Assessment Of Potential Use Of Telemetry For Monitoring Oil-Field Water Use

By
North Dakota State Water Commission
Water Appropriations Division Staff

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EXECUTIVE SUMMARY

Beginning in 2011, at the request of Governor Dalrymple, the staff of the Water Appropriation Division of the North Dakota State Water Commission conducted a pilot study to evaluate the feasibility of using telemetry to monitor real-time or frequent-time water pumping data from water depots. This brief Executive Summary is offered to provide a synopsis of the conclusions of the study, and recommendations for future action. The full report (27 pages plus appendices) provides more complete discussion of the issues.

Telemetry systems from three different vendors were installed and monitored on four different sites. Varying communication options for telemetry data were also examined. The use of telemetry was found to be feasible. Conclusions, approximate costs, and optimal system options, along with projected full-time employees (FTEs) required for effective use of telemetry are presented below as recommendations, and are discussed in more detail in the report.

Baseline FTE requirements for State Water Use Monitoring and Administration

All water use in North Dakota has been administered by one Water Rights Administrator (WRA), a single FTE, who implements an annual reporting program *[See Item (1), p. 19 for a more complete description]*. Increasing areas of critical concern throughout the state, and most recently demands of oil-field water-supply depot monitoring, have increased demands on the WRA position. This has caused excessively long (and uncompensated) hours for the administrator, and backlogs in the implementation of some important administrator functions, including field inspections of water permit perfections, and calibration and inspection of pump installations. They also have caused an excessive draw of time from hydrologists who would normally be analyzing water permits and monitoring the impacts of permit use. Because of this, the Water Appropriation Division of the North Dakota State Water Commission has requested one additional FTE for employment of a WRA Assistant in the 2013-2015 biennium budget. All estimates of FTE requirements for the recommended actions in this report will use the one additional FTE request as a basis for comparison.

Recommendations

Recommendation 1# - Necessity for Telemetry: The status quo, consisting of no telemetry and the use of state-wide annual report forms and monthly reports from oil-field water depots, can be adequately administered by the current WRA with one additional FTE. Current methods are deemed adequate because the nature of potential damage to other water users and the water resource has not been critical for any given violation. Rather damage would potentially result from long-term cumulative abuse of the resource through over-pumping, which can be effectively regulated with less frequent (annual plus spot check) monitoring, combined with appropriate penalties for violations. An effective regulatory system for oil-field use should consist of: (a) monthly and annual reporting of water use by the operator for each water permit; (b) requirement of a state-sealed in-line totalizing meter if there are concerns over meter tampering; (c) at least one annual inspection of the meter and apparatus on the water-depot site by the SWC staff; (d) sufficiently severe fines and punitive measures to assure that violations are not profitable.

If the Legislature prefers implementation of telemetry:

Recommendation 2# - Recommended Oil-Field Water Supply Telemetry System: The primary State use of telemetry for water supply depot monitoring would be as a supplemental source of information for evaluation of the water use by permit holders who do not return their forms in a timely or accurate fashion. Three potential systems were reviewed, (a) a "pull" system, (b) a comprehensive state controlled system, and (c) a "push" system. A "push" system, in which multiple vendors can customize their delivery to conform with a state provided "Simple Object Access Protocol (SOAP)" is recommended.

Advantages of the "push" system are: (a) The SOAP protocol has already been written and established by the State as a part of the pilot project and is capable of implementation on a larger scale; (b) the "push" system can be implemented with minimum State cost, and within the single additional FTE manpower requirement described above; (c) it places primary responsibility for data delivery on the vendors, and minimizes State involvement with the data acquisition process; (d) a "push" system would be robust, with future capability for manageable expansion to other water uses if needed in the future; (e) it allows for maximum competition and free enterprise for metering and telemetry vendors, and (f) it allows for adaptation of sites to the most efficient local carrier of data communication, using appropriate vendors. Other options would have large additional FTE requirements, and would require further detailed study.

(See Item 1, pages 6-8, and Item 6 on pages 25-27 for discussion of all three options).

Recommendation 3# - Cost Centers: It is recommended that water supply depot water permit holders pay the cost of telemetry system hardware, installation, and annual operational costs. Costs of deployment vary from as little as $1,000 per site for hardware and installation of basic telemetry systems to about $40,000 for more sophisticated supervisory control and data acquisition (SCADA) systems (often with multiple sites). In addition, about $200 to $500 per year per installation would be required for communication and data repository services. These should not be prohibitive for an industrial water supplier.

Recommendation 4# - Field Inspection Should be Continued with Telemetry: The "push" system is not a substitute for State field inspection of metering devices, as no metering or telemetry devices are tamper proof.

(See Item #7, pages 27 for discussion)

Recommendation 5# - Use of Telemetry: Real-time, or frequent data delivery to the State should not imply State responsibility or liability for early notification of water suppliers when they over pump their annual water allocation, nor should telemetry be considered as a justification for mitigation of penalties. While the State may be able to devise an automated notification system to help alert water depot water users, State personnel have many duties on a statewide basis that will draw their attention at times. There is concern that excessive involvement of the State with the internal control functions of water providers would be disadvantageous for both the State and the water providers, and that the manpower needs for the State to perform such a function would be large.

(See Item #4 on page 24 for discussion).

TABLE OF CONTENTS

Page

INTRODUCTION

Following the 2011 (Sixty-second) Session of the North Dakota Legislature, Governor Dalrymple requested that the staff of the State Engineer conduct a pilot study to evaluate the use of "remote terminal water metering devices," and report results prior to the next (2013) Session of the Legislative Assembly. In addition, the State Engineer assured the Governor that in the interim the Water Appropriation Division would develop and use a monthly reporting system for industrial water users supplying more than 15 acre-feet per year for oil-field use in western North Dakota, and increase the frequency of meter readings by staff. This report summarizes the actions, conclusions, and recommendations of the State Engineer's staff resulting from the Governor's directive.

PILOT STUDY

A pilot study on telemetry was initiated immediately after the end of the Session, and consisted of three phases: 1. Research and review, 2. Data transfer testing, and 3. Installation and field testing on four sites.

Definitions

The following paragraphs provide definitions for some of the descriptive terms used in the study:

Water Meters – Water meters are devices used to measure the amount of water passing through or discharging from a water-conveyance facility. Most of the meters are mechanical, employing some variation of a impeller to register on an analogue counter. Some are magnetic, which measure water as an electro-magnetic field and register the calibrated output as a digital display. The magnetic digital output can normally be transmitted without translation. Mechanical meters require a device to convert the analogue output to a digital signal, such as a pulse counter. Conversion devices are usually available from the original meter vendor. Other meters, such as the Panametric™ [1] meter used by the North Dakota Water Commission to check other meters or calibrate other methods of water-use estimation, use sound deflection in the moving water to measure flow.

All industrial water users and, since the Spring of 2007, all irrigation water users in critical aquifer management areas (Ex: Central Dakota Aquifer), and all new irrigation water users in the State of North Dakota have been required to install in-line totalizing water meters as described in Appendix A. Prior to Spring, 2007 all water users were required to meter water use by an acceptable method approved by the State Engineer.

SCADA SYSTEM - A Supervisory Control and Data Acquisition (SCADA) system is a computerized industrial control system (ICS) that is typically used for large-scale processes having multiple sites or functions. These systems usually consist of remote

[1] TM – the trademark symbol is used for the first use of a trade name. Thereafter it will be omitted.

terminal units, which collect sensor signals and convert them to digital data, a supervisory computer system, which gathers the data and processes the data and implements programmed control commands according to programmed goals and processes, and a human-machine interface, which presents the data to a human operator.

Telemetry - Telemetry is a technology that allows the remote transmission of data. Telemetry use for water monitoring in North Dakota would require conversion of metering output to a digital format, a carrier for transferring digital data to the receiving site, and a computer platform for organizing and presenting transmitted data in a usable format. Potential communication carriers available for water monitoring in western North Dakota would be dial-up telephone transmission, internet transmission, radio transmission, and satellite transmission.

Water Meter Survey

A 2011 survey of water meters used at 73 water depot locations indicated that there were 18 different brands used. Of these, McCrometer™ was the most common, used at 53% of the sites. Neptune™ was second at 12%, and Sensus™ was third at 9%. The remaining 26% was shared among fifteen brands. A list of in-line meter brands used by North Dakota water depots at the time this study was initiated is appended *(Appendix B)*.

Telemetry Survey

A survey was conducted during the summer of 2011 to find water depots that are using telemetry in their day-to-day operations. Several depots were using on-site SCADA systems, similar to gasoline card control systems, but only one was employing telemetry. SCADA systems facilitate precise facility management, including tracking precise use quantities and times by specific depot users. However, they do not necessarily include telemetry. Since the summer of 2011, several more depots have added telemetry to their operational monitoring and control systems. These include, but are not limited to, the Southwest Water Authority, the Lalim depot, the Savage-Ames Water depots, the City of Williston, the City of Killdeer, and the City of New Town.

Overview of Remote Monitoring Systems

A remote monitoring system used for recording and reporting pumping information consists, fundamentally, of a gauge or meter, a means for translating meter readings to a digital format, and a telemetry platform capable of sending the data to a server from which it can be accessed and interpreted. Telemetry platforms can vary widely from simple dial-up internet connectivity to elaborate satellite-based communication systems. Likewise, the telemetry component of the remote monitoring systems can range from a turn-key vendor-provided system that includes simple utilities to transmit meter information for a single site to a complex custom SCADA system with embedded operational functions for remote monitoring and remote control functions with capabilities to include multiple sites. Depending upon the type of system that is deployed, data can reside locally, on remote servers, or both.

