Table of Contents

SANTA FE IRRIGATION DISTRICT AUTOMATED METERING PROGRAM DEVELOPMENT REPORT .......................................................... 1

EXECUTIVE SUMMARY .................................................................................................. 1
  Background Information .......................................................................................... 1
  Purpose of the Report .......................................................................................... 1
  Current Manual Meter Reading Program .............................................................. 1
  Potential Meter Reading Program Performance Enhancements ....................... 2
  Two Basic Automated Metering Approaches Considered ..................................... 2
  Automated Metering Equipment Evaluation and General Findings ................. 3
  Recommended Automated Metering Equipment and Approach ....................... 4
  Recommended Automated Metering Program ...................................................... 6
  Recommended Phased Implementation Plan ......................................................... 7
  Recommended First Phase Demonstration Project .............................................. 7

SECTION 1 – BACKGROUND AND OBJECTIVES .................................................... 10
  Background .......................................................................................................... 10
  Automated Metering Program Development Report Objectives ....................... 11

SECTION 2 – CURRENT DISTRICT METERING PROGRAM ................................... 13
  Current Metering Reading Frequency and Cycles ............................................... 14
  Higher Risk and/or More Time Consuming Meter Locations ............................. 15
  Current Meter Reading Resources Requirements and Costs ............................. 16
  Current Meter Replacement Program .................................................................. 17
  Approximate Equipment Costs for Manual Metering Components ................. 18

SECTION 3 – GENERAL ASSESSMENT OF AUTOMATED METERING EQUIPMENT ...................................................................................... 19
  Recent Water Industry Trend toward Automated Meter Reading ...................... 19
  Metering Equipment Components ...................................................................... 21
  Meter Body and Automated Registry (Encoder) ................................................... 22
  Transmitter ........................................................................................................... 23
  Data Receivers and Collectors ............................................................................. 24
  Automated Metering Software and Integration with District Billing Software .... 25
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred Automated Metering Equipment Functionality</td>
<td>25</td>
</tr>
<tr>
<td>General Comparison Automated metering Key Component Cost</td>
<td>26</td>
</tr>
<tr>
<td>Findings from the General Assessment of Automated Metering Equipment</td>
<td>27</td>
</tr>
<tr>
<td>Badger/Orion and Sensus Selected for More Detailed Evaluation</td>
<td>29</td>
</tr>
<tr>
<td>SECTION 4 – DETAILED EVALUATION OF ORION/BADGER AND SENSUS AUTOMATED METERING OPTIONS</td>
<td>30</td>
</tr>
<tr>
<td>Meters and Encoders</td>
<td>30</td>
</tr>
<tr>
<td>Transmitters</td>
<td>32</td>
</tr>
<tr>
<td>Meter Boxes</td>
<td>33</td>
</tr>
<tr>
<td>Collectors and Gateways</td>
<td>33</td>
</tr>
<tr>
<td>Software</td>
<td>34</td>
</tr>
<tr>
<td>Ability to Accommodate a Fixed Based Configuration Considering The District’s Topography</td>
<td>34</td>
</tr>
<tr>
<td>Badger/Orion and Sensus Automated Metering Equipment Cost Comparison</td>
<td>35</td>
</tr>
<tr>
<td>SECTION 5 – RECOMMENDED AUTOMATED METERING PROGRAM</td>
<td>40</td>
</tr>
<tr>
<td>Recommended Manufacturer and Approach</td>
<td>40</td>
</tr>
<tr>
<td>Recommended Phased Implementation Plan</td>
<td>40</td>
</tr>
<tr>
<td>Recommended First phase Demonstration Project</td>
<td>41</td>
</tr>
<tr>
<td>APPENDIX A USER SURVEYS</td>
<td></td>
</tr>
<tr>
<td>APPENDIX B AGENCIES UTILIZING AUTOMATED METERING SURVEY</td>
<td></td>
</tr>
<tr>
<td>SUMMARY INFORMATION</td>
<td></td>
</tr>
</tbody>
</table>
Santa Fe Irrigation District Automated Metering Program Development Report

Executive Summary

Background Information

The 2009 AMMP 10 year Capital Improvement Program (CIP) originally included approximately $3 million for an automated metering program. In 2010, due to changes in the economy and a reassessment of priorities, the SFID Board of Directors deferred implementation of the metering program, and subsequently removed it from the 10 year CIP. A study that was initiated to evaluate potential automated metering technologies was placed on hold. Since 2010, District Staff has continued to monitor the progress of other agency’s automated metering programs and the evolution of automated metering technologies. With the assistance of consultants, District Staff has prepared this Automated Metering Program Development Report that describes the automated metering evaluation efforts and findings.

Purpose of the Report

The purpose of the Automated Metering Program Development Report is to:

- describe the District’s current manual meter reading program and objectives,
- identify current program limitations and desired improvements,
- evaluate automated metering equipment and costs to achieve program improvements,
- survey other Agencies to obtain “lessons learned” information,
- develop a recommended automated metering program for the District.

Current Manual Meter Reading Program

The District has a total of 6,478 potable meters and 834 fire flow meters. Each of the meters are read bimonthly to accommodate a bimonthly billing cycle. The fire flow meters are only used in emergency conditions and are read to assure that no flow has passed through the meters. There are also 49 recycled water meters that are read monthly. All of the recycled water meters are read on the same day.

The meter readers (i.e., District Utility Workers) must visit each meter to collect the data. A keypad on an electronic hand-held device is used by the meter reader to log the meter reading. Historic data downloaded to the hand-held device can inform the meter reader if the reading is substantially different than historic readings. This enables the meter reader to assess field conditions to determine if the result of the usage anomaly can be readily identified. The meter readers then take the information gathered in the field and download to a program that is used by administrative staff to further evaluate usage anomalies and prepare customer bills. Where usage anomalies are identified, administrative staff will contact customers to make them aware of the anomaly and assist in determining the cause.

There are three District Utility Workers assigned to read, maintain, and replace meters. Approximately 50% of the time of all three workers is directed toward meter reading. Approximately 50% of the time for two of the workers is for meter maintenance and 50% of the time for the third worker is for meter
replacement. Approximately 30% of the time of one Equivalent Administrative Staff person is directed toward evaluation of metering data, compilation of bills, and customer service associated with usage anomalies and awareness. An outside service is used to produce and mail the bills.

**Potential Meter Reading Program Performance Enhancements**

For decades the District’s manual meter reading program has effectively and efficiently provided the information needed to bill customers for usage, and has provided 6 customer usage data points per year for evaluation and customer service activities. However, automated metering technology is now available that could provide the following enhancements:

- the ability to obtain more detailed water usage information could enhance the ability to achieve conservation objectives by providing more information for staff and customers,
- the ability to obtain more detailed water usage information could provide a level of data that facilitates amicable resolution of customer billing disputes,
- labor and vehicle costs associated with data collection could be reduced (though additional labor is required to monitor and evaluate the additional data),
- employee safety could be enhanced by reducing exposure to traffic, aggressive animals, and other dangers including insects, snakes, and rodents.

**Two Basic Automated Metering Approaches Considered**

The two most widely used automated metering approaches are mobile-based and fixed-based systems. For a mobile-based system, an electronic register is incorporated into the meter itself. The electronic registers (called encoders) are then coupled with transmitter devices within the meter box located in the field. The data recorded by the encoder is stored in the field in the transmitter, encoder, or both depending upon the equipment manufacturer. Periodically (typically the same cycle time as would be set up for a manual reading program), a utility worker drives by the meters and a device located in the utility worker’s vehicle collects the meter data sent out by the transmitter in the meter box.

The components required for a fixed-based system are similar to a mobile-based system with the following exception. Instead of driving by periodically to collect the data, a series of permanent antennae are set up at strategic locations throughout a service area to form the “fixed-based” to collect the data transmitted from the meter site on a much more frequent basis. The advantage of this approach is the availability of substantially more data for the District and its customers. However, this approach is more capital intensive due to the need for fixed-base infrastructure.

Both of these approaches were considered in detail in the report. The use of cellular technology is also being introduced by multiple meter manufacturers. However, where feasible, a fixed-based approach is more desirable since it relies on basic radio transmissions and the risk of fluctuating cellular service costs is eliminated.
Automated Metering Equipment Evaluation and General Findings

The approach and equipment used by water utilities to implement automated metering programs differ depending on several utility-specific factors including program objectives, funding limitations, compatibility with existing equipment, topography, and others. In order to establish an understanding of the capabilities and performance histories of various equipment manufacturers and automated metering programs, multiple phone surveys and discussions were conducted with several automated meter equipment manufacturers and water utilities. The equipment manufacturers surveyed included:

- Badger/Orion
- Itron
- Master Meter
- Metron-Farnier
- Mueller Systems
- Sensus

The list of equipment manufacturers surveyed was intended to cover the most prominent suppliers and types of equipment currently utilized in our region. In order to monitor the progress of their programs over the past several years, three separate surveys were conducted with the several water utilities. Table E-1 (presented on the next page) provides a list of the water utilities surveyed and their current programs.

In addition to the surveys, comprehensive field visits were held with Operation and Maintenance Staff of the Olivenhain Municipal Water District (OMWD) and San Dieguito Water District (SDWD) to observe their currently installed systems and discuss lessons learned during program implementation. Both agencies were very helpful in the sharing of information and experiences.

The following summarizes the findings of the general automated metering equipment evaluation:

- There have been multiple problems with all of the automated metering systems over the past several years.
- The major problems appear to have been mitigated.
- There are no industry standards and the equipment and capabilities can vary substantially between manufacturers.
- There are still significant problems with combining equipment components from different manufacturers.
- Industry leading manufacturers have tended to stand by their products and fix their problems. It is important to pick a stable industry leader.
- Costs vary based on features and capabilities.
### Table E-1
Water Utilities Surveyed To Discuss Automated Metering Programs

<table>
<thead>
<tr>
<th>Water Utility (Total Connections)</th>
<th>Automated Meter Equipment</th>
<th>Mobile or Fixed Base</th>
<th>% Connections Using Automated Metering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olivenhain Municipal Water District (27,000 Connections)</td>
<td>Sensus</td>
<td>Mobile and Fixed Base</td>
<td>Currently 68% mobile vs. 32% fixed – future vision is 100% fixed</td>
</tr>
<tr>
<td>San Dieguito Water District (11,500 Connections)</td>
<td>Badger/Orion</td>
<td>Mobile</td>
<td>100% covered – no plan for fixed</td>
</tr>
<tr>
<td>City of Carlsbad</td>
<td>Itron</td>
<td>Mobile *</td>
<td>100% covered – maybe fixed for commercial</td>
</tr>
<tr>
<td>Fallbrook Public Utilities District (10,000 Connections)</td>
<td>Itron</td>
<td>Mobile</td>
<td>100% covered – Fixed is option</td>
</tr>
<tr>
<td>Helix Water District (55,000 Connections)</td>
<td>Master Meter</td>
<td>Piloting Mobile</td>
<td>Only 1% included in Pilot ** - Will consider fixed in future</td>
</tr>
<tr>
<td>Otay Water District (49,000 Connections)</td>
<td>Master Meter</td>
<td>Mobile</td>
<td>100% covered – Considering fixed</td>
</tr>
<tr>
<td>Padre Dam Municipal Water District (24,000 Connections)</td>
<td>Datamatic - Zenner</td>
<td>Fixed</td>
<td>100% covered</td>
</tr>
<tr>
<td>Rainbow Municipal Water District (7,800 Connections)</td>
<td>Itron</td>
<td>Mobile</td>
<td>75% covered – no plan for fixed</td>
</tr>
<tr>
<td>Valley Center Municipal Water District (10,000 Connections)</td>
<td>Sensus</td>
<td>Mobile</td>
<td>100% covered – Fixed is option</td>
</tr>
<tr>
<td>Vallecitos Water District (22,000 Connections)</td>
<td>Sensus</td>
<td>Mobile</td>
<td>100% covered – Fixed is option but delaying due to cost</td>
</tr>
</tbody>
</table>

* Formerly had 5,000 meters in a fixed based system. Full deployment to fixed was too expensive. Changed original 5,000 to drive by.
** Formerly piloted Datamatic fixed based system (too expensive and too much data)

### Recommended Automated Metering Equipment and Approach

Following a general assessment of multiple equipment manufacturers, Badger/Orion and Sensus equipment was selected for a more detailed evaluation. These two manufacturers were short-listed for the following reasons:

- Badger/Orion and Sensus are both proven industry leaders.
- When compared to each other, Badger/Orion and Sensus have different equipment features that offer different advantages to the District.
- Both of these systems are currently being used by agencies in San Diego County including OMWD and San Dieguito Water District.
- There are advantages to using equipment currently used by nearby agencies including ability to establish user groups to share knowledge, the potential sharing of antennae sites, and others.

Both Badger/Orion and Sensus can provide proven mobile-based equipment solutions. SDWD uses a mobile-based Badger/Orion system and OMWD uses both mobile-based and fixed-based Sensus systems. However, following completion of a frequency propagation analysis requested by the District, it was
determined that it was not practical to implement an Badger/Orion fixed-based system due to the District’s hilly terrain and the number of antennae sites required for their transmitter equipment. Figure E-1 provides a graphic representing the significant topographic variance across the District’s service area. The hilly terrain makes it challenging to connect signals from the meters to the antennae sites.

\[ \text{Figure E-1} \]

\text{Topographic Variances Across SFID’s Service Area}

Since Sensus provides equipment with more powerful transmission capabilities, a fixed-based network can be achieved with a more practical number of antennae sites. Initial propagation studies show that three antennae sites can accommodate nearly 85% of the District’s meters using Sensus equipment. It is anticipated that the remaining 15% of the meters could be collected by two additional antennae sites.

Table E-2 provides estimated costs for mobile-based, fixed-base, and the existing manual-based metering programs. Costs are not provided for a fixed-based Badger/Orion system since its implementation would not be feasible.
<table>
<thead>
<tr>
<th>Item</th>
<th>Complete Mobile-Based System</th>
<th>Complete Fixed-Based System</th>
<th>Existing Manual Metering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Program 7,312 Meters</td>
<td>Badger/Orion</td>
<td>Sensus</td>
<td>--</td>
</tr>
<tr>
<td>Equipment Cost</td>
<td>$1,800,900</td>
<td>$2,645,700</td>
<td>Not Feasible</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$440,200</td>
<td>$444,700</td>
<td>Not Feasible</td>
</tr>
<tr>
<td>10% Contingency</td>
<td>$224,100</td>
<td>$309,000</td>
<td>Not Feasible</td>
</tr>
<tr>
<td>Total Installed Cost</td>
<td>$2,465,200</td>
<td>$3,399,400</td>
<td>Not Feasible</td>
</tr>
<tr>
<td>Annual Software Service Fees</td>
<td>$3,700</td>
<td>$5,000</td>
<td>Not Feasible</td>
</tr>
</tbody>
</table>

### Table E-2
Estimated Metering Program Alternative Costs

Mobile-based automated metering systems expedite the collection of metering data and reduce risks to the meter reader. However, the level of information collected during normal reading cycles is similar to the information collected during manual reading operations. The detailed data (e.g., hourly and daily meter readings) stored at the meter site requires more time to collect than a typical mobile-based drive-by can provide. If more detailed information is needed, the meter reader must park near the site to allow the information to upload into the system. The information recorded at the site is eventually over-written by new data and is not available for future access.

Fixed-based automated metering systems regularly transmit data (typically six times per day) for storage and subsequent review and assessment. This approach typically provides hourly readings of flow data from each customer each day. Meters can also be configured to obtain more detailed usage information for leak detection or other purposes. However, some agencies have determined that the labor required to evaluate the additional information outweighed the value of the data.

