

**Automated Water Metering Integration
Technology and Use in San Diego County
Backgrounder**

May 2012

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Executive Summary

Automated Meter Reading, known as AMR, and Advanced Meter Infrastructure or Automated Meter Integration, both abbreviated to AMI, systems represent the newest step in water meter devices although such technology has been evolving since the 1970s. Traditional water meter devices require a meter reader to visit each individual water meter to check the customer's water usage. AMR/AMI systems use wireless or radio technology to allow for faster and more frequent collection of meter reads.

These technologies also allow for efficiency gains from;

- Reducing the number of necessary meter readers and their associated expenses,
- Eliminating the need for estimating water use (which often under-estimates actual water consumption), and
- Improving customer satisfaction through;
 - Accurate billing,
 - Enhanced leak identification,
 - Shorter billing cycles, and
 - Improved data for possible conservation measures.

Defining Automated Meter Reading (AMR)

AMR typically refers to the ability to collect data from meters remotely and automatically. AMR is used primarily for monthly customer billing and reduced operational costs. These systems typically comprise meters fitted with communication modules, collection systems and supporting software to manage collection of the data. Some fixed-network AMR systems can also provide interval data collection, outage detection and restoration notification capabilities.

Defining Advanced Meter Infrastructure (AMI)

AMI typically refers to systems that are capable of collecting detailed energy or water usage data frequently. Collection and presentation of more timely and granular data enables utilities to support time-based pricing and demand response programs, educate customers on their consumption and alter usage patterns. AMI data is collected much more frequently, and comprehensively. In addition, AMI generally refers to the ability for meters to receive information as well, which can include the ability to turn on and off water service.

Defining Automated Metering Integration (AMI)

In practice, the distinction between AMR and Advanced Metering Infrastructure is blurring. One of California's largest vendors for AMR services, Datamatic, offers products that have capabilities usually associated with Advanced Metering Infrastructure, notably its two-way communication system. Two-way communication systems are a key feature of utilizing water conservation programs, such as time-of-use (TOU) programs, as it offers customers detailed data on their usage. The blurring of the distinction between AMR and Advanced Metering

Infrastructure explains the use of the more recent term Automated Meter Integration (also AMI) that is more inclusive of all automated metering technologies. The acronym ‘AMI’ now stands for two different terms. No matter which it stands for, AMI is more inclusive than AMR and implies more advanced technology. The two terms abbreviated with the acronym AMI can be used interchangeably in almost all cases.

Local Implementation

Within San Diego County, there are several examples of water retailers at various stages of utilizing automated metering technology. Most water agencies are using, considering, or have considered using automated metering technology, however only about half currently use the technology, and several of those are using it in a very limited fashion. Some have implemented, or are implementing, full networks, and are touting a successful system, while others have performed analyses and pilot studies and concluded that the technology is not yet consistent enough to guarantee the appropriate returns through savings and/or it does not currently make sense for their community’s specific topography. To compare the implementation status of each of the local water retailers, see the table on page 9.

Legacy and Current Technologies and Techniques

Data Analysis Technologies and Techniques

Water delivery system data analysis techniques can be grouped primarily into three groups; hydraulic modeling used as a real time management tool, regression-based analysis, and acoustic systems known as “noise loggers” which require access to infrastructure.

Noise Logging

Noise logging technology is the practice of collecting data by placing noise sensors in the system. This acoustic system requires often difficult-to-get access to the infrastructure and numerous places. In a period of low use, noise signals are sent and monitored. The sensors can infer the speed at which water is moving through the system, and deduce where leaks are located.

Regression-based Analysis

Developing a statistical model and using it to predict the most vulnerable areas of the system would be a regression-based process, and is limited by not using real-time data.

Hydraulic Modeling

Further developing planning models to work with real-time data is the most direct method of identifying system loss; however it also requires the highest level of initial investment in infrastructure.

Automated Meter Reading Technology

AMR meters most commonly communicate monthly or daily totals to a central collector using infrared technology, radio signals, satellite, or a fixed cable-based network. The different technologies provide different levels of benefits at different costs.

Contact

The most basic AMR technology provides meter readers relatively modest relief. Hand-held computers are used along with an attachment using a technology that will receive the reading from the meter. Using a wand or other sensor, meter readers would still have to make either contact or close to contact at each meter.

Drive by

Providing the opportunity to reduce the number of meter reader positions, some AMR meters broadcast the information, generally via radio signals, continuously. This enables meter readers to receive the readings with computers by driving down the local road. Additional time savings are made by virtually eliminating access issues including potentially dangerous dogs. More commonly today, these meters utilize two-way communication technologies enabling a replacement of the continuous broadcasting with a response to a signal sent from inside the vehicle.

