US Water Alliance

Stantec

Recovering Stronger

Transforming Water Management Post COVID-19

A Promising Water Pricing Model for Equity and Financial Resilience

Preface

Public services should be easily accessible to the public. Since individuals may have widely varying abilities to pay for those services, how services are collectively funded matters. In the water and wastewater sector, the most common method of pricing and paying for service places significant pressure on both utilities and communities. Meanwhile, the most common approaches to helping low-income and other customers struggling with water bills have significant challenges. Most customer assistance programs suffer from low enrollment and high administrative red tape, inclining block rates do not typically account for variations in wealth or ability to pay among residential customers, and most debt relief and payment plan programs, if present, are reactive rather than proactive.

Together, with our partners in Cincinnati and Milwaukee, the US Water Alliance and Stantec modeled a sophisticated, cost-based approach to pricing water. While there will always be a need for additional safeguards to ensure affordability and equitable water management, **this model represents an opportunity to avoid common challenges, achieve greater equity by reducing water bills for most low-income households, and do so while preserving revenue and improving financial resilience.**

The model in this report achieves these outcomes by shifting certain, but not all, utility costs from usage-based rates to a charge based on property characteristics. Doing so helps low-income customers avoid water debt and related consequences and is also justifiable and innovative from a cost perspective. For example, larger homes in lower-density urban areas may pay the same rates as everyone else, but the costs of delivering services to them tend to be greater than those for smaller homes in higher-density areas. In these cases, people living in smaller homes (often lower-income communities) are effectively subsidizing larger properties. Thereby, shifting some charges to a cost-based fee better reflects financial realities.

In tandem with further local, state, and federal action to realize water as a common good, we hope models like this can make a meaningful difference to customer and utility finances and better safeguard public health and essential services for all people.

One Water, One Future.

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Introduction

Water and wastewater services, while not free, are a common good. Not only are clean drinking water and proper wastewater treatment beneficial to an individual's health and quality of life—universal access to these services provides collective benefits. Water access protects public health, safeguards ecosystems, and boosts economies. The risks of living without these services also stretch beyond household walls. Without safe and accessible water and sanitation, individuals face waterborne illness and lowered quality of life—effects that reverberate throughout their communities. The COVID-19 pandemic underscored the lifesaving importance of water services; a recent study showed that areas with water shutoff moratoria in place during the pandemic saw lower COVID death and infection rates.[1] The effects reverberate economically, too: recent research shows that water access challenges cost the US economy more than $8 billion annually.[2]

However, the predominant approach to funding water and wastewater systems does not reflect their critical importance. While other common goods like roads and libraries are funded collectively through fees, tax revenue, and combinations of the two, water services are funded by individual customer payments. Water and wastewater utilities rely almost exclusively on revenue from residential, commercial, and industrial customers within their service areas. They use economic pricing models to develop rates intended to cover the cost of service, including those required for capital expenditures. Widespread inability to pay water bills, as occurred during the onset of the pandemic when the American Water Works Association projected the water sector's annual revenue loss due to unpaid bills at $4.92 billion, threatens utilities' ability to recover the revenue required to deliver services safely and reliably over time.[3] Thus, individual financial hardship can put essential services that are necessary to public health at risk.

This type of funding model exposes both individuals and communities to health and economic risks. Households that do not pay their water bills may face consequences like service shutoffs, property tax liens, and additional penalties and fees. This can push struggling customers into deeper debt, making it even harder to get current on bills. Meanwhile, utilities that cannot collect adequate revenue from rates run the risk of financial instability, putting vital operations and system maintenance at risk. Utilities that struggle financially may not be able to secure loans with favorable terms, which raises costs, leads to deferred maintenance, and drives the need for further rate increases to maintain quality levels of service. Utilities' financial dependence on customers makes them highly vulnerable to economic crises and growing income inequality. As utilities plan for an increasingly unpredictable world of pandemic impacts, climate disasters, and economic volatility, they—and the communities they serve—need strategies to cover costs and maintain stable services.

Public services should be easily accessible to the public, and how they are collectively paid for matters. The current, dominant water pricing model places undue pressure on both utilities and communities. Recognizing this tension, many utilities have created customer assistance programs that provide bill discounts, assistance with payment, and/or flexible payment options to help prevent consequences like service shutoffs for low-income customers. These tools can be very helpful, but any one solution is seldom adequate to address the scope of the water affordability challenge and each has historically been underutilized. Burdensome application requirements and lack of program awareness among the qualifying customer base are barriers to participation, and program funding and administrative costs add to the financial burden for utilities, affecting all ratepayers. Fundamental changes to the utility pricing model are needed to address the shortcomings of the exclusively usage-based structure, enhance revenue stability, and integrate equity considerations.

The water sector and community advocates can innovate and surface utility revenue models and pricing structures that better reflect water's fundamental role in a thriving society and the true costs and value of providing safe, reliable water and wastewater service. Of course, federal funding is crucial and should contribute a larger share of utility revenue than it presently does. However, utilities can use the tools at hand to begin billing for water in more equitable ways while advocating for change at the federal level. **The time is right to develop innovative ways to price and fund water that support system sustainability, equity, and public health.**

Innovative pricing structures can minimize the need for shutoffs and have some advantages over existing affordability strategies. By developing rates that are affordable for everyone, utilities can collect more revenue from customers who can afford to pay without burdening those who cannot. Changes to rate and pricing structures automatically reach everyone: there is no need to apply or enroll, or to track customer data and manage programs. This may be a more effective approach for hard-to-reach customers. Fundamentally, rate structure changes are more sustainable for utilities: after an implementation period, they require less ongoing administration and resources than customer assistance programs. The pricing model presented here can coexist with assistance programs and other affordability strategies, depending on the needs of different utilities and communities. Utilities may find that evolved pricing models effectively make water affordable for the majority of ratepayers, and that other types of programs can help reach outliers and are still needed to safeguard affordability and promote equitable water management.

This report highlights the opportunity for innovative pricing models to address the water affordability challenge, making residential water bills more affordable and equitable while still enabling utilities to collect the revenue required to operate. It proposes an alternative paradigm for pricing and funding an essential service by distributing some water system costs based on characteristics correlated to income. This shift would send a powerful message that **all people deserve health, well-being, and dignity and that investments in essential services like water should be shared across society.** The model proposed in this report is based upon costs related to property characteristics, and our findings suggest it can effectively redistribute costs to higher-income areas with greater ability to pay while lowering bills for lower-income neighborhoods and areas with high rates of shutoffs. Under this model, water rates would be more affordable for more people, thus strengthening both equitable water access and utilities' financial stability.

About the study

In partnership with Stantec Consulting Services, Inc., the US Water Alliance conducted this study to evaluate a promising pricing model that uses property-based characteristics to recover certain utility costs. The study used real data from two drinking water utilities—Greater Cincinnati Water Works (GCWW) and Milwaukee Water Works (MWW)—to explore the implications of the pricing model on customers and water service providers. Community-based social service partners in each city collaborated to weigh in on the modeling approaches and verify what the model data were showing. Their insight was critical to confirm how the proposed approach would impact different populations based on their relational and lived experience of different neighborhoods and populations. This report presents the key findings from the GCWW Case Study and discusses practical considerations for implementation, as well as potential obstacles and opportunities. This report will be updated to include key findings from the MWW Case Study, practical considerations for implementation, and potential obstacles and opportunities.

About Greater Cincinnati Water Works

Greater Cincinnati Water Works is a regional water utility owned and operated by the City of Cincinnati, Ohio. It has the distinction of being the oldest municipally owned utility in Ohio, first organized over 200 years ago. Today, GCWW's service area has grown to serve a population of over 1.1 million. GCWW supplies more than 48 billion gallons of water a year through nearly 3,200 miles of water mains to about 242,000 residential and commercial accounts. Although GCWW's focus is primarily on drinking water, the utility provides billing for various types of utility services, including water, sewer, stormwater, and trash services, and manages the public stormwater system for the City of Cincinnati.

The utility's operational, maintenance, and capital financing costs are primarily derived from system user charges. Historically, GCWW has used industry-accepted cost-of-service methodologies to assist with water rate setting and currently employs a rate structure with a fixed water availability fee based on meter size plus a volumetric charge. For larger volume water users (mainly commercial and industrial), a declining commodity charge is applied as usage increases over set thresholds. GCWW bills monthly and allows customers to set up payment plans for past due balances as a form of customer assistance. More recently, GCWW has promoted utility bill assistance via COVID-19 pandemic relief funding. However, even with relief funds available, it has been challenging and resource-intensive to connect customers to the appropriate funding sources, which all require some form of customer application. The patchwork of relief programs that each have specific requirements results in many customers falling through the cracks. Additionally, pandemic relief funds do not address the multitude of issues that may cause customers to fall behind on utility bills, and thus, affordability issues persist.

GCWW does not currently have a sustainably-funded customer assistance program to offer bill discounts or reduced rates for qualified customers. Based on the utility's recent experience with pandemic relief funding, the traditional approach to customer assistance programs is only marginally successful, can be resource intensive to implement, and does not reach many customers in need. GCWW is interested in exploring alternative options that may provide a more holistic approach to bill affordability issues that would reach customers in need while minimizing the overall cost to operate traditional types of programs. This project opens the rate-making discussion by considering non-traditional but valid elements to cost-of-service analyses, including the social value of water.

The GCWW billing and water system information used as part of this study was provided for exploratory analyses only. The provision of data to the US Water Alliance does not imply the City of Cincinnati's endorsement or acceptance of any changes or modifications to the current GCWW rate structure, which must be approved by the City of Cincinnati Council.

Defining Terms

This report focuses on water and wastewater affordability as a component of water equity. These are our definitions of the two terms, drawing from a range of sources.

Water equity: Equity refers to just and fair inclusion—a condition in which everyone has an opportunity to participate and prosper. Water equity occurs when all communities have access to safe, clean, affordable drinking water and wastewater services; are resilient in the face of floods, drought, and other climate risks; have a role in decision-making processes related to water management in their communities; and share in the economic, social, and environmental benefits of water systems.

Water affordability: Water affordability means that the costs of water systems are distributed equitably across society. When water is affordable, cost is never a barrier to accessing safe, clean, reliable services. For the purposes of this report, water affordability means that all residential customers in a utility's service area, regardless of income, can pay for water and wastewater services without having to forgo or cut back on other necessary expenses like housing, food, medication, transportation, or other utility services.

Methodology—Greater Cincinnati Water Works Study

This study evaluates the feasibility and impacts of using an evolved and rational pricing model to recover a share of water system costs and better reflect the public and social value of water services and more equitably distribute costs. **The hypothesis of the study is that specific system costs can be removed from traditional charges like flow and customer-based rates and instead be redistributed with a cost-based methodology using property characteristics that are more reflective of customers' ability to pay, increasing affordability and equity.** Our approach maintains and is informed by the nexus between the costs of providing water services and the use of readily available property characteristics to charge customers for specific system costs. Some of the property characteristics this model considers might result in a more equitable cost allocation by considering variables that have previously been left out of traditional cost allocation models. This model could potentially allow utilities to improve affordability outcomes without collecting customer income data or creating customer assistance programs. Further, this model could be used alongside customer assistance programs as part of a holistic, multipronged approach to affordability.

