



City of New York

OFFICE OF THE COMPTROLLER

John C. Liu
COMPTROLLER



IT AUDIT

Tina Kim

Deputy Comptroller for Audit

Audit Report on the Reliability and
Accuracy of the Automated Meter
Reading Data Administered by the
Department of Environmental Protection

7A13-060

October 4, 2013

<http://comptroller.nyc.gov>



THE CITY OF NEW YORK
OFFICE OF THE COMPTROLLER
1 CENTRE STREET
NEW YORK, N.Y. 10007-2341

John C. Liu
COMPTROLLER

October 4, 2013

To the Residents of the City of New York:

My office has audited the Department of Environmental Protection (DEP) to determine whether the Automated Meter Reading (AMR) data transmission is accurate and secure. We audit entities such as DEP as a means of ensuring that systems and technological resources of City agencies are cost-effective, efficient and secure, and operate in the best interest of the public.

We found that AMR data transmission from the AMR device to the AMR database is accurate and secure. However, we found several water meter issues that could affect billing. We noted that the installation of the AMR, originally scheduled to be completed by September 2012, has not been completed. Approximately 33,463 water meters (about 4 percent) still do not have AMR installed and those customers are on estimated billing. In addition, 19,315 of the 33,463 had failed attempts to install AMR due to vacant property or large old meters incompatible with the AMR system. The remaining meters are AMR ready, but have not been installed. We also noted 17,094 of the 818,176 installed meters are currently on estimated billing due to reading issues or no communication with AMR.

Water meters tend to deteriorate with age; therefore, many older meters do not record water usage or submit inaccurate readings. As a result, incorrect information is being transmitted for billing. DEP has replaced most of the small meters that pre-dated 1998 due to incompatibility with AMR. However, the audit found that DEP does not have an aging report for meters to identify meters that are older and may need to be replaced, although its database has the elements available for such a report. Finally, the audit determined that DEP does not have a disaster recovery plan for the Data Collection Units in case of an unexpected event.

The results of the audit have been discussed with DEP officials, and their comments have been considered in preparing this report. Their complete written response is attached to this report.

If you have any questions concerning this report, please e-mail my audit bureau at audit@comptroller.nyc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "John C. Liu".

John C. Liu

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THE CITY OF NEW YORK OFFICE OF THE COMPTROLLER IT AUDIT

Audit Report on the Reliability and Accuracy of the Automated Meter Reading Data Administered by the Department of Environmental Protection

7A13-060

AUDIT REPORT IN BRIEF

The Department of Environmental Protection (DEP) protects the environmental health, welfare, and natural resources of the City. DEP manages the City's water supply, which provides more than one billion gallons of high quality drinking water daily to more than half the population of New York State, and maintains the City's water distribution network, fire hydrants, and storm and sanitary sewage collection systems. DEP also bills and collects on approximately 836,000 water and sewer accounts and manages citywide water conservation programs.

DEP contracted with Aclara Systems¹ from July 7, 2008, to July 12, 2013, to implement the Citywide Advanced Metering Infrastructure Program for the Automated Meter Readers (AMR) in the amount of \$68,327,500. Under the terms of its contract, Aclara Systems provides the design, installation, and modification of the Aclara software. In addition, the contract includes the purchase of AMR Meter Transmission Units (MTU) and Data Collection Units (DCU) equipment. DEP's mission for AMR installation was to eliminate estimated billing, improve billing accuracy, and provide customers with tools to manage their water usage online. The contract was extended to July 14, 2014.

Audit Findings and Conclusion

We found that the AMR data transmission from the AMR device to the AMR database is accurate and secure. However, we found several water meter issues that could affect billing.

We noted that the installation of the AMR, originally scheduled to be completed by September 2012, has not been completed. Approximately 33,463 water meters (about 4 percent) still do not have AMR installed and those customers are on estimated billing. In addition, 19,315 of the 33,463 had failed attempts to install AMR due to vacant property or large old meters incompatible with the AMR system. The remaining meters are AMR ready, but have not been installed. We also noted 17,094 of the 818,176 installed meters are currently on estimated billing due to reading issues or no communication with AMR.