The type of monitoring system that is deployed will be dictated by local conditions, which include the number of sites being monitored, the level of control required by the operator, and geographic conditions that will dictate the types of communications infrastructure that may be available. The available communications infrastructure will vary widely from region to region, and given the remote nature of some of the sites to be monitored, it is likely that the communications capabilities deployed in western North Dakota will include cable, satellite, cell-phone technology, radio transmission, and wired solutions. In most cases, the deployment will require customization either for the metering equipment or for the telemetry communications infrastructure to properly address the needs of each installation.

Discussion of Practical Requirements for State Reception and Use of Data from Remote Monitoring Systems for Regulatory Use

From a regulatory standpoint, the method used to access and interpret the data is critical in terms of manpower, money, and usefulness for State regulatory functions.

There are three potential options for receiving and using the data. These are:

1. A "pull" system is one in which the depot client chooses the vendor and the method of data transposition, telemetry, and storage, and the State accesses the data periodically at the client or vendor's site, then translates the digital data from the vendor's format into a single usable format.

   The "pull" option would be extremely expensive and time consuming to implement by a State agency.

   a. With 96 current water depots using different local protocols or vendors, the State would have to implement multiple access protocols, formats, and access credentials. For example, one vendor might have a single access protocol and credential for a single user with multiple pumping sites, while another might have different credentials and access codes for each individual site. One vendor may provide ftp protocol for the data while others may use the http protocol.
   b. State regulators would be required to routinely establish access for individual clients' data, which would be extremely time consuming.
   c. The State agency would be required to keep track of and adjust to changes in protocols, formats, addresses and credentials as the vendors and clients make changes and upgrades. This would place the burden of resolving access problems on State personnel as they would be required to troubleshoot and resolve these types of problems.
   d. A "pull" protocol is not scalable and would make expansion difficult. All of the problems discussed in (a) and (b) would be multiplied with expansion to more sites. Should the State eventually expand this approach to statewide industrial or irrigation use it would likely become chaotic and unmanageable.
   e. A positive attribute is that the client would be able to choose between multiple vendors.

2. The State could implement a "total state control" system, in which the State works with a few select vendors under contract to develop a single format and protocol, and in which the data is all sent directly to the State, which in this case would provide the backend infrastructure for receiving the data. The "total state control" option would be, essentially, a state-controlled SCADA system.
   a. A "total state-control" system would require a considerable State investment in implementing the initial code and infrastructure. It would also require considerable ongoing support and maintenance.
   b. It would avoid the problems of multiple access protocols and credentials and ongoing changes, and it would be scalable and robust.
   c. A major drawback would be that implementation of a "total state control" system would likely be practical only with a few vendors, and would therefore restrict choices and limit the flexibility that competition and free enterprise provide. It would also likely result in higher overall implementation prices because no single vendor provides the best possible solution in all cases.

3. The State could pursue an alternate approach that would build off of the current "pull" approach that allows each depot to pursue the solution that best fits their unique conditions and needs, and yet still provides the data to the State in a consistent format using "push technology" that is much more manageable and flexible. The State would develop and deploy SOAP (Simple Object Access Protocol) services that would provide the necessary protocol to allow any vendor to file the appropriate data required by the State. SOAP is defined as a "protocol specification for the exchange of information in a decentralized distributed environment."[2] It is commonly employed for implementation of WEB Services in computer networks. Advantages of the SOAP application would be:
   a. Choice and free enterprise would be preserved. Any vendor willing

[2]Definition by World Wide Web Consortium (W3C), in W3C Note 08 May, 2000. http://www.w3.org/TR/2000/NOTE-SOAP-200-20000508/

to implement the protocol could serve the state client depots.

b. The burden and responsibility for data delivery to the State server would be relegated back to the vendor and client. State regulatory time and expense in adjusting addresses, credentials and protocols, and in trouble shooting problems would be eliminated.

c. The use of a standards-based SOAP service would be robust and could easily scale from serving a few clients to serving thousands of clients.

d. A SOAP protocol for receiving and presenting digital data has already been developed and implemented as a part of the pilot study and would be available for expanded use. Documentation of the SOAP Service Specifications has been written for the North Dakota State Water Commission WEB page.[3] A copy is provided in *Appendix C*.

Of the three options, the "push" system option would be the least expensive and time consuming for the State to implement, and would be the most robust for future potential use and expansion. While a state-controlled system would provide the necessary utility for reporting data and the necessary utility to scale beyond a few systems, it carries tremendous cost and inflexibility in that the State would be tied to a single vendor and the State would be required to either build or contract much of the infrastructure to support this. The "pull" system would be the least attractive and most unmanageable of the three options as it will require significant manpower resources to implement, maintain, and monitor, and would provide limited options for scales of use beyond the water depots.

Methods of Data Transmission

There are four primary methods available for transmitting digital data. These are: 1. satellite, 2. cell phone, 3. radio, and 4. hardwired internet.

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[3] ND State SOAP service specifications for water-use data transfer. http://www.swc.nd.gov/SWCTelemetrySOAPSpec.html

Of these, hardwired internet transmission would provide, arguably, the most robust data delivery platform. However, while hardwired internet may be available for higher population areas, it will likely be unavailable for many rural areas of western North Dakota, and would be expensive and time consuming to wire into those areas (requiring contractors and the acquisition of easements for buried line installation). Cell phone transmission, such as used by the HOBO™ telemetry system, would cover most locations in western North Dakota, but may have gaps in some areas. The possibility of radio transmission was investigated, but found to be economically infeasible.[4] Satellite transmission provides the best geographical coverage in western North Dakota.

Of the four options, satellite and cell phone transmission were determined to provide the best overall combination of data communication and cost effectiveness. However, should the State elect to require telemetry using the SOAP protocol described above, the method of transmission would be irrelevant to State concerns, so long as the vendor was capable of providing the data to the regulatory agency in the format and frequency required.

Cost of Deployment

Costs of telemetry system deployment for several different vendors were examined.[5] Costs ranged from about $1,000 to $40,000, with the latter applying to the more sophisticated SCADA systems. Lower cost system deployments generally ranged from about $1,000 to $8,000, not including the cost of the meter. An additional cost of about $200 to $500 per year per installation would be required for communication and data repository services.

Time of Deployment

Telemetry systems are normally not available on the shelf, and generally take

[4] M. Hove of the North Dakota State Water Commission Water Appropriation Division met with representatives from the North Dakota State Radio Agency on Oct. 6, 2011. The network is used exclusively by the Highway Patrol, and would need a minimum of a half million dollar upgrade for use in water-use data transmission, provided the Highway Patrol would consent.

[5] The main vendors included McCrometer, HOBO, Design Solutions & Integration, Informational Data Technologies, Red Lion, Watch Technologies, and Microcom SCADA.

about 2 to 4 months from the time of order to deployment. One example is the Neptune™ pulse counter, which is normally manufactured only after order, and which took about 6 weeks for delivery in one of the SWC pilot projects.

FIELD ASSESSMENTS

Any feasibility study investigating the deployment of advanced technology should always employ pilot studies which test, as nearly as possible, the full application of the technology. For this study, four depot sites were selected *(A Map of depot locations and pilot study sites is provided in Appendix D)*. The three technologies deployed included one HOBO installation at the Dodge Water Depot, two McCrometer installations at the Timber Creek and Trenton Depots, and one Information Data Technologies (IDT™) installation at the Jim Schaper Depot. These were selected because they demonstrated the two main transmission methods thought to be most feasible (HOBO – cell phone, and McCrometer and IDT – satellite). In addition, McCrometer meters are already the most commonly used monitoring devices, deployed at 53% of the depots, and McCrometer has been conducting its own pilot telemetry tests in other states.[6]

1. HOBO pilot study was conducted at the Dodge Depot.[7] The HOBO data logger was ordered in October, 2011 and was received in December, 2011 at a cost of $1,600, which included a solar panel and a one-year data plan subscription. The annual subscription cost after installation and one year of operation would be $325.00. The HOBO unit is powered by a solar-charged battery by converting on-site AC current if available. The equipment was installed in January of 2012. The Dodge Depot Installation is shown on Figure 1.

   The Dodge Depot was using a Neptune analogue meter. Thus, a Neptune pulse counter was required to translate the analogue meter readings to a digital 4 to 20 mA electrical and pulse count signal that can be transmitted by cell phone using HOBO. Neptune pulse counters are built on order and are not available off the shelf. Delivery of the Neptune pulse counter took six weeks after order. The

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6 According to Ken Quandt, regional representative for McCrometer, the Central Colorado Conservancy Water District has been working with McCrometer for over three years on a telemetry pilot study.

7 The Dodge Water Depot was built by the Southwest Pipeline Project in 2010, and operates under a water permit held by the North Dakota State Water Commission. Mary Massad, manager of the SW Water Authority, who operates the system, authorized the participation of her employees in deploying the HOBO™ meter and the telemetry system. .

Neptune pulse counter should be able to operate with almost any type of telemetry device. The pulse counter with the Neptune meter requires 24 volt DC current, which is independent from the HOBO logger.