We compiled and analyzed utility data across a four-step process to evaluate the impact of our model on utilities and residential customers. Each step is described in further detail in the following sections:

1. **Determine System Costs and Assign Them to Customer Classes:** Isolate specific utility system costs allocated to a particular group of customers by summarizing findings from a detailed cost-of-service study.

2. **Compile Data on Current and Proposed Billing Units:** Collect, align, and join customer billing, parcel, and building data to summarize potential billing units under current and evolved pricing models.

3. **Calculate Current and Proposed Unit Costs:** Calculate unit costs by system function under current and proposed pricing models by translating current flow and customer unit costs to unit costs based on select property characteristics.

4. **Compare Estimated Bill Impacts on Customers:** Use unit costs under the current pricing model to subtract current system function cost recovery in existing bills and replace them with estimated cost recovery allocations using the evolved pricing model to estimate changes in bills.

Property characteristics considered in the study

In this study, we evaluated the impacts of assessing a charge to customer bills based on more granular data than historically used in rate-setting and based on property characteristics. We used the following characteristics as proxies for household-level economic data because they generally correlate to income, poverty, and unemployment levels. They are also associated with increased system costs. In our analysis, we compared these different characteristics to determine which would be most effective in reaching equitable outcomes (recognizing that this also depends on the context in different cities). The following list outlines our rationale for the characteristics we included in the analysis:

- **Frontage feet:** Properties with longer frontages require further extension of distribution system pipelines to reach all customers, increasing both the capital and maintenance costs of the distribution system and increasing the potential for system water losses.

- **Parcel area**: Larger parcels have potential for higher water use, requiring greater capacity and supply and treatment needs. Parcel area could also serve as a proxy for the same rationale described under frontage feet if frontage feet information is not readily available.

- **Building footprint:** Larger buildings are associated with greater fire protection demands, as well as having the potential for a greater number of occupants that could increase capacity needs.

- **Property value:** Properties of higher value can be said to receive a greater benefit from fire protection, because fire protection is in place to protect the property from damage and loss of value.

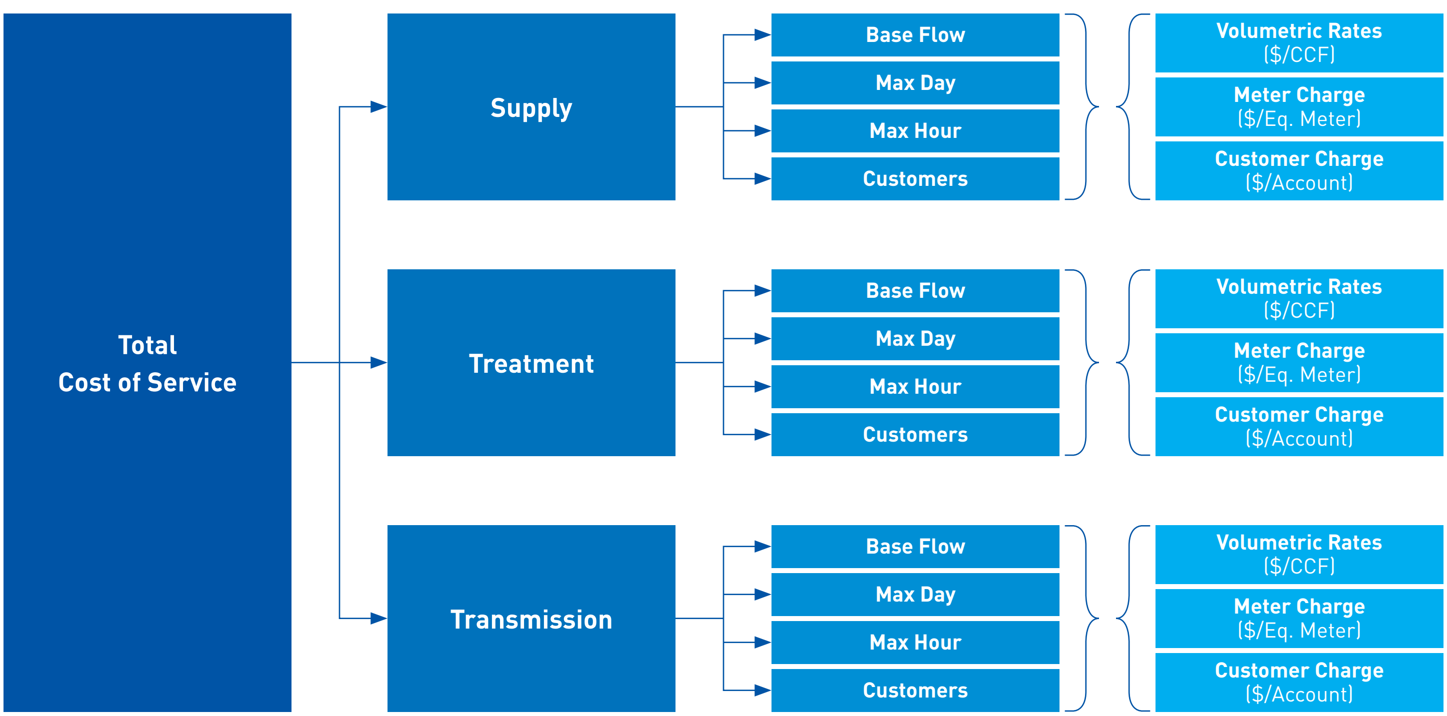
- **Number of bedrooms:** A greater number of bedrooms represents a higher potential number of occupants for a household, representing a greater potential need for water supply and treatment. We did not consider the number of units because this study focused on homeowner-occupied units, as described below.

Step 1:
Determine System Costs and Assign Them to Customer Classes

Step 1 summary: In this first step, we used city data on utility cost of service to determine what costs were incurred by residential users within city limits. Utilities use cost-of-service studies to determine the total cost of providing and treating water and maintaining the system. They then determine the costs of delivering water to different customer classes (i.e., residential, commercial, and industrial). These analyses are used to determine how much utilities will charge customers to recover the costs of operating the system. In this study, we considered the costs of water distribution, supply, treatment, pumping, and transmission as costs that could be recovered through this pricing model.

Determining the specific types of water system costs allocated to a group of customers requires a detailed cost-of-service (COS) study or analysis. Utilities could also consider taking a less data-intensive approach and identify a percentage of total costs to be included in the alternative pricing model. This may be appropriate for some systems, given the rigor and/or infrequency of performing cost-of-service studies. We used GCWW's most recent detailed COS study. This study used the base-extra capacity methodology[4] to allocate water system costs to functions and customer classes. Figure 1 illustrates the general approach to this method of COS-based rate setting. Generally, the process begins by determining the total revenue required from rates for a given test year. This revenue requirement is then allocated across system functions to estimate how much it costs the utility to provide these functions and services to customers. Functional costs are then allocated to general design and usage parameters, including average, maximum day, and peak hour flows as well as customer-related parameters. Finally, these costs can be allocated to each customer class based on their respective share of those average, maximum day, and peak hour flows, as well as customer parameters. Once costs have been broken down to this level, rates are designed to establish how these costs will be recovered from customers.

Figure 1:
Overview of cost-of-service rate-setting methodology



In GCWW's COS rate study, the revenue requirements were broken down by customer type and customer class, reporting detailed costs that can be assigned to inside-city customers, to various outside-city retail and wholesale customers, or as "common to all" customers. We used the COS study to isolate utility system costs allocated to inside-city residential customers only. We focused on these customers for several reasons, including the consistency of water billing data and rates paid for a single customer group, as well as the relative consistency and completeness of parcel and building data within the city and similarities in customer characteristics (such as meter size, range of consumption, parcel/building sizes, etc.). Additionally, limiting the focus to these customers where property data was cleaner, complete, and consistent made for more alignment of the functional costs in the COS study and the bill impacts. Within this group of customers, we focused on homeowners, since residents that own their own homes pay water bills directly to the utility (as opposed to renters, whose water bills may be added to their rent and paid through their landlord).

Once the inside-city residential customers were isolated by extracting solely the customers in the residential customer class and the inside-city customer category from the billing data, we aligned costs for specific system functions that were allocated to these customers. This analysis disaggregated costs for distribution, supply, treatment, pumping, and transmission. We allocated functional costs to common units of service used in the base-extra capacity approach to rate setting, namely base flow, maximum day flow, peak hour flow, customers/bills, and equivalent meters.

Finally, to simplify the analysis of bill impacts, all costs captured in the flow-related parameters of the cost allocation process (i.e., base flow, maximum day, and peak hour costs) were divided by total inside-city billed flow to calculate a single volumetric unit cost per hundred cubic feet (CCF). All costs allocated to the customer and meter-related parameters were divided by the total number of bills to determine a single monthly unit cost in terms of dollars per bill. These costs were further broken down into operations and maintenance costs and capital costs to allow for different combinations of cost recovery options in the evolved pricing model. Table 1 provides an example of the process, illustrating the steps to deriving the distribution system functional costs allocable to inside-city residential customers from the total cost of service.

Table 1 shows that the example case with distribution system costs being recovered through an evolved pricing model using property characteristics would represent approximately $8.2 million of the $24.8 million in total inside-city residential revenue requirements, or about 33 percent of the total class-level revenue requirements. The remaining 66 percent of costs would continue to be recovered using existing methods. As highlighted later in the report, there could be other types of system costs, such as public fire protection or water supply, that may be well suited for inclusion in this pricing model based on property characteristics. Recovering other costs in addition to distribution system costs through this pricing strategy would be expected to enhance the magnitude of the bill impacts we identified.

