Average Ratings
Treatment of Construction Work In Progress

	Implementation				
Alternatives	**Administrative Burden**	**Public Understanding**	**Public and Political Acceptance**	**Risk of Implementation**	**Legal Defensibility**
Capitalize Interest	8.3	7.0	7.0	8.3	7.0
Include in Rate Base	4.2	8.3	8.3	5.6	7.0
Rate from 0 to 10 (10 most preferred)	5.6	7.0	8 4	8.4	9.8

	Equity				
Alternatives	**Interclass**	**Intraclass**	**Inter-generational**	**Inside/ Outside City**	**Industry Standards**
Capitalize Interest	7.0	7.0	9.7	9.7	8.3
Include in Rate Base	7.0	7 0	4.2	4.2	5.6
Rate from 0 to 10 (10 most preferred)	8.4	8.4	5.6	8.4	5.6

	Customer				
Alternatives	**Affordability**	**Economic Development**	**Rate Shock/ Volatility**	**Understand Bill**	
Capitalize Interest	7.0	7.0	6.3	7.0	
Include in Rate Base	7.0	7 0	8.3	7.0	
Rate from 0 to 10 (10 most preferred)	7 0	7.0	7.0	7.0	

	Conservation				
Alternatives	**Average-Day Savings**	**Peak-Season Savings**	**Peak-Day Savings**	**Sustainability**	
Capitalize Interest	8.3	8.3	8.3	8.3	
Include in Rate Base	8.3	8.3	8.3	8.3	
Rate from 0 to 10 (10 most preferred)	5.6	7.0	9.8	7.0	

	Financial				
Alternatives	**Revenue Sufficiency**	**Revenue Stability**	**Rate Stability**	**Rate Predictability**	**Financial Risk**
Capitalize Interest	7.0	7.0	7.0	7.0	7.0
Include in Rate Base	8.3	8.3	8.3	8.3	8.3
Rate from 0 to 10 (10 most preferred)	5 6	8.4	7.0	7.0	9.8

Alternatives	**Weighted Average Score**
Capitalize Interest	1,284
Include in Rate Base	1,232

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REDOAK CONSULTING
A DIVISION OF MALCOLM PIRNIE

Issue Paper #2
Water Cost Allocations

Subject: Water Cost Allocations and Fire Charges

Date: December 31, 2007

Introduction

A water cost-of-service analysis is a method of allocating costs (known as revenue requirements, which is the topic of Issue Paper #1) to the customer classes that a utility serves. Over the years industry standards have evolved to guide practitioners in the conduct of these analyses. This issue paper looks at methods of allocating costs for water utilities.

The American Water Works Association (AWWA) provides many of the industry standards for water ratemaking. This organization publishes the definitive industry manual on water rates entitled *Principles of Water Rates, Fees, and Charges*.[1] Although the manual covers the principles of water ratemaking in detail, many of the specific methodological options for a specific cost allocation process are left to the practitioner to develop for the particular circumstances. This issue paper explores the options for cost allocations available to the Austin Water Utility (AWU).

Overview of the Cost-of-Service Process

The cost-of-service process can be described in 9 distinct steps. These are:

1. Determine revenue requirements;
2. Determine customer classes;
3. Estimate customer characteristics;
4. Allocate costs to functions;
5. Allocate costs to cost pools;
6. Allocate costs to categories;
7. Allocate costs to customer service characteristics;
8. Allocate costs to customer classes; and
9. Design rates.

This issue paper covers steps 4 through 8. The remaining steps are presented in other issue papers.

Peak-Related Costs and Allocation Methods

Water systems are designed to meet both the average and peak demands of their customers. Therefore, data on total annual consumption and contributions to system peak demands are needed to allocate costs fairly among customer classes. Data on the number

[1] American Water Works Association, *Manual of Water Supply Practices—M1, Principles of Water Rates, Fees, and Charges*, Fifth Edition, (Denver, Colorado: American Water Works Association, 2000)

of customers with meters of various sizes must also be available to allocate customer- and meter-related costs.

As natural monopolies, the competitive market fails to efficiently price utility services. The study of these market failures and corresponding approaches to mitigate the failures falls within the utility economics discipline.

Utility economists have developed pricing theories and models to guide the development of utility rates. The core of this pricing theory is called the *peak-load pricing model.* Under the peak-load pricing model, the fixed costs of a utility are recovered from customer classes in proportion to each class's contributions to the utility's required capacity. Under this approach, the utility's capacity-related costs (i.e., the fixed cost of its capacity, both capital and O&M) depend on the size of facility required to meet the utility's peak demands. The types of peaks vary from utility to utility and are often driven by the technical choices and corresponding facilities available to meet customer demands.

For water utilities, the peak demands that drive capacity vary by the nature of the facility being employed and the customers using them. For example, water treatment plants are often sized to meet the peak-day demand of the utility. The finished water storage reservoirs are often sized to meet the system's peak-hour demand. The peak-load pricing model provides a framework for allocating the utility's fixed costs based on the demands by the utility's customers.

AWWA has identified two broad cost allocation methods for allocating a utility's costs and, thereby, determining water rates. Each of these cost allocation methods has its origins in the peak-load pricing models. These methods are[2]:

- Base/Extra-Capacity Method, and
- Commodity/Demand Method.

The primary difference between the cost allocation methods is the approach used to allocate peak-related costs to customer classes. The base/extra-capacity method is a deviation from the strict peak-load pricing model that accounts for the benefits that customers with lower peaking factors experience by the investment in capital-intensive

[2] A third method identified by AWWA is called the functional-cost method. This method allocates costs to four water functions. These functions are (1) production and transmission, (2) distribution, (3) customer costs, and (4) hydrants and connections. This method was developed by the Michigan Section of the American Water Works Association in 1949 and published in the first edition of the *M1 Manual* in 1954. This method is considered archaic and not widely accepted because it fails to recognize the capacity-related costs incurred by water utilities to serve customers. Although this method has been mentioned in the fourth and fifth editions of the *M1 Manual*, it is no longer considered a viable method by AWWA. For that reason, it is not further discussed in this issue paper.

facilities that lower the utility's overall costs for off-peak users.[3] Because the utility must select its production technologies from those that are effective and available but differ in their intensity of use of capital and O&M, the optimal technology may not be the technology chosen if it were merely used to meet peak-period demands. For instance, when planning future capacity with multiple technologies, a water utility will often select a technology based on its total costs (i.e., O&M and capital costs) [4] compared to the total costs of other technologies, given the utility's forecast of water demands.

For example, a water utility may have two options in meeting the demands of its customers. One option may be a conventional filtration facility using surface water with a relatively low per unit variable cost but a relatively high fixed cost. The alternative option may be a smaller treatment facility augmented with supplies from a ground water system. In this case, assume the cost of pumping and the limitations on supplies makes the groundwater system have higher operating costs than the larger filtration facility option. It may be cheaper for those customers with higher peaks for the utility to use the ground water to meet their peak capacity so that the smaller filtration facility would be a non-peaking facility. This would reduce the cost attributed to the peak users under the strict peak-load pricing model. However, this outcome may be less efficient if the marginal cost of the larger filtration facility is lower than that of the groundwater system. In that instance, the alternative with the lowest overall costs may be the option with the larger filtration facility (which is sized larger to meet the peak-day demands.)

This finding is often the case for water utilities. As such, the larger filtration facility (which tends to be more capital intensive with lower marginal unit costs for operations) provides value to both those customers who peak on the facility and those that do not.[5] The base/extra-capacity method deviates from the strict peak-load pricing model to account for this possibility.

Figure 1 presents a hypothetical cross section of a water system asset that is sized to meet multiple demands of the water system. This figure illustrates the cost allocation differences between the base/extra-capacity method and the commodity/demand method.

[3] As the literature on peak-load pricing has matured, some authors suggest that, under certain conditions, non-peaking customers should pay a portion of the capacity-related costs of peak-related facilities. For example, if the production function for a utility allows for the substitution of O&M expenses for capital (i.e., a neoclassical production function), the peak-load pricing allocation approach may charge a portion of the capacity costs to non-peaking customers. See Elizabeth E. Bailey and Erick B. Lindenberg, "Peak Load Pricing Principles: Past and Present," in *New Dimensions in Public Utility Pricing*, ed. Harry M. Trebing (East Lansing, Michigan: Institute of Public Utilities, Graduate School of Business Administration, Michigan State University, 1976, 10. See also John C. Panzar, "A Neoclassical Approach to Peak Load Pricing", *The Bell Journal of Economics*, 7(2) (Autumn 1976): 521-30.
[4] These *total costs* are often called present worth estimates, which take into account the time-value of money.
[5] Almost all customers have a peak demand that exceeds their average demand. However, the relative portions of the peak-related costs attributable to customer classes vary. For example, some large customers may have a peak-day demand that is 125 percent of their average-day demand, while other customers my have a peak-day demand that is more than 250 percent of their average-day demand.

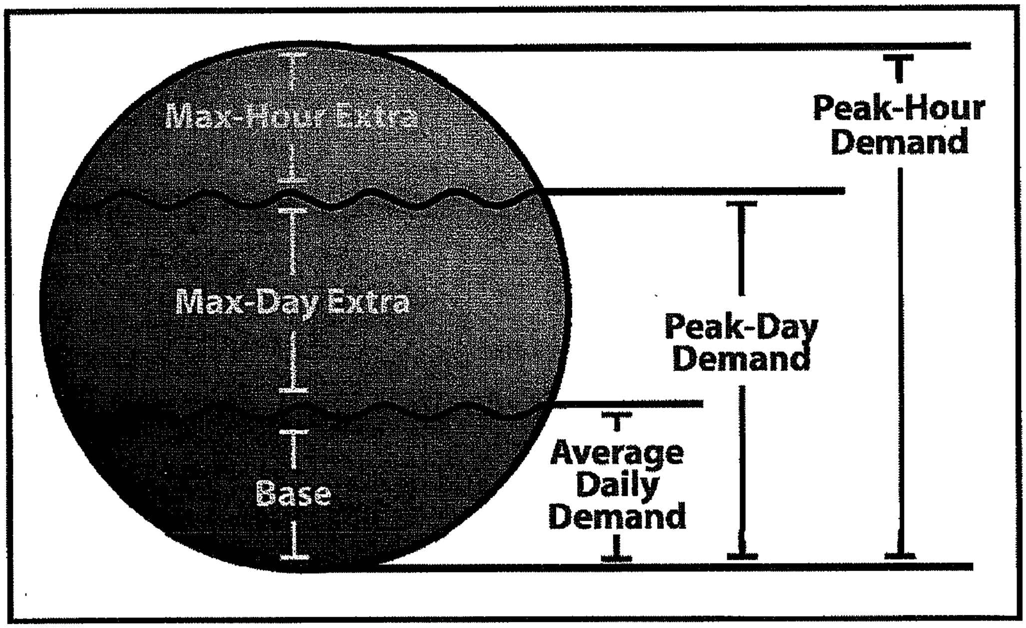

Figure 1: Hypothetical Water System Asset

Commodity/Demand Method

The commodity/demand method more closely follows the strict peak-load pricing model. With the commodity/demand method, costs are commonly distributed to the following customer service characteristics:

- Commodity
- Demand
- Customer
- Meters and services
- Fire

Commodity costs are those costs incurred exclusively in providing water on an average-day basis or for expenses that tend to vary with the total amount of water produced, regardless of demands. These costs have the same unit costs for each level of output regardless of the rate of use of the water. Commodity costs may include facilities sized exclusively to meet average-day demand, or operating costs like chemicals, power, etc., where the cost per unit does not vary based on the rate of usage.[6] Commodity costs are

[6] The classic example is chemicals. Generally the cost of chemicals is related to the total amount of chemicals used in the production of the water. The amount of chemicals used is typically the same for each gallon of water treated. Historically power costs have been identified as commodity costs for water

allocated equally to all water produced (in other words, equally to all water on an average-day basis.)

