City of Bloomington Utilities Water Conservation Plan

Approved by: City of Bloomington Utilities Service Board

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CITY OF BLOOMINGTON INDIANA
utilities department

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I. Introduction

Background

City of Bloomington Utilities (CBU) is committed to producing the best drinking water possible while protecting and conserving Indiana's natural resources. As part of this commitment, CBU has developed a water conservation plan that outlines a broad range of strategies to preserve Monroe County's water supply for future generations.

The City of Bloomington Utilities Water Conservation Plan (Plan) addresses both supply-side and demand-side measures that will provide benefits to the utility and its customers. It offers tools to reduce water waste, while meeting the demands of the community and environment. The Plan provides a roadmap that, once implemented, will make the region more resilient to the stresses put on the water supply by drought, population growth, and resource competition.

This Plan largely draws upon the 2009 Water Conservation Plan prepared by Wittman Hydro Planning Associates (WHPA). WHPA worked with CBU to define water conservation goals for the utility and to develop several water conservation measures. Upon further study of the WHPA Plan, and given the rise of new communication mediums, CBU has identified and included additional measures that were not featured in the WHPA Plan. This initial CBU Water Conservation Plan represents CBU’s current water conservation strategy. This plan is not meant to be a static framework, but, instead, it will evolve as new conservation strategies become necessary and as new goals are identified.

Water Conservation in Bloomington

Traditionally, utilities have responded to water supply concerns by simply tapping into additional resources and expanding infrastructure capacity. This option is becoming less feasible and more expensive as the amount of untapped resources diminishes. Practicing efficient water use now—while water supplies are still relatively abundant—will provide CBU the time it needs to optimize its operations, to better prepare itself against the threats of climate change and resource competition, and to cultivate a conservation-oriented mindset among its employees and customers.

In 2014 CBU will complete a multi-year project to expand its drinking water treatment and distribution capacity. Such projects are expensive but often necessary to meet the needs of a growing customer base. Effective water conservation programs will postpone future needs to expand capacity by reducing water loss and increasing customer efficiencies.

Water conservation efforts will also help protect CBU against the effects of climate change. The 2014 National Climate Assessment predicts that heat waves in the Midwest will increase in intensity and frequency (U.S. Global Change Research Program, 2014). As these conditions develop, demand for Monroe Reservoir's water will increase on multiple fronts.

Municipal water demand will surge during hot, dry weather patterns, and so will the need to augment low-flowing rivers with water from the reservoir. Having a well-established conservation ethic and known conservation measures in place will help prepare CBU and its customers for this possibility.

In addition to water availability, water quality is expected to be impaired by erratic climate patterns. First, higher temperatures may increase algal blooms and bacterial and fungal growth in the reservoir. Second, increased flooding may increase pollutant loading into the reservoir. Third, reduced stream flows decrease the dilution potential of waterways. If any of these situations increases the treatment required, efficient water consumption practices will minimize the impact of higher treatment costs to the consumer.

Another important consideration is the inherent connection that exists between water and energy, commonly referred to as the water-energy nexus. In simple terms, this refers to the water used in energy generation, the energy used in water production, and the relationship between the two. Bloomington uses nearly twice the amount of energy to extract, produce, and deliver drinking water as other similarly sized water utilities (Electric Power Research Institute, 2013). This is largely due to the energy required to distribute water over the region's uneven topography. Because of this, water conservation efforts will directly result in decreased energy consumption, and, therefore, decreased greenhouse gas emissions. Additionally, practicing wise water use will provide a buffer to the consumer against water rate increases that result from likely future increases in electricity costs.

Lastly, Monroe Reservoir is the largest body of water that lies completely within the borders of Indiana, and neighboring communities have expressed interest in using it as a water source. It can be expected that this interest will continue, especially as other water supplies become stressed. By including conservation in long-term planning, Bloomington will be better prepared for future constraints.

II. CBU's Water Supply System

Water Resources

The construction of Monroe Reservoir was completed in 1965 by the U.S. Army Corps of Engineers, and it became CBU's primary water source soon after. In 1996, the reservoir became CBU's only water source when the Griffy Lake Water Treatment Plant was removed from service. Monroe Reservoir is currently managed by the Indiana Department of Natural Resources (IDNR), from whom CBU purchases water at a rate of $33.00 per million gallons.

The water in Monroe Reservoir is committed to multiple purposes. The storage in the reservoir between 538 feet above mean sea level (AMSL) and the spillway crest elevation of 556 ft. AMSL (representing 259,000 acre-feet) is dedicated to flood control. The portion of the reservoir between its dry level of 515 ft. AMSL and 538 ft. AMSL (160,000 acre-feet of storage) is allocated to both the public water supply and low-flow augmentation of the White River.

The Monroe Water Treatment Plant treats all raw water extracted from Monroe Reservoir by CBU. An infrastructure expansion project, scheduled to be completed in 2014, will increase the plant's capacity from 24 million gallons per day (MGD) to 30 MGD. Included in these upgrades is the necessary infrastructure to support the future addition of another 6 MGD of capacity, which would increase the total capacity to 36 MGD. Black and Veatch, the engineering firm tasked with the current expansion project, estimates the cost of this future expansion, in 2014 dollars, to be $7.5 million.

The project also increases the capacity of CBU's transmission and distribution (T&D) infrastructure. Updates include a second raw water main from the intake tower to the plant, a second finished water main from the plant to the T&D system, and a new pump station and two million gallon water tank on the southeast side of Bloomington. This project increases both the capacity and security of CBU's water infrastructure, which serves over 25,000 residential, commercial, and industrial customer accounts; Indiana University; and 9 wholesale customers.

Water Production

Figure 1 displays the average raw water extraction rate and the peak extraction day for each year from 1995 through 2013. With some annual fluctuations, raw water extraction has increased an average of 1.7 percent per year. Peak day withdrawals show more variability, but this is to be expected given the many factors influencing this figure, such as weather events and operation and maintenance practices. The highest peak and average day withdrawals both occurred in 2012 when the region was experiencing drought conditions. It is expected that extraction rates will continue to increase in coming years; however, the implementation of a water loss control program and efficient water use practices may reduce this rate of increase. It should be noted that rates of raw water withdrawal and finished water production are not

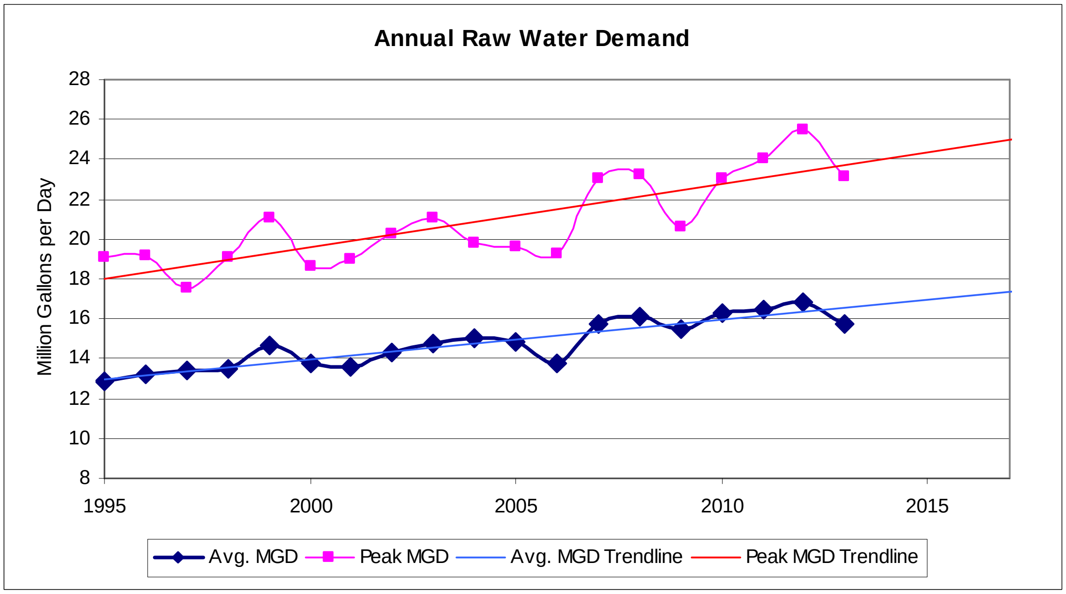

Figure 1: Yearly average water production rate and peak day production at the Monroe Water Treatment Plant, 1995 through 2013.

equivalent to customer demand. Changes in supply side water loss may cause production to increase or decrease, while demand stays unchanged.