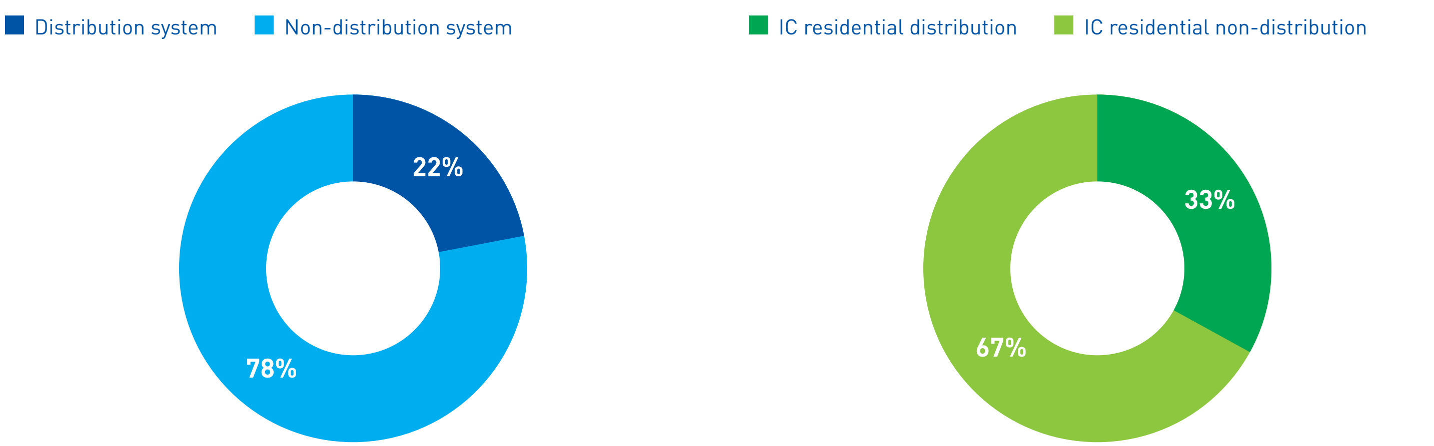
Table 1:

Example cost allocation process summarizing distribution costs allocated to inside-city residential customers

Cost Allocation Process	Cost Allocations		
Total Cost of Service (COS)	$179,265,700		
Customer COS			
Total COS to Inside City	**COS to Inside City** $64,430,000	**COS to Outside City** $114,835,700	
Total COS to Residential	**Residential** $78,317,200	**Non-Residential** $100,948,500	
Total COS to Inside City Residential	**Inside City Residential** $24,816,700	**Outside City Residential** $53,500,500	**Non-Residential** $100,948,500
System Function COS			
Distribution COS	**Distribution System** $39,504,730	**Non-Distribution System** $139,760,970	
Functional COS to Customer Class			
Distribution COS to Inside City Residential	**Dist. Syst. to Inside City Res.** $8,224,572	**Dist. Syst. to Others** $31,280,158	**Non-Dist. Syst.** $139,760,970

Figure 2:

Distribution system costs as a share of total costs and distribution system costs allocated to inside-city residential customers as a share of total inside-city residential customer costs



Step 2:
Compile Data on Current and Proposed Billing Units

Step 2 summary: We used utility data to assign shares of system costs to different parcels in the city. We then compared this data with census tract-level socioeconomic data and parcel-level shutoff data to evaluate the potential impacts of this pricing model on lower-income households.

To align water use under the current pricing approach with the potential impacts of changes under the evolved model, we collected all utility billing and property information and connected it to each parcel in the city using a premise identification number. We used the following information from various sources:

- **Utility billing data**
  - Customer classification
  - Monthly/quarterly water consumption
  - Monthly/quarterly water bill
  - Account identification number
  - Premise identification number

- **County parcel data**
  - Premise identification number
  - Parcel size in acres
  - Assessed property value

- **County building data**
  - Premise identification number
  - Building size in square feet

- **Generated data**
  - Property frontage in linear feet
  - Number of bedrooms

All but the last two datasets were provided from GCWW or Hamilton County, Ohio, sources. We could not obtain frontage feet data from existing property-related data sources, so this information was generated from a spatial analysis conducted in ArcGIS. We offset road centerlines to intersect property boundaries and extract the frontage boundary. The resulting GIS layer is imperfect, but we determined that the level of accuracy was suitable for a pilot-level analysis. We also could not locate the number of bedrooms in the available parcel or building information, and the County Assessor's office confirmed that this data is not available. We arrived at an estimate by pairing census tract-level data estimates of the average number of bedrooms per household with the number of households evaluated in each tract. The product of households and number of bedrooms was used as the denominator in the calculation of the unit costs, and the average number of bedrooms could be used for evaluation of bill impacts. The availability of specific and reliable property data is a key consideration in determining which property-based characteristics could be used in this model. Nevertheless, estimations are common in cost-of-service analyses, and the estimated values used in this study are consistent with use of estimated values in traditional cost-of-service studies.

These data were compiled through a combination of spatial analysis conducted in ArcGIS and database analysis to join data based on unique identifiers like premise identifications. As is typically the case in this form of analysis, we dropped a small share of data points from the dataset where complete water consumption, parcel, or building data were not available. We also scrubbed the data for outliers and known inconsistencies. The final output of this analysis was a master dataset containing account-level data for each of the current and proposed pricing strategies of interest (except for number of bedrooms, which was summarized only at the tract level). The total billing units for each of the current and proposed pricing strategies are presented in Table 2.

After compiling, reviewing, and cleaning the account, parcel, and building data, the information was rolled up to the census tract and neighborhood for further analysis at a summary level. This tract and neighborhood-level summary allowed us to evaluate the resulting bills relative to income and other socioeconomic characteristics (as discussed later). GCWW also provided data on water shutoffs at the account level, which was joined into the master dataset to be used in evaluating the bill impacts of the evolved model.

Once the data were rolled up to the census tract level, we analyzed the correlations of the current and proposed billing units with consumption, median household income, and lowest quintile income as a preliminary screening step in the analysis. This correlation analysis provided an initial assessment of the potential for each approach to improve affordability and equity outcomes. These correlation coefficients are also shown in Table 2, with the shading indicating stronger (green) or weaker (orange and yellow) correlations between the variables of interest.

Based on the correlation analysis, each of the evolved method parameter options has approximately equal or greater correlations with income levels as compared to the correlation between consumption and income. Only parcel area and median household income yielded lower correlations than consumption and median household income. This provided early insight into the strong potential for each of these alternative approaches to improve equity outcomes over the use of water consumption as a pricing method.

Table 2:
Current and proposed billing units used in the pricing analysis

Stronger correlation — Weaker correlation

		Correlation Analyses		
	Units of Service	**Consumption**	**Median Household Income**	**Lowest Quintile Income**
Current				
Customer Bills	834,624	N/A	N/A	N/A
Consumption (CCF)	4,412,181	N/A	0.5662	0.5271
Evolved Method				
Property Value	$11,642,369,546	0.6579	0.7842	0.6828
Number of Bedrooms	162,970	0.4156	0.7549	0.7860
Frontage Feet (Linear Feet)	4,538,872	0.5194	0.6260	0.6292
Building Area (Square Feet)	100,401,975	0.5662	0.5947	0.5671
Parcel Area (Acres)	13,020	0.5526	0.5651	0.5677

Step 3:
Calculate Current and Proposed Unit Costs

Step 3 summary: In this step, we calculated the cost of service to individual units under the current pricing structure and under the proposed pricing model. We then calculated what typical bills would be for the average customer in each census tract and neighborhood under each pricing alternative. Table 3 shows this calculation process using frontage feet as an example.

As previously mentioned, this analysis focused on residential customers inside Cincinnati, and a certain number of accounts and parcels were dropped from the analysis in the process of compiling the data sources. As a result, unit costs could be calculated using the existing COS study values, but small adjustments were made to analyze costs recovered from the total billed flow, frontage feet, parcel area, building area, property values, and number of bedrooms from the customers with all available data to be included in the analysis.

In the final step in developing the cost basis for the analysis, we calculated the unit costs of service for the current and evolved models, focusing on specific system function costs and particular customer class(es) of interest. The steps to calculating the unit costs are outlined below and further detailed in Table 3, with frontage feet as an example of a property characteristic that can be used to recover distribution system costs.

- **Cost of service to current billing units:** The COS analysis allocated system costs to base (i.e., total), maximum day, and peak hour flow parameters, and to meters, billing, and customer parameters. To simplify the conversion of existing unit costs to alternative billing units, the three flow parameters were grouped and divided by total flow, and the three customer-related parameters were aggregated and then divided by the number of customers. Unit flow costs were then calculated as dollars per CCF of billed flow. Unit customer costs were calculated as dollars per account (or bill for typical monthly bills).

Table 3:
Unit cost calculations to convert flow and account unit costs to frontage feet unit costs. Frontage feet is used as an example; this calculation was performed for all the property-based parameters

Row label	Description	Formula	Flow (CCF)	Customer (Bills)
A	Total Distribution Costs		$5,490,801	$2,733,771
B	COS Units of Service		4,826,465	834,624
C	COS Unit Cost	C = A/B	$1.14	$3.28
D	Billing Units		4,412,181	829,056
E	Costs to be Recovered	E = C*D	$5,019,493	$2,715,533
F	**Total Costs to be Recovered**	**F = E(Flow)+E(Customer)**		**$7,735,026**
G	Frontage Total Units (feet)			4,538,872
H	**Alternative Billing Unit Cost**	**H = F/G**		**$1.70**

- **Cost of service recovered by analyzed customers:** The unit costs calculated in the previous step were multiplied by the total flow and the total number of accounts included in the analysis in recognition of the fact that a portion of accounts were dropped when merging the various datasets. This calculation determined the total costs to be recovered by the customers with sufficient data for complete analysis.

- **Determination of alternative unit costs:** The total cost of service to be recovered from customers included in the analysis was finally divided by the totals of each unit of interest for the alternative pricing methods (summarized in Table 3 using frontage feet as an example) to determine a unit cost of service for the specific system function allocable to these customers.

Once unit costs were developed for the alternative pricing methods, typical bills were calculated for each individual customer and for the average customer in each census tract and neighborhood using each property characteristic. This calculation of revenue-neutral unit costs allowed for bills to be reduced based on the current unit costs for the specific system function, and to subsequently add back the system function costs based on the alternative pricing method unit cost and the typical values for each alternative.

Step 4: **Compare Estimated Bill Impacts on Customers**

Step 4 summary: We used the information generated in the previous steps to compare estimated water bills under the proposed pricing model to existing bills. We performed this calculation at the parcel, census tract, and neighborhood level for each property characteristic.

Finally, we used the information generated in the preceding steps to evaluate the affordability impacts to residential customers of shifting cost recovery to a property-based billing component. This final step involves a comparison of typical bills before and after a shift in cost recovery between current and alternative billing units.

The fundamental calculations were the same at the account, tract, and neighborhood levels. We estimated monthly bill impacts by calculating the typical bill based on current rates and consumption levels. Next, we estimated the current COS-based cost recovery for each system function (i.e., distribution) based on the breakdown of the COS analysis described above. We compared this current cost recovery to the same system cost recovery using the unit costs for the alternative pricing model and multiplied by the specific parcel billing units, or by the census tract- or neighborhood-level typical value for the alternative model. After this, we compared the difference between these two cost recovery estimates against the original bill to determine the bill impact in dollar and percentage terms. Finally, we used the information generated in the preceding steps to evaluate the affordability impacts to residential customers of shifting cost recovery to a property-based billing component. This final step involves a comparison of typical bills before and after a shift in cost recovery between current and alternative billing units.

Table 4 shows an example of the neighborhood-level bill impact calculation using the distribution system cost category and frontage feet as the alternative billing unit.

