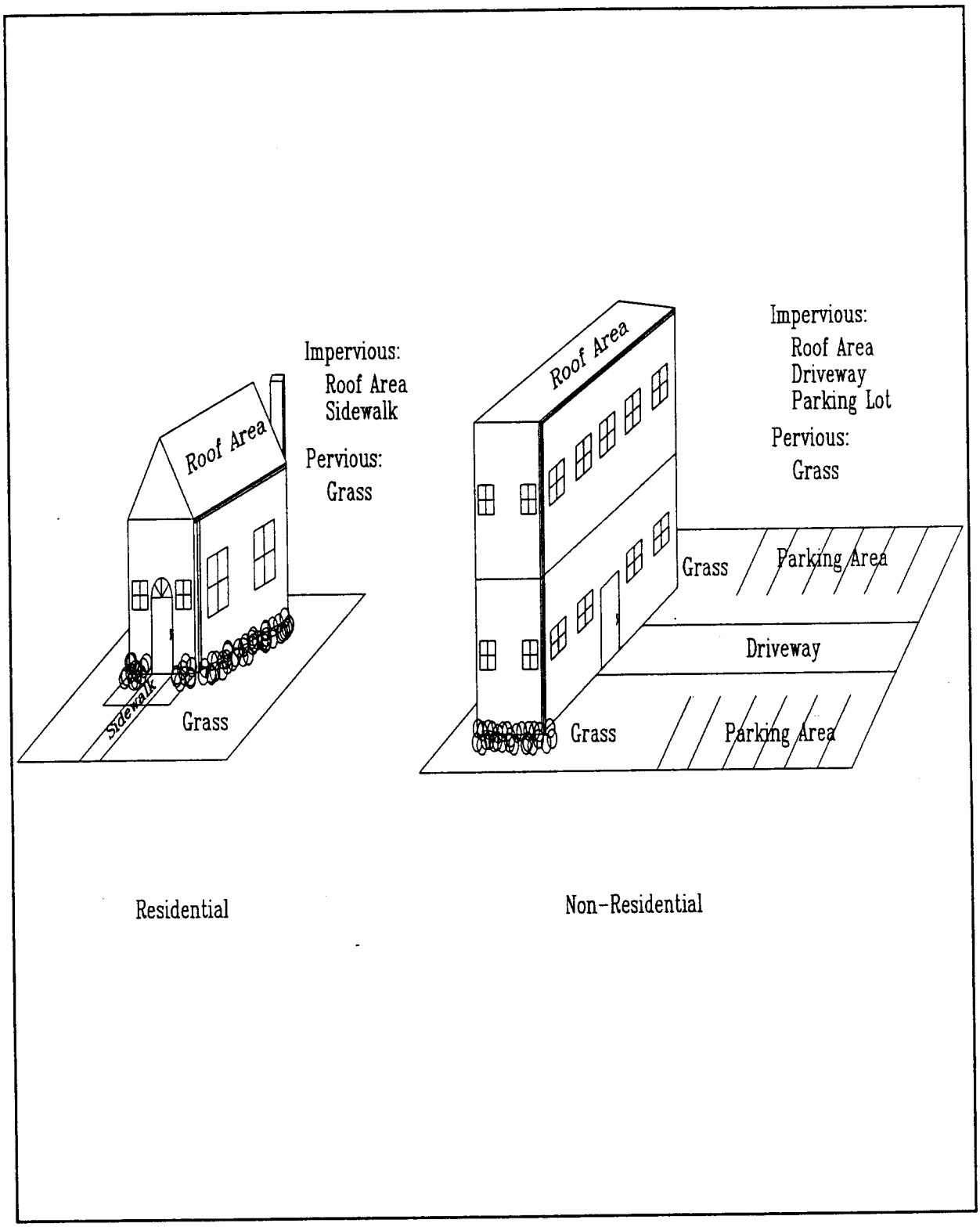
Impervious Area



METHOD: IMPERVIOUS AREA

DESCRIPTION: The impervious area (roof area, parking areas, driveways, sidewalks, etc.) is the only parameter used to measure the contribution to runoff. The impervious area is usually determined by measurements from aerial photographs. The bill for each property is determined by multiplying the impervious area of each parcel by the stormwater rate.

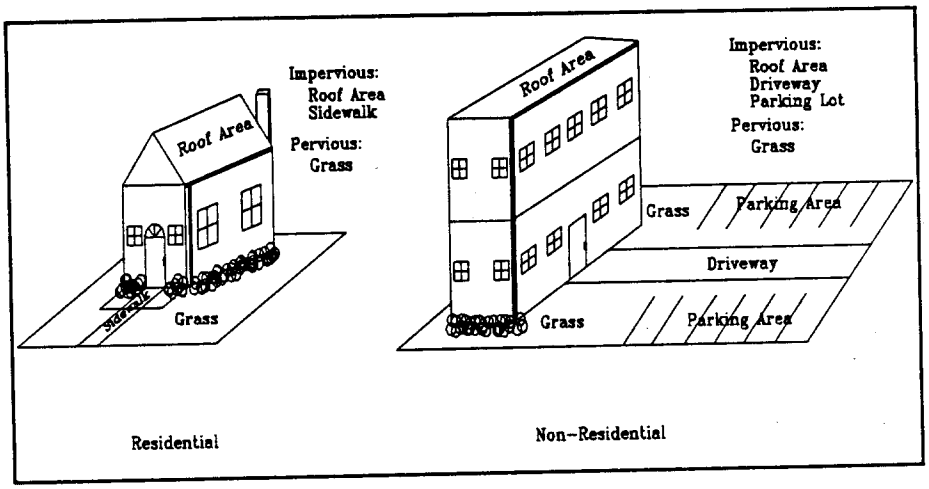


Figure 1-1

EXAMPLES: Louisville-Jefferson County Metropolitan Sewer District; Tulsa, Oklahoma; Numerous cities and counties in Florida.

DATA REQUIRED:

- Measurement of impervious area;
- Aerial photographs;
- Current and projected land usage;
- Service address, and approximate property boundary. Owner's name and address will be determined for all consolidations, during the billing system implementation phase. Ownership data availability is subject to the quality of the property ownership database.

ALGORITHM: Service charges are computed by multiplying the impervious area (in sq. ft.) of each parcel by a rate calculated as part of the cost of service and rate study analyses. This type of rate structure is typically modified by developing the two major categories of single family residences and non-single family residences. The typical computational procedure is:

1. Using aerial photography, measure the impervious area of a representative sample of single-family residential (SFR) parcels to determine the average impervious area. This area will represent one (1)

Equivalent Runoff Unit (ERU).

2. All SFR parcels are assigned a flat rate equal to one ERU. The impervious area of non-SFR parcels are measured from aerial photographs. Each parcel's impervious area is divided by the average impervious area representing 1 ERU to determine the number of ERU's for each parcel.

3. The number of ERU's is multiplied by the rate per ERU to determine the amount to be billed (per month or year).

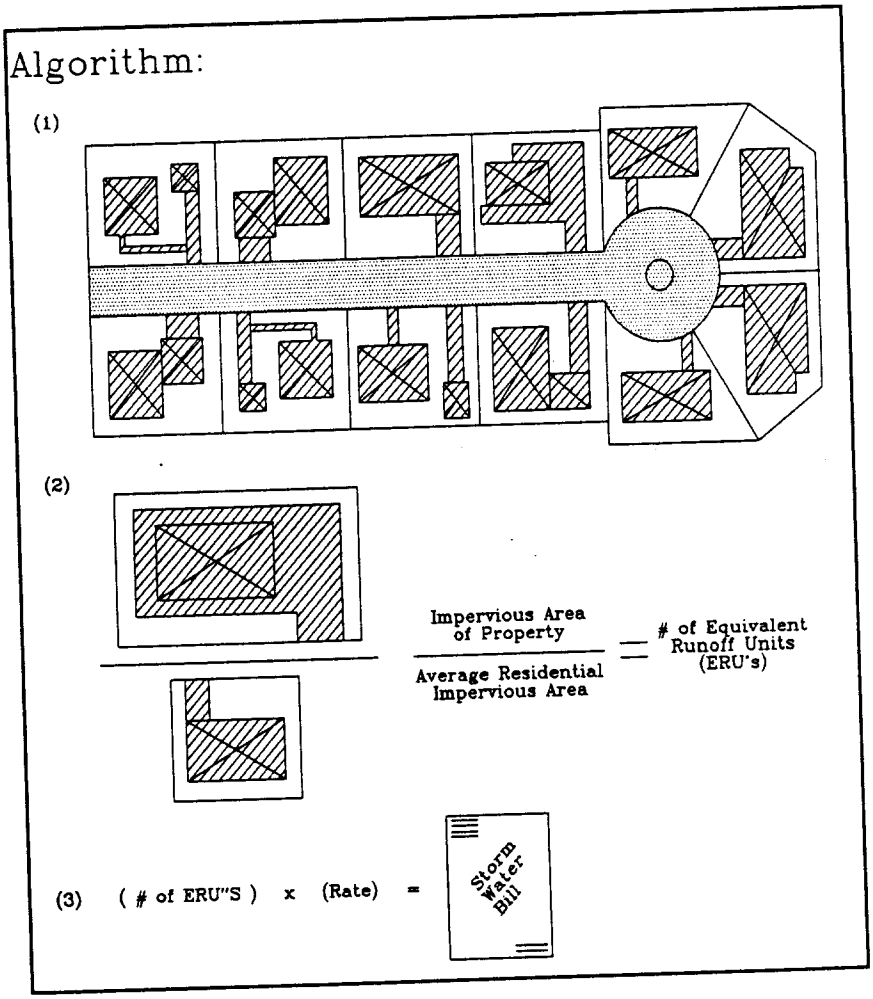


Figure 1-2

PUBLIC UNDERSTANDING:

Of the commonly used rate structures, this method is the easiest for the public to understand. As the above example indicates, the contribution to storm water runoff from a parcel is proportional to the impervious

area. The hydrological impact of paving or developing land areas is simple to explain, because the actual impervious area of each parcel is the basis for the service charge calculation.

