

Appendix B. Utility Analyses

This appendix contains the results of three analyses of utility operations that are summarized in the report:

- Utility peak water demand
- Utility per capita water use
- Utility non-revenue water loss

- B-1. 2012 Max Daily Percent of Max Capacity for select utilities
- B-2. Max Daily Percent of Max Capacity during drought and normal years for small and large utilities
- B-3. 2012 Peak Usage Multiplier for select utilities
- B-4. Monthly Peak Usage Multiplier during drought and normal years for small and large utilities
- B-5. Drought and normal year per-capita water usage for small and large utilities
- B-6. Per-capita water usage for select utilities during drought conditions
- B-7. Table showing results of the Non-Revenue Water analysis for 77 selected utilities

Appendix to:

Southwest Indiana Regional Water Study

Letsinger, S.L., Gustin, A.R., Waddle, R.C., Petty, A.E., and Durai, R.S., 2026. Regional water study: Water Demand and Availability in Southwest Indiana. Report to Indiana Finance Authority. 145 p.

<https://www.in.gov/ifa/regional-water-studies/southwest-indiana-regional-water-study>

Utility Peak Usage

When considering the long-term resilience of public water utility community systems and localized hydrologic conditions in our study area, attention must be given to the concept of peak usage. Most utilities record increased demand during warmer summer months when water is used for outdoor purposes such as irrigating individual lawns and gardens, filling swimming pools, hosing off pets, and powering slip-n-slides. The degree of this peak demand varies depending upon both the severity of meteorological conditions during a given year as well as the type of customer base that a utility serves.

Datasets Considered

Two different datasets were analyzed to assess peak usage for utilities in our study area: the Significant Water Withdrawal Facilities database (SWWF) managed by the IDNR, and Monthly Reports of Operations (MROs) managed by the IDEM. The SWWF database is a fairly comprehensive digital product that records monthly volumes of water pumped by any facility that has the capacity of pumping 0.1 MGD (about 70 GPM) from groundwater and/or surface water sources. In contrast, the MRO records are worksheets submitted by utilities recording how much water they are treating on a daily basis. These sheets are handwritten (or sometimes typed) and scanned into the IDEM Virtual Filing Cabinet as PDF documents. These documents must be manually examined and digitized to extract usage information. A great deal of effort was required by team members on this research project to compile and analyze this dataset in a meaningful way.

Years of Interest and Data Availability

Because a considerable amount of work was required to gather and process the MRO data, a decision was made to focus on a limited subset of years – ‘normal’ years with average precipitation, ‘drought’ years with decreased precipitation and abnormally high temperatures, and ‘recovery’ years following drought years. For this study, 2011 and 2021 are examples of normal years, 2012 and 2022 as drought years, and 2013 and 2023 as recovery years. Some utilities had incomplete data for specific months or years in either the SWWF dataset, the MRO documents, or both. Efforts were made to fill in gaps in both datasets by either copying data from adjacent months / years or averaging their values. After analyzing the different years, it was determined that the drought year of 2012 and the normal year of 2021 most clearly highlight the differences in peak demand, and those years were accordingly used in the peaking factor analysis.

Monthly Reports of Operation (MRO) Analysis

The Monthly Reports of Operation submitted by utilities provide an informative insight into the way that different utilities operate and how much water they are actually treating on any given day. The sheets generally list daily volumes, but also give a monthly summary of the single day minimum, maximum, and average amount treated for that month. A subset of utilities in the study area were selected and the summary of minimum, maximum, and average daily treatment values were compiled into a spreadsheet.

These different metrics were considered and plotted in different ways to look for meaningful trends. Eventually, it was determined that comparing the maximum daily treatment to the known facility maximum treatment capacity offered the most useful analog. By considering what percentage of their maximum capacity a utility is operating at during peak usage, utilities of all sizes can be directly compared across different years. The results of this comparison for all utilities during the drought year of 2012 can be seen in Figure B-1.