Table 4:
Example of bill impact calculations using distribution system costs and frontage feet

A	**Neighborhood Typical Bill**		**$26.35**

Current Distribution System Cost Recovery

Row label	Item	Formula	Value
	Distribution System Unit Costs		
B	Customer		$3.28
C	Flow (CCF)		$1.14
	Distribution System Cost Recovery		
D	Neighborhood Typical Consumption (CCF)		6.07
E	**Typical Current Bill Cost Recovery**	**E = B + (C x D)**	**$10.19**

F ### Alternative Pricing Method Cost Recovery

Row label	Item	Formula	Value
	Frontage Feet Unit Costs		
G	Frontage Unit Cost ($/LF per month)		$0.142
H	Typical Frontage (LF)		52.7
I	**Typical Alternative Bill Cost Recovery**	**I = G x H**	**$7.49**
J	**Bill Impact**	**J = I – E**	**($2.70)**
K	**Percent Bill Impact**	**K = J / A**	**-10.2%**

Study Findings:
Equity and Affordability Impacts

Findings summary: Finally, we evaluated equity and affordability impacts under the new pricing model. Our goal was to identify property characteristics that would result in more equitable outcomes than the current utility pricing model—outcomes in which a greater share of water system costs are provided by customers with more ability to pay and cost-based justifications to pay more. We evaluated equity outcomes at the parcel and neighborhood level, along with data on household income and water shutoffs. Our calculations also considered the magnitude of bill impacts under the different options and the number of accounts in each neighborhood. Under all these measures, property value was the most effective at achieving equitable outcomes.

After calculating costs and bill impacts under the evolved pricing model, we were ready to evaluate how this model would affect customers. This section includes discussion of both parcel-level and summary-level bill impacts to understand the overarching affordability and equity outcomes. Affordability and equity are interrelated but distinct characteristics. For the purposes of this discussion of findings, reductions in bills, particularly in low-income regions of the city, are considered improvements in **affordability**. However, when some customers' bills decrease, others must increase to maintain revenue neutrality. The overall goal of this study is to distribute water system costs more equitably—not simply to lower all customers' bills. Therefore, we consider situations where bills decrease in lower-income neighborhoods and increase in higher-income neighborhoods to represent improvements in **equity**. In these scenarios, the utility collects a lower share of revenue from customers with less ability to pay by collecting more revenue from customers with higher ability to pay (note that some states may have statutory limitations that make this approach challenging; see the "Considerations for Implementation" section below for a further discussion of this issue). We make this distinction between affordability and equity to describe the impacts of the model clearly and to allow for a consideration of the tradeoffs involved in maintaining a predetermined level of revenue.

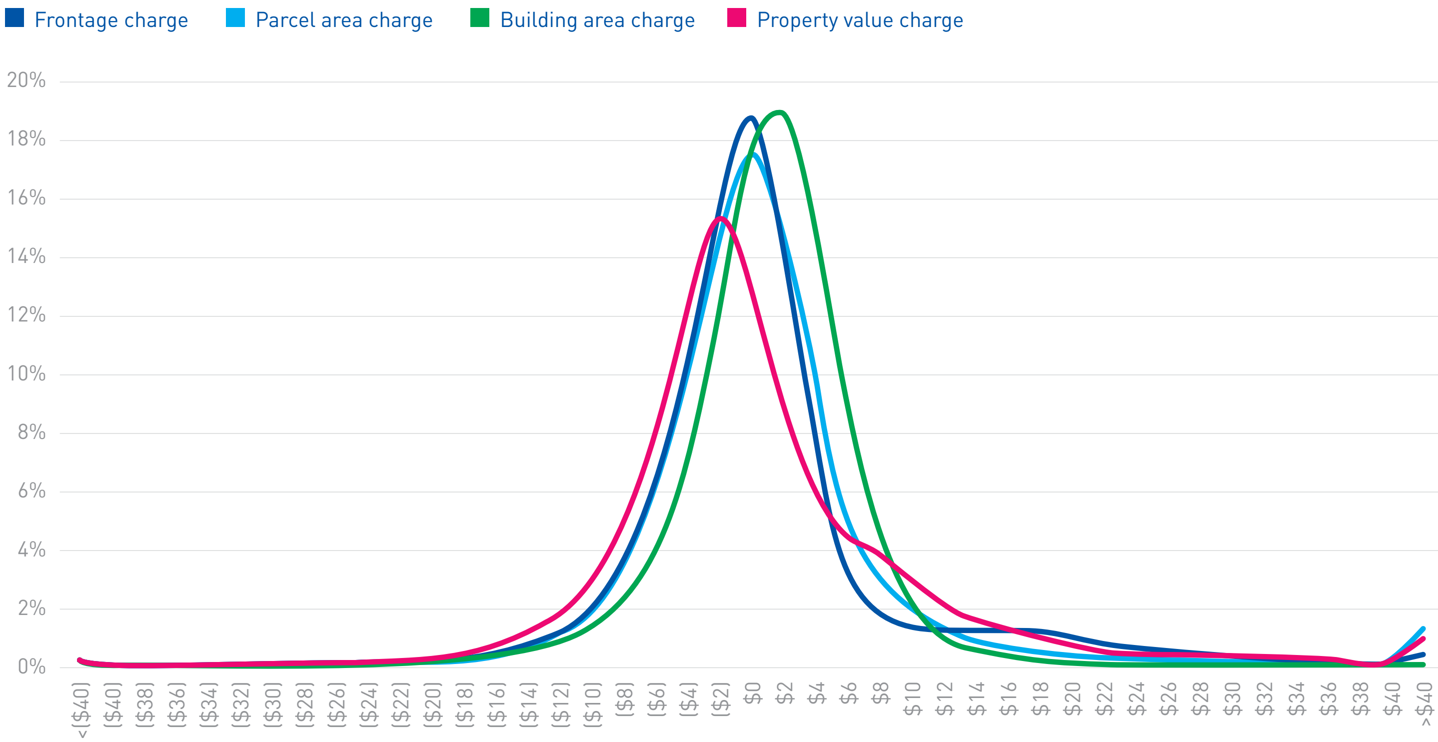
It should be noted that we could not evaluate billing based on the number of bedrooms at the parcel level because these data were only available at the census tract level. Our parcel-level analysis was limited in efforts to compare bill impacts to socioeconomic characteristics. Parcel-level impacts were rolled up to the census tract and neighborhood levels to place those impacts in the context of income, poverty, and other socioeconomic characteristics.

Parcel-level impacts

We started by evaluating bill impacts at the parcel or account level to understand the range of impacts that could be expected from shifting a portion of customers' bills from consumption and flat per-bill charges to a property-based charge. Figure 3 shows the range and distribution of bill impacts resulting from recovering residential distribution system costs through a charge based on the different property characteristics.

The distribution of bill impacts shown in Figure 3 provides some insight into the changes to customer bills under each property characteristic. For example, building area has a high distribution peak and narrower spread, suggesting that most customers would see almost no change to their bills, with smaller numbers of customers seeing an increase or decrease of about $12. In comparison, property value shows a lower peak and wider spread. This indicates that fewer people would see a small change in their bills and more customers would see their bills increase by up to $40. This finding alone does not mean that any characteristic is more equitable or effective, but it is useful in understanding the potential implementation considerations for each option.

Figure 3:
Monthly bill impacts histogram for recovery of distribution system costs from the evolved pricing model



Neighborhood-level impacts

To understand bill impacts relative to socioeconomic characteristics, we overlaid the bill impact data with census data on income, poverty, and unemployment. We also included data on water shutoffs, since they may be an indicator of affordability challenges. This summary highlights a sample of 11 diverse Cincinnati neighborhoods out of the 50 that we included in our analysis. A summary of accounts, shutoffs, socioeconomic, consumption/bills, parcel, building, property value, and bedroom data by neighborhood is provided in the appendix.

Table 5 shows bill impacts for each property characteristic in the 11 neighborhoods. After determining approximate bill impacts for each neighborhood, these impacts were compared to the neighborhood's income levels, including median household income (MHI) and lowest quintile income (LQI). Because actual income characteristics are not available by neighborhood, estimates were calculated using weighted averages of census tract income characteristics for the tracts making up each neighborhood, weighted by the share of a tract within the neighborhood and the number of households in each tract. As a point of comparison, the Cincinnati citywide MHI is $40,640 and LQI is $14,284.[5] Table 5 also presents the percentage of accounts experiencing at least one shutoff due to nonpayment and the typical monthly bill in the neighborhood. Finally, the color coding illustrates equity impacts in each neighborhood under the pricing alternatives. Green indicates that typical bills are reduced in neighborhoods where the MHI is below the citywide MHI, or that typical bills are increased in neighborhoods where MHI is greater than the citywide MHI. We consider these outcomes equitable because they align bills more closely to ability to pay than the current pricing model. Red indicates that the proposed pricing model does not create an equitable change.

Table 5:
Neighborhood income characteristics and typical bill impacts under evolved pricing model options

