City of Galveston

Advanced Metering Infrastructure

HGSD Final Report

Executive Summary

Introduction

The City of Galveston (City) has commissioned E-Source for services to perform a Feasibility and Business Case Analysis of the costs, implementation project management of the Advanced Metering Infrastructure (AMI), including the standards and general requirements applicable to the local utility environment and its related water and energy conservation objectives. The City selected Badger Meter Inc. as it's smart water solutions partner, and procured the Badger product family. This report sets forth the findings of the AMI Assessment (the Assessment) for the City. This report relates closely to the water efficiency opportunities, and the technologies implemented by the City.

Background – Meter Reading and Billing in the City of Galveston

The City was an early adopter of Automated Meter Reading (AMR) technology and has realized the benefits of AMR since ~2004, when the City installed AMR Meter Interface Units (MIUs) from Badger. Galveston has been reading the meters with the Badger's mobile drive-by system. The AMR system was at end-of life and would no longer be supported beyond 2021, requiring the City act.

Strategic Alignment

The utility of future will be a fully digital system. The need to embrace digital business transformation concepts marks a fundamental rethinking of how an organization uses technology, people, and processes to enhance business performance. Typical utility industry disruptive forces as noted below are driving countless changes for the data-driven utility as they evaluate legacy systems and processes to innovate and build new organizational capabilities.

- Natural disasters & extreme weather
- Environmental and regulatory priorities
- Customer engagement expectations
- Market evolution
- Technology innovation
- Aging infrastructure
- Evolving workforce
- Rising cybersecurity threats

The benefits of moving to AMI technology better align with the City's community vision of providing exceptional quality of life through safety, connection, resiliency, preservation,

transparency, and creating a contemporary culture. Ultimately, the community will need to engage with the City to help promote water sustainability, and support overall Water Conservation Plan objectives as follows:

- Reducing water consumption
- Reducing loss and waste of water
- Improving the efficiency of the water utility (minimizing future rate increases)
- Extending life of water supplies by reducing rate of growth in demand

AMI technology will also provide a network infrastructure to promote smart city initiatives beyond the meter, and sustainable benefits that will support the City's strategic vision going forward. Benefits can be realized by the City through organizational effectiveness and streamlined business process discipline and alignment to impact:

- Customer engagement and effectiveness,
- Utility analytics and analysis,
- Environmental partnership, and
- Operational efficiency.

Customer Service Improvement Benefits

The City determined the following key customer service processes would be impacted and could experience improvements through an AMI implementation.

Key Customer Service Processes Impacted by AMI

- Billing and Bill Processing:
  - Reduction of bill auditing for Hi/Lo reads due to replacement of failing equipment and access to daily usage
  - Reduction in Read-to-Bill cycle time
- Field Customer Service Orders:
  - AMI will reduce the overall number of field service orders by reducing dependence on a field visit for investigations, and other billing and consumption related activities
  - Reduction in estimated reads due to missing reads related to failed devices
  - Streamlines the Move-in/Move-out process that captures final and starting meter reads for new accounts without need for a field visit
    - The City remote valves remove the need to physically visit the meter to capture a read for move-in and move-out orders. (Off-Cycle Reads) – special reads only

Key Customer Service Processes Impacted by AMI

- Reduction in call center activity due to customer access to data through portal; near real time data.
- Reduction in bad debt write-off and high bill complaints due to customers managing consumption habits: Better and more detailed data provided with AMI to address customer's questions and identify potential high usage
- Reduction on collections: AMI enables proactive notification before excessive usage presents a financial burden to the customer
- A customer self-service web portal that presents customers' hourly usage which has been very effective in communicating with customers on their usage patterns and assist in validating high consumption periods
- AMI has helped staff assist and educate customers on their water use and identify actions to improve their water use efficiency

1.1.1. Distribution Operations Benefits

The City identified the following distribution system operations have been impacted and improved through the AMI implementation.

