



PHILADELPHIA WATER DEPARTMENT – WATER REVENUE BUREAU

WATER AUDIT REPORT FOR FISCAL YEAR 2007

July 1, 2006 – June 30, 2007



City of Philadelphia Water Accountability Committee

February 15, 2008



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CITY OF PHILADELPHIA
Philadelphia Water Department - Water Revenue Bureau
WATER AUDIT FOR FISCAL YEAR 2007
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Introduction

For the 10th consecutive year Philadelphia's Water Accountability Committee compiled a detailed water audit of the water supply and billing operations of the City of Philadelphia. As given in this report and related worksheets, the audit format uses the best practice method published in 2000 by the International Water Association (IWA), an effort assisted by the American Water Works Association (AWWA). This format requires that a water supplier determine the amount of water that went to billed consumption, other authorized consumption, and losses. Losses represent inefficiencies and are categorized as *Apparent Losses*, or non-physical losses, due to customer meter inaccuracies, data/billing error and unauthorized consumption; and *Real Losses*, or actual physical losses. Leakage is the largest component of real and total losses for many water systems, and causes excess treatment and delivery costs. Apparent losses are significant since they are typically valued at higher costs than leakage, and can have a substantial financial impact in terms of lost revenue for utilities that bill customers based upon metered consumption.

Non-revenue Water (unbilled authorized consumption plus apparent losses plus real losses) rose notably in Fiscal Year 2007 (FY2007); likely due to billing distortions rather than actual physical losses. Despite this indication of rising losses, significant progress was achieved on several major water loss initiatives. The Philadelphia Water Department (PWD) and Water Revenue Bureau (WRB) reported increased losses of 3.2 billion gallons, or 8.8 Million Gallons per day (MGD); going from 27,139 million gallons (MG), or a daily average of 74.4 MGD, in FY2006 to 30,370 MG (83.2 MGD) in FY2007. Still, as of the close of FY2007, *water losses remain roughly 40% lower than the level experienced prior to the reinstatement of the Water Accountability Committee in 1992*. Annual losses routinely registered between 43,800 - 51,100 MG (120-140 MGD) in years prior to 1992. Figure 1 illustrates the long-term decline in Non-revenue water.

During FY2007 the PWD and WRB continued a number of successful loss reduction activities including the American Water Works Association Research Foundation (AWWARF) project "Leakage Management Technologies" (AWWARF Project #2928) and launching of the SAHARA inline transmission main leak detection service. As part of Project 2928, PWD completed installation of permanent equipment in a small area of the water distribution system to monitor leakage and test innovative leakage control techniques, including pressure management. During FY2007 PWD continued to investigate the feasibility of installing fixed network Automatic Meter Reading (AMR) equipment in this pilot District Metered Area (DMA). This upgrade would serve to enhance the capabilities of new leakage management controls and to preview next-generation AMR equipment. SAHARA is a highly accurate inline large-diameter water main leak detection technology that PWD contracted for use starting in FY2007.

The Water Accountability Committee's Working Group continued to meet regularly to monitor water auditing and loss control activities. The two WRB representatives on the Working Group roster both retired and new appointments are expected. Dennis Blair of the Steering Group retired and Chris Crockett was appointed to Mr. Blair's former position of head of Planning & Research. Several members continued active participation in water industry endeavors during the year. Michael Hogan continued in a leadership role in the Eastern Meter Management Association. George Kunkel continued serving as trustee in AWWA's Distribution & Plant Operations Division and was active in promoting new water auditing and loss control methods on a number of fronts.

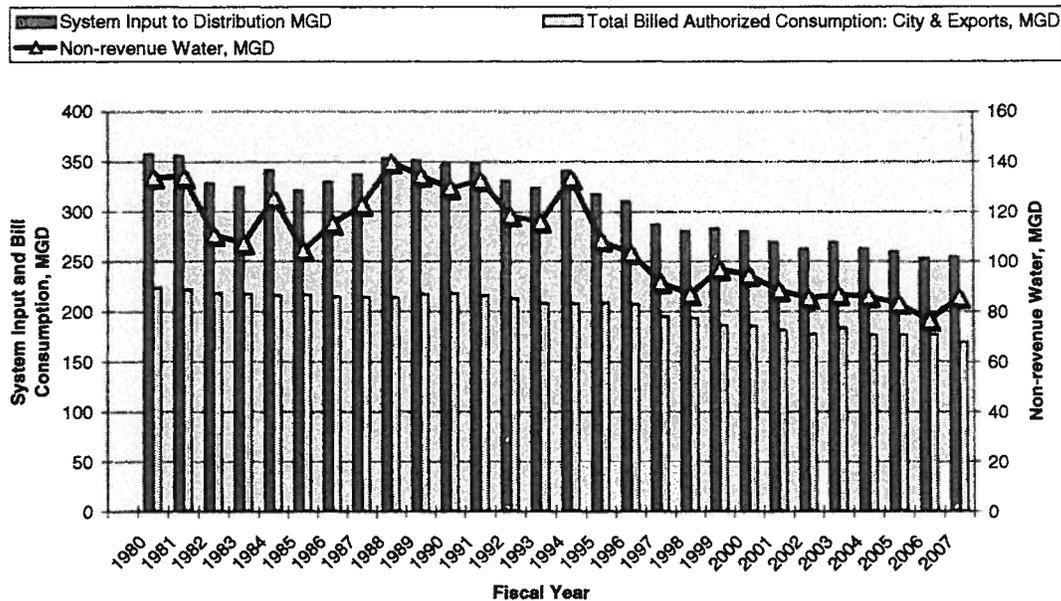
During FY2007 Mr. Kunkel neared completion of editing the draft of the revised AWWA M36 publication *Water Audits and Leak Detection*. Mr. Kunkel was also active in promoting the use of the IWA/AWWA water audit method to officials in the Delaware River Basin Commission, Pennsylvania Department of Environmental Protection and similar agencies in Texas and Georgia. Mr. Kunkel is also an alternate member of the Delaware Water Resources Regional Committee established by Pennsylvania's Water Resources Planning Act (Act 220). This act set forth a process to update the state water plan, which is being assisted by six regional committees across the commonwealth. During FY2007 AWWARF published the formal report for Project 2928 and the project "Evaluating Water Loss and Planning Loss Reduction Strategies". Mr. Kunkel served on the project advisory committee for the latter project.

In April 2006 AWWA issued a basic water audit software package, making it available for free from its website. The software features the IWA/AWWA method and has drawn great interest from water utilities across North America. The software was created by a sub-committee of the AWWA Water Loss Control Committee and included G. Kunkel of PWD and David Sayers of DRBC. Mr. Sayers served as the primary programmer of the software. During FY2007 the same AWWA sub-committee upgraded the software by adding several other capabilities. The DRBC has taken a keen interest in improved water accountability and supported the software development. Mr. Kunkel assisted DRBC's Water Management Advisory Committee in drafting revision to the DRBC Water Code to update it with the terminology and methods of the IWA/AWWA approach. The DRBC Commissioners are scheduled to vote on these changes before the close of calendar 2007. PWD and DRBC have successfully partnered to promote improved water accountability both in Philadelphia and in the Delaware River Basin.

Water Loss in Fiscal Year 2007

Distribution system input in FY2007 was 93,167 MG (255.3 MGD) of treated water, with 86,258 MG (236.3 MGD) - near the record low - distributed to the city and 6,910 MG (18.9 MGD) exported to the Bucks County Water & Sewer Authority (BCWSA) and Aqua America's two interconnections. BCWSA registered 5,329 MG (14.6 MGD) while Aqua America drew 876 MG (2.4 MGD) and 694 MG (1.9 MGD) at its Tinicum and Cheltenham connections. Export sales represented 7.4% of total water supply in FY2007, partially offsetting declining city delivery. The WRB registered customer billed consumption averaging 61,868 MG (169.5 MGD), a significant drop from 177.0 MGD in FY2006. This drop in billings is believed to have played the majority role in the rise in Non-revenue Water for FY2007. Billing adjustments are known to distort overall billing totals. Fortunately the city is poised to launch a new customer billing system in FY2008 and it is hoped that processes will be better managed. Customer billed consumption is derived largely from automatic meter readings; with a small portion of the data based upon manual meter readings, estimates and adjustments.

Philadelphia Water Department Water System Input, Consumption and Non-Revenue Water



*Fiscal Year 1994 featured a severely cold winter with high distribution system leakage losses and high NR water
During Fiscal Years 1999 and 2000 NR water peaked due to billing adjustments during the primary AMR installation phase*

FIGURE 1

After subtracting unbilled authorized consumption for firefighting, street cleaning and other needs, water losses totaled 30,370 MG (83.2 MGD), a notable jump from 27,139 MG (74.4 MGD) in FY2006. Due to perceived significant variations in billing amounts between FY2006 and FY2007, apparent losses rose to 7,957 MG (21.8 MGD) in FY2007 compared to 5,520 MG (15.1 MGD) in FY2006. Real losses also rose from 21,619 MG (59.2 MGD) in FY2006 to 22,412 MG (61.4 MGD) in FY2007. Mild winter weather in FY2006 resulted in fewer leaks, but more typical cold weather, and leakage levels, returned in FY2007. Apparent loss costs rose by over 50% to \$30.9 million. Since the rise in apparent losses is largely attributed to billing adjustment error, not all of this cost is assumed to be recoverable as revenue. Real loss costs are \$5.1 million vs. \$4.3 million in FY2006. Real loss costs increased in part due to the rising variable cost of water, which jumped from \$160.48/MG in FY2006 to \$193.82/MG in FY2007. This cost has risen 50% in the past two years largely due to rising water treatment chemical costs.

System Input for FY2007 was the second lowest on record, only higher than the FY2006 level of 92,637 MG (253.8 MGD). This continues a decades-old pattern of decreasing water withdrawals, treatment and distribution. The average supply of the past eleven years is 19.8% lower than the period of 1987-1996 and over 27% lower than the city's highest registered amount of 135,087 MG (370.1 MGD) in 1955. The city-only system input of 86,286 MG (236.4 MGD) is 36.1% below the 1955 level, when no wholesale accounts existed. This downward trend, attributed to declining population, reduced leakage and reduced average consumption, continues to exert a growing impact on the city's water supply operations and long-term planning as its water supply infrastructure is operating at the low end of its design range. The PWD has been gradually downsizing parts of its water supply infrastructure (pumping capacity) but additional reduction is needed.

Residential (small meter) accounts registered consumption of 28,433 MG (77.9 MGD), while industrial/commercial (large meter) accounts were billed at 23,944 MG (65.6 MGD) for the year. The method to tabulate these totals was changed starting in FY2006. As shown in the "Accountability Trend" worksheet from FY1997-2005, large meter consumption declined steadily. This did not display the actual drop in large meter consumption, instead reflecting that large meter accounts were being transferred to small meter control days (meter reading routes). Consumption is traditionally reported by control day, but, starting in FY2006, the actual registered consumption on large vs. small meters is used, showing a more realistic breakdown of 46% large meter billed consumption vs. 54% small meter billed consumption. This proportion was verified in billing system data mining analysis performed by Water Systems Optimization, Inc. (WSO) in FY2006. The number of billed accounts in the city, both large and small, continues to drop due to the city's population reduction and gradual completion of Automatic Meter Reading (AMR) devices on the final remaining accounts not yet AMR capable.

Philadelphia's Water Audit

Philadelphia's Water Accountability Committee issued its first comprehensive water audit in FY1998. Starting in FY2000, the committee employed the international standard method now known as the IWA/AWWA Method. This method was published in 2000 after three years of detailed effort by the IWA Water Loss Task Force to identify appropriate performance measures for water supply systems. This format is given in the IWA publication *Performance Indicators for Water Supply Services - Manual of Best Practices*. The method includes a set of rational definitions for water consumption and losses and a set of performance indicators to assist target-setting and benchmarking with other water utilities. The method is advocated by AWWA in its August 2003 Committee Report "Applying World-wide Best Management Practices in Water Loss Control". AWWA is moving forward to rewrite its manual publication "Water Audits and Leak Detection" based upon this method.

The PWD is one of a growing number of North American water utilities employing the IWA/AWWA method. Water loss has become a major water supply issue in many parts of the world and this method has been grasped in whole, or in part, in the United Kingdom, South Africa, Brazil, Malaysia, Australia and New Zealand. Likewise it is being embraced in the United States by the Delaware River Basin Commission, the Texas Water Development Board, Metropolitan North Georgia Water Planning District, the state of Washington and the California Urban Water Conservation Council. In January 2003 the State of Texas passed legislation requiring water utilities to routinely submit water audits starting in 2006. The Texas Water Development Board incorporated the IWA/AWWA water audit method into its process and collected water audits for the 2005 calendar year from over 2,000 water utilities. The PWD is taking a progressive posture in applying these new methods, improving its water loss standing and gaining recognition as a model for North American water suppliers.