Networks

Radio signals, cell-phone technology and satellites can all be used, often in conjunction with each other, to deliver readings from an AMR meter to a central location for billing purposes. Alternatively, a “fixed network” of cables, most commonly electricity cables, can be utilized. While these types of technologies can be used in an AMR capacity, it is what allows “smart meters,” capable of providing more detailed information, to work with a more advanced AMI system. The term “fixed network” is often used in reference to a network that utilizes cell phone technology. It is important to note how the term is used regardless of if it is an appropriate use.

Advanced Metering Infrastructure Technologies

AMI meters are known to differ from AMR ones in that advanced metering infrastructure meters have the ability to receive information as well as transmit it. This is an example of a capability that leads to additional functionality. The primary reason for a meter to receive information is so that a central location can remotely turn on or off service. More significant functionality comes from the dramatically increased intervals at which readings can be reported. Even if all of these functionalities are not going to be used initially, the capability allows for an easier and cheaper transition to using them in the future as technology gets better and cheaper.

AMR meter readings typically do not occur more than once a day, however time-of-use data may be stored in the interim on some meters. In general, “smart meters” paired with an AMI system can enable point-in-time readings, effectively providing continuous water level information. Other functionality that can be attributed to dramatically increased readings would be the ability to, more accurately:

- Detect customer's leaks
- Address customer complaints
- Detect system loss
- Determine the location and severity of a water main break
- Monitor compliance with restrictions.

Several other benefits of varying value are associated with an AMI system including:

- Increasing the percentage of billings that are based on actual rather than estimated usage to nearly 100 percent.
- Detecting theft
- Obtaining off-cycle billing information

Meter Data Management (MDM)

“Smart meters” and AMI gain much of their functionality from the dramatically increased amount of data involved. This data can either be fed directly into a Customer Information System (CIS) that is primarily designed for billing, or it can go into a Meter Data Management (MDM) system that typically has a broader focus.

Case Study

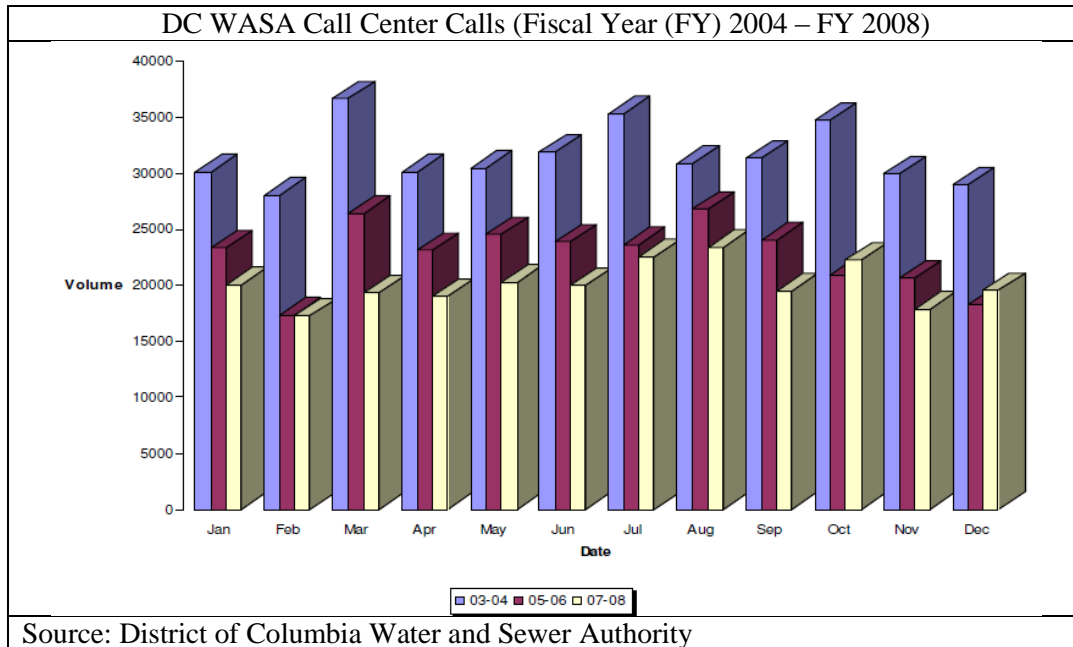
District of Columbia Water and Sewer Authority (DC WASA)

In 2002, the District of Columbia Water and Sewer Authority (DC WASA) started planning an AMR project to serve 580,000 customers. By 2007, the project was “substantially completed” just under budget at \$41 million including all meter replacements. Twenty (20) positions were eliminated and the percentage of bills based on actual readings (as opposed to estimated) increased from 77 to 95 percent.

Their report¹ on the transition is helpful in assessing the level of savings associated. However the technology has further developed since, and costs have changed as well. DC WASA further lowered their costs by leveraging the new technology to improve their call center performance, meter maintenance process, account transfer process and billing exception process.