Considering the District’s service area topography, demographics, and water usage, it is recommended that a fixed-based automated metering system utilizing Sensus metering equipment be implemented. This approach offers the following advantages to the District:

- A fixed-based system optimizes the amount of metering data available for use by the District and its Customers.
- More comprehensive usage data from a fixed-based system facilitates conservation efforts as well as other system management and administrative activities.
- The use of Sensus equipment provides:
  - A well-established equipment manufacturer that better assures long-term service capabilities.
• Equipment that is suited for fixed-based systems in very challenging terrain (such as the District’s hilly service area).
• A Reduced number of required antennae sites for signal collection and transmission.
• Equipment that was previously pilot-tested and is currently being used by neighboring OMWD offering the potential joint use of antennae sites, sharing of implementation experiences and ideas, as well as other potential advantages.

Recommended Phased Implementation Plan

A recommended six phase fixed-based automated metering program has been defined. The first phase of the program will serve as a “demonstration project” that enables the District to confirm the capabilities of metering equipment and software identified in this report. Depending upon the results of the first demonstration project phase, and the availability of resources, the District may choose to expedite program implementation and reduce the number of subsequent phases.

Table E-3 provides a summary of the recommended phased implementation program and estimated program costs. Two antennae sites implemented in Phase 1 are also anticipated to serve the needs of phases 2, 3, and 4. It is anticipated that one additional antennae will serve phase 5, and 2 additional antennae site will serve the needs of Phases 6. The actual number of required antennae sites will be confirmed during additional propagation studies conducted during the first demonstration project phase.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Number of Meters (Domestic and Fire)</th>
<th>Antennae Sites</th>
<th>Estimated Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>411</td>
<td>2</td>
<td>520,000</td>
</tr>
<tr>
<td>2</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>3</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>4</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>5</td>
<td>1,500</td>
<td>1 (Additional)</td>
<td>750,000</td>
</tr>
<tr>
<td>6</td>
<td>901</td>
<td>2 (Additional)</td>
<td>551,000</td>
</tr>
<tr>
<td>Total</td>
<td>7,312</td>
<td>5</td>
<td>$3,846,000</td>
</tr>
</tbody>
</table>

Recommended First Phase Demonstration Project

Phase 1 will include the installation of approximately 411 automated meters divided between two existing meter routes. As shown on Figure E-2, approximately 179 domestic meters and 5 fire flow meters will be installed within existing meter route 106 located in the southwestern portion of the service area and approximately 188 domestic meters and 39 fire flow meters will be installed within meter route 501 located in the northeastern portion of the service area. These specific meter routes were selected for the following reasons:

• they represent customers from both coastal and inland portions of the service area,
• they enable the ability to confirm the requirements for constructing antennae equipment on sites currently owned by the District and OMWD,
they provide the distance required to enable staff to confirm the ability of the meter transmitters achieve the performance proposed by the manufacturer,
they include areas with various meter reading challenges (access, traffic, or others),
they include a mixture of individual meter demand types.

Figure E-2
Phase 1 Meter Locations To Be Served By New Antennae At Larrick Reservoir and At The Joint SFID/OMWD Tower Site

The Phase 1 Project includes the installation of two antennae sites. The first will be at the Larrick Reservoir and the second will be at the Joint Tower site currently located in the Crosby area within the OMWD service area. The District currently has a radio antennae located on the Joint Tower site. Data from the new automated meters will be transmitted to the new antennae sites where it will be collected and conveyed to the District’s administration building. New automated metering software will be provided for use in managing the metering data. The metering software will be integrated with the District’s financial software as part of the phase 1 project. The phase 1 project will confirm the capabilities of the software and address any financial software integration challenges.
The Phase 1 Project will enable the District to confirm the amount of District labor required to facilitate equipment installation by a third party contractor and achieve a smooth transition from manual to automated data collection. It will enable the District to better define equipment manufacturer terms and conditions for subsequent larger program phases. The Phase 1 Project will also enable the District to gain an understanding of the available usage information and how the District and its customers may best use the information.
Section 1
Background and Objectives

Background

There are currently 6,478 potable water meters, 834 fire flow meters, and 49 recycled water meters serving Santa Fe Irrigation District (District) customers. Meters provide the basic function of measuring the quantity of water that an individual home or business consumes. Currently, in order to bill customers for the volume of potable water used, and provide data for the evaluation of potable water usage, the District meters potable water delivered to each customer and manually reads each meter on bi-monthly intervals. Fire flow meters are located adjacent to potable meters and are read at the same time as the potable meters. Recycled water meters are read monthly. The current manual metering practice has successfully achieved the basic metering objectives of the District for many years.

Recent advancements in technology have introduced equipment to the water industry that enables automation of meter data storage and collection. Automated metering may be used to enhance basic manual reading activities and/or achieve certain objectives that manual meter reading cannot accomplish. The term “automated metering” covers a broad range of available automated metering technologies. There are multiple ways to apply automated metering to achieve a variety of objectives. In addition, the costs associated with automated metering are significant, and performance histories are limited for certain technologies.

The 2009 Asset Management Master Plan included a capital project for the implementation of a District-wide automated metering program. A study was initiated in early 2010 to define the most viable automated metering approach and equipment. However in mid-2010, in light of economic conditions, the District reassessed its 10 year capital improvement program (CIP) and decided to place the automated metering project on hold and subsequently removed it from the 10 year CIP. Though work associated with the automated metering study was also placed on hold, District Staff continued to monitor the progress of various automated metering programs and equipment manufacturers.

There have been significant advancements in the automated metering field in the past several years. In addition to addressing immediate revenue limitations, placing the automated metering project on hold enabled the District to monitor the progress of newly installed automated metering systems and gain valuable knowledge from the lessons learned by agencies and equipment manufacturers who installed the equipment. Many agencies have been required to conduct major modifications to their original system components. Currently available automated metering equipment is significantly more reliable than previous versions. Due to the fact that the automated meter industry has significantly stabilized, and the reliability of the equipment has significantly improved, it now is a more appropriate time to consider transitioning from manual read meters to automated meters.
Automated Metering Program Development Report Objectives

Though the current manual meter reading program has been effective for many years, there are challenges and limitations associated with the existing program as summarized below:

- Manual collection of meter data is time consuming.
- Customer potable usage data is limited to a data base of bi-monthly readings (i.e., 6 readings per year).
  - This limits the amount of data available to support enhanced conservation efforts.
  - This limits the amount of data available to address customer billing disputes.
- Reading of meters located in high traffic areas requires additional time to take the precautions necessary to reduce safety risks.
- Reading of meters located on “cross country” lines on easements outside of right-of-ways requires additional time to access. There is also a higher probability of aggressive animals in these areas.

The use of automated metering equipment could address some of the challenges and limitations of the current manual metering program. However, as indicated previously, there are significant costs associated with automated metering and several agencies have experienced problems with the implementation of their automated metering programs. There currently are no established standards in the automated metering industry and the capabilities and approaches of different equipment, and their manufacturers, can be significantly different.

In order to assess the value of an automated metering program, the Automated Metering Program Development Report was initiated to achieve the following objectives:

1. Provide a summary of the current manual meter reading program to establish a baseline for current capabilities and estimated manual meter reading program costs.
2. Provide a general assessment of available automated metering equipment and costs.
   a. Conduct a survey of familiar agencies currently utilizing automated metering equipment to identify lessons learned.
   b. Conduct a survey of automated metering equipment manufacturers to determine equipment option capabilities.
3. Provide a detailed assessment of the apparent most viable automated metering approaches and costs.
4. Provide a recommended automated metering program description and potential phased capital program for consideration in the 10 year CIP.

In lieu of moving forward with one large District-wide automated metering project, it may be more prudent to implement a program that systematically replaces manually-read meters with automated meters as part of the District’s ongoing meter replacement program (currently part of the District’s ongoing Operations and Maintenance program). This approach will enable the District to use a limited number of proven automated meters at selected locations in order to confirm their effectiveness prior to making major investments in equipment. In addition, other agencies that implemented a full system-wide replacement project have learned that a major disadvantage to one-time system replacement approach is the potential of simultaneous failure of components (such as batteries) throughout the system.
The Automated Metering Program Development Report was developed primarily by District Staff. It built upon the work initiated by Brown and Caldwell in 2010. In addition, District Staff utilized the support of Dexter Wilson Engineering, Inc. who provided significant input in the development of the final document. The Staffs of Olivenhain Municipal Water District (OMWD) and San Dieguito Water District (SDWD) also provided significant information and insights regarding their on-going programs, including field evaluations of their ongoing installations and operations.
Section 2
Current District Metering Program

Figure 2-1 depicts the District’s service area. The District serves a population of over 19,400 people located within the communities of Rancho Santa Fe, Fairbanks Ranch, and the City of Solana Beach. The District provides potable water service through approximately 6,478 potable water meters. The potable water meters vary in size from ¾” to 10”. Over 90% of the potable meters are either ¾” or 1”. The system includes an additional 834 fire flow meters. Fire meters are located where the property is required to have a fire protection system. There should typically be no flow through the fire meter. However, fire services must be metered and read at regular intervals to confirm there is no flow. Fire meters are located adjacent to domestic meters and are read and maintained at the same time as the domestic meter. Recycled water for landscape irrigation is served through approximately 49 recycled water meters.

Figure 2-1
SFID Service Area Map
Current Meter Reading Frequency and Cycles

In order to bill customers for the volume of water used, and provide data for the evaluation of water usage, the District currently meters water delivered to each customer and manually reads each meter on bi-monthly intervals. The current manual metering practice has successfully achieved these basic metering objectives for many years.

As shown in Figure 2-2, in order to facilitate potable meter reading, the potable meters are broken into 4 “Cycle” groups (Cycle Nos. 1, 3, 5 and 7). These four cycle groups are further broken down into 9 to 10 separate routes. The lowest number of potable meters in a route is 118 and the highest number of meters in a route is 278. The majority of the routes include approximately 150 to 200 potable meters. Reading of the meters is staggered such that each month, two of the four cycles are read. This enables all of the District’s meters to be read within a 60 day period and accommodate the District’s bimonthly billing cycle. In addition there is one week provided between the reading of each cycle in order to enable time to process meter reading data collected from the field and create customer bills.

Fire flow meters are located adjacent to the potable meters and are read at the same time as the potable meters. Recycled water meters are read monthly. Since there are relatively few recycled water meters, all of the recycled water meters can be read in less than one day.

Figure 2-2
Current Meter Reading Cycle Group Map
Higher Risk and/or More Time Consuming Meter Locations

Certain meter sites require more time to collect readings and/or have higher safety risks than other locations. In most cases, the Meter Reader is able to drive to each individual meter, pull to the side of the road, exit the vehicle, remove the lid, take the reading, replace the lid, and then drive forward to the next meter. In other cases, where the right-of-way along a road is limited and the risk of being struck by passing vehicles is greater, the Meter Reader will drive to a particular location and walk along a roadway to read a stretch of meters prior to getting back in their vehicle. In still other cases, meters may be located behind private gates or within cross-country canyon areas that take additional time to gain access to the meter. Meter Readers must always be cognizant of potential health and safety risks such as cars and animals (both domestic and feral).

Figure 2-3 provides a graphic depicting some of the higher risk meter locations with District’s service area. These areas typically require more time to safely collect the meter readings.
Current Meter Reading Resource Requirements and Costs

**Meter Reading, Maintenance, and Replacement Resource Requirements:** There are currently three District Utility Workers assigned to read, maintain, and replace meters. Throughout this report these Utility Workers are referred to as “Meter Readers”. It takes all three Meter Readers approximately one week to read a meter cycle. Since two cycles are read per month, meter reading occupies approximately 50% of their time. In general, for two of the Meter Readers, the remaining 50% of their time is assigned to the maintenance of the meters, meter boxes, and areas around the meter. Half of the third Meter Reader’s time is typically assigned to meter replacement activities.

The Meter Readers use handheld digital devices to enter meter reading information gathered in the field. They remove the lid of the meter box, enters the meter serial number to identify which meter is being read into the handheld digital device, enters the value displayed on the register, and then continues on to the next meter. Software in the handheld device contains downloaded historical use records (downloaded by District Administrative Staff discussed later in this section) that enable the Meter Reader to be made aware of high and/or low usage anomalies. The handheld device will provide an audible alarm if there is an anomaly. This enables the Meter Reader to conduct a preliminary field assessment of the potential cause of the anomaly, and to make notes in the record for future assessment. For example if the device signals that the read is unusually high the Meter Reader may look for readily available evidence of a leak, or to see if there is new landscaping that may be requiring additional irrigation to get established. If there is an unusually low reading, the Meter Reader may turn on a hose bib to confirm that that meter is operating properly. The system includes codes that the Meter Readers can enter to reflect their field observations.

Once the meter reading has been complete, the Meter Readers return to the District’s Administration Office and gives the handheld device to District Administration Staff for downloading of data to the District’s system and billing software.

**Administrative Staff Meter Related Billing and Customer Service Resource Requirements:**

It takes approximately 30% of One Equivalent Administrative Staff Person to manage and process data gathered by the Meter Readers. Administrative Staff take the information gathered by the Meter Readers and check the data for anomalies, share pertinent information regarding anomalies with customers, and prepare the billing file using “Datastream” software. Administrative staff then sends the reviewed billing data to a billing service that prints and mails out the bills. The following summarizes the general activities of the Administrative Staff resource requirements.

Every two weeks, two Administrative Staff members review the information collected by the Meter Readers in order to determine if there are any anomalies in the data and to prepare the information for billing. The software used to collect and process the meter reading data enables Administrative Staff to set alarms that notify both the Meter Readers and Administrative Staff of high or low usage readings compared with historic data (this information is also uploaded to the handheld device for use by the Meter Readers in the field). It takes approximately 12 hours per staff person (a total of 24 hours every two weeks) to review the data collected in the field and accomplish the following activities:

- Identify any field notification notes and associated maintenance requirements included in the report and distribute to appropriate maintenance staff.
- Identify and address high read anomalies (above 90% usage for the same period over the last 3 years). This includes review of customer historic usage to see if there are any recurring patterns; review file for any notes regarding changes in irrigation, leak history, pool filling history, or others; if exceptionally high, ask meter reader to recheck reading; contact customer if warranted.
to discuss the higher than anticipated usage. Typically there could be 20 to 80 customer calls per cycle depending on the season (usage increases substantially between winter and summer). This approach provides the customer with information one to two weeks prior to the customer receiving the bill and helps reduce the number of billing disputes.

- For low reads, determine if this is a sign of meter aging/failure. See if meter reader turned on a hose bid to determine if meter operates properly.

- Following checking of data, a billing file in Datastream is then prepared. This is a relatively low level data entry effort that involves authorizing the program to accept the data and instructing it to create a file that is sent to Infosend.

- When Infosend receives the file, they create electronic copies of bills. The electronic copies of the bills, along with a summary cover sheet showing the number of bills and billing amounts, are sent to the Administrative Staff for final checking.

- Following acceptance of the bills by the Administrative Staff, Infosend sends out customer bills.

Table 2-1 provides a summary of annual operation and maintenance costs associated with the current manual meter reading program.