Key Operational Processes Impacted by AMI

- Meter Reading Processing:
  - AMI removes the need to physically visit (drive-by) the meter and capture a reading on a monthly basis (On-Cycle reads)
  - Reduction in vehicle operation, and maintenance costs associated with the reduction in drive-by meter reading
- Pressure Management: Real time alerts and time-series measurement data which improves ability to optimize daily pumping and hydraulic grade lines
- Water Quality Monitoring: Right sizing flushing and dosing practices based on system data, versus legacy process which depended on customer complaints and frequency-based flushing
- System Modeling and Planning: Time-stamped AMI data is being used to calibrate and refine the current operational planning for the distribution system, resulting in better predictive planning related to water treatment, pressurization, pumping, and storage

Key Operational Processes Impacted by AMI

- System Leak Detection: AMI has enabled the ability to conduct water loss analyses to help improve the accuracy of reporting for unaccounted water
  - AMI improves the City's ability to identify customer side leaks
  - AMI system provides time-stamped usage for the meters across the system, providing a tighter window of usage and a more accurate accounting of water into and out of the system

1.1.2. Beyond the Network – The Real Work of AMI

AMI real potential is achieved when a utility expands beyond the reading of meters to utilizing the data and expanding the use of the communications network provided by the AMI technology to place AMI communication-enabled devices for operational purposes. The Badger Meter AMI communications network provides the City a ready-made opportunity to place such devices where they are needed, without the often expensive and time-consuming effort to have telephony connections and power service installed.

AMI enabled sensors have been placed throughout the system on the AMI communications network, creating an opportunity for the City to develop other Smart City initiatives and best practices related to advanced data analytics.

1.2. Conclusions

In the water utility industry, AMI has become a reality because of the advancements in communications technology and battery life, coupled with the reduction in the cost of communications components. The City installed a new smart water solution which included a new analytical platform, the replacement of ~28,000 highly advanced meters of every size, pressure monitoring technology, water quality technology, remote connect/disconnect technology, and launched a new portal that interfaces with customers.

AMI Software and Device Deployment

The AMI deployment consisted of a new cellular network, the Beacon AMI software platform, the Eye on Water customer portal, a 100%-meter change out, water quality devices and pressure monitoring devices.

The City opted to install the Badger E-Series Plus ultrasonic meter for all available sizes, which communicate on a cellular network. All of the meters provide customer side leak detection through continuous consumption monitoring. Additionally, each meter monitors temperature, backflow, empty pipe, and tampering. The 5/8th" meters all have the ability to remotely connect/disconnect via a motor operated gate valve, integrated with the water meter. The 1", 3", 6" and 8" meters have pressure monitors built into them. The City also installed MetriNet and Nano water quality devices as well as Syrinex pressure monitoring devices throughout the water distribution system.

The Water Meter deployment is approximately 50% complete and is expected to reach the 100% mark by late Spring. Early supply chain issues caused meter installation delays, however City inventories are currently healthy and meters are being changed out at a rate of 300 – 500 meters per week.