The perceived equity and fairness of the Impervious Area Method is very good. The individual rates of each parcel will vary based on the amount of impervious area without placing an unfair burden on any particular landowner.

UNDEVELOPED PROPERTY:

It is difficult to include undeveloped property in this funding method since there is no impervious area on undeveloped property (by definition).

WATER QUALITY:

Impervious area has been found to be a significant indicator of water quality impairment. Any future programs dealing with water quality issues will include impervious area as a critical parameter.

IMPLEMENTATION:

The ease and cost of implementation of a rate structure based on impervious area is directly proportional to the data requirements and the availability of existing data. The methodology is not complex, but the measurement of the impervious area of numerous parcels is a very labor-intensive task. This effort is greatly simplified by establishing two categories of properties:

- Single Family Residences
- Non-Single Family Residences (Non-SFR)

Single Family Residential (SFR) properties can include duplexes as well as one-family units. It is not cost-effective to measure the impervious area of every SFR; rather, a statistical sample of SFR's is measured (using aerial photography) to determine the average SFR impervious area. This is used as the base unit or the ERU.

The non-SFR properties include but are not limited to the following:

- Apartments
- Condominiums
- Other multi-family units
- Commercial - malls, strip developments, etc.
- Schools
- Churches
- Public properties
- Office buildings
- Other institutional properties

- Industrial properties
- Roads and highways
- Parking lots

Each of these units are individually measured for the amount of impervious area which exists within their property boundary.

As compared to other rate structures, the ease and cost of the implementation of this method is slightly higher due to the measurement of impervious area.

TECHNICAL ACCURACY/ DEFENSIBILITY: Since the fees to be charged to each parcel are directly related to measured impervious area, and this parameter has been accepted as a contributor to increased runoff and water quality problems, this method has a high degree of technical accuracy and legal defensibility. This rate structure methodology has been challenged and upheld in the states of Washington and Kentucky.

FLEXIBILITY: To ensure a stable, equitable, continuous funding source for stormwater programs, rate structures must be flexible in order to incorporate local basin and geographical requirements, provide for updating on a continuous basis, and be compatible with related systems such as Geographical Information Systems (GIS), Management Information Systems (MIS) and existing billing systems.

The flexibility of the Impervious Area Method can be summarized as follows:

- Basin and geographical requirements, such as detention credits or surcharges for properties located in floodplains, can be incorporated into the billing system after the rate structure has been developed.

- The updating for new construction can be accomplished with minimum adjustment of the normal planning procedures for most cities. For example, the computation of impervious area can be a requirement of obtaining a building permit for new developments, and the city staff can input the new data into the system in a manner similar to adding a new water service account.

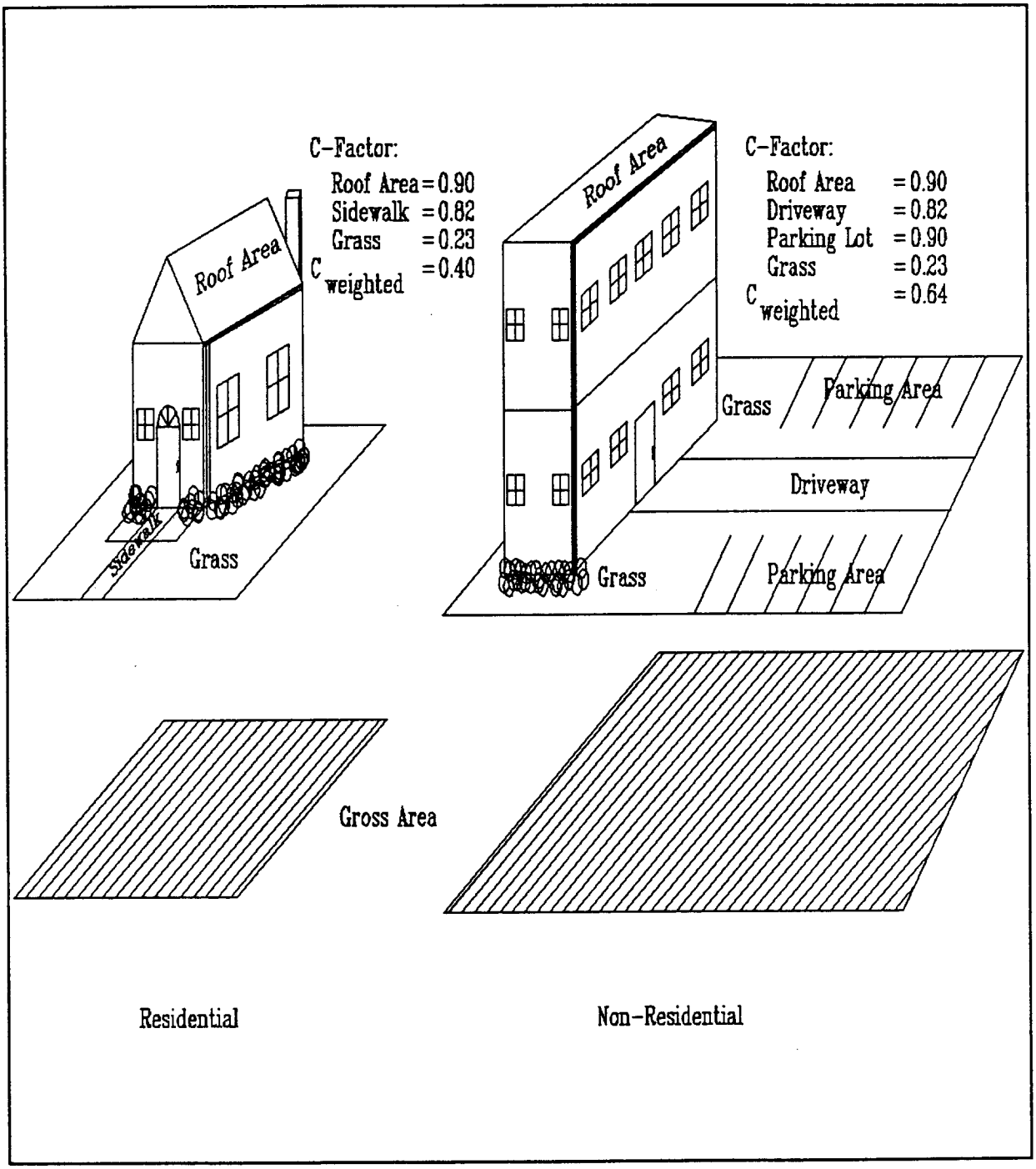
- The ongoing updating and customer service categories can be accomplished by utilizing and training current customer service staff.

- The Impervious Area Method is very compatible with the development and use of new or existing GIS or MIS systems. The development of a stormwater utility billing system can be the impetus for the development of a comprehensive GIS or MIS, which can provide numerous benefits to local government.

SUMMARY:

The Impervious Area Method is a very accurate and legally defensible method, and can be cost-effective for localities which are highly developed (such as cities, as compared to counties) and those which have a relatively high percentage of residential property. The property data required is usually available for most communities, and the aerial photographs necessary for the measurement of impervious area are relatively inexpensive. The Impervious Area Method has been chosen by the majority of the city and county programs currently operating stormwater utilities in the United States. This method is convenient for municipalities which currently charge properties for sanitary sewer and potable water service, and a high percentage of the developed parcels receive these bills. Non-metered parcels will receive "stormwater-only" bills. This method is easily explained to the general public.

Gross Area and Intensity of Development
(C-Factor or Runoff Factor Method)



METHOD: GROSS AREA AND INTENSITY OF DEVELOPMENT (C-FACTOR or RUNOFF FACTOR METHOD)

DESCRIPTION: This rate structure is based on the gross area (total area) of each property, and its intensity of development classification, i.e. the runoff factor. The stormwater bill for each property is determined by multiplying the gross area of the property by the runoff factor. This unit is then multiplied by the stormwater rate.