<table>
<thead>
<tr>
<th>Staff Type</th>
<th>Hours Per Year</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter Reading</td>
<td>3,210</td>
<td>$40</td>
<td>$128,400</td>
</tr>
<tr>
<td>Meter Maintenance</td>
<td>2,080</td>
<td>$40</td>
<td>$83,200</td>
</tr>
<tr>
<td>Meter Replacement</td>
<td>1,040</td>
<td>$40</td>
<td>$41,600</td>
</tr>
<tr>
<td>Administrative Staff</td>
<td>624</td>
<td>$35</td>
<td>$21,840</td>
</tr>
<tr>
<td><strong>Subtotal Annual Labor</strong></td>
<td></td>
<td></td>
<td><strong>$275,040</strong></td>
</tr>
<tr>
<td><strong>Subtotal Annual Vehicle Cost</strong></td>
<td>33,000 miles (3 vehicles, 11,000 miles each)</td>
<td>$0.56 per Mile</td>
<td><strong>$18,480</strong></td>
</tr>
<tr>
<td><strong>Total Annual O&amp;M Cost</strong></td>
<td></td>
<td></td>
<td><strong>$293,000</strong></td>
</tr>
</tbody>
</table>

In addition, Infosend charges approximately $30,000 annually for processing of water bills and Datastream charges $15,000 annually for the District’s billing financial software maintenance.

**Current Meter Replacement Program**

Table 2-2 provides a breakdown of existing potable and fire flow water meters based on approximate meter age. Manually-read meters can have a relatively long life expectancy of approximately 20 years. However, meters do not typically fail completely. Over time, due to wear of mechanical components, aging meters tend to continue to operate but gradually underestimate the volume of flow passing through the meters.
Table 2-2
Approximate Number and Age of Potable Water Meters

<table>
<thead>
<tr>
<th>Age of Meter</th>
<th>0 to 5 Years</th>
<th>6 to 10 years</th>
<th>11 to 15 years</th>
<th>16 to 20 Years</th>
<th>Over 20 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Meters</td>
<td>1,500</td>
<td>1,600</td>
<td>1,400</td>
<td>700</td>
<td>2,100+</td>
</tr>
</tbody>
</table>

The District annually evaluates overall potable water production and use data to provide a general check of meter accuracy. To date, the existing meters have been reliable and there have been relatively few significant problems. Historically, the District did not have a consistent meter replacement program. Therefore, there are significantly more old meters in the system. Over the past 10 years, the District implemented a meter replacement program that replaced an average of 300 meters per year utilizing District operations and maintenance staff. Since the District is essentially built-out, meters shown to be between 0-10 years old are primarily a result of the District’s ongoing meter replacement program.

Approximate Equipment Costs for Manual Metering Components

The cost of a manual meter and register is approximately $130 (based on a 1-inch meter). The cost of the meter box is approximately $115 and the cost of the lid is approximately $60. Assuming only the replacement of meters (and not boxes or copper service pipelines), the cost to replace all 7,312 potable and fire flow meters would be approximately $950,000 (metering equipment only). Handheld devices cost approximately $5,000 each.
Section 3
General Assessment of Automated Metering Equipment

Recent Water Industry Trend Toward Automated Meter Reading

Water meters provide the basic function of measuring the quantity of water that an individual home or business consumes. Water runs through the meter once a faucet, shower, etc. is turned on and the volume of water that passes by is cumulatively logged (or registered) by the meter. The cumulative volume of water is visibly displayed on the register which is then read by the water utility to generate a bill for the consumer. There are three basic methods used in the water industry for obtaining the information logged in the field at the meter.

- Manual Meter Reading: The District currently relies on a manual reading process where a Meter Reader (utility worker) physically opens the meter box on site and reads the register. The Meter Reader then takes the collected data to the District offices where it is downloaded into the billing software.
- “Mobile” type Automated (or Automatic) Meter Reading: Under a mobile meter reading system, the Meter Readers remain in their vehicles and drive the meter route. Specialized equipment installed in the meter box enables the reading on the register to be transmitted from the meter to additional specialized equipment in the Meter Reader’s vehicle. The Meter Reader then takes the collected data to the District offices where it is downloaded into the billing software.
- “Fixed” type Automated (or Automatic) Meter Reading – also referred to as Advanced Metering Infrastructure (AMI) - uses a network of fixed-base antennae and other equipment to convey the transmitted signal from the meter box through a fixed radio network directly to the District’s Information Technology Business Management System(s). Depending upon the equipment used, this type of system can also enable two way communications between the office and the field. The meter readings are automatically downloaded into the billing software.

Over the past 5 to 10 years, there has been a trend in the water industry toward the automation of meter readings in an attempt to achieve the following objectives:

- Reduce operation and maintenance costs
- Enhance safety
- Enhance water use knowledge
  - Improve conservation
  - Provide usage patterns when in dispute
- Improve customer service and information availability
• Improve billing efficiency
• Others

The approach and equipment used by water utilities to implement automated meter reading programs differ depending on several utility-specific factors including program objectives, funding limitations, compatibility with existing equipment, topography, and others. In order to establish an understanding of the capabilities and performance histories of various equipment manufacturers and automated metering programs, multiple phone surveys and discussions were conducted with several automated meter equipment manufacturers and water utilities. The equipment manufacturers surveyed included:

• Badger/Orion
• Itron
• Master Meter
• Metron-Farnier
• Mueller Systems
• Sensus

The list of equipment manufacturers surveyed was intended to cover the most prominent suppliers and types of equipment currently utilized in our region. Appendix A provides more detailed information acquired from each manufacturer. In order to monitor the progress of their programs over the past several years, three separate surveys were conducted with the water utilities identified in Table 3-1. Appendix B provides the latest detailed surveys for each water utility.
Table 3-1
Water Utilities Surveyed To Discuss Automated Metering Programs

<table>
<thead>
<tr>
<th>Water Utility (Total Connections)</th>
<th>Automated Meter Equipment</th>
<th>Mobile or Fixed Base</th>
<th>% Connections Using Automated Metering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olivenhain Municipal Water District (27,000 Connections)</td>
<td>Sensus</td>
<td>Mobile and Fixed Base</td>
<td>Currently 68% mobile vs. 32% fixed – future vision is 100% fixed</td>
</tr>
<tr>
<td>San Dieguito Water District (11,500 Connections)</td>
<td>Badger/Orion</td>
<td>Mobile</td>
<td>100% covered – no plan for fixed</td>
</tr>
<tr>
<td>City of Carlsbad</td>
<td>Itron</td>
<td>Mobile *</td>
<td>100% covered – maybe fixed for commercial</td>
</tr>
<tr>
<td>Fallbrook Public Utilities District (10,000 Connections)</td>
<td>Itron</td>
<td>Mobile</td>
<td>100% covered – Fixed is option</td>
</tr>
<tr>
<td>Helix Water District (55,000 Connections)</td>
<td>Master Meter</td>
<td>Piloting Mobile</td>
<td>Only 1% included in Pilot ** - Will consider fixed in future</td>
</tr>
<tr>
<td>Otay Water District (49,000 Connections)</td>
<td>Master Meter</td>
<td>Mobile</td>
<td>100% covered – Considering fixed</td>
</tr>
<tr>
<td>Padre Dam Municipal Water District (24,000 Connections)</td>
<td>Datamatic - Zenner</td>
<td>Fixed</td>
<td>100% covered</td>
</tr>
<tr>
<td>Rainbow Municipal Water District (7,800 Connections)</td>
<td>Itron</td>
<td>Mobile</td>
<td>75% covered – no plan for fixed</td>
</tr>
<tr>
<td>Valley Center Municipal Water District (10,000 Connections)</td>
<td>Sensus</td>
<td>Mobile</td>
<td>100% covered – Fixed is option</td>
</tr>
<tr>
<td>Vallecitos Water District (22,000 Connections)</td>
<td>Sensus</td>
<td>Mobile</td>
<td>100% covered – Fixed is option but delaying due to cost</td>
</tr>
</tbody>
</table>

* Formerly had 5,000 meters in a fixed based system. Full deployment to fixed was too expensive. Changed original 5,000 to drive by.

** Formerly piloted Datamatic fixed based system (too expensive and too much data)

In addition to the surveys, comprehensive field visits were held with Operation and Maintenance Staff of the Olivenhain Municipal Water District (OMWD) and San Dieguito Water District (SDWD) to observe their currently installed systems and discuss lessons learned during program implementation. Both agencies were very helpful in the sharing of information and experiences.

Our research discovered that several automated metering systems, or system components, installed within the past 5 to 10 years (both mobile-based and fixed-based systems) have needed to be replaced due to performance and/or maintenance problems. These problems were experienced by multiple equipment manufacturers who discovered the limitations of their equipment under actual field conditions. In addition, water utilities were learning that automated meter equipment manufacturers’ claims of ease of compatibility with existing utility metering equipment were not completely accurate.

Though some automated metering equipment manufacturers appeared to perform better than others, our research has shown that essentially all of the automated meter manufacturers had “learning curve” problems that needed to be addressed over the past several years. From discussions with several utilities, as well as discussions with equipment manufacturers, it appears that the majority of the problems associated with the implementation of automated metering systems have been surfaced and mitigated.
Based upon the lessons learned in the industry, it is clear that implementation of a successful automated metering system requires the careful assessment of several complex issues that ultimately impact the cost and reliability of the system.

The following provides a summary of information obtained from the various surveys, field visits, and discussions. This information was used to narrow down the potential automated equipment and approach options for the District.

**Metering Equipment Components**

An understanding of the various components and functions of both manual and automated metering systems is an important step in the ability to select an automated metering system that best meets the District’s needs.

**Manual Meter Equipment Components:** The District currently utilizes manual read metering equipment. There are generally two components to a traditional manually read meter: the meter body and the meter register. The register is a mechanical device that records the volume of water going by and the body is what houses this register.

The District maintains approximately 6,478 potable water meters and 834 fire flow meters. The majority of the meters are ¾” and 1” meters. Over the years, the District has purchased meters and registers from a variety of manufacturers including Badger, Master Meter, Performance, Precision, Rockwell, Sensus, and others.

Under the current manual reading program, a Meter Reader manually uses a handheld digital device to enter information gathered in the field. The Meter Reader removes the lid of the meter vault, and enters the meter serial number to identify which meter is being read into the handheld digital device, enters the value displayed on the register, and then continues on to the next meter. Once the meter readings have been completed for the day, the handheld device is returned to the office, connected to a computer, and the data is downloaded to the District’s system and billing software.

**Automated Meter Equipment Components:** There are two basic types of automated systems – mobile-based systems and fixed-based systems. In the case of mobile systems, the main equipment components consist of a meter body (similar to the manual system), meter register (specially equipped for automated meter reading and referred to as an encoder), data transmitter, and a data receiver in the form of a handheld device or an antennae and laptop. In the case of a mobile-based system, after driving by the
water meters to receive the transmitted data, the handheld device or laptop would be taken back to the District and connected to a computer to download the data to the District’s system and billing software. In the case of fixed-based systems, a meter body, register, and transmitter are required (as in the mobile-based systems), but the data receivers are a set of permanent physical infrastructure (antennae towers equipped with radio signal collection and transmission equipment) which collects and transmits the data directly to the District office, thus eliminating the need for Meter Readers to visit each meter to collect the reading.

The following paragraphs summarize the typical components of automated meter reading systems. These paragraphs also describe the surveyed manufacturers’ approach to providing the components for mobile-based and fixed-based systems.

**Meter Body and Automated Register (Encoder)**

In order to be integrated into a mobile-based or fixed-based network, the meter must be capable of converting the physical determination of the volume of water that has passed through the meter into an electronic signal. This is accomplished through an encoder. The encoder looks very similar in shape to a register and replaces the register for automated meter reading. For certain manufacturers, if the existing meter body can accommodate the encoder, the meter body can be reused assuming the encoder and meter body are manufactured by the same company. Warranty validity has been an issue when the components are from different manufacturers.

![](Badger_Meter_Absolute Digital Encoder.png) ![](Sensus ICE Encoder.png)

**Transmitter**

The next component of an automated system is a transmitter. This is the piece of equipment that sends the digital water use reading to the receiver. The transmitter can be wired to the encoder, attached to the encoder, or integrated into the encoder. Badger Meter, Itron, and Sensus all provide transmitters which are wired to the encoder. Master Meter and Mueller have wired or integrated options. Metron-Farnier has an integrated transmitter.
In evaluating transmitters, in addition to the physical configuration, consideration must also be given to the quantity of data which is stored within the transmitter. In most cases a specific number of data points can be stored. The interval at which data is collected (every 5 minutes, hourly, daily, etc.) then drives the length of time the transmitter can store the data. Most commonly, data is collected on an hourly basis resulting in storage times generally ranging from 40 days to 170 days based on the manufacturer. For mobile-based systems this is particularly important as the length of time the transmitter stores data must be compatible with the District’s billing frequency. Since fixed-base systems have more frequent data downloads through the fixed network, the issue of data storage time is not as critical.

Batteries are required to power the transmitters. Most manufacturers offer a 20 year warranty on the life of the battery. Most meter transmitter manufacturers also provide the meter body and encoder. Of the vendors surveyed, Itron is the only company surveyed that does not manufacture its own meter and encoder.

In some cases, transmitter manufacturers have claimed that their equipment can be used effectively with encoders by other manufacturers. However, our surveys have indicated that mixing the components of equipment manufacturers has been one of the more significant challenges and causes of system problems. Great care must be taken to make certain that system components will fully function, that connectors are fully compatible and will not rapidly deteriorate, all of the reporting features will be made available, and that equipment warranties will be honored if multiple equipment manufacturer components are being considered in an automated metering program.

**Data Receivers and Collectors**

The equipment which receives the data from the transmitters varies between mobile-based and fixed-based systems and among manufacturers.

**Mobile Based:** In mobile-based systems, the data receivers come in the form of a hand-held device for walking by transmitters or an antennae/laptop combination for drive-by systems. Meter readers then physically take the hand-held or laptop device back to the office where the data is downloaded. All manufacturers have hand-held or laptop devices for mobile-based systems which communicate with the transmitters the manufacturers provide.
Fixed Based: In fixed-based systems, additional permanent infrastructure must be installed throughout the service area to collect the data from the transmitters and relay it to the water utility office. The infrastructure would include a series of towers, antennae, collectors, and transmitters. The number and size of towers and associated equipment are dependent upon the terrain of the service area and the power of the signal from the transmitter located with the meter. Since the District’s service area is very hilly with relatively large trees, it poses a greater challenge than an area with a relatively flat topography. Though a fixed-base system would eliminate the need for staff to visit meters to read the customer usage, field visits would still be required to maintain the meter box.

Automated Meter Software and Integration with District Billing Software

Each automated metering equipment manufacturer provides their own software designed for the collection and management of metering data. Most major manufacturer’s offer software that can achieve the District’s data management and reporting objectives. However, there are no industry standards and the software created by one manufacturer is not compatible with another manufacturer. In addition, if the field equipment is not specifically configured for the software, the full benefit of alarms and other data management features are often not able to be realized. It is critical that the system components and associated software be appropriately selected to maximize the value of the automated metering system.

Most automated metering software has been developed with an open architecture that enables integration to a variety of Billing Software and/or Enterprise programs. For any automated meter system, proprietary software from the manufacturer is required to read the collected data and provide the “handshake” to the District’s billing software. From the survey of manufacturers, the manufacturer will prepare the file to integrate to the billing software as part of the program startup. Additional software can be purchased (from the manufacturer or third party) to allow manipulation of the data (e.g., graphing trends) or to allow customers access to the data.

Preferred Automated Metering Equipment Functionality

Each of the automated meter equipment manufacturers offer multiple models of the various equipment components. The different models vary in capabilities and costs. Following evaluation of available functionality of the various systems, the following summarized the District’s preferred capabilities of the automated metering equipment components (individually and in combination). It is important to note that the preferences are not listed in order of importance and it is understood that it may not be possible to achieve all of the preferred capabilities.