The Dodge HOBO was operated from January through the present (November 2012). The setup and calibration time took about 3 weeks because of issues in setting up the right scaling factors between the Neptune metering device and the HOBO unit. The HOBO unit can be ordered to transmit by etherenet, radio, or cell phone. Ethernet in remote areas would be unavailable or extremely costly to deploy in most cases. Radio transmission was determined to be infeasible. The problem with cell phone calibration was that it required web access for configuration to finish calibration, but web access was not available on site, nor would it usually be, so transportation to web access sites was required and was time consuming. Calibration could have been speeded up with a mobile wi-fi acess at the site or in the vehicle. With temporary local web access installation time by an experienced professional would likely be as little as one day.

The HOBO unit logs and stores data on a minute basis for up to three months, and uploads the data to an ONDATSET™ computer server by cell phone every hour. The data had to be accessed by the Office of the State Engineer from the central server through its web interface for use. The data was accessed monthly during the trial period. The data was downloaded as a comma-delimited text file, which could be formatted for agency interpretive software.

The main problems with HOBO deployment were the limited range of sending applications by cell phone from transmitting towers. On a signal scale of 0 to 5, ranging from no communication to best, respectively, at least a mid-range strength was required for consistent transmission. The Dodge Depot was about 1.5 miles from a tower and routine signal strength was 3, which provided consistent uploads on the hour 100% of the time. At the Schaper Water Depot, a distance of about 11 miles from the tower and in a valley, the HOBO signal strength was 0 to 1, and was configured to upload every hour. The unit missed up-linking about 75% of the time. Under most conditions a two hour reading for totalizing data would be more than adequate. But potential users should be aware that there could be potential difficulties with transmission related to landscape position, distance from towers, line of sight with intervening barriers (such as buildings), weather, and other factors. *(An analysis of topographical effects on transmission at the Dodge and Schaper Depots is provided in Appendix E.)*

One issue was an occasional "bounce" in the readings, which may have resulted from cavitation, electrical interference, or other factors. Cumulative potential error over a monitoring period of 9 months would have been about 1 to 2%. The error of transmitted data generally appeared to be an overestimate of pumping, compared with the meter. The error is considered be inconsequential with respect to regulatory concerns. *(Graphical Comparisons of meter and telemetry data are provided in Appendix F).*

2. McCrometer integrated metering and telemetry systems were deployed at two locations: 1. The Timber Creek Water Depot, in McKenzie County about 20 miles south of Williston, and 2. the Trenton Depot, located near Trenton in Williams County. The Timber Creek Water Depot (Figure 2) is operated by Mike Ames under the authority of a water permit held by Bratcher Farms. The Trenton Water Depot (Figure 3) is owned and operated by Steve Mortenson.

   McCrometer, working with the Central Colorado Water Conservancy District, has developed a telemetry system that is integrated with its metering devices, including a dedicated pulse counter for allowing the analogue meter to communicate with the telemetry device. McCrometer uses a satellite data transmission system. The standard transmission protocol is to record and download data every six hours to a dedicated remote McCrometer server. Readings are therefore limited to six-hour frequencies. Frequencies of measurement could be increased, but at additional cost. The system is powered by an internal battery, charged by a solar panel. Unlike the HOBO meter, the same battery powers both the telemetry transmission device and the pulse counter.

The cost of installation was $2,100 for the telemetry transmission box and the solar panel, plus $300 for each pulse counter. The transmission box can be used for up to two pulse counters. Ongoing data transmission costs are $17 per month per telemetry unit for 5 measurement parameters (used for two fill points at one depot). Increased measurement parameters or frequencies would increase cost approximately proportionately. Total hardware costs per site were about $2,700, and were identical for each of the two sites. Precise installation costs are not known because the hardware was installed by State employees and employees of the depot. However, a rough estimate is installation cost at least equal to half the cost of the hardware.[8]

The hardware was ordered in March and arrived in April of 2012. Installation and calibration, however, took about 4 weeks because of the complexity of the calibration and the need for a web connection, and a lack of onsite web connections. An adept installer could plausibly complete installation within a couple of days.

The State office was able to easily access and download the data. The data is downloaded in a tab-delimited text format that can be formatted for State applications. The Trenton Depot system was first operational in May and continues to be operated as of December, 2012. The Timber Creek Depot telemetry system was operated from May through October, at which time it was decommissioned because new operators installed their own SCADA system.

[8] McCrometer has indicated that they are adopting a price structure which would cost $3,600 for hardware and installation of a telemetry system on a McCrometer metered site. Monthly costs for communication and data repository would be $16 per installation.

3. A third system was deployed in October of 2012 at the Jim Schaper Water Depot, which is seven miles north of Halliday, ND. The vendor is Informational Data Technologies (IDT™). The Schaper Depot installation is shown on Figure 4. IDT employs satellite transmission hardware that is adaptable to a wide range of pulse counters and meters, unlike the integrated McCrometer transmission system, but similar to the HOBO telemetry system. The transmission system is powered by an internal battery, which should have a 10-year life at one reading per day. The communication cost is $6 per month per sending unit. The cost of increased frequency of readings is proportional to the number. For example, two readings per day would cost $12 per month, four per day would cost $24 per month. In addition, the life of the battery decreases proportionally with frequency of readings. For example, five readings per day would result in a two-year battery life, rather than ten years. The transmission device cost was $450, and is dedicated to one meter. The Schaper Water Depot, with two fill points, required two devices, at a cost of $1,100. Installation costs were covered by the manufacturer, but would likely be approximately half of the hardware cost. Installation by an expert took about 2 hours for two transmission devices on one site. If a single buyer were to purchase 278 or more units, the annual total cost of transmission would be constant at $20,000 per year. IDT has estimated the company cost of completing the SWC SOAP protocol at less than $10,000.

   The data is transmitted to the IDT secure data center, located in Sioux Falls, South Dakota. The data is accessible to the client via a custom web page. Currently data access is time-consuming for a State regulatory application. However, IDT has indicated a willingness to build an export function and format that would be usable for a State SOAP format, and would be capable of pushing data to a published State SOAP Service.

Figure 1. Installation of On-Set Computer HOBO Data Logger at the Dodge Depot operated by SWWA

Figure 2. Installation of McCrometer Telemetry at Timber Creek Depot operated by Mike Ames.

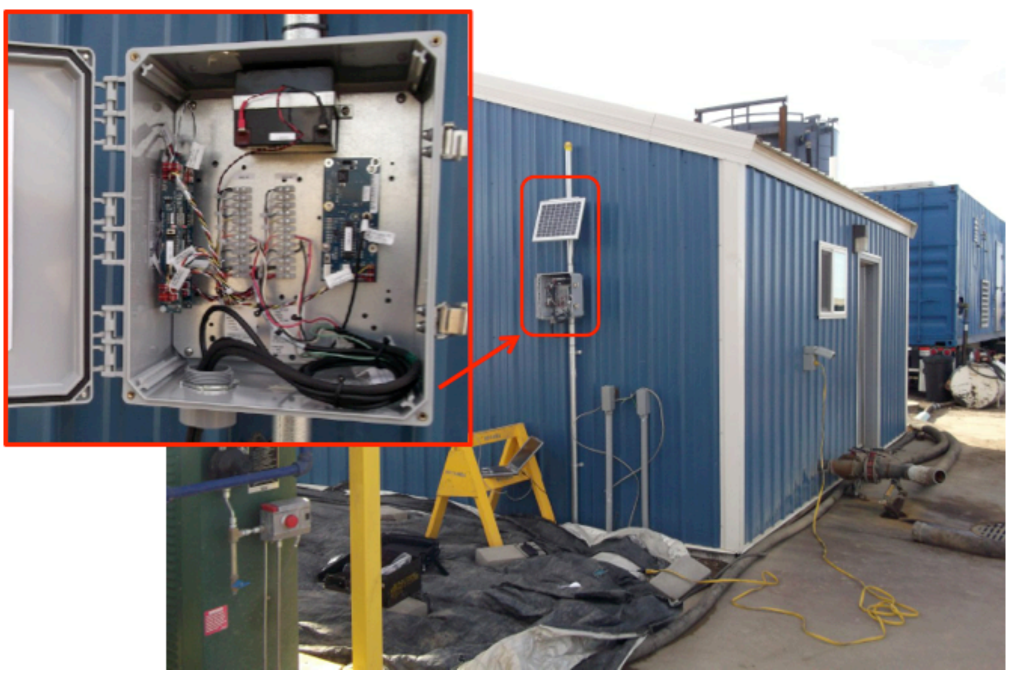

Figure 3. Installation of McCrometer Telemetry at the Trenton Water Depot owned by Steve Mortenson.   (LEFT) Pulse counter installed on McCrometer Meter : (RIGHT) Exterior installation of telemetry system