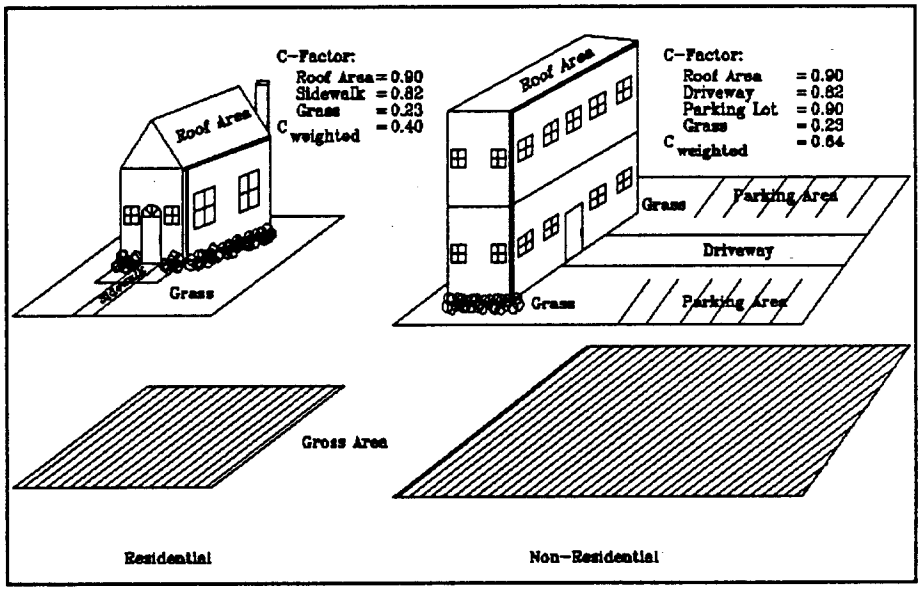


Figure 2-1

EXAMPLES: Bellevue, Washington; Tacoma, Washington; Cincinnati, Ohio

In Bellevue, the intensity of development is a measure of the percentage of impervious area based on the land use shown below:

- Undeveloped (natural terrain, 0% impervious coverage)
- Light Development (up to 20% impervious)
- Moderate Development (20% to 40% impervious)
- Heavy Development (40% to 70% impervious)
- Very Heavy Development (over 70% impervious)

A discrete gross area measurement was made for every parcel - residential and non-residential.

In Tacoma, a method similar to Bellevue's was used. However, "the monthly charge for a specific parcel is obtained by multiplying the number of size increments in a parcel by the appropriate rate per 46.45 square meters (500 sq. ft.) and adding a fixed charge of $0.44" *(American Public Works Association - Urban Stormwater Management, Special Report No. 49).*

In Cincinnati, The rate methodology uses land use as an indicator for the intensity of development by assigning a "coefficient of runoff" to several hundred specific land uses in the auditor's records.

DATA REQUIRED: The following data are required in the development of a billing system based on gross area and intensity of development:

- Property records to determine the total area of each property
- Land Use map and land use code of each property
- Aerial photography (only if detailed runoff factor analysis is the policy)
- Existing utility routing maps
- Auditor's property valuation maps (tax maps)
- Service address, and approximate property boundary. Owner's name and address will be determined for all consolidations, during the billing system implementation phase. Ownership data availability is subject to the quality of the property ownership database.

ALGORITHM: A general procedure for determining the Equivalent Runoff Unit (ERU) and Service Charge for the Gross Area and Intensity of Development Method is as follows:

1. Determine the general land use categories to be used, based on the land use classifications typically listed in the property tax record database (Allen County Auditor's files).

2. Assign a rate factor (RF) to each general land use category. The determination of the RF should be based on actual hydrological properties as much as possible. The runoff coefficient or "C" factor used in the Rational Method engineering computation is commonly used for the rate factor. Typical values range from 0.10 for agricultural parcels to 0.82 for commercial lots. Figure 2-2 illustrates one example of percent impervious and rate factors, based on engineering judgement and standard engineering methods.

Example Rate Factors For Stormwater Utility Planning Studies

Land Use Category	Average Percent Impervious	Rate Factor
Agriculture	–	0.10
Commercial	0.85	0.82
Commercial Residential	0.70	0.68
Parks	0.07	0.11
Playgrounds	0.13	0.17
Schools	0.50	0.50
Industrial	0.72	0.70
Apartments	0.65	0.64
Residential		
Acreage ⟨ 1/8	0.65	0.40
1/8 ⟨ A ⟨ 1/4	0.38	0.40
1/4 ⟨ A ⟨ 1/3	0.30	0.40
1/3 ⟨ A ⟨ 1/2	0.25	0.40
1/2 ⟨ A ⟨ 1	0.20	0.23
1 ⟨ Acreage	0.12	0.16
Residential Agricultural	–	0.16
Residential Community	–	0.64
Condominium	–	0.64
Condominium Community	–	0.64
Marshland	–	0.00
Other Nonstandard Categories		
Cooperative	–	0.64
Mobile Home Sites	–	0.64
Group Quar	–	0.64
Motel	–	0.82
Other	–	0.50

Note: Estimates of the average percentage of impervious area are from SCS TR-55 or the Rational Method. The estimate of 0.65 for apartments was taken from the TR-55 estimate for townhouses. 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. Residential Agricultural was assigned the same rate factor as Residential [1 ⟨ Acreage]).
Source: Maryland Sediment and Stormwater Administration

Figure 2-2

3. Determine the gross area (A) for each parcel in each category, from the county auditor's files. If the gross area cannot be extracted from existing records, the cost to compute the areas by digitizing maps may be prohibitive and the impervious area method may be preferred.

4. For each parcel or category, ERU = RF x A.

5. ERU x the rate per ERU is the amount to be billed to each parcel on a periodic basis. The rate charged per ERU is based on the rate study and cost of service analysis for the municipality.

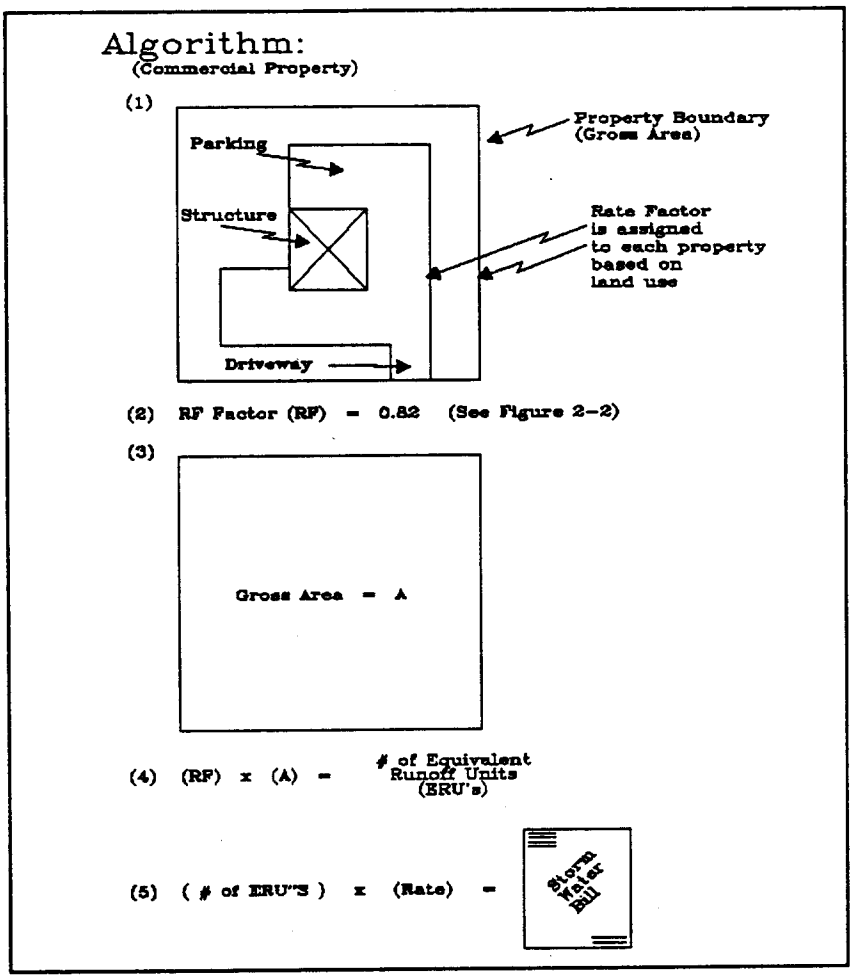


Figure 2-3

PUBLIC UNDERSTANDING:

The public will generally have difficulty understanding the methodology used for this rate structure. It may be difficult for a non-engineer to fully grasp the relationship between the rate factors and their contribution to runoff.

The perceived equity and fairness of the Gross Area and Intensity of development method is subject to the understanding of rate factors. The individual rates of each parcel or category will vary based on the amount of gross area of each parcel, but the selection of the rate factors may appear arbitrary, and are often left to "good engineering judgement".

UNDEVELOPED PROPERTY:

This rate method offers the ability to charge undeveloped property. Separate rate factors can be assigned to undeveloped properties. Typically, undeveloped and agricultural land are assigned an RF equal to 0.10.

WATER QUALITY: Pollutant indices can be related to rate factors and land use classifications to incorporate consideration of the impact of each parcel on water quality.

IMPLEMENTATION: The ease and cost of implementation of a rate structure based on gross area and intensity of development is directly proportional to the data requirements and the availability of existing data. In most cases, the information is derived from existing data obtained from land use records from municipal planning departments and property records from county auditor's offices. The cost can be estimated on a "per parcel" basis after considering the difficulty of extracting the necessary data from these sources. If either of these sources do not provide adequate (accurate, reliable, up-to-date) information, then gross area may have to be measured from available tax maps overlaid onto aerial photographs, or existing land use may have to be obtained from aerial photographs and zoning maps. In either case, the cost of implementation may increase to a point such that the more hydrologically accurate impervious method may be more cost-effective.

As compared to other rate structures, the ease and cost of the implementation of this method is rated as "moderate", if the necessary data is readily available. The cost of the implementation of this rate structure will generally be less than that of the Impervious Area Method, assuming either one or a combination of databases contain all of the necessary data.

TECHNICAL ACCURACY/ LEGAL DEFENSIBILITY: Since the fees to be charged to each parcel are directly related to the size of each parcel, and if the rate factors are based on hydrological principles, this method has a moderate degree of technical accuracy and legal defensibility. Care should be taken to ensure that any grouping of certain categories of parcels is done in a logical and straightforward manner. The use of engineering judgement leaves this method susceptible to challenge in many cases.