1. If the District chooses to move immediately to a fixed-based system, the need for flexibility to transition from a mobile-based to fixed-based system becomes moot. However, if a mobile-based system is pursued, the equipment should have the flexibility to transition to a fixed-based system.
2. Meter and Encoder
   • AWWA compliant
   • Purchased as a single unit from the same manufacturer
   • 20 year battery life
3. Transmitter
   • Mobile-based and fixed-based flexibility (See No. 1)
   • Battery Life of 20 years
   • Data Storage – 30 days or more (under mobile-based scenario)
   • Hard-wired or Touch Coupler Connections to Encoder
4. Hardware
   - Shall accommodate use of hand-held, drive by, or fixed based data collection.
   - Equipment must be specifically configured for automated metering manufacturer’s encoder and software
   - Must be capable of integrating with typical field laptop
   - Gateway/Collector (Located on Tower for Fixed Based Systems)
     - Data Storage – 30 days or more
     - Battery backup – 4 hours or more

5. Software
   - Options for either District-hosted or manufacturer-hosted approaches
   - Compatible with current and potential future District financial software
   - Provides options for customer access to data

6. Data Collected – Configuration of automated metering components must enable full capabilities of automated meter software including meter reading, ID determination, and full range of notifications and alarms (note that the range of alarms and notifications varies by manufacturer and between mobile and fixed based systems).

7. Flexibility to use a combination of other manufacturers’ components without losing any system functionality – Though this is a desirable feature that would enable more competitive acquisition of components, it has been determined that equipment manufacturers often make this claim but cannot support it. It has been discovered that either some of the system functionality is lost (ability to receive the full spectrum of notifications/alarms), maintenance problems have occurred with connective components (wiring and connectors), or warranty issues have arisen.

**General Comparison Automated Metering Key Component Cost**

Table 3-1 provides a general comparison of the approximate costs for key system components and services from various automated metering manufacturers. The list of required components does not represent the full list of equipment required for a complete and operable system. A more detailed discussion of required components and cost information for two of the manufacturers is provided in Section 4 of this report. The purpose of the information in Table 3-2 is to provide a general comparison of the variation of costs between different systems manufacturers. The equipment cost represents manufacturer equipment models that achieve the majority of the preferred performance objectives described above. Costs may vary based on the size of the project, the model of equipment selected, and other factors.
## Table 3-2
### General Comparison of Approximate Costs For Key Automated Metering Components

<table>
<thead>
<tr>
<th>Key Selected Items *</th>
<th>Badger Orion</th>
<th>Itron</th>
<th>Master Meter</th>
<th>Metron Farnier</th>
<th>Sensus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1” Meter and Body Encoder</td>
<td>$150</td>
<td>$150</td>
<td>$283</td>
<td>$150</td>
<td>$200</td>
</tr>
<tr>
<td>Transmitter</td>
<td>$90</td>
<td>$90</td>
<td>$100</td>
<td>$300</td>
<td>$150</td>
</tr>
<tr>
<td>Initial Software Purchase</td>
<td>$0.25 per month</td>
<td>$32,000</td>
<td>$16,000</td>
<td>$10,000</td>
<td>$60,000 if District-hosted, $120,000 if Sensus-hosted</td>
</tr>
<tr>
<td>Annual Fees</td>
<td>$2,875/yr</td>
<td>$2,000</td>
<td>$5,000</td>
<td>$1,500/yr plus $0.50/yr/transmitter</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

*This is not intended to provide a complete list of equipment required for an automated metering program

Though all of the manufacturer’s provide equipment that ultimately performs the basic duties (flow measurement, recording of information, transmission of information, data storage and management) there are no standards in the industry and the overall capability of the components can vary depending upon the manufacturer. The costs for components can vary substantially depending on the manufacturer and any enhanced capabilities of the equipment. The full capabilities of each system must be considered in determining the value provided.

### Findings from the General Assessment of Automated Metering Equipment

The following summarizes the findings from the general assessment of automated metering equipment.

- Over the past 5 years, the application of automated metering technology in the water industry has surfaced many unexpected challenges that required major changes in automated metering technology and implementation approaches:
  - Battery life issues
  - Overstated ability to be compatible with other manufacturers’ equipment (primarily between encoders and transmitters)
  - Problems with connections between encoders and transmitters
  - Limited warranty protection
  - Others
• Of the ten utilities surveyed, one presently has a completely fixed-based system (Padre Dam), one has a portion of their system as fixed and is in the process of transitioning the remaining to fixed (OMWD), four are evaluating the transition to fixed (Fallbrook, Helix, Otay, Valley Center), one has evaluated the transition to fixed but is delaying due to cost (Vallecitos), and three have no plans to transition (Carlsbad, SDWD, Rainbow MWD).

• Of the ten utilities surveyed, one provides customers with access to data via a web-based portal developed by a third party (Padre Dam). However, the utility noticed interest waned after initial installation and customer access is not being used as anticipated.

• Based upon the “lessons learned” in the industry, it appears the number of problems has significantly been reduced and water utilities are more pleased with the current performance of both mobile- and fixed-based automated metering systems.

• Multiple equipment manufacturers can provide equipment that meets the District’s objectives of:
  o Reducing the cost associated with collection of manual meter reads
    ▪ General time required
    ▪ Reads in gated areas or on cross country easements
  o Improving Safety
    ▪ Traffic
    ▪ Animals and Insects
  o Improving level of usage data available (through either mobile- or fixed-based approaches)
    ▪ To encourage conservation
    ▪ For conflict resolution when there are billing disputes
    ▪ Improving opportunities for customer access to information

• There are no set industry standards for automated metering equipment. The equipment offered by the various manufacturers can be substantially different and have significantly different performance characteristics and cost.

• Though manufacturers often claim otherwise, equipment components between manufacturers are not truly compatible. Actual operating history has demonstrated that either system functionality (availability of notifications, alarms, etc.) is compromised and/or maintenance problems occur when equipment components from different manufacturers are combined (such as encoders and transmitters). Substantial problems with wiring and connectors have also been encountered. Warranty issues have also been a problem when combining different manufacturer components (primarily between meters and encoders).

• Most automated metering manufacturer software would be compatible with the District’s existing and proposed financial software.

• Field maintenance appears similar between the various systems (whether mobile-based or fixed-based). Both mobile- and fixed-based systems require similar equipment in the meter box (meter body, encoder, and transmitter). Fixed-based systems would require periodic maintenance of network infrastructure.

• There would be labor savings for both mobile-based and fixed-based systems associated with data collection. Time will still be required to maintain each meter box (weed abatement, etc.). It is critical that the transmitter at the meter box is unobstructed. Non-metallic meter box covers are required to accommodate signal transmission.

• A mobile-based system can be implemented at a lower cost than a fixed-base system since it does not require the construction of a fixed-base network to transmit signals from the meters to the District’s office. A mobile-based system would accomplish several of the objectives established for an automated metering program. However, a major limitation be substantially lower levels of customer use information. In addition, a fixed-base system essentially eliminates collection time and provides ability for two way communications.
• A fixed-based system would cost more than a mobile-based due to the need to construct a fixed-base network. However, there is essentially no data collection time required, substantially more use data is available, and it provides flexibility for data management opportunities. The District’s hilly terrain makes it more challenging to implement a fixed base system. Certain equipment manufacturers include capabilities that are geared more toward fixed-based applications and may be more suitable for the terrain found in the District’s service area. Other manufacturers may not be suited for fixed-base applications due to limitations of their equipment.

• There are advantages to utilizing equipment currently being used by other agencies in the region. A key advantage is the ability to create a “user group” that shares information on equipment performance and solutions to any problems that may arise. The San Dieguito Water District (SDWD) uses Badger/Orion mobile-based automated metering equipment. Olivenhain Municipal Water District (OMWD) uses Sensus automated metering equipment and has both mobile-based and fixed-base capabilities. The majority of OMWD’s automated metering system is currently mobile-based. However, there are plans to transition to a fully fixed-based system in the future. There is a potential to share fixed network towers if the District pursues a fixed-based system.

Badger/Orion and Sensus Selected For More Detailed Evaluation

Following the analysis of multiple equipment manufacturers, the Badger/Orion and Sensus systems were selected for further consideration since they offered the following advantages.

• Both manufacturers are proven industry leaders and have demonstrated a commitment to support their products during the past several years of “learning curve” in actual field applications.

• Olivenhain Municipal Water District utilizes the Sensus system (both mobile-based and fixed-based approaches) and the San Dieguito Water District utilizes the Badger/Orion system (mobile-based approach). There are several advantages to utilizing equipment that has been field tested by neighboring agencies. In addition to establishing a “user group” that can share information regarding system operation and maintenance approaches to improve efficiency, there may be opportunities to realize cost savings through joint use of certain facilities such as antennae sites.

• The equipment offered by the two manufacturers have distinctly different characteristics from one another that offer different advantages to the District. Additional assessment of both equipment manufacturers is necessary to confirm the advantages offered and the associated costs.

A detailed discussion of Badger/Orion and Sensus is presented in Section 4 of this report.
Section 4
Detailed Evaluation of Orion/Badger and Sensus Automated Metering Options

As described in Section 3, Badger/Orion and Sensus were chosen for a more detailed evaluation and comparison. The following summarizes the reasons for selecting Badger/Orion and Sensus for the more detailed evaluation:

- Badger/Orion and Sensus are both proven industry leaders,
- When compared to each other, Badger/Orion and Sensus have different approaches that provide different advantages to the District,
- These systems are currently being used by Agencies San Diego County including:
  - San Dieguito Water District (Badger/Orion)
  - Olivenhain Municipal Water District (Sensus)
  - Valley Center Municipal Water District (Sensus)
  - Vallecitos Water District (Sensus).
- There are several potential advantages to using equipment currently used by nearby Agencies
  - “User Groups” can share knowledge
  - Potential cost saving opportunities:
    - ability to share facilities (antennae sites)

The evaluation included a detailed assessment of the various automated metering equipment options offered by Badger/Orion and Sensus. In addition, radio frequency propagation studies were conducted to compare the number of fixed based antennae and signal collector equipment required to implement fixed based systems for both manufactures.

Summary Descriptions of Badger/Orion and Sensus Automated Metering Equipment Components

The following summarizes the Badger/Orion and Sensus automated metering equipment components that would most likely be applicable to automated metering approaches under consideration by the District. Estimated cost information presented later in this section was based on the use of the equipment described below.

Meters and Encoders

Badger/Orion Meters and Encoders:

Badger manufactures meters and automated metering equipment. Orion is the name used for Badger’s line of automated meter metering components including transmitters, collectors, and software. The
Badger Recordall meter body is typically used for automated meter applications since it can accommodate both manual read type registers as well as Badger digital encoders used for automated meter reading applications. Badger meters utilize the nutating disc technology to measure flow through the meter. Badger meter bodies are made of bronze. The District currently utilizes Badger meters (as well as other types of meters) as part of the existing distribution system.

Badger/Orion automated metering systems can utilize two different types of Badger Encoders refers to as “Absolute Digital Encoders” (ADE) by Badger. The first ADE is the Badger model HRE-M that is a High Resolution Encoder that comes with a mechanical display, 8 wheels of resolution, and no battery. The second available ADE is the Badger model HRE-D that is a High Resolution Liquid Chrystal Display (LCD) Encoder that has an LCD display, 9 digit resolution, and a battery with a 20 year battery life warranty. An HRE-M is dedicated to a specific meter size and model, whereas an HRE-D can be programmed to any meter size and model and has magnetic tamper and tilt (or removal) sensor. Also, HRE-D toggles between rate of flow, consumption, and meter ID. The HRE-D also provides meter alarms including exceedance of temperature limits, magnetic tamper or encoder removal, reverse flow, suspected leak, 30-day no usage, and end of battery life. The Badger/Orion encoders do not provide any data storage capability. Data storage for Badger/Orion systems are provided in the transmitters (described later in this section).

The HRE–M and HRE-D encoders can be factory wired to Badger/Orion transmitters. They can also be connected to a Badger/Orion transmitter with a touch coupler connection.

Since the HRE-D provides the highest resolution and is the most state-of-the art encoder offered by Badger, it is assumed that any cost comparison of Badger/Orion automated metering approaches with other manufacturers would include the use of HRE-D encoders in the Badger/Orion equipment package. The HRE-D can accommodate both mobile and fixed based Badger/Orion automated metering systems.

Sensus Meters and Encoders:

Three Sensus meter types were considered most applicable for this study.

- **Sensus SR2 Meter** – The Sensus SR2 meter has a bronze body and utilizes oscillating piston type positive displacement technology to measure flows through the meter. The SR2 meter can accommodate the Sensus ER or the Sensus ICE encoders described later in this section. Sensus initially indicated that the SR2 meter was being phased out due to the roll-out of newer models. However, they more recently have indicated that they may maintain production and service of these meters since there are several customers who use them and may not want to replace them. The SR2 Meter is available up to a 1-inch meter.

- **Sensus Accustream Meter** - The Sensus Accustream Meter has a composite body and utilizes the oscillating piston positive displacement technology to measure flows through the meter. The Accustream meter can accommodate a Sensus Opto ER digital encoder. The Accustream is available up to a 1-inch meter.

- **Sensus iPERL Meter** – The Sensus iPERL Meter has a composite body and uses electromagnetic flow measurement technology to measure flows through the meter. The iPERL meter has its own fully integrated digital encoder. The iPERL is available up to a 1-inch meter.

- **Sensus Omni Meter** – The Sensus Omni Meters are to be used for meter sizes of 1.5 inches or greater. The Omni meters have a coated ductile iron body and utilize the floating ball technology to measure flows through the meter.
Multiple Sensus Encoder types were considered potentially applicable for this study.

- **Sensus ER Encoders** – Sensus ER is a mechanical encoder register with 8 wheels of resolution. ER encoders do not provide any data storage.
- **Sensus Opto ER Encoder** – Sensus Opto ER is a digital and programmable encoder register that can accommodate 3 meter sizes. The Opto ER encoder has a 20 year battery life. Opto ER encoders do not provide any data storage.
- **Sensus iPERL** – Sensus iPERL encoders are fully integrated into the Sensus iPERL meter. The iPERL is digital and programmable. The iPERL offers leak and tamper alarms (under a fixed based configuration). The iPERL encoder has a 20 year battery life. The integrated iPERL encoder stores up to 1,100 data points with resolution configurable from 15 minutes to 24 hours. This is in addition to data storage in the transmitter.
- **Sensus R2 Encoder** – Sensus R2 Encoders are digital encoders that are compatible with the Sensus Omni meters for applications equal to or greater than 1.5-inches. The R2 Encoder has 8 wheels of resolution.
- **Sensus T2 Encoder** – Sensus T2 Encoders are digital encoders that are compatible with the Sensus Omni meters for applications equal to or greater than 1.5-inches. Sensus T2 Encoders store up to 1,100 data points with resolution configurable from 15 minutes to 24 hours. This is in addition to data storage in the transmitter.

Since the Accustream and iPERL meters and encoders can accommodate both mobile and drive by configurations, and since Sensus has indicated that SR2 meters may be phased out in favor of the newer models, it is assumed that any cost comparison of Sensus automated metering approaches with other manufacturers would include the use of either Accustream meters with Opto ER encoders, or iPERL meters with integrated iPERL encoders in the Sensus equipment package for meters up to 1-inch. Note that Sensus Omni Meters with T2 encoders would be used for meters 1.5 inches. Connections to Sensus transmitters for both Accustream and iPERL meters would be through touch coupler connections.