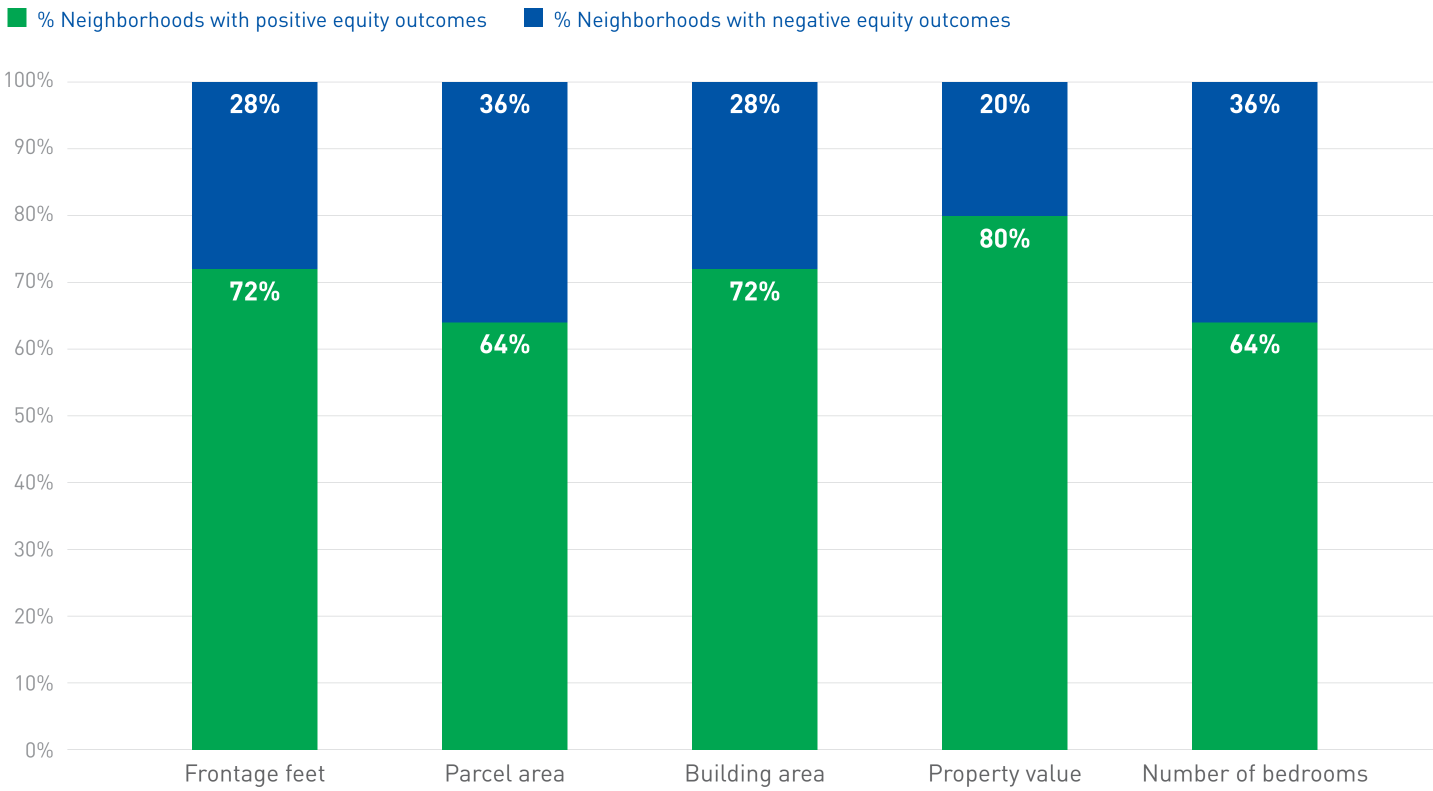
Decrease   Increase

					Bill Impacts				
Neighborhood	**MHI**	**LQI**	**% Acct Shutoffs**	**Typical Bill**	**Frontage Feet**	**Parcel Area**	**Building Area**	**Property Value**	**No. of Bedrooms**
Neighborhood A	$13,706	$7,235	13.0%	$24.11	($1.25)	($0.49)	($0.69)	($7.56)	($1.06)
Neighborhood B	$15,271	$6,956	0.0%	$20.84	$14.74	$36.38	$4.17	($2.13)	$0.94
Neighborhood C	$28,905	$13,351	5.9%	$24.01	$2.22	$6.04	$2.09	($2.65)	$0.02
Neighborhood D	$32,047	$13,431	8.2%	$26.35	($2.70)	($3.39)	($2.36)	($7.33)	($1.42)
Citywide LQI		**$14,284**							
Neighborhood E	$39,562	$19,476	5.6%	$24.41	($1.53)	($1.64)	($1.38)	($5.40)	$1.02
Citywide MHI	**$40,640**								
Neighborhood F	$41,081	$16,168	3.6%	$24.07	($1.32)	($2.89)	($0.50)	($3.42)	$1.08
Neighborhood G	$49,139	$17,927	0.5%	$26.37	$1.88	$3.75	$1.53	$6.34	($1.41)
Neighborhood H	$57,806	$24,680	0.7%	$21.36	$2.68	$5.84	$2.10	$0.76	$1.29
Neighborhood I	$84,973	$34,147	0.6%	$22.41	($1.09)	($6.22)	$0.17	$19.39	($1.03)
Neighborhood J	$97,631	$40,553	0.5%	$27.95	$0.47	$1.70	$0.89	$18.49	($0.13)
Neighborhood K	$131,083	$64,363	0.6%	$26.33	$0.81	$1.12	$0.04	$17.82	$1.98

Table 5 demonstrates the variability in outcomes for the sample neighborhoods under each characteristic. These results indicate that of the characteristics we are considering, property value produces the greatest number of favorable outcomes among sample neighborhoods. Number of bedrooms was the least successful in improving equity. We also performed this evaluation for all 50 neighborhoods, as shown in Figure 3.

Figure 3 also shows property value to be the most effective in achieving equitable outcomes, followed by frontage feet and building area. It is also worth further investigating the magnitude of impacts under each alternative. For example, in reviewing the results from Figure 4, using property value produces positive outcomes in a large majority of neighborhoods, and Table 5 demonstrates that the magnitude of the impact is generally larger than the other property characteristics.

Figure 4:
Percentage of Cincinnati neighborhoods with positive and negative affordability outcomes



Neighborhood-level histograms provide more insight into how different property characteristics affect bills. The figures below show bill impacts in Neighborhoods D (low-income) and J (high-income), each of which represent different contexts and contain many account and parcel datapoints. These histograms allow for a comparison of the range of bill impacts within specific neighborhoods and illustrate the similarities and differences in outcomes under each pricing alternative in two distinctly different neighborhoods in the city.

This comparison of neighborhoods shows a general tendency toward bill reductions in neighborhoods experiencing the greatest number of shutoffs (although the neighborhoods with high numbers of shutoffs do not necessarily see the largest bill reductions). Frontage feet, parcel area, and building area are all generally centered around a mean of zero change in bills, with slight differences pushing the average change in bills modestly down in Neighborhood D and up in Neighborhood J. The use of property value, however, yields vastly different results as very high property values in Neighborhood J push the distribution of bill impacts far to the right with many accounts experiencing bill impacts greater than $40. In Neighborhood D, however, bill impacts using property value stay closer to zero with the peak of the distribution around a $4 to $6 bill reduction.

Figure 5:

Neighborhood D (low-income) monthly bill impacts histogram for recovery of distribution system costs from alternative pricing model

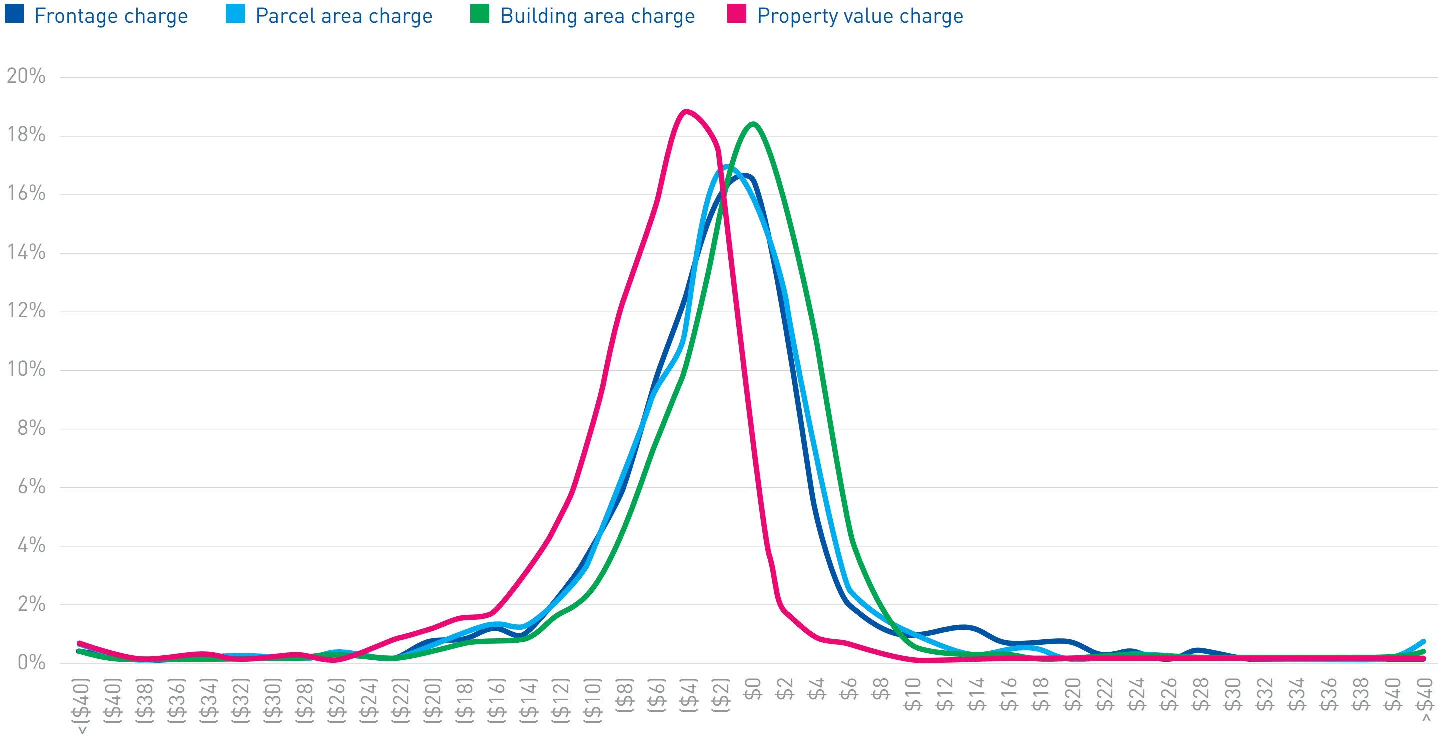
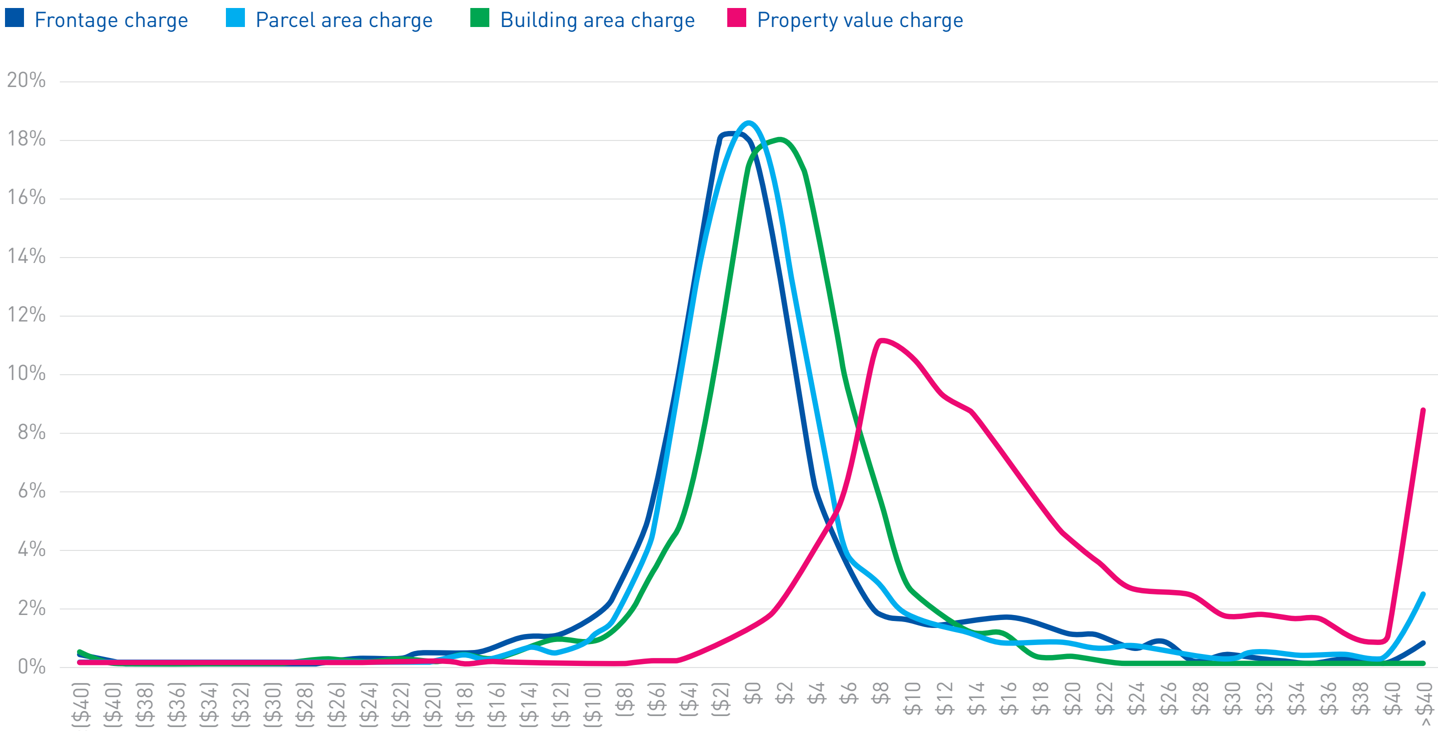


Figure 6:

Neighborhood J (high-income) monthly bill impacts histogram for recovery of distribution system costs from alternative pricing model



To combine these elements, we calculated correlation coefficients for each alternative, quantifying the correlation between bill impacts and the difference between the neighborhood MHI/LQI and the Cincinnati citywide MHI/LQI. The number of accounts varies substantially between neighborhoods, so to account for this fact we weighted the correlation calculation based on the number of accounts in each neighborhood. Table 6 shows these weighted correlation coefficients between bill impacts (increases/decreases in bills under each option) and neighborhood income deviations from the citywide value (positive for incomes greater than the citywide MHI or LQI; negative for incomes less than the citywide MHI or LQI).