Demand costs are those costs associated with meeting the peak demands of the utility's customers. The demand costs are generally divided into peak-day and peak-hour demands. In some circumstances other time-steps (such as peak-season) may be appropriate. The peak-day demand costs are those costs associated with facilities sized to meet the peak-day demand of the utility's customers. Water treatment plants are commonly allocated as peak-day facilities. Peak-hour demand costs are the costs associated with facilities sized to meet the peak-hour demand of the utility's customers. Distribution-related costs are often identified as peak-hour demand costs.

Typical customer costs are those costs expended in serving customers, regardless of water demand. Examples include billing, customer service, and meter reading.

Meter and services costs are those costs that vary with the size of the meter and service used to serve a customer. Examples of meter and services costs are the costs of meter testing, maintenance, and replacement.

Fire costs are discussed separately in a subsequent section of this issue paper.

Considering the hypothetical asset depicted in Figure 1, assuming it functions to meet the peak-hour demand of the system, the entire costs under the commodity/demand method for this asset would be allocated to customers based on the peak-hour demand they place on the system.

Had the hypothetical asset depicted in Figure 1 been sized to meet the peak-day demand, the costs would be allocated to customers based on their percentage of the peak-day demand on the system. Only those facilities specifically sized to meet average-day demand would be allocated to customers based on their average-day demand.

Base/Extra-Capacity Method

The base/extra-capacity method differs from the commodity/demand method in how it prorates the costs of facilities meeting multiple demand requirements. The base/extra-capacity method allocates costs to the following customer service characteristics:

- Base,
- Extra-Capacity,
- Customer,
- Meter and Services, and

utilities. However, many power tariffs for water utilities include demand charges where the utility pays higher costs to cover the capacity it requires in the electric utility's system. These demand charges have become more common and significant.

- Fire.

Base costs are costs that tend to vary with the amount of water produced and a portion of the cost of capacity that meets average-day demand. Base costs are the costs that would be incurred if water consumption occurred evenly from day to day and hour to hour and the system did not need to invest in additional capacity to meet peak requirements.

Extra-capacity costs represent costs incurred to meet water demands that exceed average levels of water usage by customers. These costs are incurred due to the water usage variations and peak demands imposed on a water system. Extra-capacity costs are typically divided into costs incurred to meet the additional capacity requirements of maximum-day and maximum-hour water demands.

Customer and meters and services costs are treated in the same manner under the base/extra-capacity method and the commodity/demand method. Fire costs are discussed separately in a subsequent section of this issue paper.

For the hypothetical asset depicted in Figure 1, the cost of the asset is prorated to three customer service characteristics (i.e., base, max-day extra capacity, and max-hour extra capacity) based on system-wide demands of the utility. Using the example in Figure 1, the asset is allocated to each of the three customer service characteristics based on the relative demands. A hypothetical calculation illustrates the allocation differences. For the hypothetical calculation, assume:

- The average-day demand of the system is 140 million gallons per day (MGD);
- The peak-day demand of the system is 215 MGD; and
- The peak-hour demand of the system is 335 MGD.

In this case, the base costs would be allocated 42 percent of the cost. The 42 percent is calculated as:

$$\left(\frac{140\,MGD}{335\,MGD}\right)=42\%$$

The max-day extra-capacity costs would be allocated 22 percent of the costs. The max-day extra capacity is the difference between the peak-day demand and the average-day demand (see Figure 1.) In our hypothetical example, the calculation would be based on:

$$\left(\frac{(215\,MGD-140\,MGD)}{335\,MGD}\right)=22\%$$

Finally, the max-hour extra-capacity is the difference between the peak-hour demand and the peak-day demand (see Figure 1.) The percentage of costs allocated to a facility sized to meet peak-hour needs would be 36 percent based on:

$$\left(\frac{(335\,MGD - 215\,MGD)}{335\,MGD}\right) = 36\%$$

Findings on Overall Methods

In summary, for our hypothetical asset that serves the peak-hour needs of the utility's customers, the commodity demand would allocate 100 percent of the costs based on each customer classes' participation in the utility's peak-hour demand. The base/extra-capacity method would allocate 42 percent based on each class's average-day demand, 22 percent based on their portion of peak-day demand that exceeds the average-day demand, and 36 percent based on their portion of peak-hour demand that exceeds the peak-day demand.

Allocation Steps

Once the overall cost allocation method (i.e., commodity/demand or base/extra-capacity) is selected, individual approaches for allocating costs must be developed. This section discusses the approaches available to allocate the components of revenue requirements to customer classes.

O&M Cost Allocations

Equitably allocating the water system's user charge revenue requirements to the customer classes involves a multi-step process. Beginning with O&M costs, the following steps are required. Allocations of capital-related costs are described in a subsequent subsection of this issue paper.

- Step 1: Functionalizes the costs to appropriate water system functions.
- Step 2: Allocate the functionalized costs to cost pools. This step identifies O&M costs that are joint (i.e., those costs that benefit all customer classes) or specific to one or more customer classes.
- Step 3: Distribute functionalized costs for each cost pool to cost categories.
- Step 4: Allocate the costs by cost pool and cost category to the appropriate customer service characteristics.

- Step 5: Distribute the O&M costs by customer service characteristic to customer classes for each cost pool based on each class's proportion of the customer service characteristics.

These steps are described in more detail in the following subsections.

Step 1: Functionalize Costs

A water utility's O&M expenditures may be allocated to water system functions (e.g., source of supply, transmission and distribution, pumping, customer services, general administration, etc.) Functionalizing costs in this manner allows the allocation of specific functions to one or more cost pools. This step enhances the accuracy and equity of the water system cost allocation to the customer classes. The water system functions selected depend on the physical nature of the water system and the manner in which the utility accounts for its costs. Tentatively, the water system functions may include:

- Source and Treatment – Average Day,
- Source and Treatment – Peak Day,
- Finished Water Storage,
- Transmission,
- Pumping—Average Day,
- Pumping—Peak Day,
- Distribution,
- Metering and services,
- Customer,
- Fire, and
- Indirect Costs (e.g., administrative and general).

Step 2: Assignment of O&M Costs to Cost Pools

This step assigns the O&M costs by function to cost pools. A cost pool is a collection of costs that are shared by a group of one or more customer classes. For example, the joint cost pool is shared by all customer classes. Tentatively, the costs pools may include:

- Joint,
- LCRA Costs,
- 1998 Bond Proposition 2,
- Wholesale and Industrial Program Costs, and
- Retail Only Costs.

Each of these is described below.

Joint Costs

Joint costs are those costs that are shared by all customers of the water system in proportion to their respective use of the system.

LCRA Costs

Wholesale customers that purchase raw water directly from LCRA will not participate in the LCRA costs charged to AWU. Currently no wholesale customers qualify for this exclusion. However, this cost pool is considered to facilitate future cost allocations if wholesale customers provide their own raw water.

1998 Bond Proposition 2

The 1998 Bond Proposition 2 cost pool would include those customer classes that pay the debt service associated with the Proposition 2 bonds. The City conducted a special election to provide funding for the purchase of land in the Edwards Aquifer Recharge Zone to protect drinking water quality. The debt service associated with the Proposition 2 Bonds is allocated to inside-city customers only.

Wholesale and Industrial Program Costs

AWU incurs costs to manage its wholesale and industrial program. These costs would be recovered from these customer classes.

Retail Only

Retail only costs are the costs incurred to provide retail services to AWU's customers. These costs will likely include certain distribution system costs that are not incurred to provide service to wholesale customers.

Step 3: Allocation of Pooled Costs to Categories

After costs are allocated to system functions and cost pools, the costs grouped in this manner are then allocated to categories. Cost categories are used to facilitate the allocation of costs by pools to customer service characteristics in Step 4. The previously allocated joint and specific costs are listed by system functions. Each system function can be associated with a cost category. For example, the function of metering can be associated with the services and metering category.

Step 4: Allocation of Costs to Customer Service Characteristics

The assignment of costs to customer service characteristics varies with the allocation methodology used. Regardless of cost allocation method used (i.e., commodity/demand or base/extra-capacity), the cost-of-service analysis requires an assumption on the appropriate demand characteristics to use.

Considering the operations and design of AWU's system, the customer service characteristics proposed tentatively include:

- Commodity/Demand –
  - Commodity,
  - Peak-day Demand,
  - Peak hour Demand,
  - Customer,
  - Meters and Services, and
  - Fire;

- Base/Extra-Capacity –
  - Base,
  - Max-day Extra-Capacity,
  - Max-hour Extra-Capacity,
  - Customer,
  - Meters and Services, and
  - Fire.

Step 5: Distribution of Costs to Customer Classes

The next step involves the projections of customer class water demands and their respective consumption characteristics. Typically, there are several customer classes that each use a different portion of total annual water consumption. In addition, each customer class's level of water consumption is different. Estimates of peak demands that describe each customer class's variation in water demand are required to allocate system costs equitably. Generally, a review of water utility consumption and production records and other empirical evidence is used to estimate each customer class's peak rates of water use.

Utilities typically collect water consumption records for customer classes only on a monthly basis, and seldom on a daily or hourly basis. Peaking factors, together with projected water consumption, can then be used to establish the costs of service by customer class.

One method of determining customer class peaking characteristics is to impute the peak-day and peak-hour demands from monthly reads. This method uses the deviations of monthly demands by class as a method of allocating the system-wide peak-day and peak-hour demands to each class. Essentially each class is allocated a portion of the peak-related demands based on their portion of the monthly demands. Although this method is necessarily subject to dispute, it is a common method used to develop peak-day and peak-hour estimates by customer class.

Capital Cost Allocations

Allocating capital costs using either the cash basis or the utility basis involves steps in addition to those outlined above. Capital costs (whether under the cash or utility basis) are generally allocated to customer classes by allocating the assets that serve each customer class. The value of these assets is called the *rate base* and is normally based on the net book value of the facilities.

Determining each customer class's portion of the system rate base is accomplished by allocating the water system's fixed assets net of accumulated depreciation. Net fixed assets are allocated to functions, cost pools, categories, and customer service characteristics as in Steps 1 through 5 above. The following additional steps result in an allocation of capital assets to customer classes.