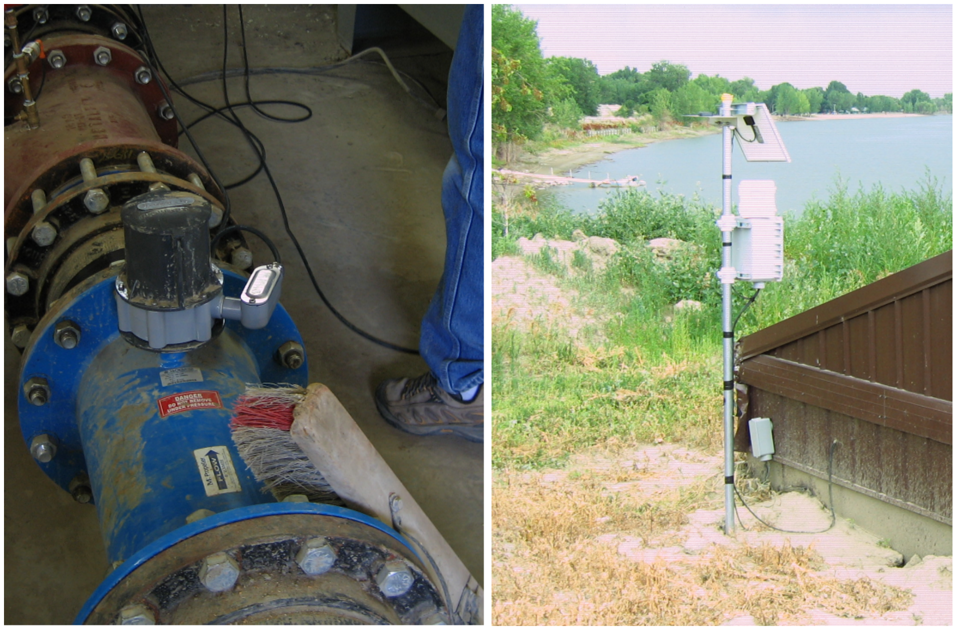

Figure 4. Installation of IDT Telemetry at the Schaper Water Depot owned by Jim Schaper.   Exterior view of the telemetry system, with the hand-held calibration system.

DISCUSSION: UTILITY AND CHALLENGES FOR STATE APPLICATION OF TELEMETRY FOR WATER DEPOT MONITORING

When evaluating the benefits to be gained from use of telemetry for monitoring oil and gas-field water-supply depots, it is important that we assess: (1) what utility the greater data frequencies would provide when compared with current monitoring practices employed by the water regulatory agency; (2) how that data would be employed, and how frequently it would be expected to be accessed and evaluated by regulatory personnel; (3) how the increased data acquisition and evaluation requirements would fit within the existing statewide requirements for water-use evaluation; (4) how the expected access and evaluation schedule would fit within current manpower capabilities, and what additional manpower requirements would be needed to properly implement use of the increased data acquisition; (5) what additional potential liability possession of that data might imply for the State; and (6) how the increased data acquisition and use would compare with common law enforcement and regulatory practices and the implications of that comparison.

It is important that the use of telemetry data be understood and evaluated within the framework of the overall duties and corresponding manpower for performing those duties on a statewide basis.

1. Current Water-Use Monitoring Practice: All water use rights for the State are currently monitored by one full time employee, with the title of "Water Rights Administrator," with periodic assistance from field technicians and staff hydrologists. The current water use monitoring system is an annual system that consists of sending out more than 3,000 water use report forms per year to each of the State's water users. Beginning in November of each year, about 2,250 forms are mailed to irrigators. In mid-January, a second mailing is sent to irrigators to remind irrigators whose forms have not yet been returned. During this time, dozens of phone calls are received asking questions about the forms. If time permits, a third reminder mailing is sent out by mid-March. By mid-May, about

95% of the forms have been returned.[9]

At the beginning of January, annual use forms are sent out for about 850 municipal and industrial water permit holders, with a requested return date of March. By mid-March, about 85% of the forms have been received. In mid-March a second letter is sent out to delinquent permit holders. By mid-May, 97 to 98% of all forms have been returned.

Methods for metering depend on the individual water permit conditions, how critical or scarce the water resource is in a given location, or how controversial the water use is vis-à-vis other local users or concerns, and the plausibility of those concerns. For the least critical irrigation situations, power use records can be used to estimate pumpage using irrigator's pump capacity data. For critical situations involving irrigation, in-line metering is required. In-line metering is required for all municipal and industrial uses. Where flow meters are not required, the Water Rights Administrator conducts spot checks during summer using a portable Panametrics Ultrasonic Flow Meter. In the past, about 10 to 20 spot checks were performed during the field season. Since 2009, only 2 or 3 per year have been performed because of the increased time demands of oil-field water use monitoring issues.

All of the water-use data is manually entered into a database. Each form is briefly examined, and if something anomalous is found, considerable time can be spent investigating the cause. All of the work involving contact, data evaluation, and data entry is performed by one FTE, the Water Rights Administrator, with temporary assistance (January through April) of one field technician. Some specific problems are referred to the managing hydrologist for the use area. In some years, if the budget permits, a temporary summer employee is hired to

[9] Reasons for failure to comply vary widely — parties have not irrigated and thought they did not need to comply if they didn't irrigate, parties are deceased or have changed address, new ownership unaware of the water permit or its requirements, and many other factors that cannot be fully investigated on an annual schedule with existing personnel.

perform water permit inspections, which includes checking meters. While the reports are substantially complete by mid-May, processing of the report forms, including evaluation, cross verification, data entry, and responses to requests for the information by the public or federal and state agencies continues throughout the year. Data requests are many, substantial, and time consuming.[10]

2. The Role of Water-Use Monitoring within the Water Appropriation Division Program: Water-use monitoring is only one facet of the Water Appropriation Division program. Water permit applications are investigated by managing hydrologists and water resource engineers, who recommend actions to the State Engineer. Evaluation of water permit applications requires extensive and scientific hydrologic evaluation by hydrologists and water-resource engineers to evaluate potential impacts and long-term viability of new permit uses. These evaluations, which increasingly require hydrologic models, are extensively data driven. To obtain the necessary data, water levels are measured in about 4,000 observation wells, mostly monthly from spring through early winter. Wells not measured monthly are measured quarterly. Observation wells are sampled for water chemistry approximately every five years, or about 1,200 samples per year. Stream gauging is contracted primarily with the U.S. Geological Survey.

   In addition, the Water Appropriation Division gages streams at a few dozen sites, as needed. All well measurements, water sample collections, and stream gaging are performed by four field technicians. The same technicians have been used to perform water meter checks in western North Dakota. About half of the water depot sites are inspected and recorded once per year, and the remaining half are inspected and recorded two to five times per year. The more frequent inspections are performed in areas where observation wells are in close proximity to meter sites and are therefore conveniently accessed on well measurement runs.

   The data from observation wells are critical not only for evaluation of new water

[10] Data requests are logged and can be provided upon request.

permits, but for monitoring the impacts of permitted use on the water resource. For example, if climatic conditions, such as drought, cause excessive depletion, the monitoring well data are used to determine if or when pumping for water permits with later beneficial use dates (junior appropriators) are to be curtailed. Observation well data are also used to evaluate the actual and potential impact of pumping by water depots and other water users on the water resource and prior appropriators.

The main point is that most of the Water Appropriation Division program and its personnel are focused on and occupied with the processing of water permits, the collection and evaluation of hydrologic data necessary for due diligence in making recommendations to the State Engineer, and in evaluating the impacts of those decisions. The monitoring, evaluation, and validation of water-use data for the entire state is performed by only one full-time employee, with periodic assistance from field technicians during the winter months. It is important to note that expansion of monitoring functions and evaluation to a frequency greater than annual for oil-field usage would require commensurately more FTEs. That FTE requirement would depend on the required frequency of data evaluation and the required response to those evaluations.

3. What is the Regulatory Expectation: In evaluating the potential benefits of a remote telemetry system for State regulatory use, it is important that we have a clear idea of the goals for using that data, what frequency it is to be used, and how it fits into a regulatory enforcement scheme. Historical evaluation has been annual, but in 2012 monthly water-meter reading reports were required for oil-field industrial permits for beneficial use of more than 15 acre-feet per year. Regulatory water-use monitoring is a component of a law enforcement scheme. Water users are permitted to use the waters of the State for specified beneficial uses under specified conditions. The purpose of monitoring is to assure compliance with the law. A secondary purpose it to provide data for evaluation of hydrologic impact. Compliance with the law is normally considered to be the

responsibility of the citizen. Drivers are responsible for complying with speeding laws. Agricultural producers are responsible for complying with pesticide label requirements. Enforcement is usually based on periodic inspection, reported violations, observed outcomes from violations and public reporting. Public reporting can be a very important source of information on violations. The scope of these limitations is based on a number of factors, including consequences of the violation, enforcement manpower, privacy concerns, and other factors. For example, agricultural services do not send real-time chemical application data to the Agriculture Department, nor is it considered the responsibility of the State Agriculture Department to direct and prevent illegal applications before the offense. The manpower requirements for such activities would be large. Similarly, it is not considered the duty of the highway patrol to stop every speeder before or when he begins to speed through centralized real-time monitoring.

Conversely, where public health might be severely and immediately impacted, real-time on-site inspection might be required. Examples are food-processing inspection or nuclear waste storage. The question is, which of these would apply to water-use monitoring for oil-field industrial use water permits? The situation of oil-field water supply depots seems most closely related to the agricultural example in that danger to public health is not involved, and in that any given single offense has a low probability of harm to the water source, to others or to the public welfare. Rather, the potential harm lies in collective offense, in which the large profitability of depot sales would result in widespread violations through over-pumping if individuals were allowed to profit from over-use. This, in the long term, could cause serious and possibly irreparable harm to the water resource, to other water users, and to future water availability.