Figure 2 displays water production rates by month at the Monroe Water Treatment Plant since 2010. The summer months show more variability than winter months due to the influence of weather on discretionary water use. This is most evident from the summer 2012 demand that spiked during the drought conditions of that year. Non-summer months display a trend of relative stability from year to year.

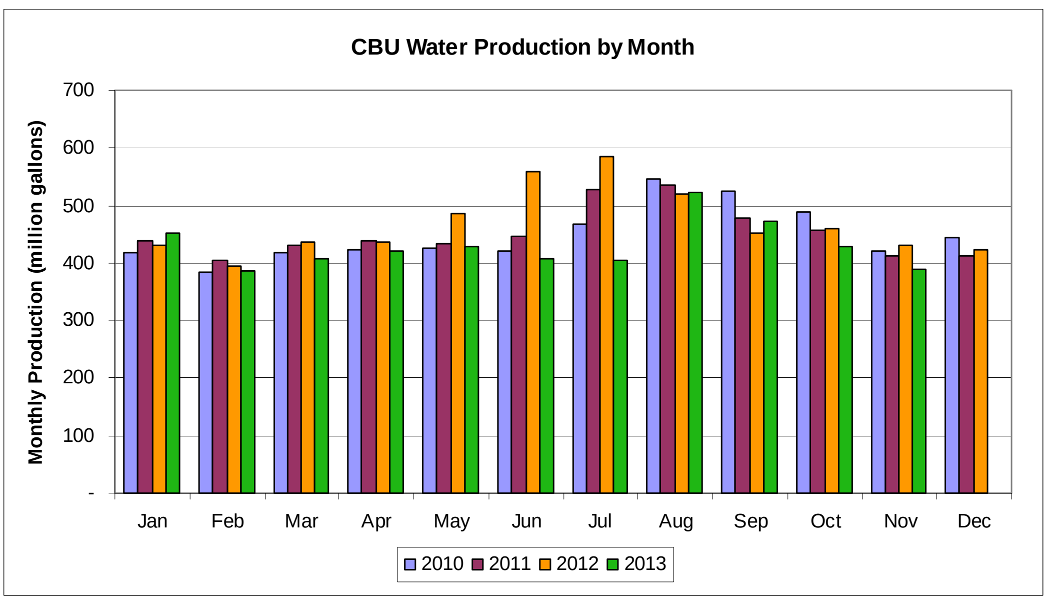

Figure 2: CBU water production by month.

The ratio of maximum day (MD) production over average day (AD) production (MD/AD) is an indicator of variable seasonal use stability, shown in Figure 3. From 2000 through 2013, this figure remained relatively stable, with a low of 1.31 and a high of 1.51. The average was 1.41. The ratio varies annually primarily due to varying weather conditions. Periods of hot and dry weather will cause the maximum day demand to increase, while long periods of temperate weather will result in a lower maximum day demand. In addition to the effects of weather, conservation programs can affect this indicator by implementing measures aimed at reducing peak summer demand.

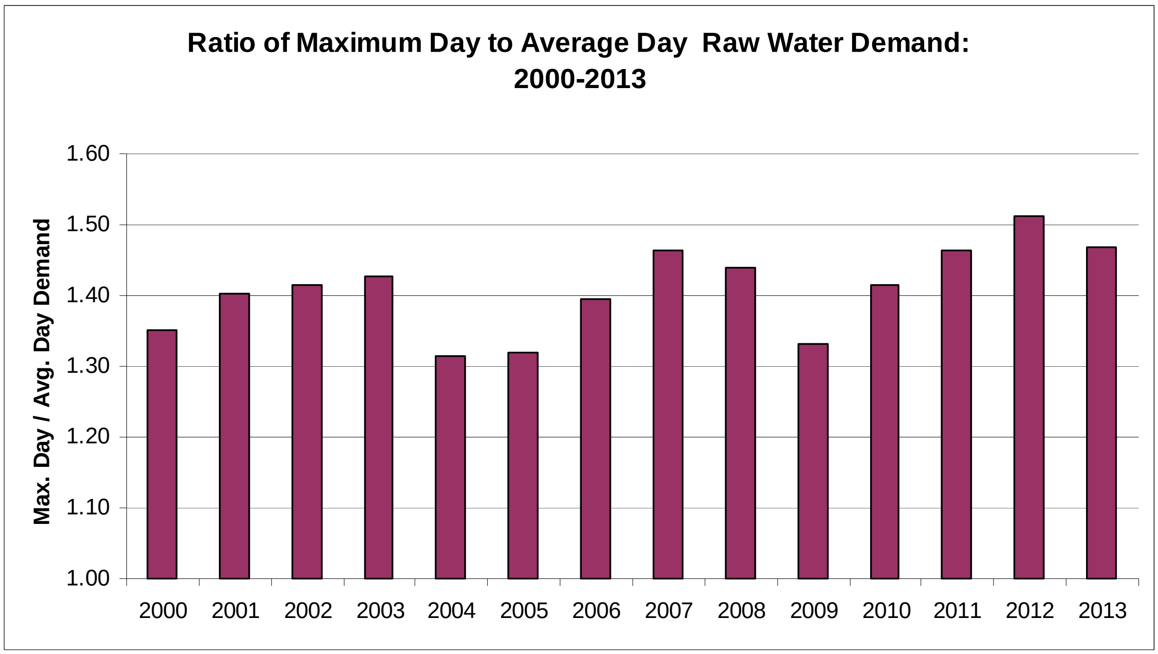

Figure 3: The ratio of maximum day demand over average day demand is an indicator of variable seasonal use stability.

Water Consumption

Monthly water consumption data since 2002 for all user classes—single-family residential (SFR), multi-family residential (MFR), commercial, industrial, Indiana University (IU), and wholesale—is displayed in figure 4. The raw data used to generate this chart is not ideal. Monthly meter reading dates vary from meter to meter and month to month, making it impossible to ascertain precise consumption data for a single calendar month. In addition to adjusting the data for inconsistent read dates, attempts were made to identify and correct erroneous readings by analyzing account-level consumption history.

