SUEZ Water New York

2016 Year-End Non-Revenue Water Report & Non-Revenue Water Reduction Plan

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PART I: PROGRAM OVERVIEW & CRITICAL ACTIVITIES

NRW is an important issue to SUEZ Water New York (SWNY) and the communities it serves. SWNY is taking this issue seriously and is expending significant resources to realize a reduction in NRW. This Non-Revenue Water (NRW) update is a continuation of the strategy set forth in the Company's prior annual NRW report and reduction plan filings.

The ultimate goal of any sustainable and responsible NRW plan is to drive the water loss percentage to the economic level. In the medium to long term, NRW levels in the 15%-18% range will be the goal to drive towards in the SWNY service area given the geographical topography, system age and composition, and the diminishing returns seen as NRW levels approach the economic level of loss. This NRW strategy will be viewed as a long-term strategy, which will continue until an economic level of water loss is reached. Water production and consumption data are constantly monitored to drive NRW to the economic level of leakage. This practice will continue once the economic level is reached, to ensure that the level is maintained. Therefore, the most important task in reducing NRW is to establish the infrastructure, procedures, and policies, in order to accurately understand the impact of water loss indicators.

As referenced in the Company's prior annual Non-Revenue Water Report and Reduction Plan filings, SWNY has established an ongoing program to improve system efficiency, reduce the cost of service through water loss reduction, and ensure sustainability of critical water supplies. The current Non-Revenue Water program focuses on developing and utilizing critical system operating data to profile the nature of water losses occurring throughout the system in greater detail, allowing for effective actions and controls to be implemented according to the specific needs that are identified (detailed in *Part II: Ongoing NRW Reduction & Sustainability Strategy*).

Numerous actions have been taken to improve the way the Company collects and validates system operating data, refine the methodologies and processes used to characterize water losses, and develop actions to resolve water loss occurrences accordingly:

1. The Company has implemented monthly meter reading and billing cycles to better correlate system consumption and production data, and improve the accuracy of mass balance and water audit calculations. 2015 was the first full year of monthly billing data, and will be used as a reference for 2016 monthly consumption patterns.

2. A *Strategic Metering Initiative* was implemented to ensure that accurate consumption data was being collected for the Company's 140 largest customer meters, accounting for approximately 20 percent of total customer usage. The reporting accuracy of compound meter bodies at or near their reasonable useful life was found to be impacted by wear and damage that had occurred over the in-service life of the meter bodies. As part of the initiative, policies and procedures for annual monitoring, testing, and replacement (where needed) of all large customer meters were improved.

3. Construction of Phase-1 of a system-wide District Metered Area (DMA) system was completed, including installation of 18 metering sites which established 8 sectorized DMA zones. These sectorized production zones typically have between 3,000 and 5,000 customer connections. Data anomalies are more readily apparent in these smaller zones which allows the Company to allocate leak detection and other resources based on the specific needs of each district.

4. Engineering Design for an Advanced Metering Infrastructure (AMI) system was completed, and installation of approximately 25% of meter RF transmitters and associated fixed collector networks were completed. The AMI system will provide high-resolution consumption information, as well as identify customer consumption patterns which deviate from typical conditions, possibly indicating tampered, removed, or malfunctioning meters.

5. Preliminary Engineering Design for Phase-1 of a system-wide pressure reduction initiative was completed. Reducing system operating pressures will assist in managing the economic level of losses, reduce main-break severity, and promote conservation through reduced flow rates at non-volumetric fixtures. Additional analysis on the expected impact on main break frequency is ongoing.

6. All customer metering points were assigned a DMA/Pressure Zone identifier to allocate metered consumption to specific zones within the system. Previously, all metered customer accounts were geocoded and mapped within the Geographic Information System (GIS), and all service points were reconciled with their corresponding record within the Customer Information System (CIS) to ensure consistency with customer metering records.

7. Production meter maintenance, testing, and repair/replacement practices and associated standards have been improved for non-source-of-supply production meters (pumping stations, PRV sites, etc.) to ensure that accurate production data is available for all Pressure Zones and DMA Zones. Source-of-supply production meters continue to be tested and maintained according to regulatory policy and requirements.

Additionally, specific process and best practice improvements have been made to strengthen core operational activities associated with water loss control, and ensure sustainability of the Non-Revenue Water Reduction initiatives:

1. Leak and main-break Find-to-Fix times, or the time between when the Company becomes aware of a leak and when it is repaired were minimized by repair policies prioritized by leak magnitude and resulting system impacts. The Company repairs most leaks within hours of discovery and will continue this practice. Dedicated leak correlation personnel have been assigned and trained on the various equipment and methods used under best-practice techniques.

2. A strategic production data/trend monitoring policy has been implemented at the management level to minimize leak and main-break awareness times, or the time between when a leak develops and when the Company becomes aware of the leak. Some leaks that develop remain as non-surfacing leaks for a period of time before they are discovered by conventional means. This desktop analysis will improve efficiency by narrowing down the area where new leakage has likely developed. This policy has been expanded to include front-line operators and supervisors in the Production Department.

3. New Business processes, policies, and procedures have been evaluated and improved to ensure proper tracking and handling of all new service requests, and proper sizing and configuration of new customer meters.

4. The Company is working to better characterize the nature of A*voidable Real Loss* occurring within the system, and identify any patterns, trends, or correlations which could help steer future leak detection surveys and associated activities, as well as identify any potential operational adjustments which could help mitigate the main-break frequency rate and severity.

5. A custom-developed Meter Data Management (MDM) program was implemented in conjunction with the AMI system, to assist with identifying customer usage patterns which could be indicative of theft or tampering.

6. The Company's continued optimization of reporting functions within its billing system has brought tighter controls on items such as estimated bills and zero read meters. The recent transition to monthly billing has further optimized use of these controls.

PART II: ON-GOING NRW REDUCTION & SUSTAINABILITY STRATEGY

The overall strategy of the Non-Revenue Water reduction program for SUEZ Water New York is to continue to monitor and characterize the nature of water loss occurring in the system within geographical or district-based regions. This information will be used to improve water-loss profiles and audit reports for various sectors of the distribution system, allowing for efficient and effective actions to be targeted according to the specific needs of each sector. Sustainability policies and procedures will be followed to ensure efficient system operation and minimize water loss.

At the current time, it is difficult to define achievable targets regarding the economic level of water loss for the SWNY system. Improved data resolution on both the production and consumption side would be needed to perform an economic level of water loss evaluation with reasonable accuracy. The completed DMA and AMI systems will provide data needed for a proper economic level of loss study. Once the individual components of NRW have been completely established and profiled for the SWNY system, the optimal efficiency point of the system will become better understood.

In general, the individual components of water loss consist of real and apparent losses, and can be further broken down as follows:

Apparent Losses – Consist of unauthorized consumption (theft & illegal use), as well as inaccuracies associated with production and billing metering.