FLEXIBILITY: To ensure a stable, equitable, continuous funding source for stormwater programs, rate structures must be flexible in order to incorporate local basin and geographical requirements, provide for updating on a continuous basis, and be compatible with related systems such as Geographical Information Systems (GIS), Management Information Systems (MIS) and existing billing systems.

The flexibility of the Gross Area and Intensity of Development Method can be summarized as follows:

- Basin and geographical requirements, such as surcharges for properties located in floodplains, can be incorporated into the billing system after the rate structure has been developed.

- The updating for new construction can be accomplished with minimum adjustment of the normal planning procedures for most cities. For example, the computation of gross area and the selection of an appropriate rate factor can be a requirement of obtaining a building permit for new developments, and the city staff can input the new data into the system in a manner similar to adding a new water service account.

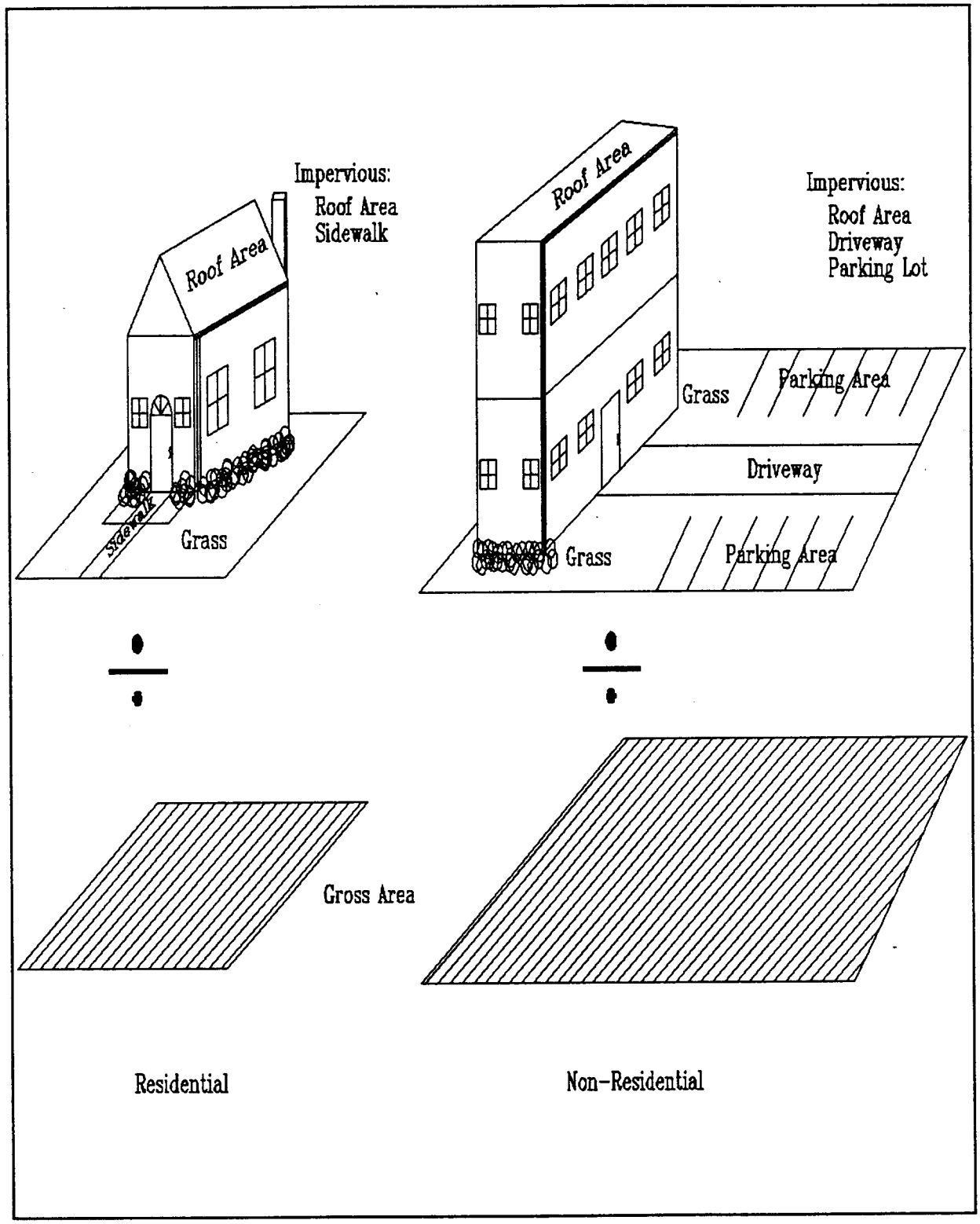
- The ongoing updating and customer service activity can be accomplished by utilizing and training current staff.

- The Gross Area and Intensity of Development Method is compatible with the development and use of new or existing GIS or MIS systems. The development of a stormwater utility billing system can be the impetus for the development of a comprehensive GIS or MIS, which can provide numerous benefits to local government.

SUMMARY:

The Gross Area and Intensity of Development Method is cost-effective method for localities which have significant undeveloped area (such as rural counties) and adequate land use and property records. The data required is usually available for most communities. This method is one of the first rate structures used for establishing storm water utilities. Computerized municipal records would greatly simplify the data management and provide significant cost savings. The Gross Area and Intensity of Development Method has been chosen often. This method may be cost effective for cities in which an existing utility billing system is not in place since a new series of accounts is required to include undeveloped land.

Impervious Area and Percentage of Impervious Coverage



METHOD: IMPERVIOUS AREA and PERCENTAGE OF IMPERVIOUS COVERAGE

DESCRIPTION: The impervious area (roof area, parking areas, driveways, etc.) and the gross area (total area) are used to calculate the percentage of imperviousness for each property. The percentage of imperviousness is organized into ranges, which are charges per 100 square feet of impervious area. The density of development has a major impact on the rates computed by this method.

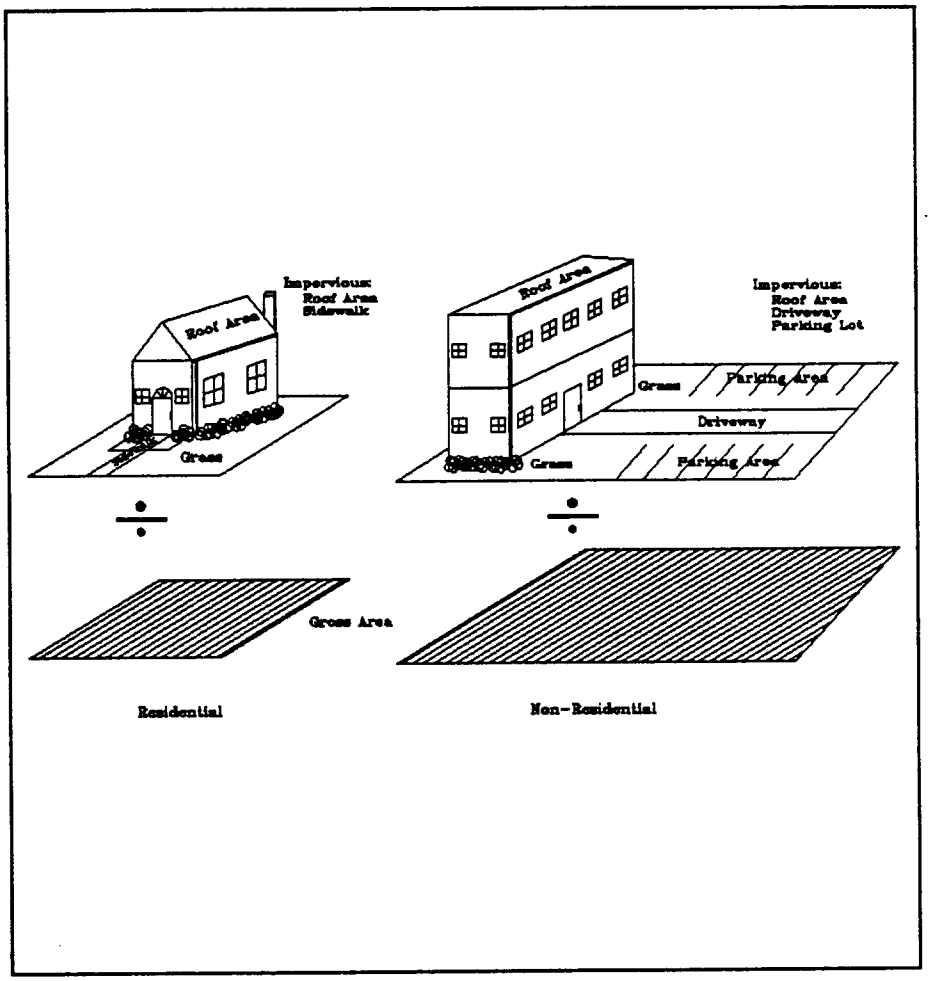


Figure 3-1

EXAMPLES: Denver, Colorado

In Denver, the amount of impervious area and the ratio of impervious area to the total area of a parcel determine a rate which ranges from $0.37 to $1.17

per 100 square feet of impervious area. Land use is not a factor in determining the rate. The Denver rate table is reproduced below.