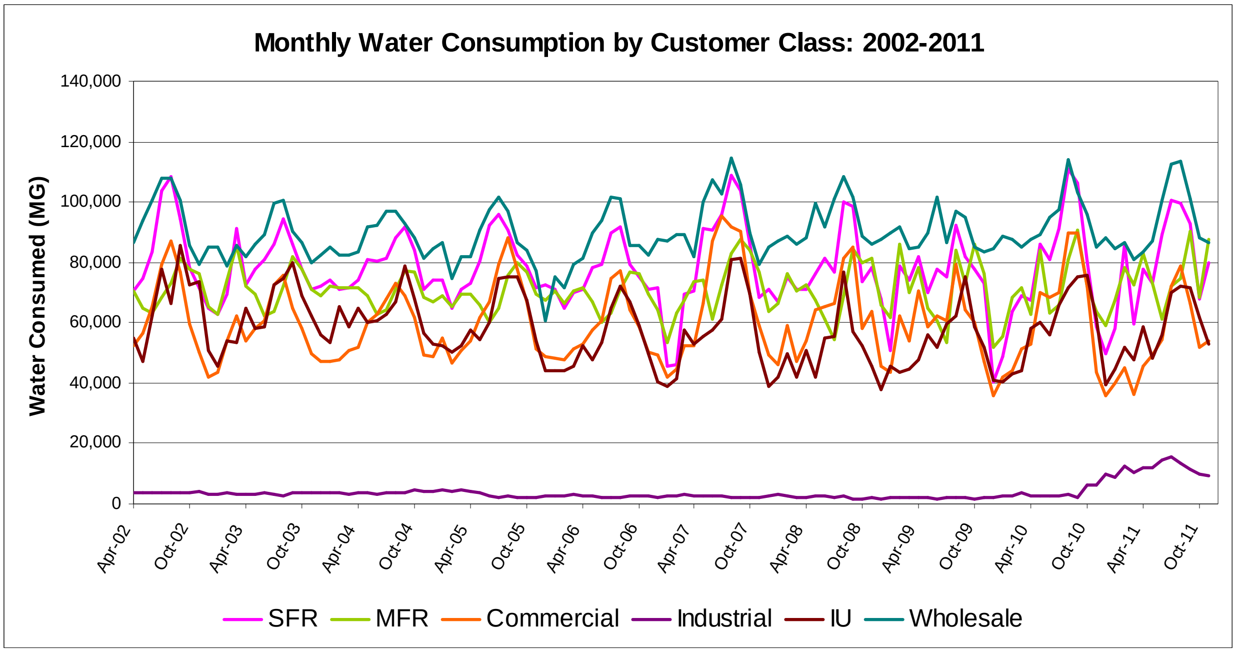

Figure 4: Monthly water consumption by user class from 2002-2011. The raw data does not align perfectly with calendar months, meaning that individual month data could be misrepresented in the chart, displaying artificially high or low use. The chart does accurately display general trends in use.

Figure 4 is composed of two sets of data. Consumption data from 2002 through 2007 was put together by WHPA, and data from 2008 through 2011 was compiled by CBU (efforts are currently underway to attain and evaluate more recent year data). Because of the quality of the raw data and the different methods used to clean the datasets, individual month consumption for each user class may not be accurately represented in the chart. Despite these shortcomings, some broad observations can be made.

With the exception of industrial users, all classes experience seasonal variations, with peaks generally occurring during the summer. Indiana University experiences its peak demand during the summer despite the decreased number of students on campus. This is primarily due to increased cooling and irrigation needs. The multi-family residential class tends to experience a small dip in consumption after the end of the IU spring semester in the early summer months, and then it reaches is peak during late summer months once fall classes are in session. This suggests that a large portion of these units are occupied by students.

The industrial user class in Bloomington makes up only a small portion of water use. Prior to October 2010, this class was comprised of only two customers. A significant increase in industrial consumption occurs at the end of 2010. This resulted from two large industrial customers switching their user class from commercial to industrial, thus doubling the number of customers in the class, and more than doubling industrial water consumption. A comparable drop in water use is visible in the commercial class as a result of this switch.

Figure 5 displays the breakdown of water consumption among all CBU user classes for 2013. Wholesale customers are the largest single user class by consumption, representing 27% of total water sales in 2013. Industrial users, on the other hand, purchased the least amount of water.

Despite the aforementioned rise in industrial water use in 2010 and 2011, industrial water purchases in 2013 dropped back to only 1% of total use.

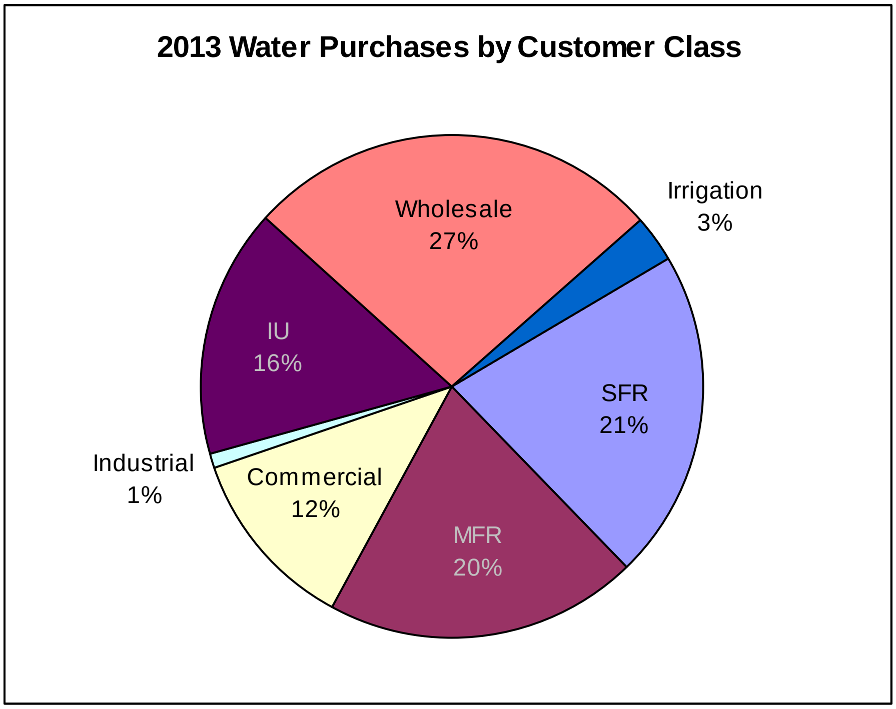

Figure 5: Breakdown of CBU customer water consumption for the 12 month period ending October 31, 2013.

Demand Forecast

WHPA prepared a demand forecast for CBU in 2009, projecting demand through 2030. Table 1 displays this forecast, with an updated implementation timeline. Conservation measures are estimated to reduce water consumption by 2%—over 100 million gallons per year—by 2030. WHPA noted that the calculations used to estimate water savings are conservative and may underestimate the savings CBU will experience after implementation.

In addition to reducing overall water consumption, minimizing peak water demand is a vital part of CBU's water conservation program because of its importance in determining the capacity needs of the utility's infrastructure. For example, the average day (AD) water production rate in 2012 was 15.32 MGD; however, the maximum day (MD) demand was 22.77 MGD. If the infrastructure was designed to only treat and distribute the average day demand, CBU would not have been able to meet the demand of its customers during much of the year. The infrastructure is designed meet peak water demand to ensure customers have access to water at all times throughout the year.

Year	Use Without Conservation (MG/Yr)	Use with Conservation (MG/Yr)	Water Savings (MG/Yr)	Water Savings (%)
2005	4,302	4,302	-	-
2010	4,398	4,398	-	-
2015	4,496	4,465	31	0.7%
2020	4,677	4,621	56	1.2%
2025	4,952	4,862	90	1.8%
2030	5,376	5,271	105	2.0%

Table 1: Demand forecast with and without water conservation measures. Calculated by WHPA (2009).