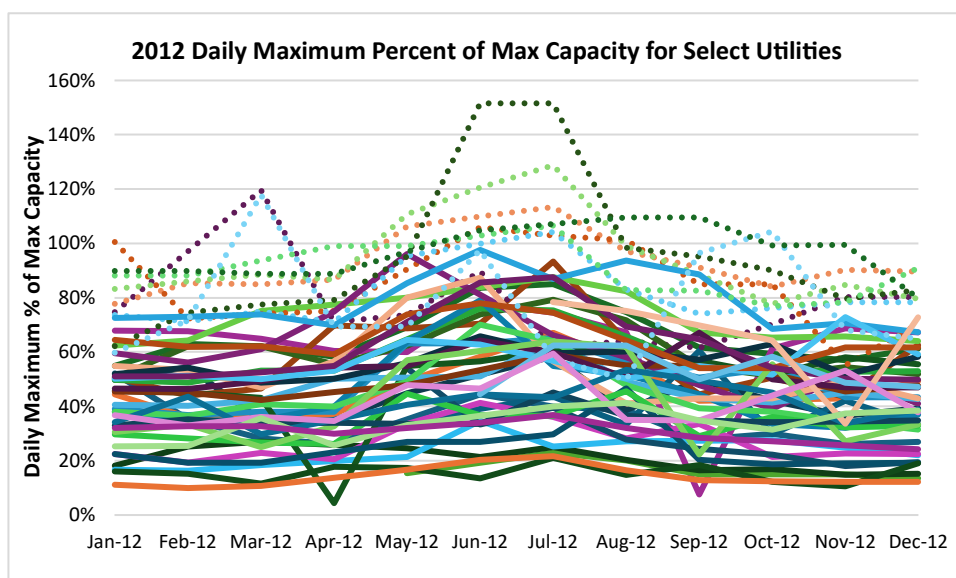
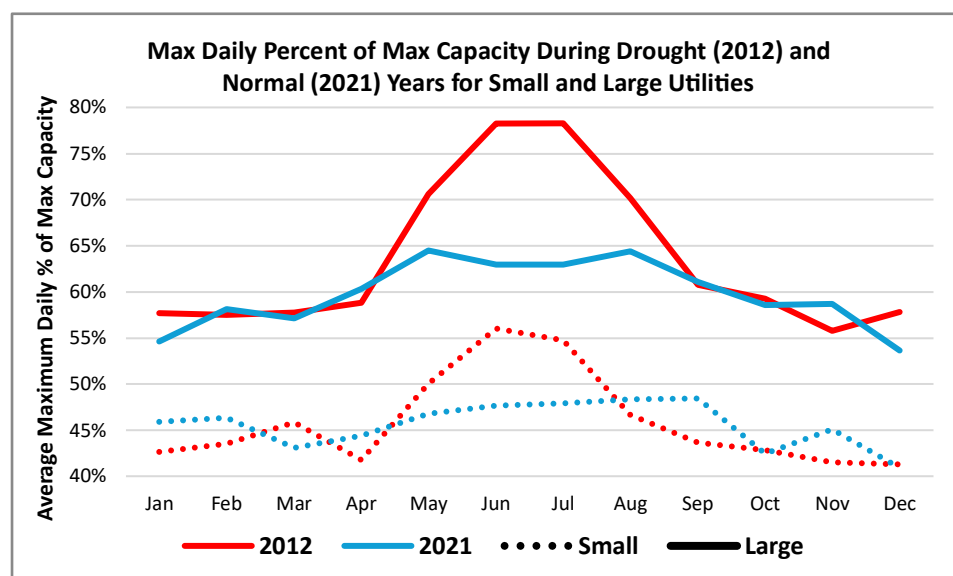


Figure B-1. Max Daily Percent of Max Capacity for select utilities in the study area. Dashed lines represent utilities that exceeded their maximum treatment capacity during the drought of 2012.

While it is hard to identify any obvious trends when looking at dozens of utilities with differing sizes and treatment procedures, a general increase in the percentage of maximum capacity that a utility is operating at can be seen during the summer months. A number of facilities (shown as dashed lines) even reported treatment volumes that exceeded their listed maximum treatment capacity. It is assumed that in these cases the facilities either pushed their systems beyond their limit or were supplementing their treated water through wholesale emergency connections with another utility. A number of such interconnections exist amongst utilities in the study area and are relied upon whenever a utility cannot meet their peak demands.

