Subject: Wastewater Cost Allocations

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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

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.

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:

- 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.

- 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.

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• 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 \textit{ad valorem} property taxes, property values may be used to allocate and recover I/I costs.

\textbf{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.

\textbf{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 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 fared 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.
**Issue 2: What are the appropriate customer service characteristics to use for the cost allocation process (e.g., flow, BOD, TSS, etc.)?**

**Overview of the Issue**

Regardless of cost allocation approach selected, the cost-of-service analyses will require the selection of customer service characteristics for the cost allocations. The selection of the customer service characteristics determines which measures of wastewater strength are included in the cost allocations.

In developing an appropriate list of customer service characteristics, the analyst may consider the following standards:

1. Does the utility incur cost to treat the constituent that comprises the customer service characteristic?

2. Do customers vary in their contribution of the constituent under consideration? Is the contribution by customers closely correlated with another customer service characteristic already being used?

3. Can the utility measure the differences in the contributions by customer class with reasonable accuracy?

The first standard considers costs. Since the purpose of identifying a customer service characteristic and the corresponding wastewater constituent is to allocate costs, those constituents that are not treated or controlled may not warrant including in the cost allocations. The constituents that are responsible for costs vary by utility. For example, some utilities are required to control the total heat load they place on their receiving waters. In these cases, utility may incur significant costs to manage the heat of its wastewater discharge and temperature may be an important customer service characteristic. On the other hand, other utilities may not be required to control temperature and spend very little to mitigate this characteristic of wastewater. In some cases, wastewater utilities incur costs to treat a constituent in wastewater even if that constituent is not regulated as part of the utility’s discharge permit.

The second standard addresses the variation in contributions of a constituent by customer class. If all customers contribute an equal concentration of the constituent measured by the customer service characteristic in question, then very little benefit would be derived by separating the costs for this additional customer service characteristic. Similarly, if the contribution of a constituent under consideration as a customer service characteristic is correlated to another constituent being measured, then the costs of the correlated constituent can be allocated according to the contributions of the original constituent. In
general, because of the administrative cost of conducting testing, etc., adding constituents to the list of customer service characteristics should be carefully considered.

The final standard is the ability to accurately measure variations in wastewater contributions by class. Using tests that are subject to significant sampling error may reduce the overall accuracy of the resulting cost allocations. Therefore, the impact of the sampling error should be incorporated in any decision regarding the selection of customer service characteristics.

Description of Alternatives
Many alternative measures of wastewater strength exist. However, considering the three standards listed above, three alternatives appear most relevant to AWU. These are:

1. Flow, BOD, and TSS only (current);
2. Add Total Kjeldahl Nitrogen (TKN)\(^4\); and
3. Add Phosphorus.

For this evaluation, the current approach is compared to approaches that add either TKN or Phosphorus to the list of customer service characteristics included in the cost allocations. The selection of appropriate customer service characteristics for the cost-of-service analysis depends on the design and operation of the wastewater system.

Evaluation of Alternatives
Overall, our evaluation suggests that AWU may consider collecting sampling data on TKN and Phosphorus to determine the importance of these customer service characteristics in allocating costs in the future. Without adequate data, it may be difficult to implement these cost allocations at this time. Specifically, the utility should consider collecting TKN and Phosphorus data as part of its industrial pretreatment program.

When considering the addition of either customer service characteristic, the administrative burden and risk of implementation were of particular concern. Currently AWU does not collect samples from its industrial pretreatment program for these constituents. Developing accurate cost allocations by customer class would likely require a significant sampling period to acquire adequate data. This sampling period might delay implementation of this study and present other administrative burdens. This likely delay resulted in a lower rating for these alternatives for public acceptance. It is likely that the importance of allocating costs to either TKN or Phosphorus will become increasingly important in the future. For that reason the addition of TKN and Phosphorus were considered to meet the policy durability criterion better than the current approach.

\(^4\)Total Kjeldahl Nitrogen (TKN) is the sum of organic nitrogen, ammonia, \(\text{NH}_3\), and ammonium, \(\text{NH}_4^+\), in biological wastewater treatment. TKN is determined in the same manner as organic nitrogen, except that the ammonia is not driven off before the digestion step.
The equity criteria generally favored the addition of TKN and Phosphorus. That finding recognizes the impact that these constituents likely have on the treatment costs at AWU’s wastewater treatment facilities. Allocating costs to these customer service characteristics likely improves the interclass and intraclass equity of the cost allocations. Intergenerational and inside-outside city equity are likely unaffected by the change in customer service characteristics. The current approach is the most common used throughout the industry, and, therefore, received a slightly higher rating. Although somewhat less common than using flow, BOD, and TSS alone, allocating costs to TKN and Phosphorus are well within the industry standard. Therefore, the difference in rating for this criterion is relatively small.