In Bloomington, peak demand occurs during the summer months, when discretionary water use is at its highest. A successful water conservation program will reduce peak demand by promoting efficient water use practices in the summer, as well as by promoting year-round conservation habits, which will lower the baseline from which the peak begins.

To project peak demand, WHPA's average day demand projections are used along with the maximum demand day over average demand day (MD/AD) ratio. An MD/AD ratio of 1.6 is used to estimate future peak demand. Since 2000, the highest ratio CBU has experienced is 1.51, which occurred during the drought of 2012 (see Figure 3). Using a value of 1.6 will help ensure that peak forecasts are not under valued, and it is consistent with past forecasts prepared for CBU by Black and Veatch. The projections shown in Table 2 represent the necessary rates of water production needed to meet demand assuming current rates of water loss. Thus, reductions in water loss will decrease the average and maximum day demand.

Year	Average Day Demand (MGD)	Maximum Day Demand (MGD)
2005	13.61	21.78
2010	13.92	22.27
2015	14.22	22.75
2020	14.79	23.66
2025	15.66	25.06
2030	17.01	27.22

Table 2: Peak demand forecast. Average day demand adapted from WHPA, and maximum day demand predicted using a maximum day over average day (MD/AD) ratio of 1.6. AD and MD demand represent the required production rates to meet customer demand assuming current rates of water loss.

As with water consumption, there are many variables that affect peak demand, and small changes in these variables can have a significant impact on projections. In Black and Veatch's Water Supply Evaluation (2007), the firm estimates a higher population growth rate than WHPA, resulting in higher AD and MD demand projections. Under Black and Veatch's population assumptions, the AD demand and MD demand in 2030 are projected to be 19.6 MGD and 32.2 MGD, respectively.

Under both forecasts, the 2030 maximum day demand is projected to be close to or over the current 30 MGD capacity of the plant, indicating that, without the implementation of water conservation measures, CBU will need to install the supplementary 6 MGD filter to bring the plant's total capacity to 36 MGD before 2030.

Water Rates

Water rates are a powerful tool that can either encourage or discourage conservation depending on the type of rate structure in place. CBU uses a uniform rate structure—a price-per-unit that stays the same no matter how much water is consumed—for all its customer classes, and customers are billed on a monthly cycle.

CBU last increased its water and wastewater rates over two phases in 2011 and 2012. Water rates increased by a total of 45.5% and wastewater rates increased 53%. Despite this, CBU's rates are relatively low in comparison to other utilities in Indiana. Figure 6 displays the average retail residential water bill for customers of all IURC regulated water utilities as of January 1, 2014, based on 5,000 gallons of consumption. The two highlighted bars identify CBU. The lower bar represents the cost to CBU customers within city limits ($22.09) and the higher bar represents the cost to customers outside city limits ($23.19). Both figures are well below the average cost of $29.84.

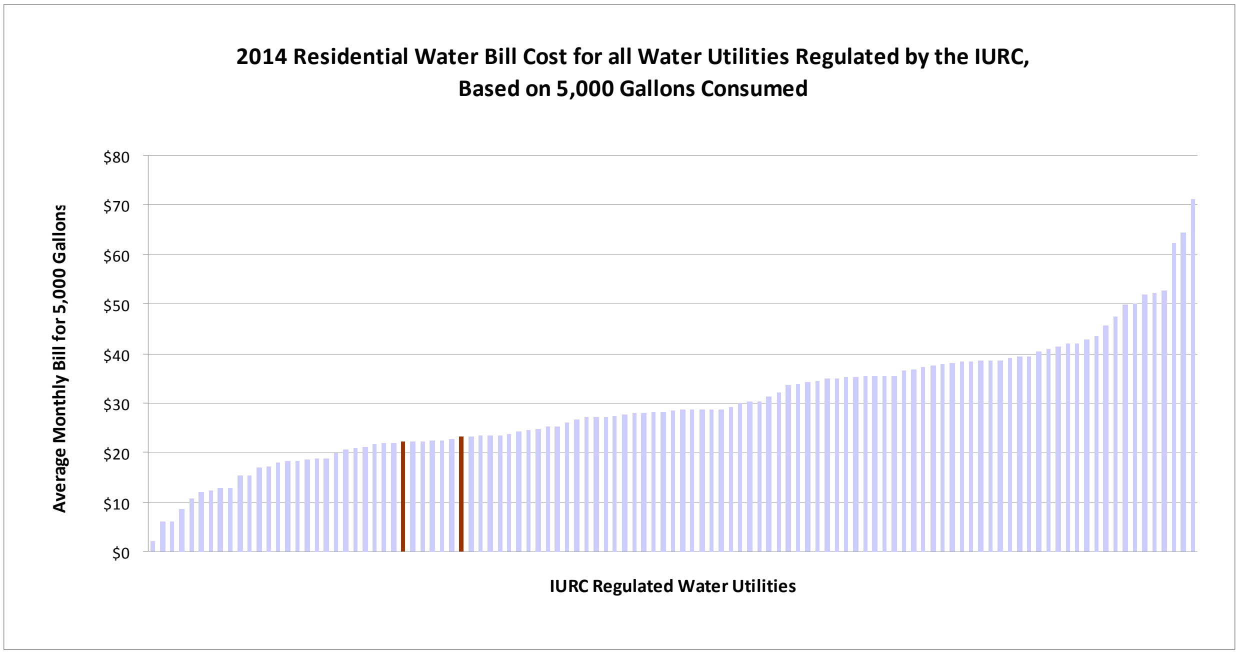

Figure 6: Residential rates for all water utilities regulated by the IURC. Rates are calculated based on a usage of 5,000 gallons. Adapted from the Indiana Utilities Regulatory Commission's "2014 Annual Water Bill Analysis."

III. Water Conservation Goals

Water Conservation Goals

Articulating goals for CBU’s Water Conservation Plan defines its intentions and provides a framework upon which the plan can be built. CBU developed its water conservation goals through a multi-step process. First, a list of conservation-related challenges facing CBU now, or that are expected to be encountered in the future, was compiled. Second, a set of goals was assembled in response to these challenges, ensuring that there was at least one goal addressing each challenge. Last, objectives were created to define the intent of each goal. The discussion of goals and objectives below identifies benchmarking and target-setting performance indicators that can be employed to measure CBU's success in reaching each objective.

Goal 1: Increase end-use water consumption efficiency.
Objective: Reduce per capita water use.
Objective: Reduce City of Bloomington water use.

Goal 2: Reduce CBU's non-revenue water.
Objective: Reduce CBU's real losses.
Objective: Reduce CBU's apparent losses.

Goal 3: Postpone the need for capital-intensive infrastructure expansion projects.
Objective: Reduce peak water demand.
Objective: Increase water use efficiency.

Goal 4: Increase water literacy among the community.
Objective: Promote water literacy among CBU customers.
Objective: Promote water education to K-12 students.

Goal 5: Improve CBU's drought preparedness.
Objective: Establish water conservation policies for drought conditions.
Objective: Ensure all user classes are involved during water emergencies.

Goal 6: Protect and preserve environmental resources.
Objective: Protect CBU's water supply.
Objective: Reduce CBU's greenhouse gas emissions.