RATE TABLE FOR STORMWATER
SERVICE CHARGE: DENVER, COLORADO

Ratio Group [a]	Rate [b]
.00 to .10	0.37
.11 to .20	0.47
.21 to .30	0.57
.31 to .40	0.67
.41 to .50	0.77
.51 to .60	0.77
.61 to .70	0.87
.71 to .80	0.97
.81 to .90	1.07
.91 to 1.00	1.17

(Minimum annual charge is $3.70/parcel)

a The "ratio group" represents the ratio of impervious surface area of a land parcel to the total parcel area.
b The "rate" for a specific ration group is multiplied by the amount of impervious area (sq ft) and divided by 100 to determine the annual service charge for a given land parcel.

(Source: Wastewater Management Div., Dept. of Public Works)

Figure 3-2

DATA REQUIRED: The following are required in the development of a billing system based on impervious area and percentage of imperviousness:

- Property records to determine the total number of parcels in each existing land use
- Gross area of each parcel
- Aerial photography
- Impervious area of each parcel
- Land use map and land use code of each property
- Service address, and approximate property boundary. Owner's name and address will be determined for all consolidations, during the billing

system implementation phase. Ownership data availability is subject to the quality of the property ownership database.

ALGORITHM:

A general procedure for determining the rates to be charged for the Impervious Area and Percent of Impervious Coverage Method is as follows:

1. Prepare a rate table similar to Denver's. The ranges to be used may be based on the data obtained relating to land use and the number of parcels in each land use. The determination of the rates to be used for each range should be based on actual hydrological properties and cost of service as much as possible.

2. IMPERVIOUS AREA/GROSS AREA x 100 = PERCENTAGE OF IMPERVIOUSNESS for each parcel. This task can be simplified by grouping similar parcels, such as residential lots, into one or more distinct categories and computing the average area of a representative sample of each category.

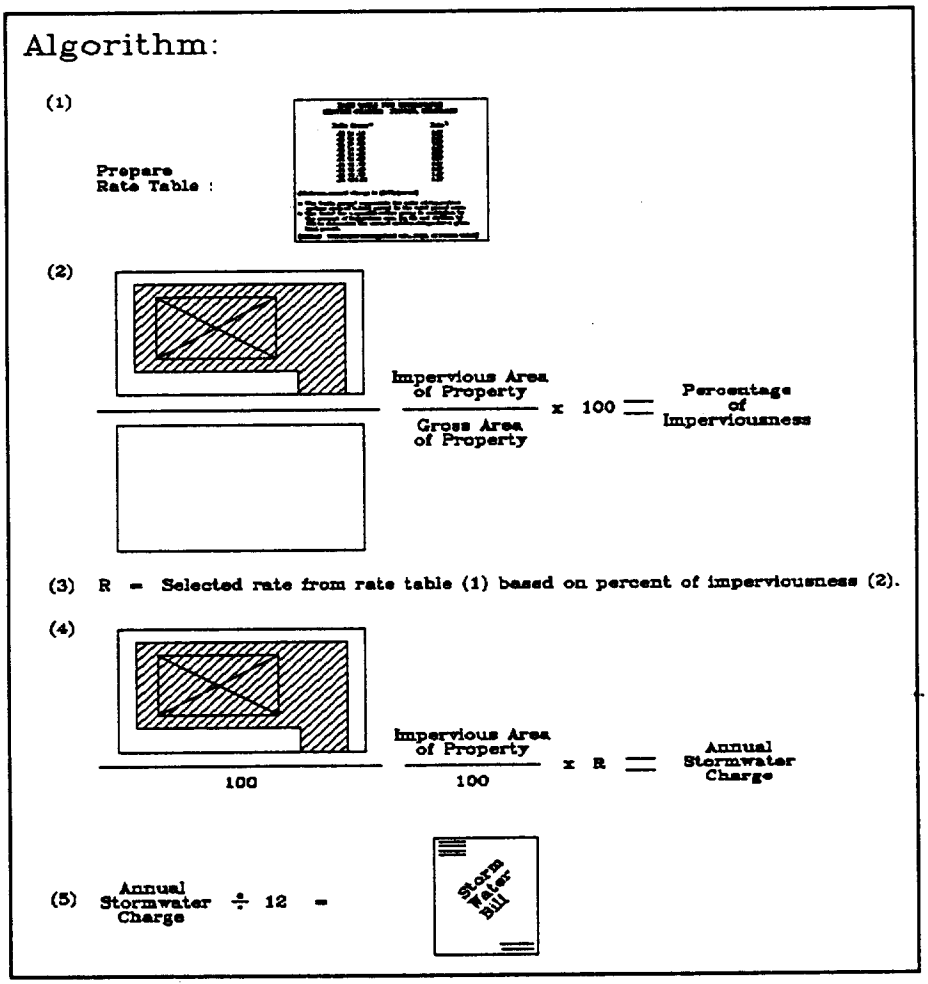


Figure 3-3

3. The rate for each parcel is selected from the rate table. The rate is the charge per 100 square feet of impervious surface.

4. The impervious area is divided by 100 and multiplied by the appropriate rate from the table to obtain the annual charge. Divide this fee by twelve to obtain the monthly charge, if desired.

PUBLIC UNDERSTANDING:

The public will generally have a poor understanding of the methodology used for this rate structure. It may be difficult for people to understand the relationship between the rates for the various ranges and the contribution to runoff, and how each was determined through engineering analyses.

Since the measurable parameters of impervious and gross area are used to compute the fees to be charged, the perceived equity and fairness of the Impervious Area and Percent of Impervious Coverage Method appears to be good. The individual rates of each parcel or category will vary based on the amount of impervious area of each parcel, but the selection of the factors used in the rate table appears to be arbitrary. Some situations are likely to occur in which one lot with a smaller gross area but higher imperviousness will be charged more than another lot with more gross area, but less impervious area. This situation may be difficult to explain or justify in terms of the contribution to runoff.

Land use is perceived to be a factor in contribution to runoff, but the incorporation of land use as a component in the development of rate factors is not clear. A sliding-scale rate factor table may be more equitable than the table used by Denver, so that the more highly developed properties pay a significantly higher rate.

UNDEVELOPED PROPERTY:

Undeveloped property may generally be included in a funding program based on this method, with the gross area used as a factor.

WATER QUALITY:

Pollutant indices can be related to the ranges in the rate table to incorporate consideration of the impact of each parcel on water quality.

IMPLEMENTATION:

As is the case with other methodologies, the ease and cost of implementation of a rate structure based on this method is directly proportional to the data requirements and the availability of existing data. In most cases, the cost and complexity of the implementation of this

method will be higher than other methods, since data is required for both gross area and impervious area, for each parcel. The information is usually derived from property records from county auditor's offices and aerial photographs.

TECHNICAL ACCURACY/ LEGAL DEFENSIBILITY: Contrary to the initial impression, this method is not necessarily more accurate than other methods, due to the use of engineering judgement in developing the rate factor table. Therefore, this method may be less accurate and legally defensible than methods which are based on more precise measurements. The rate table should be based on hydrological principles. It may be difficult to demonstrate that the increments of increased charges for each range is related to a corresponding increase in the cost of service. Care should be taken to ensure that any grouping of certain categories of parcels is done in a logical and straightforward manner.

FLEXIBILITY: To ensure a stable, equitable, continuous funding source for stormwater programs, rate structures must be flexible in order to incorporate local basin and geographical requirements, provide for updating on a continuous basis, and be compatible with related systems such as Geographical Information Systems (GIS), Management Information Systems (MIS) and existing billing systems.