It is useful to compare the results in Figure 4 to those in Table 6 as the magnitude of impacts and deviations in incomes from the citywide values factors into the analysis of correlation coefficients. Comparing the outcomes under the frontage feet and building area options, Figure 4 shows that the same number of neighborhoods will realize equity improvements while Table 6 shows that the use of building area yields a stronger correlation between bill impacts and deviations from citywide income characteristics. This indicates that the relationship between the two variables of interest is closer to a linear relationship, and there are fewer extreme impacts under the options with higher correlations. Similar results can be seen in comparing the use of parcel area and number of bedrooms, with number of bedrooms showing slightly greater correlation results. In all results, the use of property value yields the greatest equity improvements.

It is also instructive to compare bill impacts in the neighborhoods with the greatest rate of shutoffs due to nonpayment. Figure 7 displays bill impact percentages by neighborhood with blue shading representing different levels of bill reductions and green shading representing different levels of bill increases. Figure 8 illustrates the percentage of accounts experiencing at least one water shutoff due to nonpayment in each neighborhood. Neighborhoods with higher rates of shutoffs are represented by darker shades of blue.

This comparison of neighborhoods shows a general tendency toward bill reductions in neighborhoods experiencing the greatest number of shutoffs. Similar relationships can be seen when using the other property characteristics in the results shown in Table 5, where typical bills would decrease under most of the options in three of the five neighborhoods with the highest rates of shutoffs. Additional bill impact maps are included in the appendix for geospatial visualization of the bill impact results.

Table 6:
Weighted correlation coefficients for bill impacts and differences between neighborhood MHI/LQI and citywide MHI/LQI

Property Characteristic	Weighted MHI-Bill Delta Correlation	Weighted LQI-Bill Delta Correlation
Frontage Feet	0.34	0.37
Parcel Area	0.22	0.29
Building Area	0.39	0.38
Property Value	0.92	0.84
No. of Bedrooms	0.38	0.46

Figure 7:
Typical bill impacts by neighborhood for alternative pricing method based on distribution system costs and property value

- <-25%
- -25% to -10%
- -10% to -5%
- -5% to 0%
- 0% to 5%
- 5% to 10%
- 10% to 25%
- >25%

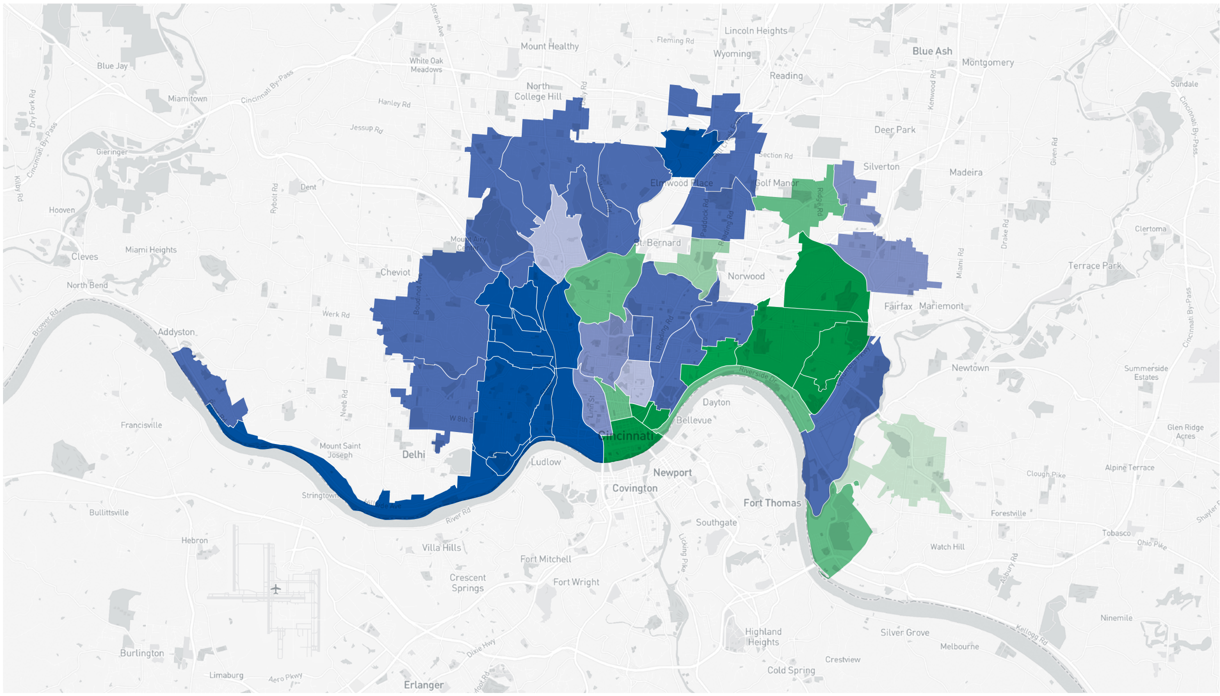
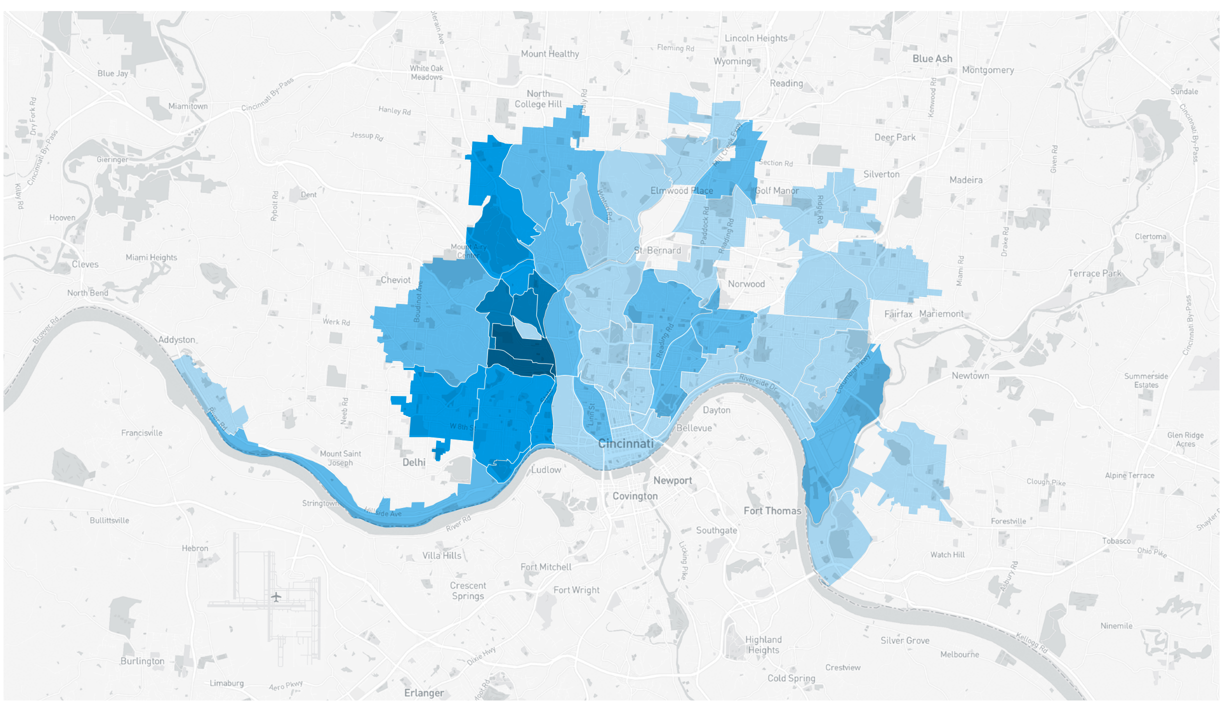


Figure 8:
Percentage of residential accounts experiencing shutoffs for nonpayment by neighborhood

- <3%
- 3% to 5%
- 5% to 10%
- 10% to 15%
- >15%



Summary of Findings

This analysis of Greater Cincinnati Water Works' cost of service analysis, billing data, residential property characteristics, and regional income data provides useful insights in considering an alternative water pricing model based on property characteristics. A few key takeaways are outlined below:

- Each of the billing options considered for the alternative model improved equity outcomes in the majority of neighborhoods, indicating that such a model would improve water bill affordability for most low-income households.

- Results varied across parcels and neighborhoods, and there are exceptions to the general trend of affordability improvements. This would likely require further intervention, such as an appeals process or some form of assistance for low-income households that do not benefit from the pricing model.

- The range of bill impact magnitudes differed across the different property characteristics, with the use of property value yielding the largest bill impacts by neighborhood and producing the widest spread in the overall distribution of account-level impacts. The other options produced relatively similar distributions of bill impacts across parcels and neighborhoods.

- In addition to improving affordability in most low-income neighborhoods, these property-related charges also tended to yield bill reductions in neighborhoods with the highest rates of water shutoffs.

Considerations for Implementation

Every utility operates under a unique set of constraints and opportunities. Local laws, economic conditions, political climate, housing characteristics, and other factors affect how this model would function for different utilities. This study is not intended to represent definitive outcomes for all cases, but rather to serve as a case study for communities and agencies looking for alternative strategies to enhance water equity and affordability. Individual utilities can modify, adapt, and iterate on the pricing model described here to fit the context in which they operate. The following considerations may be useful for utilities as they assess the possibility of implementing a variation of the pricing model presented here.

Protections for outliers

This pricing model adds a charge to utility bills based on publicly available property data. These data provide enough of a proxy to help utilities improve affordability without requiring the collection and verification of household income data. This is intended to be easier and more cost-effective for utilities and customers than assistance programs that require customer application and income verification. Findings indicate that the property attributes included in the study are generally good proxies for income, but they do not always perfectly reflect customers' financial conditions. There will be cases when bills increase for households that cannot pay them. This could be due to publicly available property data being incorrect or out of date, or because a household's property does not reflect their economic conditions; for example, a low-income family living in a large house. The risk of outlier cases depends on which characteristics are used in the evolved pricing model and housing conditions in the city. For example, if the model is based on square footage, wealthy people living in small apartments could pay a reduced bill. If parcel area is used, lower-income homeowners whose homes are on large lots could be charged more than they can afford.