- Production meter inaccuracies
  - Includes source of supply & purchased water interconnections.
- Customer billing meter inaccuracies
  - Losses caused by inaccuracies associated with aged or stopped billing meters.
  - Losses caused by improperly sized billing meters.
- Unauthorized or non-compliant service connections
  - Increased risk due to customer billing meters located within private property.
- Theft and unauthorized use from fire hydrants
- Tampered billing meters or reading equipment
  - Increased risk due to customer billing meters located within private property.
- Data handling errors within the meter or billing systems

Real Losses – Consist of physical water losses from the system up to the point of customer consumption.

- Un-avoidable Annual Real Losses (UARL), including normal background leakage
  - IWA methodology used to calculate the minimum achievable level of real losses.
- Potentially recoverable Real Losses (burst, joint, or outside service leakage)
  - Could exist as Surfacing or Non-Surfacing
- Storage facility overflows
- Un-metered customer service line leaks (inside service leaks)
  - Leakage on non-company owned infrastructure which contribute to non-revenue producing water losses.

Furthermore, certain authorized un-billed consumption also contributes to the volume of non-revenue producing water:

1. Water used for Company internal purposes such as:
   - Hydrant flow tests & hydrant maintenance
   - Chlorination of water mains
   - Distribution system flushing & maintenance
   - Operational use at sources of supply
   - Instrumentation use at system facilities

2. Water used by external authorities such as:
    - Fire Department activity including training/drilling
    - Water used by Municipalities for street-sweeping or maintenance activities.

Authorized un-billed consumption is currently considered lost water, and is included in the overall NRW percentage. Fire department use is currently considered unmetered authorized usage, and Company internal use is also considered to be non-revenue water. These activities represent regulatory requirements, and are not under the direct control of SUEZ Water New York. As a result, these lost volumes of water are unavoidable, and can be better reflected by removing this usage from the calculation of the NRW percentage. Please reference the New York Uniform System of Accounts instructions under *§ 566.3* and the requirements of account 927, copied below, which describe accounting for such usage.

§ 566.3 - Water or steam used by the utility

A. If the utility desires to charge the appropriate accounts in any of its water operations with the cost of water or steam used from its own supply, the credit therefore shall not be made to operating revenue accounts, but to account 929, Duplicate Charges--Credit.

B. Water supplied by the utility from its own supply to other departments shall be accounted for in the following manner: If the water is supplied under a definite arrangement whereby the actual costs are allocated between or among the departments using the water, the credit in the accounts of the water department shall be made to the appropriate operations or maintenance account or accounts, except that the amount of any return or interest, and the amount of depreciation and taxes charged against the other departments shall be credited to account 473, Interdepartmental Rents. If the charges are at tariff or other specified rates for the water supplied, then the entire amount charged shall be credited to account 467, Interdepartmental Sales.

§ 567 section 927- Franchise Requirements

A. This account shall include payments to municipal or other governmental authorities, and the cost of materials, supplies and services furnished such authorities without reimbursement in compliance with franchise, ordinance, or similar requirements; provided, however, that the utility may charge to this account at regular tariff rates, instead of cost, utility service furnished without charge under provisions of franchises. (See also account 302, Franchises and Consents.)

B. When no direct outlay is involved, concurrent credit for such charges shall be to account 929, Duplicate Charges-Credit.

Treatment of these un-billed usages in this manner enables the utility to account for miscellaneous authorized use without undue penalties associated with lost or unaccounted for water volumes.

Smart Network Initiatives & Efficiency Improvement Projects

In order to better understand the extent to which the various water loss components exist within the SWNY system, a process was developed to measure the individual components of water loss, beginning with the equipment and facilities necessary to collect information regarding current system operation and the corresponding systems to organize and evaluate the information. This information will be used to better allocate resources for actions and interventions aimed at maximizing system efficiency, and implement policies and procedures for best practices and sustainability. The process can generally be broken down into the following components:

1) Information Generation

   Includes facility design, equipment implementation, and system operational changes needed to divide the distribution system into sectorized production zones, and generate and record high resolution operating and customer usage information.

2) Information Handling & Management

   Includes data collection, validation, and management procedures needed to organize, store, and report on system operating and usage information.

3) Data Processing & Evaluation

   Use system operating and customer usage information to measure and characterize the nature of water loss occurring in each DMA/Pressure Zone, and develop reduction strategies accordingly.

   FIGURE 1 illustrates a sample Water Loss Profile for a given water system.

4) Actions & Interventions

   Execute the proper corrective actions needed to reduce water loss and maximize system efficiency, based on the specific strategies developed for each sector of the system. Typical actions include targeted leak detection and repair, and customer meter installation, replacement, or verification.

5) Sustainability

   Develop policies, procedures, and best practices necessary to prevent recurrence of excessive water loss, and maintain system efficiency. Newly implemented DMA and AMI systems, along with monthly billing procedures will be used to monitor system performance on a continual basis, and generate alarms to notify operators of possible anomalies or events within the system.

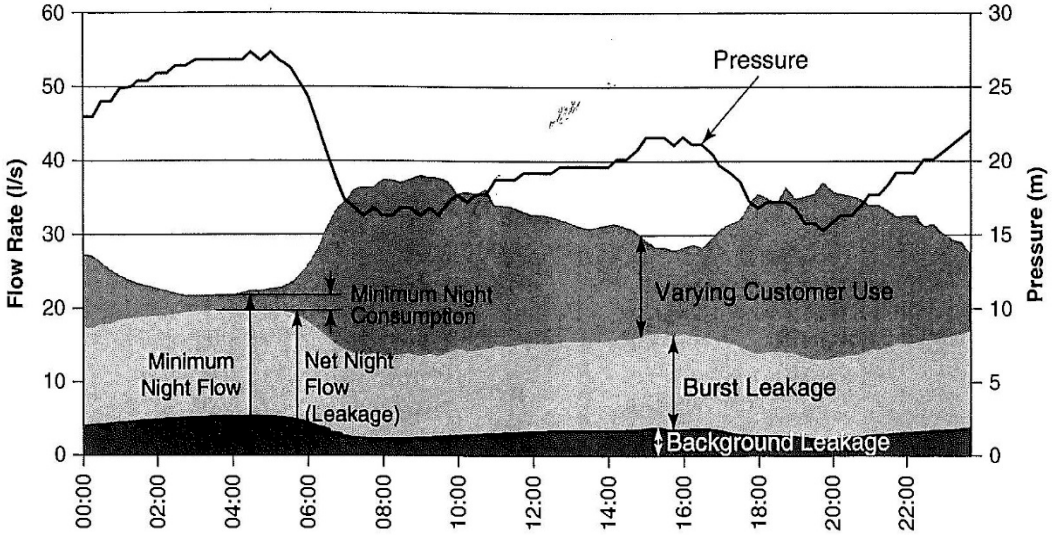


FIGURE 1 – Example Water Loss Profile

Critical activities associated with improving the collection and evaluation of system operating information have been identified, evaluated, and finalized within the Company's January 2017 Rate Order. These activities are needed to better align and monitor system efficiency indicators to further improve the performance of the system, and are discussed in greater detail below.