From the standpoint of hydrologic and personal impact, then, the timing of detection of offenses is not critical.[11] It is, however, critical that offenses be

[11] Current permit over-use represents less than one-half of one percent of state-wide reported industrial users. The percent of over-use, by permit, in the west is less.

detected and that appropriate penalties be assessed to assure that continued non-compliance is not profitable or probable.

The question, then, is at what frequency should water use be monitored by the State? A related question is whether it should be a function of a state agency to assume the responsibility for prevention of non-compliance rather than enforcement of violations. Is it the responsibility of the State to prevent depot operators from violating conditions of their permits and incurring the resulting penalties? Or conversely, is the appropriate role of the State one of enforcement of laws and conditions? These questions are asked with the understanding that the preventative role implies more State resources for use of the real-time data and for the communication role that would be adopted by the State. Essentially, the State would be assuming part of the internal control functions of the operator.

An important consideration is that the water user has obtained a **right** from the State Engineer to put water to beneficial use. It is suggested that, as with any right, there exists an associated level of individual **responsibility** to comply with conditions required to exercise that right.

4. <u>Consideration of Risk, Culpability and Liability:</u> Would the possession of high-frequency, real-time monitoring data by the State imply a State responsibility to take proactive communication measures with water-permit holders to prevent over-pumping and the resulting penalties? Would there be a State liability involved? And would the failure of the State to communicate proactively provide a mitigating defense for the offending permit holder in a court action? While these questions would ultimately need to be answered by the courts, it does not seem unreasonable that an over-appropriator may have a mitigating defense if the State knew of the violation (or had the requisite information to know of the violation) and failed to immediately take enforcement action. Similarly, if a highway patrol officer followed a speeder for many miles without pulling the speeder over, the speeder may feel there has been acquiescence to the speeding.

If the speeder later challenges a ticket in court, the court may be likely to agree with the speeder that it is "unfair" to be ticketed when the officer let the behavior continue for so long without taking any enforcement action.

5. Utility of Telemetry for State Regulatory Use: The use of telemetry would provide a back-up and confirmation source of water-use information. It would not, however, provide assurance against criminal manipulation. Telemetry systems are not tamper proof. Transmissions could be interrupted by various means, natural or artificial, which would mask periods of tampering. On the other hand, such interruptions might serve as a potential flag for possible tampering, particularly if no service or less than average service for the "down" period is registered after resumption of transmission. Further evidence of tampering and unregistered pumping during the "down" period would likely be needed, however, for regulatory action to be taken.

6. Labor and Cost: Manpower requirements to use the telemetric data are difficult to assess with current knowledge, but would vary with the system adopted, the frequency of monitoring (accessing and evaluating) the data by State regulators, and the response protocols adopted. The current situation, as described above, is that one FTE, the Water Rights Administrator, monitors all of the more than 3,000 State water use reports on an annual program. Because of increasing time demands from oil-field water depot permits and newly implemented monthly reporting requirements for water depots, and increasing monitoring demands in other state water-use sectors, one additional FTE is being requested during the 2013 legislative session as a part of the Water Commission budget. The following comments are offered as a general assessment of potential additional labor requirements, assuming the granting of the requested FTE:

    a. A "pull" system (discussed above), in which state regulators would have to actively access data from varying data sources, would be extremely time consuming for even an annual evaluation program, with about 125 water depots currently in operation as of December, 2012, about 152 water depot permits that are undeveloped or in processing, and more applications being received. Monthly or daily access and evaluation, combined with problems discussed above for the pull system would render this system very difficult to administer. While the actual work load cannot be adequately evaluated before the fact, it is considered likely that additional employees over the one additional FTE requested, would be required. This system would become unwieldy were it to be expanded to broader state-wide application.

b. A "total state control" State SCADA system would be amenable to a consistent State SOAP data receiving protocol, already developed, which would enable reasonably efficient data screening on the receiving end. Screening software has been developed to flag failing data deliveries and water depots approaching or exceeding their limits. On the data receiving and evaluation end, this could conceivably be implemented within the capabilities of the one additional requested FTE, at least initially. However, the full control state system would require additional FTEs, either in state employment or in external contracts, to install, maintain, and inspect local installations. These employees or contractors would need advanced expertise in the field of metering and telemetry, which are outside of the current expertise and functions of current State Water Commission employees. A realistic cost and labor estimate for a "full control" program would require an evaluation by outside consultants. First, consultants would be required to prepare a "Request for Proposal" (RFP) protocol for the State, which would be let for bids. The bid winner would then conduct a full evaluation of the needs for implementation of the State SCADA system. It seems likely, however, that long-term costs to the State would be large. The RFP and State program plan and cost analysis would require a fiscal note or budget item.

c. The "push system," would likely be the least costly and labor intensive, for reasons discussed above. A data-receiving protocol has already been developed to receive the data and organize and present it in a usable format. Software has already been developed, as a part of the pilot study, to screen the data to flag delinquent deliveries and water depots approaching or exceeding permit limits. Manpower needs would vary with required screening intervals, but if kept to monthly or possibly weekly intervals, labor requirements could plausibly be kept within the limits of the one additional FTE requested. The major additional labor requirement would be incurred in contacting delinquent water users.

7. Field Inspections: Use of telemetry for data acquisition is not a substitute for annual and random field inspections of water depots, and will not minimize or eliminate field inspection time, nor does it mitigate the need for monitoring the water resource in the Water Appropriation Division's field data acquisition program. Remote data acquisition cannot detect meter tampering or irregular water delivery configurations that circumvent metering. Moreover, the physical presence of State inspectors is important for a state water regulatory and enforcement program for the same reasons that it would be important for police or other law enforcement programs. It keeps the issue of State oversight of the water resource as an immediate and clear concern and priority for water users, provides assurance of State oversight to local residents concerned with the resource, provides a point of contact for the public to report violations in field, and provides an opportunity for the agency to communicate with and educate local people concerning State water regulatory programs.

   Increasing demands on field staff for processing monthly water reports from water depots and for additional on-site inspections have taxed the field technician time available for the water resource monitoring program and have stressed travel budgets. It is not expected that telemetry would decrease time or budget requirements or otherwise compensate for or adversely affect the current requirements of the broader field monitoring program.

NORTH DAKOTA STATE WATER COMMISSION - WATER APPROPRIATION DIVISION
(701) 328-2754

Flowmeter Specfications

1. The water flowmeter must be certified by the manufacturer to record neither less than 98 percent nor more than 102 percent of the actual volume of water passing the water flowmeter when installed according to the manufacturer's instructions.
2. The water flowmeter must have a display that is readable at all times, whether the system is operating or not.
3. The water flowmeter must have a totalizer that meets the following criteria:
    - i. Is continuously updated to read directly only in acre-feet, acre-inches, gallons, cubic feet, or barrels (42 U.S. gallons)
    - ii. Has sufficient capacity, without cycling past zero more than once each year, to record the quantity of water diverted in any one calendar year;
    - iii. Has a dial or counter that can be timed with a stopwatch over not more than a 10-minute period to accurately determine the rate of flow under normal operating conditions; and
    - iv. Has a nonvolatile memory if the meter is equipped with an electronic totalizer.
4. The water flowmeter must be installed according to manufacturer's specifications and must be properly maintained according to manufacturer's recommendations, including proper winterization such as removal during the winter.
5. The water flowmeter shall be available for inspection by the representatives of the State Engineer.

APPENDIX B: In-Line Water Meter Brands Used at North Dakota Depots

* Information was updated after the start of the pilot study.

Depot ID#	Depot Name	Meter Location	Meter Name
57	Alexander, City of	15010105B	Kimray
185	American Eagle Energy	16310112D	FM-42
3	Ames' Red Mike Depot	15409617BCBB	McCrometer
3	Ames' Red Mike Depot	15409617BCBB	McCrometer
3	Ames' Red Mike Depot	15409617BCAAB	McCrometer
3	Ames' Red Mike Depot	15409617BCAAB	McCrometer
2	Ames' Wildrose Depot	16009732DDD	McCrometer
2	Ames' Wildrose Depot	16009732DDD	McCrometer
2	Ames' Wildrose Depot	16009732DDD	McCrometer
2	Ames' Wildrose Depot	16009732DDD	McCrometer
59	Anderson Water Depot	15210327BD	Brooks
96	Aune, Dwight	15310336D	Not Developed *
78	Baker, Roger	15509631D	McCrometer
79	Baker, Roger	15409610CC	McCrometer
17	Barstad (Three Forks-Stanley) Depot	15609104CBD	Bernard
17	Barstad (Three Forks-Stanley) Depot	15609104CBD	Bernard
49	Basic Energy Services Depot	15009924DADA	Sensus
9	Berg (Blue Ridge - Ames) Water Depot	15910017DAA	McCrometer
9	Berg (Blue Ridge - Ames) Water Depot	15910017DAA	McCrometer
51	Berry (Cartwright) Water Depot	15110436BDB	McCrometer
51	Berry (Cartwright) Water Depot	15110436BDB	McCrometer
51	Berry (Cartwright) Water Depot	15110436BDB	McCrometer
51	Berry (Cartwright) Water Depot	15110436BDB	McCrometer
30	Blankenship, Walter	14609531A	Nuflo *
50	Bratcher-Ames (Timber Creek) Depot	15110109CAAC	McCrometer
50	Bratcher-Ames (Timber Creek) Depot	15110109CAAC	McCrometer
50	Bratcher-Ames (Timber Creek) Depot	15110109CAAC	McCrometer
50	Bratcher-Ames (Timber Creek) Depot	15110109CAAC	McCrometer
54	Chimney Butte Land	14309908DDBC	Neptune
66	Crosby, City of	16309728C	Sensus
43	Dwyer, Mike water depot	15110220DDCB	McCrometer
44	Dwyer, Tim Water Depot	15110214BAAA	McCrometer *
44	Dwyer, Tim Water Depot	15110214BAAA	McCrometer *
19	Edwards Water Depot	15408915DDCC	Neptune
53	Energy Equity	14210328ABD	Blancett
61	Ferebee, Robert Water LLC	14509223CBB	McCrometer
61	Ferebee, Robert Water LLC	14509223CBB	McCrometer
4	Gafkjen (Athens-Ames) Water Depot	15710005A	McCrometer
4	Gafkjen (Athens-Ames) Water Depot	15710005A	McCrometer
25	Grenora, City of	15910312CA	Neptune
25	Grenora, City of	15910312CA	Rosemount
82	Gunlikson Depot	15810019C	McCrometer

APPENDIX B: In-Line Water Meter Brands Used at North Dakota Depots

* Information was updated after the start of the pilot study.