Utilities can protect these outliers by creating an appeals process for customers who have been charged inaccurately. There are examples of similar appeals processes at some stormwater utilities that assess charges based on parcel area or impervious area. The appeals process should include the option for low-income households whose bills have increased to submit documentation verifying their income and potentially receive a bill reduction and/or be directed to other assistance programs. This income verification process would be similar to many customer assistance programs and potentially present the same challenges. However, our findings suggest that under the evolved pricing model, most low-income households would see their bills reduced automatically, so a much smaller group of low-income households would have to verify their income than under a traditional customer assistance program that requires **all** low-income people to submit income verification paperwork. The appeals and income verification processes should be simple and clearly publicized to ensure that customers are aware of their options. The utility can also track indicators to alert them to possible outliers. For example, if a household is being charged at a higher rate based on property characteristics but falls far behind on their bills, it may indicate that they cannot afford the new charge. In these cases, the utility can reach out to verify income and offer support.

Cost of service considerations

This study focused on restructuring rates on a "revenue neutral" basis within a customer class from traditional rate structures to incorporating a pricing model that reflects property characteristics. Utilities could also incorporate property-based characteristics into the rate-setting process before determining the revenue requirements for each customer classification. Referring back to Figure 1, this would mean including, for example, total building area as a basis for allocating specific system costs to each customer class, similar to the use of number of accounts and flow. While the approach presented herein restructures rates and affects cost recovery between customers within the residential customer class (i.e., affecting intraclass equity), this approach to including property characteristics in cost allocation would step "upstream" in the process and shift costs between customer classes (i.e., affecting interclass equity).

Rate design considerations

The pricing model options discussed in this report focused on a straightforward charge per unit of measure (i.e., dollars per square foot) applied to every individual parcel. Another possibility is structuring the charge in similar ways to water rates (i.e., uniform, tiered, fixed charge with a minimum allotment, etc.). For example, the evolved pricing method was evaluated to include a minimum allotment of water in the charge using each identified property characteristic. As a test case, the minimum allotment was set at 35 gallons per capita per day to represent efficient indoor usage[6] for the average Cincinnati household size of 2.1 people,[7] or about three CCF per month in a minimum usage allotment. Including this minimum allotment in the model generally yielded an increase in the bill impacts, making bill reductions and increases larger. In one of the 11 sample neighborhoods, however, the bill impact shifted from a bill reduction to a bill increase as the charge based on number of bedrooms for Neighborhood J went from a $0.13 reduction in Table 5 to a $0.35 increase in Table 7.

In addition to potential minimum allotments, this pricing method could potentially be implemented as tiered rates, similar to approaches commonly employed by stormwater utilities to create tiers of impervious area for residential customers. This approach could reduce the need for precise measurements of property characteristics, as charges are based on ranges, and could mitigate some of the outlier impacts, as the smallest and largest customers are grouped into tiers.

Revenue considerations

Two key points are worth considering in terms of revenue generation and revenue impacts. First, this analysis focuses on maintaining revenue neutrality by shifting revenue out of current rates and directly into the evolved pricing method, but another strategy would be to use this approach to generate additional revenue for specific utility functions or services. For example, utilities could use one of the alternative pricing methods to recover costs associated with increasing the rate of replacement of aging pipelines. This model could provide incremental funds for the mounting infrastructure investment needs of water systems.

Table 7:
Neighborhood income characteristics and typical bill impacts for each pricing strategy with a three CCF minimum allotment

Decrease   Increase

					Bill Impacts				
Neighborhood	MHI	LQI	% Acct Shutoffs	Typical Bill	Frontage Feet	Parcel Area	Building Area	Property Value	No. of Bedrooms
Neighborhood A	$13,706	$7,235	13.0%	$24.11	($1.69)	($0.65)	($0.93)	($10.32)	($1.43)
Neighborhood B	$15,271	$6,956	0.0%	$20.84	$19.71	$49.27	$5.27	($3.33)	$0.86
Neighborhood C	$28,905	$13,351	5.9%	$24.01	$3.03	$8.25	$2.85	($3.62)	$0.02
Neighborhood D	$32,047	$13,431	8.2%	$26.35	($3.37)	($4.32)	($2.90)	($9.70)	($1.62)
Neighborhood E	$39,562	$19,476	5.6%	$24.41	($2.04)	($2.18)	($1.83)	($7.32)	$1.44
Neighborhood F	$41,081	$16,168	3.6%	$24.07	($1.80)	($3.94)	($0.67)	($4.66)	$1.48
Neighborhood G	$49,139	$17,927	0.5%	$26.37	$2.88	$5.43	$2.40	$8.98	($1.61)
Neighborhood H	$57,806	$24,680	0.7%	$21.36	$3.31	$7.63	$2.52	$0.68	$1.41
Neighborhood I	$84,973	$34,147	0.6%	$22.41	($1.70)	($8.70)	$0.01	$26.28	($1.62)
Neighborhood J	$97,631	$40,553	0.5%	$27.95	$1.18	$2.84	$1.75	$25.78	$0.35
Neighborhood K	$131,083	$64,363	0.6%	$26.33	$1.42	$1.84	$0.36	$24.65	$3.02

Second, the evolved pricing model would generate a fixed revenue stream similar to a flat monthly customer charge or meter charge. This balance between fixed and variable revenue is an important consideration, particularly in regions with significant water conservation trends. The challenge to increasing traditional fixed charges, however, is that it reduces the ability of low-income households to lower their water bill by reducing water usage. This model could increase fixed revenues while charging based on property characteristics that tend to correlate with income, which would reduce bills and cost burdens for many lower-income households.

State legal and regulatory context

The pricing model presented here will be much more straightforward to implement in some states than others. It could prove challenging in states with strict limitations on utilities' use of rate revenues or on the level of precision and methods used in cost allocation and rate design processes. For example, while many states use language like "reasonable" and "equitable" in rate setting requirements, California's Proposition 218 requires strict proportionality between customer classes and between customers within a class. As a result, even such common rate structures as tiered or budget-based rates are commonly challenged in the courts. Some states limit the use of property value as a basis for charges to solely property taxes. Others narrowly define user rates/fees as charges for services that serve a regulatory purpose and are both proportional to service and controllable by the customer (i.e., water use that can be reduced by a user). Careful consideration and analysis from legal counsel will be critical in determining the viability of pursuing any of the options discussed.

Utilities should consider this model even if they are operating in a more restrictive context. It may be possible to change the laws to make innovative approaches feasible. Utilities can join forces with other agencies, trade associations, and advocacy groups that are organizing to repeal laws that restrict equitable policies.

Municipal context

Depending on a given utility's relationship with local government, pricing structure changes may entail different processes. Some utilities may require city council approval or inter-departmental or agency agreements to implement this model. In some cases, utility billing is handled by another agency (e.g., water service provider bills for wastewater service), in which case the utility would need to ensure that they can incorporate necessary data into the existing billing system or arrange to supplement the bills with the new charge. The utility would also likely need to collaborate with city or county agencies to manage updates to property-based data. For instance, the county assessor's office is often the keeper of property value and parcel and building feature data. Utilities should consult with their government affairs and legal departments to determine what is needed.

Tax considerations

Although the pricing model proposed here does not function exactly like a tax, it may affect tax issues. In some jurisdictions, a pricing model like this could be considered a tax and might require a vote or another procedure to be adopted. Utilities should also consider how the overall tax burden is affecting low-income communities to understand the potential effects of this new charge. For example, high property taxes can be a cost burden for low-income homeowners and tax relief measures may be called for. Organizations focused on housing anti-displacement and economic justice may be able to provide insight.

Administrative burden on utility

This model will likely be easier to manage in the long term than other affordability programs requiring ongoing administration. However, it does require up-front research and design, as well as ongoing data collection. Utilities should assess their ability to implement it effectively and take steps to build their capacity as needed.

Utilities will need the research capacity to compile their data, analyze Census data on income and other demographic characteristics, and determine which property characteristics make sense to use. The methodology section above explains which datasets were used for this analysis. This data may not be available in every situation, and utilities may need to modify the model depending on their constraints. Additionally, the data often require extensive analysis, cleaning, and quality reviews to compile parcel data and utility billing data into a single comprehensive dataset. Parcel data requires frequent updates to ensure the billing parameters reflect current property characteristics. This kind of analysis often requires additional staff with expertise in GIS and business intelligence systems. If utilities do not use a business intelligence system, they may want to consider doing so to facilitate data integrity, sharing, and analysis. This process may involve dialogue and data sharing between other city departments, likely requiring policy and operational changes to address data silos and barriers to sharing.

Once the model is implemented, utilities should set up systems to track, collect, and analyze data on the impacts of the new charge to analyze its effectiveness in distributing costs. This could include tracking bill payment behavior, numbers of appeals cases, changes in numbers of shutoffs, and impacts on revenue. Utilities can partner with community-based organizations to hear from low-income households about how they are being affected. Tracking the model's impacts will allow utilities to adjust it to ensure that it is furthering equity goals.

Table 8 presents an overview of some of the advantages and disadvantages of each property characteristic in terms of implementation and potential impacts.

Table 8:
Pricing strategy advantages and disadvantages

Pricing Strategy	Advantages	Disadvantages
Frontage Feet	• Relationship between frontage and distribution pipeline length and associated costs	• Not always included in existing parcel data • Generating precise frontage measurements could be a challenge
Parcel Area	• Relationship between parcel size and distribution pipeline length and potential capacity demands for supply and treatment • Parcel area measurements readily available in most existing parcel datasets	• Higher variability leading to larger swings in bill impacts could shock customers
Building Footprint	• Relationship between building size and potential supply and treatment capacity demands • Building area measurements readily available in most existing parcel or building datasets	• Would require frequent updates to ensure changes are reflected in billing • Higher potential costs to maintain a current and accurate dataset
Property Value	• Relationship between property value and the benefits received from fire protection service intended to minimize damages • Strongest correlation with income leading to greatest gains in equity	• Could be viewed as a property tax and would require research into potential legal issues and taxing/charging authorities of the utility • Would require frequent updates to ensure changes are reflected in billing
Number of Bedrooms	• Relationship between number of bedrooms, number of people, and potential capacity demands for water supply and treatment	• Not always included in existing parcel or building data and could not be generated from a geospatial analysis • Would require frequent updates to ensure changes are reflected in billing • Higher potential costs to gather/purchase data and to maintain a current and accurate dataset

Community engagement and collaboration

Utilities that are considering this type of approach will want to involve organizations representing low-income communities—as well as residents themselves—throughout the process to ensure that the pricing model they develop is responsive to community needs. Working collaboratively with community-based organizations to gather data on affordability needs, workshop potential pricing models, and solicit resident input is essential to avoiding unintended consequences and building grassroots knowledge and consensus. This will also build community-based organizations' abilities to participate in water decision-making and advocate for equitable affordability policies.