The summer peaking trend becomes much more clear whenever the data is averaged across utilities, and this can be taken one step further to consider the operational differences between large and small utilities. Based on the distribution of utility sizes in our study area, a population served of less or more than 5000 was used as the threshold to differentiate between small and large utilities, respectively. These results are shown in Figure B-2.

Figure B-2. Average Maximum Percent of Max Capacity for small and large utilities during a drought year (2012) and a normal year (2021). The colors represent the years and dashed vs solid lines represent small and large utilities, respectively.



With both large and small utilities, it is evident that the summer drought of 2012 led to a much larger peak demand than is seen during years with normal precipitation and temperature (2021). Although this trend is mirrored between large and small utilities, there is an important distinction between the two groups. In general, larger utilities seem to have a baseline operational level that is closer to their maximum capacity, and they tend to see a larger proportional peak during extreme conditions. During normal years, large utilities have a summer baseline operational capacity of around 60-65% of their maximum capacity. During the drought of 2012, these large utilities saw on average a peak demand of nearly 80%. On the other hand, smaller utilities saw on average an increase from a normal year baseline operational capacity of around 45-50% to a peak summer demand of approximately 55%.

Significant Water Withdrawal Facilities (SWWF) Analysis

Any utility with the capacity to pump more than 0.1 MGD (~70 GPM) is required to submit the sum of their monthly pumped volumes to the IDNR for compilation in the Significant Water Withdrawal Facilities database. This database goes back to 1985 and generally contains an accurate account of how much water each utility is pumping per month. Unlike the daily data in MRO records, SWWF data is aggregated to monthly totals. However, a peak usage analysis can be performed for any given year by comparing the annual minimum and maximum reported values. This ratio is the peak-usage multiplier and it can be used to again compare utilities of different sizes. The monthly values are represented relative to the lowest monthly usage during that year, meaning that the month with the least usage has a peak usage multiplier of 1. The results can be seen in Figure B-3.

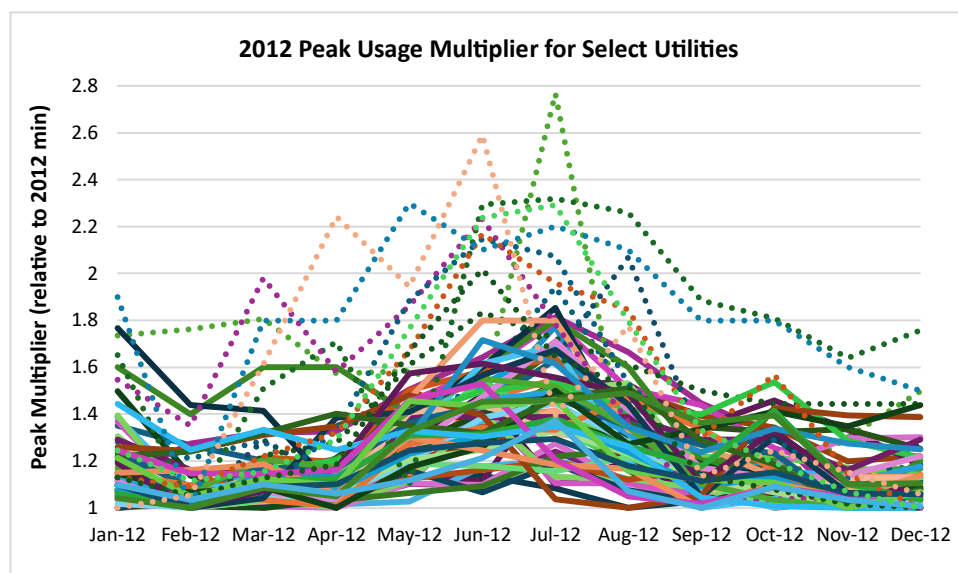
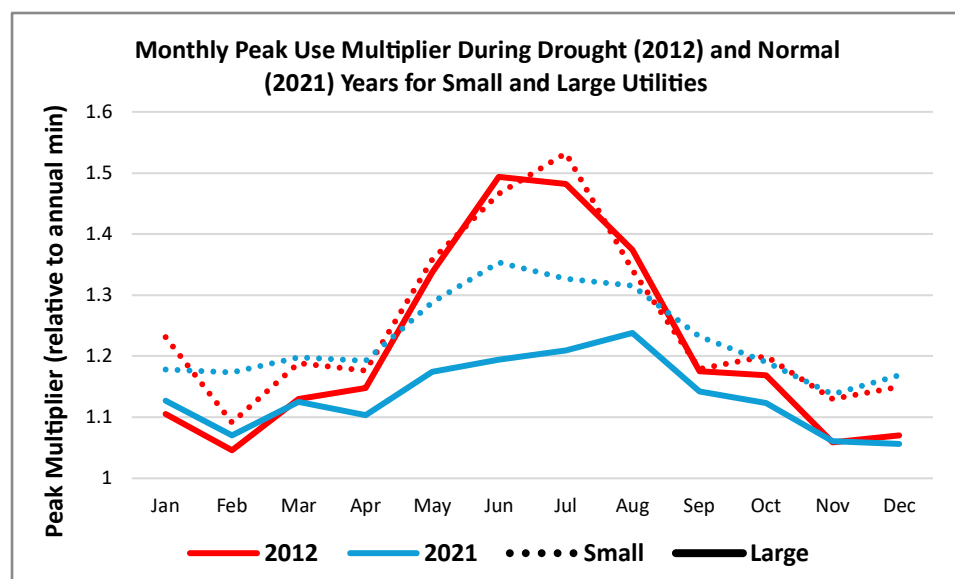