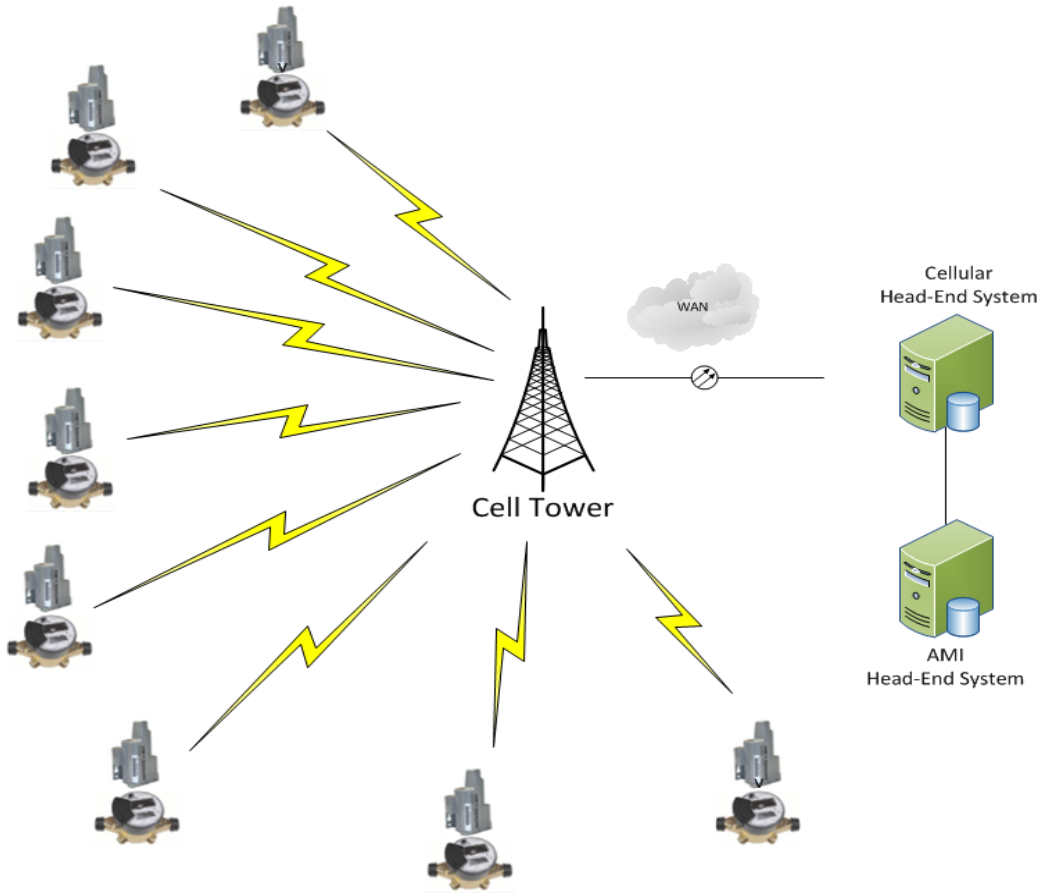
Project meter installations are as follows:

Meter Size	Total Quantity
5/8"x3/4"	24,728
3/4"	1
1"	1,119
1-1/2"	237
2"	462
3"	100
4"	59
6"	181
8"	16
10"	11
Total	**26,914**

Meter totals do not include new meter sets attributed to growth.

Wi-Fi / Cellular Enabled Systems

Systems that communicate using a cellular network or to the Internet via a transmission beacon rather than radio are considered Wi-Fi/cellular enabled (Figure Cellular / Wi-Fi AMI Networks). The method of transferring the data for these systems is much like a Star Network, but the means of data transfer happens through a cell or Wi-Fi connection, rather than through an elaborate transmission system of collectors and receivers. One of the advantages of utilizing cellular systems includes the ability to use existing communication infrastructure.