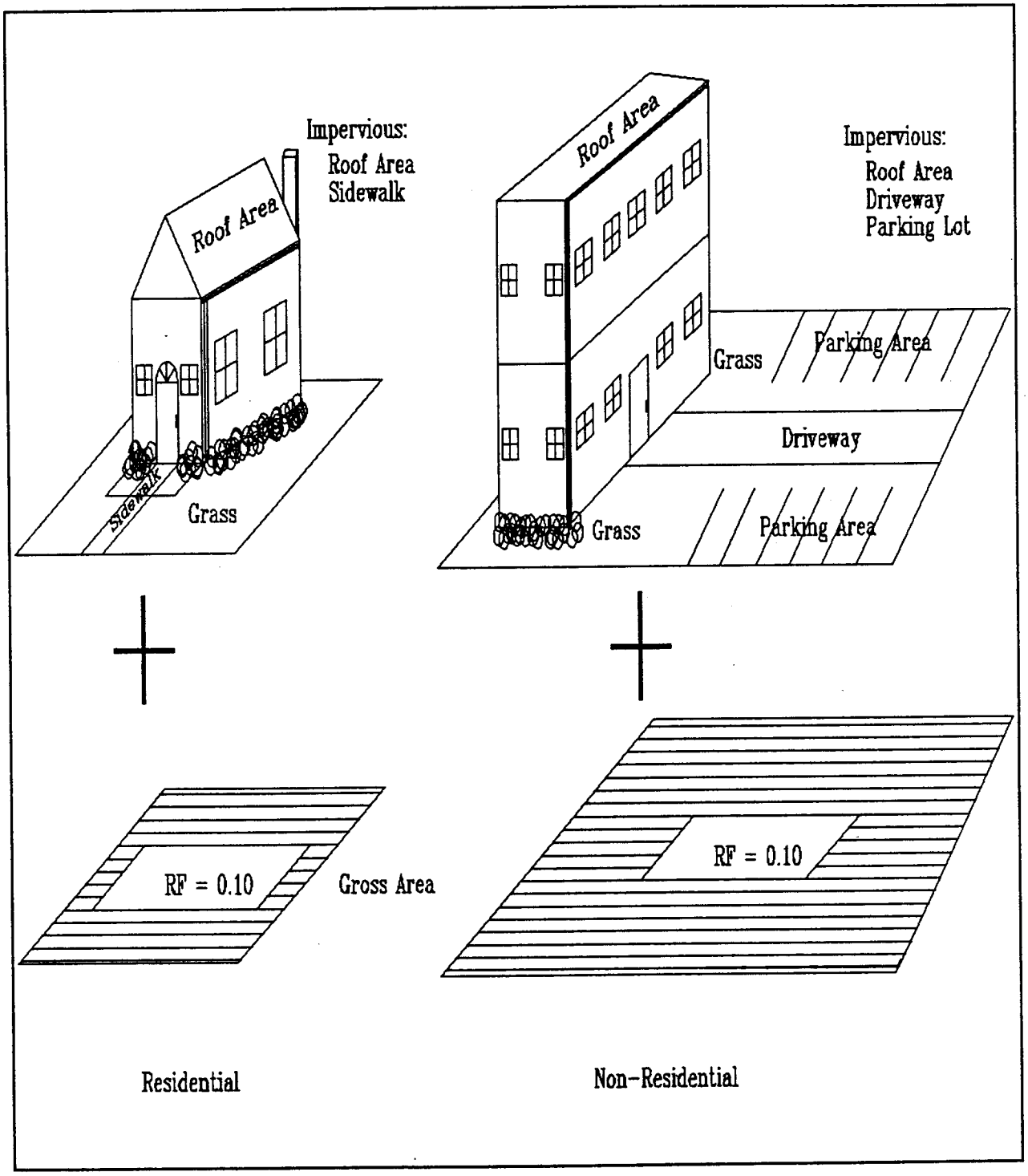
The flexibility of the Impervious Area and Percent of Impervious Coverage Method is relatively high, due to the capability to add more ranges, or adjust the rates for each range as required to improve the perceived equity. Other common rate modifications, such as credits for on-site detention or surcharges for flood-prone properties, can be implemented as desired. The updating and maintenance of the system can be accomplished with minimum adjustment of the normal planning procedures for most cities. For example, the computation of gross and impervious areas and the selection of an appropriate range can be a requirement of obtaining a building permit for new developments, and the city staff can input the new data into the system in a manner similar to adding a new water service account.

The Impervious Area and Percent of Impervious Coverage Method is compatible with the development and use of new or existing GIS or MIS systems. The development of a stormwater utility billing system can be the impetus for the development of a comprehensive GIS or MIS, which can provide numerous benefits to local government.

SUMMARY: The Impervious Area and Percent of Impervious Coverage Method is

appropriate for localities which have a significant percentage of highly developed, non-residential land and a minimum of undeveloped land. This method can shift more of the financial burden on highly developed properties, without regard to land use. The measurement of impervious area is a labor-intensive task, but significant savings could result from the development of flat rates to be used for single-family residences. The aerial photographs required for the measurement of impervious area are relatively inexpensive. The Impervious Area and Percent of Impervious Coverage Method is rarely used by municipalities currently operating stormwater utilities in the United States, since data regarding both impervious area and gross area are required.

IMPERVIOUS AREA AND GROSS AREA, INCORPORATING UNDEVELOPED PROPERTY



METHOD: IMPERVIOUS AREA and GROSS AREA, INCORPORATING UNDEVELOPED PROPERTY

DESCRIPTION: There are basically only two different rate structures for stormwater utilities based on cost of service and contribution to runoff:

- Rates based on impervious area (the first method described in this paper);
- Rates based on gross area and intensity of development (the second method of this paper); or
- Rates based on both methods.

There are numerous variations of the two basic methods; most of the variations are designed to increase the fairness of the financial burden placed on the residential versus non-residential properties. The key issues for each program initiating a stormwater utility relate to the computation of the cost of services and each of the evaluation criteria in the matrices in the page A-1.

The method described in this section is a combination of the impervious area plus gross area method, incorporating undeveloped property. If a stormwater program is designed for an urban and rural area or an urban-county government such as the City of Indianapolis, then all property owners should contribute to the program.

The basic premise behind this rate structure is to implement the impervious area rate method described in this report, while incorporating an intensity of development factor for all undeveloped properties. This approach will require a two step process in the development of this rate design. The base rate will include a charge for the pre-developed gross area for all properties in the service area, developed or undeveloped. This base rate will be determined by multiplying the gross area by an undeveloped rate factor which simulates the contribution to runoff. The second tier of the rate design will include a charge for impervious area for all developed properties. This rate will be determined as outlined in the first rate method described in this document.

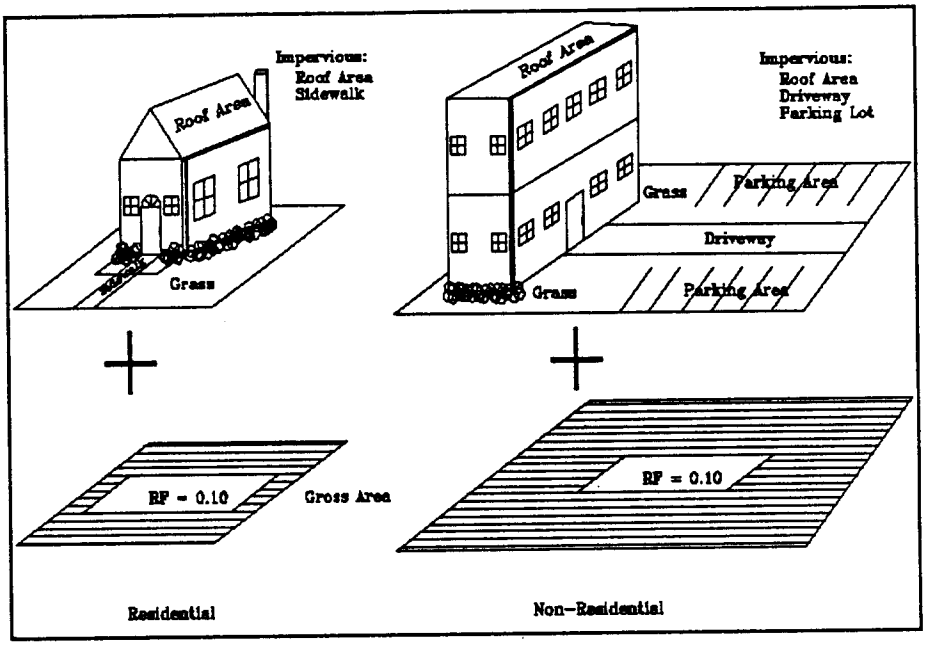


Figure 4-1

DATA REQUIRED: The following are used in the development of a billing system based on impervious area and gross area:

- Property records to determine the total number of parcels in each existing land use
- Gross area of each parcel
- Aerial photography
- Impervious area of each developed parcel
- Service address, and approximate property boundary. Owner's name and address will be determined for all consolidations, during the billing system implementation phase. Ownership data availability is subject to the quality of the property ownership database.

ALGORITHM: A general procedure for determining the rates to be charged for the Impervious Area and Gross Area, Incorporating Undeveloped Properties Method is as follows:

1. Determine the gross area and assign a rate factor of 0.10 to all properties. The use of a rate factor of 0.10 approximates the

contribution of runoff of undeveloped parcels, and the runoff of developed parcels prior to their development. Determine the average residential gross area and define this area as one pre-development unit (PDU). Establish the rate per PDU from the cost of service analysis and compute the number of PDU's for each parcel.

2. Determine impervious area for all developed parcels. Determine the average residential impervious area and define this area as one equivalent residential unit (ERU). Establish the rate per ERU from the cost of service analysis. Compute the number of ERU's per parcel.