Figure B-3. Peak Usage Multiplier (Relative to 2012 minimum) for select utilities in the study area. Dashed lines represent utilities with the greatest peak usage multipliers.

Similar to the MRO analysis, it can be a little difficult to identify trends when so many dozens of utilities are displayed together, but in general there is a notable peak during summer months. Some utilities have a more extreme peak that exceeds 2x their baseline usage, while others see a muted seasonal peak of around 1.2x their baseline usage. To make a meaningful comparison to the MRO analysis, this SWWF peaking analysis was performed for both 2012 and 2021 and averaged across groups of small and large utilities that serve less than or more than 5000 people. The results of this are shown in Figure B-4.

Figure B-4. Average Peak Usage Multiplier (relative to annual minimum) for small and large utilities during a drought year (2012) and a normal year (2021). The colors represent the years and dashed vs solid lines represent small and large utilities, respectively.



When looking at average peak usage multipliers, a similar but distinct trend emerges as compared to the MRO analysis above. Both small and large utilities show an increased average peak usage multiplier during the drought of 2012 that are nearly identical, reaching around 1.5x their baseline minimum. During the normal year of 2021, both large and small utilities show relatively decreased summer peaking. However, small utilities tend to see greater peaking factors during summer months (~1.35x baseline) than larger utilities (~1.2x baseline). One reason for this might be related to larger utilities typically serving a more diverse set of customers from different sectors. For example, the relatively steady and significant monthly demand from industrial manufacturing facilities helps to minimize the peaking factor caused by increased domestic irrigation during normal years for large utilities. In contrast, small utilities that are serving almost entirely residential customers will see more exaggerated peaks when the majority of their customers begin irrigating their yards and gardens during the growing season. The caveat of all this is that during drought conditions, large utilities experience the same peak usage multiplier as small utilities but on average have less available capacity to meet that increased demand.

Per-Capita Usage

An additional way to consider the fluctuations of seasonal usage at various utilities is to convert water usage into per-capita water usage. This was accomplished by dividing monthly usage totals by the product of the utility population served and the number of days in a given month. It uses the same monthly totals that are employed in the SWWF Peaking analysis, but relates the water used to an individual consumption rate rather than the minimum annual month. The same 'drought' and 'normal' years – 2012 and 2021 – were used to facilitate comparison with the other peaking analyses.