**Transmitters**

**Badger/Orion Transmitters:**

Two Badger/Orion transmitters are most applicable to the District’s needs. The two transmitters are the Badger/Orion ME (Orion SE) and the Badger/Orion SE (Orion SE). The Orion ME and SE models are essentially the same physical device, but are programmed differently. The Orion ME is used for mobile operations. The Orion SE can be operated in mobile mode or fixed-system mode. The Orion ME can be migrated to Orion SE upon payment of a licensing fee. In mobile mode, the Orion SE broadcasts at a low power (10 milliwatts) every 5-6 seconds for the purpose of mobile reads. In fixed-system mode, the Orion SE broadcasts at a higher power (1 watt) every hour for the purpose of fixed network reads and every 10-12 seconds for the purpose of mobile back-up reads.

The transmitters store 90 days of hourly data (or other combination of 2,160 data points). In combination with the Badger/Orion encoder, features transmitted include indicators of leak, tamper, low usage, low battery, reverse flow, encoder error, and other programming notification. The transmitters utilize a FCC-protected non-licensed 900 MHz radio frequency. The transmitters have a 20 year warranty (based on 24 transmissions per day).
**Sensus Transmitters:**

The Sensus transmitter that is most applicable to either a mobile-base system that can migrate to a fixed-based system, or a direct fixed-based system is the Sensus 520M. This transmitter automatically connects to a fixed-based tower if available. Note that Sensus also makes a 520R model that is used by several agencies for mobile-based only systems. However, according to Sensus this equipment is planned to be phased out in the next few years.

The Sensus 520M stores 35 days of hourly data (or other combinations of 840 data points). The primary advantage of the Sensus 520M is its ability to transmit at a relatively high power of 2 watts on a FCC Primary Use licensed frequency. This enables the signal to reach much further distances thereby reducing the number of antennae towers required to capture the signals in a fixed-base network system. Combined with the appropriate Sensus meters and encoders (Accustream or iPERL), the Sensus 520M will transmit several features including indicators of leak, tamper, low usage, low battery, reverse flow, encoder error, and other programming notification. Warranties are based on battery life. The Sensus 520M has a 20 year warranty based on 6 transmissions per day.

**Meter Boxes**

The meters, encoders, and transmitters for both Orion/Badger and Sensus automated metering equipment can be fit into existing SFID meter boxes. Meter box lids may need to be replaced with special lids that accommodate an opening for the transmitter antennae. Existing meter box lids made of composite materials may be modified by drilling through the lid.

**Collectors and Gateways**

**Badger/Orion Collectors/Gateways:**

Mobile-Based Systems: For mobile-based systems Badger/Orion utilizes handheld devices and a laptop configured receiver to collect transmitted data.

Fixed Based Systems: For fixed based systems, the Badger/Orion gateway stores 60 days of hourly reads for up to 2500 endpoints. It has a 4 hour battery backup. In conjunction with the software and the 90 days of endpoint storage, any missed data due to temporary environmental problems (e.g., car parked over meter) will be automatically back filled. In the case of a gateway going out of service (e.g., lightning strike), the endpoints will automatically be reassigned to a redundant gateway with no utility involvement required (or use in mobile mode).

**Sensus Collectors and Gateways:**

Mobile-Based Systems: For mobile-based systems, Sensus utilizes handheld devices and a laptop configured receiver to collect transmitted data.

Fixed-Based Systems: For fixed-based systems, up to 30 days data storage are available at the antennae base station.
Software

Badger/Orion Software:

Badger/Orion provides system software for operation of the mobile-base and fixed-base automated meter reading systems. This software allows for the integration of the collected data with the District’s billing software. Badger provides this standard system software for either mobile-base or fixed-base.

Sensus Software:

Sensus provides system software for operation of the mobile-base and fixed-base automated meter reading systems. This software allows for the integration of the collected data with the District’s billing software. Badger provides this standard system software for either mobile-base or fixed-base.

Ability to Accommodate a Fixed-Based Configuration Considering the District’s Topography

Both Badger/Orion and Sensus provide equipment that can accommodate both mobile-based and fixed-based automated metering applications. The requirements for a mobile-based system are clear for both manufactures since a vehicle is used in the case of both manufactures to drive by the meter locations to collect the metering data. However, a fixed-based system requires the installation of antennae towers, fixed collectors, and other associated equipment to gather the signals from the meter locations and transmit them to software located within the District’s administration building.

Figure 4-1 provides a graphic representation of the topography of the District’s service area. As shown on Figure 4-1, the District is very hilly and the topography varies dramatically throughout the service area. The topography of the District’s service area makes it challenging to implement a fixed network system. The number and heights of the antennae towers are dependent upon topography and the strength of the signal from the transmitter in the meter box.

In order to compare equipment capability and fixed network requirements, Badger/Orion and Sensus were asked to identify the number of existing SFID meters that could be served from four potential antennae locations on existing District property, and four potential future joint District/OMWD antennae tower locations on OMWD property, shown in Figure 4-2. Badger/Orion and Sensus were provided with a GIS layer of the District’s meter locations. The actual heights and locations of antennae sites may vary. However, this performance test was developed to confirm the proposed capabilities of the proposed equipment considering the District’s specific topographic challenges and actual meter locations. For the purpose of the test, the heights of the potential antennae locations were fixed meet realistic restrictions at each site.

Both Badger/Orion and Sensus performed independent propagation studies to determine their fixed-based equipment requirements. Badger/Orion concluded that due to the topography and the relatively small number of meters that could be served from the identified antennae sites, it would not be practical to implement a fixed-based system using Badger/Orion equipment. Considering the topography, the Badger/Orion metering equipment would require numerous antennae sites throughout the service area to accommodate a fixed-based system.
Figure 4-1 District Service Area Topography

Figure 4-2 Potential Antennae Sites Used To Confirm Fixed-Based Automated Metering Capabilities
However, Sensus determined that their equipment could collect the signals from approximately 5,750 of the District’s meters (approximately 80% of the District’s 7,312 total potable and fire flow meters) utilizing three of the proposed antennae sites. This is primarily due to the fact that the Sensus equipment transmits at a much higher wattage than the Badger/Orion Equipment. Figure 4-3 shows the proposed coverage area by Sensus equipment utilizing three potential antennae sites.

![Figure 4-3 District Potable Meter Coverage With Sensus Meters Utilizing 3 Potential Antennae Sites](image)

As described above, the potential antennae sites and heights provided to Badger/Orion and Sensus were intended to help clarify equipment capabilities. Actual antennae heights and locations will be confirmed during subsequent project implementation activities. It is apparent from the assessment that a fixed-based system can be implemented within the District’s service area using Sensus equipment, and cannot be implemented using Badger/Orion equipment. It is apparent that with the addition of more antennae at strategically located positions, full coverage of the District’s service area could be accomplished with a Sensus system.
Badger/Orion and Sensus Automated Metering Equipment Cost Comparison

The following summarizes the cost associated with the purchase of automated metering equipment. Table 4-1 (on the following page) presents the costs for a mobile based system for both Badger/Orion and Sensus. Table 4-2 presents the cost for a fixed based system for Sensus only since Badger/Orion has determined that a fixed base Badger/Orion system is not practical for the District’s topography. The cost for a Sensus Accustream meter with an Opto ER encoder is the same as the cost of a Sensus iPERL meter/encoder with Sensus 520M transmitter. It is assumed that the Sensus iPERL would be used in lieu of the Accustream since the iPERL is the current state-of-the-art.

Installation costs are based on quotes provided to OMWD for the installation of their equipment by an outside service provider (Aqua Metric). Per the quote, a residential meter and transmitter replacement (for meters up to 1-inch) is $40. Meter box clean-out including lid replacement (with new lid purchased by the District) is $13.50. New meter lids alone are $65. It was assumed that the majority of the existing composite material lids can be drilled and replacement will not be required. An estimate of $60 per meter was assumed to cover installation and other general work associated with the meter box site. A 10% contingency was added to account for costs such as miscellaneous new lids, requirements for larger meters, mitigation of service alignment issues, District staff time required to support installation efforts, and other unforeseen issues.
Table 4-1  
Full Build-out (7,312 Potable and Fire Meters)  
MOBILE-BASED APPROACH  
Badger/Orion vs. Sensus Cost Comparison

<table>
<thead>
<tr>
<th>Component</th>
<th>Badger/Orion Recordall (Bronze) meter with HRE-D encoder and ME transmitter</th>
<th>Sensus iPERL meter/encoder and 520M transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Units</td>
<td>Unit Cost</td>
</tr>
<tr>
<td>1-inch meter body and encoder</td>
<td>7,312</td>
<td>$150</td>
</tr>
<tr>
<td>Transmitter</td>
<td>7,312</td>
<td>$90</td>
</tr>
<tr>
<td>Drive-by Reading Equipment and Systems Software</td>
<td>3</td>
<td>$11,000</td>
</tr>
<tr>
<td>Back-up Hand Held</td>
<td>2</td>
<td>$6,500</td>
</tr>
<tr>
<td><strong>Subtotal For Equipment and Software Purchase</strong></td>
<td></td>
<td><strong>$1,800,900</strong></td>
</tr>
</tbody>
</table>

| Installation Costs                             |                                                             |                                                             |
| Software Installation & Training               | 1               | $1,500    | $1,500     | $6,000    | $6,000     |
| Meter Installation*                            | 7,312           | $60       | $438,700   | $60,000   | $438,700   |
| **Subtotal For Equipment and Software Installation** |                                 | **$440,200** |           | **$444,700** |

| **Subtotal for Equipment & Software Purchase and Installation** | $2,241,100 | $3,090,400 |

| 10% District Labor and Contingency             | $224,100       | $309,000   |

| **Total Estimated Equipment Purchase and Installation (with 10% District Labor/Contingency)** | $2,465,200 | $3,399,400 |

Annual Automated Meter Software Maintenance Costs

| Software                                      | 1               | $3,700    | $3,700     | $5,000    | $5,000     |

| **Total Cost for Equipment and One Year Service** | $2,468,900 | $3,404,400 |
### Full Build-out (7,312 Potable and Fire Meters)

**FIXED-BASE APPROACH**

Cost of Sensus Fixed Based Options
(Badger/Orion Equipment Would Not Be Viable For The District’s Topography)

<table>
<thead>
<tr>
<th>Equipment and Software Purchase Cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
<td><strong>Number of Units</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Unit Cost</strong></td>
</tr>
<tr>
<td>1-inch meter body and encoder</td>
<td>7,312</td>
</tr>
<tr>
<td>Transmitter</td>
<td>7,312</td>
</tr>
<tr>
<td>Collector/Tower</td>
<td>5</td>
</tr>
<tr>
<td>Backup Drive-by Reading Equipment</td>
<td>1</td>
</tr>
<tr>
<td>Backup Hand-held</td>
<td>1</td>
</tr>
<tr>
<td>Software Analytical</td>
<td>1</td>
</tr>
<tr>
<td>System Software for Fixed-Base</td>
<td>1</td>
</tr>
<tr>
<td><strong>Subtotal for Equipment and Software Purchase</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Installation Costs**

<table>
<thead>
<tr>
<th>Installation Costs</th>
<th><strong>Included in Software Purchase</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter installation*</td>
<td>7,312 $60</td>
</tr>
<tr>
<td>Collector/Tower</td>
<td>5 $25,000</td>
</tr>
<tr>
<td><strong>Subtotal for Equipment and Software Installation</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **Subtotal Equipment and Software Purchase and Installation** |       | $3,458,400 |
| 10% District Labor and Contingency |       | $345,300 |
| **Total Estimated Equipment Purchase and Installation (with 10% District Labor/Contingency)** |       | $3,804,200 |

**Annual Automated Meter Software Maintenance Costs**

<table>
<thead>
<tr>
<th></th>
<th><strong>Number of Units</strong></th>
<th><strong>Unit Cost</strong></th>
<th><strong>Total</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metering Software</td>
<td>1</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>Collector Software</td>
<td>5-Towers Drive-by</td>
<td>$2,500 $5,000</td>
<td>$12,500 $5,000</td>
</tr>
</tbody>
</table>

| **Total Cost For Equipment and One Year Service** |       | $3,846,700 |
Santa Fe Irrigation District Automated Metering Program Development Report

Section 5
Recommended Automated Metering Program

Recommended Manufacturer and Approach

Based upon the detailed automated metering equipment assessment described in Sections 3 and 4 of this report, and considering service area topography, demographics, and water usage, it is recommended that the District implement a fixed based automated metering system utilizing Sensus metering equipment. This approach offers the following advantages to the District:

- A fixed based system optimizes the amount of metering data available for use by the District and its Customers.
- More comprehensive usage data from a fixed based system facilitates conservation efforts as well as other system management and administrative activities.
- The use of Sensus equipment provides:
  - A well-established equipment manufacturer that better assures long-term service capabilities.
  - Equipment that is suited for fixed based systems in very challenging terrain (such as SFID’s hilly service area).
  - Reduced number of required antennae sites for signal collection and transmission.
  - Equipment that was previously pilot tested and is currently being used by neighboring OMWD offering the potential joint use of antennae sites, sharing of implementation experiences and ideas, as well as other potential advantages.

Recommended Phased Implementation Plan

Table 5-1 provides the estimated life expectancy for key automated meter components. The automated metering program should be phased to avoid the need for total system-wide replacement of aging components in the future.

A recommended six phase fixed-based automated metering program has been defined. The first phase of the program will serve as a “demonstration project” that enables the District to confirm the capabilities of metering equipment and software identified in this report. Depending upon the results of the first demonstration project phase, and the availability of resources, the District may choose to expedite program implementation and reduce the number of subsequent phases.
Table 5-1

Typical Life Expectancy of Automated Metering Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Approximate Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter Body/Mechanical Components</td>
<td>15-20 years</td>
</tr>
<tr>
<td>Encoder</td>
<td>15-20 years (Typically battery failure*)</td>
</tr>
<tr>
<td>Transmitter</td>
<td>20 years (Typically battery failure*)</td>
</tr>
<tr>
<td>Collector</td>
<td>15-20 years</td>
</tr>
<tr>
<td>Tower</td>
<td>20 to 40 years</td>
</tr>
<tr>
<td>Computers/Handheld Devices/Software</td>
<td>3 to 5 years (software is regularly updated )</td>
</tr>
</tbody>
</table>

*Sensus warrants battery for 10 years unconditionally and the remaining 10 years is prorated

Table 5-2 provides a summary of the recommended phased implementation program and estimated program costs. Two antennae sites implemented in Phase 1 are also anticipated to serve the needs of phases 2, 3, and 4. It is anticipated that one additional antennae will serve phase 5, and 2 additional antennae site will serve the needs of Phases 6. The actual number of required antennae sites will be confirmed during additional propagation studies conducted during the first demonstration project phase.

Table 5-2

Recommended Phased “Fixed Base” Automated Metering Program

<table>
<thead>
<tr>
<th>Phase</th>
<th>Number of Meters (Domestic and Fire)</th>
<th>Antennae Sites</th>
<th>Estimated Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>411</td>
<td>2</td>
<td>520,000</td>
</tr>
<tr>
<td>2</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>3</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>4</td>
<td>1,500</td>
<td>0</td>
<td>675,000</td>
</tr>
<tr>
<td>5</td>
<td>1,500</td>
<td>1 (Additional)</td>
<td>750,000</td>
</tr>
<tr>
<td>6</td>
<td>901</td>
<td>2 (Additional)</td>
<td>551,000</td>
</tr>
<tr>
<td>Total</td>
<td>7,312</td>
<td>5</td>
<td>$3,846,000</td>
</tr>
</tbody>
</table>

Recommended First Phase Demonstration Project

Phase 1 will include the installation of approximately 411 automated meters divided between two existing meter routes. As shown on Figure 5-1, approximately 179 domestic meters and 5 fire flow meters will be installed within existing meter route 106 located in the southwestern portion of the service area and approximately 188 domestic meters and 39 fire flow meters will be installed within meter route 501 located in the northeastern portion of the service area. These specific meter routes were selected for the following reasons:

- they represent customers from both coastal and inland portions of the service area,
- they enable the ability to confirm the requirements for constructing antennae equipment on sites currently owned by the District and OMWD,
they provide the distance required to enable staff to confirm the ability of the meter transmitters achieve the performance proposed by the manufacturer,
they include areas with various meter reading challenges (access, traffic, or others),
they include a mixture of individual meter demand types.