Depot ID#	Depot Name	Meter Location	Meter Name
56	Hartel Depot	15009823BAAC	Badger
81	Helgeson, Toby	15810029DCCC	Great Plains Meter
18	Jensen Water Depot	15709035DDC	McCrometer
18	Jensen Water Depot	15709035DDC	McCrometer
12	Johnson Water Depot	15510017A	McCrometer
21	Killdeer City Depot	14509523BCDC	Neptune
21	Killdeer City Depot	14509523CBB	Neptune
46	Killdeer Golf (Dunn Co, Medicine Hils) Depo	14509514ADAA	Neptune
99	Klose, Vernon	15110327A	SeaMetrics
6	Krabseth Water Depot	15810021BBB	McCrometer
6	Krabseth Water Depot	15810021BBB	McCrometer
5	Lalim Water Depot	15409616BBC	McCrometer
5	Lalim Water Depot	15409616BBC	McCrometer
5	Lalim Water Depot	15409616BBC	McCrometer
5	Lalim Water Depot	15409616BBC	McCrometer
5	Lalim Water Depot	15409616BBC	NUFLO
58	Landtech Enterprises, L. L. C.	15010117ACAC	ABB
86	Mortenson, Steve	15310217CDDA	McCrometer
32	Mortenson, Steve	15410216AADA	Not in service *
37	Mortenson, Steve	15210414B	Not in service *
86	Mortenson, Steve	15310217CDDA	McCrometer
86	Mortenson, Steve	15310217CDDA	McCrometer
29	New Town City Depot	15209217CCDC	Rosemount
29	New Town City Depot	15209217CCDC	Rosemount
13	Nordsven Water Depot	14409316BCCC	Badger
184	Northwest Water Transfer	15610115B	J.M. Geyser
45	Olson Water Depot	14409421CDDD	McCrometer
33	Ortloff Water Depot	15609321AADA	Brand-Master
33	Ortloff Water Depot	15609321AADA	Brand-Master
62	Parshall City Depot	15209036AABA	Rosemount
62	Parshall City Depot	15209036AABA	Rosemount
16	Pavlenko Water Depot	14509529AAAD	Neptune
16	Pavlenko Water Depot	14509529AAAA	Neptune
63	Pennington Depot	15109204CCCC	McCrometer
63	Pennington Depot	15109204CCCC	McCrometer
63	Pennington Depot	15109204CCCC	McCrometer *
63	Pennington Depot	15109204CCCC	Not Developed *
63	Pennington Depot	15109204CCCC	Not Developed *
36	Powers Lake City Depot	15909336ABAC	McCrometer *
36	Powers Lake City Depot	15909336ABAC	McCrometer *
36	Powers Lake City Depot	15909336BBBC	Sensus
14	Quarne Water Depot	15909505C	McCrometer

APPENDIX B: In-Line Water Meter Brands Used at North Dakota Depots

* Information was updated after the start of the pilot study.

Depot ID#	Depot Name	Meter Location	Meter Name
39	Reistad (Westby) Water Depot	16310234CBBC	McCrometer
39	Reistad (Westby) Water Depot	16310234CBBC	McCrometer
34	Rismon Water Depot	15709206AABA	Neptune
20	Sax Water Depot LLC	15109827DDDD	McCrometer
20	Sax Water Depot LLC	15109827DDDD	McCrometer
22	Schaper (J and L Water) Depot	14609120AADA	Sensus
22	Schaper (J and L Water) Depot	14609120AADA	Sensus
192	Schneider, Les	14309626C	McCrometer
181	Schneider, Les	14309633C	McCrometer
55	Schollmeyer, Clarence	14709530BBBB	Badger *
11	Sheldon Water Depot	15409618ADAAA	McCrometer *
11	Sheldon Water Depot	15409618ADAAA	McCrometer *
11	Sheldon Water Depot	15409618ADAAB	McCrometer *
11	Sheldon Water Depot	15409618ADAAB	McCrometer *
11	Sheldon Water Depot	15409618ADAAA	McCrometer *
41	Signalness' Camel Butte Fresh Water Depot	15009604ADAC	McCrometer
41	Signalness' Camel Butte Fresh Water Depot	15009604ADAC	McCrometer
42	Simonson Water Depot	15009922ADAD	McCrometer
42	Simonson Water Depot	15009922ADAD	McCrometer
42	Simonson Water Depot	15009922ADAD	McCrometer
7	Simpson Water Depot	15809733DAD	McCrometer *
7	Simpson Water Depot	15809733DAD	McCrometer *
7	Simpson Water Depot	15809733DAD	McCrometer *
7	Simpson Water Depot	15809733DAD	McCrometer *
7	Simpson Water Depot	15809733D	McCrometer
7	Simpson Water Depot	15809733DAD	McCrometer
7	Simpson Water Depot	15809733DAD	McCrometer
7	Simpson Water Depot	15809733D	McCrometer
7	Simpson Water Depot	15809733D	McCrometer
7	Simpson Water Depot	15809733D	McCrometer *
7	Simpson Water Depot	15809733D	McCrometer *
35	Sjol Water Depot	15609021BBDB	Neptune
35	Sjol Water Depot	15609021BBDB	Neptune
8	Smith Water Depot	15610021CCCC	Neptune
8	Smith Water Depot	15610021CCCC	Neptune
80	Sorenson, Rick (Terry Smith depot)	15610020C	SeaMetrics *
92	Southwest Water Authority, Belfield city de	13909905DBCA	Neptune *
92	Southwest Water Authority, Belfield city de	13909905ADCD	Neptune *
93	Southwest Water Authority, Dickinson city	13909506ABCB	Sensus *
93	Southwest Water Authority, Dickinson city	13909609ABBB	Neptune *
64	Southwest Water Authority, Dodge	14409115BBBB	Neptune *
97	Southwest Water Authority, Glen Ullin city	13908831ABCCB	Not Developed *

APPENDIX B: In-Line Water Meter Brands Used at North Dakota Depots

* Information was updated after the start of the pilot study.

Depot ID#	Depot Name	Meter Location	Meter Name
94	Southwest Water Authority, Sentinel Butte	14010519DADD	Turbines Inc. *
28	Stanley, City of	15609128A	No longer used
23	Syth, Kimberly	15110431ACDC	Micrometer
15	Truchan (M and L Freshwater Service) Dep	14509528BBC2	Badger
15	Truchan (M and L Freshwater Service) Dep	14509528BBC1	Badger
48	Watford City City Depot	15009919DAAB	Sensus
48	Watford City City Depot	15009919DAAB	Sensus
27	Weyrauch, Betty	15509628C	Sensus
27	Weyrauch, Betty	15509628C	Water Specialties
67	Williston City Depot	15410131DC	Sensus
67	Williston City Depot	15410131DC	Sensus
26	Wurtz & Ames Parshall Depot	15209015CCCC	McCrometer
26	Wurtz & Ames Parshall Depot	15209015CCCC	McCrometer

APPENDIX C: North Dakota State Water Commission Pilot SOAP Service Specifications

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NDSWC SOAP Service Specifications

The North Dakota State Water Commission has developed the following SOAP service for purposes of reporting daily meter readings to comply with remote meter reporting requirements for specified water permits with telemetry projects.

This service is currently a draft specification and may be modified or refined prior to official implementation.

There are currently two components to the SOAP service that is being deployed. The first component consists of a discovery tool that will provide feedback to identify depot information (i.e. the meter locations, type, and Station ID numbers). This component of the service does not require any form of password as this information is considered as part of the public record. This service, which is described below, requires a single parameter (Depot ID). The second component of the service includes the utility to file the meter readings for each depot station. In order to post meter readings, the user will be required to obtain a correct username and password from the SWC.

The Web Service specifications can be accessed at http://devserver.swc.nd.gov:8082/4dwsdl

xml_Get_Depot_Information

Input Parameters

Parameter	Data Type	Description
DepotID	Integer	The Depot ID is the unique Record ID that identifies the Depot in the ND State Water Commission system. If you do not have this information you will need to contact the ND State Water Commission for this information.