There is a fair amount of variability in per-capita water usage across the study area, with the biggest utilities tending to have the highest rates. The single greatest per-capita usage rate of all utilities (by far) is Patoka Lake, who saw a per-capita usage of more than 600 GPD during the drought of 2012. The reason behind this is likely twofold; partially because there are non-residential customers who inflate per-capita water use calculations, and partially because the wholesale of water to other utilities causes their population served counts to not represent the entirety of the population that they indirectly serve.

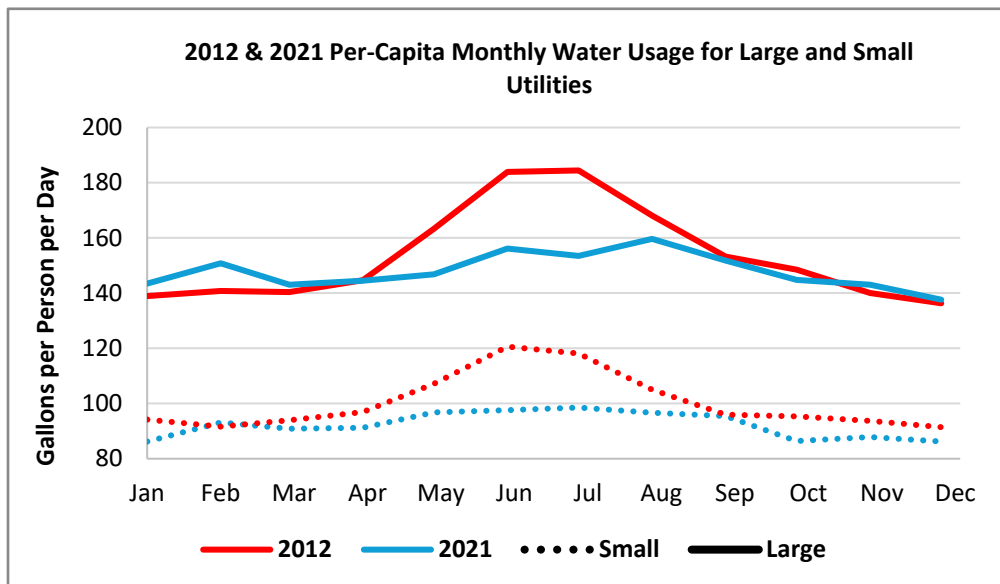


Figure B-5. 2012 and 2021 Per-capita water usage for large and small utilities. Larger utilities tend to have higher per-capita usage than small, during both drought and normal years

With these caveats in mind, the per-capita water usage is considered for both large and small utilities, divided using a population served greater than or less than 5000 people. The results echo each of the first two analyses – the 2012 droughts caused a notable increase in per-capita usage for both small and large utilities relative to their 2021 baseline usage, with larger utilities both having a higher baseline per-capita usage and showing a more pronounced increase in per-capita usage during the summer of 2012.