Messaging and framing

Explaining this pricing model to the public and gaining support is a critical part of implementation. Under this model, some households will see their water bills increase, so utilities should expect some concern, as would occur with any rate increase. Others will see their bills go down, which is an opportunity to highlight the equitable and affordable distribution of water system costs. Outreach for this initiative should be part of a larger effort to build trusting relationships with communities, ideally in partnership with community-based organizations.

Development of a strategic engagement and messaging framework aligned with audience needs will be an important step for utility leaders and elected officials concerned about pushback from their constituents, equity organizations advocating for affordability policies, and utility staff whose leadership is resistant to new or increased charges for infrastructure improvements. The following messages can be used and adapted to the local context:

- Utilities' mission is to provide life-sustaining services for all people. Universal access to water means that we all thrive and our society functions smoothly.

- Delivering water services and maintaining systems is expensive, and utilities need significant funding. Raising rates across the board makes it hard for some people to afford their bills, putting a strain on households already struggling with housing and other costs. This has a follow-on effect on the financial health of the utility.

- The current system is not equitable: physically larger homes pay the same rates as everyone else, but it costs more to deliver services to them. In effect, people living in smaller homes in higher-density areas (often lower-income communities) are effectively subsidizing these households.

- This pricing model can make bills more affordable and reduce water shutoffs. Lower-income people will automatically receive lower bills without having to apply for assistance or verify their income.

- By distributing costs in a way that is based on better data, leverages modern technology and billing systems, is more representative of where costs come from, and is more consistent with the ability to pay, utilities can deliver high-quality services without making bills unaffordable. This benefits everyone by ensuring that all communities have access to water and can protect their health. In addition, this model may result in savings for the utility by reducing (or even eliminating) the costs of metering, lowering the costs of collections, and lessening the need for new affordability programs. Revenue collection may increase, which would benefit all customers.

Utilities will also want to conduct significant listening sessions with and outreach to communities and others to explain this pricing model and understand community concerns. Given the existing historical mistrust of utilities among some communities, outreach sessions will need to be developed with intentionality and care for authentic and meaningful engagement.

Providing clear, transparent explanations of why the pricing model is being implemented and what it pays for will be critical in presenting this model to the public and ratings agencies. Utilities can consider including separate line items on water bills to show exactly where the charge goes. For customers whose bills decrease under the new model, outreach is needed to reassure them that their costs will not go up in another area due to this new model alone. Since it is unusual for bills to decrease, these customers may be concerned that it is too good to be true. This is an opportunity to increase public awareness of how utilities work and what water bills pay for. Utilities will also need to consider how frequently to review cost and parameter data and update their charges. That frequency may depend on locally unique factors and property assessment cycles.

Areas for Further Research

There are many issues and considerations related to this pricing model that were beyond the scope of this initial pilot study and should be explored further. These areas include:

- **Effects on renters and multi-unit buildings.** Low-income residents are often disproportionately renters and can be more vulnerable to water affordability challenges. However, they are also harder for utility assistance programs to reach because they generally do not pay their water bills directly. Some tenants have water utility bills included in their rent or pay them through their landlord's account. Multi-unit buildings may have one meter for the whole property or be classified as commercial properties. This varies from city to city. This study focused on the residential customer class, which generally tends to mean single-family homes with some duplex, triplex, etc. style housing also included. Further research is needed to fully understand how to apply this pricing model equitably to other types of renter-occupied units. It may be possible to use a similar model and include property characteristics such as rental unit sizes and rent amounts. Although this study did not quantify the actual impacts on renters in multi-family structures, charges based on parcel-based parameters like frontage feet, parcel size, building area, and property value would likely further reduce bills to multi-family tenants as the fixed property-based charge would be distributed over a greater number of housing units, thereby reducing the charge per household.

- **Incorporation of property-based metrics in the allocation of costs.** Additional research should be done to understand the impacts of including factors like frontage feet, parcel area, building area, property value, or number of bedrooms in the allocation stage of the cost-of-service analysis. While the approach reflected in this study focused on the impacts of an evolved pricing model based on property characteristics to intraclass equity by affecting cost recovery between customers within the residential customer class, using these parameters to allocate system costs to different customer classes would also impact interclass equity, since cost distributions between classifications would likely be affected. This could be an opportunity to redistribute costs more equitably between residential, commercial, and industrial customers, recognizing that the consequences of unaffordable bills (like shutoffs, liens, or debt) are direr for homes than for businesses because they more directly affect public health and wellbeing.

  Utilities should also keep in mind that unaffordable water bills for businesses can impact the economic development in an area, which may indirectly affect residents' health and quality of life.

- **Application of this model to other community services.** This model could be applied to stormwater and wastewater as well as other local government services. It could be especially well-suited to stormwater, since its costs are closely tied to property characteristics like square footage and impervious surfaces. Even if stormwater rate structures already include property-based charge parameters, an analysis could be conducted as part of a stormwater rate analysis to evaluate whether any of the other property characteristics identified herein could be incorporated to yield more equitable and affordable outcomes.

- **Legal barriers to innovative pricing models.** While this model is an evolution in sophistication rather than a fundamentally new or distinct form of pricing, the state's legal and regulatory context is an important factor in the possibility of implementing this model. The unique circumstances and rate-setting environments in each state are complex and worthy of a separate study and report. This would help utilities assess the model's feasibility, as well as identify state laws that they can advocate to change.

- **Utility cost savings.** More research is needed to understand whether this pricing model would lower costs for utilities by reducing the need for resources to install, manage, and read meters, perform collections, administer customer assistance programs, and possibly reduce the number of written-off charges. For utilities that do not yet have an assistance program, focusing on a more equitable pricing approach may be a more equitable and cost-effective strategy. For utilities and especially small communities struggling with the costs of metering, exploring a property characteristic-based revenue model that does not also require metering may reveal cost savings from planning, delivering, and operating meter systems. At the same time, implementing this model would still incur some costs connected to the billing system and data collection and management.

- **Ratings agencies.** Ratings agency determinations can significantly lower or increase utility borrowing costs. More exploration is needed into how ratings agencies might consider this form of pricing in their rating decisions.

- **Conservation.** One argument in favor of usage-based rates is that they encourage water conservation to lower customer bills. This model did not seek to estimate potential influences on customer conservation behavior or supplementary conservation education efforts. More research is needed.

- **International models.** Many countries fund water systems through measures that go beyond individual usage charges and recognize the societal benefits of water. For example, Ireland's water systems are funded entirely through taxes and do not charge customer rates. Most other countries do not allow residential water shutoffs for nonpayment. While every context is different, international examples could provide useful lessons in funding water as a social good and avoiding punitive consequences like shutoffs. Further research should explore how these practices could be instructive for the US context.

Conclusion

Unlike other common goods, residential water and wastewater service costs are primarily charged based on individual usage. The result is a system that places a significant cost burden at the local level and threatens access to a life-sustaining resource for those who struggle to pay for it. This study set out to contribute solutions to the challenges of water stress and shutoffs through a pricing model that would distribute water system costs more equitably while avoiding some of the drawbacks of other affordability measures. Our findings were very promising: under the proposed model, greater equity would be achieved in water service cost recovery, with water bills decreasing for most low-income households and increasing for higher-income households. The property-based charges also tended to reduce bills in the neighborhoods with the highest rates of shutoffs due to nonpayment. These methods could have the added benefit of increasing the proportion of fixed revenue while simultaneously addressing affordability concerns, potentially meeting multiple utility objectives. While there are exceptions to these findings, the report includes recommendations to ensure protections and affordability safeguards beyond rate making.

The affordability challenge is a growing problem, and new approaches are critical to provide equitable access and ensure utility revenue stability. As a sector, we need to continue investigating and developing innovative models like this one and addressing potential obstacles. By doing so, we can move towards a pricing model that distributes costs equitably and recognizes water's essential value to society.

Notes

1 Kay Jowers et al., "Housing Precarity & the COVID-19 Pandemic: Impacts of Utility Disconnection and Eviction Moratoria on Infections and Deaths Across US Counties" (National Bureau of Economic Research, January 25, 2021), https://www.nber.org/system/files/working_papers/w28394/w28394.pdf.

2 "Economic Impact of Closing the US Water Access Gap" (DigDeep, 2022), https://www.digdeep.org/draining.

3 "The Financial Impact of the COVID-19 Crisis on U.S. Drinking Water Utilities," American Water Works Association and the Association of Metropolitan Water Agencies, April 14, 2020, https://www.awwa.org/Portals/0/AWWA/Communications/AWWA-AMWA-COVID-Report_2020-04.pdf.

4 "Water Rates, Fees, and Charges M1: Seventh Edition," American Water Works Association, 2017, https://www.awwa.org/Portals/0/files/publications/documents/M1Ed7LookInside.pdf.

5 US Census Bureau, American Community Survey, 2019, https://data.census.gov/cedsci/.

6 B. Dziegielewsk et al., "Residential End Uses of Water, Version 2" (Denver, CO: Water Research Foundation, 2016).

7 US Census Bureau, American Community Survey, 2019, https://data.census.gov/cedsci/.

About the US Water Alliance

The US Water Alliance advances policies and programs to secure a sustainable water future for all. Established in 2008, the Alliance is a nonprofit organization that brings together diverse interests to identify and advance common-ground, achievable solutions to our nation's most pressing water challenges. Our members and partners include community leaders, water providers, public officials, business leaders, environmental organizations, policy organizations, and more. We:

Educate the nation about the true value of water and water equity, as well as the need for investment in water systems. Our innovative approaches to building public and political will, best-in-class communications tools, high-impact events, media coverage, and publications are educating and inspiring the nation about how water is essential and in need of investment.

Accelerate the adoption of One Water principles and solutions that effectively manage water resources and advance a better quality of life for all. As an honest broker and action catalyst, we convene diverse interests to identify and advance practical, achievable solutions to our nation's most pressing water challenges. We do this through our strategic initiatives and One Water Hub, which offer high-quality opportunities for knowledge building and peer exchange. We develop forward-looking and inclusive water policies and programs, and we build coalitions that will change the face of water management for decades to come.

Celebrate what works in innovative water management. We shine a light on groundbreaking work through story-telling, analysis of successful approaches, and special recognition programs that demonstrate how water leaders are building stronger communities and a stronger America.

About Stantec

Many of the world's most innovative engineers and scientists have come together in Stantec's Water business because they view a community's interaction with water a bit differently—as a single holistic system rather than as unconnected networks divided by jurisdictional boundaries. Our team provides a new path towards water sustainability with innovative solutions that allow for the reuse and conservation of this precious resource. Working throughout the hydrologic cycle, we use innovative solutions to make sure the appropriate quality and quantity of water is where it should be and available when it's needed. Creative management approaches and innovation are driving the municipal transition to new strategies and technologies—merging planning with execution and sustainability with affordability. Our experts lead their fields and guide our work with scientific rigor, an inventive spirit, and a vision for growth. Every day, we help communities improve their water efficiency and protect their water resources for future generations.

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