.25 to $4.40 monthly. No utilities currently exist in Maryland. Thus, creation of utilities, even with charges at the low end of this spectrum, would greatly increase funds available for stormwater management.

Planning for a utility involves systematic consideration of a variety of technical, administrative, financial, and political issues. However, even with efficient planning and management, new facilities cannot be constructed and maintained, and stormwater management cannot be provided, if people are not willing to pay. It seems, therefore, that in most cases, the financial issues are the critical ones. The experience of other utilities seems to indicate that people will accept utilities if charges are not too high. While this experience is helpful, whether a utility will be accepted in any particular case depends on the amount of the proposed charges and other specifics of the proposal. Local officials must use their judgement to determine whether the utility approach is appropriate for their situation.

This guide outlines a brief, general approach to estimating user charges that local officials in Maryland can use in utility planning studies. With this approach, officials can easily assess the effects of a variety of factors on user charges. While this approach should yield enough information for local officials to determine whether to establish a utility, officials should recognize that significant effort is required to actually implement a utility. As noted, the time required to plan a utility easily can approach or exceed two years, and implementation can be expensive.

The Sediment and Stormwater Administration can provide technical assistance to local officials interested in establishing a utility. Inquiries are encouraged.

7.0 NOTES

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43. People who wish to receive the most current information from the taxation parcel files should contact the Maryland Department of State Planning, Planning Data Office, 301 W. Preston, Baltimore, MD, 21201, (301) 225-4510.
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