SWNY is currently in the construction phase of a system-wide Sub-District Metering (DMA) program, which will reduce the current largest metered zones (PD-10/20/95/40/33) into smaller, more manageably sized sub-districts. Sub-District Metering is a proven effective way to reduce the awareness time of non-surfacing leakage, and minimize potentially recoverable real losses associated with leaks. The DMA system will also reduce the leak investigation area and enable the operations team to quickly and efficiently identify, locate, and resolve water loss events and other operational anomalies which may occur throughout the system. It will enable the Company to continuously monitor system performance and efficiency in smaller zones, and deploy field crews in the most effective manner based on the specific needs of each DMA zone. The solution will also improve the accuracy of water loss audits within the zones, assist with planning functions, and better match production information to customer usage with higher resolution and accuracy.

The table below summarizes the breakdown of DMA meters for each of the major Pressure Districts that are being addressed. All other Pressure Zones within the system already contain less than 3,000 service connections and can be considered to be DMA equivalents at the current time.

Pressure District	Total No. of Connections in Pressure District	Proposed No. of DMA Zones	Average No. Services per DMA Zone	No. of DMA Metering Sites Required [2]
PD10 [1]	29,451	8	3,681	23
PD95	11,644	5	2,328	7
PD20	15,659	7	2,237	18
PD40	6,226	2	3,113	4
PD33	2,630	2	1,315	1
			TOTAL:	**53**

Note 1: Not including the 5 DMA Meters already installed in PD10. These meters bisected PD-10 into Northern & Southern Zones

Note 2: Total number of required metering sites could potentially be reduced by utilizing boundary valves where practical. This requires coordination with water quality and fire flow requirements.

SWNY is also in the installation phase of a system-wide Advanced Metering Infrastructure (AMI) program, which will improve the frequency, resolution, and accuracy of customer consumption information, as well as reduce the level of effort needed to accomplish routine meter-reading and billing activities. The system will utilize a network of fixed-collectors (located throughout the service territory) to continuously collect data transmissions from customer billing meters, and compute the associated consumption in near-real-time.

This near real-time consumption information can be aligned with corresponding production information within each DMA zone to reveal the precise magnitude and nature of any water losses occurring within each zone. The system will also enable the Company to monitor usage patterns and metering accuracy for large consumers, as well as identify and prevent theft of service and illegal meter tampering. This high-resolution consumption data will also be used in conjunction with the *Strategic Meter Testing Policy* for large customers to ensure proper meter sizing and metering accuracy associated with those accounts.

While the DMA program is specifically intended to identify and resolve *Avoidable Real Losses*, other measures must be taken to maximize the economically recoverable level of loss, including system background leakage which cannot be reasonably detected or repaired by conventional means. The Company intends to reduce these losses to economic levels with pressure reduction in conjunction with targeted infrastructure replacement for under-performing assets.

Pressure reduction opportunities throughout the system have been evaluated in conjunction with the Sub-District Metering (DMA) initiative. The primary goals of the pressure reduction initiative are as follows:

- Reduce the economic level of real losses to the unavoidable level, by addressing system background leakage which cannot be reasonably detected or repaired by conventional means. Research has shown that the quantity of water lost through leakage (including background leakage) is proportional to the operating pressure of the system.

- Reduce main-break severity, and promote asset longevity by reducing the overall stress on system infrastructure and minimizing surge & thrust intensity.

- Promote conservation through reduced flow rates at non-volumetric fixtures. Consumption in free-flow uses can be reduced without requiring changes in water use habits by customers. SWNY's Non-Revenue Water and Water Loss Control efforts are intended to work collectively with our Conservation Strategy.

Dynamic Pressure Management practices have been examined (PRV settings modulate according to flow rate) to retain maximum system capacity and avoid impacts on available fire flow as a result of pressure reduction. Dynamic Pressure Management would allow for the maximum possible reduction in pressure across all operating conditions. In general, pressures throughout the system will be reduced as much as possible while maintaining regulatory service requirements, and avoiding impacts to critical customers, system facilities such as tanks or sources of supply, or available fire flow. A diagram illustrating the components of real-loss management is provided below.

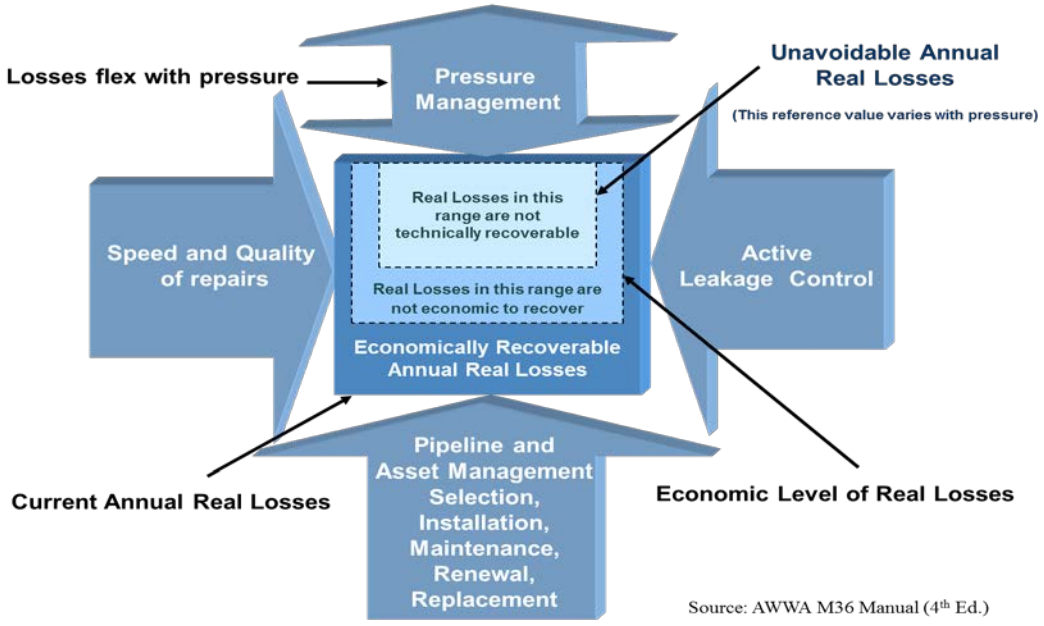


Diagram Illustrating the Real Loss Management Components

Also established within the Company's January 2017 Rate Order were measures to accelerate the Company's Underground Infrastructure Renewal Program (UIRP). A more aggressive program of targeted infrastructure replacement will help to achieve the economically recoverable level of Real Losses, as well as promote sustainability of efficient water loss levels once achieved.

SWNY's below-ground infrastructure is considered young by industry standards, with a current average asset age of only 50 years. Generally, underground infrastructure demonstrates a useful life of 75-100 years or longer under typical operating conditions. As such, an infrastructure replacement program based largely on asset age would likely not deliver the maximum value per dollar of investment, especially considering that many of the Company's best performing assets are among the oldest. As a result, the Company has implemented an industry-leading capital planning and infrastructure replacement tool called *InfoMaster* to improve the sophistication of such evaluations and allow for additional metrics such as pipe failure rate and water loss profiles to be considered within the analysis.