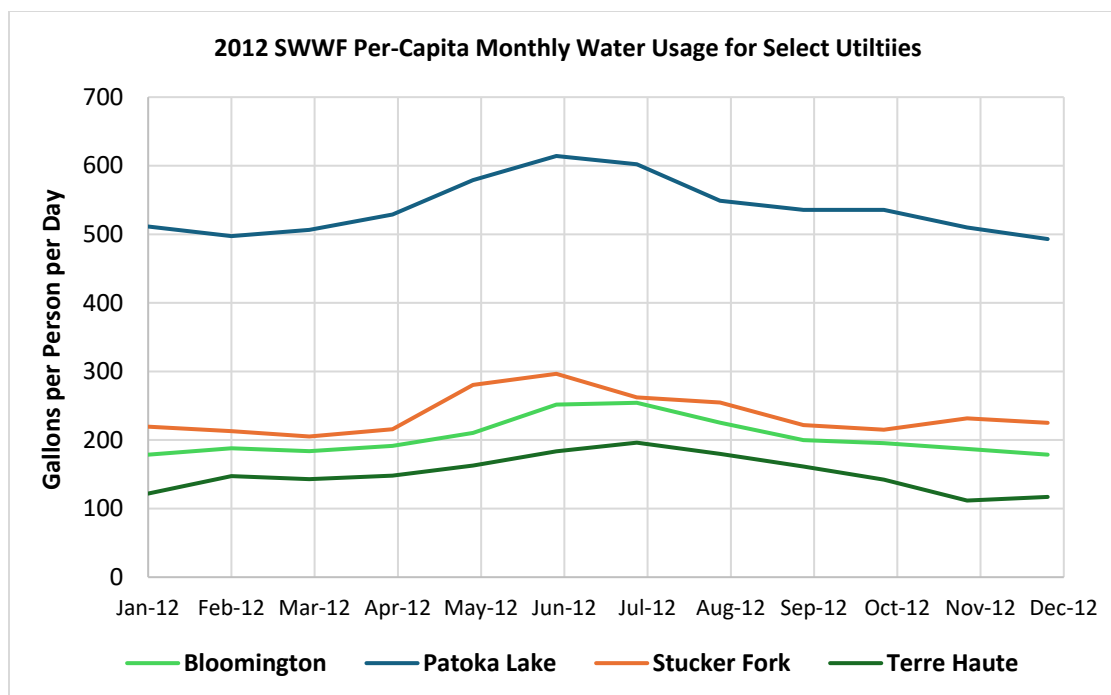


Figure B-6. Plot comparing per-capita water usage for four of the largest utilities in the study area during the drought year of 2012. Patoka Lake has a much higher per-capita water usage than other utilities due to wholesaling water.

Interpretation

Though the MRO and SSWF peak usage analyses show similar trends, only by combining the results of the analyses can inferences be made about the difficulties that utilities of different sizes may experience during future climate extremes. It is clear from Figure B-2 that during normal operational conditions, larger utilities are operating closer to their maximum capacity than smaller utilities. In contrast, Figure B-4 suggests that during normal years, smaller utilities tend to experience more extreme peak usages. These two facts work in tandem – larger utilities are able to safely operate closer to their maximum capacity because they tend to experience less extreme peaks during typical summers. In contrast, smaller utilities have a baseline operation that is not as close to their maximum capacity, but on average they experience more severe peaking factors during normal years.

As future weather conditions are forecasted to be more extreme in duration and intensity (see section FIXME in report), there will undoubtedly be times in the 50-year planning period where southwestern Indiana will experience droughts that are similar to (or worse than) those seen in 2012. During drought periods, both small and large utilities experience similarly increased peaking factors. However, larger utilities tend to see more proportionally significant peaks, and are ultimately operating closer to their maximum capacity. The drought of 2012 caused the City of Bloomington to implement watering restrictions due to increased demand related to lawn irrigation (USAToday, 2012). Bloomington’s water source (Lake Monroe) had sufficient capacity to provide additional water, but the increased demand caused their water treatment facility to approach its maximum operational capacity. In the years since this drought, Bloomington has upgraded their treatment capacity and increased the amount of water they are permitted to pump from Lake Monroe (Bloomington Herald-Times, 2024b).

The interconnections between utilities for emergency purposes is one safeguard that could help prevent regional water shortages during future drought conditions. However, larger utilities are already operating closer to their maximum capacity, and during drought conditions they may be unable to provide emergency wholesale water if their own system is struggling to handle increased peak demand. Smaller utilities tend to have more operational capacity leeway during these extreme conditions, but the scale of their operation means that they are not capable of supplying the quantities of water that larger utilities require during prolonged droughts. The largest utilities in the study area run the highest risk of experiencing water shortages during drought conditions. If the biggest utilities do not expand their overall capacity to account for future demand increases and usage peaks, summer watering restrictions may become a common practice to ensure that the public supply systems do not become overstressed and can reliably provide water for critical uses like fire protection, hydration, and sanitation.

Non-Revenue Water Analysis

Every water utility produces some water that does not provide revenue for the utility. Such “non-revenue water” has three causes: 1) real losses, which happen when water is lost through physical leaks; 2) apparent losses, which occur when water is consumed but not metered accurately; and 3) unbilled authorized consumption, which describes water that is provided without charge to certain consumers, such as local governments (IFA, 2024). If these non-revenue water volumes become too large, they can strain the finances and capacity of the utility as well as waste natural resources.