The call center was one operation that was able to see major cost savings and customer service improvements with the implementation of AMI technology. The volume of calls dropped significantly with the implementation. While there are more customers now, and fewer employees, calls have dropped in number and time translating directly to lower costs. The following chart demonstrates the drop in number of calls over the most appropriate 3 year period.

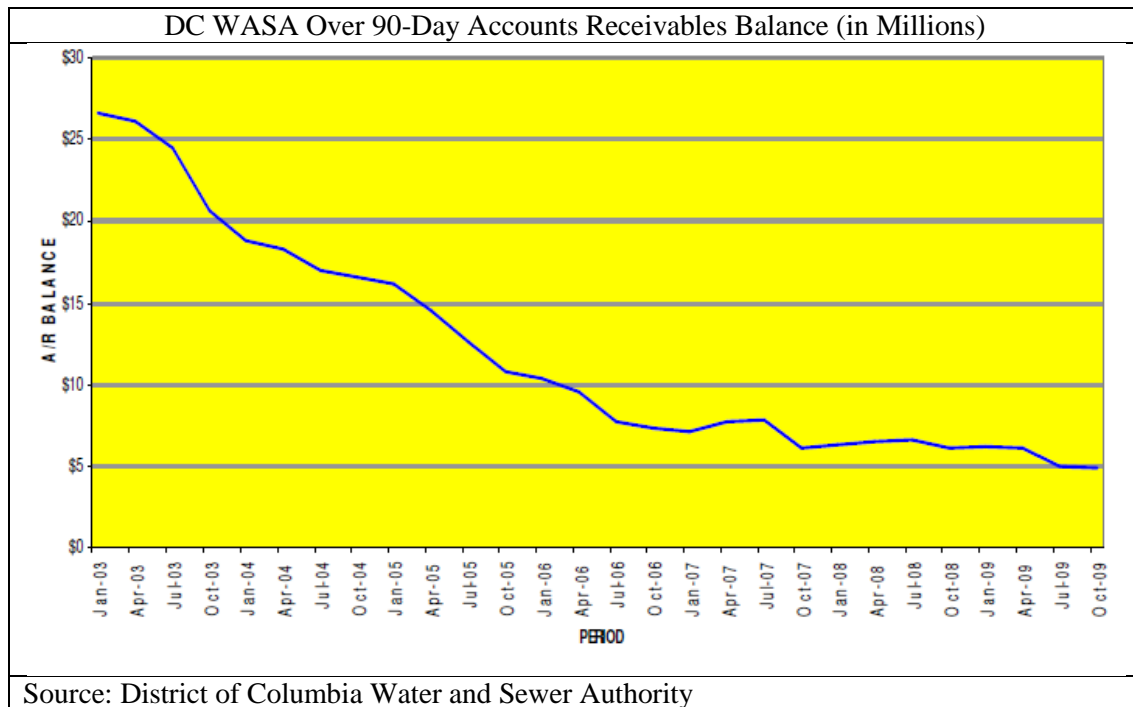
¹ District of Columbia Water and Sewer Authority. “Automated Meter Reading Project”.
http://www.dcwasa.com/customercare/DC_Water_AMR_White_Paper.pdf



Prior to the project, complaints of high bills caused major operational issues due to the inaccuracies of the old meters and the significant number of estimated readings. These complaints often demanded a costly process including a 10 minute phone call, a site visit, and even an administrative hearing. With much more data, and increased reliability, the department can demonstrate to the customer the reason for a higher than normal bill. Pinpointed reasons including leaking toilets, irrigation, pool filling, or even kids back from college visiting home with laundry, are all much more helpful explanations than sending out a technician to check a meter that is working properly.

New customer connections for DC WASA was also a major cost driver as it was a timely, often multiple visit process. With their new AMI technology, this is generally a remote electronic task. This task alone saves over \$200,000 a year.

In addition to cost reductions in actually reading the meters, the call center, and new customer connections, DC WASA saw improved collections. DC WASA credits improved accuracy in billing and the ability to bill with increased frequency with the Over-90 Day Accounts Receivables Balance dropping over 80 percent to an all time low. The following graph demonstrates this decrease.



Local Experiences

Within San Diego County, there are several examples of water retailers at various stages of utilizing AMR/AMI technology. This section summarizes the degree to which each local agency uses, or has considered using, related technology.

In San Diego County, most water agencies are using, considering, or have considered using AMR/AMI technology. Only about half currently use the technology, and several of those are using it in a very limited fashion. Some have implemented, or are implementing, full networks, and are touting a successful system, while others have performed analyses and pilot studies and concluded that the technology is not yet consistent enough to guarantee the appropriate returns through savings and/or it does not currently make sense for their community's specific topography.