NRW Sustainability Assessment

In the absence of real-time consumption information, water audits and mass balance assessments traditionally rely on estimates and averages in an attempt to align water produced with water consumed within a given region or district of the system. The 12-month rolling-average calculation serves as a lagging indicator of current NRW, as any particular loss reduction instance is not realized right away, but rather produces gains incrementally across a full 12-month period. As a result of this lagging indicator, NRW fluctuations are often improperly correlated to the actions or events which actually produced the reductions (or increases).

In order to properly assess the sustainability of water loss levels, longer-term NRW trends must be differentiated from impacts caused by seasonal or short-term events such as cold weather, drought, billing anomalies, rate increases, or other circumstances outside of the specific actions the company is undertaking to reduce water loss levels. To better understand the factors that influence sustainable water loss levels, it's important to establish the following considerations:

1. Annual Baseline consumption levels are defined across the November through March time period, when typically only indoor water use occurs. Water usage patterns across this time period are generally stable on a daily basis as well as year-over-year, which establish baseline level flow rates for which current-year production (draft) data can be benchmarked. The November/December time period is particularly useful, as outdoor usage has ceased, but the weather has not yet become cold enough to impact Real Loss.

2. Real Losses have much more of an ability to influence short term water loss levels than do Apparent Losses such as metering inaccuracy, theft, etc., which are generally much more consistent from year-to-year, and develop or resolve relatively slowly over time, as compared to Real Losses.

3. Water lost due to normal surfacing leaks are generally considered to be losses that are not economical to recover beyond a certain extent. These losses can only be reduced through pressure reduction (where practical) and large-scale targeted infrastructure replacement, along with minimized find-to-fix times for repairs.

4. Water lost due to the awareness time of non-surfacing leaks, or the time between when a leak develops and when the company becomes aware of the leak, represents *Avoidable* Real Loss, and can be greatly reduced by early identification of such leakage. Non-surfacing leaks typically generate a much larger total volume of water loss than surfacing leaks, due to their ability to remain un-detected for long periods of time, even at high flow rates.

In water systems with well-developed SCADA systems, production data can be used as a leading indicator of current NRW levels. Production patterns (specifically draft, which factors in storage volume change and water that is not available for consumption) actually reflect consumption patterns, only offset uniformly by the baseline level of leakage. The degree of this offset can be used to determine the extent to which real-loss (leakage) levels within the system have been reduced (or increased), especially when used during the winter months when consumption patterns are stable. System/Zone draft patterns represent instantaneous conditions, independent of any Apparent Losses associated with theft, metering inaccuracies, or billing-system related adjustments, estimates, anomalies, or reporting lag. Rather than attempting to estimate consumption values over short intervals (with current technology), assessments can be more accurately performed during periods where consumption can be nearly removed from the equation.

Analysis of Internal Actions Contributing to Water Loss Reductions

Over the past few years, SUEZ companies have undertaken various measures to improve the way the Companies collect, validate, and evaluate system operatinig data, refine the methodologies and processes used to characterize water losses, and develop actions to resolve water water loss occurrences accordingly. NRW reductions to-date can be primarily attributed to the following activities:

- Reductions in the awareness time of non-surfacing leakage
- Improvements in the find-to-fix times of normal surfacing leakage
- Large-scale cleanup of existing baseline levels of non-surfacing leakage associated with consecutive severe winter seasons (2014/2015)
- Apparent Loss reduction through improved metering accuracy for large customers

The proportion of non-surfacing leaks in a similar nearby SUEZ company, Suez Water Westchester (SWWC), is currently 23%, meaning that nearly one in every four leaks that develop would normally remain undetected by the Company. The DMA system in that Business Unit has enabled the Company to reduce the awareness time of newly developing non-surfacing leakage, as well as identify zones which demonstrate high levels of existing baseline water loss. The minimized awareness time is evidenced by the fact that virtually no production increases were seen across the 2014/2015 winter seasons within that system. As a result, SWWC is currently approaching the economic level of Real Loss, despite the effects of consecutive severe winters combined with a high proportion of non-surfacing leakage.

The SWNY (Rockland County) System suffers a similar percentage of non-surfacing leaks to that of SWWC, and also serves a larger geographical region, resulting in a number of very large Pressure Zones. Large production zones reduce the Company's ability to effectively identify and localize water loss events, and lead to a very high degree of field activity and manpower needed to resolve events. The effectiveness of reducing the awareness time of non-surfacing leakage to improve operational and maintenance efficiency has been demonstrated in SWWC and is expected to deliver similar improvements within the SWNY Company upon full deployment of the DMA system.

Large Customer Metering & Apparent Loss Analysis

The Company has defined Strategic Meters to be the collection of large customer meters accounting for 20% of total system consumption. The most recent Strategic Meter Replacement list identified a total of 140 meter replacements. Many of the Strategic Meters which were compound meters were inspected and demonstrated compromised accuracy impacts associated with damage to the meter body components. Forensic analysis of 12 damaged meter bodies revealed that tuberculation accumulation had caused excessive wear and damage to the components of the meter bodies.

Furthermore, SWNY has improved upon the Strategic Meter initiative and implemented a meter testing policy whereby all large customer meters will undergo field testing as they become due for UME register replacement. This will ensure that only meter bodies/UME registers which fail testing are replaced, and enable the company to address many more large meters per year for a given investment level, as well as reduce lost consumption associated with meters that have failed before their standard scheduled replacement date based on meter size.

Addressing Apparent Losses at small (residential) customer meters provides much less return for a given investment level, and approaches the economic level of loss on the Apparent Loss side. Small-scale theft such as lawn irrigation systems which bypass the meter are difficult to identify and require extensive field activity to confirm and resolve. As a result, small-meter losses are difficult and less economical to address without high-resolution consumption data to support a desktop analysis of suspected Apparent Loss prior to allocation of field-resources, similar to the desktop analyses performed on Real Losses using the DMA systems prior to deploying leak detection resources.

Customer metering accuracy is generally considered to be sustainable with proper monitoring, testing, sizing, and replacement policies. However, Apparent Losses associated with outdoor use theft and irrigation, are likely to be impacted by external factors such as weather patterns or dry summer conditions.

Impact of External Influences on Water Loss Levels

Extreme cold can directly impact levels of Real Losses occurring throughout the system. According to a Water Research Foundation (WRF) study, the average pipe-break rate for water utilities is between 21 to 27 breaks per 100 miles of pipeline per year. For the 8-year period between 2006 and 2013, the average pipe-break rate in SWNY, for example, was slightly over 26 breaks per 100 miles of pipe per year, which is consistent with industry averages. However, this number surged to nearly 37 during the severe winter weather outbreak of the 2014/2015 season. This surge in main breaks resulted in a corresponding surge in non-surfacing leakage, which would continue to exist if no additional efforts had been undertaken to resolve the events. Real Losses remain in effect until actions cause them to be reduced.

The losses which developed over the severe winter season of 2014/2015 would become the new baseline level of flow without specific intervention, and thus increase the NRW percentage by a corresponding amount. However, the additional actions (desktop evaluations and field activities) that were taken during the remainder of 2015 and 2016 have returned the losses back to previous levels or better. (Detailed Analysis in *Part III: 2016 Progress Update & Findings*)

DMA System flow rate analysis of discovered leaks indicates that many non-surfacing leaks reach full failure during the winter months, likely resulting from additional stresses acting on the pipe from frozen ground movements and changes in water temperature. Therefore, clean-up of existing baseline leakage throughout the year has likely contributed to the reduced occurrences of un-avoidable Real Loss during the 2016 winter, and minimized the level of emergency-type conditions that strain the Operations & Maintenance groups and impact find-to-fix times for repairs.