- Step 6: Determine the rate base for each customer class.
- Step 7: Determine the rate of return.
- Step 8: Allocate the return on rate base among the customer classes.

Step 6: Determine Rate Base by Customer Class

The first part of determining the rate base for each customer class is to summarize the net fixed assets allocated by cost pool and category to customer service characteristics and customer class. The net fixed assets allocated to each customer class is the value of the plant in service that is used and useful for that customer class less the accumulated depreciation for those assets. The second part of determining rate base by customer class is to calculate an allowance for working capital, or a percentage of the O&M costs allocated to each customer class. The allowance for working capital recognizes the carrying costs of working capital that the utility incurs for operation.

Adding the net plant in service and allowance for working capital results in the rate base attributable to each customer class.

Step 7: Determine Rate of Return

The rate of return used in the analysis depends on the method used to determine total revenue requirements. Under the utility basis, a fair rate of return is assumed to be a return that could be earned by investing the owners' money in a comparable investment, an investment which has similar risks. The rate of return is often referred to as the cost of capital. It is generally calculated using a weighted average of the utility's cost of debt and the return on the utility's equity.

Under the utility basis with cash residual method the rate of return is different for owner and non-owner customers. When using this method of determining revenue requirements, the rate of return for owner customers is calculated after the cost allocated to the non-owner customers is determined. The rate of return for owner customers would equal the return required so that the expected revenue from owner and non-owner customers equals the cash-basis revenue requirements.

Under the cash basis, the rate of return is determined to be the return required to generate the cash-basis needs of the utility. Even though depreciation is not an element of the cash-basis revenue requirements, often a portion of the cash-basis revenue requirements is allocated in the same manner as depreciation. In those cases, the depreciation and O&M costs are subtracted from the total revenue requirements before calculating the required rate of return. The difference, when divided by the total rate base, equals the rate of return used.

Step 8: Allocation of Return on Rate Base to Customer Classes

The final step in allocating capital costs is to allocate the return on rate base to each of the customer classes. The return on rate base for each customer class is calculated by multiplying the rate base allocated to each customer class in Step 6 by the respective rate of return from Step 7. The result of Step 8 is the return on rate base attributable to each customer class.

Allocating Depreciation Expenses

Allocating annual depreciation expenses follows the same steps as for O&M costs. Depreciation is allocated on the same basis as the associated asset. Although depreciation is not an element of revenue requirements under the cash basis, a portion of the capital cost under the cash basis is often allocated in the same manner as depreciation.

Cost of Service by Customer Class

After the revenue requirements are fully allocated by function, pool, and categories to the customer characteristics for each class, the O&M and capital costs are summed for each class to determine the total cost of service by customer class.

Allocation of Fire-Related Costs

Water utilities normally provide fire protection services that require them to supply enormous amounts of water whenever, and wherever, a fire occurs. The cost of providing the capacity for fire protection can be a substantial part of a water utility's total cost and an ongoing issue for those responsible for setting service charges for private fire lines. Unfortunately, the approach for setting charges for private fire services varies among jurisdictions leaving many utility professionals confused about cost allocation and recovery issues.

Distinctions in Fire-Related Costs

An important first step in understanding the treatment of fire-related costs in setting rates is to understand the types of costs a utility incurs in providing water for fire suppression.

As a first cut, fire-related costs can be separated into direct and indirect costs. Subsequently, these direct and indirect costs can be further distinguished as either public or private costs. Each of these categories of costs is described below.

Direct vs. Indirect Costs

Direct costs include the cost of installing and maintaining fire hydrants and other facilities used *directly* to meet the fire protection needs of the utility's customers. Indirect costs consist of the costs of over-sizing the system (e.g., storage, distribution mains, etc.) to meet peak fire-flow demands.

Of these two types of costs, indirect costs are the most difficult to quantify. For water storage facilities, the fire storage component can be calculated for each storage facility using the design standards for the service area. These standards will often depend on the type of development that is served by the storage facility and are described as rates of flow (e.g., gallons per minute) and duration (e.g., number of hours of sustained flow). For other facilities, fire demands can be determined with the same techniques used in setting water rates. This determination can require extensive technical analysis of water demands to determine the portion of facilities allocated to fire.[7] The largest impact will be on the utility's peak-hour demand.

Public vs. Private Fire Costs

Public fire service consists of providing water for fire suppression at public fire hydrants. Private fire service entails providing individual customers with additional fire protection by means of private fire lines, hydrants, and sprinkler systems. By providing additional localized fire protection to large private customers, fires at these locations may be controlled more quickly requiring less capacity in the public fire system. This may reduce the utility's overall need for stand-by capacity, thereby reducing the total fire-related cost.

Figure 2 illustrates the distinction between direct and indirect costs for both public and private fire service.

[7] The AWWA manual on water rates contains a chart that relates the percentage of a utility's revenue requirement assumed to be incurred for fire protection and the number of customers. See American Water Works Association, *Manual of Water Supply Practices—M1, Principles of Water Rates, Fees, and Charges*, Fifth Edition, (Denver, Colorado: American Water Works Association, 2000), page 219.

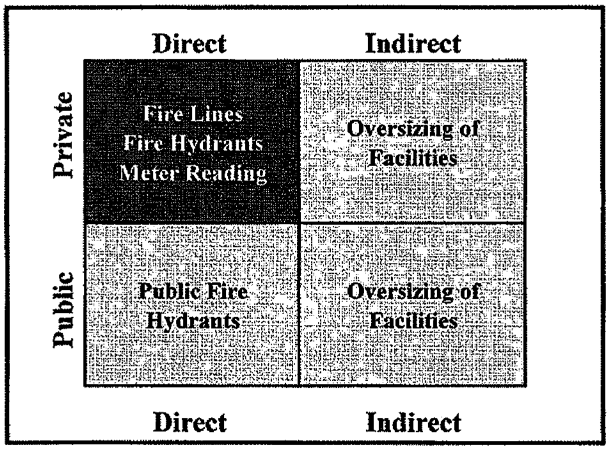

Figure 2: Fire Cost Matrix

The shading indicates how the various costs are typically grouped for the purpose of cost recovery. Indirect public and private costs as well as direct public fire costs are often grouped together. Depending on the utility and percentage of total costs attributable to fire protection, these costs are sometimes ignored during the utility's rate-setting process. By ignoring these costs, the utility treats them as an overhead cost, which is allocated to all customers. Some utilities allocate these fire-related costs in other ways.

Determination of Fire-Related Costs

The most common approach used to determine the portion of a utility's costs attributable to fire protection is the proportional cost method described in the AWWA *M1 Manual.*[8] Using this method, the cost of indirect fire protection is determined on the basis of the potential water demand for firefighting purposes in proportion to the total potential water demand of the system. This approach is commonly used because it allocates costs to fire protection consistent with either the commodity/demand or the base/extra-capacity methods frequently used in cost-of-service studies.

Costs associated with the provision of direct fire service, such as hydrants or preventive maintenance costs, are also included. Because a utility can generally identify its private fire customers, many utilities make the purchase and maintenance of private hydrants, meters, standpipes, and sprinkler systems the responsibility of these customers. The direct private fire costs borne by the utility typically include only meter checks, facility inspections, and billing and administrative costs. Using the number of equivalent fire connections for private and public connections, the utility can allocate total fire service costs to the two types of customers. The portion of the public fire costs related to

[8] American Water Works Association, *Manual of Water Supply Practices—M1, Principles of Water Rates, Fees, and Charges*, Fifth Edition, (Denver, Colorado: American Water Works Association, 2000), page 218.

providing service to private customers can be determined by using the relative demands of various size hydrants or sprinkler connections.

Recovering Fire Service Costs

Private Fire Service Charges

Once the fire-related costs are identified, the next step for a utility is to select an appropriate cost recovery method. Available options typically include:

- Value of protected property,
- Size of service connection,
- Number of equivalent dwelling units,
- Per account, and
- Number of sprinkler heads.

Basing private fire charges on the size of the connection is regarded as the best method of estimating each customer's maximum demand in case of a fire. To calculate the charges by connection size, the total allocated costs are divided by the total number of equivalent fire service connections. This equivalent unit rate is then multiplied by the respective demand factors for each connection size to arrive at the fire service charge schedule applicable to private fire service customers. However, given that the costs incurred by the utility do not typically depend on the size of the connection, calculating private fire charges on a per account basis may also be appropriate. Allocating private fire costs based on the number of sprinkler heads is fairly uncommon because of high administrative burden and the fact that the localized operation of modern sprinkler systems makes the total number of sprinklers in a building an inaccurate proxy for actual fire demands.

It is important to decide early whether a separate charge for indirect fire costs will be included in the private fire service charge. This question is of particular importance if the customer that pays the private fire charge also pays public fire charges (which include an allowance for the indirect fire costs). In many cases, the addition of a private fire service *reduces* the utility's total indirect fire costs. Charging customers that have private fire services for both the public and private indirect costs could result in a double charge. Also, it may discourage the installation of private fire services which, if not installed, would increase the demand on the public system as firefighting becomes relatively less effective.

Public Fire Service Charges

Many methods of recovering costs of public fire service exist. Because residential customers often have a more uniform level of fire protection requirements than non-residential customers, utilities frequently use different rate designs for the two types of customers. While the method of determining the costs associated with fire protection are fairly standard, the utility usually decides on the cost recovery methodology.

Residential Customers

When designing fire service charges for residential customers, the utility typically assumes that the required fire flows are equal for all customers. Thus, one of the most common approaches used to assess public water system fire charges is on a per dwelling unit basis.

Although rare, residential customers who own private fire facilities may be assessed, in addition to the public water system fire charge, a private fire charge, which recovers the utility's direct fire costs for the private facility.

Non-Residential Customers

Because the fire flow requirements for non-residential customers can vary significantly, most utilities assess public fire protection costs to these customers based on a method recognizing the potential difference in fire-flow demand. Commonly used proxies for the differences in fire-flow demand include the number of square feet of the protected building, water usage, meter size, etc. The rationale for using building size as a measure of fire demands is the belief that larger buildings require greater fire flows. This approach lacks differentiation in water system fire charges based on building materials, design, and use. The approach assumes that it generally requires more water over longer periods to fight a fire in a larger structure than in a relatively smaller one.

The approach based on water usage assumes the customer's potential fire demands are related to the amount of water they purchase. This approach is often used where the availability of other data are limited and is one of the least accurate proxies for fire-flow demands. Another approach used with limited data is to base estimates of fire costs on the size of a customer's water meter. This approach assumes that larger customers, with greater fire-flow demands, have larger meters.

Another method discussed in the AWWA *M1 Manual*[9] is to base fire charges on the value of the building and improvements (i.e., the value of the property excluding land). This method presents several challenges to water utilities. First, basing a fee on property value may violate local and/or state tax limitations. Secondly, water utilities may find it difficult to maintain an adequate database of the value of improvements to real property.