Each of the local retailers were contacted to discuss their efforts and thoughts regarding the use of AMR and AMI technology, and nearly all participated. Interviews were informal and no verification was attempted. Those agencies that would like to request alteration of the description of their activities are encouraged to contact SDCTA staff. The results are summarized in the following table, and more detailed descriptions are included as Appendix A.

AMR/AMI Implementation Status of San Diego County Water Retailers

	AMI System		Conversion Status	System Meters		
	Drive by	Network		AMR/AMI	Total	AMR/AMI %
Carlsbad Municipal Water District	Ongoing Pilot	Implementation Suspended	Scaled back from implementing a network system due to cost	6,000	30,000	20%
City of Del Mar	None		Staff is investigating	0	Unknown	0%
City of Escondido		Past Pilot	On hold due to recession	0	26,000	0%
Fallbrook Public Utility District	Implemented		Implemented over past 4 years	9,000	9,000	100%
Helix Water District		Past Pilot	Did not implement due to lack of confidence in savings projections	0	55,500	0%
Lakeside Water District	None		Not considering	0	6,900	0%
City of Oceanside	None		Planned implementation of TBD system by 2015	0	43,000	0%
Olivenhain Municipal Water District	Implemented	Ongoing Pilot	100 networked meters outfitted in December 2011	24,000	24,000	100%
Otay Water District	Ongoing Implementation		Started in 2002, expected to finish in 2015	37,000	49,000	76%
Padre Dam Municipal Water District		Implemented	Implemented in 2009 and 2010	23,000	23,000	100%
City of Poway	None		Prior research showed the technology was too expensive to use for anything more than access and safety issues.	0	14,000	0%
Rainbow Municipal Water District	Ongoing Implementation		Implementation, initiated 10 years ago, has moved slowly due to funding issues.	4,800	7,500	64%
Ramona Municipal Water District	Considering		Meeting with vendors to assess implementing a drive by system	0	9,500	0%
Rincon del Diablo Municipal Water District		Ongoing Implementation	About a year into implementation	3,100	8,000	39%
City of San Diego		Pilot Planned	Pilot soon to be initiated	0	275,000	0%
San Dieguito Water District	Implemented		Implemented in 2004	12,000	12,000	100%
Sweetwater Authority	None		Not considering due to cost.	0	34,000	0%
Vallecitos Water District	Implemented	Considering	Considering using existing meters to upgrade to a network system.	21,500	21,500	100%

Other Experiences Outside of San Diego County

Other water providers have undertaken the transition, or are starting their planning process to utilize AMR/AMI technology as well. This section describes anecdotal information that has become available on those transitions.

- A cost-benefit analysis of **Las Vegas Valley Water District** AMI transition identified some \$32 million in direct hard cost savings over the life of the hardware with an additional \$44 million in related benefits to their Customer Service and Conservation Divisions.²
- In 2005, **Denver Water** budgeted \$30 million over five (5) years to install an AMR system.³ Today, with a rather traditional AMR technology, one or two drivers in trucks can read more meters in one day than the previous staff of 33 meter readers, saving millions of dollars a year.⁴
- The water utility for the **City of Pasadena, Texas** has shifted over nearly its entire network of water readers to an AMR system resulting in an 80 percent decrease in labor costs for the utility in reading meters. It also improved efficiency by over 85 percent, as well as improving accountability by reducing lost water by 60 percent.⁵
- **Pagosa Springs, Colorado** installed an AMR system through Datamatic with an initial cost of \$747,383. The estimated total savings for the utility was \$480,329 per year, with a projected Net Present Value (NPV) of \$5,675,679 over 15 years.⁶

Experienced Difficulties

The **Atlanta Department of Watershed Management** in Georgia is still experiencing issues surrounding ratepayers seeing huge, obviously flawed water bills.⁷ Some increases have topped 900 percent. Some ratepayers have hired plumbers to inspect, have talked with the water department, and have yet to figure out the issue.

² Datamatic. "Case Study: Las Vegas Valley Water District" http://www.datamatic.com/lvwwd_casestudy.pdf

³ Fong Tillie. "Water is switching to Itron automated meter reading." *Denver Rocky Mountain News*. <http://waterindustry.org/New%20Projects/iltron-denver-amr.htm>.

⁴ Denver Water.

<http://www.denverwater.org/WaterServiceSupport/TroubleshootingRepairs/WaterMeters/AutomaticMeterReading/>. Accessed October 2011.

⁵ "Texas Utility Cuts Meter Reading Costs, Improves Efficiency with AMR". *Water and Wastes Digest*. (April 2002) Volume:42 Number 4. <http://www.wwdmag.com/Texas-Utility-Cuts-Meter-Reading-Costs-Improves-Efficiency-with-AMR-article3062>

⁶ Data Provided by Datamatic

⁷ CNN. "Skyrocketing water bills mystify, anger residents."

<http://www.cnn.com/2011/US/03/01/water.bills.war/index.html>.