Figure 5-1
Phase 1 Meter Locations To Be Served By New Antennae At Larrick Reservoir and At The Joint SFID/OMWD Tower Site

The Phase 1 Project includes the installation of two antennae sites. The first will be at the Larrick Reservoir and the second will be at the Joint Tower Site currently located in the Crosby area within the OMWD service area. The District currently has a radio antennae located on the Joint Tower site. District Staff has coordinated closely with OMWD Staff and has confirmed OMWD’s willingness to work with the District to implement this project at the Joint Tower Site.

Data from the new automated meters will be transmitted to the new antennae sites where it will be collected and conveyed to the District’s administration building. New automated metering software will be provided for use in managing the metering data. The metering software will be integrated with the District’s financial software as part of the phase 1 project. The phase 1 project will confirm the capabilities of the software and address any financial software integration challenges.
The Phase 1 Project will enable the District to confirm the amount of District labor required to facilitate equipment installation by a third party contractor and achieve a smooth transition from manual to automated data collection. It is recommended that a sole-source agreement with Sensus be negotiated based upon cost information gathered to date and comparison with the costs for recent Sensus projects such as the OMWD project. The first phase project will provide the District the opportunity to work with the manufacturer through installation to better define equipment manufacturer terms and conditions for subsequent larger program phases. The Phase 1 Project will also enable the District to gain an understanding of the available usage information and how the District and its customers may best use the information.
Appendix A
Three user surveys were conducted over the course of the last five years in 2010, 2012, and late 2014/early 2015. Attached are the responses of the most recent surveys.

The following Users of AMR/AMI products were contacted for their feedback:
1. City of Carlsbad
2. Coachella Valley Water District
3. Fallbrook Public Utility District
4. City of Gresham, Oregon
5. Helix Water District
6. Olivenhain Municipal Water District
7. Otay Water District
8. Padre Dam Municipal Water District
9. Rainbow Municipal Water District
10. San Dieguito Water District
11. Valley Center Municipal Water District
12. Vallecitos Water District

The following questions were asked of each User:

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.
   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)
   c. If not, are you planning on installing one in the near future? (general description)
   d. Reason for conversion.
2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)
3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs).
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)
5. Please describe you experience with your current vendor (positive, negative, problems)
6. What would you have done differently if you had it to do over?
7. How did you approach your procurement process, what would you do differently?
8. What would be you general recommendation to anyone going through this process, what should they avoid, etc.
Contact Name: Mario Remillard (760 438-2722) Dave Ahles (760 602-2748)

Water System Name: Carlsbad

Number of Connections: 28,900 with monthly billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   In 2014, converted from a fixed-base to mobile-base. Previously had approximately 5,000 Itron 200W transmitters. Full buildout was anticipated to need 18 collectors, however subsequent investigation found the need for 40 collectors to completely cover the system. Additionally, too much data (not utilizing effectively) and it was hosted by Itron. Present system is drive-by with Itron 100W transmitters. 90% of meters are Badger and 10% are Hersey. There is no customer access to data.

   b. Are you planning on converting/upgrading your current system in the near future? (General description of system).

      No.

   c. If not, are you planning on installing one in the near future? (general description)

      Would consider Itron fixed-base for commercial areas.

   d. Reason for conversions (cost, safety, conservation, etc.)

2. Describe your experience with your current system. (Positive, negative, has it meet your system goals, etc.)

   Working with Itron was positive. They traded out transmitters and provided the drive-by equipment free of charge.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Initial fixed-base estimate was $15,000,000 to fully convert system. Revised fixed-base estimate was $21 million. Carlsbad put $4 million into fixed-base, going to drive-by they saved $9 million.
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

In comparison to prior to fixed-base, went from 6 meter readers to 4 meter readers with drive-by; previous reading took 20 days and takes 5 days with drive-by.

5. Please describe your experience with your current vendor (positive, negative, problems)

Very positive, Vendor has resolved all issues and problems they have had with system.

6. What would you have done differently if you had it to do over?

Contract out some of the back-in support needed to convert the system. Did not realize the extent of existing billing information/etc. that would be needed to convert system.

7. How did you approach your procurement process, what would you do differently?

Had current history with Itron and there were able to call new system an upgrade so utility did not have to go through any RFP process.

8. What would be your general recommendation to anyone going through this process, what should they avoid, #1 concern of O & M and Admin staff, etc.

Make sure that AMI is the system you want. There is a significant amount of effort/expense to an AMI system. Do not make conversion if you just want/need a drive-by or manual system. Make sure that you want the data/information.
Contact Name: Raul Aquirre (760 398-2651)

Water System Name: Coachella Valley

Number of Connections:

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

      Yes, currently utilizing Master Meter system. Started as a pilot project about 6 years ago. Currently have about 10% of meter converted. Convert as meters are replaced. Current system does not provide any direct customer access to reading or billing data. Only utilize Master meters do not attempt to places master registers on other meters.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system).

      No current plans.

   c. If not, are you planning on installing one in the near future? (general description)

   d. Reason for conversions (cost, safety, conservation, etc.)

      No specific reason but felt all of the above reasons lead them to converting.

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)

   Very positive. Liked system and especially likes wireless aspect of system. Vendor has been responsive and system has met their goals. Not aware of any unexpected benefit.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Did not have any budget information to share with me.

4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

   Currently pay about $5,000 per year in software license cost. Have not had to replace any batteries or other items that vendor has not paid for.
5. Please describe your experience with your current vendor (positive, negative, problems)

   Very positive, Vendor has resolved all issues and problems they have had with system.  
   Had some minor equipment issues.

6. What would you have done differently if you had to do over?

   None.

7. How did you approach your procurement process, what would you do differently?

   Formal RFP, developed information/decision matrix, had 10 different vendors submit 
   proposals, went on site visits to other utilities.  Selected Master Meter.

8. What would be your general recommendation to anyone going through this process, 
what should they avoid, #1 concern of O & M and Admin staff, etc.

   Utility had no recommendation, though process went will and are happy with results. 
   Did not have any concerns to share with us.
Contact Name: Todd Lange (760-497-3976)

Water System Name: Fallbrook Public Utilities District

Number of Connections: 10,000 with monthly billing (converted from bi-monthly with AMR project)

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   Yes, Itron/Hersey system with Itron transmitter and Hersey, Badger, and Master Meters. Started installation in 2005. The entire system has been converted. Drive by readings collected monthly.

   There is not direct customer access to meter readings.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

   Getting ready to go to fixed-base with collectors and repeaters. Some radios have to be changed to go to fixed.

   c. If not, are you planning on installing one in the near future? (general description)

   d. Reason for Conversion.

   Primary reason for conversion was to allow utility to convert to monthly billing while minimizing labor costs.

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)

   Positive, Vendor has been very responsive. Have overcome some minor issues but all in all the conversion went smoothly. Utility met goal of monthly conversion of billing system while minimizing additional labor costs.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Todd thought the total cost of the AMR system was about $1,700,000. The cost to go to fixed is estimated to be $255,000 for 17 repeaters (plus install and radio change out). Not sure if software will need to be changed out or not.

4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

   Approximately $8,000 per year.
5. Please describe your experience with your current vendor (positive, negative, problems)

   Generally positive, had some initial meter register/transmitter issue related to system but have resolved problems. Have some minor lingering problems with rodents eating through transmitter wiring. Have tried a number of different solutions but problem still persists. In general, great Itron service through manufacturer and local representative.

6. What would you have done differently if you had it to do over?

   Would have made vendor supply complete system meter/transmitters package to avoid some of the register/transmitter issues.

7. How did you approach your procurement process, what would you do differently?

   Utility used a formal RFP process. Had 4 vendors respond and narrowed to Hersey/Itron as Hersey did not have their own AMR system at that time. Hersey partnered with Itron for the transmitters and AMR system. Utility has a long history of using Hersey meters and therefore felt comfortable with selection.

8. What would be your general recommendation to anyone going through this process, what should they avoid, etc?

   Same answer as question 6. O & M and Administrative staff did not have any major concerns with conversion. Project has meet system goals but would likely convert to full AMI system if had to do it over. For example, Rancho California Water District is converting to Itron fixed-base system with Badger meters. Also would like to see customer service improved (e.g., ability to open and close account from the office, provide customers with historical data).
Water System
AMR/AMI Survey
Updated October 2014

Contact Name: John Aho 503-618-2687 ext. 2633 (Project Manager),
Brian Stahl (Director)

Water System Name: City of Gresham, Oregon

Number of Connections: 16,000
   bi-monthly with conversion to monthly likely

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   AMI – Sensus System. Completed installation in 2012. High watt radio system with
   2 base stations. Converted entire system at one time including all meters. Using
   Sensus meters (SR2 and iPERL) and transmitters (520R). Sumses Omni meters for
   1.5” and greater with C2 and T2 registers.

   b. Are you planning on converting/upgrading your current system in the near
      future? (general description of system)

      Yes. Considering changing data hosting from City-hosted to Sensus-hosted. Sensus
      proposal includes 5 years data storage (typically only 13 months) and customer
      access to data.

   c. If not, are you planning on installing one in the near future? (general description)
      No

   d. Reason for conversion.

      Cost was major factor, the water system needed to replace a significant number
      of old meters. City received a matching stimulus grant of approximately 50% of
      cost. ($2.0 million) City was originally only planning to install 1,200 but with
      grant, decided to do entire system.

2. Describe your experience with your current system. (positive, negative, has it meet your
   system goals, etc.)

   Brian Stahl – Very happy “A bean counters dream.”
   John – Very happy as well.

3. What was you initial capital cost of the system? (meter change out/modification,
   hardware and software, other costs)

   Initial cost $4,100,000. Did not count staff time for the project which was substantial.
   2 – 2 man crews worked alongside contractor for entire time project was being installed.
   Have a few larger installations left – 400 1.5”/2” and 135 3” and greater (estimated cost
   is $1.1 million)
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

Yearly software license fee <$10,000 per year. Utility will maintain own data base system.

Single meter reader “takes care of” AMI system. 75% of work on customer service items (new service on/off, etc.) 25% AMI maintenance (replace transmitter, reprogramming, etc.)

Annual upkeep on AMI system is low. In initial installation of 16,000 only had problems with 30 which were replaced by Sensus. City doesn’t have a back-up drive-by system because TGBs overlap 80-90% of the time.

5. Please describe you experience with your current vendor (positive, negative, problems)

Very Positive, Major problem was with modifications to meter box lids. All lids in sidewalks had to be replaced due to tripping hazard caused by antenna. Vendor was unaware of problem. (20% of meter lids were in sidewalk). Data analyst has had challenges working with Sensus directly, better luck with local rep.

6. What would you have done differently if you had it to do over?

Understanding of cost of staff time to due this type of project. It is significant and should not be underestimated.

7. How did you approach your procurement process, what would you do differently?

Formal RFP process. Initial screening with selection of final 3. Formal interviews of those 3 with additional data required, presentation, estimated costs and existing client list. Made final selection and awarded.

8. What would be you general recommendation to anyone going through this process, what should they avoid, etc.

Understanding the commitment needed from all parts of utility to fully implement new system. Don’t underestimate.
Contact Name: Tim Ross, 619-596-1323

Water System Name: Helix Water District

Number of Connections: 56,000 with bi-monthly billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   Utility has 2 different programs. (1) AMR system is a Master Meter system. Utility installed 500 meter in 2005 in and have been evaluating results. Presently only have about 100 meters (in hard to reach places) using Itron radios and hand-held. (2) The District piloted a Datamatic AMI system with about 320 meters. Pilot program was abandoned and are now doing manual reads. Datamatic system was too expensive (~$20 million with debt service). All Datamatic equipment sold to Padre Dam. The benefit was monthly reads, but the District wasn’t really using the data so not cost-effective or justifiable in the long term.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

   Utility is currently overhauling accounting, billing, etc. software. Once in place, will look at AMI solution then (perhaps spending only a couple million per year).

   c. If not, are you planning on installing one in the near future? (general description)

   See above

   d. What are the goals/reasons for implementation of AMR/AMI?

   Customer Service, conservation and cost saving are the primary goals of the original AMR/AMI Pilot programs

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.

   Current experience with the system is very positive with both vendors. Both systems have work well. Since they are still pilot programs, utility is unsure if they will meet all of the utilities goals.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Tim did not know the cost of the Master Meter pilot program. Datamatic pilot program cost $150,000 to implement (capital and operational costs). Future AMI system is expected to cost $16,000,000.
4. What are your current operational costs? (Yearly upkeep, vendor fees, battery replacement, etc.)

   Since this is only a pilot program did not have any operational costs data. However he did indicate that they were likely not going to convert to monthly billing due to high cost of conversion of their entire billing system and ongoing other operational cost associated with monthly billing.

5. Please describe you experience with your current vendor (positive, negative, problems)

   Datamatic no longer in business. Experience with Itron very positive.

6. What would you have done differently if you had it to do over?

7. How did you approach your procurement process, what would you do differently?

   For pilot program - Sole-sourced Datamatic due to particular AMI package that met the Districts needs. Did not elaborate on selection criteria.

8. What would be you general recommendation to anyone going through this process, what should they avoid, etc.

   Thinks pilot process if very helpful to gain full understanding of different systems and would recommend it for any utility.
Contact Name: Rainey Sullimet (760 753-6466) and Mike Perez (760) 415-7152

Water System Name: Olivenhain MWD

Number of Connections: 27,000 customers with monthly billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

Yes, utility has a Sensus system with Badger meters. They started installing the system in 1997 under a phased program. They have both mobile and fixed based equipment. Approximately 19,000 meters are equipped for mobile based and 8,000 in the 4S Ranch area are fixed based. There is one tower (antennae) site installed that collects data from the 8,000 meters in the 4S Ranch area.

They have 2 generations for transmitters and equipment in their system. The majority of the meter bodies are Sensus meters with SR2 Sensus Encoders and 520R Sensus Transmitters and other Sensus automated metering components (software, etc.).

They also are testing other manufacturers meter bodies and encoders (Badger, Neptune, others) in combination with Sensus transmitters and automated metering components. This approach has had mixed results due to challenges associated with materials used to connect the devises (spent a significant amount of money to address the connection issue). They found that the touch coupler connections are the way to go. Do not use splices. In addition, the use of mixed manufacturer system components can impact warranties and increase risk of disagreements regarding responsibility if the system does not perform as expected.

The system has no direct customer access to billing information.

b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

Eventually the Utility is currently looking into conversion to a completely fixed base system. They intend to replace the 520R transmitters with 520M transmitters in order to accommodate fixed based operations in the future (You cannot use the existing 520R equipment for fixed base operations). The conversion from mobile based to fixed base is estimated at approximately $7,000,000.
c. If not, are you planning on installing one in the near future? (general description) NA

d. What were the reasons for conversion?

To reduce reading costs and gain additional usage data. There is new software available from multiple vendors that help manage the large amount of data obtained from a fixed network system. They are currently evaluating which software to purchase.