General NRW Sustainability Conclusions

NRW reductions to-date are action-driven and are likely to be sustainable through 2017, barring extreme events causing recurrence of Avoidable Real Loss in the form of non-surfacing leakage. In general, sustainability of any NRW program hinges on the Company's ability to identify and localize water loss events in an efficient manner using new technology for data collection and evaluation techniques.

Short-term sustainability is dependent on the Company's ability to reduce the awareness time of newly developing Avoidable Real Loss. Regional water systems demonstrate a high percentage of non-surfacing leakage, which can remain hidden for long periods of time and generate large volumes of water losses with a single occurrence. Production data is a leading indicator of such losses, and can be used independent of consumption data when evaluating short-term system efficiency. Large-scale Real Loss clean-up is beneficial to conduct prior to implementation of a

DMA system or fixed leak logger deployment, as baseline levels of loss are much easier to maintain once achieved. Real Loss reductions are more likely to be sustainable in zones where the awareness times of new leaks can be minimized.

Long-term sustainability of efficient water loss levels are dependent on the continuation of short-term optimization activities *plus* the ability shrink the economic level of loss by:

1. Pressure reduction & optimization throughout the system (where practical).

2. Targeted infrastructure replacement considering water loss criteria for below-ground assets.

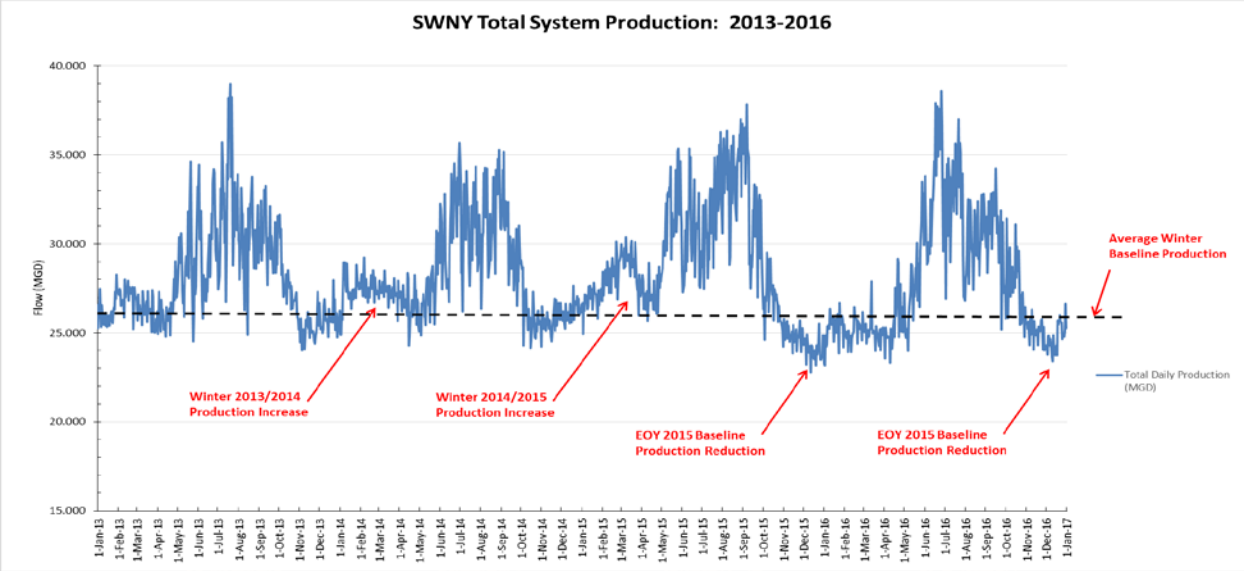
3. Implementing effective policies for monitoring, testing, and replacement of customer meters, particularly for large users.

PART III: 2016 PROGRESS UPDATE & FINDINGS

The annual AWWA Water Audit for SWNY indicates a year-over-year NRW decrease of 2.4% in 2016. The decrease can largely be attributed to reductions in the awareness time associated with Avoidable Real Loss in the form of non-surfacing leakage. Consecutive severe winters (2013-2014 & 2014-2015) have caused a surge in main-breaks across these time periods, which have produced a corresponding impact on Real Losses in prior years. Many of the leaks that developed during the severe winter seasons, particularly the Jan-Mar 2015 time period, were non-surfacing and required extensive desktop analysis and field surveying to localize and resolve. The system-wide clean-up of non-surfacing leakage has resulted in a reduction in total system production of 376 MG, of which only 43 MG can be attributed to a reduction in total system consumption. This yields a year-over-year ***net reduction in production of 333 MG*** (3.2% of total system production for 2016).

GRAPH-2 below depicts SWNY total system production across the 2013 through 2016 time period. The distinct surges in system baseline production levels can be seen across the winter 2013/2014 and 2014/2015 periods, which cannot be attributed to any significant increases in consumption.

Also evidenced in GRAPH-2 is a substantial decrease in system baseline production in subsequent years. These reductions in current system production levels are the result of on-going water loss recovery actions to assess, identify, locate, and repair damage to underground infrastructure sustained during the severe weather of the 2014/2015 winter.



GRAPH-2: SWNY Total Daily Production 2013-2016

The severe increase in weather-driven non-surfacing leakage sustained in 2014/2015 required a significant increase in field leak detection resources to identify and localize. As such, SWNY retained a 3rd party leak detection vendor to assist SWNY personnel with field leak survey and correlation activities. The field activities were coordinated using desktop evaluations of likely areas of the system where Real Losses had developed, based on production data and baseline flow analytics. The table below provides a breakdown of key statistics associated with the contract leak detection effort within the two largest Pressure Zones of the system.

	PD-10	PD-20		
Length of Mains Surveyed:	460	285	mi	
Percent of Total System:	40	27	%	
Completion Time:	45	30	days	
Leaks on Mains:	15	14		
Leaks on Services:	36	13		
Leaks on Valves/Hydrants:	16	37		
Total NYLD Possible Leaks Identified:	67	64		
SWNY Confirmed/Repaired Leaks:	57	47		
SWNY No Leak Confirmed:	10	17		
Total Volume Recovered (NYLD):	1.0	0.7	MGD	NYLD Estimated (Leak Signal Strength)
Total Volume Recovered (AWWA):	0.9	0.9	MGD	AWWA Methodology Used to Estimate

TABLE 1 – Contract Leak Detection Survey Results (2016 Surveys, PD-10 & PD-20)

Phase I of the system-wide deployment of District Metered Areas (DMA) has been completed on schedule during 2016. A total of 18 DMA Meter sites were designed and constructed throughout 2016. These installations resulted in the sectorization of 9 total DMA regions, including the complete sectorization of PD-95 and PD-40 and the partial sectorization of PD-10 South. A map of currently installed DMA meter locations and completed zones is provided in Appendix B.