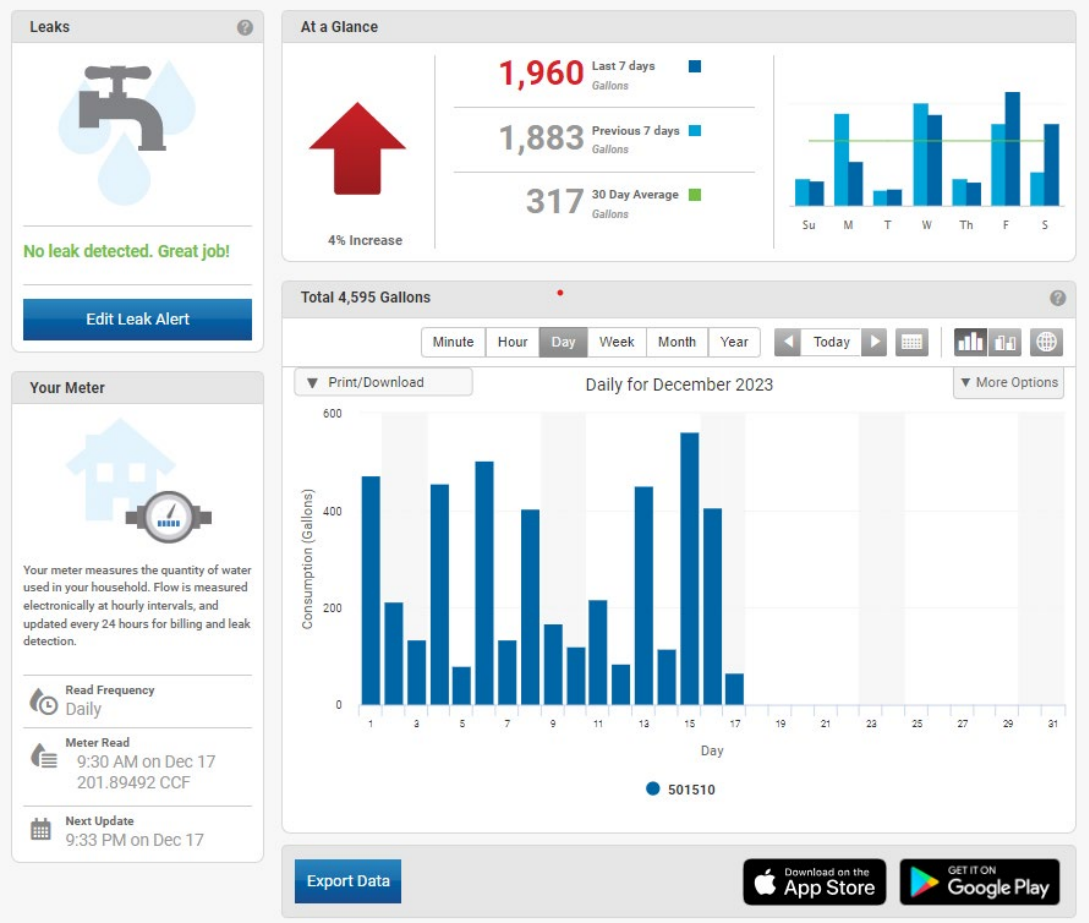


Cellular/Wi-Fi AMI Networks

Customer Portal

Customer portals provide customers and customer service personnel access to customer interval and usage data which is often provided in a graphical format. The representation of detailed usage data from AMI can be provided to the customer portal from the CIS or MDMS,

or often from both. The following pictures present samples of data provided to the customer over a web portal. Note the second picture indicates continuous consumption, indicating a potential customer-side leak.



System Analysis

Time-synchronized data from the AMI can be used to support system modeling. This data can be correlated to production meters, pressure monitors, backflow devices, etc. to gain a clearer picture of water flow and system performance to a level of confidence heretofore unattainable for most utilities.

Leak Detection

AMI can support system leak detection through two primary methods. The first is to compare an interval of time-stamped meter consumption data from a specific area against the data from a City metered area/zone (DMA/DMZ) meter. Differences in the consumption and in-flow can be identified as potential system leakage. The second is to deploy acoustic leak detection (ALD) devices and/or institute a leak detection survey program. Note that undetected leaks are

typically related to high bill complaints, and that neither of these methods are directly related to "customer-side" potential leak notification, which can be provided using AMI.

Water Losses and Loss Analysis

AMI has shown the ability to help water utilities improve accuracy in the reporting of unaccounted for water. The AMI can time stamp usage for the meters across the system and provide a tighter window of usage, resulting in a more accurate accounting of water into and out of the system.

As shown in Figure the figure below, AMI provides a network solution that includes: system analysis, water loss analysis, and leak detection.