2. Describe your experience with your current system. (Positive, negative, has it meet your system goals, etc.)

Overall, they have had a positive experience with system. There were multiple implementation issues but the manufacturer has worked with them to mitigate the problems. At times they have had some difficulties working with the manufacturer but the equipment has performed well and has met their goals. There has been a learning curve during installation, implementation, and operations.

3. What was your initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

Initial system cost $5,000,000 although a significant portion of the costs (55%) was paid for by capacity fees for new connections.

4. What are your current operational costs? (Yearly upkeep, vendor fees, battery replacement, etc.)

Initially there were significant costs to mitigate various problems that came up during early implementation:

- earlier generation equipment did not have long battery life, they initially had numerous battery failures during their warranty period.
- earlier testing of alternative equipment components (which was significant)

Based on the current situation and the new generation of equipment, the cost now to maintain the equipment is relatively low (a specific cost was not available). There is time now required to evaluate and manage data. Staff who previously read and maintain the manual readers now spend more time analyzing information and implementing next phases.
5. Please describe your experience with your current vendor (positive, negative, problems)

Positive in terms of the system reliability and support. Early on they had trouble obtaining replacement batteries especially for equipment under warranty. They were not sure if the problem is related to the local Senses distributor or a company-wide issue. Other utilities they had talked to did not have a similar problem.

6. What would you have done differently if you had it to do over?

No recommendation.

7. How did you approach your procurement process, what would you do differently?

They initially had only Sensus meters so they migrated sole-sourced to the Sensus system. More recently they used Aquametrics to install their fixed based meters. They noted that the contract installer will go as fast as you let them. They suggested we slow the process down as appropriate to make certain District Staff has time to carefully make sure the automated meters are functioning properly (and registering correctly with the financial software) and that customer coordination is facilitated.

8. What would be your general recommendation to anyone going through this process, what should they avoid, etc.

Be sure that you have a fully defined warranty provision with the vendor. It needs to cover such issues as backlogs, timing, and definition of defective.

Note: OMWD Staff also provided SFID Staff with a comprehensive field tour of their facilities.
Water System
AMR/AMI Survey
Updated November 2014

Contact Name: Shannon Kaufman (619 670-2788) Tim Kerran (619 670-2263)

Water System Name: Otay Water District

Number of Connections: 50,000 Monthly Billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   Yes, Master Meter drive-by system. Started installing system in 2004 and completed installation within last year or so. Also utilize Sensus meters for large services w/Master’s XTR interface. Have also converted some existing Badger meters with Master registers. Customers have no access to real time reading information. Historical reading data can be obtained from meter if requested. Drive-by system only reads current billing information unless full monthly information is requested. The District runs two separate collection systems: the drive-by system is for billing purposes. They have a second set of collectors on staff vehicles to collect data for staff purposes (leaks, FYI). Also have two golf courses on Master Meter’s cellular system; District will look at Metron Farnier (Verizon cellular) once Master Meter compatible.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

   Scoping – maybe 2017. In general, they are changing their meter replacement schedule to 15 years (rather than 20 yrs). 90% of Padre Dam meters older than 15 years failed the low flow test.

   c. If not, are you planning on installing one in the near future? (general description) NA

   d. What was the reason for conversion?

   Large growth in the system and wanted to reduce meter reading labor costs.

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)

   Very positive, System has meet goals.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Unsure of total cost but it cost $150 - $200 per meter to convert.
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

*Master has an annual software fee but does not know the amount. Have not had any extra ordinary operations cost history but know at some time that battery replacement will be needed.*

5. Please describe you experience with your current vendor (positive, negative, problems)

*Very positive, Master has excellent support staff/reps. They are especially happy with software support staff, which is very patient (Green Tree). The only operational issue they have found is that meter transmitters will not work under water in large meter vaults. Tim has some concern about battery life but they have not experienced any failures. Understands that at some point this item will have a budget impact.*

6. What would you have done differently if you had it to do over?

*Nothing, they felt system transition has gone very smoothly.*

7. How did you approach your procurement process, what would you do differently?

*Tim did not know how the utility selected the vendor.*

8. What would be you general recommendation to anyone going through this process, what should they avoid, etc.

*Do your home work, proceed slowly and work through system. This will allow utility to overcome any obstacles and uncertain of O & M and Administrative Staff.*
Water System
AMR/AMI Survey
Updated October 2014

Contact Name: Tom Martin, 619-258-4635

Water System Name: Padre Dam MWD

Number of Connections: 24,000 (bi-monthly currently converting to monthly)

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   Datamatic – Installed 2011. Complete AMI system including meters, receivers, transmitters, software and customer interface. Customer interface is through web-based third party connection. Low power unlicensed radio system with multi-repeaters. 41 repeaters installed in air valves, pump stations, reservoirs, etc. (only 8”x12” in size). Utilizing Amco, Hersey and Sensus meters which were supplied by vendor – encoded meters. Datamatic went bankrupt and purchased by Zenner.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

   Potentially. Datamatic/Zenner system is very high maintenance (battery changes, radio replacements). Datamatic couldn’t keep up with warranty, hence bankruptcy. Bringing on consultant in the next year or so to evaluate whether they should make a change. Also, Zenner currently hosts data, District is considering self-hosting to more readily access data.

   c. If not, are you planning on installing one in the near future? (general description)

   NA

   d. Reason for conversion.

   Converted to obtain cost but mainly conservation goals wanted customers to have access to real time consumption data. System is meeting goals but do not feel customers are using it as much as intended. Have seen a tapering off of utilization. Multiple departments utilize data (customer service department, meter department).

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)

   System has meet meter goals, but warranty issues/bankruptcy have been problematic.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   Regarding initial installation - Initial system costs $6,000,000 with and additional $2,000,000 in internal costs to utility.
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

Vendor charges $0.10 cents per month per customer for data management of reading data. Had third party develop web-based interface to data management system.

5. Please describe you experience with your current vendor (positive, negative, problems)

Positive experience. Customers and utility are happy with interface and results of conversion. Currently are experiencing some problems of customers unplugging wired connection between meter and transmitter. Customers can replug connections incorrectly and have to send field personnel.

Bankruptcy has been an issue.

6. What would you have done differently if you had it to do over?

Better planning of repeater locations, have had to rethink and change locations to make the system work properly.

7. How did you approach your procurement process, what would you do differently?

Developed internal committee with all sectors of utility represented. Review different products and decided on current vendor. Started a pilot project of 250 accounts. After pilot project, negotiated price and had vendor install system.

8. What would be you general recommendation to anyone going through this process, what should they avoid, etc.

Recommend pilot project also goes through billing not just obtaining readings. Can identify problems and correct prior to complete conversion. The utility has learned a lot from process.

Did not have any real concerns related to the system after pilot project. Felt it would meet system needs and does.
Water System
AMR/AMI Survey
Updated October 2014

Contact Name: Kenny Diaz, 760-728-1178 (old comments from Gene Barkley)

Water System Name: Rainbow MWD

Number of Connections: 7,800 connections with monthly billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   *Itron is current vendor for their drive-by AMR system (50W and 100W radios). The
   originally had Raymar but were unhappy with results. Started installing the Itron
   system in 2006 and have currently converted about 75% of system. They are
   utilizing their own crews for replacement and replacing as necessary (planned and
   unplanned replacement). Primarily use Badger meters, previously used Hersey but
   not happy with Hersey meters.*

   *The System does on have any direct client access to real time billing information.*

   b. Are you planning on converting/upgrading your current system in the near
      future? (general description of system)

   *No plans to convert to AMI due to geography, but are evaluating cellular with
   Badger (proprietary network) and Translucent Technologies (Verizon). Costs are
   about $1,000 more per year than AMI.*

   c. If not, are you planning on installing one in the near future? (general description)
      NA

   d. What was the reason for conversion?

      *Wanted to speed up the billing process and reduce labor costs.*

2. Describe your experience with your current system. (positive, negative, has it meet your
   system goals, etc.)

   *The utility has had a very positive experience with current vendor. Had problems with
   older 50W radios but were under warranty and replaced by Itron. They have met the
   system goals but he was unsure if there was any significant labor savings since they did
   not reduce work force.*

3. What was your initial capital cost of the system? (meter change out/modification,
   hardware and software, other costs)
   *Unsure of total system cost. They budget $200,000 per year for conversion of meters.*

4. What are your current operational costs? (Yearly upkeep, vendor fees, battery
   replacement, etc.)
$3,400 per year for maintenance on MC-Lite (drive-by equipment) and two handhelds.

5. Please describe your experience with your current vendor (positive, negative, problems)

   The overall experience with the vendor is positive. However they still get 3-4 failures per billing cycle that they have to deal with.

6. What would you have done differently if you had it to do over?

   He would like to see the entire system converted faster.

7. How did you approach your procurement process, what would you do differently?

   Gene was not at utility when selection was made but thought they went through a selection process. He is aware that staff members toured other utilities with AMR systems.

8. What would be your general recommendation to anyone going through this process, what should they avoid, etc.

   Gene did not have any specific recommendations but though that AMR/AMI is a worthwhile endeavor and worth the expense.

   Kenny – Transfer risk to vendor, especially if installing a new technology (e.g. if x% of equipment not reading correctly, vendor responsible for new equipment and install, etc.).
Water System
AMR/AMI Survey
Updated December 2014

Contact Name: Bill O’Donnell (760 602-2748) and Joe Aurora (760) 633-2861

Water System Name: San Dieguito Water District

Number of Connections: 11,500, bi-monthly with conversion to monthly at some time in future

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   Utility has an AMR system, Badger – Orion, they have been using the mobile based system since 2003. The program was phased in between 2003 and 2008 and the District is 100% converted. This includes both potable meters and fire flow meters.

   District can and does provide utilization profiles for customers on request. Up to 90 days of data can be stored at meter.

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system) No

   c. If not, are you planning on installing one in the near future? (general description) NA

   d. What was the reason for conversion?

      Meter reading costs, system efficiency and conservation goals. They feel system achieved goal.

2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)

   Very Positive, Utility has long history with Badger meters and new system has worked very well.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)
The project cost was approximately $2,000,000 for the 11,500 meters. They hired two temporary contract workers to install the meters.

4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

The specific value was not available. They thought it was reasonable. They had some implementation issues initially but they were mitigated and currently do not have significant issues. The software maintenance cost is approximately $2,000 for 5 user licenses.

5. Please describe your experience with your current vendor (positive, negative, problems)

Very positive. The only problem they have experienced is that the original transmitter installed on the 1st replacement meters did not have the ability to store reading data. They have about 20% of meter without profile technology.

6. What would you have done differently if you had it to do over?

Initially waited for new technology to allow complete profile.

7. How did you approach your procurement process, what would you do differently?

Had positive history with vendor and had them develop pilot program. Pilot program was for a number of other utilities. Rolled out pilot program to existing system without any formal selection process.

8. What would be your general recommendation to anyone going through this process, what should they avoid, etc.

Would recommend other utilities to go through conversion to automated meter reading. Feel the new system is worth the investment and effort. Did not have any major concerns prior to implementation due to pilot program. Conversion went very smoothly.

Note: SDWD Staff also provided SFID Staff with a comprehensive field tour of their facilities.
Water System
AMR/AMI Survey
Updated January 2015

Contact Name: Ando (760-522-5076) Greg Hoyle (760 749-1600)

Water System Name: Valley Center Municipal Water District

Number of Connections: **10,000**  Monthly Billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   **Sensus AMR system**, started with a pilot program in 2005-06 and finished system in 2008-09. System utilizes Sensus meter and transmitter. Utilizes single transmitter for multiple meters in bank settings and for residential and fire meters for same home. Have wire from meter to transmitter which is installed in meter lid. Have had minor maintenance issue with wire. They have experienced a few gofers problems and customer who removed lid and broke wire. Send out flyer to customers explaining new system and warning them about care needed when removing lid.

   *No customer access to current reading information. Are in process to installing a new online payment process with will allow customers to access historical billing information on line.*

   b. Are you planning on converting/upgrading your current system in the near future? (general description of system)

   **Yes, the District is presently piloting a Neptune fixed-base system. They also evaluated Badger (not interested in monthly cost of cellular) and Itron (required additional infrastructure over Neptune).**

   **Neptune system has been in place for several months. They have one collector on a reservoir reading ~25 meters located ~ 1 mile away (collecting hourly reads). Data fed to Amazon-based cloud service for the demo period (not integrated into billing). Permanent system would use District’s existing SCADA backhaul to move data (they have 50 SCADA sites throughout District) rather than installing separate system. The District doesn’t have plans to do a wholesale change but are requiring new developments to install fixed-base infrastructure.**

   c. If not, are you planning on installing one in the near future? (general description)

   **NA**

   d. Reason for conversion.

   *In converting to drive-by - One of the first installations of pilot project was for hard to read and safety issues. System worked very well and went forward with full conversion. Have been able to reduce meter staff and found cost saving in vehicle maintenance*
2. Describe your experience with your current system. (positive, negative, has it meet your system goals, etc.)
   Regarding drive-by, experience is positive, the utility has a long history with vendor as they were a Sensus only customer. The system has met their goals.

3. What was your initial capital cost of the system? (meter change out/ modification, hardware and software, other costs).
   For drive-by, system cost was $1,400,000. Were able to keep cost low by using temporary workers ($10.00/hr) for the installation. They also had high scrap brass values which lowered cost of system.

4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)
   For drive-by, $14,000 per year annual fee. Only major replacement of system was to change the notebook computer for a "tough book" type on original drive by system.

5. Please describe your experience with your current vendor (positive, negative, problems)
   Regarding Sensus, experience has been positive, vendor has been very responsive and has resolved all of the small issues with system.

6. What would you have done differently if you had it to do over?
   Regarding drive-by, would have waited for technology change. Would have liked to have AMI capability.

7. How did you approach your procurement process, what would you do differently?
   Regarding drive-by, since utility was a Sensus only customer, they negotiated with Sensus for fixed cost for 3-4 year installation period. Have been happy with results.

8. What would be your general recommendation to anyone going through this process, what should they avoid, etc.
   For drive-by installation, the District felt utilization of temporary workers held cost down significantly. O & M and administrative staff were very comfortable with conversion and did not have any major concerns.
Contact Name:  Zac Garcia, 760-744-0460 ext.298

Water System Name: Vallecitos Water District

Number of Connections: 22,000 with monthly billing

1. Does your district (City) have an AMR or AMI system?
   a. If so, vendor, date installed, general description, etc.

   AMR – Driveby. Using Sensus transmitters with Sensus meters (98% are SR2, but converting to iPERL), >1.5” using Sensus Omni meters. AMR project started in 2004, finished in 2012. Have three different radios/transmitters: about 2,000 “C” radios (drive-by only); 4,000 520Ms (drive-by or fixed-based); and 16,000 520Rs (drive-by only). Currently use system for billing purposes only. Have followed OMWD path closely.

   b. Are you planning on converting/upgrading your current system in the near future? (General description of system).

   Planning to transition to fixed-based and are changing out 520Rs for 520Ms as needed. In January of this year, Sensus provided cost for upgrading to fixed-based. Estimated at $5 million to change out MXUs and install towers, etc. However, District cannot justify expense at this time as they are still paying for initial installation.

   c. If not, are you planning on installing one in the near future? (general description)?

   See above.

   d. Reason for conversions (cost, safety, conservation, etc.)

   Customer service, leak detection.

2. Describe your experience with your current system. (Positive, negative, has it meet your system goals, etc.)

   Been very happy with the system overall. Only issues has been with original “C” radios. Wire splicing to connect meter to radio corrodes causing battery to fail. Product is warranted for 20 years, but replacement from manufacturer is slow and is often a challenge.

3. What was you initial capital cost of the system? (meter change out/modification, hardware and software, other costs)

   About $2.5 million (not sure as a different project manager).
4. What are your current operational costs? (yearly upkeep, vendor fees, battery replacement, etc.)