Output Parameters

Model of the meter

Parameter	Data Type	Description
DepotName	Text	Official Name for the Water Depot
StationIDList	Array of Integer	Index number assigned to each station record
LocationList	Array of Text	Legal Description for each Station ID
LocationNameList	Array of Text	Name assigned to each pump station
MeterNameList	Array of Text	Name of the meter
ModelList	Array of Text	
SerialNoList	Array of Text	Serial number for the meter
UnitsList	Array of Text	Units in which the meter records
PrecisionList	Array of Text	Precision of the meter reading (i.e. 10,100,1000, etc)

xml_Post_Meter_Reading

Input Parameters

Parameter	Data Type	Description

APPENDIX C: North Dakota State Water Commission Pilot SOAP Service Specifications

StationID	Integer	Index number assigned to the station.
Username	Text	*
Password	Text	*
ReadingDate	Date	*
ReadingTime	Time	*
MeterReading	Text	*

* Contact the ND State Water Commission for user credentials.

Output Parameters

Parameter	Data Type	Description
Posted	Boolean	Returns True if meter reading was properly posted.
DatePosted	Date	Date Reading was posted
TimePosted	Time	Time Reading was posted
ReadingID	Integer	Record Index assigned to meter reading

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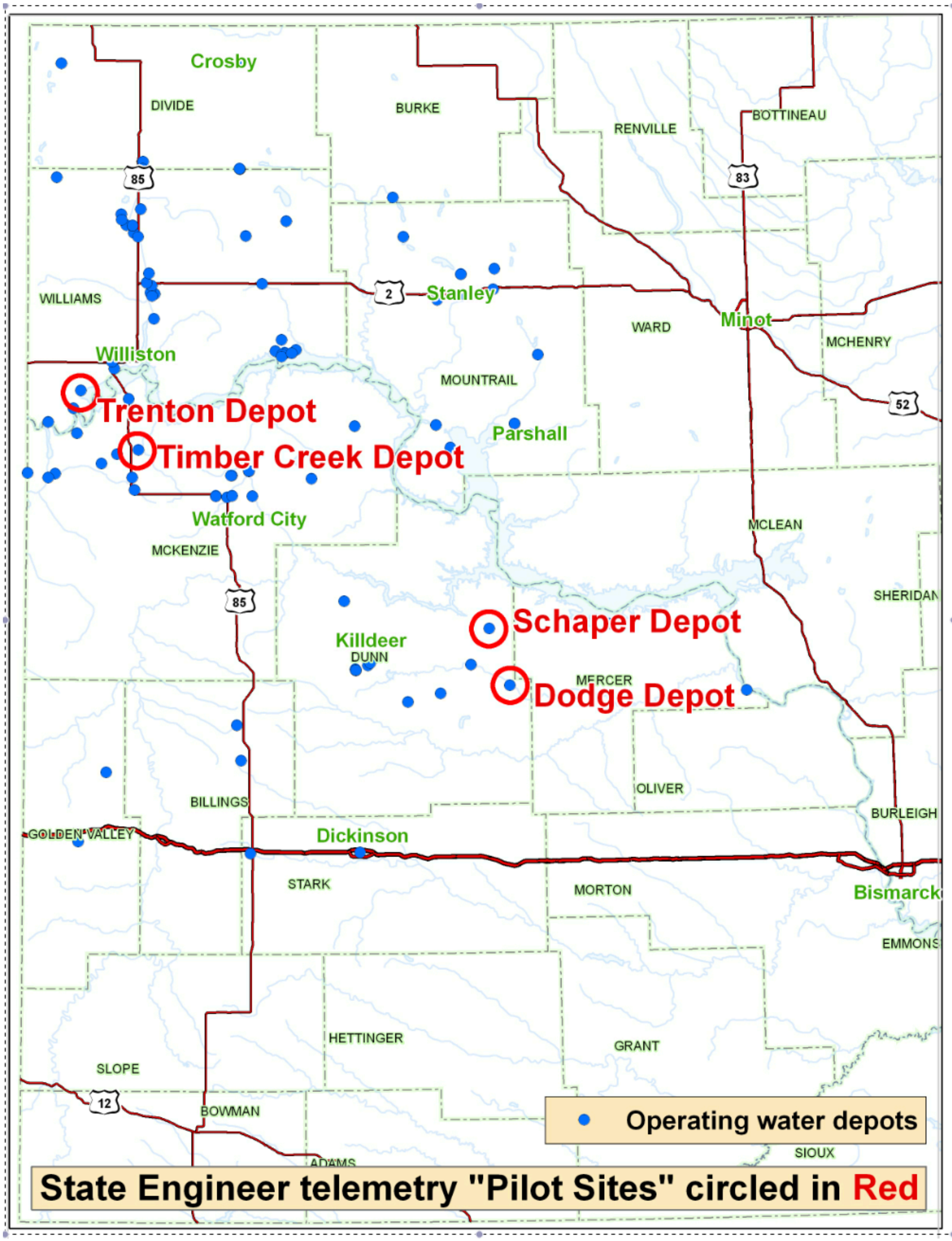
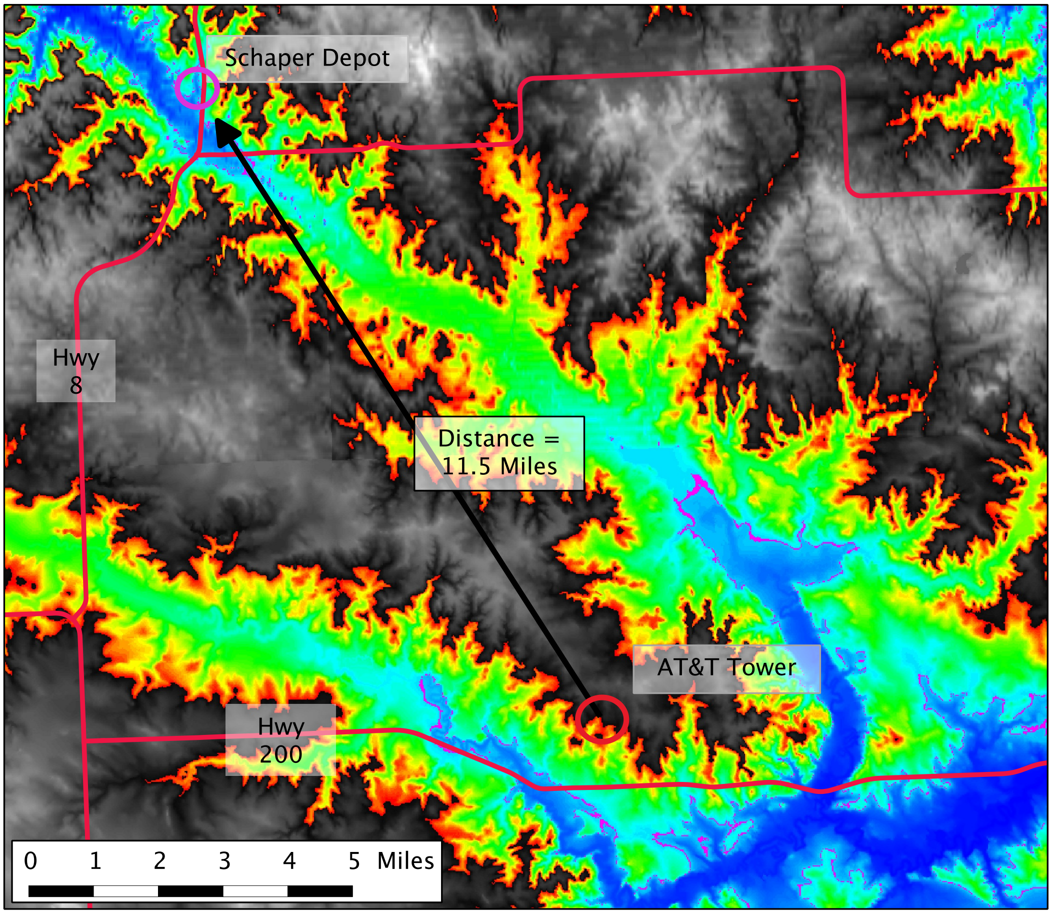
APPENDIX D: Map of Water Depots and Pilot Sites for the Telemetry Study

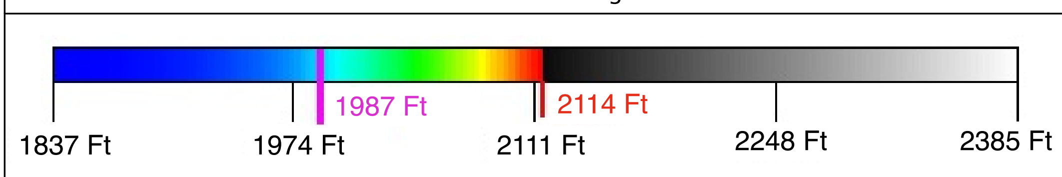


APPENDIX E: Example of Local Phone Transmission Interference With Telemetry in Western North Dakota

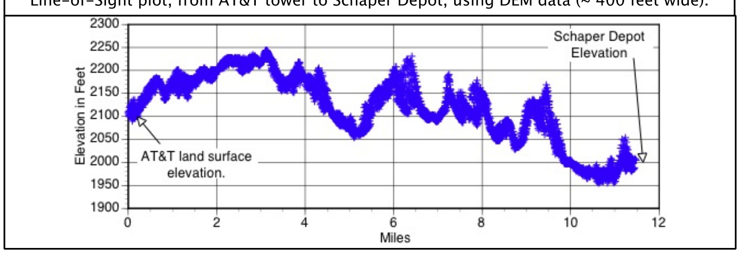
Digital Elevation Model (DEM) of the area between the Schaper Water Depot (where the HOBO logger was to be located) and the nearest AT&T cell phone tower.