¹ Aclara provides networking, data-value management, and customer communications to water, gas, and electric utilities globally. Over 500 utilities in nine countries rely on Aclara to connect with their customers.

Water meters tend to deteriorate with age; therefore, many older meters do not record water usage or submit inaccurate readings. As a result, incorrect information is being transmitted for billing. DEP has replaced most of the small meters that pre-dated 1998 due to incompatibility with AMR. However, the audit found that DEP does not have an aging report for meters to identify meters that are older and may need to be replaced, although its database has the elements available for such a report.

Finally, the audit determined that DEP does not have a disaster recovery plan for the DCUs in case of an unexpected event.

Audit Recommendations

This report makes a total of nine recommendations, including that DEP should:

- Create a standardized timeline for completion of the installation of AMR on all water meters.
- Ensure AMR issues are resolved in an adequate timeframe.
- Replace outdated water meters as soon as practical to enable AMR installation.
- Ensure that information for new meters and AMR installed are immediately entered and updated into DEP's database for billing.
- Develop an aging report to assist in making cost benefit decisions regarding replacement of older meters.
- Ensure DEP staff updates the status of RTS cases after work is performed.
- Ensure AMR cases are resolved in a reasonable timeframe.
- Develop a disaster recovery plan for DCUs.
- Immediately repair DCUs currently not functioning.

DEP Response

In their response, DEP officials agreed with the report's findings and recommendations and described the steps they have taken or will take to implement them.

INTRODUCTION

Background

The Department of Environmental Protection (DEP) protects the environmental health, welfare, and natural resources of the City. DEP manages the City's water supply, which provides more than one billion gallons of high quality drinking water daily to more than half the population of New York State; maintains the City's water distribution network, fire hydrants, and storm and sanitary sewage collection systems; and manages 14 in-City wastewater treatment plants as well as seven treatment plants upstate. DEP also bills and collects on approximately 836,000 water and sewer accounts and manages citywide water conservation programs.

DEP contracted with Aclara Systems from July 7, 2008, to July 12, 2013, to implement the Citywide Advanced Metering Infrastructure Program for the AMR in the amount of \$68,327,500. DEP extended the contract to July 14, 2014, with an increase in value to \$72,579,565. Under the terms of its contract, Aclara Systems provides the design, installation, and modification of the Aclara software. In addition, the contract includes the purchase of AMR, MTU, and DCU equipment. DEP's mission for AMR installation was to eliminate estimated billing, improve billing accuracy, and provide customers with tools to manage their water usage online. Prior to AMR, Con Edison was the primary meter reading resource at residential and commercial properties. AMR intended to eliminate the need for such manual reading by electronically transmitting water meter readings to DEP's database for water billing purposes.

In February 2009, DEP began installing AMR using contractors. DEP has various contracts² for the installation of AMR and replacement of small meters for AMR compatibility totaling \$105,424,652. In addition, DEP has ongoing contracts³ to repair and replace large and aged water meters. These contracts total over \$21 million for a two-year period citywide. The total cost of these various contracts is approximately \$195 million.

The AMR battery-powered MTUs are small, permanently sealed modules that are connected to water meters and are located at commercial and residential properties. MTUs read the meters and transmit the meter data⁴ via an encrypted radio transmission to the DCUs, which are located on rooftops or are pole-mounted. DCUs are intelligent network devices that receive, process, and store meter reading information transmitted from the MTUs. The DCUs are connected to the Department of Information Technology and Telecommunications' (DoITT) NYCWiN⁵ system. Using the NYCWiN system, the meter reading is transferred to the Network Operations Centers at DoITT facilities in Brooklyn and Manhattan and then to DEP's Aclara database four times a day. Thereafter, the software sends the reading to the Customer Information System (CIS) for billing. The software also sends the data to the My DEP Account.