DC WASA reported three “lessons learned” in their report on their AMI transition experience. Proper planning can avoid or minimize these issues. DC WASA reported:

1. Spending an “inordinate amount of time with the contractor making sure that a significant percentage of large meters were installed under this contract before they substantially completed the project.”
2. “Time spent setting up appointments, rescheduling appointments, being denied access to the meter became challenging. Access issues seriously delayed this project’s completion.”
3. “Many installations required significant ancillary work in order to install a meter that was not anticipated during the project start. In a few cases, it became cost prohibitive to install a meter because of the infrastructure conditions.”

The Helix Water District, as discussed in Appendix A, recently discontinued their “Smart-Meter” Pilot Program. At a recent Board of Directors meeting, the Field Operations and Distribution Manager Tim Ross, the Project Manager of the Smart-Meter Project, presented figures that demonstrate an unsuccessful program, and offered the alternative to abandon it. His final conclusion, and ultimately the Board’s, was that the technology, at its current price and level of effectiveness, does not provide the savings boasted by manufacturers. Tim Ross, in a discussion with SDCTA staff, identified three savings projection categories that he feels are often inflated.

- **Savings from Decreasing “System Loss”** – Savings from non-revenue water efficiency increases utilize additional technologies that cost more to implement. Agencies possible savings due to identifying system leaks and tampering will be determined based on the existing efficiency and will vary by agency.
- **Revenue Recovery from Meter Accuracy** – Replacing meters with traditional meters would also increase meter accuracy. This should be considered before crediting AMR with this savings.
- **Labor Savings** – Helix Water District was unable to find evidence of staffing reductions in agencies that have adopted AMR/AMI technology.

Other Considerations

AMR/AMI technology has been considered a step towards enabling a system to be used for Water Budget Based Billing. For this allocation model to be enforceable, some type of automated system would need to be used and it would need to include individual apartments. Because apartment buildings tend to have one meter, additional sub-meters on individual apartments are private property. When meters are not owned and operated by a water utility, they fall under the jurisdiction of the County Sealer of Weights and Measures.

Before a meter can be sold, the manufacturer needs to submit the model to the State Department of Food and Agriculture Division of Measurement Standards. After approval from the State, State law still requires that new sub-meters be tested (although a sample of a large number may suffice) and re-tested every 10 years. In order to do routine testing, they have to be brought in to the County office. The County does not have mobile testing abilities in part because of the water supply required and the need to dispose of water after testing. Each test uses approximately 65 gallons of water. Due to backlog, it can take one to six weeks to get a meter tested.

The Annual Registration Fee of \$100 per location plus \$2 per meter, each year includes all routine testing including initial testing, retesting every ten years, and additional testing when there is a reasonable complaint or question. The State Business and Professional Code authorizes Counties to charge this fee and sets limits. The County Code of Regulatory Ordinances actually sets the device registration fee.

Appendix A – Local Experience Detail

Carlsbad Municipal Water District

Carlsbad Municipal Water District has worked with Itron to install about 6,000 end points (approximately 20 percent of their system) under the first phase of implementing an AMR network from 2008 to 2011. Due to its cost, they have recently suspended the network-based AMR system implementation and initiated a smaller pilot program for a drive-by system.

The system loss in their relatively old system was around six percent before the technology was implemented. No significant system loss savings have been seen or are expected. System loss, often referred to as non-revenue water, refers to the amount of water that is lost due to leaks or theft in the system. The water savings that have been seen are generally on the consumer's side.

The major issues Carlsbad Municipal has been having are related to the ability of the radio signal local collectors to receive information due to the often uneven terrain. The unpredictability of radio waves is a significant hurdle for the District.

The nearly continuous readings, at every fifteen minutes, have developed large amounts of data, making Meter Data Management (MDM) an issue.

City of Del Mar

The City of Del Mar has a relatively small and efficient system with a system loss around three percent. Although the City is not officially looking into any of these technologies yet, staff is currently investigating all possibilities.

City of Escondido

A few years ago, the City of Escondido did a small pilot with Itron that included only about a dozen meters and identified where antennas would be mounted. They were looking at a networked system. The idea of making this conversion passed as recession pains were felt. Currently, the system loss is around five percent. They have a standing meter replacement program that tests a sample of meters every 15 years, and decisions are made to replace groups of meters with newer, but technologically the same, meters based on how well the sample is functioning. Their large meter replacement program is more aggressive, replacing meters more often. Their whole system is about 26,000 meters.

Fallbrook Public Utility District

The Fallbrook Public Utility District transitioned to a radio-based drive-by system, over the past four years or so. This was determined to be the best system for them given the hilly and relatively rural nature of the area. Each of the over 9,000 meters in their system has been upgraded. After being read each month, data is fed into an older accounting system.