Goal 1: Increase end-use water consumption efficiency

Reducing water waste by increasing customer water use efficiency is often the first and most obvious goal of any water conservation plan. Using efficiency as a resource makes it possible to effectively expand a community's water supply without having to tap into new sources. A variety of conservation measures will be employed in order to achieve this, including promoting the adoption of efficient appliances and fixtures, encouraging customer behavior change, and educating CBU customers. This goal will be benchmarked by calculating the gallons of water consumed per capita per day (GPCD). CBU will then use this performance indicator to set target goals for customer water use efficiency.

Goal 2: Reduce CBU's non-revenue water

CBU will determine its non-revenue water by completing annual water audits. This process calculates both real losses (physical water losses) and apparent losses (water that is consumed but not paid for).

The American Water Works Association (AWWA) recommends using the normalized performance indicator of real losses per service connection per day for target setting (AWWA, 2012). After determining current rates of real losses, CBU will use this performance indicator to set target values.

Apparent losses are equally important when considering non-revenue water. In fact, because apparent losses are consumed but not paid for, and because the retail unit price of water is more expensive than the unit cost of production, these losses represent a larger decrease in a utility's revenue per unit lost than real losses. CBU will use the volume of apparent losses per day to benchmark and set targets for apparent loss reduction.

Goal 3: Postpone the need for capital-intensive infrastructure expansion projects

Because the infrastructure capacity of a water utility is based on peak customer demand, the implementation of peak shaving measures can extend the life of treatment and delivery networks by postponing the need for infrastructure expansion projects. Additionally, reducing overall water consumption can aid in peak reduction programs by lessening the baseline from which the peak is set. Since Bloomington's annual peak water demand occurs in the summer, any measure that promotes efficient water use in June, July, August, and September will also help minimize peak demand.

CBU will measure the success of this goal by monitoring the annual peak demand. This will be measured both absolutely (MGD) and in relation to the average day demand (MD/AD).

Goal 4: Increase water literacy among the community

A water literate public will be more likely to participate in conservation efforts and care for their watershed. They will understand their own water footprint; they will grasp how their actions impact local water supplies; and they will be cognizant of the infrastructure that serves their water, wastewater, and stormwater needs. Ensuring that both CBU staff and the public are water literate will lay the groundwork necessary for a successful water conservation program.

Due to the qualitative nature of this goal, there is no single performance indicator that can easily gauge its success. However, this goal can be loosely assessed by the number of outreach events held each year, and by gauging the success of other, more quantifiable goals detailed in this document.

Goal 5: Improve CBU's drought preparedness

The drought conditions of 2012 marked the first time CBU implemented emergency water conservation measures. It is likely that CBU will not face a similar crisis for several years due to the nearly completed expansion project; however, this does not give CBU grounds to become complacent on the subject. Adopting a drought contingency plan will prepare the utility for future crises by detailing the steps needed to guide the community through a water emergency. Having a clear plan in place will minimize backlash from the public when emergency measures are implemented, and it will help to make a smooth resolution to water crises more likely.

CBU will review the drought contingency plan implemented in 2012, and make updates where needed. During this review, CBU will ensure that all users have an equitable role to play in responding to water emergencies by including measures that apply to each user classes.

Goal 6: Protect and preserve local environmental resources

Protecting Monroe Reservoir and its watershed is vital to ensuring that future generations in Monroe County have access to a clean and abundant water supply. CBU will take steps to ensure it is playing an active role in the protection of our natural resources through education and community outreach.

CBU will also take steps to preserve our natural resources by reducing greenhouse gas (GHG) emissions that are either directly or indirectly emitted by the utility. Through the review of its operations, CBU will ensure that best management practices are being employed in order to minimize emissions, and CBU will continue to take part in city-wide energy and GHG reduction targets.

IV. CBU Water Conservation Measures

The 2009 WHPA Water Conservation Plan assessed 40 water conservation measures and screened them based on four criteria: 1) relevance to conservation goals, 2) anticipated water savings, 3) cost to CBU, and 4) cost to CBU customers. After screening the measures, 19 were removed from the list, mostly due to either high costs or limited water savings. The conservation measures deemed most practical from WHPA's assessment, along with additional measures appended by CBU, are displayed in Table 3.

Measure	Estimated Annual Water Savings (gal./year)	Implementation Phase	Goal(s) the Measure Addresses
Water Loss Control			
Annual Utility Water Audit	n/a	1	2
Utility Leak Detection & Repair Program	107.0 million	2	2
Meter Testing & Replacement	n/a	2	2
City Government Water Use Audit	1.7 million	2	1
Public Education			
Public Education Campaign	Unknown	1	4, 6
Water Conservation Information on CBU Website	Unknown	1	4
End-of-season Notices to Turn Off Automatic Irrigation Systems to all Customers	0.9 million	1	1, 4
Water Conservation Billing Information	Unknown	1	1, 4
Primary & Secondary School Programs	Unknown	1	4, 6
Peak Notification to Large Users	n/a	1	3
Peak Notification to all Users	n/a	2	3
Social Media Campaign	Unknown	1	4
Annual Conservation Report	Unknown	1	4
Government Regulations			
The Feasibility of Several Ordinances will be Considered	Unknown	3	1, 3
Review CBU's Drought Contingency Plan	n/a	1	5
Economic Incentives			
Conservation Pricing	30.1 million	3	1, 3
Low-Income Leak Detection & Repair Program	1.0 million	2	1, 3
Rain Sensor Rebate	2.2 million	2	1, 3
Reevaluate Summer Sewage Average	Unknown	2	1, 3
Alternative Water Supply			
Alternative Water Supply	15.0 million	3	1, 3

Table 3: Proposed water conservation measures to be implemented by CBU. Estimated savings calculated by WHPA.

The conservation measures are designed to be implemented in three phases over a ten-year period (2014 to 2024). New measures will be implemented in each phase, and ongoing measures will carry over into later phases.

Phase 1 consists of CBU's first steps into building its water conservation program. Measures in this phase include community outreach programs and an analysis of supply-side operations to develop the foundations of CBU's water loss control program. Implementation of phase 1 measures will begin in 2014 and 2015.

Phase 2 will expand community outreach efforts and focus on measures that will take more preparation to implement. These measures will likely be implemented after phase 1 measures, loosely scheduled between 2016 and 2020.

Phase 3 is dedicated to measures that require a relatively large amount of expense, time, and collaboration to implement, such as the development of an alternative water supply and the implementation of local ordinances. Phase 3 will also expand upon earlier measures and include the possible implementation of advanced conservation billing information and retrofitting customer meters with an advanced metering infrastructure (AMI). Phase 3 is expected to occur between 2021 and 2024.

Phases are meant to guide CBU as its water conservation plan is put into practice, not to act as a strict timeline. It is likely that actual implementation of the phases will overlap, and some measures will be implemented before or after their assigned phase. CBU will continually assess its progress in implementing water conservation measures, and adjustments will be made as required.

Water Loss Control Program

Annual utility water audit

The water audit is the first stage in the development of a robust water loss control program. It is a valuable tool that allows a utility to quantify water consumption and water losses that occur in the distribution system and management process. Real losses (physical losses of water) and apparent losses (water that is consumed but not paid for) are both captured in a water audit.

A standardized water audit can be used as a benchmarking and target-setting tool, as well as a tool to evaluate its performance against peer utilities. The International Water Association (IWA) and American Water Works Association (AWWA) Water Audit Method is currently the industry standard. It is divided into three levels: 1) top-down approach, 2) component analysis, and 3) bottom-up approach.