The work that water utility managers undertake to develop an accurate water audit is an evolutionary process. Once the water auditing process is launched, additional auditing and procedural refinements can be incorporated over time to make the audit an accurate and reliable tool. During FY2007 the Water Accountability Committee continued work to further refine its water audit using methods that have been developed for the drinking water industry. During the latter part of FY2003, the PWD contracted with WSO to provide guidance on auditing improvements and loss control interventions. The work performed by WSO built upon the foundation work conducted under Philadelphia's Leakage Management Assessment project conducted in 2001. The major items conducted during FY2007 included:

- **Data Mining and Analysis of the Customer Billing System:** Work was conducted in recent years using data mining software to analyze billing system data for fiscal years 2003 to 2005. During early FY2007, WSO completed analysis of FY2006 data and the results are included in this water audit report. The effort gauged the extent of difference existing between the aggregate customer billed consumption in the water audit and the value calculated from the raw billing data. Consistently, for the four years analyzed, the *total* volumes tabulated from the data mining work compared favorably with the billing totals routinely reported to PWD, with variances of only 1-2% each year. However, on a month-to-month basis or by segregating meter sizes, considerable variance is seen throughout the business year. WSO also analyzed anomalies existing in the billing records such as negative consumption occurring due to billing adjustments.

- **District Metered Area #5 Field Testing and Startup:** In addition to its contract with PWD, WSO also provided PWD with assistance in its role as the primary researcher on AWWARF Project 2928. The PWD was able to benefit from WSO's dual role to continue design, procurement, installation and testing work on the first permanent DMA installation in the PWD. During the fall of 2006 and the spring of 2007 WSO guided PWD in field testing and calibration of the new equipment (pressure reducing valves, flowmeter and electronic controller) used in DMA5 to provide continuous flow monitoring and demonstrate pressure management technology. After testing, the initial control settings were identified and the DMA5 was launched into continuous operation. DMA5 has been dubbed PWD's "field laboratory" and leakage and main break rates will be carefully monitored over time.

Philadelphia's water audit has evolved over ten years to become a highly effective tool to gauge water supply efficiency in the city. The water audit is widely circulated both within the city and the water industry at large. It has become a recognized format that a number of other water utilities have patterned in their water accountability efforts. With the assistance of WSO, the WAC envisions further improvements in the water audit and greater usefulness in its ability to help set loss reduction priorities.

Initiatives to Economically Control Water and Revenue Losses

Reducing Apparent Losses

Due to the need to shift personnel to several other priorities the Revenue Protection Program realized relatively modest water and revenue recoveries in FY2007. Table 1 reveals FY2007 recoveries of 0.36 MGD and \$531,400 on 449 accounts. While results for FY2007 were lower than previous years, it is expected that additional significant recoveries are still possible. The Metering Unit provides staff to investigate suspect accounts, but in FY2007, focused upon AMR ERT installations in the remaining "hard-to-install" population. Metering was successful in reducing the backlog of hard-to-install accounts from 9,232 in FY2006 to 5,008 in FY2007. These accounts usually require several visits to successfully address, thus much resource time was dedicated to this important function. The Metering Unit also dedicated time in preparation for the startup of the *Service-Link* work order management system and the coming of the new Basis2 Customer Billing System.

The Revenue Protection Program pursues targeted groups of water-using accounts suspected to be unbilled. In FY2007, most recoveries occurred in the NB9 (vacant properties) and NB3 (shutoff accounts). Many NB3 customers manage to illegally operate their curbstop valves to restore water service. The WRB's Reinspection Program, which inspects shutoff accounts, checked 15,199 accounts and, upon threatening shutoff again, obtained payment to restore 2,984 accounts that had illegally reactivated their service at the curbstop. This resulted in recoveries of additional revenue of \$340,380. The rate of accounts found illegally restored was 19.6% in FY2007, just slightly less than rates of over 20% during the initial years of this program.

PWD - WRB Revenue Recovery History							
PWD Revenue Protection Program					WRB Reinspection Program*		Total
Fiscal Year	Accounts Recovered	Water Recovered, MGD	Revenue Recovered	Categories of Greatest Recovery**	Reinspections Recovered	Reinspections Revenue Recovery	Total Recovered Revenue
2007	449	0.36	\$531,400	NB9 (Vacant properties) & NB3 (Shutoff for non-payment)	2,984	\$340,380	\$871,780
2006	1,436	1.01	\$1,413,000	Estimated Accounts (#1), Non-billed Accounts (#3,#9) and Zero Consumption Accounts	2,513	\$209,768	\$1,622,768
2005	2,397	1.74	\$2,835,000	NB3 & Zero consumption accounts	2,553	\$249,261	\$3,084,261
2004	1,941	1.67	\$2,003,000	Zero consumption accounts 0.74 MGD; tampering is most common cause of lost water in this group	1,991	\$446,327	\$2,449,327
2003	1,360	1.14	\$1,782,000	Zero Consumption Accounts	2,221	\$604,379	\$2,386,379
2002	932	0.69	\$1,037,000	Zero Consumption Accounts	2,721	\$668,932	\$1,705,932
2001	711	5.81	\$2,900,000	Missing Accounts, Hand Estimates, NB6 accounts	3,261	\$498,952	\$3,398,952
2000	716	1.39	\$2,100,000	NB6 accounts	2,737	\$393,949	\$2,493,949
Total	9,942	13.81	\$14,801,400		20,981	\$3,411,948	\$18,013,348

*The Reinspection Program inspects customer service connections on accounts that have been shutoff for payment delinquency.

**EC-1 & NB-9 accounts are vacant properties, NB-3 accounts are shutoff for payment delinquency, NB-6 new accounts awaiting occupancy

**Zero Consumption accounts are investigated after registering zero consumption (unchanged meter readings) for 4 consecutive months

TABLE 1

In recent years the Revenue Protection Program has focused heavily on zero consumption accounts, which are accounts that have valid, unchanged meter readings for at least four consecutive months. While 1,915 such accounts were investigated in FY2006, only 27 such accounts were investigated in FY2007. Typically only 30-35% of zero consumption accounts in the City are found to be vacant properties, while 40-50% are found to have unchanged consumption due to some form of unauthorized consumption: meter or AMR ERT (reading device) tampering. The other common cause of zero consumption is ERT failure. In 2003 ITRON added staff to address ERT failures and the incidence of ERT failures in zero consumption cases has dropped in recent years. It is believed that unauthorized consumption is still a large component of apparent loss in the city and a significant volume has been estimated in the FY2007 water audit.

After the successful two-year installation of AMR devices at over 400,000 residential properties from 1997-1999, the AMR program has steadily continued in its second phase of installations. Phase II includes residential properties not accessible in the first phase (hard-to-install population) as well as large (commercial, industrial) accounts and city properties. Due to the complexities of properties with persistent access difficulty, staffing shortages and a variety of existing large meter types, this phase is proceeding at a gradual pace. As of the end of FY2007 almost 93% of large meter accounts are AMR capable. These include the majority of large meters up to size 8-inch. The implementation of AMR was not envisioned to directly improve water loss indicators. Oddly, heavy adjustment activity during the initial AMR installation phase from 1997-1999 likely caused temporary billing reductions. However, as the AMR installation moves into the remaining customer accounts that still lack this capability, the success of the program is well documented in providing multiple benefits, most notably stable billings.

Revenue Protection innovated the use of nighttime AMR System meter readings to assist leakage investigations in DMAs. Initially performed in the temporary DMA4 in 2003, night readings have been conducted in DMA5 on three occasions as part of AWWARF Project 2928. Revenue Protection arranges for separate rounds of special night AMR readings, one around 2:00 AM and one around 4:00 AM of designated flow measurement days. Subtracting the calculated customer consumption from the DMA system input quantifies the leakage in the DMA. Philadelphia is the first known water utility to use an AMR system in conjunction with a DMA; an innovation noted by a number of industry stakeholders. During FY2005 AMR night readings were gathered in DMA5 and indicated a large difference between customer consumption and the water supply input, inferring a high leakage rate. Leak repair work was conducted in FY2006 and this difference was reduced by roughly two thirds, from a night flow rate of 1.7 MGD to 0.6 MGD. Night readings were again gathered in FY2007 and showed similar consumption levels of 0.225 MGD as the previous two rounds of readings.

The success of the AMR System in improving customer meter reading and assisting leakage management in the DMA structure is leading PWD to plan for the next generation AMR technology by piloting fixed network capability in DMA5. The AMR System will be undergoing widespread battery changeout by 2010, and contracted meter readings by ITRON will occur until 2017. Fixed network AMR allows for meter reading data to be automatically gathered at frequent intervals, as short as every 15 minutes, better assisting DMA leakage assessments as well as billing complaints such as high bill questions. Diurnal consumption patterns can be assessed to calibrate PWD's hydraulic model. During FY2006 and FY2007 PWD held discussions with ITRON, Inc. and Badger Meter on their fixed network capabilities. By evaluating the performance of the system that is piloted in DMA5, the PWD will be well situated to determine the long-term evolution of AMR throughout the city. Pending resource availability around the Service-Link and new Basis2 Customer Billing System projects, this initiative will be pursued further in FY2008.

While the Revenue Protection Program has been highly successful in recovering over \$18 million during its existence, it is believed that considerable revenue recovery potential remains in the customer population. Non-billed accounts again rose notably in FY2007 by more than 1,700 accounts to 97,744. Many NB accounts, which qualify for this status by their non-water using status, have been found to be consuming water. With the growing number of NB accounts, apparent losses of 855 MG and over \$4 million revenue impact are estimated for this component.

Apparent loss also occurs from billing adjustments when the billing system modifies consumption values to create monetary credits. Data mining analysis quantified volumes of "negative consumption" in billing records, which cause collective customer consumption to be under-stated. Due to the timing of the adjustments during the year, not all of the negative consumption is an apparent loss since some of the negative volume is offset by over-estimation earlier in the year. The adjustment estimate rose from 1,601 MG in FY2006 to 3,426 MG in FY2007, with a final cost impact of over \$16 million. 1,825 MG of this volume accounts for the data anomaly that led to the notable reduction in Non-revenue Water in FY2006, and the reverse of this trend in FY2007. Since a large portion of this volume is believed to be due to data error, it is not reasonable to view this entire cost as recoverable revenue. Still, recovery of a portion of this amount is still significant. It is hoped that the structure of the new Basis2 Customer Billing System will prevent the unusual data adjustment activity that the city has experienced for many years.

Stephen Junod leads the Revenue Protection Program. Jack Meade leads the Metering Unit, who performs the field inspections for the program and corrects metering problems as they are uncovered. The Metering Unit has suffered with one of the lowest staffing levels in the PWD in recent years, but hiring has improved in the past two years. It is believed that the city could benefit greatly by focusing effort to restore full staffing of this unit, since their work frequently results in direct revenue enhancement.

The city launched its new Basis2 Customer Billing System on January 2, 2008. Basis2 is a software system developed by Prophecy International, a company from Australia in partnership with Oracle, who is under contract to the city. Work on this system, including testing and training, occurred steadily and the startup occurred on target. The former legacy billing system worked reliably for several decades to generate monthly water bills, but became very outdated with significant functionality limitations. In recent years the PWD has identified several new needs for customer consumption information including use in leakage nightflow analysis, meter rightsizing and to assign demand loadings in hydraulic models. The new system will also bring improved functionality to billing data management. Certain billing shortcomings, such as negative consumption values due to billing adjustments, can be addressed once the new customer billing system is fully implemented and proven.

The battle to thwart unauthorized consumption continues, with both successes and challenges experienced in FY2007. Unauthorized fire hydrant openings have been successfully minimized due to the effectiveness of the hydrant Center Compression Lock (CCL). This has been confirmed during heat waves of recent years when peak flows were contained such that no additional peak hour pumping was required. Hot weather fire hydrant abuse, which caused great system stress for many years, is now only a relatively mild incident each summer. Considerable water is still taken sporadically from fire hydrants, both illegally and legally through a cumbersome permitting process. Hydrant policy and enforcement practices could benefit from a comprehensive review and possible overhaul.