While none of the approaches presented here accurately reflects the specific fire-flow demands for each property, basing non-residential fire protection charges on the number

[9] American Water Works Association, *Manual of Water Supply Practices—M1, Principles of Water Rates, Fees, and Charges*, Fifth Edition, (Denver, Colorado: American Water Works Association, 2000), page 227.

of square feet of a building is one of the closest proxies available, but it may impose significant data requirements on the part of the utility.

Methodological Options Under Review

When considering the issue of cost allocations, the following methodological options are important to consider:

1. Which is the most appropriate overall method for allocating costs (i.e., commodity/demand or base/extra-capacity?)

2. What are the appropriate time steps (e.g., peak-season, peak-day, and/or peak-hour) for the cost allocation method?

3. Should AWU charge private fire connections for both the direct and indirect fire costs?

4. How should AWU recover its public fire cost in its cost-of-service methodology?

Each of these issues is explored further in the following sections. The discussion for each issue includes:

- Overview of the issue,
- Description of the alternatives,
- Evaluation of the alternatives using the executive team's evaluation criteria, and
- Consultant's preliminary findings and recommendations.

After presentation to the executive team and public involvement committee, the consulting team will finalize its recommendations.

Issue 1: Which is the most appropriate overall method for allocating costs?

Overview of the Issue

The first cost-allocation policy to resolve is which overall cost allocation method is best for AWU and its customers. The alternative selected will determine the method of allocating costs to each of the customer classes.

Description of Alternatives

The two available alternative methods are:

1. Commodity/demand, and
2. Base/extra-capacity (current approach).

These methods are fully described in an earlier section of this issue paper.

The primary difference between the alternatives is the treatment of peak-related costs. The commodity/demand method more strictly follows the peak-load pricing model. The base/extra-capacity method includes an allowance for the beneficial use of peak-related facilities by customers during the off-peak period.

Evaluation of Alternatives

Attachment A presents the weighted evaluations of the alternatives.[10]

The differences between the two overall approaches are very narrow. In general, the base/extra-capacity method faired somewhat better because it is AWU's current practice and is not creating any apparent problems. Under implementation, the base/extra-capacity would generally be easier to implement since it is AWU's current practice. This also suggests it would be more acceptable to the public and political leaders. Because the base/extra-capacity method already includes an allowance for allocation of an appropriate level of costs to off-peak users, the policy would likely be more durable if AWU increases the complexity of its water system.

We expect the base/extra-capacity method to be more equitable from an interclass equity perspective since it shares the costs of peak-related facilities with off-peak customers. Other measures of equity are unaffected by the overall method of cost allocations.

The base/extra-capacity method may be more affordable to residential customers if we assume these customers have higher peaking factors. Alternatively, the base/extra-capacity method may increase the allocation of costs to businesses with lower peaking factors, which may have an offsetting impact to economic development. No other customer impacts differ among the alternatives.

Because the commodity/demand method may increase the cost of water for customers with higher peaking factors, it may elicit greater conservation during the peak season and on the peak day. No other conservation criteria are impacted differently by the cost allocation methods.

The financial criteria do not vary based on the alternative.

Preliminary Findings and Recommendations

The consulting team recommends AWU use the base/extra-capacity method for allocating costs. This method is consistent with current practices and future uncertainties.

[10] The weights for the criteria used in these evaluations do not include the actual weights for all members of the executive team. The full executive team's weights will be incorporated into the analysis after the weights of all members have been determined.

Issue 2: What are the appropriate time steps for the cost allocation method?

Overview of the Issue

Regardless of cost allocation approach selected, the cost-of-service analyses will require the selection of time steps for the cost allocations. The time steps are used to determine which peak demands are included in the cost allocations.

Description of Alternatives

Many alternative time steps exist in theory. But only two alternatives are relevant to AWU. These are:

1. Peak-day and peak-hour demands (current approach), and
2. Peak-season, peak-day, and peak-hour demands.

The selection of appropriate time steps for a cost-of-service analysis depends on the design and operation of the water system.

Evaluation of Alternatives

The two alternatives are very similar in their evaluations. From an implementation perspective, the administrative burden may be higher in implementing a new time step to the current peak-day and peak-hour demands. However, the difference in administrative burden is likely to be trivial.

The real distinction in the alternatives is the impact on equity. Currently AWU does not have facilities that are sized or operated to meet the utility's peak-season demands. Introducing the peak-season time step diminishes the interclass and inside/outside city equity. This is the only significant differentiator between the options.

The customer, conservation, and financial criteria do not vary based on the alternative.

Preliminary Findings and Recommendations

The consulting team recommends AWU use peak-day and peak-hour time steps for the cost-of-service analysis. These time-steps are consistent with AWU operations and facilities. Introducing an additional time step may diminish the accuracy of the cost allocations.

Issue 3: Should AWU charge private fire connections for both the direct and indirect fire costs?

Overview of the Issue

AWU may be incurring significant costs to provide fire protection to its customers. These costs are incurred both as direct and indirect fire costs. Water utilities throughout the industry have differing approaches to charging for private fire connections. Some utilities determine the charges for private fire connections to recover only the direct costs (e.g., billing, cross-connection controls, meter reading, billing, etc.) of the service. Other utilities include some of the indirect fire costs (e.g., the cost of over-sizing facilities, etc.) in the charge.

Description of Alternatives

AWU does not charge separately for private fire connections. Two approaches to private fire lines are generally available in the industry. These are:

1. Charge private fire connections for the direct costs of providing the service (current approach); and
2. Charge private fire connections both the direct and indirect costs of providing the service.

The primary difference in the approaches is philosophical. Under the first alternative, private fire connections do not place an additional burden on the indirect fire costs of the system merely because they have a private fire connection. In fact, everything else being equal, private fire connections generally reduce the fire flow requirements of a facility and reduce the burden on the indirect fire costs of the utility.

Alternatively, private fire connections provide a service to private properties that benefit directly through lower insurance premiums and/or the ability to meet certain fire codes in a cost-effective manner. Additionally, many of those properties with private fire connections have those connections because of the disproportionate burden they place on the firefighting capabilities of the City. Including both the direct and indirect fire costs in the private fire connection charges for these customers may enhance the overall fairness of the charges.

Evaluation of Alternatives

Including only the direct fire costs in the private fire connection charge minimizes the administrative burden of determining the parameters necessary to calculate an appropriate share of the indirect fire costs. Also, the public and political acceptance of charging only the direct fire costs to private fire connections may be greater since all customers benefit from the indirect fire costs through either public hydrants or private connections. In other words, there is no specific benefit that accrues to private fire connections that is not also available to others. This lack of specific benefit and additional costs may reduce the public and political acceptance of charging indirect fire costs to private connections.

The *Direct Costs Only* alternative is more equitable than the alternative that includes indirect fire charges. This evaluation assumes that customers with private fire connections would be entitled to use the public fire suppression system in the event of a fire emergency. Also, this evaluation assumes that the current system of charges does not subsidize private fire connection customers. In other words, the evaluation assumes that the current allocation of fire costs (both direct and indirect) is fair and equitable.

Depending on the number of private fire connections and their size, the inclusion of both direct and indirect fire charges in the private fire connection charge may reduce the remaining costs allocated to residential customers. This may enhance affordability for residential customers. As a consequence, however, this burden will likely fall on large commercial, industrial, and institutional customers. This additional burden may have negative impacts on economic development.

The conservation criteria do not vary based on the alternative.

Other than a slight improvement in revenue stability, the financial criteria do not vary based on the alternative. The improvement in revenue stability would result from having a larger portion of AWU's costs covered by a fixed fire charge that does not vary with weather, economic cycles, etc.

Preliminary Findings and Recommendations

The consulting team tentatively recommends AWU include only direct costs in its fire charges to those customers with private fire connections. Without additional information, it appears that charging these customers for both private and public fire protection may result in an inequitable allocation of costs.

Issue 4: How should AWU recover its public fire cost in its cost-of-service methodology?

Overview of the Issue

AWU has made significant investments in its infrastructure to provide fire protection services to its customers. These investments include over-sizing transmission and distribution mains, pumping facilities, and finished water reservoirs. A specific charge to customers for fire protection could more equitably recover these costs.

Additionally, as AWU pursues rate designs that provide greater water conservation, its revenue may become less stable. Designing a charge structure that provides more fixed revenue from fire protection charges may allow AWU to be more aggressive with its conservation efforts while maintaining the necessary financial health of the utility.

Description of Alternatives

Red Oak identified four options that AWU can use to recover some or all of its fire-related costs. These options include:

1. Recover indirectly through the cost of water services (current approach);
2. Assess a fixed charge based on the value of the real property improvements;
3. Assess a fixed charge that varies by fire customer class; and
4. Assess a fixed charge based on the size of the water meter.

The first alternative is the most commonly used method of recovering fire charges. Under this alternative, fire-related costs are treated like overhead costs and embedded in the overall costs of water.

The second alternative establishes a charge based on the value of the real property improvements (excluding land.) The rationale for a charge based on real property improvements is that properties which are more valuable require greater fire protection. This alternative is very similar to an *ad valorem* property tax and may be considered a tax rather than a fee in some jurisdictions. Such a determination may affect the legality of the fee for AWU.

The third and fourth alternatives are designed to avoid the tax versus fee controversy. Under these alternatives, AWU's fire-related costs are recovered in a fixed monthly charge. Under alternative 3, the fixed monthly charge is based on a classification of each customer's fire flow requirements. The fourth alternative recovers the fire-related costs as a portion of AWU's fixed charge based on the size of the customer's water meter.

Evaluation of Alternatives

The implementation criteria vary significantly by alternative. The simplest alternative to implement is including the fire cost as an indirect cost for water services. Recovering the fire costs by meter size is slightly more difficult. The meter size data is readily available and currently integrated into AWU's billing system. Developing data on the value of the improvements is substantially more burdensome. Although this data likely exists in tax assessor records, developing the data and integrating it into the water billing system may be extremely costly and infeasible at this time. Developing a separate database of fire demands by property would require a significant amount of time and resources. It is doubtful that the current water billing system could maintain this data—although that fact has not been verified.

Public understanding would be similar for each of the alternatives. The charge by fire class may be less understandable to the public since it would require the development of a new billing determinant not previously used by AWU.

Political and public acceptance is difficult for Red Oak to gauge. Based on prior experience, Red Oak assumes the value of improvements would be less acceptable to both elected officials and the general public. This approach may appear indistinguishable from an *ad valorem* property tax and, therefore, be less accepted. The other alternatives do not differ significantly.

Including the fire costs as an indirect cost presents very little risk of failure to implement. Also, because the meter sizes are already included as a billing determinant, the fixed charge by meter size has fairly low risk. However, the other two alternatives present significant risk of implementation. The data requirements and the capabilities of the water billing system may prove impossible to overcome. Accordingly, these alternatives received relatively low marks on risk of implementation.

The ratings for the alternatives on legal defensibility and policy durability are the same. Red Oak recommends that AWU consult its legal counsel for a determination of the legal defensibility of each of the alternatives. However, Red Oak is specifically concerned about the ability of the alternative based on the value of real property improvements to be defended as a fee rather than a tax. This determination is outside our expertise.