The first level is a desktop analysis, which generates a broad overview of the state of the utility based on readily available data. This part of the audit will be carried out annually as part of an ongoing assessment of CBU's performance. The second and third levels are to be completed as part of CBU's utility leak detection and repair program.

Utility leak detection and repair program

Leaks in a water system are physical losses (i.e. real losses) that result in unnecessary water loss while inflating overall production and energy costs. The economic feasibility of repairing leaks can be determined on a case-by-case basis using the variable production cost (the total cost of purchased power, water, and chemicals divided by the total volume of produced water) used in the IWA/AWWA Water Audit. This method calculates a leak's cost to the utility, which can be weighted against the cost of repairing the leak.

A preliminary estimate of the amount of resources to invest in a leak detection and repair program can be made using the results of the water audit. Performance indicators from the audit can be used to benchmark the program's success and for target-setting. The 2009 WHPA Plan suggests setting a target rate of non-revenue water (NRW); however, AWWA advocates that the industry move away from the use of this indicator, citing that it is mathematically skewed (it is affected by changes in the customer base as well as by water loss control programs and conservation efforts) and that it does not take into account volume and cost data (the most important factors in water loss assessment) or differentiate between real and apparent losses (AWWA, 2012).

Two alternative, more appropriate performance indicators exist. The first is the volume of real losses per service connection per day. Because this figure is normalized against the number of service connections, it is a good operational performance indicator that can be used for real loss reduction target-setting. The second is the infrastructure leakage index (ILI). The ILI is calculated as the ratio of the current annual real losses (CARL) over the unavoidable annual real losses (UARL). The non-dimensional nature of the ILI makes it ideal for inter-utility comparisons.

Meter testing and replacement program

The meter testing and replacement program can be broken down into individual parts to be implemented separately.

- Test a sample of removed meters in order to better understand the level of under-registered consumption in the system. The results of these tests should be maintained in a data-set of meter ages and accuracy.
- Screen consumption data and meter sizes in order to identify and replace inappropriately sized meters. Oversized meters will under-register flow, which will increase apparent losses and non-revenue water, thus decreasing revenue to the utility.

- Convert the meter infrastructure to use AMI technology. This equipment will allow CBU to remotely read customer meters, transfer data automatically into the billing system, identify leaks quicker, and provide customers with more detailed water use data.

City government water use audit

In addition to asking the Bloomington community to adopt wise water use practices, the City of Bloomington will examine its water use by performing a water audit of all its buildings and public spaces. The purpose of the audit is to determine where the city is using the greatest amount of water and where efficiency improvements can be made. The audit will focus on indoor fixtures such as toilets, faucets, and urinals, and on outdoor use such as irrigation. The amount of water savings that results from the audit depends on the changes the city makes based on the audit's findings.

In 2009 the city passed a green building ordinance requiring 15 city buildings to conduct analyses determining the feasibility of meeting LEED-Silver standards based on a simple 10-year payback period. CBU may want to consider incorporating the city water audit into the certification process, since water efficiency is part of the LEED rating system.

Public Education

Public education campaign

Educating the public in water conservation practices, as well as in the importance of water conservation, is a critical component of a successful conservation program. Many people believe that the Midwest is immune to long-term water shortages; however, factors such as population growth, over use, resource competition, and drought can all lead to extended periods of water scarcity. In fact, Bloomington experienced numerous periods of water scarcity before Monroe Reservoir was constructed, leaving city officials scrambling to acquire new water supplies. The primary role of a public education campaign is to change the common mentality of water being an unlimited resource to one of water being a limited and valuable resource. As the public’s outlook changes, behavioral changes will be easier to implement.

CBU’s initial public education campaign will introduce and promote its water conservation plan to the community. This campaign will explain why conservation is important for CBU and its customers, the benefits of water conservation, and actions that customers can take to reduce water waste. Future campaigns will address proper irrigation practices, the benefits of native landscapes, and conservation-themed workshops, among other initiatives.

There are many opportunities for CBU to partner with community organizations to leverage existing resources and reach more members of the community. Organizations such as the Chamber of Commerce, Housing and Neighborhood Development, Indiana University, Bloomington Parks & Recreation Department, neighborhood associations, and church groups, among others, have existing programs and membership that would make them good partners in implementing education efforts related to water conservation.

Water conservation information on utility website

Though some water conservation information is already available on the utility's website, CBU will continue to develop the website's content to include relevant, up-to-date information. The website will focus on CBU customer-specific messaging and content, and links to resources that provide broader conservation information will also be provided. As part of this effort, CBU will clean the website of out-of-date content and make use of a re-branded conservation campaign.

End-of-season notices to turn off automatic irrigation systems to all customers

At the beginning of October each year, CBU will send all customers a reminder to turn off their automatic irrigation systems until next summer. By the end of October, lawn watering is no longer necessary as the first frost has typically occurred and grass begins preparing for winter dormancy. Not all CBU customers use automatic irrigation systems; however, the notice will remind all customers who water their lawns to reduce watering in preparation for winter.

Water conservation billing information

In addition to the obvious task of billing customers for water consumption, a utility bill can also be a powerful conservation tool. Well designed utility bills should clearly convey a variety of information to the customer, such as the amount of water used (with defined units), trends in the customer's water use, comparison's to the average household water use of other customers in the area, and a clear breakdown of costs. CBU will work with the company that prints its customer bills to develop an enhanced bill design.

As part of this redesign, CBU will examine the possibility of building in more space for conservation messaging. The current design allows for only 60 characters of text, which greatly limits the information CBU print on the bill. CBU will also develop several bill inserts to communicate more detailed conservation information, such as indoor and outdoor conservation tips, home weatherization guides, and automatic irrigation shutoff reminders.

In the long term, CBU will research the development of billing and GIS systems that can work in tandem to track water use by geographic location. Customers will be provided with their water use habits in comparison with the water use trends of their neighborhood, which has been proven to be an effective conservation strategy for many utilities. This will likely be feasible only when the utility adopts an advanced metering infrastructure.

Primary and secondary school programs

CBU staff will work with local primary and secondary school programs to educate students on the importance of water conservation and about water conservation practices. Depending on the availability of resources, CBU will either develop its own curriculum or modify a pre-packaged curriculum that consists of in-class activities and take-home materials that can be shared with students' families.

Peak day notification to large customers for peak shaving

CBU will work towards establishing triggers for sending large water users notification of peak demand events. The notifications will alert large water users and prompt them to shift water intensive activities to a later time of day. The notification messages will not ask large users to forgo a specific activity on the forecasted peak day, but rather to adjust their water use schedule. Such cooperation will help reduce peak demand, ensuring that customer water needs are able to be met during emergency events.

Peak notification to all customers for peak shaving

In addition to working with large commercial and industrial users, CBU will explore the development of a peak notification program for all users. This will require the collection of customer contact information, and customer consent, to send notifications (emails, SMS messages, automated voice calls, etc.) to users during peak events.

Social media campaign

CBU will develop a social media presence to promote itself to its customers. The social media campaign will convey conservation practices to customers, publicize CBU conservation goals, share utility- and conservation-related news, and advertise CBU workshops and events. In addition to conservation-oriented messaging, CBU will use social media to deepen its relationship with its customers and to educate the public of the utility's operations. Social media can also be an effective medium for customers to communicate with the utility.