   *Wasn’t sure.*

5. Please describe you experience with your current vendor (positive, negative, problems)

   *Deal directly with Aquametrics which has generally been positive except for the warranty issue on the older MXUs*

6. What would you have done differently if you had it to do over?

   *Avoided wire splicing (but this was what was available at the time).*

7. How did you approach your procurement process, what would you do differently?

   *Wasn’t sure how initial procurement was done.*

8. What would be you general recommendation to anyone going through this process, what should they avoid, #1 concern of O & M and Admin staff, etc.
Appendix B
Appendix B

Agencies Utilizing Automated Metering Survey Summary Information
Vendor
AMR/AMI Survey
Revised May 2013

Contact Name: Lisa Engstrom, 414-371-7287 office, 414-793-6649 cell,
lengstrom@badgermeter.com

Vendor Name: Badger

1. General description of automatic meter reading system – Preferred system is Orion. Galaxy (AMI) is an older one-way communication system. New AMI is Orion SE. Orion system’s can migrate from AMR to AMI.
   a. AMR – Two types of systems available, Orion and Itron
      i. Orion – Badger’s system
         1. Orion endpoints available as standalone (to be wired to another manufacturers encoder/register) or can come wired to Badger’s ADE register.
         2. Utilize Non-license radio frequency
         3. Transmits every 4 – 5 second
         4. ME and SE endpoints transmit several hundred yards (not line-of-sight)
         5. Transmitter (endpoint) compatible with Badger and other brands. Requires test to confirm if it works with Master meters. If the register uses the Sensus 3-wire protocol it should be compatible.
         6. Mobile or walk by data collection
         7. Stores 90 days of hourly data.
         8. Data may contain data profiling information
         9. Data management program @ utility w/billing interface
        10. Customer access: In-home monitor (~$100 each) to be released in Fall 2013. Reads directly from the endpoint. Alternatively, web-based customer portal.
        11. Have hybrid system to migrate to AMI – Involves utilization of localized Gateway receivers/transmitters
           a. Orion CE = AMR, one-way
           b. Orion ME = AMR to AMI, two-way /
           c. Orion SE = AMI, two-way, fixed based, if collector goes down automatically goes into mobile mode and data is stored in endpoint).
           d. Orion ME is recommended for drive-by b/c of maximum flexibility with two-way (remote data profiling, future remote meter shutoff)
           e. For CE or ME don’t have to get out of vehicle to take monthly reading, but if you want to do data profiling with the CE you have to walk to the meter to collect it. With ME, you can remain in vehicle or query from office.
        12. Endpoints are compatible with other manufacturers encoder registers (Sensus, Neptune, Elser, Hersey, and Metron)
        13. Reliability guarantee on 99.75% of reads
   ii. Itron System – See Itron data sheet
b. AMI – Galaxy system (older one-way communication).
   i. FCC Licensed System
   ii. Galaxy Transmitter @ Meter
   iii. Galaxy Base-stations
   iv. Data Transferred to Utility via Wi-Fi, cellular or LAN
   v. Data management Program w/billing interface
   vi. Can share data w/customers

2. References/Utilities who use system
   a. Orion – San Dieguito Water District, South Coast Water District (Laguna Beach), City of Thousand Oaks, Rowland Water District (Rowland Heights, CA), Walnut Valley, multiple others nationwide

3. Cost
   a. Capital Cost – have “starter packages”
      i. For mobile, with hand-held, accessories, software, and 30 ME universal endpoints (or 24 ME and ADE registers) to either Badger or competitor meter ($10,000) or laptop/drive-by, antennae, software, transceiver, maintenance, training and 30 ME endpoints (or 24 ME and ADE registers) ($16,000)
      ii. For fixed-mode, basics and gateway (software, maintenance, etc.). Just came out in last year, so not as many customers. Get 30 end points, collector, gateway, maintenance, Analytics software, maintenance, and training ($29,000) (may want to have hand-held or laptop as backup)
      iii. Summary of component costs:
         1. Meter plus standard register = $90
         2. Meter plus ADE register = $130
         3. ADE register + ME/SE endpoint = $140
         4. ADE register alone = $50
         5. Meter + ADE = ME/SE endpoint = $230
      iv. Price breaks
         1. One 1” meter+ADE+endpoint is approx $215
         2. 300 of the same is just under $200 each
         3. 1000 purchased over 3 years is about $190 each
         4. Free shipping on orders over $15,000
   
   b. O & M Cost
      i. Fees/annual maintenance
         1. Starter package includes hardware and software maintenance for first year.
         2. ~$200 per month for hardware and software maintenance, 24/7 technical support, trouble-shooting
      ii. Normal operational costs
         1. 20 year warranty on endpoints
         2. Return Materials Incident (RMI) repair

4. Other notes
   a. Starter package takes about 4 weeks to receive from purchase order issue
   b. While processing, Badger needs “Flat file” from Datastream to customize software for billing.
   c. Training is two days – first day on software, second day on hardware.
Contact Name: Gary Lee, 760-402-8930

Vendors Name: Itron

1. General description of automatic meter reading system?
   a. AMR – ChoiceConnect, 60W Endpoint (released 2005)
      i. Consumption, leak notation (but no time stamp), no data storage
      ii. Utilize Non-license radio frequency
      iii. Water EndPoint transmitter can adapt to nearly every standard meter.
           (Master meters by end of year-with encoded meter)
      iv. Wired connection between meter and transmitter
      v. Radio-based Mobile or walk by data collection (Handheld/Mobile PC)
      vi. Data management program @ utility w/billing interface
   b. AMR – ChoiceConnect, 100W Endpoint
      i. Utilize Non-license radio frequency
      ii. Water EndPoint transmitter can adapt to nearly every standard meter.
          (Master meters by end of year-with encoded meter)
      iii. Wired connection between meter and transmitter
      iv. Meter EndPoint stores 40 days of hourly data and transmit reading device
      v. Has 3 power modes – lower mode for drive-by, medium mode for highpowered drive-by (i.e., if meter is set back from road), and high mode for fixed-based
      vi. MVRS allows to preprogram data acquisition prior to going to field
      vii. Radio-based Mobile or walk by data collection (Handheld/Mobile PC)
      viii. Data management program @ utility w/billing interface
      ix. Leak sensor available
      x. Home monitor or smart phone app available $150. Home monitor reaches 200 – 300 feet from transmitter.
   c. AMI – 2 types
      i. ChoiceConnect
         1. Non-FCC Licensed System (low 100 watt)
         2. Utilizes 100W transmitter – easy migration from AMR to AMI
         3. Local neighborhood repeater/connectors gather data
         4. Repeaters transmit data to Collectors to fill in system voids
         5. Collectors send data to Utility
         6. Data management Program w/billing interface
         7. Ability to share data with customers
         8. Just now available, November 1st customer - Cleveland
      ii. SaveSource
         1. FCC Licensed System (high watt)
         2. Regional Base Stations Collectors of meter data
         3. Data management program w/billing interface
4. Ability to share real time data with customer
5. Leak detection sensor available
6. Not currently available for water accounts.

2. References/Utilities who use system
   • Carlsbad, AMR with 100W, daily residential reads
   • VID, AMR with 100W
   • Rainbow, AMR with 100W
   • Fallbrook, AMR with 100W
   • Poway, AMR with 100W
   • Rancho California, Temecula 60W
   • New Metro-Water in AZ, pilot in Big Bear, pilot in Cucamonga (AMI, only out a year and a half)
   • City of Cleveland
   • City of Ottowa
   • City of San Diego (hybrid of AMR and AMI)

3. Costs
   
   **Capital Costs for AMR**
   What is meter replacement program?
   Replace register only in 5-year or less (register cost + $75-$90 for 100W)
   Replace meter for greater than 5-year (meter cost + $75-$90 for 100W)
   Hand-held $5,000
   MCLite without handheld $12,000
   MC3 Laptop with radio $20,000
   MVRS Software $7,000
   Training done by distributor
   Analytics software (for use by engineering and for customer access) $25,000 – this was built for the City of San Diego, but are planning a demo for Carlsbad

   **O&M Costs for AMR**
   Handheld and radio, $600 per year
   Laptop and radio, $1000 per year
   Software, $1,650 per year for 7,500 to 10,000 connections
Vendor
AMR/AMI Survey
June 2013

Contact Name: Ed Amelung, 714-566-5395
Brian Jensen, HD Supply, 714-292-9480 Cell, Brian.Jensen2@hdsupply.com

Vendors Name: Master (Distributes through HD Supply)

1. General description of automatic meter reading system?
   a. AMR – 3G
      i. Transmitter inside Meter Register (no wire connection)
      ii. Can retrofit all Master meters and majority of other vendors meters (may void other vendor warranty)
      iii. Non-license radio frequency
      iv. Data logging in meter (4000 data points = 166 days of hourly data)
      v. Mobile or walk by data collection, then download data back at District via USB, etc. (have option to use cellular card to transfer single meter information to District)
      vi. Data management program @ utility w/billing interface and customer access to use data
   b. AMI – FixedLink
      i. Non-FCC Licensed System
      ii. One-way system (are currently testing 4 version of 2-way web-based system)
      iii. Utilizes AMR transmitter plus Universal Booster (possibly one booster for two meters). Read taken every 15 minutes and transferred to collector every 4 hours
      iv. Booster within lid (mushroom style)
      v. Collectors (Repeaters) needed to transmit data to Utility (no data stored at repeater)
      vi. Data management Program w/billing interface
      vii. Ability to share data with customers

2. References/Utilities who use system
   a. Otay Water (Drive-by with cellular card)
   b. Golden State Water (Drive-by via trash trucks)
   c. City of Escondido is evaluating
   d. City of Ontario
   e. City of Coachella

3. Cost (see attached)
Vendor
AMR/AMI Survey
June 2013

Contact Name: Millard Jones, Office 303-449-8833, Cell 720-641-5261, mfjones@metronfarnier.com

Vendor’s Name: Metron-Farnier

1. General description of automatic meter reading system
   a. Key component manufactured by Metron is the Innov8 digital register. Works with AMR Drive-by and Verizon fixed network options.
      i. Register works with Senses, Badger, and Neptune meters
      ii. Register does not work with Master meters
      iii. Metron-Farnier also has their own meter
      iv. No wires
   b. AMR – Drive-by
      i. Two-way drive-by radio system
      ii. 32,000 data points (5 minute intervals of data for 111 days)
      iii. 20 year battery life
   c. AMI – Fixed network, Verizon system
      i. Relies on the existing Verizon network
      ii. A CDMA chip (cell phone chip) is added to register
      iii. A VPN (virtual private network) is established and past 24 hours of data sent once per day between midnight and 4am to host computer.
      iv. Cannot “ping” register (remotely or via drive-by) for data.
      v. 10 year battery life
      vi. Are working with manufacturers to develop a CDMA for applications similar to this which would increase battery life and the ability to ping data. Qualcomm is interested but doesn’t yet see the demand to pursue.
      vii. System to be officially launched in June of this year

2. References/Utilities who use system
   a. City of San Juan Capistrano

3. Cost
   a. AMR – Drive-by
      i. AMR register is $100 per register
      ii. $1,500 annual maintenance
      iii. Also software and vehicle hardware costs (~$10k)
   b. AMI – Verizon
      i. $300 per register, TBD for annual maintenance or start-up costs
      ii. Very small charge from Microsoft for storage of data (alternatively District could store)
1. General description of automatic meter reading system?
   a. AMR
      i. Utilize Hot Rod or Integral Hot Rod transmitters
      ii. FCC Compliant, no license required for either transmitter
      iii. Transmits data every 2 seconds
      iv. Hot Rod transmitter works with any absolute encoder register Integral
          Hot Rod only with Hersey meters. Meter must have Translator register.
      v. Integral Hot Rod ships directly with meter, Hot Rod attaches to meter with wires
      vi. Drive-by (“Street Machine”) or walk-by (“Pit Stop”) data collection
      vii. Data is downloaded to management software and then exported to billing program
      viii. Hot Rod endpoints can store up to 170 days of hourly consumption data.
      ix. 20 year warranty on battery
      x. The consumer portal provided for Mi.Net could be provided, would cost District $6,500 per year to host the portal.

   b. AMI – Mi.Net
      i. Fixed base system
      ii. Utilizes Mi.Net W Meter Interface Unit which connects directly to only Hersey meters with Translator register
      iii. Sends data to Mi.Hub collectors
      iv. Data to District via telephone, Ethernet, fiber, DSL, cellular, or Wi-Fi
      v. Data to management software and then exported to billing program
      vi. Can share data with customers

   c. AMI – Itron System (SaveSource)
      i. Must change transmitter
      ii. FCC Licensed System
      iii. Utilizes base stations to collect data
      iv. Data management Program w/billing interface
      v. Ability to share data with customers

2. References/Utilities who use system (see attached)

3. Cost
   a. $85-90 for transmitter
   b. $12-15k for mobile/vehicle equipment (laptop, antennae, receiver)
   c. $7,000 for software plus $5,000 for billing extract file
   d. $3,600 for training
   e. Annual O&M $2,500 for software upgrades and phone support
1. General description of automatic meter reading system?
   a. AMR
      i. Radio Read AMR (Drive-by)
         1. High power transmitter allows for easy migration to AMI
         2. Transmits approximately 200 feet line-of-sight
         3. Wire connection between meter and transmitter
         4. Can connect (wire) multiple meters to a transmitter
         5. Do not have integrated meter/transmitter; transmitter is located outside meter box
         6. Hand held or mobile collection of data
         7. Activation signal to transmitter for data (collects on command, two-way communication)
         8. Stores hourly for 45 days
         9. Data management program @ utility w/billing interface
         10. Just released statement that radio (same for all AMR-AMI) is compatible with newest Master meters. District would need to purchase new register from Master and then would be compatible. Alternatively, could purchase Sensus IPro or any other compatible.
         11. Radio battery has 20 year life.
         12. Customer monitoring available through web-based portal
         13. Guarantee 98.5% of reads
   
   b. AMI – FlexNet system.
      i. FCC Licensed System
      ii. Transmitter @ meter
      iii. Compatible with multiple meters
      iv. Tower Gateway Basestations
      v. Data Transferred to Utility
      vi. Data management program w/billing interface
      vii. Customer monitoring available through web-based portal

2. References/Utilities who use system
   a. Olivenhain MWD – 5,300 meters on AMI
   b. Valley Center MWD – AMR
   c. Vallecitos – AMR
   d. Elsinore – AMR & AMI
   e. Oxnard – AMR
   f. City of Norco - AMI
3. Cost

**For AMR**

Radio (AMR or AMI) - $150 each (maybe two meters if close)
¾” meter IPro non-mechanical - $160
1” meter IPro non-mechanical - $200
Hand-held (AMR) - $5,000 (software, hardware, training)
Drive-by (AMR) - $35,000 (software, hardware, antennae, laptop, receiver, training)
Annual maintenance = $5,000 from Aquametric and Sensus
Web-portal for customer access = $40k-$100k depending on features, plus annual cost

**For AMI, add below costs to above**

Collector, Tower Gateway Basestation, putting up cell network, cover miles (other manufacturers are Wi-Fi based that cover square feet (AMI) - $30,000 each (72 to cover City of San Diego at 372 sq miles vs 200 for others which are more Wi-Fi based)

Software (AMI) – Sensus-hosted “cloud” – monthly charge based on # of meters, software, maintenance, upgrades, servers, technical support, training - $10,000 per month for ~15,000 meters. Alternatively, District maintains servers, then just upfront cost of $50,000 to cover hardware, software, and training.