Helix Water District

Helix Water District decided not to continue implementing their networked AMR system after performing a pilot. After going through a pilot, and reviewing the experience of Padre Dam Municipal Water District, the District has determined that the extensive savings that were projected by the manufacturer are likely too optimistic.

One of the commonly boasted savings categories for AMR or AMI can be achieved with the replacement of traditional technology, with the same technology. Replacing an older meter with a new meter utilizing the same technology is sufficient to achieve significant saving in many cases. The older the meters get, the slower they run. American Water Works Association (AWWA) recommends replacement every 15 years. After testing them at 15 years, Helix discovered that they are still fairly accurate, and that 30 years would be more appropriate.

Helix Water District staff believes that many of the cities that go for the advanced systems do so because they do not have a formal meter change program, so they have a lot of older, slow running meters. As addressed earlier in this report, another potential savings category is “non-revenue water” or system loss. The system loss in Helix averages around ten percent, due to leaks and theft in the system. AMR manufacturer savings projections take credit for reclaiming that loss, through identifying leaks and theft, but if a system is newer, a decrease in system loss might not be a major savings.

The staff at the District related to reading meters includes five meter readers and two additional staff turning on or off service. It has been difficult for the District staff to find any evidence of staffing reductions after implementation at other agencies.

Lakeside Water District

The Lakeside Water District is using relatively traditional technology. Readers are currently entering their readings into hand-held computers. The central office is able to download that data from the hand held computers. The approximately 6,900 meters in the system are read every other month.

Where the Lakeside Water District differs from other districts, is that the meter reading responsibilities are only about half of the work assigned to three part-time high school or college students. The District likes the current program, including the ancillary benefits of providing good work experience for local youth.

At this point, they are not considering additional AMR or AMI technology. The current methods started about 15 years ago and is much cheaper than employing full-time staff with benefits. Because of their general meter replacement program, where a typical residential meter is replaced after no more than 20 years, and most larger meters after no more than 10 years, they estimate that they have achieved a relatively efficient system with between two to three percent system loss.

City of Oceanside

The City of Oceanside recently developed a water conservation master plan that includes the implementation of AMR technology by 2015. They have yet to decide on exactly what type of technology they are going to adopt, or if they will use pilot studies. Staff has indicated that they have heard negative feedback regarding network systems. Because of this, a drive-by system is looking more attractive, however it is likely that multiple pilots will occur. Staff estimates the current system loss at around seven percent. The City is a member of, and is following the best management practices published by, the California Urban Water Conservation Council.

Olivenhain Municipal Water District

About a decade ago, the Olivenhain Municipal Water District moved from a traditional system to a drive-by AMR system. Over time, the meter reading team decreased from approximately six, to three. The meters, with what is now decade old technology, did require additional maintenance as they got older. Because the District moved from bimonthly to monthly readings, they were able to see a benefit in earlier leak detection by identifying meter readings that differed significantly from their neighbors'. This was partially to credit for the District's relatively low system loss of around three percent.

Partially motivated by the opportunity for additional labor savings, the District, in December of 2011, initiated a pilot study. One hundred AMI outfitted meters were installed at a cost of around \$20,000. The network will be linked with a data management system and their billing system, and will provide customers significantly more information to aid in conservation linked.

Otay Water District

The Otay Water District's system loss is approximately five percent. They utilize drive-by AMR and mechanical (traditional) technologies. The district is in the process to converting to the newer AMR technology that they believe is well-proven and cost-effective. The transition started in 2002 and is expected to be completed in FY 2015. Of the 49,000 meters in the system currently 37,000 meters are read automatically, and 51,000 total meters are expected in the system by 2015.

The estimated cost of the entire transition capital improvement project, over the life of the project, is \$10.4 million and the estimated savings is projected to reach \$5.02 million.⁸ The primary benefit expected by the District from this transition was the reduction of meter reader positions. They have already begun realizing these benefits. The District has reduced the number of fulltime meter reading positions from seven permanent and one temporary position to four permanent positions. By 2015, the district expects to reduce the number of meter readers to three positions. Based on estimates taken during the housing boom, the district had projected it would need nine meter readers as of this date, and 11 full-time positions at ultimate build-out.

⁸ Otay Water District. "District AMR progress report." *Staff Report to Regular Board*. July 15, 2011.

The District has emphasized the benefits of using a phasing in strategy for the transition for the following reasons:

- Cost - Replacing approximately 50,000 meters at once would have had a tremendous impact on the budget and would impact rates. By phasing the implementation, the District was able to manage costs in order to avoid significant changes.
- Quality control - Phasing the installation of new meters provided the time necessary to implement a quality control process to ensure the accuracy of new meters.
- Batteries/transponder lifespan - Batteries and transponders have a set lifespan. Phasing the installation of the meters facilitates the replacement of batteries and transponder units at planned intervals.