DEM Elevation Legend

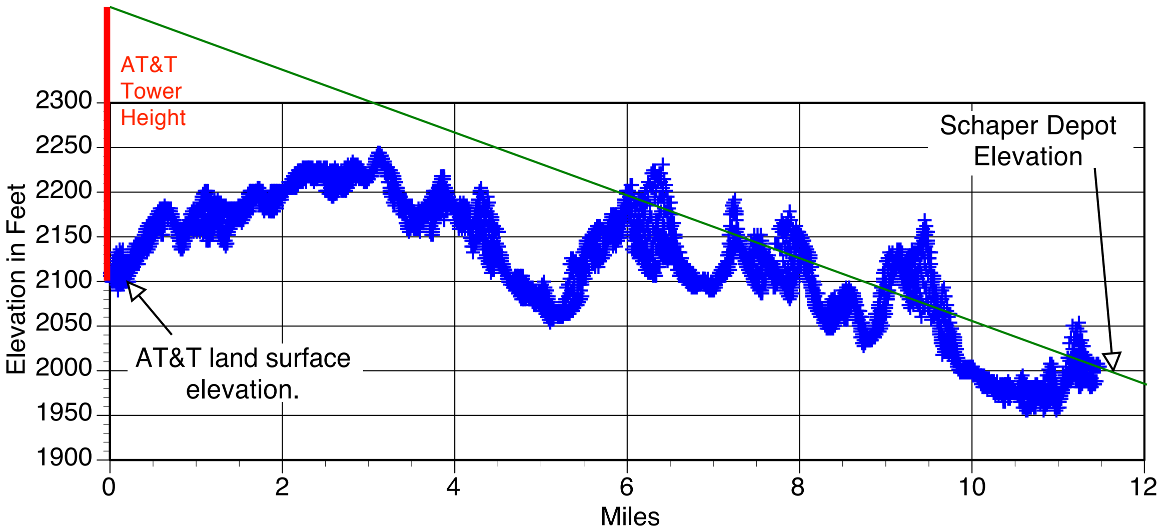


Line-of-Sight plot, from AT&T tower to Schaper Depot, using DEM data (~ 400 feet wide).



APPENDIX E: Example of Local Phone Transmission Interference With Telemetry in Western North Dakota

Line-of-Sight plot, from AT&T tower to Schaper Depot, using DEM data (~400 feet wide).



AT&T Communications Tower :
Tower is 290 Ft. high
(1.5 miles Northeast of Dodge)

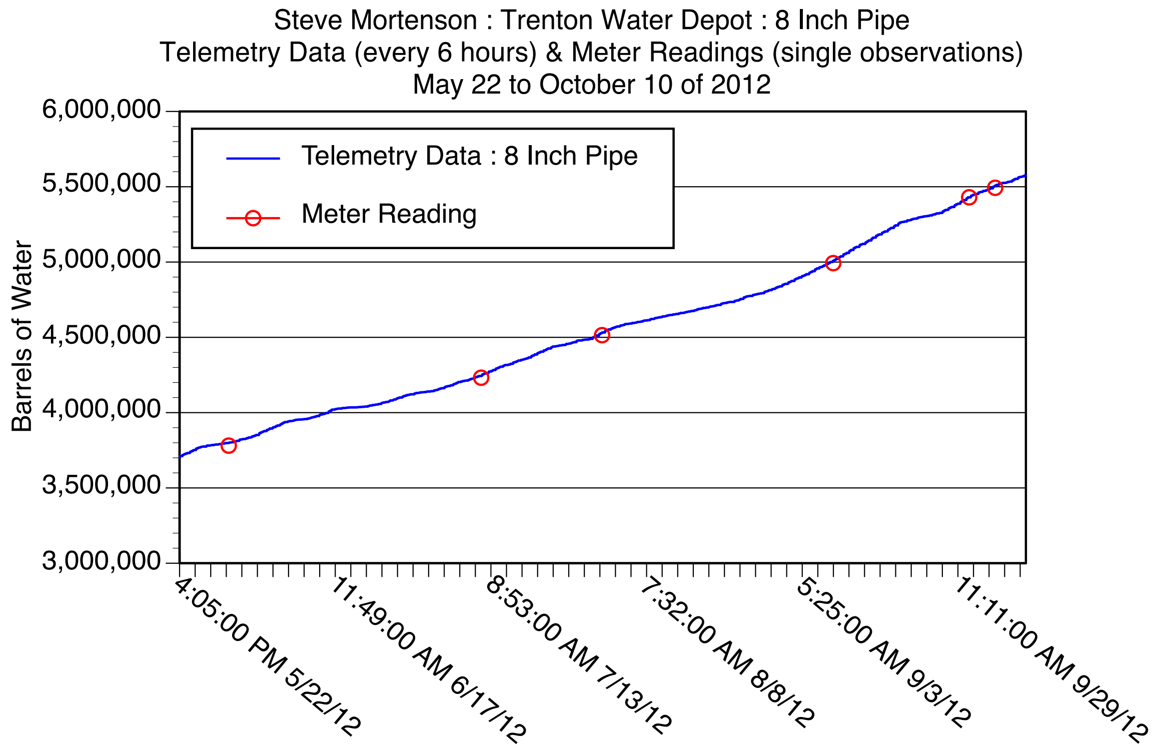
Tower height was confirmed to be 290 Ft. by AT&T representative Angela Alberino.

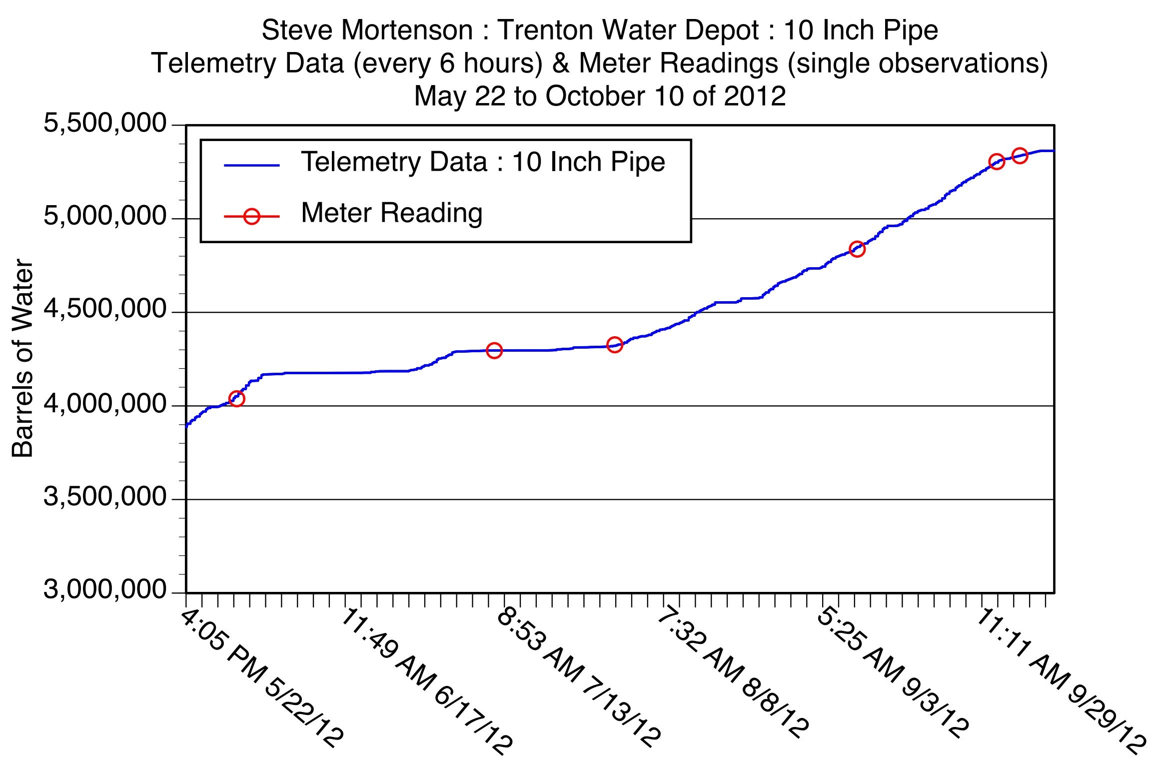
Latitude: 47° 18' 45.72"
Longitude: 102° 9' 50.40"

Angela Alberino
440.570.1516 Cell
angela.alberino@att.com

APPENDIX F: Comparison of Meter and Remote Transmission Data

The water use charts below, show the meter readings based on the telemetry data collected from the McCrometer Telemetry system and "on-site" meter readings from the Trenton Water Depot location of Twp153-Rng102-Sec.17.





APPENDIX F: Comparison of Meter and Remote Transmission Data

The water use charts below, show the meter readings based on the telemetry data collected from the McCrometer Telemetry system and "on-site" meter readings from the Timber Creek Depot location of Twp151-Rng101-Sec.09.