Unauthorized consumption at the customer connection also continues to be a concern, as missing and tampered meters and meter reading equipment and the illegal restoration of shutoff services lines continue to occur in high numbers. It is also suspected that fire connections, which should only be used during fire and testing situations, are being exploited for standard water supply. Investigations into zero consumption accounts in recent years always found a high percentage of accounts that had witnessed unauthorized consumption. Unfortunately, only 27 zero consumption accounts were investigated in FY2007 due to the need to dedicate staff to the hard-to-install population. Given the size and demographics of the city, the PWD and WRB will likely always need to dedicate a significant effort into suspect consumption patterns. The strong potential for unauthorized consumption is always there.

Reducing Real Losses

The PWD has a reputation as a United States water industry leader in instituting innovative leakage control techniques. The PWD has operated a leak detection program for over 25 years. The Squad uses state-of-the-art leak correlators and leak noise loggers and surveyed 1,024 miles of pipeline, or approximately one-third of the distribution system in FY2007. Under AWWARF Project #2928 the PWD designed and constructed DMA5 to demonstrate the benefits of continuous leakage monitoring and pressure reduction techniques. The FY2007 Water Audit indicates real (leakage) losses of 22,413 MG (61.4 MGD); a modest increase compared to FY2006's level of 21,620 MG (59.2 MGD). The Infrastructure Leakage Index (ILI) notched higher to 10.3 in FY2007 compared to 9.9 in FY2006; still much lower than the high value of 13.1 in FY2002. The ILI represents the ratio of current leakage to the theoretical level of Unavoidable Annual Real Losses (UARL). Typical cold winter conditions likely resulted in slightly higher leakage than FY2006, but some of the increased leakage volume in FY2007 is attributed to the accounting effects of the increase in Non-revenue Water during the year.

The PWD has instituted many leakage control interventions and has achieved notable success in stemming leakage losses. Still, significant leakage exists in the system and the PWD is challenged to maintain arguably the oldest water distribution system in the United States. The PWD must therefore continue to pursue progressive leakage management techniques to the extent that they prove practical and successful in the Philadelphia service area. Additionally, a major policy shift is needed to shorten repair response time for leaks on customer service lines. Current policy requires customers to arrange leak repairs, a practice that has proven to be an inefficient leakage control policy. Also, improved work order management is needed to better deploy leak detection and repair personnel, track results and analyze trends. The current system is not sufficiently robust to adequately track leak categories and repair times. These issues must be addressed if the city is to bring its leakage levels closer to economic levels.

During PWD's Leakage Management Assessment (LMA) Project in FY2001 Bristol Water Services (BWS) consultants provided information on progressive leakage management techniques pioneered in the United Kingdom since the 1990's. The project team also included independent consultant Allan Lambert, perhaps the world's foremost authority on water system leakage. BWS later launched its American affiliate, WSO. PWD has retained the services of WSO since 2003. In 2005 WSO became an independent consulting group.

The consultant team guided the PWD-WRB in assembling the Philadelphia water audit via the IWA/AWWA method and compared its water loss performance indicators with water systems from around the world. Four temporary DMAs were operated in 2001 and the PWD was instructed in creating spreadsheets to perform nightflow analysis for measured flows into these small areas of the water distribution system. High leakage was indicated in only one of the four DMAs, suggesting that leakage is not evenly spread across the PWD system and detailed nightflow analysis has good potential to strategically guide leakage management efforts.

The project highlighted the impact of leaks on customer service lines, which are often the greatest source of leakage losses in utilities. Most drinking water utilities in the United States require that their customers hold the responsibility to arrange for leak repairs on at least a portion of their service lines. Philadelphia is one of a minority of utilities that assign customers responsibility for the *entire* service connection length. However, customer managed repair policies have been found to be very inefficient water loss control practices. The PWD should consider policy and/or program changes that will reduce the run time of customer service line leaks. The average time for customers to address known service leaks is believed to be 4-5 weeks, whereas efficient practices target the completion of such repairs in 1-4 days. In FY2004 the PWD proposed a warranty program for water service line and sewer lateral maintenance as part of the FY2005 water rate increase, however this proposal did not receive sufficient political support. Still, ways to improve the response to service line leaks should be pursued.

An important concept in effective leakage management is the influence of time and pressure on leakage losses. It is believed that Philadelphia's leak repair efforts do not keep pace with the number of leaks identified in its leak detection program, although this assessment is hampered by limitations in the PWD's current leak repair tracking process. Since the amount of water lost from a leak is dependent upon the duration that it runs, the effectiveness of a water supplier in promptly pinpointing leak sources and completing repairs is critical. PWD's information tracking process for non-emergency leak repairs is not sufficiently robust to fully capture leak durations and results. The PWD's potential to improve its leakage management will depend not only on applying effective leakage control techniques, but also its ability to better manage the complex information that accompanies these activities. In FY2006 and FY2007 PWD has been actively planning for a new work order management system that will provide these needed capabilities.

Research and many successful case studies worldwide have confirmed the strong influence that excessive water pressure has on leakage rates, particularly for small "background" leaks, on infrastructure in poor condition. Closely controlling water pressure has been found to economically reduce leakage losses in areas of high pressure. The PWD designed a pressure control application in DMA5 as part of the AWWARF project. Data is now continuously gathered from the DMA and leakage and main break rates are being carefully observed over the early life of the DMA in order to discern the benefits of the DMA structure.

In FY2002 the PWD launched a pilot study to closely monitor flows and leakage in the perceived high leakage DMA4 in West Philadelphia. This work continued periodically through FY2004 and the AMR System was employed to measure customer consumption during night hours; an innovative technique to enhance the minimum hour analysis technique of quantifying leakage rates. This method found that a significantly larger portion of the high nightflow was actually high consumption in a number of customer properties. Therefore less leakage than originally believed existed. As the project team needed to redirect its efforts to the startup of the AWWARF project, work in DMA4 was suspended.

The initial field measurements and data gathering for AWWARF Project 2928 began in FY2005 with the selection of the area boundaries and configuration to meet the goals of quantifying leakage rates and managing pressures in a high leakage area of the city. DMA5 was sited in the city's Germantown section to assess an area of older infrastructure and high water pressure; the latter characteristic was important in demonstrating new pressure management technologies. Also, the newly created Geographical Information System and hydraulic model could be employed in this area. After replacing a number of defective valves, a trail boundary configuration was established to create a temporary DMA. It was determined to include two separate supply main feeds in the design of the permanent DMA; one that would serve as the primary supply for routine flows and the second in closed standby mode, ready to automatically open to supply a large flow in event of emergency such as a fire flow, main break or similar event.

Baseline data was gathered, including flow measurements and pressure data taken from fire hydrant datalogging devices. Water quality sampling found that acceptable water quality conditions are maintained when the DMA is in place. Fire flow tests were conducted, with and without the DMA in place. Night AMR readings quantified customer consumption occurring during the minimum night hours. In total, this small distribution grid witnessed unprecedented assessment and analysis in a manner keying on the operational efficiency in a discrete section of the water distribution system.

Data gathering in DMA5 in FY2005 found initial minimum hour nightflows registering 1.7 MGD, greatly in excess of the 0.225 MGD of customer consumption registered by the night AMR readings. The stark difference between water flowing into the DMA as supply and leaving the DMA as customer consumption suggested very high leakage. During early FY2006 leak detection and repair activities were conducted and abated four main breaks and ten service connection/miscellaneous leaks in the DMA, bringing minimum night flowrates down to approximately 0.6 MGD. Construction of the primary inflow site at Chew Ave. and Walnut Lane was completed in October 2006 and the standby site at Greene & Johnson Sts. in January 2007. DMA5 was commissioned into permanent service on February 6, 2007.

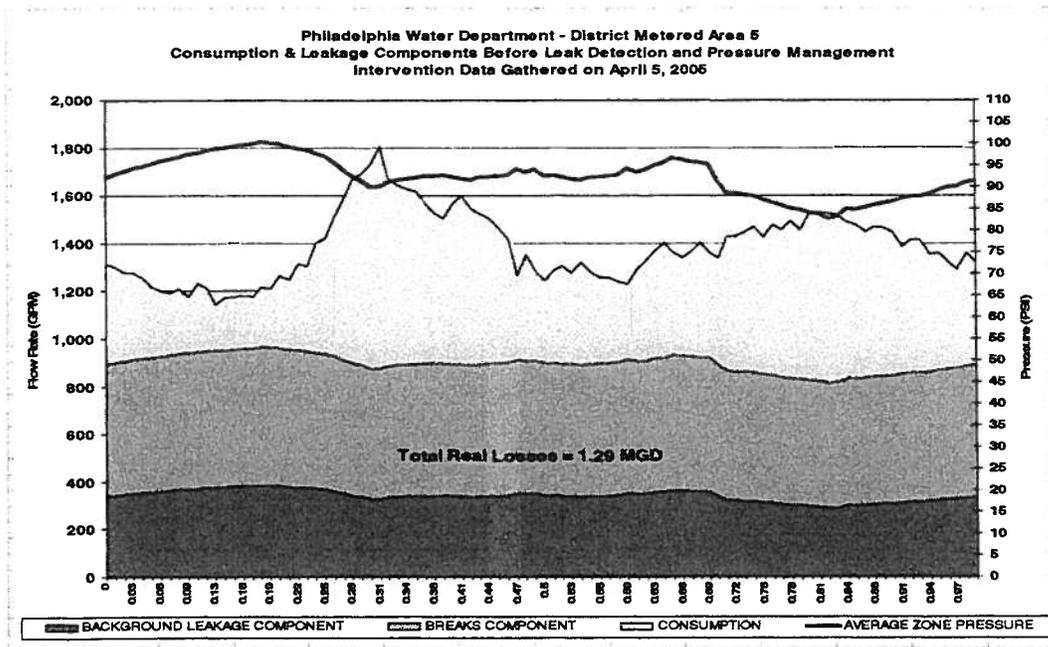


Figure 2 - Hydraulic trend from initial testing in Philadelphia's District Metered Area 5 showing high leakage rates prior to leak detection work and DMA equipment installation

DMA5 has been operating reliably since its commissioning. Flows and pressures are continuously monitored and archived by the PWD's SCADA System at the Load Control Center. A flow-modulated pressure control mode is employed in the DMA. In most water distribution systems, pressure drops during periods of high demand, and rises when consumption is low. A distinct pressure range was established for DMA5 and pressures fluctuate across this range during the diurnal cycle; with pressures at the higher end of the range delivered when consumption is high and lower pressure delivered when consumption is low and leakage is at its greatest proportion of the entire flow. Leakage and main break rates are being watched to determine if rates are lower in the DMA, and response times are reduced due to the continuous availability of data. Warm weather water quality samples were taken and found to reflect typical water quality for the PWD distribution system. City fire protection regulations and building conditions in the DMA are being reviewed in order to ascertain that adequate flows and pressures continue to provide for fire protection in the DMA.

The final report for AWWARF Project 2928 was published in July 2007. Ten water utilities from across the United States and Canada participated in this research; with six of the ten installing permanent equipment for improved leakage control. The conclusions of the project find that, with some adjustment for North American conditions, the successful leakage control methods pioneered internationally in the past twenty years are applicable for water utilities here. The findings of this research are expected to have strong bearing on new methods that are utilized by North American drinking water utilities in coming years. As water utilities become increasingly pressured from the impact of drought, infrastructure needs and funding shortfalls, water efficient technologies will attract ever greater attention. The PWD again stands to benefit from both the new technology studied in this research and the exposure of being one of the participating utilities in a high profile undertaking.