The customer criteria do not vary based on the alternatives.

Sustainability may be enhanced by adding cost allocations based on TKN or Phosphorus customer service characteristics. If AWU adopts extra-strength surcharges for these constituents, customers with higher loadings may adopt practices that reduce their overall contribution of the constituent to the wastewater system, thereby reducing the environmental impacts of treating these constituents. The other conservation criteria do not vary based on the alternatives.

The financial criteria do not vary based on the alternatives.

**Preliminary Findings and Recommendations**

The consulting team recommends AWU implement a sampling protocol to develop data on TKN and Phosphorus for its industrial pretreatment program. Once data are available, the consulting team recommends that AWU consider adding these customer service characteristics to its cost-of-service methodology. The consulting team further recommends that the cost-of-service model be developed to facilitate the introduction of these customer service characteristics.

**Issue 3: How should I/I be estimated and allocated in the cost allocation process?**

**Overview of the Issue**

The total volume of wastewater at AWU’s wastewater treatment plants consists of contributed wastewater and inflow and infiltration (I/I). Infiltration is the flow entering the sanitary sewer resulting from high groundwater or precipitation that occurred days or weeks before the observed flow in the sanitary sewer. Inflow results from rainfall that enters the sanitary collection system through a number of direct connections such as catch basins, roof drains, foundation drains, and manhole covers. The I/I in the system may be estimated based on available studies or comparisons of contributed wastewater
and metered plant flows. Customers generally cannot influence the level of I/I in the system. Generally, the utility mitigates I/I to reduce the flow-related costs of treatment and allow the flow-related capacity of the facilities to be available to customers, thereby avoiding expansions of capacities. Utilities generally establish a threshold for cost-effectiveness of I/I abatement measures based on the present worth cost of conveying and treating I/I.

The cost associated with collecting, conveying, and treating I/I must be allocated within the cost-of-service methodology. Currently the assumed I/I flow used to determine the cost of service in AWU’s wastewater system is 10.5 percent of total flows.

Description of Alternatives

As described on page 11 of this issue paper, the USEPA has issued guidelines on the allocation and recovery of I/I costs using several approaches. Based on these approaches, four alternatives are evaluated here. These are:

1. Combined connections and volume (Current),
2. Contributed wastewater volume,
3. Number of connections, and
4. Land area.

As described on page 12, the primary differences among the alternatives are base on alternative philosophies regarding the appropriate allocation of costs. AWU currently uses the combined approach which attributes 50 percent of the I/I flows to customer classes based on the number of connections and 50 percent based on the class’ contributed wastewater flow. The other approaches are consistent with USEPA guidelines.

Evaluation of Alternatives

Implementing the first three alternatives should be simple. A significant administrative burden is expected from using land area since these data are not readily available. For similar reasons, the land area has a greater risk of implementation. Public understanding may be enhanced by a simpler method, so both contributed wastewater volume and number of connections scored somewhat better than the combined approach. The number of connections may be slightly less understandable since most costs spent on I/I are incurred to augment flow-related capacities of the utility (e.g., collection, lift stations, treatment, etc.) All of the alternatives are legally defensible since they are specifically identified by the USEPA. Also, all the alternatives should have similar policy durability.

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6 Since AWU does not base its user charges on ad valorem property taxes, the value of property would not be consistent with USEPA guidelines. Therefore, it is not considered in this evaluation.
Interclass and intraclass equity should not be affected by the alternatives. As mentioned above, the difference in philosophies may be reflected by differences in preferences for each of the alternatives. These preferences may be reflected in how one evaluates interclass and intraclass equity. Other than philosophic reasoning, no technical advantage for interclass and intraclass equity exists. Intergenerational and inside/outside city equity would not vary by alternative. Each of the alternatives is consistent with industry standards, but combined approach and land area are relatively less common.

Since residential customers have relatively more connections than flow, allocating I/I to classes based on the number of connections may increase the cost to residential customers, thereby reducing affordability. Similarly, because the combined approach includes an element allocated based on the number of connections, it too may be less affordable. The opposite is likely true for economic development. Since commercial and industrial customers likely have fewer connections than flow, allocating costs based on the number of connections may provide more economic development benefits. Basing the allocation on flow would likely increase the costs to non-residential customers thereby reducing their ratings for economic development. The other customer criteria do not vary based on the alternatives.

Since customers cannot control the system’s I/I, the conservation criteria do not vary based on the alternatives.

The financial criteria do not vary based on the alternatives.

**Preliminary Findings and Recommendations**

The consulting team recommends AWU allocate and recover its I/I cost based on the contributed flow of each customer class. This recognizes the fact that individual customers cannot manage I/I, and that the cost of I/I is primarily in consuming flow-related capacity.

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