For the equity criteria, the alternatives differ in their ratings for interclass, intraclass, and industry standards. For interclass and intraclass equity, the alternatives that are based on value and fire classes score better. This evaluation is based on the ability of these alternatives to fairly recover fire-related costs based on the costs imposed by the customer. The most conventional alternatives are the indirect costs and the fixed charge by meter size. As a result, these options scored higher on the alignment with industry standards. The value of improvements option scored lowest on industry standards since most water utilities charge based on the cost of a service rather than the value of a service. Although the value of the improvements to real property may be a proxy for the fire flow requirements, in most cases it is a proxy for the value of the service received by a customer.

The affordability criterion may best be met by the value of improvements alternative. The value of a property is similar to the approach used to assess property taxes with the intent to incorporate an ability to pay element into the assessment. That is, owners of properties with higher values are thought to have a greater ability to pay property taxes. The fixed charges by fire class may similarly allocate more fire-related costs to those customers imposing significant fire flow requirements on the system. These customers may have a greater ability to pay.

The impacts on economic development are difficult to estimate. It is possible that recovering fire costs as an indirect cost would allocate relatively more costs to residential customers. This may reduce the costs to commercial interests, thereby providing greater economic development. This outcome is highly speculative and therefore the relative ratings are fairly close.[11]

The understandability of the bill was much lower for the value of improvements alternative. That rating is based on the assumption that real property values are unusual items for water bills and may prompt questions and confusion for AWU's customers. Less difficult to understand is the charge base on fire class and meter size. The simplest alternative for understandability of the bill is treating fire costs as an indirect cost. Under this alternative the fire costs are not shown on the bill at all.

Peak-season and peak-day conservation may be enhanced by the alternatives that increase the fixed revenue to the utility. Under these alternatives, AWU will have the ability to pursue relatively more aggressive block rate designs that reward customers for conserving water while maintaining the financial stability and health of the utility. The other conservation criteria are likely unaffected by the alternatives.

Revenue sufficiency is likely improved by using the value of improvements alternative. This additional source of revenue may reduce the pressure on rates, thereby providing more sufficient revenue for the utility. For revenue stability and financial risks, the indirect cost alternative was rated lowest. This low rating results from the reliance of volume-based rates to generate revenue for fire charges. The other alternatives all provide a fixed monthly charge which would not be impacted by weather or economic cycles.

Preliminary Findings and Recommendations

The consulting team tentatively recommends AWU recover some or all of its fire-related costs in a fixed monthly charge based on meter size. While meter size may not be the best proxy for fire flow demands, the two alternatives that improve upon meter size have significant implementation issues. The consulting team further recommends that AWU consult competent legal counsel if it considers implementing a fire charge based on the value of real property improvements.

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[11] Determining the impact on economic development is quite difficult since alternatives that allocate more costs to residential customers may reduce the disposable income of residential customers that interact with local businesses. Similarly, costs transferred from business to consumers may be partially offset by changes in compensation workers demand to offset the cost of living. Discerning the impact on economic development can be extremely difficult and subject to error.

City of Austin
Issue Paper #2: Water Cost Allocations

Attachment

A

Evaluations of Alternatives

REDOAK CONSULTING
A DIVISION OF MALCOLM PIRNIE

Evaluations Based on Average Ratings
Cost Allocation Methods

Alternatives	Implementation: Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Commodity / Demand	■■■■	■■■■■	■■■■	■■■■■	■■■■■	■■■■■
Base / Extra-Capacity (Current)	■■■■■■	■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■■

Alternatives	Equity: Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Commodity / Demand	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	
Base / Extra-Capacity (Current)	■■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	

Alternatives	Customer: Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Commodity / Demand	■■■■■	■■■■■■	■■■■■	■■■■■		
Base / Extra-Capacity (Current)	■■■■■■	■■■■■	■■■■■	■■■■■		

Alternatives	Conservation: Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Commodity / Demand	■■■■■	■■■■■■	■■■■■■	■■■■■		
Base / Extra-Capacity (Current)	■■■■■	■■■■■	■■■■■	■■■■■		

Alternatives	Financial: Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Commodity / Demand	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	
Base / Extra-Capacity (Current)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	

Alternatives	Weighted Average Score
Commodity / Demand	■■■■■■■■■■
Base / Extra-Capacity (Current)	■■■■■■■■■■

Average Ratings
Cost Allocation Methods

Alternatives	Implementation					
	Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Commodity / Demand	3.9	4.9	3.9	4.9	4.9	4.9
Base / Extra-Capacity (Current)	5.9	4.9	5 9	4.9	4.9	5.9
Weights Rated from 0 to 10 (10 most important)	3.4	4.3	4 3	4.5	6.0	4.8

Alternatives	Equity					
	Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Commodity / Demand	4.9	4.9	4.9	4 9	4.9	
Base / Extra-Capacity (Current)	5.9	4.9	4.9	4.9	4.9	
Weights Rated from 0 to 10 (10 most important)	5.0	4 8	3.6	4.3	3.8	

Alternatives	Customer					
	Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Commodity / Demand	4.9	5.9	4.9	4.9		
Base / Extra-Capacity (Current)	5.9	4.9	4.9	4.9		
Weights Rated from 0 to 10 (10 most important)	5.5	4.1	5.5	4.3		

Alternatives	Conservation					
	Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Commodity / Demand	4.9	5.9	5.9	4.9		
Base / Extra-Capacity (Current)	4.9	4.9	4.9	4.9		
Weights Rated from 0 to 10 (10 most important)	4.6	4.3	6.2	5.8		

Alternatives	Financial					
	Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Commodity / Demand	4.9	4.9	4.9	4.9	4.9	
Base / Extra-Capacity (Current)	4.9	4.9	4.9	4.9	4.9	
Weights Rated from 0 to 10 (10 most important)	6.7	6.5	6.0	5.8	6.0	

Alternatives	Weighted Average Score
Commodity / Demand	592
Base / Extra-Capacity (Current)	608

Evaluations Based on Average Ratings
Time Steps for Cost Allocation Method

Alternatives	Implementation: Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Peak Day and Hour (Current)	■■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
Peak Season, Day, and Hour	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■

Alternatives	Equity: Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Peak Day and Hour (Current)	■■■■■■	■■■■■	■■■■■	■■■■■■	■■■■■	
Peak Season, Day, and Hour	■■■■	■■■■■	■■■■■	■■■■	■■■■■	

Alternatives	Customer: Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Peak Day and Hour (Current)	■■■■■	■■■■■	■■■■■	■■■■■		
Peak Season, Day, and Hour	■■■■■	■■■■■	■■■■■	■■■■■		

Alternatives	Conservation: Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Peak Day and Hour (Current)	■■■■■	■■■■■	■■■■■	■■■■■		
Peak Season, Day, and Hour	■■■■■	■■■■■	■■■■■	■■■■■		

Alternatives	Financial: Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Peak Day and Hour (Current)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	
Peak Season, Day, and Hour	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	

Alternatives	Weighted Average Score
Peak Day and Hour (Current)	■■■■■■■■■■
Peak Season, Day, and Hour	■■■■■■■■■■

Average Ratings
Time Steps for Cost Allocation Method

	Implementation					
Alternatives	**Administrative Burden**	**Public Understanding**	**Public and Political Acceptance**	**Risk of Implementation**	**Legal Defensibility**	**Policy Durability**
Peak Day and Hour (Current)	6.0	5.0	5.0	5.0	5.0	5.0
Peak Season, Day, and Hour	5 0	5.0	5.0	5.0	5.0	5.0
Weights Rated from 0 to 10 (10 most important)	3 4	4.3	4.3	4.5	6.0	4.8

	Equity					
Alternatives	**Interclass**	**Intraclass**	**Inter-generational**	**Inside/ Outside City**	**Industry Standards**	
Peak Day and Hour (Current)	6.0	5.0	5.0	6 0	5.0	
Peak Season, Day, and Hour	4.0	5.0	5.0	4.0	5.0	
Weights Rated from 0 to 10 (10 most important)	5.0	4.8	3.6	4.3	3.8	

	Customer					
Alternatives	**Affordability**	**Economic Development**	**Rate Shock/ Volatility**	**Understand Bill**		
Peak Day and Hour (Current)	5.0	5.0	5.0	5.0		
Peak Season, Day, and Hour	5.0	5.0	5.0	5.0		
Weights Rated from 0 to 10 (10 most important)	5.5	4.1	5.5	4.3		

	Conservation					
Alternatives	**Average-Day Savings**	**Peak-Season Savings**	**Peak-Day Savings**	**Sustainability**		
Peak Day and Hour (Current)	5.0	5 0	5.0	5.0		
Peak Season, Day, and Hour	5.0	5.0	5.0	5.0		
Weights Rated from 0 to 10 (10 most important)	4.6	4.3	6.2	5.8		

	Financial					
Alternatives	**Revenue Sufficiency**	**Revenue Stability**	**Rate Stability**	**Rate Predictability**	**Financial Risk**	
Peak Day and Hour (Current)	5.0	5.0	5.0	5.0	5.0	
Peak Season, Day, and Hour	5.0	5.0	5.0	5.0	5.0	
Weights Rated from 0 to 10 (10 most important)	6.7	6 5	6.0	5.8	6.0	

Alternatives	**Weighted Average Score**
Peak Day and Hour (Current)	610
Peak Season, Day, and Hour	588

Evaluations Based on Average Ratings
Direct and Indirect Fire Costs for Private Fire Connections

Alternatives	Implementation: Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Direct Costs Only	■■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■	■■■■■■
Both Direct and Indirect Costs	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■

Alternatives	Equity: Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Direct Costs Only	■■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■	
Both Direct and Indirect Costs	■■■■	■■■■■	■■■■■	■■■■■	■■■■■	

Alternatives	Customer: Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Direct Costs Only	■■■■■■	■■■■■	■■■■■	■■■■■		
Both Direct and Indirect Costs	■■■■■	■■■■■■	■■■■■	■■■■■		

Alternatives	Conservation: Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Direct Costs Only	■■■■■	■■■■■	■■■■■	■■■■■		
Both Direct and Indirect Costs	■■■■■	■■■■■	■■■■■	■■■■■		

Alternatives	Financial: Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Direct Costs Only	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	
Both Direct and Indirect Costs	■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■	

Alternatives	Weighted Average Score
Direct Costs Only	■■■■■■■■■■
Both Direct and Indirect Costs	■■■■■■■■■■

Average Ratings
Direct and Indirect Fire Costs for Private Fire Connections

Alternatives	Implementation: Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Direct Costs Only	5.8	5.8	4.9	4.9	4.9	5.8
Both Direct and Indirect Costs	4.9	4.9	4.9	4.9	4.9	4.9
Weights Rated from 0 to 10 (10 most important)	3.4	4.3	4.3	4.5	6.0	4.8

Alternatives	Equity: Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Direct Costs Only	5.8	5.8	4.9	4.9	4.9	
Both Direct and Indirect Costs	3.9	4.9	4.9	4.9	4.9	
Weights Rated from 0 to 10 (10 most important)	5.0	4.8	3.6	4.3	3.8	