The My DEP Account allows customers with AMR to view their water consumption in real time, view past billing and payment histories, and sign up for paperless billing. In addition, customers can request a leak notification by email. Leak notifications are sent when DEP records five consecutive days of above average water consumption (300 percent or more water

² The vendors for the contracts are Constructamax-Alafogiannis Plumbing JV, Kentrel Corporation, Corix Utilities, and Contract Callers Inc.

³ The vendors for the contracts are JES Plumbing and Heating Corporation, SAKS Plumbing & Heating Corporation, and Constructamax-Alafogiannis Plumbing JV.

⁴ Meter data includes the MTU ID number, any error messages, and the current MTU status.

⁵ NYCWiN provides mission-critical communications to the City's agencies, enables the secure transfer of critical information in real time, and allows City agencies to coordinate their mobile resources to better serve the City's residents, businesses, and visitors.

consumption). Customers who do not have a My DEP Account will receive a water leak notice by mail informing them that DEP tracks their water usage and has found a potential leak on their properties. In addition, DEP uses the Referral Tracking System (RTS) to keep track of all customer complaints, meter issues, and AMR-related problems.

Objectives

The objectives of this audit were to determine whether AMR data transmission is accurate and secure.

Scope and Methodology Statement

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. This audit was conducted in accordance with the audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The scope of this audit was from the inception of the AMR in 2009 to June 2013. Our fieldwork was conducted from August 2012 through June 2013. Please refer to the Detailed Scope and Methodology at the end of this report for the specific procedures and tests that were conducted.

Discussion of Audit Results

The matters covered in this report were discussed with DEP officials during and at the conclusion of this audit. A preliminary draft report was sent to DEP officials and was discussed at an exit conference held on August 22, 2013. On September 3, 2013, we submitted a draft report to DEP officials with a request for comments. We received a written response from DEP on September 17, 2013. In their response, DEP officials agreed with the report's findings and recommendations and described the steps they have taken or will take to implement them.

The full text of DEP's response is included as an addendum to this final report.

FINDINGS AND RECOMMENDATIONS

We found that AMR data transmission from the AMR device to the AMR database is accurate and secure. However, we found several water meter issues that could affect billing.

We noted that the installation of the AMR, originally scheduled to be completed by September 2012, has not been completed. Approximately 33,463 water meters (about 4 percent) still do not have AMR installed and those customers are on estimated billing. In addition, 19,315 of the 33,463 had failed attempts to install AMR due to vacant property or large old meters incompatible with the AMR system. The remaining meters are AMR ready, but have not been installed. We also noted 17,094 of the 818,176 installed meters are currently on estimated billing due to reading issues or no communication with AMR.

Water meters tend to deteriorate with age; therefore, many older meters do not record water usage or submit inaccurate readings. As a result, incorrect information is being transmitted for billing. DEP has replaced most of the small meters that pre-dated 1998 due to incompatibility with AMR. However, the audit found DEP does not have an aging report for meters to identify meters that are older and may need to be replaced, although its database has the elements available for such a report.

Finally, the audit determined that DEP does not have a disaster recovery plan for the DCUs in case of an unexpected event.

Meters Still on Estimated Billing

DEP's mission for AMR installation was to improve billing accuracy and prevent the need for estimated billing. Our review found that DEP still has AMRs to be installed due to the need for old water meters replacement or other issues and AMRs that have been installed and have reading issues.

DEP began installing AMR in 2009 and was scheduled to complete AMR installation by September 2012. However, DEP reported that it is behind schedule due to AMR incompatibility with the water meters. In September 2012, DEP provided us with a list of 9,419 large meters and 20,751 small meters, which need to be replaced. As of June 24, 2013, there are 33,463 meters (about 4 percent) that still need AMR installed (see Table I).