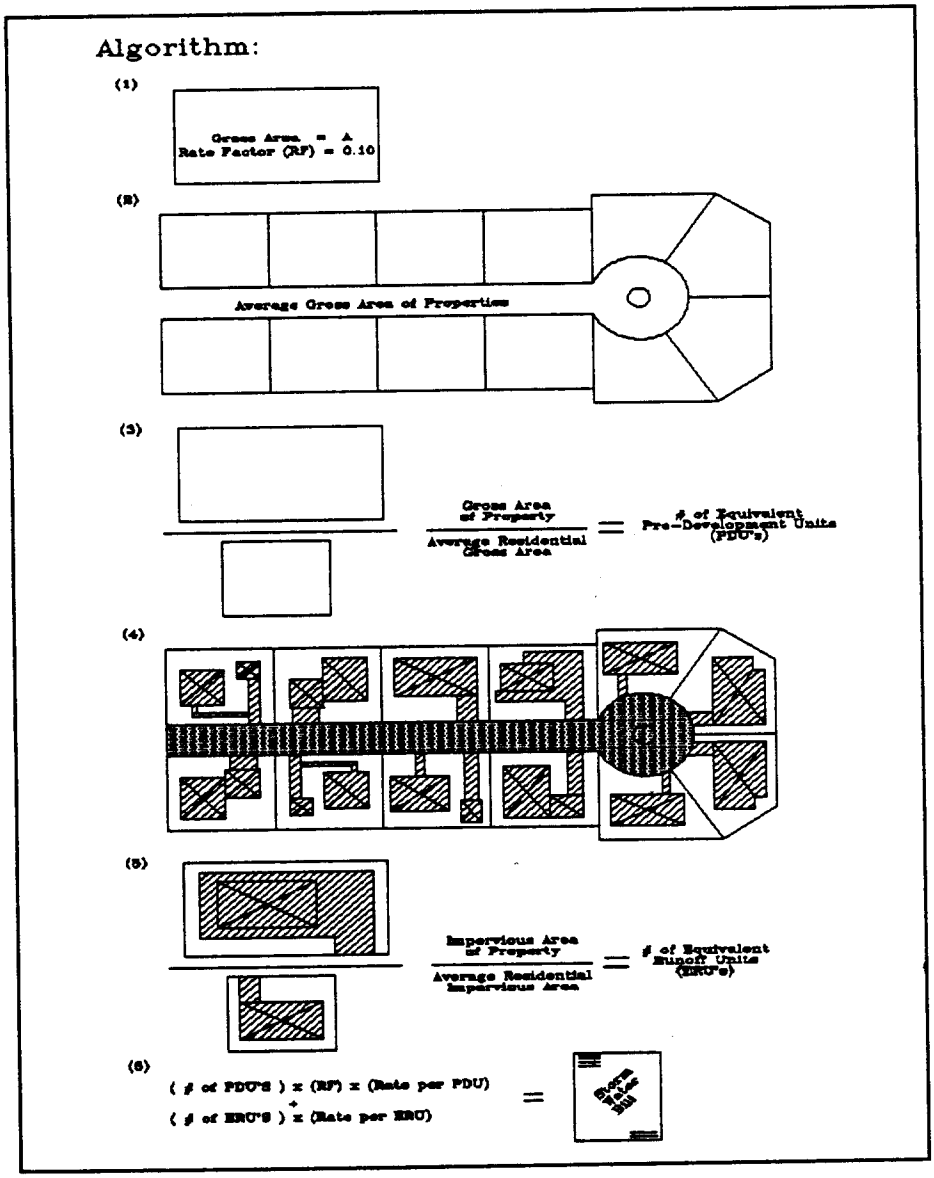


Figure 4-2

3. (# of PDU's x RF FACTOR x Rate per PDU) + (# of ERU's x Rate per ERU) = TOTAL CHARGE for each parcel.

4. The fees to be charged to each parcel can be adjusted by other modifying factors, if desired. The specific computations would be developed on a case-by-case basis.

PUBLIC UNDERSTANDING: The public will generally have a good understanding of the methodology used for this rate structure. It may be difficult for the general public understand the dual rate concept.

UNDEVELOPED PROPERTY: Undeveloped property is included in this rate structure method by determining the gross area and assigning a rate factor of 0.10 to all properties.

WATER QUALITY: Of all the rate structures discussed in this issue paper, this method lends itself best to the addition of water quality considerations because of its multiple tiered approach. This will allow a third tier to be added in the future if desired.

IMPLEMENTATION: As is the case with other methodologies, the ease and cost of implementation of a rate structure based on this method is directly proportional to the data requirements and the availability of existing data. In most cases, the implementation of this method will be slightly higher than other methods, since data is required for both gross area and impervious area for each parcel. The information is usually derived from property records from county auditor's offices and aerial photographs. The cost can be estimated on a "per parcel" basis after considering the difficulty of extracting the necessary data from these sources. The algorithm used for this method is slightly more complicated than other common methods.

TECHNICAL ACCURACY/ LEGAL DEFENSIBILITY: This method incorporates the best elements from both the impervious area and intensity of development methods previously discussed. However, this method is untested because it has never been implemented.

If the rates are based on hydrological principles and actual cost of service, this method has a good degree of technical accuracy and legal defensibility. It may be difficult to demonstrate that the rates for each area are related to a corresponding increase in the cost of service. Care should be taken to ensure that any grouping of certain categories of parcels is done in a logical and straightforward manner. Using flat rates

for certain categories would negate much of the benefits of this method relating to accuracy.

FLEXIBILITY:

To ensure a stable, equitable, continuous funding source for stormwater programs, rate structures must be flexible in order to incorporate local basin and geographical requirements, provide for updating on a continuous basis, and be compatible with related systems such as Geographical Information Systems (GIS), Management Information Systems (MIS) and existing billing systems.

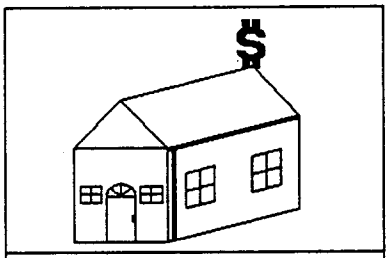
The flexibility of the Impervious Area and Gross Area, Incorporating Undeveloped Properties Method is relatively high, due to the capability to adjust the rates, or add further rate modifications as required to improve the perceived equity. Other common rate modifications, such as credits for on-site detention or surcharges for flood-prone properties, can be implemented as desired. The updating and maintenance of the system can be accomplished with minimum adjustment of the normal planning procedures for most cities. For example, the computation of gross and impervious areas can be a requirement of obtaining a building permit for new developments, and the city staff can input the new data into the system in a manner similar to adding a new water service account.

The Impervious Area and Gross Area, Incorporating Undeveloped Properties method is compatible with the development and use of new or existing GIS or MIS systems. The development of a stormwater utility billing system can be the impetus for the development of a comprehensive GIS or MIS, which can provide numerous benefits to local government.

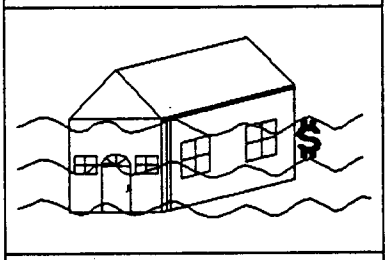
SUMMARY:

The Impervious Area and Gross Area, Incorporating Undeveloped Properties Method may be the best method for urban county governments, because of the treatment of undeveloped parcels and the reliance on actual measurements of impervious area. This methods also allows for expansion in the future (water quality issues). However, the measurement of impervious area is a labor-intensive task, but significant savings could result from the development of flat rates to be used for single-family residences. The aerial photographs required for the measurement of impervious area are relatively inexpensive. The Impervious Area and Gross Area Incorporating Undeveloped Properties Method described in this document is not a common method, due to the relatively high cost of developing a system based on more variables.

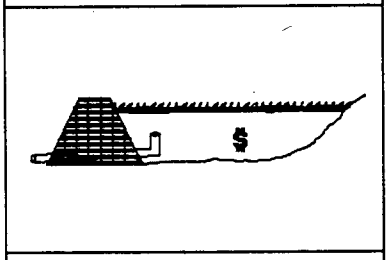
RATE STRUCTURE MODIFYING FACTORS



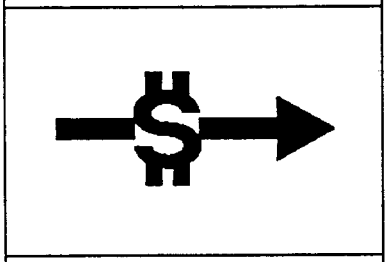
Flat Rate Charges



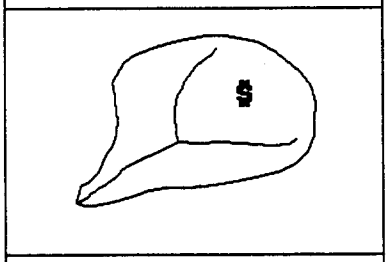
Floodplain Surcharges



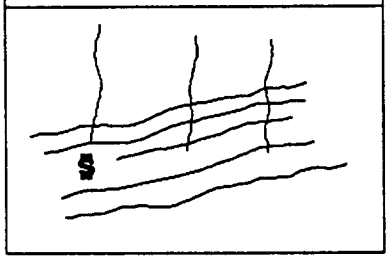
Credits



Fixed Overhead Costs



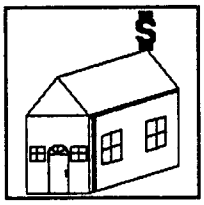
Drainage District Surcharges



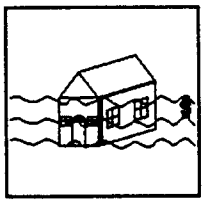
NPDES/CSO/Water Quality Factors

RATE STRUCTURE MODIFYING FACTORS

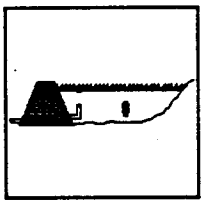
The following six factors are commonly used with selected rate structures to modify the basic stormwater service charge. Not all of the factors described will be appropriate for Fort Wayne, and other factors not described may apply to Fort Wayne. These factors can be developed and discussed in subsequent policy issue meetings.



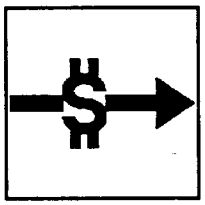
Flat Rate Charges



Floodplain Surcharges



Credits



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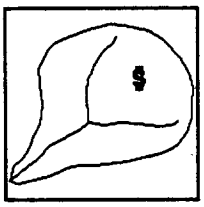
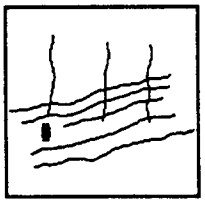


Drainage District Surcharges

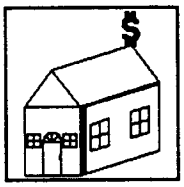


NPDES/CSO/Water Quality Factors

The purpose of using modifying factors such as these is to enhance the service charge rate structures by:

- Improving equity and fairness
- Simplifying the rate development procedure
- Improving operational issues
- Reducing implementation cost
- Reducing account file maintenance
- Improving environmental regulatory funding
- Improving public perception

Obviously, not all of these enhancements would apply to each of the modifying factors. For example, using flat rates for residential property would simplify the procedure, reduce the cost, and reduce the file maintenance, but it would decrease the equity and fairness. Consideration of the use of these factors should be weighed against the disadvantages of gathering and maintaining data.