Alternatives	Customer: Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Direct Costs Only	5.8	4.9	4.9	4.9		
Both Direct and Indirect Costs	4.9	5.8	4.9	4.9		
Weights Rated from 0 to 10 (10 most important)	5.5	4.1	5.5	4.3		

Alternatives	Conservation: Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Direct Costs Only	4.9	4.9	4.9	4.9		
Both Direct and Indirect Costs	4.9	4.9	4.9	4.9		
Weights Rated from 0 to 10 (10 most important)	4.6	4.3	6.2	5.8		

Alternatives	Financial: Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Direct Costs Only	4.9	4.9	4.9	4.9	4.9	
Both Direct and Indirect Costs	4.9	5.8	4.9	4.9	4.9	
Weights Rated from 0 to 10 (10 most important)	6.7	6.5	6.0	5.8	6.0	

Alternatives	Weighted Average Score
Direct Costs Only	610
Both Direct and Indirect Costs	588

Evaluations Based on Average Ratings
Recovery Methods for Public Fire Costs

Alternatives	Implementation					
	Administrative Burden	Public Understanding	Public and Political Acceptance	Risk of Implementation	Legal Defensibility	Policy Durability
Indirect Costs of Water (Current)	■■■■■■■■	■■■■■	■■■■■	■■■■■■■■	■■■■■	■■■■■
Value of Improvements	■■	■■■■■	■■■	■■	■■	■■
Fixed Charge by Fire Class	■■■	■■■	■■■■■	■■■	■■■■■	■■■■■
Fixed Charge by Meter Size	■■■■■■■	■■■■	■■■■■	■■■■■■	■■■■■	■■■■■
Ratings	■■■	■■■■	■■■■■	■■■■■	■■■■■■	■■■■■

Alternatives	Equity					
	Interclass	Intraclass	Inter-generational	Inside/ Outside City	Industry Standards	
Indirect Costs of Water (Current)	■■■■	■■■■	■■■■■	■■■■■	■■■■■■	
Value of Improvements	■■■■■■■	■■■■■■■	■■■■■	■■■■■	■■	
Fixed Charge by Fire Class	■■■■■■■	■■■■■■■	■■■■■	■■■■■	■■■■	
Fixed Charge by Meter Size	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	
Ratings	■■■■■	■■■■■	■■■■	■■■■■	■■■■	

Alternatives	Customer					
	Affordability	Economic Development	Rate Shock/ Volatility	Understand Bill		
Indirect Costs of Water (Current)	■■■■	■■■■■■	■■■■■	■■■■■■		
Value of Improvements	■■■■■■■	■■■■	■■■■■	■■		
Fixed Charge by Fire Class	■■■■■■	■■■■	■■■■■	■■■■		
Fixed Charge by Meter Size	■■■■■	■■■■■	■■■■■	■■■■■		
Ratings	■■■■■	■■■■	■■■■■	■■■■		

Alternatives	Conservation					
	Average-Day Savings	Peak-Season Savings	Peak-Day Savings	Sustainability		
Indirect Costs of Water (Current)	■■■■■	■■■■■	■■■■■	■■■■■		
Value of Improvements	■■■■■	■■■■■■	■■■■■■	■■■■■		
Fixed Charge by Fire Class	■■■■■	■■■■■■	■■■■■■	■■■■■		
Fixed Charge by Meter Size	■■■■■	■■■■■■	■■■■■■	■■■■■		
Ratings	■■■■	■■■■	■■■■■■	■■■■■		

Alternatives	Financial					
	Revenue Sufficiency	Revenue Stability	Rate Stability	Rate Predictability	Financial Risk	
Indirect Costs of Water (Current)	■■■■	■■■■	■■■■■	■■■■■	■■■■	
Value of Improvements	■■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■■	
Fixed Charge by Fire Class	■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■■	
Fixed Charge by Meter Size	■■■■■	■■■■■■	■■■■■	■■■■■	■■■■■■	
Ratings	■■■■■■	■■■■■■	■■■■■■	■■■■■	■■■■■■	

Alternatives	Weighted Average Score
Indirect Costs of Water (Current)	■■■■■■■■■■
Value of Improvements	■■■■■■■■■
Fixed Charge by Fire Class	■■■■■■■■■■
Fixed Charge by Meter Size	■■■■■■■■■■■

Average Ratings
Recovery Methods for Public Fire Costs

	Implementation					
Alternatives	**Administrative Burden**	**Public Understanding**	**Public and Political Acceptance**	**Risk of Implementation**	**Legal Defensibility**	**Policy Durability**
Indirect Costs of Water (Current)	8.0	5.0	5.0	8.0	5.0	5.0
Value of Improvements	2.0	5.0	3.0	2.0	2.0	2.0
Fixed Charge by Fire Class	3.0	3.0	5.0	3.0	5.0	5.0
Fixed Charge by Meter Size	7.0	4.0	5.0	6.0	5.0	5.0
Weights Rated from 0 to 10 (10 most important)	3.5	4.4	4.6	4.8	6.1	5.0

	Equity					
Alternatives	**Interclass**	**Intraclass**	**Inter-generational**	**Inside/ Outside City**	**Industry Standards**	
Indirect Costs of Water (Current)	4.0	4.0	5.0	5.0	6.0	
Value of Improvements	7.0	7.0	5.0	5.0	2.0	
Fixed Charge by Fire Class	7.0	7.0	5.0	5.0	4.0	
Fixed Charge by Meter Size	5.0	5.0	5.0	5.0	5.0	
Weights Rated from 0 to 10 (10 most important)	5.2	5.0	3.6	4.6	3.8	

	Customer					
Alternatives	**Affordability**	**Economic Development**	**Rate Shock/ Volatility**	**Understand Bill**		
Indirect Costs of Water (Current)	4.0	6.0	5.0	6.0		
Value of Improvements	7.0	4.0	5.0	2.0		
Fixed Charge by Fire Class	6.0	4.0	5.0	4.0		
Fixed Charge by Meter Size	5.0	5.0	5.0	5.0		
Weights Rated from 0 to 10 (10 most important)	5.3	4.2	5.3	4.4		

	Conservation					
Alternatives	**Average-Day Savings**	**Peak-Season Savings**	**Peak-Day Savings**	**Sustainability**		
Indirect Costs of Water (Current)	5.0	5.0	5.0	5.0		
Value of Improvements	5.0	6.0	6.0	5.0		
Fixed Charge by Fire Class	5.0	6.0	6.0	5.0		
Fixed Charge by Meter Size	5.0	6.0	6.0	5.0		
Weights Rated from 0 to 10 (10 most important)	4.4	4.4	6.3	5.5		

	Financial					
Alternatives	**Revenue Sufficiency**	**Revenue Stability**	**Rate Stability**	**Rate Predictability**	**Financial Risk**	
Indirect Costs of Water (Current)	4.0	4.0	5.0	5.0	4.0	
Value of Improvements	6.0	6.0	5.0	5.0	6.0	
Fixed Charge by Fire Class	5.0	6.0	5.0	5.0	6.0	
Fixed Charge by Meter Size	5.0	6.0	5.0	5.0	6.0	
Weights Rated from 0 to 10 (10 most important)	6.0	6.3	5.7	5.5	6.1	

Alternatives	**Weighted Average Score**
Indirect Costs of Water (Current)	605
Value of Improvements	565
Fixed Charge by Fire Class	612
Fixed Charge by Meter Size	632

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REDDAK CONSULTING
A DIVISION OF MALCOLM PIRNIE

Issue Paper #3
Wastewater Cost Allocations

Subject: Wastewater Cost Allocations

Date: January 15, 2008

Introduction

A wastewater cost-of-service analysis is a method of allocating costs (known as revenue requirements) to the customer classes that a utility serves. Over the years, industry standards have evolved to guide practitioners in the conduct of these analyses. This issue paper looks at methods of allocating costs for wastewater utilities.

The Water Environment Federation (WEF) provides many of the industry standards for wastewater ratemaking. This organization publishes an industry manual on wastewater rates entitled *Financing and Charges for Wastewater Systems*.[1] Although the manual covers the principles of wastewater ratemaking in detail, many of the specific methodological options for a specific cost allocation process are left to the practitioner to develop for the particular circumstances. This issue paper explores the cost allocations available to the Austin Water Utility's (AWU) wastewater system.

Overview of the Cost-of-Service Process

The cost-of-service process can be described in nine distinct steps. These are:

1. Determine revenue requirements;
2. Determine customer classes;
3. Estimate customer characteristics;
4. Allocate costs to functions/unit processes;
5. Allocate costs to cost pools;
6. Allocate costs to categories;
7. Allocate costs to customer service characteristics;
8. Allocate costs to customer classes; and
9. Design rates.

This issue paper covers steps 4 through 8. The remaining steps are presented in other issue papers.

Wastewater Strength and Allocation Methods

Wastewater systems are designed to collect, convey, and treat pollutants in the sanitary sewer system. The costs of collection and conveyance are generally related to the volume of wastewater the utility receives from its customers. The cost of treatment is often related to both the volume of wastewater and the effort required to remove the pollutants that are part of the wastewater stream.

[1] Water Environment Federation, *Financing and Charges for Wastewater Systems*, Manual No. 27, (Alexandria, VA: Water Environment Federation, 2004).

The volume of wastewater a utility receives includes the amount of wastewater contributed by the utility's customers and an amount that is introduced in the collection and conveyance system, which is referred to as inflow and infiltration, or I/I. As the name implies, I/I has two principle sources. The first is inflow. Inflow is water introduced to the wastewater collection and conveyance system through direct connections such as catch basins, roof drains, foundation drains, manhole covers, and other similar connections. Infiltration is the flow entering the wastewater collection system through leaky pipes in areas of high groundwater or standing water from storm events, etc. Utilities often invest money to mitigate I/I to avoid the cost of treating what would otherwise be clean water. Generally, utilities spend resources on mitigating I/I until the cost of additional mitigation equals the benefits of recovered flow-related capacity and treatment costs.

I/I is caused by a variety of factors—age of pipe, high groundwater, rainfall—none of which are directly attributable to a specific customer class. I/I therefore, is often attributed to customer classes based on each class's contributed wastewater volumes, number of connections, land area, etc.

Within a wastewater treatment plant, utilities invest in plant and equipment, and incur operating expenses for processes designed to treat specific types of pollutants. For example, many wastewater treatment plants include aeration facilities that introduce oxygen into the wastewater system to facilitate the biological processes that remove certain constituents of the wastewater. With aeration facilities, for example, many utilities incur power costs that are used to mix air (which naturally contains oxygen) with the wastewater. This process, called aeration, is a primary means of reducing the levels of some pollutants in the wastewater.

The wastewater industry has developed measures of the levels of pollutants in wastewater and the appropriate processes used to treat these pollutants. One common measure of the level of pollutants in wastewater is called biochemical oxygen demand (BOD). BOD is a measure of the amount of oxygen required to treat wastewater. Wastewater with higher BOD levels require more aggressive treatment than wastewater with lower BOD levels. Under these circumstances, for example, the utility may spend more on power to aerate wastewater with higher BOD levels than wastewater with lower BOD levels. These measures of wastewater strengths form the basis for allocating costs in a wastewater cost-of-service study.