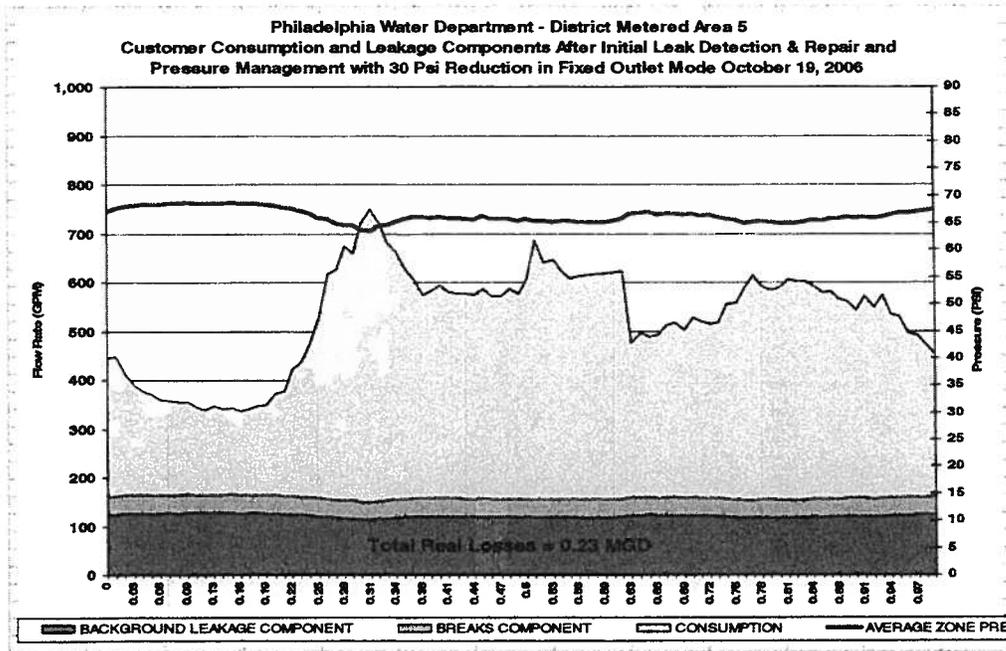


Figure 3 - Hydraulic trend from in Philadelphia's District Metered Area 5 showing reduced leakage rates and pressures after leak detection work and DMA equipment installation

While much effort was dedicated to investigate progressive new methods of leakage management, traditional leak detection and repair efforts also continued during FY2007. Leak Detection crews surveyed 1,024 miles of the system's 3,014 miles of pipeline for leaks; utilizing state-of-the-art technology, including leak correlators and correlating leak loggers. PWD's Distribution Unit repaired 832 main breaks and over 3,000 leaks; up from 660 and 1,600 such events in FY2006. During FY2007 441 customers took advantage of the PWD's assistance program to have repairs conducted on their leaking water service lines. During FY2007 the PWD continued to provide an improving level of leakage management despite the great challenges of a large, aging water distribution system.

FY2007 also featured the initial use of the SAHARA inline transmission main leak detection technology offered by the Pressure Pipe Inspection Company (PPIC). Large diameter transmission pipelines have historically been difficult to survey for leaks using above-ground acoustic leak detection technology. Leak detection has been particularly limited in detecting small leaks occurring at pipe joints on these mains. The SAHARA system employs a highly accurate acoustic sensor attached to a tether and inserted into an active water main. It travels through the main with the flow of water and, being inside the pipeline, is very accurate in pinpointing even extremely small leaks. Like most water utilities, PWD's leak detection program has encountered limitations in detecting leaks on large piping and the SAHARA technology offers the capability to provide this needed leak detection service.

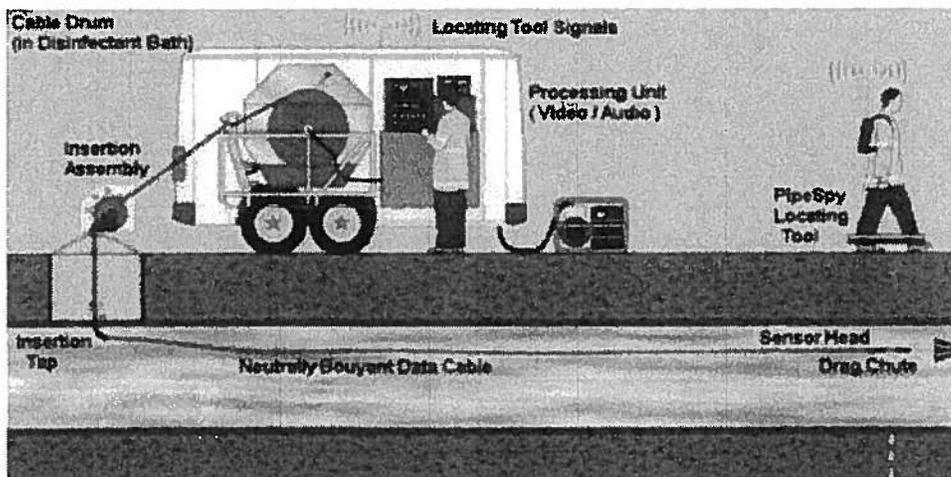


Figure 4 - Schematic of SAHARA inline transmission pipeline leak detection technology

During June 2007, PPIC provided scans using the SAHARA service on a total of 3.70 miles of 48-inch diameter pipeline in Philadelphia. Scans were performed on the West Philadelphia truck main from the former Georges Hill Reservoir site to 57th and Christian Sts., a total of 3.0 miles of pipe. The four Queen Lane Gravity Mains leaving the Queen Lane Water Treatment Plant were also scanned. Each run was about 900 ft for a total of 0.70 miles. The scans found three leaks, all of which were classified as "small" by PPIC. All of the leaks were quickly repaired by the Distribution Unit. The first leak, in 53rd St, north of Media St, actually was discovered on a parallel 6-inch main. The experience of these initial scans in the PWD network confirms that this technology has strong potential to better assess leakage conditions on the most critical supply mains in the city.

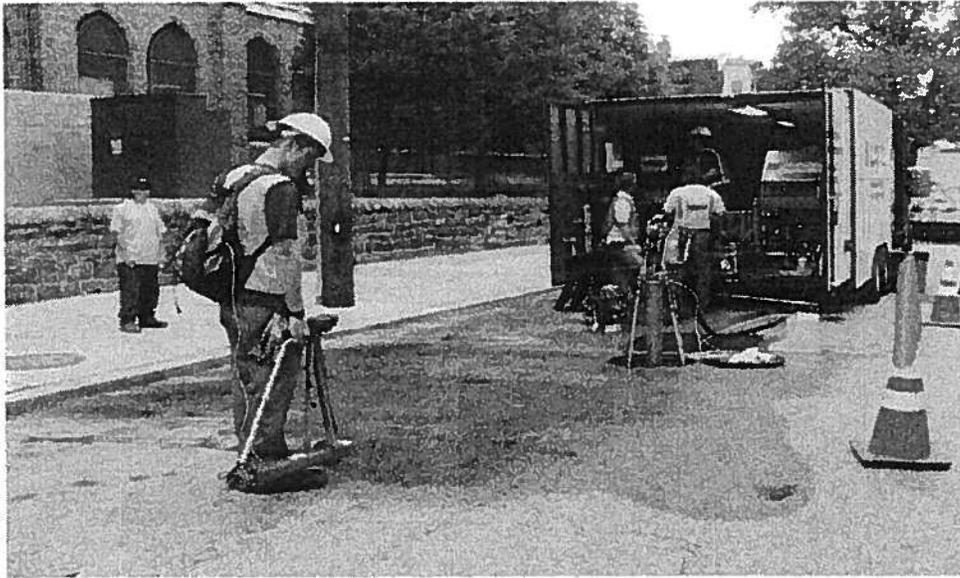


Figure 5 - SAHARA inline transmission pipeline leak detection technology in use in Philadelphia at 53rd Street, south of Warren St. June, 2007

Looking Ahead

The City of Philadelphia has made significant improvements in its accountability and has witnessed its non-revenue water drop by more than 40% over the last fifteen years. Still, significant loss reduction potential exists and the PWD remains challenged to optimize its water supply and revenue capture functions. It is believed that the next level of significant loss reduction will only come about if certain new loss control interventions are implemented. The following recommendations are viewed as the necessary steps to take the city's loss reduction to the next level:

1. Implement the new Basis2 Customer Billing System in FY2008. The city's customer meter population is highly accurate and the Automatic Meter Reading (AMR) System provides reliable, accurate meter readings to calculate customer consumption for monthly water bills. Additional needs for customer consumption data have come about in recent years including assessments of leakage using minimum hour flow analysis, customer meter rightsizing analysis and to assign demands in hydraulic models. The former legacy Customer Billing System, while reliable in generating monthly bills, had great limitations and shortcomings, such as adjustments that result in negative consumption data. In order to enhance the City's business process to provide reliable billing and customer consumption management, it is critical that the new Basis2 Billing System be implemented in FY2008. It was launched on schedule on January 2, 2008 but must be fully implemented. The new system will provide much higher functionality than the former system and serve as the foundation for improvement in accountability and apparent loss control.

2. Pursue fixed network Automatic Meter Reading (AMR) capabilities in DMA5. Philadelphia has gained distinction as perhaps the first water utility in the world to utilize AMR in conjunction with a DMA. On a number of occasions PWD has arranged for ITRON to gather night customer meter readings at 2:00 AM and 4:00 AM, allowing customer consumption to be segregated from DMA input flows to determine distribution system leakage rates. In these cases, meter readings were gathered in the traditional driveby manner. Fixed network capabilities provide customer meter readings on demand at small time increments with data continuously transmitted, and without the need for driveby meter reading. Establishing fixed network capabilities here will efficiently provide customer consumption data for leakage analysis, hydraulic modeling and other needs, and will also serve as a pilot for the next generation of AMR equipment that the PWD-WRB will eventually install throughout the city.

3. Expand the Workscope and Staffing of the Revenue Protection Program: while this eight-year program has been highly successful in recovering missed revenues it is believed that significant recovery potential still exists in the city. The FY2007 Water Audit reflects a second consecutive year of significant increase in the estimate of apparent losses, now valued at more than \$30 million per year. The number of Revenue Protection investigations and recoveries is limited by the staffing in the PWD Metering Unit. While hiring resumed in FY2006, it is believed that full, or even expanded staffing, is cost justified. Likewise, an expanded workload is envisioned to investigate a wide number of potential apparent loss occurrences, such as fire connections. Staffing is also needed to restore meter accuracy testing to develop a long-term meter changeout strategy and large meter rightsizing. It is therefore recommended that hiring efforts continue in the Metering Unit and expand the Revenue Protection Program's analytical capabilities.

4. Refine work order tracking on the water distribution system to consider progressive strategies and terminology (ex: reported, unreported leaks) in its design. The PWD has operated a successful leak detection program for many years, but can benefit from further refinements to its leak survey practices, repair strategies and long-term distribution system planning criteria. Rational strategies can only be developed if reliable information on leakage occurrences and repairs is available. Current work order tracking and information systems could benefit from improvements in terminology, information capture and distribution. Investigations into street-side work order management systems have been conducted over the past two years and it is hoped that a new system can be launched in the near future.

5. Monitor District Metered Area (DMA) 5 and implement operational refinements in order to optimize water supply efficiency in this area. PWD's current leak survey policy, which is typical of the US water industry, surveys areas of the distribution system on an average of once every three years. But new leaks occur between surveys and, for those leaks that go unreported, the infrequent leak survey interval allows them to run at length. Water supplied to DMA5 is monitored continuously and emerging leakage is evidenced in high night flowrates; which allows leak detection and repair to be implemented quickly and efficiently. DMA5 also features a flow modulated pressure control scheme that lowers pressure when water demand is small and leakage predominate. Data is being gathered and analyzed in attempt to determine when a level of optimization is achieved. Additional refinements in pressure levels might be considered here, as long as service level requirements (including fire protection) can be met. The long-term performance of DMA5 will have bearing on the planning of additional DMAs in Philadelphia's water distribution system.

6. Pursue improvements to the current policy regarding maintenance of customer service line leakage repairs. A majority of the city's unreported leakage occurs on customer service lines. Current policy places the burden of repair on customers and - even with the city's HELP Loan Program - results in an average leak response time in the order of weeks. Best practice response times for repairs are 1-4 days. Previous efforts to investigate a warranty program confirmed that an improved approach must be both technically and politically viable. It is believed that an improved program that can reduce average leak repair response time from the current 5-6 weeks down to one week or less will significantly reduce the current service line leakage rate of 10,769 MG (29.5 MGD) estimated in the FY2007 Water Audit at a cost impact of \$2.1 million. New programs have been developed in the water industry to address customer service line management and these should be further investigated. This is likely the single most important action that can be taken to gain further, significant leakage reductions in the city.

The City of Philadelphia's Water Department and Water Revenue Bureau have taken highly progressive steps to assess their water loss status on a world scale. Philadelphia has developed a national reputation as a pioneer in this field. It operates the largest water utility Automatic Meter Reading System in the United States and is pursuing upgraded AMR technology. It has improved its accountability by compiling annual water audits, cut its non-revenue water significantly and recovered considerable additional revenue in a manner that is cost-effective and fair to rate-payers. By participating in the American Water Works Association Research Foundation Project "Leakage Management Technologies" the city remained on the cutting edge of new leakage management technology. Philadelphia's Water Accountability Committee will continue its efforts to address water loss by compiling this annual water audit and coordinate improvements at the local, regional, national and international levels.