Padre Dam Municipal Water District

In 2009, Padre Dam Municipal Water District estimated that the district may be losing \$250,000 to \$500,000 a year because of inaccurate meter readings. Through these savings and others, the AMI project was expected to pay for itself within three years.⁹ Since, they have initiated the full AMI project in steps. The district has seen two of their relevant staff of six (at one point 7) retire, and replacing them was not necessary. The transition to AMI technology did have remaining staff shifting responsibilities. In the future, they foresee software improvements allowing for further staff reductions. In addition, the accuracy of meter reading has improved significantly.

Call volume has decreased, however they have seen some increase in the length of calls, possibly due to the data available to customer service representatives to pinpoint the reason for higher than normal bills. They have additionally leveraged the technology to provide autopay and e-billing options.

City of Poway

The City of Poway does not currently utilize AMR or AMI technology. Each of their meters is visually read by meter readers. They did research technologies to some extent a few years ago, however no pilot studies have been performed or are planned to be performed. They looked into drive-by technology, as well as networks. The conclusion of that research was primarily the expensive nature of the technology. The new meters and transmitters are expensive in of themselves. They also learned that much of the technology was still relatively new, and that several issues still exist.

The City's system includes just under 14,000 water meters. They are planning limited use of AMR technology on roughly 200 meters specifically to deal with access and safety issues. This technology would be similar to drive-by technology utilizing radio signals and hand held computers. Currently the City has three meter reader positions, and occasionally need to utilize staff from other areas to assist.

⁹ Mike Uhrhammer. "No Need to Manually Read the Water Meter -- It Will Call In." http://www.padredam.org/PDFs/Padre-Dam-Release_092409.pdf . September 24, 2009.

Rainbow Municipal Water District

The Rainbow Municipal Water District is currently implementing a drive-by AMR system. They are engaged in an extended implementation that has utilized available staff time and funds over the past ten years. Now, working with their second firm as part of this process, they have installed 4,795 automated reading devices to the meters. The system includes a total of approximately 7,500 meters.

The District started the transition about 10 years ago, and it has moved slowly due to funding issues and staff time obligations. The expected benefits have been realized to date. One common issue experienced by the District is the occasional bad read, but overall, the District feels that the system is beneficial. Staff has indicated that it now takes significantly less time to read the meters, with less staff. There used to be four meter readers, and now there are two. The remaining staff time has been dedicated to installations, and other needs. The District does note that a there was a need for a significant amount of trouble shooting, but considers it an excellent program.

Ramona Municipal Water District

The Ramona Municipal Water District currently reads its 9,500 system meters with traditional technology. They have considered going to a drive-by AMR system, but currently use hand-held devices and read each meter visually. The District maintains two meter reader positions who read most meters once every two months. There are about 500 accounts that require monthly readings. While one reader's workload is nearly all reading meters, the second has other responsibilities, primarily maintenance and customer service. They currently replace meters when it is necessary, aiming for every ten years. On average, meters are about 12 or 13 years old.

The District has met with multiple vendors and currently would prefer going with Mastermeter because of their prices and internal transmitter. The District had received some negative feedback about a system from a different vendor in the past.

Rincon del Diablo Municipal Water District

The Rincon del Diablo Municipal Water District is currently implementing a full system conversion to AMI from a more traditional system based on hand-held devices and two meter reader positions. The District considered other options before settling on the radio signal based network with ten repeater sights including a drive-by system. They currently have around 3,000 meters installed that are automatically read every four hours. The system, by design, only collects a manageable amount of data, as additional upgrades to the data management system would be necessary if significantly more data were to be collected. Those improvements are likely to occur in the future.

Due to an existing "aggressive" meter replacement program, system loss is relatively low at around 3.5 percent.

To keep costs down, the Rincon del Diablo Municipal Water District used in-house meter technicians to make the installations and was able to do it at about a cost of \$18 each meter. The actual meters and radio transmitters, including large meters, averaged around \$250. They expect a payback period of between 12 and 15 years, but hope to exceed that expectation.

One difficulty found was that a good inventory of meter types was not taken and caused there to be several delays while appropriate materials were found during implementation. Another lesson learned was that steel or concrete meter box lids often caused difficulties when working with radio signals.

City of San Diego

In recent months, the City of San Diego has begun building momentum in the initiation of their drawn out efforts to initiate an AMI system. The following are a few of several AMI related past actions demonstrating the history of AMI planning at the City of San Diego:

- FY 2006 - the City hired an AMI consultant
- FY 2008 - RFP was issues for a system implementation
- FY 2009 - Vendor selected and some deployment before the City Attorney initiated a new direction, postponing further deployment
- FY 2011 - New RFP for AMI consultant issued

It deserves to be mentioned that the Water Research Foundation is currently completing a nearly \$1 million study that began in 2006 entitled *Automated Meter Reading: Best Practices for Selection, Acquisition and Implementation* (Research Project #4000) that will provide a road map for decision-making, project success, and demonstrable business success for utilities considering AMR projects. The San Diego Public Utilities Department was originally identified as a project participant.