Annual conservation report

A brief annual conservation report will be assembled each year highlighting CBU's conservation successes of the previous year and its goals for the upcoming year. The report may be distributed as a bill insert and/or posted to the utility's website. Delivering the report in the spring or early summer will aid in developing a conservation mindset among CBU's customers before the onset of high-use months.

Government Regulation

Evaluate water conservation through government regulation

CBU will examine the potential water savings that can be realized through the implementation of local government regulations. Communities across the United States have adopted local ordinances that have both reduced wasteful water use and allowed utilities to better understand how water is consumed within their community. Such ordinances include mandatory submetering of new multi-family units, permanent water waste ordinances, building codes requiring the use of water efficient appliances, toilet retrofit ordinances, and irrigation system requirements for new development, among others.

The design, implementation, and enforcement of government ordinances intended to encourage efficient water use will require the collaboration of many stakeholders, including officials from the City of Bloomington and Monroe County, building associations, neighborhood groups, property owners, and other members of the community. In addition to working with these groups while a regulation is being considered and designed, CBU will need to dedicate a significant amount of resources to educate its customers when the ordinance is to go into effect, the details of the ordinance, the reasons why the ordinance is necessary, and who the ordinance applies to. Failing to do any of the above may rouse public disapproval and confusion, resulting in poor compliance and a loss of trust from the public.

Due to the complexity involved in using government regulation to encourage water conservation, these efforts will require much time and care to develop and will likely not go into effect until Phase 3 of the Water Conservation Plan. In fact, depending on the success of other conservation efforts, CBU may conclude that pursuing government regulation is not the best means to promote water conservation among its customers.

Review CBU's drought contingency plan

In 2012, much of North American was crippled by severe drought, causing water supply emergencies across the continent. In Bloomington, peak water demand reached all-time highs, pushing CBU's treatment and delivery capacity to its limit. CBU responded by creating its first drought contingency plan, which consists of three stages designed to be implemented based on the severity of the water crisis. Stage 2 drought response measures were put into practice in August of that year. CBU experienced a peak demand reduction of nearly 20% as a result of the measures. If needed, increased reductions could likely be realized by implementing stage 3 drought response measures during future water emergencies.

CBU has since expanded the capacity of its infrastructure, and it is unlikely that peak demand will reach the new plant capacity limits for several years to come. However, this should not give cause for utility personnel to ignore the likelihood of future crises. CBU will reevaluate its drought contingency plan and update its emergency conservation measures. Measures should be analyzed and updated in light of CBU's expanded infrastructure and also by evaluating the effectiveness of the various measures implemented in 2012. CBU will also strive to ensure that the drought contingency plan does not rely solely on one or a few user classes to reduce demand, but that all classes actively participate in drought relieve efforts in a manner that is in accordance with the relative share each user class's demand.

Economic Incentives

Conservation pricing

CBU uses a uniform rate for each customer class. Uniform rate structures do not fully discourage water waste, because each unit of water use is priced at the same rate no matter how much is consumed. CBU will evaluate the costs and benefits associated with the implementation of a conservation rate structure. Conservation pricing promotes water conservation by pricing discretionary water use at higher rates than non-discretionary use and can reduce seasonal, peak demand. Additionally, these rates may be more affordable for low-income customers that do not have large amounts of discretionary use.

As part of this evaluation, CBU will obtain information from communities in the Midwest who have adopted conservation rate structures. This information will be used to better understand the impact these rate schedules had on water consumption and how customers responded to the new rates.

Low-income home leak detection and repair program

A low-income home leak detection and repair program will target homeowners whose income falls within a predetermined range and that live in a home built prior to 1994. The 1992 Energy Policy Act set uniform water efficiency standards for showerheads, faucets, urinals, and toilets manufactured after January 1994. By targeting homes that were built before 1994, the program will maximize water savings.

In one implementation approach, an inspector will be provided to locate and fix leaks within the home and to upgrade inefficient fixtures. If severe leaks are found in the home, low-income homeowners may be eligible for Emergency Home Repair (EHR) grant money that is currently available through Bloomington's Housing and Neighborhood Development (HAND) department.

CBU will communicate with HAND and the Department of Economic and Sustainable Development to determine if this program should be incorporated into existing city programs, or if CBU should develop this as a stand-alone program.

Rain sensor rebate

A rain sensor is a device that automatically interrupts an irrigation system's run cycle when a specific amount of precipitation has occurred. Rain sensors are relatively inexpensive devices (most models cost less that $50) that can be installed by the homeowner or a contractor. In addition to a rebate, CBU can provide information on proper sensor settings for the region as part of a public education campaign on lawn watering.

Reevaluate summer sewage average

CBU customers are billed a uniform wastewater rate based on the volume of potable water they consume. This is a reasonable practice during most of the year when the majority of water use takes place indoors. During the summer, all CBU customer classes, except industrial, experience a spike in water use, primarily due to outdoor irrigation practices. Water used outdoors generally does not end up in the sewer, and, some argue, should not be charged as such.

To account for this, Bloomington uses a summer sewage average. This is the practice of basing summer wastewater fees—applicable in June, July, August, and September—on the average metered water consumption from billings issued in April and May (or actual use, if less). Doing this helps to avoid charging customers wastewater fees for outdoor water use. However, this practice does not accurately charge the customer if indoor water use also increases during the summer.

CBU will examine the benefits and drawbacks of eliminating or redesigning the summer sewage average. If properly carried out, the removal of this policy can encourage water conservation without incurring public disapproval. Most outdoor water consumption is in the form of lawn irrigation, and all CBU customers are entitled to install a separate meter on their irrigation systems. This water is billed at a lower rate than general residential water use, and it does not incur wastewater charges, resulting in a lower water bill for many CBU customers. Additionally, the widespread use of irrigation meters will provide CBU information about how its customers use water. This is knowledge that can be used to make more informed decisions regarding conservation strategies, capital projects planning, and rate adjustments.

Alternate Water Supply

Alternate water supply

In 1925, Griffy Lake was constructed to provide a much-needed water source for Bloomington. The Griffy Lake Water Treatment Plant served the city until it was retired in 1996, at which time Monroe Reservoir became Bloomington's sole water source.

The WHPA Water Conservation Plan suggested that the existing infrastructure at Griffy Lake could be recommissioned and used to treat and distribute non-potable water to large irrigators, such as Cascades Golf Course and IU athletic fields. Providing water to these two users alone would reduce drinking water demand by as much as 0.5 MGD during peak periods, and this figure would increase as new non-potable transmission lines are added to the system. Providing non-potable water will also reduce CBU's treatment costs by reducing the amount of water treated to drinking level standards.

There are many barriers that CBU would have to overcome to develop this project. Recommissioning the Griffy Lake Plant would require a complete overhaul of the facility. The building, plant processing gear, interior piping, and pumps would all need to be replaced to make the plant operable. The existing facility would likely need to be demolished and a new pumping station with a clarification basin be built. Additionally, existing transmission and distribution lines from the plant would need to be repaired and, in some areas, replaced. In light of these factors, it is doubtful that the benefits CBU and its customers would receive from recommissioning the Griffy Lake Plant would outweigh the costs of the project.

However, other options for non-potable water systems exist. Decentralized cisterns that collect stormwater can provide non-potable water while also alleviating downstream flood conditions during rain events. This concept was included as an option in the *Master Plan and Redevelopment Strategy* for Bloomington's Certified Technology Park.

As part of its long-term water conservation program, CBU will evaluate the various options available for reducing drinking water demand and treatment costs by providing its customers with non-potable water.