Additionally, Phase I of the system-wide deployment of Advanced Metering Infrastructure (AMI) has been completed on schedule during 2016. At the current time, much of the County is now covered under the Sensus FlexNet network, which establishes the gateway by which Sensus meter readings are collected. A total of 18,500 Sensus customer meter RF transmitters were installed in 2016.

Pressure management opportunities throughout the system have been evaluated and a number of preliminary areas have been identified which could be candidates for pressure reduction. Pressure reduction initiatives are complex and require a careful evaluation to prevent impacts to the system's ability to provide the regulatory minimum service pressure for customers, as well as provide sufficient emergency and fire flow capacity. A map of areas of the system under investigation for pressure reduction is provided in Appendix C.

SWNY continues to utilize its expanded *Production Data Monitoring and Evaluation Process* to reduce the awareness time typically needed to identify and localize water loss events, as well as identify specific areas of the system (Pressure Zones) which are demonstrating higher-than-expected baseline levels of water loss.

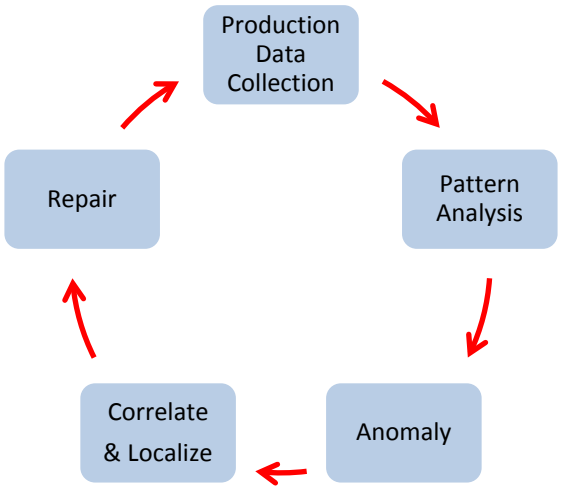


Diagram Illustrating the Production Data Monitoring and Leak Localization Process

Many factors contribute to the failure rate of below-ground infrastructure such as pipe age, pipe material, pipe cohort group (vintage), installation quality and technique, soil conditions, water temperature, and system operating pressure, as well as other operational factors related to how water is treated, supplied and pumped throughout the network. As such, SWNY is expanding its real-loss evaluations in an attempt diagnose the root cause of main- breaks in the distribution system, which will better enable the Company to profile and reduce real losses as part of its Non-Revenue Water reduction efforts. Using documentation from each water main-break and AWWA recommendations for calculating water lost to main- breaks and service leaks, SWNY is able to analyze specific water loss events to establish any correlations between the number and type of main-breaks and other observed conditions.

Furthermore, Real Losses in the SWNY System were overstated within the 2016 AWWA Water Audit, given the fact that metered consumption used for Company internal purposes**,** although un-avoidable, is currently considered to be water delivered to the system, and therefore is contributing to the non-revenue producing volume which the company must report. Company use water could be more accurately accounted for by removing this usage from the Non-Revenue Water calculation.

Authorized Un-Billed Consumption (Company Internal Use):

- Operational/Facility Use: 5.77 MG
- House Meters (Offices): 0.19 MG

Total Internal Use: 5.96 MG

Please refer to APPENDIX A for the complete SWNY AWWA Water Audit Report for 2016.

On the apparent loss side, the *Strategic Metering Initiative* was expanded upon to include field testing of all large customer or compound meters in the system. This will ensure that only meter bodies/UME registers which fail testing are replaced, and enable the company to address many more large meters per year for a given investment level, as well as reduce lost consumption associated with meters that have failed before their standard scheduled replacement date based on meter size.

The results of the 2016 large meter field testing program are detailed in the table below:

Total # Meters Field Tested:[1]	357
Passed Test (No Action Required):	94
Failed Test – UME Replacement:	138
Failed Test – Full Body Replacement:[2]	125

TABLE 2 – Strategic & Large Meter Testing Program Results (2016)

Note 1. Any meter that was unable to be field tested received either a UME replacement or full meter body replacement based on field inspection of meter age and condition.

Note 2. Any meter identified on the Strategic Meter List automatically received a full body replacement. The list does not include 45 Strategic Meter full-body replacements performed in 2015.

Much like the approach taken for targeting real-losses, apparent loss investigations begin with a comprehensive desktop review to better focus field activities on the locations that most likely demonstrate theft of service or tampering issues. Desktop evaluations involve compiling service point information from various internal and external data sources to identify 'red-flag' type discrepancies, or data which is outside of expected parameters for a given service point. Lock-wing type service connections, which consist of a master service from the street serving multiple meter sets within the property, present unique challenges for both desktop and field investigations, as these meter sets are located within private property not controlled by SWNY. Denial of SWNY access by customers presents difficulty in confirming if all meter sets associated with a lock-wing type service remain in compliance with Company Tariff requirements after the initial installation. SWNY continues to work with customers and invokes the protections provided by the Tariff to address these issues. However, denial of access delays SWNY's ability to rectify meter set issues and also impacts productivity as some properties must be visited multiple times.

Service points which consist of both a private well and SWNY water service connection also present specific challenges related to benchmarking expected consumption levels and patterns for such accounts. Unauthorized use of water from fire hydrants is also an issue throughout the service territory, and presents a high risk for cross-contamination of the public water supply associated with improper or missing backflow devices. With over 6,300 hydrants throughout the County, it is not practical for SWNY to police unauthorized usage by municipalities, contractors, or residents at all potential locations. The Company continues to work with municipalities and local law enforcement to curb unauthorized use of hydrants. The Company also purchased additional hydrant meters to expand the hydrant meter rental program and encourage proper use of hydrants.

The transition to monthly meter-reading and billing cycles has allowed for seasonal consumption comparisons to be performed across the customer base, and has improved the quality of theft-of-service investigations particularly related to outdoor use theft. According to seasonal indicators of system water loss levels, outdoor use theft is a major contributor to SWNY water losses across the summer time period. Analysis of 2016 water loss data reveals that, on average, volumetric water losses trend higher by 29.7 MG per month during the typical outdoor use period of May through October. This increase yields a total approximate outdoor use water loss of 178.2 MG, or nearly 2% of total annual production (which impacts NRW percentages by 2 points). 2016 was a particularly favorable period for evaluating seasonal water loss trends, as the mild winter early in the year prevented the typical spike in Real Losses associated with the cold weather. As such, Real Losses along with indoor use theft could be considered to be relatively constant throughout the year, allowing estimates for outdoor use theft to be extracted from summer data.

The implementation of a fully deployed AMI system will further improve the quality of such evaluations, as well as enable the Company to identify discrepancies between production and consumption trends throughout the system.

PART IV: NRW PROJECT TEAM & OBJECTIVES

In order to accomplish the goals of the NRW reduction program as outlined in *Part II: Ongoing NRW Reduction & Sustainability Strategy*, components of the program were broken down into individual, manageable task items categorized by department involvement and staff responsibility. The project team consists of the following departments and associated responsibilities:

Engineering/GIS:

Assist with facility design and implementation, hydraulic modeling & GIS updates and evaluations, and capital improvement projects as part of an overall asset management strategy.