Since then, the City of San Diego has postponed the deployment of AMI prioritizing the deployment of a new Enterprise Resource Planning (ERP) Customer Care Solutions technology that will work with the AMI technology in the future.¹⁰ According to the Independent Rate Oversight Committee FY 2010 Annual Report, “the decision to postpone the deployment of the AMI technology was due to the recommendations of an expert in the utilities community.” Additionally, the report concludes that AMI is expected to minimize future rate increases.

The postponed \$15 million program, with an expected payback period of 4.5 years, is planned to include:

- 27,000 meters (about 10%),
- A focus on downtown, surrounding areas, and difficult to read meters, and
- A fixed-network radio system for communication.

¹⁰ City of San Diego Independent Rates Oversight Committee Fiscal Year 2010 Annual Report. <http://www.sandiego.gov/mwwd/pdf/iroannualreportfy10.pdf>.

In this fiscal year (FY 2012) they started replacing some older meters with AMI equipped meters, and have moved forward with two pilot programs.

The first is known as the Smart Water Systems Pilot and is being performed by a partnership of Brady Consulting and IBM. This pilot is described as a project regarding smart water systems for the 21st century. They are proposing to use analytic based software called SCADA (Supervisory Control And Data Acquisition). There may be some infrastructure improvements, but this is really about what they can figure out with the software and existing infrastructure. It would be significantly more effective with more data provided by automatic meters.

The other is a recently presented effort to issue another Request for Proposal (RFP) starting with the implementation of 10,000 meters located all around the City. The City currently has approximately 275,000 meters overall. It is planned to use a phased approach, and target the largest users for conservation data analysis. Once implemented, AMI will be used for all new meter installations. Because some utilities with non-revenue water loss rates higher than San Diego have been able to produce a measureable reduction in non-revenue water loss, the RFP will also solicit proposals for optional leak detection devices. The project is expected to cost \$4.9 million, and the net present value of the project is \$7.1 million, and staff has noted that they consider this a conservative estimate. They expect savings through a reduction of four full-time staff and the prevention and detection of theft and failing meters among other sources.

San Dieguito Water District

The San Dieguito Water District implemented an AMR drive-by system (Orion through badger meter) starting with a six month pilot program in 2004 immediately followed by a full system implementation. The system includes approximately 12,000 meters, and has a system loss of under 10 percent. The major improvement must be credited to the mere replacement of so many old “slow” meters. Prior to implementation, the District used two meter readers full-time and had an ineffective meter replacement program. It took about four days for two people to read 2,000 meters. Now, with the drive-by system, it takes one person half of a day to read the same amount of meters. The freed up staff time has been used to identify more likely leaks and communicate that information to customers, as well as increase the amount of maintenance that is done. Rededication of staff time has allowed for the initiation of a valve maintenance program.

The District is not considering acquiring further technology, which is seen as cost ineffective to do in the middle of a program given that the meters have an 18 to 20 year battery life.

It is also noteworthy that the District still has to have someone go to each meter and make sure the automated read matches the manual read once a year per the recommendation of the manufacturer.

Sweetwater Authority

The Sweetwater Authority currently reads all meters visually. They maintain about three meter reader full-time positions, but each also has customer service responsibilities including

maintenance and repairs. The Authority has one of the larger systems with around 34,000 meters. Each is read every other month. Reading responsibilities require four to six hours per day from each of the three reading staff. Meters are changed every 12 to 15 years. Currently, the Authority has not moved forward with formal analysis because of what they have heard from other agencies regarding the cost of the technology.

Vallecitos Water District

In 2004, Vallecitos Water District began converting water meters to an AMR system based on radio signals for meter reading ease. Each of the 21,500 meters in the whole system are read once a month.¹¹ Meters were read monthly before and after the transition to the AMR system. Now, after having contractors replace nearly all meters, the District has a low system loss around three or four percent. Only the 150 larger meters were left to be replaced by agency staff. Currently, there are about 40 meters left to convert.

Transmitters, to send the reading to the vehicle, have been installed as part of the purchase. A supplementary step that is being considered is the addition of antenna towers as a step toward a network-based system.

The drive-by system allowed the number of staff dedicated to metering (six) to remain the same, while the system has grown from 16,000 to 21,500 meters.

The District describes their transition as smooth, and attributes the success, in part, to engaging in discussions with the Olivenhain District before implementation.

The only noteworthy issue that the Vallecitos District has had, is that the life of the battery appears to be significantly less, at four to five years, than they were led to believe; 20 years. While the replacements are covered under their original contract, the District's staff is left with the task of installation.

¹¹ Vallecitos Water District. <http://www.vwd.org/contentpage.asp?ContentID=64>. Accessed October 2011.