The 2024 Indiana Finance Authority water-loss audit dataset was used to provide an overview of non-revenue water in the region for 99 utilities in Southwest Indiana. These water audits tracked the water supply for each utility during calendar year 2023 to estimate non-revenue water. The IFA dataset also provided the ownership type, water source, purchased-water share, service population, and service area of each utility. Utilities were classified as urban if a majority of their service area overlapped a U.S. Census Bureau urban area. Of the 99 utilities that submitted water-audits, 22 had extreme or unknown estimates of non-revenue water and were omitted, leaving 77 utilities for this analysis.

Utilities of different sizes were compared by normalizing non-revenue water quantities per service connections per day, which is in line with the 2024 IFA statewide analysis. For each utility, a number of parameters were calculated including unit non-revenue water, unit real loss, unit apparent loss, and unit unbilled authorized consumption, all of which are measured in gallons/service connection/day. Overall, the median unit non-revenue water was 57.28 gallons/service connection/day. Real losses were the greatest contributor to non-revenue water, with the median unit real loss at 48.65 gallons/service connection/day. Median unit apparent loss was 2.61 gallons/service connection/day, and median unit unbilled authorized consumption was 1.25 gallons/service connection/day. Non-revenue water cost these utilities more than \$7.5M in 2023, according to the water-audit data.

Table B-7 provides the median unit real loss, median unit apparent loss, median unit unbilled authorized consumption, and median unit non-revenue water across various categories of utilities. Non-for-profit utilities, regional water districts, conservancy districts, utilities that primarily use surface-water sources, utilities that do not purchase most of their water, utilities serving 5000 to 19,999 people, urban utilities, and utilities with service areas ranging from five to 50 square miles appear to face higher rates of non-revenue water. With the

right resources and infrastructure improvements, utilities can decrease this burden to safeguard their finances and water supply.

Table B-7. Results of the Non-Revenue analysis for 77 selected utilities in the study area. Shaded green rows identify the dominant characteristic(s) in each class.

	Utility Category	Median Unit Real Loss (gallons/service connection/day)	Median Unit Apparent Loss (gallons/service connection/day)	Median Unit Unbilled Authorized Consumption (gallons/service connection/day)	Median Unit Non-Revenue Water (gallons/service connection/day)
	Full population	48.65	2.61	1.25	57.28
Ownership	Investor Owned	42.00	1.01	0.35	43.24
	Municipal	43.96	2.68	2.99	53.83
	Not-for-Profit	52.46	2.45	1.05	60.15
	Regional Water District/Conservancy District	64.49	5.82	5.10	125.27
Water Source	Groundwater	42.62	2.51	1.12	51.01
	Surface water	60.97	3.76	5.10	68.05
Percentage of Purchased Water	< 50% purchased water	47.39	2.51	1.40	60.20
	> 50% purchased water	50.40	3.76	0.68	54.61
Table B-7, continued	Utility Category	Median Unit Real Loss (gallons/service connection/day)	Median Unit Apparent Loss (gallons/service connection/day)	Median Unit Unbilled Authorized Consumption (gallons/service connection/day)	Median Unit Non-Revenue Water (gallons/service connection/day)
Service Population Size	0-999	30.35	2.68	0.35	41.77
	1000-4999	46.14	2.45	1.13	53.83

	Utility Category	Median Unit Real Loss (gallons/service connection/day)	Median Unit Apparent Loss (gallons/service connection/day)	Median Unit Unbilled Authorized Consumption (gallons/service connection/day)	Median Unit Non-Revenue Water (gallons/service connection/day)
	5000-9999	71.92	2.16	7.78	83.23
	10000-19999	60.12	4.75	9.32	76.58
	65000-84999	46.41	3.32	1.89	51.62
Rural/Urban Classification of Utility	Rural	46.14	2.68	1.18	54.61
	Urban	61.28	1.32	4.65	79.12
Service Area Size (square miles)	< 5	30.35	2.47	1.10	41.77
	5-15	74.48	3.76	0.68	78.61
	15-50	63.91	2.13	2.99	71.08
	> 50	56.82	3.74	4.83	67.75

Sources

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