Table I
Citywide Total Meter Registers in
Customer Information System
as of June 24, 2013

Borough	Meter Registers in CIS	AMR Installed	AMR Not Installed
Manhattan	57,299	52,502	4,797
Bronx	88,861	84,870	3,991
Brooklyn	268,837	255,743	13,094
Queens	319,590	310,164	9,426
Staten Island	117,052	114,897	2,155
Total	851,639	818,176	33,463

According to DEP, there are several reasons for AMR not being installed including: 1) the meter is on vacant property; 2) the current meter is old and incompatible with the AMR system; 3) the customer actively refused AMR installation and/or meter replacement; or 4) severe plumbing problems prevented replacement of the meter and installation of AMR. Of the 33,463 meters that do not have AMR, 14,148 of these meters (less than 2 percent) are ready for AMR (see Table II). These meters are currently on estimated billing.

Table II
Citywide AMR Not Installed
as of June 24, 2013

Borough	AMR Not Installed		
	Meters with Failed Attempts (A)	Ready for AMR (B)	AMR not Installed (A+B)
Manhattan	3,254	1,543	4,797
Bronx	2,452	1,539	3,991
Brooklyn	7,712	5,382	13,094
Queens	5,080	4,346	9,426
Staten Island	817	1,338	2,155
Total	19,315	14,148	33,463

In addition, DEP performs daily diagnostic tests for invalid and non-numeric data. We analyzed and examined the June 24, 2013, weekly AMR summary reports provided by DEP and found that 17,094 meters have reading issues. The report showed there are 8,962 meters that have reading errors or irregular readings due to wire damage, incorrect programming, or vandalism. In addition, 7,462 meters citywide have had no communication with the AMR system for more than five days. Additionally, there are 670 meters that have AMR installed, but have other issues such as data not being uploaded into the AMR system, data entered incorrectly, or data erroneously deleted (see Table III).

Table III
Citywide AMR Completed with Issues
as of June 24, 2013

Borough	AMR Installed	Good Reads	Reading Errors	No Communication	Other Issues
Manhattan	52,502	49,274	1,304	1,786	138
Bronx	84,870	82,727	1,164	861	118
Brooklyn	255,743	249,818	3,784	1,923	218
Queens	310,164	305,228	2,252	2,516	168
Staten Island	114,897	114,035	458	376	28
Total	818,176	801,082	8,962	7,462	670

Other reasons that customers received estimated bills include readings that were: 1) consistently the same; 2) inconsistent with previous readings; or 3) declining over time rather than increasing (running backward). This can result in DEP customers being over-billed or under-billed.

Recommendations

DEP should:

1. Create a standardized timeline for completion of the installation of AMR on all water meters.

DEP Response: DEP agreed with this recommendation.

2. Ensure AMR issues are resolved in an adequate timeframe.

DEP Response: DEP agreed with this recommendation.

3. Replace outdated incompatible water meters as soon as practical to enable AMR installation.

DEP Response: DEP agreed with this recommendation.

Discrepancies in Meter Information on CIS

From June 11, 2013, to June 13, 2013, with DEP inspectors, we observed readings from water meters and AMR on 38 commercial properties throughout the five boroughs. We found that for those commercial meters that are transmitting data (26 out of 38), data is being accurately read from the meter to the AMR and then to DEP's database. The remaining meters reviewed were new. Although AMRs have been installed, information for these meters still needed to be uploaded to the database in order for the information to be reflected in CIS and My DEP Account and for customer billings to be processed. However, because the information was not uploaded, these meters were still relying on estimated billing.

Recommendation

4. Ensure new meters with AMRs installed are entered and updated into DEP's database for billing.

DEP Response: DEP agreed with this recommendation.

Other Issues

Aging of Meters

Water meters tend to deteriorate with age, resulting in inaccurate readings. Often, old meters are damaged or do not record water use at all. Aged meters can decay and lose their recording capabilities. DEP officials informed us that aged meters may have inaccurate readings and can under-register water usage thereby causing inaccurate bills. DEP replaced most of the small meters that pre-dated 1998 due to the incompatibility of these meters with the AMR system. However, it did not replace older larger meters.