Philadelphia Water Department - Water Revenue Bureau
Water Accountability Committee - Fiscal Year 2007

Steering Group

Bernard Brunwasser, Water Commissioner
Marleen Duley, WRB Deputy Revenue Commissioner
Debra McCarty, Deputy Commissioner
Joseph Clare, Deputy Commissioner
Stephen Furtek
Charles Zitomer
Dennis Blair

Working Group

George Kunkel, Chair
James Aleo
Thomas Barr
Joseph Galante
Michael Hogan
Stephen Junod
John Meade
Roy Romano
Jeffrey Simmet

City of Philadelphia Annual Water Audit Summary - IWA/AWA Water Audit Method

Fiscal Year 2006 - July 1, 2006 to June 30, 2007

	Volume, Million Gallons	Average Volume, MGD	Costs/Year
Water Supplied			
System Input	94,119.8	257.9	
Minus Correction for Master Meter and data handling error	952.8	2.6	
Corrected System Input	93,167.0	255.3	
Minus Exports	6,908.5	18.9	
Water Supplied (City only)	86,257.5	236.3	
Authorized Consumption			
Billed Metered	54,969.0	150.6	
Billed Unmetered	0.0	0.0	
Unbilled Metered	0.2	0.0	\$868
Unbilled Unmetered	843.6	2.3	\$214,310
	55,812.8	152.9	\$215,178
Water Losses			
	30,444.7	83.4	
Apparent Losses			
Customer Meter Inaccuracies	141.8	0.4	\$676,011
Unauthorized Consumption	2,222.7	6.1	\$3,955,458
Systematic Data Handling Error	5,592.9	15.3	\$26,212,840
Apparent Loss totals	7,957.3	21.8	\$30,844,309
Real Losses			
Tank Overflows/Operator Error	2.0	0.0	\$388
Reported & Unreported Leakage**			
Transmission Main Leaks/Breaks	5.9	0.0	\$1,146
Distribution Main Leaks/Breaks	613.3	1.7	\$118,868
Customer Service Lines	10,930.4	29.9	\$2,118,571
Hydrant & Valve Leaks	202.5	0.6	\$39,256
Measured Leakage (DMAs)	882.7	2.4	\$171,083
Background Leakage	9,850.5	27.0	\$1,909,268
Leakage Liability Costs			\$759,198
Real Loss totals	22,487.3	61.6	\$5,117,778
Water Losses - Total Cost	30,444.7	83.4	\$35,962,087

Fiscal Year 2007 Financial Data

\$5,102	Apparent Losses per MG-Small Meter Accounts (5/8" & 3/4")
\$4,413	Apparent Losses per MG-Large Meter Accounts (1" and larger)
\$4,350	Apparent Losses per MG for City Property Accounts
\$4,799	Apparent Losses per MG - Overall Average Customer Rate
\$183.82	Real Losses - Marginal Cost per MG
\$759,198	Real Loss indemnity costs - added to total of Real Losses
\$207,254,500	Water Supply Operating Cost for Fiscal Year 2006

Fiscal Year 2007 Infrastructure Data

12,919	Number of Large Meter Accounts, 1-inch and greater
457,383	Number of Small Meter Accounts, 5/8 & 3/4 inch (also includes some large meter accounts)
79,744	Number of actual connections in Non-billed account population
3,014	Miles of transmission and distribution pipeline
25,198	Number of fire hydrants
12	Ave length of service connection: curbstop to customer meter, ft.
14.7	Average length of fire hydrant leads, ft.
55	Average operating pressure, psi

Notes

**The breakdown of leakage categories is approximate and should not be interpreted literally as most of these components are based on estimates rather than measured from minimum hour analysis. It is believed, however, that the overall estimate of leakage is reasonably representative of aggregate system conditions.

City of Philadelphia Annual Water Audit - IWA/AWA Water Audit Method
Fiscal Year 2007 - July 1, 2008 to June 30, 2007
Performance Indicators for Water Supply System Losses

Water Resources Performance Indicator

Inefficiency of Use of Water as a Resource = Real Losses over system input volume, percent
 = 22,487.3 MG divided by 86,257.5 MG x 100% = 26.1%

Operational Performance Indicators

	Million Gallons	MGD
Water Losses	30,444.7	83.4
Apparent Losses	7,957.3	21.8
Real Losses	22,487.3	61.6
Unavoidable Annual Real Losses	2,178.8	6.0 (see next page for calculation)
Real Losses Normalized		112.0 Gallons/Service Connection/Day
Apparent Losses Normalized		39.6 Gallons/Service Connection/Day
Infrastructure Leakage Index (ILI) = Real Losses over UARL		
=	22,487 MG divided by	2,178.8 MG = 10.3

Financial Performance Indicator for Non-revenue Water

Non-revenue Water = Unbilled Authorized Consumption + Apparent Losses + Real Losses
 = 0.2 + 843.6 + 7,957.3 + 22,487.3 = 31,288.5 Million Gallons
 = 85.7 MGD

Non-revenue Water by volume = Non Revenue Water over Water Supplied, %
 = 31,288.5 MG divided by 86,257.5 MG x 100% = 36.3%

Non-revenue Cost Ratio is the annual cost of Non Revenue water over the Annual Running Costs for the water supply system, in %

Non-revenue Water Costs		Unbilled Metered (Somerton Tanks Farm)	
	\$868	Unbilled Unmetered (Authorized Consumption)	
	\$214,310	Apparent Losses	
	\$30,844,309	Real Losses	
	\$5,117,778	<u>Total</u>	
	\$36,177,265		

Non Revenue Cost Ratio = \$36,177,265 divided by \$207,254,500 x 100% = 17.5%

Calculation of Unavoidable Annual Real Losses (UARL): IWA/AWWA Water Audit Method

Unavoidable Annual Real Losses (UARL) is a reference value that can be calculated for any water distribution system and is used in calculating certain performance indicators. It is not an actual measure of any leakage component, however. The IWA/AWWA calculation for UARL is powerful since it is determined on a system-specific basis. The UARL is the theoretical minimal level of leakage that would exist in a distribution system after all possible leakage management actions are implemented, using the best of today's available technology.

The IWA/AWWA calculation includes leakage allowances based upon the number of customer service connections, length of service connection piping between the curbstop or property line and the customer meter, and average system pressure; all of which are key factors in the rate of active leakage in a water distribution system.

Calculation of Unavoidable Annual Real Loss (UARL) for Philadelphia Water Department Fiscal Year 2007, July 1, 2006 - June 30, 2007					
Infrastructure Component	Quantity	Unit Rate for Unavoidable Annual Real Losses	Average Pressure, psi	Unavoidable Annual Real Losses, Million Gallons	Unavoidable Annual Real Losses, MGD
Total Pipeline Mileage, including pipeline total & sum of fire hydrant leads	3,084	5.40 gals/mile/day/psi	55	334.3	0.916
Number of Service Connections (includes active and Non-billed connections that remain in place)	550,046	0.15 gals/service/day/psi	55	1,656.3	4.538
Service Connections, curb-stop to meter	551,959 X 12 ft./5280 ft/mile	7.5 gals/mile/day/psi	55	188.2	0.516
Unavoidable Annual Real Losses				2,178.8	6.0

**PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWWA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007**

CATEGORY/COMPONENTS	VOLUME, MGD Gallons	AVERAGE VOLUME, MGD	ANNUAL COSTS	QUANTIFICATION MECHANISM	DESCRIPTION
I. System Input Volume					
I-1 Unmetered System Input	84,116.9	257.9		Master Meter Total (See Worksheet #10) Estimate (Inferred, 2002)	Treated water system input volume from Load Control Center SCADA System direct. Composite average daily adjustment via mass balance method, performed by Load Control Unit; method applied to annual water audit standing in FY2004.
I-2 Connection for master meter and data handling error	952.0	2.6			
I-3 Connected System Input	83,167.0	255.3		Line I-1 adjusted by I-2 (See Worksheet #10)	
I-4 Exports	6,909.5	18.9		Master Meter Total	Wholesale supply sold to Bucks County Water & Sewer Authority and Aquia Pennsylvania
I. System Input Volume	86,257.5	236.3		Line I-3 minus I-4	Water supplied to distribution system of Philadelphia city proper
II. Authorized Consumption					
II-1 a. Billed Metered	54,969.0	150.6		Customer Billed Consumption from WRB/PWD Billing System. Derived from automatic meter readings (majority) and manual meter readings.	12,919 Active Accounts in Large Meter Control Days (meter reading routes) 8/30/2007 457,383 Active Accounts in Small Meter Control Days (5/8" & 3/4" Meters) 8/30/2007. Export Volume is NOT included in this amount.
II-2 b. Billed Unmetered	0.0	0.0	\$868	Metered	Billed water is typically metered in the city.
c. Unbilled Metered	0.2	0.2	\$668		Consumed 199,500 gallons in FY2007. (Note: the Farm suspended operation of its pilot initiative in mid-2007)
II-3 Somerton Tanks Farms - Urban Farm					
Unbilled Metered Sub-total					
a. Unbilled Unmetered					
-Account Unmetered					
II-4 Scheduled Accounts (temporarily unmetered)	10.8		\$62,020	Estimate (Subjective, 1999)	Assume 150 accounts with unmetered consumption of Roadworks (196 gallons)
II-5 Unmetered Fire Connections	0.2		\$900	Estimate (Subjective, 1999)	Assume 75 fire connections without fire flows totaling 2,800 gallons
Account Unmetered Sub-total	11.0	0.0	\$52,820		
-Account Unmetered					
-Authorized Consumption from the Institute					
II-6 Firefighting - Standard System	65.4		\$10,669	Estimate (Inferred, 1994)	Estimated Fire Department consumption for wetting lines (1980 study)
II-7 Street Cleaning	190.0		\$34,888	Estimate (Inferred, 1990)	Estimated consumption by Streets Department cleaners (1980 study)
II-8 Filling Swimming Pools (City & Private)	7.0		\$1,357	Estimate (Subjective, 1997)	Arbitrary estimate 100 fillings of City's 80 pools; average pool yielded as 75,000 gal in FY1999. 8 Hydrant permits issued for private users in FY2006
Fire Hydrant Permits					
II-9 Construction Permits	197.3		\$38,230	Estimate (Inferred, 1999)	FY2006: 137 Construction Permits issued. Assume 59 gallons per minute (gpm) for 8 hrs/day for 80 day construction period.
II-10 Community Gardens	115.2		\$22,329	Estimate (Inferred, 1995)	FY2006: 80 Urban Garden permits issued. Assume 25 gpm for 8 hrs/day for 120 day growing season
II-11 Miscellaneous Fire Hydrant Permits	9.4		\$465	Estimate (Inferred, 1999)	FY2006: 10 miscellaneous Permits issued. Assume 50 gpm for 4 hrs/day for 20 days
II-12 Sewer Flushing, Citywide Sewer Cleaning contract & misc. contract cleanings	9.8		\$1,901	Estimate (Inferred, 1998)	Citywide contract for sewer flushings recorded 8,413,750 gallons used in these activities in FY2007 and 1,395,600 gallons for other miscellaneous contracted activities; total 9,809,350
II-13 Sprinkler Program	0.1		\$12	Estimate (Inferred, 1998)	5 sprinkler locations in FY2006; 10 days > 30 degrees F (Assumed 2.5 gpm for 8 hours)

**PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWVA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007**

Item	Description	Quantity	Value	Estimate (Subjective, Revised in 1998)	Estimate (Subjective, 1998)	Value	Estimate (Subjective, 1998)	Estimate (Subjective, 1998)	Notes
III-9	Residual Unmetered Consumption	438.0	\$84,898		\$84,898				Unmetered public lines. Assumed 50 events per day for 1 hour at 400 gpm. Assumed 200 illegal connections to water mains or fire service lines.
III-9	Illegal Connections/Fire Connections	14.5	\$49,372		\$49,372				
III-10	Illegal Reconnection of Business Lines; NBS Category	215.7	\$1,035,024		\$1,035,024				FY2007: 2,884 illegal reconnections found in 15,199 reconnections (19.6%). \$48 illegally reconnected accounts found by Delinquency & Restoration Services in FY2007.
III-11	Illegal Reconnection Program, Water Rev Bureau	28.1	\$120,707		\$120,707				19.6% of the 18,205 accounts shut-off but not reconnected assumed illegally reconnected (31,403 total shut-offs in FY2007).
III-12	Unconfirmed Illegal Reconnect; NBS	229.5	\$1,101,669		\$1,101,669				Only 10 cases of tampering (meter offline) detected in FY2007 due to workshifting limitations. 656 accounts uncovered in FY2006. Assume 750 accounts have experienced tampering.
III-13	Illegal Activities include Private Premises Tampering with meters and AMR ERTs	54.2	\$280,143		\$280,143				
III-14	Confirmed missing meters	163.0	\$764,897		\$764,897				Meter Shop confirmed 2,253 missing meters outside of Zero Consumption Investigations.
III-15	Small meters, 6/8 inch and 3/4 inch	26.0	\$174,689		\$174,689				Meter Shop confirmed 38 large meters missing during FY2007.
III-16	Large meters, greater than 3/4 inch	36.1	\$184,347		\$184,347				Assumed 500 additional undiscovered 6/8" accounts are missing meters.
III-17	Estimated Consumption, 6/8-3/4 inch	2,292.7	\$3,955,438		\$3,955,438				
III-17	SCADA System Metered Data	0	\$0		\$0				None in FY2007.
III-18	Date Error SCADA System Program Error	0	\$0		\$0				FY2007 average 48.3% of attempted manual readings were successful. Assume 1% of these are in error by 2%. (Use 5,439 guideline for consumption for large meter accounts)
III-19	Miscellaneous Meter Readings; only non-AMR accounts are manually read as of 6/30/07	5.8	\$29,896		\$29,896				FY2007 18,719 Estimated Accounts (EA) - 70 (tom down) gives 18,649 accounts. Assume 10% of these are under-estimated 25%.
III-20	AMR reading device (ERT) failure (tampering from Zero Consumption Investigations)	38.3	\$180,088		\$180,088				FY2007 only 27 zero-consumption accounts investigated. In FY2006 100% 1.4% of 1,015 accounts with ERT failure. Assume this rate for typical 12,000 zero-consumption accounts in the system. ITRON Inc. attributes ERT failure.
III-21	Estimating error	30.1	\$144,371		\$144,371				Assume 100 active connections exist in the city without accounts or billing. Revenue Protection found 11 such customers in FY2007.
III-22	No Billing/Customer without an Account	66.9	\$474,501		\$474,501				Assume 100 active connections exist in the city without accounts or billing. Revenue Protection found 11 such customers in FY2007.
III-23	Non-billed Accounts with active consumption	12.6	\$60,542		\$60,542				FY2007 87,744 NB accounts exist. Excluding 18,790 NBS accounts gives 78,954 NB accounts. Assume 15% are active water users.
III-24	Billing Adjustments & Waivers	78.4	\$3,756,671		\$3,756,671				The Customer Billing System awards financial credits when needed by adjusting consumption to negative values, thereby distorting actual customer consumption totals. Data mining analysis quantified total volume attributed to negative adjustments in FY2006.
III-25	Small Meter Accounts	884.9	\$3,919,868		\$3,919,868				City properties are often given low priority for meter/higher reading/billing functions.
III-26	Large Meter Accounts	650.0	\$2,827,677		\$2,827,677				Approximately 1,275 such accounts exist. A number of PWD facilities are large water consumers.
III-27	City Properties	450.0	\$1,957,823		\$1,957,823				
III-28	PWD accounts lacking billing	26.0	\$106,757		\$106,757				
III-29	Other city accounts lacking billing	1825.0	\$8,759,035		\$8,759,035				
III-30	Exceptional Adjustment Activity FY2007	5,292.9	\$28,212,840		\$28,212,840				
III-31	City Properties	7,987.3	\$30,844,308		\$30,844,308				
III-32	City Properties	2.0	\$888		\$888				One event (Lower Roxborough Storage Basin) on 2/3 & 2/4/07.
III-33	City Properties	0.0	\$0		\$0				No events in FY2007.
III-34	City Properties	0.0	\$0		\$0				Lease losses are a factor of the type of leak and the duration that it runs. Reported leaks and breaks evidence themselves quickly, which results in shorter durations than Unreported Leaks, which often run at length undetected.
III-35	City Properties	0.0	\$0		\$0				
III-36	City Properties	0.0	\$0		\$0				
III-37	City Properties	0.0	\$0		\$0				
III-38	City Properties	0.0	\$0		\$0				
III-39	City Properties	0.0	\$0		\$0				
III-40	City Properties	0.0	\$0		\$0				
III-41	City Properties	0.0	\$0		\$0				
III-42	City Properties	0.0	\$0		\$0				
III-43	City Properties	0.0	\$0		\$0				
III-44	City Properties	0.0	\$0		\$0				
III-45	City Properties	0.0	\$0		\$0				
III-46	City Properties	0.0	\$0		\$0				
III-47	City Properties	0.0	\$0		\$0				
III-48	City Properties	0.0	\$0		\$0				
III-49	City Properties	0.0	\$0		\$0				
III-50	City Properties	0.0	\$0		\$0				
III-51	City Properties	0.0	\$0		\$0				
III-52	City Properties	0.0	\$0		\$0				
III-53	City Properties	0.0	\$0		\$0				
III-54	City Properties	0.0	\$0		\$0				
III-55	City Properties	0.0	\$0		\$0				
III-56	City Properties	0.0	\$0		\$0				
III-57	City Properties	0.0	\$0		\$0				
III-58	City Properties	0.0	\$0		\$0				
III-59	City Properties	0.0	\$0		\$0				
III-60	City Properties	0.0	\$0		\$0				
III-61	City Properties	0.0	\$0		\$0				
III-62	City Properties	0.0	\$0		\$0				
III-63	City Properties	0.0	\$0		\$0				
III-64	City Properties	0.0	\$0		\$0				
III-65	City Properties	0.0	\$0		\$0				
III-66	City Properties	0.0	\$0		\$0				
III-67	City Properties	0.0	\$0		\$0				
III-68	City Properties	0.0	\$0		\$0				
III-69	City Properties	0.0	\$0		\$0				
III-70	City Properties	0.0	\$0		\$0				
III-71	City Properties	0.0	\$0		\$0				
III-72	City Properties	0.0	\$0		\$0				
III-73	City Properties	0.0	\$0		\$0				
III-74	City Properties	0.0	\$0		\$0				
III-75	City Properties	0.0	\$0		\$0				
III-76	City Properties	0.0	\$0		\$0				
III-77	City Properties	0.0	\$0		\$0				
III-78	City Properties	0.0	\$0		\$0				
III-79	City Properties	0.0	\$0		\$0				
III-80	City Properties	0.0	\$0		\$0				
III-81	City Properties	0.0	\$0		\$0				
III-82	City Properties	0.0	\$0		\$0				
III-83	City Properties	0.0	\$0		\$0				
III-84	City Properties	0.0	\$0		\$0				
III-85	City Properties	0.0	\$0		\$0				
III-86	City Properties	0.0	\$0		\$0				
III-87	City Properties	0.0	\$0		\$0				
III-88	City Properties	0.0	\$0		\$0				
III-89	City Properties	0.0	\$0		\$0				
III-90	City Properties	0.0	\$0		\$0				
III-91	City Properties	0.0	\$0		\$0				
III-92	City Properties	0.0	\$0		\$0				
III-93	City Properties	0.0	\$0		\$0				
III-94	City Properties	0.0	\$0		\$0				
III-95	City Properties	0.0	\$0		\$0				
III-96	City Properties	0.0	\$0		\$0				
III-97	City Properties	0.0	\$0		\$0				
III-98	City Properties	0.0	\$0		\$0				
III-99	City Properties	0.0	\$0		\$0				
III-100	City Properties	0.0	\$0		\$0				
III-101	City Properties	0.0	\$0		\$0				
III-102	City Properties	0.0	\$0		\$0				
III-103	City Properties	0.0	\$0		\$0				
III-104	City Properties	0.0	\$0		\$0				
III-105	City Properties	0.0	\$0		\$0				
III-106	City Properties	0.0	\$0		\$0				
III-107	City Properties	0.0	\$0		\$0				
III-108	City Properties	0.0	\$0		\$0				
III-109	City Properties	0.0	\$0		\$0				
III-110	City Properties	0.0	\$0		\$0				
III-111	City Properties	0.0	\$0		\$0				
III-112	City Properties	0.0	\$0		\$0				
III-113	City Properties	0.0	\$0		\$0				
III-114	City Properties	0.0	\$0		\$0				
III-115	City Properties	0.0	\$0		\$0				
III-116	City Properties	0.0	\$0		\$0				
III-117	City Properties	0.0	\$0		\$0				
III-118	City Properties	0.0	\$0		\$0				
III-119	City Properties	0.0	\$0		\$0				
III-120	City Properties	0.0	\$0		\$0				
III-121	City Properties	0.0	\$0		\$0				
III-122	City Properties	0.0	\$0		\$0				
III-123	City Properties	0.0	\$0		\$0				
III-124	City Properties	0.0	\$0		\$0				
III-125	City Properties	0.0	\$0		\$0				
III-126	City Properties	0.0	\$0		\$0				
III-127	City Properties	0.0	\$0		\$0				
III-128	City Properties	0.0	\$0		\$0				
III-129	City Properties	0.0	\$0		\$0				
III-130	City Properties	0.0	\$0		\$0				
III-131	City Properties	0.0	\$0		\$0				
III-132	City Properties	0.0	\$0		\$0				
III-133	City Properties	0.0	\$0		\$0				
III-134	City Properties	0.0	\$0		\$0				
III-135	City Properties	0.0	\$0		\$0				
III-136	City Properties	0.0	\$0		\$0				
III-137	City Properties	0.0	\$0		\$0				
III-138	City Properties	0.0	\$0		\$0				
III-139	City Properties	0.0	\$0		\$0				
III-140	City Properties	0.0	\$0		\$0				
III-141	City Properties	0.0	\$0		\$0				
III-142	City Properties	0.0	\$0		\$0				
III-143	City Properties	0.0	\$0		\$0				
III-144	City Properties	0.0	\$0		\$0				
III-145	City Properties	0.0	\$0		\$0				
III-146	City Properties	0.0	\$0		\$0				
III-147	City Properties	0.0	\$0		\$0				
III-148	City Properties	0.0	\$0		\$0				
III-149	City Properties	0.0	\$0		\$0				
III-150	City Properties	0.0	\$0		\$0				
III-151	City Properties	0.0	\$0		\$0				
III-152	City Properties	0.0	\$0		\$0				
III-153	City Properties	0.0	\$0		\$0				
III-154	City Properties	0.0	\$0		\$0				
III-155	City Properties	0.0	\$0		\$0				

PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWWA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007

Item	Leakage	Component Analysis (FY2006)	Component Analysis (FY2007)						
II-26 Transmission Main Breaks - Reported	2.0	\$380	\$0						
II-26 Transmission Main Breaks - Unreported	0.0	\$0	\$0						
II-27 Transmission Main Leaks - Reported	4.8	\$766	\$0						
II-28 Transmission Main Leaks - Unreported	0.0	\$0	\$0						
II-29 Distribution Main Breaks - Reported	34.1	\$4,612	\$0						
II-30 Distribution Main Breaks - Unreported	0.0	\$0	\$0						
II-31 Distribution Main Leaks - Reported	68.5	\$19,054	\$0						
II-32 Distribution Main Leaks - Unreported	122.2	\$23,688	\$0						
II-33 Service Line Leaks - PWD Repair: Reported	861.12	\$188,820	\$0						
II-34 Service Line Leaks - PWD Repair: Unreported	438.5	\$94,900	\$0						
II-35 Service Line Leaks - Customer arranged repairs: Reported	1,021.4	\$187,903	\$0						
II-36 Service Line Leaks - Customer arranged repairs: Unreported	0.0	\$0	\$0						
II-37 Abandoned Service Line Leaks - Reported	2,108.0	\$405,153	\$0						
II-38 Abandoned Service Line Leaks - Unreported	111.2	\$21,561	\$0						
II-39 Hydrant Leaks - Reported	5.2	\$1,009	\$0						
II-40 Hydrant Leaks - Unreported	118.1	\$22,889	\$0						
II-41 Valve Leaks - Reported	23.0	\$4,452	\$0						
II-42 Valve Leaks - Unreported	56.2	\$10,890	\$0						
II-42 Valve Leaks - Unreported	5,001.4	\$969,353	\$0						
Measured Leakage in District Mapped Areas (DMA) and several main lines									
II-43 DMA1 - Lower Roborough Gruffy Dist.	3.7	\$707	\$0						
II-44 DMA2 - Upper Roborough Gruffy Dist.	8.8	\$1,599	\$0						
II-45 DMA3 - Chestnut Hill District	31.4	\$6,084	\$0						
II-46 DMA4 - Belmont Gruffy District	32.1	\$6,226	\$0						
II-47 DMA5 - Roborough High Service District	168.0	\$32,562	\$0						
II-48 Repeated Active Leaks Ongoing Leaks	659.0	\$123,605	\$0						
Measured Leakage sub-total	882.7	\$171,083	\$0						
Background Leakage									
II-49 Unlined Underground Reservoirs	184.0	\$35,856	\$0						
II-50 Booster Pumping Station Piping	184.0	\$35,856	\$0						
II-51 Transmission Mains	64.0	\$12,405	\$0						
II-52 Distribution Mains	418.0	\$81,018	\$0						
II-53 Customer Service Lines	3,240.0	\$627,990	\$0						
II-54 Hydrants & Valves	0.0	\$0	\$0						
Background Leakage sub-total	4,088.9	\$792,725	\$0						
Leakage Total	9,973.9	\$1,928,190	\$0						
B. Real Losses Total	9,975.9	\$1,933,578	\$0						
Indemnity Costs for damage incidents from water leakage (FY2005 data)		\$759,198	\$0						
Total Cost of Real Losses		\$2,692,776	\$0						

**PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWWA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007**

City of Philadelphia - Preliminary Water Audit Summary Fiscal Year 2007 July 1, 2006 - June 30, 2007

Water Supplied

	Million Gallons	Mgd	Annual Cost
System Input	94,119.8	257.9	
Correction for Master Meter & data handling error	952.8	2.6	
Corrected System Input	93,167.0	255.3	
Minus Exports	6,909.5	18.9	
Water Supplied (City only)	86,257.5	236.3	

Authorized Consumption

Billed Metered	54,969.0	150.6	
Billed Unmetered	0.0	0.0	
Unbilled Metered	0.2	0.0	\$368
Unbilled Unmetered	843.6	2.3	\$214,310
Authorized Consumption	55,812.8	152.9	\$215,176

Water Losses

	30,444.7	83.4	
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Apparent Losses

Customer Meter Inaccuracies	141.8	0.4	\$676,011
Unauthorized Consumption	2,222.7	6.1	\$3,955,468
Systematic Data Handling Error	5,592.9	15.3	\$26,212,840
Apparent Loss Total	7,957.3	21.8	\$30,844,309

Real Losses

Tank Overflow/Operator Error Reported & Unreported Leakage	2.0	0.0	\$388
Transmission Main Breaks & Leaks	5.9	0.0	\$1,146
Distribution Mains Breaks & Leaks	254.6	0.7	\$49,354
Customer Service Lines	4,538.3	12.4	\$879,627
Hydrant & Valve Leaks	202.5	0.6	\$39,256
Measured Leakage (DMAe)	882.7	2.4	\$171,083
Background Leakage	4,089.9	11.2	\$792,725
Leakage Liability Costs			\$759,198
Real Loss Total	9,975.9	27.3	\$2,692,776

Water Loss Total - Preliminary Audit

	17,959.3	49.1	\$33,537,085
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Balancing Error = Water Losses - (Apparent + Real Losses)

	12,511.4	34.3	
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Fiscal Year 2007 Financial Data

\$5,102	Apparent Costs per MG-Small Meter Accounts (5/8" & 3/4")
\$4,413	Apparent Costs per MG-Large Meter Accounts (1" and larger)
\$4,350	Apparent Costs per MG for City Property Accounts
\$4,799	Overall Average Customer Rate
\$193.82	Marginal Cost per MG for Real Losses
365	Number of days in the Fiscal Year
12,919	Number of Large Meter Accounts, 1-inch and greater
457,393	Number of Small Meter Accounts, 5/8 & 3/4 inch (also includes some large meter accounts)

Water Supply Operating Cost

	\$207,264,500
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The Balancing Error reflects the fact that not all components of loss, particularly leakage are included in the water audit. Since the distribution system is not metered for leakage continuously, a large portion of leakage is not captured in this preliminary audit.

**PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWWA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007**

City of Philadelphia - Water Audit Fiscal Year 2007 - Balancing Error Adjustment

While the source of the water loss represented by the Balancing Error is not specifically known, the City of Philadelphia applies this error to three major leakage categories in an apportioned manner.

Adding the quantities of estimated and measured leakage into the Water Audit gives a final summary and allows for an approximation of losses that equal the audited total of 74.4 MGD. The Balancing Error in FY2007 is 33.4 MGD is compared to 32.7 MGD, 36.0 MGD, 28.1 MGD, 26.3 MGD, 20.7 MGD, 29.1 MGD and 25.9 MGD during the seven previous years.

Certain accounting changes were implemented in FY2004 and FY2002. For FY2004 & FY2002, restructuring of the leakage components was incorporated into the top down water audit, resulting in an increased balancing error. A detailed component analysis was added by WSO, Inc. in FY2004. Leakage estimates are subject to a possible wide degree of error since most of the leakage losses are inferred from leakage repair results, which are not documented in a comprehensive manner. Improved work order management is needed to better document and analyze leak detection and repairs. Obtaining minimum hour flow data from District Metered Areas is a more reliable means to quantify leakage.

As the Philadelphia Water Department and Water Revenue Bureau further employ the use of District Metered Areas to gather actual leakage measurements and data management is improved, the magnitude of the Balancing Error should gradually reduce, giving a more reliable water audit.

It is possible that some of the amount of the Balancing Error is actually Apparent Loss.

Assigning the Balancing Error to Real Losses: from the Preliminary Water Audit

	Million Gallons	Mgd	% of Total	Multiply % by Bal. Error - Million Gallons
Unreported Leakage on Distribution Mains	254.6	0.7	2.9%	358.6
Unreported Leakage on Active and Abandoned Customer Service Lines	4,338.3	12.4	51.1%	6,392.1
Background Leakage	4,089.9	11.2	46.0%	5,760.6
Total	8,882.8	24.3	100%	12,511.4

Category Assigned to Balancing Error	Million Gallons	Mgd	Annual Cost	Quantification Mechanism	Description
Unreported Leakage on Distribution Mains	613.5	1.7	\$118,868	Balancing Error Adjustment (FY2004)	Unreported leakage on distribution mains adjusted by apportioned balancing error
Unreported Leakage on Active and Abandoned Customer Service Lines	10,930.4	29.9	\$2,118,571	Balancing Error Adjustment (FY2004)	Service line leakage adjusted by apportioned balancing error
Background Leakage	9,850.5	27.0	\$1,905,268	Balancing Error Adjustment (FY2004)	Background leakage adjusted by apportioned balancing error
	21,394.2	58.6	\$4,142,707		

**PHILADELPHIA WATER DEPARTMENT - WATER REVENUE BUREAU
 DETAILED WATER AUDIT USING IWA/AWWA WATER AUDIT METHOD
 FISCAL YEAR 2007 JULY 1, 2006 - JUNE 30, 2007**

City of Philadelphia - Complete Water Audit Summary Fiscal Year 2007 July 1, 2006 - June 30, 2007

Water Supplied

	million Gallons	Mgd	Annual Cost
System Input	94,119.8	257.9	
Correction for Meter Meter & data handling error	952.8	2.6	
Corrected System Input	93,167.0	255.3	
Minus Exports	6,909	18.9	
Water Supplied (City only)	86,257.5	236.3	

Authorized Consumption

Billed Metered	54,989.0	150.6	
Billed Unmetered	0.0	0.0	
Unbilled Metered	0.2	0.0	\$668
Unbilled Unmetered	843.6	2.3	\$214,310
Authorized Consumption	55,812.8	152.9	\$215,178

Water Losses

30,444.7 **83.4**

Apparent Losses

Customer Meter Inaccuracies	141.8	0.4	\$676,011
Unauthorized Consumption	2,222.7	6.1	\$3,955,458
Systematic Data Handling Error	5,592.9	15.3	\$26,212,840

Apparent Loss Total

7,957.3 **21.8** **\$30,844,309**

Real Losses

Tank Overflow/Operator Error	2.0	0.0	\$388
Reported & Unreported Leakage			
Transmission Main Breaks & Leaks	5.9	0.0	\$1,146
Distribution Mains Leaks & Breaks	613.3	1.7	\$118,868
Customer Service Lines	10,930.4	29.9	\$2,118,571
Hydrant & Valve Leaks	202.5	0.6	\$38,256
Measured Leakage (DMAs)	882.7	2.4	\$171,083
Background Leakage	9,850.5	27.0	\$1,909,268
Leakage Liability Costs			\$759,199

Real Loss Total

22,487.3 **61.6** **\$5,117,778**

Water Loss Total

30,444.7 **83.4** **\$35,962,087**

Fiscal Year 2007: Financial Data

\$5,102	Apparent Costs per MG-Small Meter Accounts (5/8" & 3/4")
\$4,413	Apparent Costs per MG-Large Meter Accounts (1" and larger)
\$4,350	Apparent Costs per MG for City Property Accounts
\$4,799	Overall Average Customer Rate
\$199.92	Marginal Cost per MG for Real Losses
385	Number of days in the Fiscal Year
12,919	Number of Large Meter Accounts, 1-inch and greater
457,383	Number of Small Meter Accounts, 5/8 & 3/4 inch (includes some large meter accounts)

\$387,254,500 **Water Supply Operating Cost**

International Water Association - American Water Works Association Standard Water Balance for the Philadelphia Water Department - Fiscal Year 2007

Volumes reported in million gallons for the reporting year, and average million gallons per-day, mgd in italic

Water Exported 6,909.5 <i>18.9</i>	Water Exported 6,909.5 <i>18.9</i>	Water Exported 6,909.5 <i>18.9</i>	Water Exported 6,909.5 <i>18.9</i>	Water Exported 6,909.5 <i>18.9</i>
System Input 93,167.0 <i>255.3</i>	Water Supplied 86,257.5 <i>236.3</i>	Authorized Consumption 55,812.8 <i>152.6</i>	Billed Authorized Consumption 54,969.0 <i>150.6</i>	Revenue Water 54,969.0 <i>150.6</i>
Own Sources 94,119.8 <i>257.9</i>	System Input 93,167.0 <i>255.3</i>	Unbilled Authorized Consumption 843.8 <i>2.3</i>	Unbilled Authorized Consumption 843.8 <i>2.3</i>	Non-revenue Water 31,288.5 <i>85.7</i>
- Correction 952.8 <i>2.6</i>	Water Imported 0	Water Losses 30,444.7 <i>83.4</i>	Apparent Losses 7,857.3 <i>21.8</i>	Leakage on Mains 11,556.9 <i>31.7</i>
				Leakage and Overflows at Storages 2.0 <i>0.0</i>
				Leakage on Service Connections up to the point of customer metering 10,930.4 <i>29.9</i>
				Billed Metered Consumption 54,969.0 <i>150.6</i>
				Billed Unmetered Consumption 0.0 <i>0.0</i>
				Unbilled Metered Consumption 0.2 <i>0.0</i>
				Unbilled Unmetered Consumption 843.6 <i>2.3</i>
				Customer Metering Inaccuracies 141.5 <i>0.4</i>
				Unauthorized Consumption 2,222.7 <i>6.1</i>
				Systematic Data Handling Error 5,592.9 <i>15.3</i>

Definitions of Terms

OWN SOURCES: the volume of water input to a water distribution system from the water supplier's own sources

WATER IMPORTED OR EXPORTED: the volumes of bulk transfers across operational boundaries

SYSTEM INPUT: the volume input to that part of the water supply system to which the water balance calculation relates, allowing for known errors.
Equal to OWN SOURCES + WATER IMPORTED +/- CORRECTION for production meter error

WATER SUPPLIED: SYSTEM INPUT minus WATER EXPORTED

AUTHORIZED CONSUMPTION: volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are implicitly or explicitly authorized to do so by the water supplier, for residential, commercial and industrial purposes.

Note: Authorized consumption may include items such as fire fighting and training, flushing of mains and sewers, street cleaning, watering of municipal gardens, public fountains, frost protection, building water, etc. These may be billed or unbilled, metered or unmetered

WATER LOSSES: the difference between SYSTEM INPUT and AUTHORIZED CONSUMPTION. Water losses can be considered as a total volume for the whole system, or for partial systems such as raw water mains, transmission or distribution systems, or individual zones

APPARENT LOSSES: includes all types of inaccuracies associated with customer metering, systematic error or manipulation of consumption data in billing and accounting systems, plus unauthorized consumption (theft or illegal consumption).

Note: Over-registration of customer meters, leads to under-estimation of REAL LOSSES. Under-registration of customer meters, leads to over-estimation of REAL LOSSES.