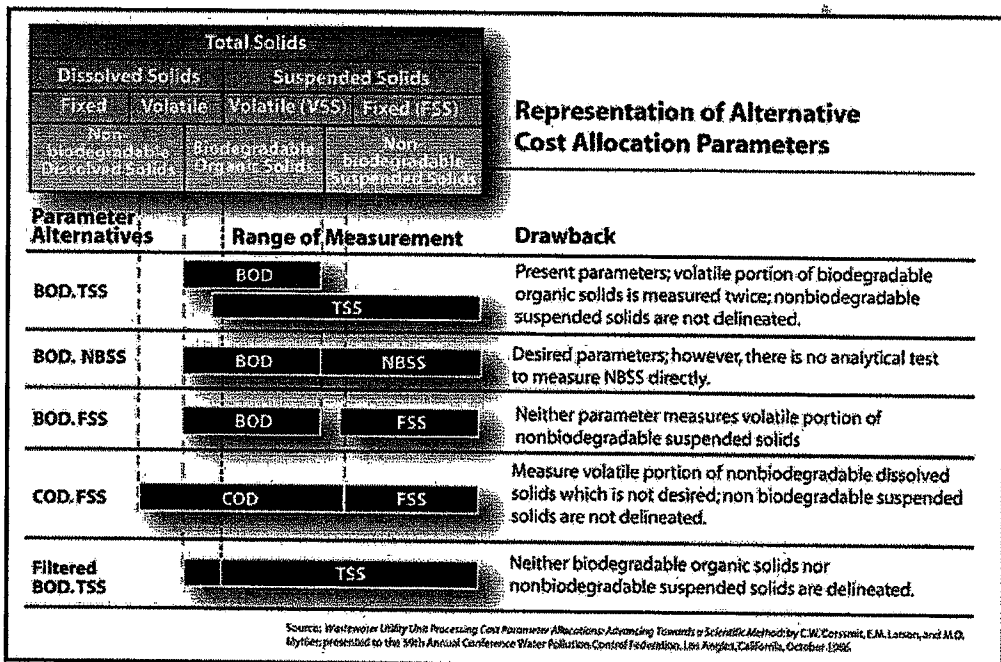

Figure 1: Measures of Wastewater Pollutants

The level of pollutants in wastewater can be characterized in many ways. Figure 1 provides an overview of common measures of a type of pollutants in wastewater commonly referred to as solids. These measures, along with others, are available to allocate costs among customer classes. Identifying the appropriate cost drivers for a wastewater cost-of-service study requires identifying those pollutants that are driving the utility's costs and allocating the costs associated with treating those pollutants to the cost drivers. The contribution of wastewater strength by customer classes is then estimated and the cost associated with each cost driver is allocated to customer classes based on their contributions.

Wastewater utilities have many steps in the treatment of wastewater that are often called unit processes. These unit processes are placed within a wastewater treatment plant to treat one or more types of pollutants. In some cases, the purpose of the unit process (i.e., the removal of one or more pollutants) is different than the criteria used to size the unit process (e.g., the size may be related to the total volume of wastewater, and therefore, the amount of wastewater, rather than its strength, may be the criteria used to size the facility.)

WEF has identified three fundamental cost allocation approaches for allocating a utility's costs and, thereby, determining wastewater rates. These methods are:

- Design Basis,

- Functional Basis, and
- Hybrid.

The three fundamental approaches are discussed further below. The primary difference among the approaches is that the design basis allocates costs based on engineering design criteria whereas the functional basis allocates costs based on operational or functional purposes. The hybrid method combines the design and functional bases.

Design Basis Cost Allocation Methodology

This approach recovers operating expenses and capital costs based on the allocation of net plant in service to customer service characteristics using the primary engineering design criteria for each facility. Typical examples of allocation factors under the design criteria are shown by facility type in the WEF Manual, some of which are summarized below:[2]

- Collection sewers, pumping, and lift stations—Peak-flow rates determine the size of mains, so these costs are assigned to the "capacity" cost component.

- Treatment plant – Various treatment plant unit processes are allocated differently. For example, primary and secondary settling basins are assigned to the "volume" cost component because settling detention times are based on design average flow. Aeration basins are assigned to the "BOD" strength cost component as BOD loading determines the size of the basin.

- Support services – Support services and general and administrative are typically allocated proportionately to all other cost components.

- Billing – These costs are assigned to the "customer" cost component.

Functional Cost Allocation Methodology

Under this approach, costs are allocated to customer service characteristic using purpose-based/cost-causative factors. Typical examples of the cost-causative factors used for the functional cost method are shown by facility and unit process in the WEF Manual, some of which are summarized below[3].

- Collection sewers, pumping, and lift stations – The main purpose of these facilities is to convey wastewater at variable rates of flow, so these costs are assigned to the "volume" cost component.

[2] Water Environment Federation, *Financing and Charges for Wastewater Systems*, Manual No. 27, (Alexandria, VA: Water Environment Federation, 2004).
[3] Water Environment Federation, *Financing and Charges for Wastewater Systems*, Manual No. 27, (Alexandria, VA: Water Environment Federation, 2004).

- Treatment plant – Treatment plant unit processes are allocated according to function. For example, the primary settling basin's main purpose is to remove suspended solids, so costs are assigned to the "suspended solids" cost component. The secondary settling and aeration basins' main purpose is to remove BOD from wastewater, so costs are assigned to the "BOD" cost component.

- Support services – Support services and general and administrative costs are typically allocated proportionately to all other cost components.

- Billing – These costs are assigned to the "customer" cost component.

Hybrid Cost Allocation Methodology

The hybrid method combines both the design and functional approaches. In some cases, the hybrid approach allocates O&M costs using the functional basis and capital costs are allocated using the design basis. In some cases, utilities have taken simple averages of the functional and design bases to create the hybrid.

Findings on Overall Methods

The three fundamental methods are accepted by the industry for use in conducting wastewater cost-of-service studies. The primary differences among the methods are philosophical. Examining a unit process where the allocations under the functional and design basis differ may help illustrate the philosophical differences.

Primary settling basins may be a good example where the allocations differ under the three methods. Primary settling basins are normally sized to meet the hydraulic requirements of the plant. This sizing is required so that the velocity of the wastewater can be low enough to allow certain solids to settle. Under the design basis, therefore, these costs would be allocated based on flow. Under the functional basis, the primary settling basins function to reduce the amount of suspended solids in the wastewater as it passes to subsequent unit processes.

The difference in the allocations illustrates the underlying philosophical differences. Under the design approach, the cost responsibility is assigned to customers in proportion to their contribution to the flow, or ultimate size of the facility in question (in our example here, a primary settling basin.) In other words, those customers with high flows are allocated relatively more of the costs to recognize that the total flow is the sizing criteria for the basins. In essence, the design approach assumes that those with more wastewater volume are driving the design costs, and therefore, these customers should bear a relatively similar burden for the cost allocations.

Under the functional method, cost responsibility is assigned based on each customer's contribution to the suspended solids at the plant. Under this approach, the method assumes that those responsible for the introduction of the suspended solids into the waste stream should bear the burden of the costs. Another way of describing the philosophical differences is that the functional method assigns cost responsibility for introducing waste constituents into the wastewater stream that require removal. Or alternatively, customer classes are made responsible for costs for making the relatively clean flows of other customers dirtier.

The hybrid method often assigns O&M costs based on function and capital costs based on design. In these cases, the capital costs are driven by the design criteria. But the cost of operating the facility and maintaining the facility are borne by customers based on the function. This hybrid approach appeals to some analyst since it mixes the two methods and assigns some costs to each.

Since the differences in the methods are primarily philosophical, no one technical solution exists.

Allocation Steps

Once the overall cost allocation method (i.e., design, functional, or hybrid) is selected, individual approaches for allocating costs must be developed. Both of the allocation methods work with either the cash or utility basis of determining revenue requirements.

O&M Cost Allocations

Equitably allocating the wastewater system's user charge revenue requirements to customer classes involves a multistep process. Beginning with O&M costs, the following steps are required. Allocations of capital-related costs are described in a subsequent subsection of this issue paper.

- Step 1: Functionalizes the costs to appropriate wastewater system functions or unit process.
- Step 2: Allocate the functionalized costs to cost pools. This step identifies O&M costs that are joint (i.e., those costs that benefit all customer classes) or specific to one or more customer classes.
- Step 3: Distribute functionalized costs for each cost pool to cost categories.
- Step 4: Allocate the costs by cost pool and cost category to the appropriate customer service characteristics.
- Step 5: Distribute the O&M costs by customer service characteristic to customer classes for each cost pool based on each class's proportion of the customer service characteristics.

These steps are described in more detail in the following subsections.

Step 1: Functionalize Costs

A wastewater utility's O&M expenditures may be allocated to wastewater system functions or unit processes (e.g., collection, pumping, preliminary treatment, primary treatment, customer services, general administration, etc.) Functionalizing costs in this manner allows the allocation of specific functions to one or more cost pools. This step enhances the accuracy and equity of the wastewater system cost allocation to the customer classes. The wastewater system functions selected depend on the physical nature of the system and the manner in which the utility accounts for its costs. Tentatively, the water system functions may include:

- Collection,
- Pumping
    - Facilities
    - Power
- Treatment
    - Preliminary treatment
    - Primary treatment
    - Aeration
    - Secondary treatment
    - Return sludge pumping
    - Effluent filtration
    - Disinfection
    - Effluent pumping
    - Solids handling
- Customer Services, and
- Indirect Costs (e.g., administrative and general).

Step 2: Assignment of O&M Costs to Cost Pools

This step assigns the O&M costs by function to cost pools. A cost pool is a collection of costs that are shared by a group of one or more customer classes. For example, the joint cost pool is shared by all customer classes. Tentatively, the costs pools may include:

- Joint,
- Wholesale and Industrial Program Costs, and
- Retail Only Costs.

Each of these is described below.

Joint Costs

Joint costs are those costs that are shared by all customers of the wastewater system in proportion to their respective use of the system.

Wholesale and Industrial Program Costs

AWU may incur costs to manage its wholesale and industrial program. These costs would be recovered from these customer classes.

Retail Only

Retail only costs are the costs incurred to provide retail services to AWU's customers. These costs will likely include certain collection system costs that are not incurred to provide service to wholesale customers.

Step 3: Allocation of Pooled Costs to Categories

After costs are allocated to system functions and cost pools, the costs grouped in this manner are then allocated to categories. Cost categories are used to facilitate the allocation of costs by pools to customer service characteristics in Step 4. The previously allocated joint and specific costs are listed by system functions. Each system function can be associated with one or more cost categories. For example, digester costs can be associated with solids handling.

Step 4: Allocation of Costs to Customer Service Characteristics

The assignment of costs to customer service characteristics varies with the allocation methodology used. Regardless of cost allocation method used (i.e., design, functional, or hybrid basis), the cost-of-service analysis requires an assumption on the appropriate customer service characteristics to use.