DEP has meter information that includes meter model, meter readings, and date of installation. However, it has not created an aging report that could be used to assist in making decisions related to replacement of its water meters (e.g., cost of under registered water usage versus cost to replace meters).

Recommendation

DEP should:

5. Develop an aging report to assist in making cost-benefit decisions regarding replacement of older meters.

DEP Response: DEP agreed with this recommendation.

Referral Tracking System Case Status Not Updated

DEP uses the Referral Tracking System (RTS) to keep track of all customer complaints and issues that may need fieldwork inspections. DEP provided us with a list of AMR-related cases on RTS. We identified 112 open cases as shown in Table IV.

Table IV
Referral Tracking System
Open Cases

Year	Number of Cases with Open Status in RTS	Number of Cases Actually Open	Number of Cases Actually Closed
2008	1	0	1
2009	1	1	0
2010	11	0	11
2011	74	14	60
2012	25	12	13
Total	112	27	85

The report indicated 112 open cases, ranging from June 2008 to November 2012, that have not been resolved according to RTS. Upon further analysis of these 112 RTS cases, DEP found that there are only actually 27 cases still open while 85 cases are closed. Moreover, DEP informed us that DEP staff are supposed to monitor RTS cases, but are not updating the status of these cases in RTS when a task is completed. We found an instance of a case indicated as open in RTS since 2008. DEP officials informed us that cases are occasionally entered in error and the AMR system did not begin until 2009.

DEP officials also indicated that there are 131 inspectors. When a DEP supervisor assigns a case, there is a 30-day turnaround time for an assignment. However, we found that there are cases that have been open since 2009 and are not being resolved in a reasonable timeframe.

Recommendations

DEP should:

6. Ensure DEP staff updates the status of RTS cases after work is performed.

DEP Response: DEP agreed with this recommendation.

7. Ensure AMR cases are resolved in a reasonable timeframe.

DEP Response: DEP agreed with this recommendation.

No Disaster Recovery Plan for Data Collection Units

DoITT is responsible for the disaster recovery plan for the AMR project. However, DCUs are not included in the plan. DEP informed us that it is investigating the cost-effectiveness of power circuits for the DCUs when they are not functioning.

Currently, DCUs have battery backup that maintains operation only for several days after the loss of site power. Without an adequate disaster recovery plan for DCUs, DEP is only resolving DCU issues after the problem arises. Due to non-functioning DCUs, water meter readings are not being transmitted to DEP and are reported with a “No Communication” status. As a result, customers may continue to be on estimated billing for an extended period of time.

Recommendations

DEP should:

8. Develop a disaster recovery plan for DCUs.

DEP Response: DEP generally agreed with the recommendation, stating “DEP agrees with recommendations 7 and 8 in principle but notes that the system’s design with overlapping DCU coverage areas is inherently resilient and the term ‘disaster recovery’ may be inappropriate in that context.”

Auditor Comment: DEP officials informed us that it only resolves DCUs with problems. DCUs only have battery backup that can last for several days, as was the case during Tropical Storm Sandy when battery backup did not last. Therefore, meter information was not transmitted to DEP. As a result, customers were charged using estimated billing for an extended period of time.

9. Immediately repair DCUs currently not functioning.

DEP Response: DEP agreed with this recommendation.

DETAILED SCOPE AND METHODOLOGY

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. This audit was conducted in accordance with the audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The scope of this audit was from the inception of the AMR in 2009 to June 2013. Our fieldwork was conducted from August 2012 through June 2013. To achieve our audit objectives, we:

- Interviewed various DEP officials including those from the Office of Information Technology (OIT);
- Conducted system walk-throughs of DEP's Referral Tracking System and its browser application (BAPPS), which includes AMR STAR, DEP STAR, My DEP Account, and CIS, to gain an understanding of the administration of the AMR data;
- Reviewed the *New York City Water Board Water and Wastewater Rate Schedule* (effective July 1, 2012) to gain an understanding of the regulations governing DEP regarding water and sewer billing;
- Reviewed samples of AMR repair letters to determine how customers are informed to make an appointment for DEP to install or make repairs on AMR equipment;
- Reviewed samples of water leak notices to determine how DEP informs customers of potential leaks on their property;
- Reviewed and analyzed weekly AMR Summaries to determine the total number of meter registers in CIS, number of AMR installed, number of AMR that need to be installed, and a breakdown of the number of AMR with valid or invalid readings;
- Reviewed and analyzed a list of RTS cases to determine open and closed AMR-related issues;
- Reviewed and analyzed the report *Plugging the Leaks Over Billing and the City's Automated Water Meters* to determine the various complaints made by DEP customers.

To determine whether the AMR data is reliable and accurate for the purpose of billing and collections, we asked DEP to provide a list of all AMR accounts. On December 31, 2012, we received AMR data that contained accounts, meters, and water meter reading information. The file contained 905,716 records for 758,906 accounts. To determine the accuracy of the AMR data and satisfy our audit objectives, we:

- Performed tests to ascertain whether critical data elements needed for billing and collection purposes were missing-- these included account, service address, read date, and meter reading;
- Tested for blank, invalid, or inappropriate dates or data;
- Reviewed the system functional design and system architecture plan to ensure that the systems function as intended and according to system specifications;

- Reviewed the system integration, documentation, and disaster recovery procedures to determine whether DEP has internal controls in place and AMR data is secure;
- Reviewed the process controls of the readings from the meter to AMR to Aclara software to CIS billing system to determine whether DEP has input controls to ensure data integrity;
- Reviewed the detailed billing and payment transactions to determine whether the meter readings are recorded correctly in the My DEP Account and CIS;
- Tested for duplicate meters to ensure that more than one account did not have the same meter number;
- Ran queries for all meters that are AMR ready to determine if any meters have a rounding issue for billing;
- Performed tests on all AMR meters that have a status of inactive or turned off to determine the reason accounts have been placed on inactive status;
- Ran queries for meters with a reading of zero indicating no consumption to determine the reason those meters had no consumption;
- Randomly selected 50 regular water meters and 50 Neptune water meters from the AMR data file to determine if meter readings were accurate in CIS and My DEP Account. We then determined whether there was a significant increase in water consumption since the last billing cycle;
- Reviewed and examined the data accuracy file to determine how DEP verifies that the correct meter was installed or the meter needs to be replaced due to age;
- Reviewed a list of meters that need AMR replacement or assessment to determine the meters that have AMR installed but have reading issues. We also determined the number of meters that were installed prior to 1998 and may need to be replaced due to age;
- Reviewed a list of meters that do not have AMR to identify the meters that still do not have AMR installed; and determined the reasons;
- Obtained and reviewed 38 meter readings from commercial properties that were transmitted from the meter to the AMR to DEP's My DEP Account to determine whether DEP accurately collects meter readings from meters to AMR and then to DEP's database.



September 17, 2013

Carter H. Strickland, Jr.
Commissioner

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Tina Kim
Deputy Comptroller
One Centre Street, Room 1100
New York, NY 10007

Re: Audit Report on the Reliability and Accuracy of the Automated Meter
Reading Data Administered by the Department of Environmental Protection

Dear Deputy Comptroller Kim:

Thank you for your letter dated September 3, 2013 regarding the above-mentioned draft report.

Attached is a copy of our formal response. Please contact John Lento at (718) 595-3424 if you have any questions.

Very truly yours,

A handwritten signature in blue ink, appearing to read 'Carter H. Strickland, Jr.'.