FLAT RATE CHARGES

Description: Developing service charges for every individual parcel in a city could result in prohibitive costs. One common method to reduce the implementation and maintenance costs is the development of flat rates to be charged to large groups of similar properties. The most common group which is charged a flat rate is single family residences. Residential property makes up a high percentage of the land usage of most cities, and most of that property is single-family residential (SFR). If a rate structure based on gross land area or impervious area is selected, the algorithm used in the computations require the tabulation of gross area from property records, or the measurement of impervious area from aerial photographs. The cost of performing this labor-intensive work would be prohibitive for most municipalities. Since hydrology is an inexact science, the enormous cost of this data acquisition and management is not justified by the relatively minor differences in runoff between essentially similar properties.

The typical procedure in implementing this flat rate for SFR's or any other category of property is to:

1. Review the available land use data and determine the number of parcels in different categories, such as agricultural, commercial, industrial, institutional, single-family residential, and multi-family residential. The categories could be further divided into subcategories based on gross area, if the information is available.

2. Generate a list of the likely candidates for flat rates, by comparing the relative percent of each category to the total number of parcels in the city.

3. For the categories chosen for flat rates, measure the parameters used in the rate structure (gross area, intensity factors, impervious area, etc.) for a representative sample of properties. Determine the averages of each parameter measured for the category.

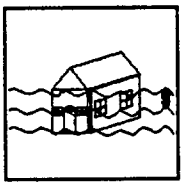
4. Estimate the gross revenue requirements and confirm it during the rate study analysis.

5. Compute the flat rate to be applied to each property in the category, based on the average parameters. Evaluate whether the rate will be publically acceptable.

6. If the rate is determined to be acceptable, develop the master account file using this flat rate for each parcel in the category.

IMPACT: Utilizing a flat rate charge for single family residences will result in:

- Less accuracy in the determination of the rates charged to each property, decreasing the level of equity and fairness.
- A greatly simplified data management effort, since a large portion of the parcels will not require actual measurements of physical parameters. The cost of implementation is reduced to a point that many more communities can find acceptable.
- The operational and maintenance issues of the billing system are greatly improved.
- The public perception of this modification is mixed. Many people will agree that it is not cost-effective to measure every parcel in a city, since many are very similar in hydrologic characteristics. Others will view certain properties as being very different from that which is determined to be the average, and question the equity of the flat rate.



FLOODPLAIN SURCHARGES

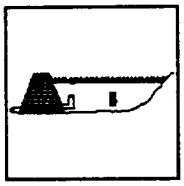
Description: In many cities, a major component of the cost of stormwater service results from providing flood protection to a relatively few number of properties located adjacent to waterways. Assessing surcharges to these properties would be more equitable than distributing the cost to the general population, since the cost of service would be more related to the benefits received. An additional advantage of using these surcharges would

be that new construction in floodplains would be discouraged.

When assessing floodplain surcharges, the following factors must be considered:

- A cost/benefit analysis to justify new construction projects.
- The cost of providing the service - construction of floodwalls or levees, erosion control, modification of the gravity drainage system, maintenance, administration costs, etc.
- The number of protected parcels, and the ability to absorb the costs of the surcharge.
- The percentage of the cost of service to be recovered by the surcharges (cost sharing).

Impact: Assessing surcharges to properties located in or adjacent to floodplains would generally improve the equity of the utility, but would complicate the implementation and operation of the system. The relatively few property owners affected may not be able to pay the high cost of capital improvements required for flood protection.



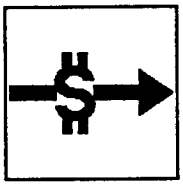
CREDITS

Description: It is becoming increasingly common for new developments to be required to construct stormwater management facilities to control runoff. These requirements are enacted to reduce the downstream flooding resulting from increasing impervious areas, or to reduce the degradation of the water quality of receiving streams. Much of the cost of service of a stormwater program would be reduced if older developments had implemented stormwater controls at the time of their development.

Many municipalities operating stormwater utilities give credits to the service charges of properties with stormwater "best management practices" such as detention or retention basins, infiltration trenches, oil & grease traps, grass swales, etc.

If no credits are provided for parcels practicing good stormwater management, an inequitable situation arises in which the newer developments effectively pay twice - first in increased construction cost and loss of usable land, and secondly by paying charges for service resulting from the poorer stormwater practices of other parcels.

Impact: Providing credits for desirable stormwater management practices results in an improved perception of equity and fairness. As with other modifications to the rate structure, providing credits would complicate the utility billing system.

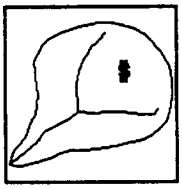


FIXED OVERHEAD COSTS

Description: If a rate structure is developed with modifying factors to be applied to improve equitability, it may be advantageous to charge a fixed, base rate to all properties as compensation for providing certain administrative services such as billing operations, the development of planning documents, initial startup costs, etc. This modification would be compatible with a policy towards charging each property according to its individual contribution to runoff or benefits received.

During the cost of service analysis, the anticipated expenditures should be itemized to the degree that all of the costs which are common to each property are totaled separately. This total cost would then be divided by the number of billing accounts to determine the fixed rate to be charged for the overhead expenses of the utility. All of the other costs should be allocated to the specific parcels in relation to receiving benefits or contributing to the stormwater runoff.

Impact: Allocating costs and service charges by the use of fixed rates for overhead costs would improve the equity and fairness of the utility, and would be easy for the public to understand and accept. The rate structure would be complicated only slightly by this modification; however, proper use of this modification would require that other modifications, such as floodplain surcharges, credits, and/or drainage district surcharges should also be applied, further complicating the utility.



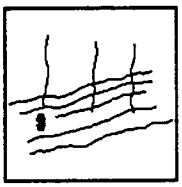
DRAINAGE DISTRICT SURCHARGES

Description: Many localities contain certain drainage basins or areas which have more complex stormwater requirements than the rest of the regions. It may increase the perceived equity of the utility to increase the funding contribution from parcels receiving additional services, by assessing Drainage District Surcharges. Properties which may be candidates for these surcharges include:

- Areas subject to more intense local flooding, which may require special solutions (similar to Floodplain Surcharges)
- Neighborhoods which, for various reasons, require more capital improvements or maintenance of their stormwater systems.

- Areas which drain to environmentally-sensitive receiving waters, requiring increased water quality controls or surveillance.

Impacts: Assessing surcharges to properties located in certain drainage districts would improve the equity and fairness of the utility, and would be easy for the public to understand. However, the delineation of special drainage districts could be a controversial issue, especially the determination of individual rates for the properties. The justification for the creation of rates charged for drainage districts would significantly complicate the utility implementation.



NPDES/CSO/WATER QUALITY FACTORS

Description: Each municipality is facing increasing responsibility for the quality of the waters of the United States. The implementation of the National Pollutant Discharge Elimination System (NPDES) stormwater regulations require major cities to obtain a discharge permit for their storm sewer outfalls, and to monitor the water quality of the discharges. Decreasing the discharge of pollutants will be the major focus of the program. Cities which have combined sewers (sanitary sewage and stormwater discharged through the same system) are required to eliminate the incidence of combined sewer overflows (CSOs). Also, even without these federal mandates, the pollutants present in stormwater had become nuisances and health hazards that many communities were attempting to mitigate.

All of these water quality issues result in demands for the resources of communities. Depending on the scope of the individual solutions, the cost of increasing the quality of the waters of the U.S. can be one of the most expensive stormwater cost allocation cities will face. Additional funding is required to deal with the problems. In fact, the NPDES regulations require that cities specify in the permit applications the source(s) of funding dedicated to improving the local stormwater quality.

When these current and anticipated demands are included in the cost of service of a stormwater utility, cities must decide how to obtain the required funding. As with other utility policy issues, it is best to require that the parties which either contribute to the problem or receive the benefits of the program shoulder the financial burden. One way is to let the properties which have the higher percentage of impervious area pay higher service charges. Impervious area and certain types of land usage have been shown to be a significant indicator the discharge of pollutants to stormwater. There are mechanisms available in most of the common rate structures to require that the more highly impervious properties pay higher service charges. The rates used for impervious areas can be increased as a city's stormwater program matures, and as the allocation of funds for water quality issues increases. Another method, which may be more equitable, would be to modify the rate structure by identifying the significant contributors of stormwater

pollution, and assessing them a water quality surcharge. The surcharge should be high enough to encourage correction of the situations which result in the pollution. The city would use the funds collected from these surcharges to improve the local water quality, by constructing regional retention basins, through increased regulation and enforcement of environmental laws, or by other methods.

Impact: Assessing a water quality surcharge would result in a more equitable and fair rate structure, since the contributors to the problems shoulder the financial burden. The surcharge must be developed in a manner which uses objective engineering practices to compute the actual cost of providing the service, and in the identification of the major contributors. This is likely to increase the cost of implementation, the complexity of the utility, and the incidence of appeals. However, having a mechanism to provide adequate environmental regulatory funding is critical to the success of a stormwater program for major cities in the 1990's and beyond.