Considering the operations and design of AWU's system, the customer service characteristics proposed tentatively include:

- Design Basis Cost Allocation Methodology –
  - Volume,
  - BOD
  - Total suspended solids (TSS),
  - Industrial monitoring, and
  - Customer related.
- Functional Cost Allocation Methodology –
  - Volume,
  - BOD
  - TSS,
  - Industrial monitoring, and
  - Customer related.

Step 5: Distribution of Costs to Customer Classes

The next step involves the projections of customer class wastewater flows and their respective wastewater strengths. Flows include both contributed volumes and volumes attributed to a customer class based on the system's infiltration/inflow (I/I). Wastewater strengths typically include BOD and suspended solids (SS), and in some cases measures of nitrogen, phosphorous, and others.

Wastewater Volumes

Wastewater flows include the wastewater contributed by a customer and an amount of system I/I attributed to the customer class. When combined, the two elements equal the wastewater volume.

Biochemical Oxygen Demand (BOD)

BOD is a measure of the concentration of biodegradable solids in wastewater. A BOD$_5$ test can be used to infer the general quality of the wastewater and its relative cost of treatment. Wastewater treatment facilities include unit processes that are designed and/or operated to reduce the BOD levels in the wastewater. A BOD$_5$ test is conducted by measuring the amount of dissolved oxygen in a wastewater sample before and after a five-day incubation period. The change in the level of dissolved oxygen is a measure of the oxygen demand placed on the sample by the biochemical process.

Total Suspended Solids (TSS)

Like BOD, TSS is a water quality measurement. It measures the amount of solids suspended in wastewater. A TSS test is conducted by pouring a carefully measured volume of water through a pre-weighed filter of a specified pore size, then weighing the filter again after drying to remove all water. The increase in weight is a dry weight measure of the particulates present in the water sample expressed in units derived or calculated from the volume of water filtered (typically milligrams per liter or mg/l).

Capital Cost Allocations

Allocating capital costs using either the design, functional, or hybrid basis involves steps in addition to those outlined above. Capital costs (whether under the cash or utility basis) are generally allocated to customer classes by allocating the assets that serve each customer class. The value of these assets is called the *rate base* and is normally based on the net book value of the facilities.

Determining each customer class's portion of the system rate base is accomplished by allocating the wastewater system's fixed assets net of accumulated depreciation. Net fixed assets are allocated to functions, cost pools, categories, and customer service characteristics as in Steps 1 through 5 above. The following additional steps result in an allocation of capital assets to customer classes.

- Step 6: Determine the rate base for each customer class.

- Step 7: Determine the rate of return.
- Step 8: Allocate the return on rate base among the customer classes.

Step 6: Determine Rate Base by Customer Class

The first part of determining the rate base for each customer class is to summarize the net fixed assets allocated by cost pool and category to customer service characteristics and customer class. The net fixed assets allocated to each customer class is the value of the plant in service that is used and useful for that customer class less the accumulated depreciation for those assets. The second part of determining rate base by customer class is to calculate an allowance for working capital, or a percentage of the O&M costs allocated to each customer class. The allowance for working capital recognizes the carrying costs of working capital that the utility incurs for operation.

Adding the net plant in service and allowance for working capital results in the rate base attributable to each customer class.

Step 7: Determine Rate of Return

The rate of return used in the analysis depends on the method used to determine total revenue requirements. Under the utility basis, a fair rate of return is assumed to be a return that could be earned by investing the owners' money in a comparable investment, an investment which has similar risks. The rate of return is often referred to as the cost of capital. It is generally calculated using a weighted average of the utility's cost of debt and the return on the utility's equity.

Under the utility basis with cash residual method the rate of return is different for owner and non-owner customers. When using this method of determining revenue requirements, the rate of return for owner customers is calculated after the cost allocated to the non-owner customers is determined. The rate of return for owner customers would equal the return required so that the expected revenue from owner and non-owner customers equals the cash-basis revenue requirements.

Under the cash basis, the rate of return is determined to be the return required to generate the cash-basis needs of the utility. Even though depreciation is not an element of the cash-basis revenue requirements, often a portion of the cash-basis revenue requirements is allocated in the same manner as depreciation. In those cases, the depreciation and O&M costs are subtracted from the total revenue requirements before calculating the required rate of return. The difference, when divided by the total rate base, equals the rate of return used.

Step 8: Allocation of Return on Rate Base to Customer Classes

The final step in allocating capital costs is to allocate the return on rate base to each of the customer classes. The return on rate base for each customer class is calculated by multiplying the rate base allocated to each customer class in Step 6 by the respective rate of return from Step 7. The result of Step 8 is the return on rate base attributable to each customer class.

Allocating Depreciation Expenses

Allocating annual depreciation expenses follows the same steps as for O&M costs. Depreciation is allocated on the same basis as the associated asset. Although depreciation is not an element of revenue requirements under the cash basis, a portion of the capital cost under the cash basis is often allocated in the same manner as depreciation.

Cost of Service by Customer Class

After the revenue requirements are fully allocated by function, pool, and categories to the customer characteristics for each class, the O&M and capital costs are summed for each class to determine the total cost of service by customer class.

Allocation of Inflow and Infiltration Costs

Overview

As described above, the amount of I/I is influenced by a variety of factors including:

- Age of pipe,
- Level of groundwater,
- Soil conditions,
- Rainfall, etc.

None of these influencing factors is directly attributable to a specific customer class.

United States Environmental Protection Agency (USEPA) Guidelines

Based on the 1972 Water Pollution Control Act, as amended, USEPA has issued guidelines in developing wastewater rates for utilities that have participated in its construction-grants program. These guidelines include specific recommendations for the treatment of I/I. The guidelines provide the following options for the allocation and recovery of I/I costs:

- Contributed wastewater volumes. These are estimates of the contributions of wastewater from the customer's premises. For residential customers, contributed wastewater volumes may be estimated from average winter water consumption. Other techniques may be available for other customer classes.

- Number of connections. Under this approach, I/I is attributed to customer classes based on the number of connections each class has within the wastewater system.
- Land Area. Since I/I is often introduced into the collection system, and the ultimate length of pipe in the collection system is based on the total area served, land area is available as a method to allocate and recover I/I costs.
- Property values. For systems that have USEPA approved system of rates based on *ad valorem* property taxes, property values may be used to allocate and recover I/I costs.

Other Observations

The approaches used to allocate and recover I/I costs vary from utility to utility. Some utilities base the allocations of I/I to customer classes based on a combination of the factors listed above. Other utilities use only one of the available methods.

The primary differences in the methods of allocating and recovering I/I costs are based on different philosophies. Some analysts consider I/I cost as another element of the wastewater system that must be managed. And since I/I generally affects the flow-related unit processes the most, the cost associated with I/I are then allocated based on a customer classes' flow. The cost of mitigating I/I are often incurred to augment the hydraulic capacity of the treatment plant and portions of the conveyance system.

Some analyst attempt to allocate the source of I/I back to the customer classes. In some cases, I/I is assumed to occur primarily in the collection system and at the point of connection of customers' services to the sewer laterals. Under this assumption, analyst may allocate I/I on a per customer basis.

AWU is unique since much of its major conveyance systems have historically be placed within natural creeks and streams. Although this placement may maximize the use of gravity to convey wastewater, it likely increases the I/I of the major conveyance systems. This unusual circumstance suggests that I/I does not correlate well to the number of connections.

Methodological Options under Review

When considering the issue of wastewater cost allocations, the following methodological options are important to consider:

1. Which is the most appropriate overall method for allocating costs (i.e., design, functional, or hybrid basis)?

2. What are the appropriate customer service characteristics to use for the cost allocation process (e.g., BOD, TSS, TKN, etc.)?

3. How should I/I cost be allocated and recovered in the cost-of-service analysis?

Each of these issues is explored further in the following sections. The discussion for each issue includes:

- Overview of the issue,
- Description of the alternatives,
- Evaluation of the alternatives using the executive team's evaluation criteria, and
- Consultant's preliminary findings and recommendations.

After presentation to the executive team and public involvement committee, the consulting team will finalize its recommendations.

Issue 1: Which is the most appropriate overall method for allocating costs?

Overview of the Issue

The first cost allocation policy to resolve is which overall cost allocation method is best for AWU and its customers. The alternative selected will determine the method of allocating costs to each of the customer classes. WEF has identified three fundamental cost allocation approaches for allocating a utility's costs and, thereby, determining wastewater rates.

Description of Alternatives

The three available alternative methods are:

1. Design basis (current approach),
2. Functional basis, and
3. Hybrid where O&M costs are allocated based on function, and capital costs based on based on design.

The primary difference among the alternative methods is that the design basis allocates costs based on engineering design criteria whereas the functional basis allocates costs based on operational or functional purposes. The hybrid allocates O&M costs based on function and the capital costs based on design. Examples of how the allocations would be done under both approaches are discussed earlier in this paper.

Evaluation of Alternatives

Attachment A presents the weighted evaluations of the alternatives.

The differences in the evaluation of the three approaches are minor. In general, the hybrid approach faired somewhat better than the other approaches because it may be more equitable since it allocates O&M costs based on function and capital costs based on design. This split in the allocation method is probably more important to some unit processes than it is to others. When, for example, power and/or chemicals are used in a unit process sized to meet peak-flow conditions, but the power or chemical is used to eliminate a constituent in the wastewater, allocating these power and chemical costs based on each classes' contribution of the constituent may provide a more equitable outcome.

AWU currently uses the design basis, and, therefore, the administrative burden of the design basis is assumed to be less than the other methods. Because the hybrid approach requires two allocation bases, we assume it is the most burdensome. Regardless, the administrative burdens of all three alternatives are minimal. The public and political acceptance of the hybrid method may exceed the other methods. This acceptance may be the result of a preference for charging customers based on both their contributions of the pollutants being treated and their contribution to the capacity requirements of the system. Because the design basis is the status quo, it was considered to have the least risk of implementation. However, the risk of implementation is likely low regardless of alternative. The alternatives did not vary for the other implementation criteria.

Both interclass and intraclass equity would likely be improved by the hybrid approach. This increase in equity is brought about by the split allocations—O&M based on function and capital based on design. The alternatives did not vary for the other equity criteria.

The customer criteria do not vary based on the alternatives.

Because the design basis may increase the unit cost of disposal for wastewater on a volume basis, it may have an incidental impact on water conservation on an average-day basis. This impact is likely to be quite small and would not be expected to include much impact on peak-season or peak-day demands. Sustainability may be improved by the hybrid approach since wastewater customers will have an incentive to reduce both their flows and wastewater pollutants. This incentive could result if the extra-strength surcharges imposed by AWU are higher to reflect the modified cost allocations.

The financial criteria do not vary based on the alternatives.

Preliminary Findings and Recommendations

The consulting team tentatively recommends AWU use the hybrid approach for allocating costs. This method appears more equitable to AWU's customers and does not introduce significant administrative burden.