Carter H. Strickland, Jr.

c: Steven Lawitts, Chief Financial Officer
Joseph Singleton, Deputy Commissioner
Jin Chang, Assistant Commissioner

AMR Audit: DEP's Response to the Comptroller's Recommendations

- 1. DEP should create a standardized timeline for completion of the installation of AMR on all water meters.**
- 3. DEP should replace outdated incompatible water meters as soon as practical to enable AMR installation.**

DEP met its goal of substantially completing the AMR system in March 2012. DEP agrees with recommendations 1 and 3 in principle and will make every reasonable effort to install the remaining devices. However, the remaining 5% fall into a number of categories that prevent us from creating a formal timeline:

- a. Vacant buildings cannot be served until they are renovated and new water meters are installed.
 - b. Buildings where DEP cannot gain access to replace the water meter and/or install the AMR device depend on the customer's responsiveness to the Denial of Access process.
 - c. Replacement of large (over 3") pre-1990 vintage meters serving city properties will be subject to a cost/benefit analysis before a decision is made to replace the meter and install AMR (there are approximately 2,571 such pre-1990 meters on city buildings or about 10% of the meters that lack AMR)
 - d. Properties with preexisting plumbing conditions or unsafe working conditions that must be remediated
- 2. DEP should ensure AMR issues are resolved in an adequate time frame.**
 - 7. DEP should ensure that AMR issues are resolved in a reasonable time frame.**

These recommendations apply to the 2% of meter registers in the system that at any given time either require repair or are experiencing an interruption in individual transmissions for some other reason. DEP agrees with recommendations 2 and 7 in principle and agrees to make all best efforts to address AMR issues that interfere with billing within 90 days of notification by either DEP or the customer.

- 4. DEP should ensure new meters with AMRs installed are entered and updated into DEP's database for billing.**

DEP agrees with recommendation 4 and will continue to do this as remaining meters are installed with AMR.

5. DEP should develop an aging report to assist in making cost benefit decisions regarding replacement of older meters.

DEP agrees with recommendation 5 in principle and is developing the recommended mechanism to generate a periodic report. In 2012 DEP began the OpX (Operational Excellence) project with the assistance of Veolia Water North America. One portion of that effort included the development of a set of models and procedures for prioritizing large meter replacements.

While DEP did not have a standard “aging report” for meter replacements, DEP has been replacing large meters based on objective criteria for the last decade. Meter replacement contracts completed over the 2004 to 2007 period were based on a CIS extract of meters 2” and larger with installation dates before 1995. Approximately 1,000 large meters were replaced through those contracts. This method was also used for contracts completed from 2007 to 2011, when DEP replaced 3,900 meters 2” and larger.

Although a standard “aging report” is not available in CIS, DEP has generated customized reports based on age, technology type, and size to select the population of meters for the upcoming contracts.

With the development of the OpX process in mid-2012 and the beginning of meter replacements at the end of 2012, DEP advanced this practice further through several complementary efforts:

- a. The iterative development of a model based on observed per-unit consumption rates, meter size, building type and meter age to narrow likely meter replacement prospects;
- b. Large-scale accuracy testing of removed meters at DEP’s new Meter Test Facility to provide support for the model’s predictions of which meters are likely to be under-registering; and
- c. Ground-testing the model and tests by using consumption from several dozen buildings using data logging technology to better understand how much water is consumed at different flow rates throughout the day, which in turn is used to match meter technologies to building types.

Between late 2012 and early September 2013, DEP replaced 5,700 meters 2” and larger based on the new OpX methodology.

6. DEP should ensure that DEP staff updates the status of RTS cases after work is performed.

DEP agrees with this recommendation and has already instructed appropriate staff to implement procedures to prevent this oversight in the future.

8. DEP should develop a disaster recovery plan for DCUs.

9. DEP should immediately repair DCUs not currently functioning.

DEP agrees with recommendations 7 and 8 in principle but notes that the system's design with overlapping DCU coverage areas is inherently resilient and the term "disaster recovery" may be inappropriate in that context.

DEP has already taken the following actions to repair unavailable DCUs and to allow expedited repair of DCUs that are removed from service in the future:

- a. Purchased twenty spare DCUs;
- b. Purchased spare parts (traffic control computers, antennas); and
- c. Requested updating of the MOU with DoITT to speed DCU repairs by DoITT's NYCWiN Contractor.