- Plan and implement a DMA Network. The DMA network will be used as the primary flow monitoring system, and provide for accurate mass-balance and water audit calculations to be performed on each zone independently.
- Plan and implement an AMI Network. The AMI network will be used to monitor customer consumption with high-resolution, and allow for period-specific consumption reports to be generated.
- Update and maintain GIS and hydraulic modeling tools, and provide assistance with specialized evaluations using spatial analysis and modeling procedures.
- Evaluate pressure management opportunities to reduce the level of real losses within the system, in conjunction with the District Metering Project.
- Evaluate below-ground asset performance and develop a prioritized Underground Infrastructure Replacement Program (UIRP) considering water loss criteria.

Customer Service & Billing:

Gather, analyze, and maintain accurate customer account and consumption information. Responsible for ensuring that every customer account within the service territory is properly maintained within the CIS system, and investigating any abnormalities.

- Implement and maintain *monthly* billing cycles for all customers to allow for more accurate water balance calculations by eliminating the need for 12-month rolling average estimates, and better align consumption and production data.
- Closely monitor monthly consumption reports and promptly investigate any abnormalities which could result in lost revenues or consumption.

- Review Meter Data Management (MDM) System and customer consumption patterns for abnormalities such as zero or negative consumption, or evidence of a tampered customer meter.
- Minimize systematic data handling errors within customer billing operations and consumption reporting processes.

Metering:

Responsible for ensuring that every customer account within the service territory is properly metered and reporting consumption, and investigating any abnormalities which may result in lost consumption.

- Maintain compliance with aged meter replacement and testing requirements.
- Monitor all large and/or un-metered services to ensure accurate reporting and compliance with SUEZ Water fire/irrigation service connection policies.
- Field test all large customer and Strategic Meters on an annual basis.
- Establish DMA/Pressure Zone specific meter read routes for improved alignment of Production and Consumption data on a monthly basis.
- Facilitate the transition to the Advanced Metering Infrastructure (AMI) system.

Production & Distribution:

Calibrate all master pay and plant meters, validate and report system production, and maintain system production structures. Operate and maintain system valves and hydrants, and manage the construction and repair policy of system infrastructure and facilities.

- Calibrate and maintain production master meters and pressure reducing valves semi-annually, and document calibration records and reports.
- Verify and maintain pressure division and DMA sectorization valves to ensure hydraulic isolation of all zones.
- Manage and administer the company's leak detection program including; targeted leak surveys, interconnection and cross-connection monitoring, hydrant and valve leak sounding, and deployment of acoustic loggers.
- Coordinate, prioritize, and manage leak and water main-break repairs, and ensure proper recording and documentation of all repairs.
- Work with local municipalities and fire departments to ensure sensible, conservation-minded water usage practices and minimize water losses through proper metering of necessary usage.

Hydraulic Modeling (Engineering Department):

As part of the Engineering Department, the Hydraulic Modeling group will be responsible for calibrating and maintaining system hydraulic models, and perform specialized analyses aimed at optimizing system operation and efficiency, and identifying areas of the system which demonstrate a high likelihood of real losses.

- Ensure that the master version of the model is current and reflective of measured system conditions including DMA meter flows and pressure point monitoring values.
- Develop specialized NRW related model scenarios focusing on demand side hydraulics to study avoidable losses.
- Utilize the software's genetic algorithm to perform "hot-spot" leakage detection, whereby the system areas which demonstrate the greatest divergence from measured conditions are identified.

Efficiency Management (NRW Manager):

Develop and maintain the overall NRW reduction strategy and action plan for all departments, and oversee implementation of the plan. Perform comprehensive water audit and mass balance calculations for all metered zones. Utilize high-resolution production and consumption information, in conjunction with leakage studies and hydraulic modeling results, to characterize the nature of water loss occurring in the various zones.

- Conduct UARL background leakage study by zone per IWA methodology, to establish the baseline proportion of real losses considered to be unavoidable.
- Establish standards for calculating NRW percentages on a DMA/district basis, including water audit templates and data handling procedures.
- Create workflow procedures to account for minor losses associated with internal activities such as flushing and chlorination, and authorized unmetered consumption such as fire department use.
- Perform water audits and develop the annual Non-Revenue Water Report and Non-Revenue Water Reduction Plan.
- Coordinate NRW reduction and efficiency improvement activities across departments.
- Develop and implement "Smart Utility" solutions for monitoring and optimizing network performance and efficiency management.

Planning & New Business:

Responsible for all new water service requests and main extensions for connecting new customers to the system, ensuring that all new service projects are consistent with and conforming to SUEZ Water standards and policies.

- Track and manage all new service requests from the point of application for service through meter installation and bill generation.
- Determine proper sizing of new customer meters to ensure maximum meter accuracy based on anticipated usage estimates and customer classification.
- Inspect new customer service connections and meter configurations to ensure compliance with Suez and Rockland County Health Department regulations.

Sustainability (All Departments):

Develop policies, procedures, and best practices needed to ensure optimal efficiency of the system. Create system efficiency indicators and typical operating profiles to assist in identifying and locating operational abnormalities or infrastructure failures.

- Implement capital improvement projects designed to maximize system efficiency, ensure proper service parameters are maintained, and eliminate under-performing assets from the system.
- Verify and document all boundary valve positions and possible cross-connections to ensure distribution system and DMA zone integrity.
- On-going routine leak detection surveys of transmission mains and high failure rate mains.
- On-going DMA and production meter calibration and maintenance.
- Maintain compliance with customer meter replacement and testing programs, and continuously monitor MDM system for customer usage pattern abnormalities.
- On-going high resolution water audits using DMA/Pressure Zone specific production data, along with monthly consumption data collected by Zone specific meter read cycles.
- Minimize the awareness time of newly developing water loss by continually monitoring and validating DMA/Pressure Zone specific production data to identify patterns and trends which could be indicative of Avoidable Real Loss.

APPENDIX A – 2016 AWWA Water Audit Summary

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

? Click to access definition
+ Click to add a comment

Water Audit Report for: SUEZ Water New York
Reporting Year: 2016 | 1/2016 - 12/2016

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

					Pcnt:	Value:	
Volume from own sources:	9	10,409.518	MG/Yr				MG/Yr
Water imported:	n/a	0.000	MG/Yr				MG/Yr
Water exported:	9	78.778	MG/Yr				MG/Yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 10,330.740 MG/Yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:	Value:	
Billed metered:	9	8,065.502	MG/Yr			
Billed unmetered:	n/a	0.000	MG/Yr			
Unbilled metered:	9	9.786	MG/Yr			
Unbilled unmetered:		129.134	MG/Yr	1.25%		MG/Yr

Use buttons to select percentage of water supplied **OR** value

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

AUTHORIZED CONSUMPTION: 8,204.422 MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption)

2,126.318 MG/Yr

Apparent Losses

				Pcnt:	Value:	
Unauthorized consumption:	8	421.887	MG/Yr		421.887	MG/Yr

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies:	9	218.117	MG/Yr	2.63%		MG/Yr
Systematic data handling errors:	8	203.717	MG/Yr		203.717	MG/Yr