V. Conclusion

Implementing an aggressive water conservation plan will ensure that CBU is prepared for future water supply constraints. Although CBU is not currently threatened by water shortages, factors such as climate change, resource competition, over use, and population growth can put strains on the system.

Water conservation benefits a utility and its customers even when water supplies are not threatened. Costly infrastructure expansion projects can be avoided or deferred if a water conservation plan successfully reduces peak and overall water demands. CBU and its customers will also enjoy reduced treatment and pumping costs when water loss control and end-user efficiencies are put into practice.

While this document provides the groundwork to begin the implementation of a robust water conservation plan, it is not a final product that can now be set aside on a shelf. This is a living document that will continually be updated to meet the needs of the community and to take advantage of innovative conservation measures. CBU will continue to develop its water conservation goals and long-term plans to ensure the availability of a clean water supply to current and future generations.

By implementing this water conservation plan, CBU is strengthening its commitment to meet the needs of the community in a method that respects the resources we depend upon.

References

American Water Works Association. (2012). *IWA/AWWA Water Audit Method*. Retrieved from http://www.awwa.org/Portals/0/files/resources/water%20knowledge/water%20loss%20control/iwa-awwa-method-awwa.pdf

American Water Works Association. (2012). *Water Loss Control Terms Defined*. Retrieved from http://www.awwa.org/Portals/0/files/resources/water%20knowledge/water%20loss%20control/water-loss-control-terms-defined-awwa.pdf

Black and Veatch. (2007). *City of Bloomington Utilities Water Supply Evaluation*. Retrieved from http://bloomington.in.gov/media/media/application/pdf/2400.pdf

Electric Power Research Institute. (2013). *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries*. Retrieved from http://www.waterrf.org/PublicReportLibrary/4454.pdf

Indiana Utility Regulatory Commission. (2014). *2014 Annual Water Bill Analysis*. Retrieved from http://www.in.gov/iurc/files/Water_Billing_Survey_2012.pdf

U.S. EPA. (2009). *WaterSense Labeled New Homes*. Retrieved from http://www.epa.gov/WaterSense/pubs/ws_homes.html

U.S. EPA. (2014). *Outdoor Water Use in the United States.* Retrieved from http://www.epa.gov/WaterSense/pubs/outdoor.html

U.S. Global Change Research Program. (2014). *Climate Change Impacts in the United States: The Third National Climate Assessment*. Retrieved from http://nca2014.globalchange.gov/downloads

Wittman Hydro Planning Associates. (2009). *Water Conservation Plan: City of Bloomington Utilities*. Retrieved from http://bloomington.in.gov/media/media/application/pdf/6836.pdf

Glossary

Acronyms

AD	Average Day (demand)
AMI	Advanced Metering Infrastructure
AMSL	Above Mean Sea Level
AWWA	American Water Works Association
CARL	Current Annual Real Losses
CBU	City of Bloomington Utilities
GHG	Green House Gases
EHR	Emergency Home Repair
GPCD	Gallons per Capita per Day
HAND	Housing and Neighborhood Development
IDNR	Indiana Department of Natural Resources
ILI	Infrastructure Leakage Index
IU	Indiana University
IWA	International Water Association
LEED	Leadership in Energy and Environmental Design
MD	Maximum Day (demand)
MFR	Multi-Family Residential
MG	Million Gallons
MGD	Millions of Gallons per Day
MG/Yr	Million Gallons per Year
NRW	Non-Revenue Water
SFR	Single-Family Residential
T&D	Transmission and Distribution
UARL	Unavoidable Annual Real Losses
WHPA	Wittman Hydro Planning Associates

Definitions

Acre-Foot: A unit of volume commonly used in the United States for the measurement of large-scale water resources. It is defined as the volume of one acre of surface area to a depth of one foot, or 43,560 cubic feet.

Apparent Loss: Non-physical losses that occur in utility operations due to customer meter inaccuracies, systematic data handling errors in customer billing systems and unauthorized consumption. In other words, this is water that is consumed but is not properly measured, accounted or paid for.

Average Day (AD) Demand: The average of each calendar day's water demand over a defined timeframe.

Class: A group of utility customers that share common characteristics that are grouped together for billing or other purposes. CBU customer classes include single-family residential, multi-family residential, commercial, industrial, Indiana University, and wholesale).

Conservation Rate Structure (Conservation Pricing): Conservation rate structures, as they relate to water utilities, are designed to encourage consumers to reduce water comsumption, particularly discretionary water consumption, through the use of price signals. Conservation rates can be designed to encourage conservation year round to encourage a reduction in overall use, or during certain seasons or times of day to reduce peak use.

Current Annual Real Losses (CARL): The volume of water lost from leaks, background losses, and operator error in a defined time period.

Demand-Side Water Conservation Measures: Programs that encourage customers to reduce the amount of water consumed or change the time water is consumed.

Drought Contingency Plan: An alternative policy of supply- and demand-side measures to implement in the case of a drought or similar water shortage designed to reduce peak demands and to extend water supply availability.

Finished Water: Water that has passed through a water treatment plant and is ready for delivery to consumers.

Infrastructure Leakage Index (ILI): Current annual real losses over unavoidable annual real losses (CARL/UARL).

Non-Potable Water: Water that does not, or may not, meet drinking water quality standards.

Non-Revenue Water: In a distribution system water audit, non-revenue water equals the volume of unbilled authorized consumption (water for fire fighting, system flushing and similar uses) added to real losses and apparent losses. Simply put, it is water that is produced, but does not generate revenue for the utility.

Maximum Day (MD) Demand: The calendar day that experiences the highest water demand in a given timeframe.

Peak Demand: As it relates to water, peak demand is the point of highest consumer water demand in a given time period (generally annually, monthly, or daily). Peak water demand is usually expressed in terms of maximum day (MD) demand or maximum hour (MD) demand. Peak demand is often the determining factor when designing the capacity of a water utility's infrastructure.

Peak Shaving: As it relates to water, peak shaving refers to the use of water conservation measures to reduce water demand during peak periods, thus resulting in a lower peak than would have otherwise occurred.

Rain Sensor: A device that is connected to an irrigation system that reduces water waste by turning off automatic irrigation systems during rain events.

Raw Water: Untreated water.

Real Loss: Physical losses of water in the distribution system, including leakage and storage overflows.

Submetering: Using water meters to separately measure a portion of a master meters water use, such as in individual apartments in an apartment complex.

Supply-Side Water Conservation Measures: Programs that decrease the amount of water a utility needs to provide in order to meet customer demand by reducing water loss and other inefficiencies in the infrastructure.

Summer Sewer Average: Wastewater fees are generally based on the volume of drinking water consumed. The summer sewer average bases summer wastewater fees on non-summer water consumption history to account for increased outdoor water use that does not enter the sewer system.

Unavoidable Annual Real Losses (UARL): The volume of real water loss that represents a utility's lowest technically achievable water loss based on the characteristics of the utility. UARL is determined by using an equation developed by the International Water Agency's Water Loss Taskforce.

Variable Production Cost: The cost of producing and supplying an additional unit of water, defined as the total cost of electricity, chemicals, and raw water divided by the total volume of produced water over a defined period (calculated annually in water audits).

Water Extraction: Drawing raw water from a water source to be treated.

Water Production: The process of treating raw water to a level that is safe for human consumption, often referred to as finished water. Total finished water is less than raw extracted water due to backwashing and other water needs during production.

Wholesale Customers: Entities who buy water from CBU for resale to retail customers.