Apparent Losses: 843.721 MG/Yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 1,282.597 MG/Yr

WATER LOSSES: 2,126.318 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 2,265.238 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	1,061.0	miles
Number of active AND inactive service connections:	9	76,820	
Service connection density:		72	conn./mile main
Are customer meters typically located at the curbstop or property line?		No	
Average length of customer service line:	8	43.9	ft
Average operating pressure:	9	103.3	psi

(length of service line, beyond the property boundary, that is the responsibility of the utility)

COST DATA

Total annual cost of operating water system:	9	$28,127,421	$/Year	
Customer retail unit cost (applied to Apparent Losses):	8	$5.42	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	9	$432.79	$/Million gallons	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 88 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer retail unit cost (applied to Apparent Losses)
3: Billed metered

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

Water Audit Report for: SUEZ Water New York
Reporting Year: 2016 | 1/2016 - 12/2016

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 88 out of 100 ***

System Attributes:

	Apparent Losses:	843.721	MG/Yr
+	Real Losses:	1,282.597	MG/Yr
=	Water Losses:	2,126.318	MG/Yr
?	Unavoidable Annual Real Losses (UARL):	831.51	MG/Yr
	Annual cost of Apparent Losses:	$6,113,165	
	Annual cost of Real Losses:	$555,095	Valued at Variable Production Cost

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	21.9%	
	Non-revenue water as percent by cost of operating system:	23.9%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	30.09	gallons/connection/day
	Real Losses per service connection per day:	45.74	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.44	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	1,282.60	million gallons/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	1.54	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software: Water Balance

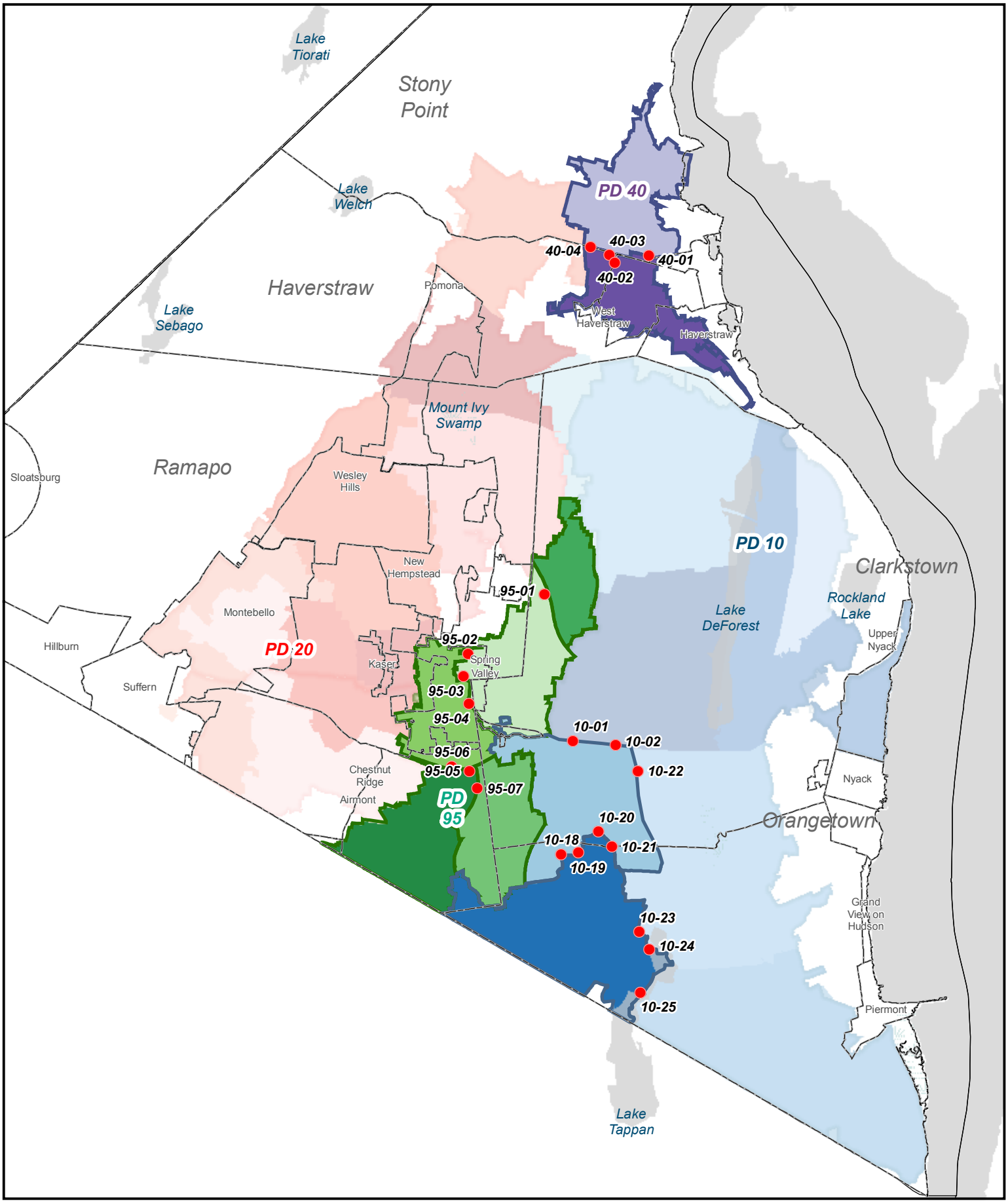
WAS v5.0

American Water Works Association.

Water Audit Report for:	SUEZ Water New York	
Reporting Year:	2016	1/2/2016 - 12/2016
Data Validity Score:	88	

		Water Exported 78.778	Billed Water Exported			Revenue Water 78.778
Own Sources (Adjusted for known errors) 10,409.518	System Input 10,409.518	Water Supplied 10,330.740	Authorized Consumption 8,204.422	Billed Authorized Consumption 8,065.502	Billed Metered Consumption (water exported is removed) 8,065.502	Revenue Water 8,065.502
					Billed Unmetered Consumption 0.000	
				Unbilled Authorized Consumption 138.920	Unbilled Metered Consumption 9.786	Non-Revenue Water (NRW) 2,265.238
					Unbilled Unmetered Consumption 129.134	
			Water Losses 2,126.318	Apparent Losses 843.721	Unauthorized Consumption 421.887	
					Customer Metering Inaccuracies 218.117	
					Systematic Data Handling Errors 203.717	
Water Imported 0.000				Real Losses 1,282.597	Leakage on Transmission and/or Distribution Mains Not broken down	
					Leakage and Overflows at Utility's Storage Tanks Not broken down	
					Leakage on Service Connections Not broken down	

APPENDIX B – DMA Meter Installation Map



suez
360 West Nyack Rd West Nyack, NY10994
Phone: 845-623-1500

Drawn By: wparco
Date: 2/23/2017
Sheet: of

SUEZ NY District Meter Areas

Completed to Date

● District Meters Installed

NOT TO SCALE