REAL LOSSES: physical water losses from the pressurized system, up to the point of measurement of customer consumption. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows

Note: Although physical losses after the point of customer flow measurement or assumed consumption are excluded from the assessment of REAL LOSSES, this does not necessarily mean that they are insignificant or unworthy of attention for demand management purposes

REVENUE WATER: those components of SYSTEM INPUT which are billed and produce revenue (also known as BILLED AUTHORIZED CONSUMPTION). Equal to BILLED WATER EXPORTED, BILLED METERED CONSUMPTION and BILLED UNMETERED CONSUMPTION

NON-REVENUE WATER: those components of SYSTEM INPUT which are not billed and do not produce revenue. Equal to UNBILLED AUTHORIZED CONSUMPTION, APPARENT LOSSES and REAL LOSSES

UNBILLED AUTHORIZED CONSUMPTION: those components of AUTHORIZED CONSUMPTION which are not billed and do not produce revenue.
Equal to UNBILLED METERED CONSUMPTION and UNBILLED UNMETERED CONSUMPTION

City of Philadelphia Annual Water Audit - Comparison of Data from Fiscal Years 2000-2007

	Fiscal Year 2007			Fiscal Year 2006			Fiscal Year 2005			Fiscal Year 2004		
	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year
Water Supplied												
Water Delivery	257.9		245.9		261.0		281.0		281.0		281.0	
Master Meter Adjustment	2.8		0.8		-0.7		1.900		1.900		1.900	
	255.3		253.9		260.3		283.000		283.000		283.000	
Authorized Consumption												
Billed Metered	169.8		177.0		178.9		176.908		176.908		176.908	
Billed Unmetered	0.0		0.0		0.0		0.000		0.000		0.000	
Unbilled Metered	0.0005	\$883	0.0005	\$1,176	0.2	\$11,871	0.483	\$11,871	0.483	\$23,856	0.683	\$23,856
Unbilled Unmetered	2.3	\$214,310	2.4	\$191,084	2.1	\$143,484	1.895	\$135,759	1.895	\$135,759	1.895	\$135,759
Authorized Consumption	171.8	\$215,178	179.4	\$192,300	179.2	\$165,165	179.285	\$156,715	179.285	\$156,715	179.285	\$156,715
Water Losses												
Water Losses	83.4		74.4		81.1		83.715		83.715		83.715	
Apparent Losses												
Unit Retail Cost	21.8	\$0,844,309	15.1	\$20,275,511	14.1	\$19,093,954	11.09	\$10,937,852	11.09	\$10,937,852	11.09	\$10,937,852
	\$4,789		\$4,500		\$4,132		\$3,945		\$3,945		\$3,945	
Real Losses												
Real Losses	61.6	\$,117,778	59.2	\$4,228,645	66.8	\$3,949,821	72.626	\$4,974,564	72.626	\$4,974,564	72.626	\$4,974,564
Variable Production Cost												
Variable Production Cost	\$193.82		\$100.46		\$130.54		\$133.53		\$133.53		\$133.53	
TOTALS												
TOTALS		\$35,952,087		\$24,505,257		\$23,042,805		\$15,012,715		\$15,012,715		\$15,012,715
Key Performance Indicators												
Key Performance Indicators												
Non-revenue Water by Volume, %		36.3%		32.2%		34.0%		35.4%		35.4%		35.4%
Non-revenue Water by Cost, %		17.5%		13.0%		12.4%		9.05%		9.05%		9.05%
Infrastructure Leakage Index (ILI)		10.3		9.9		11.0		12.3		12.3		12.3

	Fiscal Year 2003			Fiscal Year 2002			Fiscal Year 2001			Fiscal Year 2000		
	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year	Water, MGD	Cost for Year
Water Supplied												
Water Delivery	271.600		261.100		270.260		280.500		280.500		280.500	
Master Meter Adjustment	-1.300		-1.900		2.702		2.805		2.805		2.805	
	270.300		263.000		267.468		277.695		277.695		277.695	
Authorized Consumption												
Billed Metered	182.600		177.680		181.700		185.800		185.800		185.800	
Billed Unmetered	0.693		0.694		0.000		0.000		0.000		0.000	
Unbilled Metered	0.682	\$76,694	0.648	\$24,342	0.838	\$27,941	0.424	\$17,109	0.424	\$17,109	0.424	\$17,109
Unbilled Unmetered	2.466	\$153,482	1.935	\$121,642	1.741	\$107,478	2.570	\$131,882	2.570	\$131,882	2.570	\$131,882
Authorized Consumption	186.431	\$180,376	180.677	\$145,984	184.079	\$134,517	188.794	\$148,991	188.794	\$148,991	188.794	\$148,991
Water Losses												
Water Losses	83.709		82.323		83.419		88.901		88.901		88.901	
Apparent Losses												
Unit Retail Cost	13.288	\$10,013,510	12.134	\$9,039,037	14.498	\$11,589,741	18.941	\$13,750,885	18.941	\$13,750,885	18.941	\$13,750,885
	\$3,671		\$3,285		\$3,103		\$3,120		\$3,120		\$3,120	
Real Losses												
Real Losses	70.471	\$3,692,256	69.169	\$3,399,029	88.924	\$2,499,148	70.148	\$2,985,129	70.148	\$2,985,129	70.148	\$2,985,129
Variable Production Cost												
Variable Production Cost	\$136.60		\$131.70		\$116.12		\$110.25		\$110.25		\$110.25	
TOTALS												
TOTALS		\$13,895,865		\$12,403,068		\$14,087,887		\$16,715,023		\$16,715,023		\$16,715,023
Key Performance Indicators												
Key Performance Indicators												
Non-revenue Water by Volume, %		32.1%		32.2%		32.1%		33.1%		33.1%		33.1%
Non-revenue Water by Cost, %		8.28%		8.09%		9.19%		11.50%		11.50%		11.50%
Infrastructure Leakage Index (ILI)		11.9		13.1		12.7		12.3		12.3		12.3

Costs Per Dry Ton of Sludge Processing

Annual Production Costs	
Wood chips	\$ 716,230
Polymer	<u>1,165,033</u>

Total \$ 1,881,263 Annual Dry Ton Production - 68,757

Electrical Cost Calculation

Annual electrical consumption at Biosolids Recycling 9,569,000 Kwh*
 Avg. Kwh/ dry ton of sludge = 9,569,000/ 68,757 = 139.17 Kwh/ ton
 Elec. Cost/ Ton = 139.17 @ \$0.02591/ Kwh \$ 3.61 / dry ton

* For the year ending 2/28/2007 (the latest data that was available)

Polymer & Wood Chip Costs -	\$ 1,881,263 / 68,757 tons	\$ 27.36	per dry ton
Electrical Costs -		3.61	"
		<u>Total \$ 30.97</u>	

Number of dry tons per MG x cost per dry ton - 0.19151 X \$30.970 \$ 5.93

Cost of Sludge Processing per Million Gallons \$ 5.93

D. Sludge Disposal Costs

Estimated Water Treatment Sludge in Dry Tons- 17,842
 Average Disposal Fee Per Dry Ton -
 Costs of Disposal - \$ 9,940,911
 Annual Dry Tons Utilized- 68,221

Average Cost Per Dry-Ton \$ 145.72 / ton

Dry Tons Of Sludge Per Million Gallons of Water Produced

17,842 tons / 93,148 million gallons = 0.19151 dry tons/ MG

Sludge Disposal Costs Per Million Gallons of Water

\$145.72 * 0.19151 tons

Sludge Disposal Costs/Million Gallons of Water \$ 27.91

E. Wastewater Treatment Plant Costs of Water Treatment Plant Direct Discharges into The Sewer System

Assumption: 25% of real losses reach the collector system and proceed through wastewater treatment

Wastewater Treatment Marginal Costs

Average Electrical Cost Per Million Gallons of Treated Wastewater -

Total Annual Approx. Wastewater System Electrical Consumption - *Not available for FY2007*

Total Annual Wastewater Treated - 169,024 MG

Average kwh/ million gal. based on the ave. for FY2000-2003 821 kwh/ MG

Average electrical cost per MG - 821 * \$0.02591 \$ 21.27 / MG

Average Chemical Cost Per Million Gallons of Treated Wastewater-

Annual Chemical Costs * - \$ 1,115,343

Average chemical cost per MG \$ 1115343 / 169024 \$ 6.60 /MG

* Does not include phosphoric acid

Total Electrical and Chemical Costs Per MG- \$ 27.87

F. Total of all Marginal Production Costs for Real Losses

Costs Per Million Gallons Of Water Produced	
Electrical	\$ 36.82
Chemical	\$ 116.20
Treated Water Sludge Processing	\$ 5.93
Treated Water Sludge Disposal	\$ 27.91
Total	\$ 186.86
Wastewater Treatment	\$ 27.87

Total Production Cost = \$186.86 + (0.25*\$27.87) =\$193.82

Total Marginal Cost per MG of Delivery Loss- \$ 193.82

**INDEMNITIES- WATER MAIN RELATED - Fiscal Year 2005 Data
(Add to total Real Loss cost total in Water Audit)**

Water Customer Service Claims

Payments (estimated)	\$	55,364
Risk Management Payments	\$	703,834
(includes lawsuits)	Total \$	759,198

II. APPARENT LOSSES (LOST REVENUE)

Totals are derived from the various retail rates charged to consumers

Small Meter Customers (5/8" and 3/4" meter size)

Mcf = 1,000 cubic feet
MG = million gallons

Usage Charge - \$21.14 + \$17.02 = \$38.16/ Mcf

133,690 cf = 1,000,000 gallons;

133.69 Mcf * \$38.16 \$ 5,102 / MG

1" and Larger (water usage) Rate- Usage Charge - \$15.99 + \$17.02 = \$33.01/ Mcf

133.69 Mcf * \$33.01 = \$ 4,413 / MG

City Accounts - Usage Charge - \$15.52 + \$17.02 = \$32.54/ Mcf

133.69 Mcf * \$32.54 \$ 4,350 / MG

Overall Average Customer Rates - Usage Charge - \$18.88 + \$17.02 = \$35.90 / Mcf

133.69 Mcf * \$35.90 = \$ 4,799 / MG

CITY OF PHILADELPHIA - LONG-TERM WATER ACCOUNTABILITY STATISTICS

Fiscal Year	Source Water Withdrawal		Water Supplied to Bucks County Exports & City	Wholesale Export Sales to Other Water Suppliers						Water Supplied to City only MGD	Billed Authorized Consumption - City of Philadelphia				Non-revenue Water				Water Resources Utilization				
	Bethlehem River Water MGD	Delaware River Water Withdrawal MGD		Water Supplied to Bucks County MGD	Water to Deer Township, MGD	Water to Asia America - Trenton Township, MGD	Water to Asia America - Chambers Township, MGD	Total Wholesale Supply to Agents MGD	% of water supplied		Total Wholesale Exports, MGD	% of water supplied	% of Total Authorized Meter Control Day**	Total Billed Authorized Consumption	Population BCWSA services	Population BCWSA services	Population: Total Aqua America services						
1980	157.3	199	387.3	12.3	3.4%	12.3	3.4%	341.2	101.9	101.9	101.9	101.9	101.9	101.9	211.6	211.6	211.6	211.6	1,094,210	1,094,210	1,094,210	2,471,210	192
1981	172.1	203.7	375.8	12.7	3.6%	12.7	3.6%	343.2	103.3	103.3	103.3	103.3	103.3	103.3	203.3	203.3	203.3	203.3	1,094,210	1,094,210	1,094,210	2,471,210	192
1982	179.1	199	378.1	12.8	3.6%	12.8	3.6%	345.3	103.3	103.3	103.3	103.3	103.3	103.3	203.3	203.3	203.3	203.3	1,094,210	1,094,210	1,094,210	2,471,210	192
1983	180.4	180.8	361.2	12.8	3.6%	12.8	3.6%	311.8	85.8	85.8	85.8	85.8	85.8	85.8	204.5	204.5	204.5	204.5	1,094,210	1,094,210	1,094,210	2,471,210	192
1984	171.4	185.1	356.5	14.3	4.3%	14.3	4.3%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1985	187.1	185.0	372.1	13.9	4.3%	13.9	4.3%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1986	172.5	186.6	359.1	14.8	4.9%	14.8	4.9%	311.8	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1987	187.2	186.6	373.8	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1988	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1989	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1990	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1991	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1992	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1993	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1994	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1995	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1996	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1997	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1998	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
1999	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2000	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2001	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2002	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2003	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2004	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2005	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2006	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192
2007	187.4	186.6	374.0	15.1	4.9%	15.1	4.9%	307.7	88.9	88.9	88.9	88.9	88.9	88.9	203.1	203.1	203.1	203.1	1,094,210	1,094,210	1,094,210	2,471,210	192

* Transition year from Quarterly to Monthly Billing method

**Control Days refer to meter reading routes

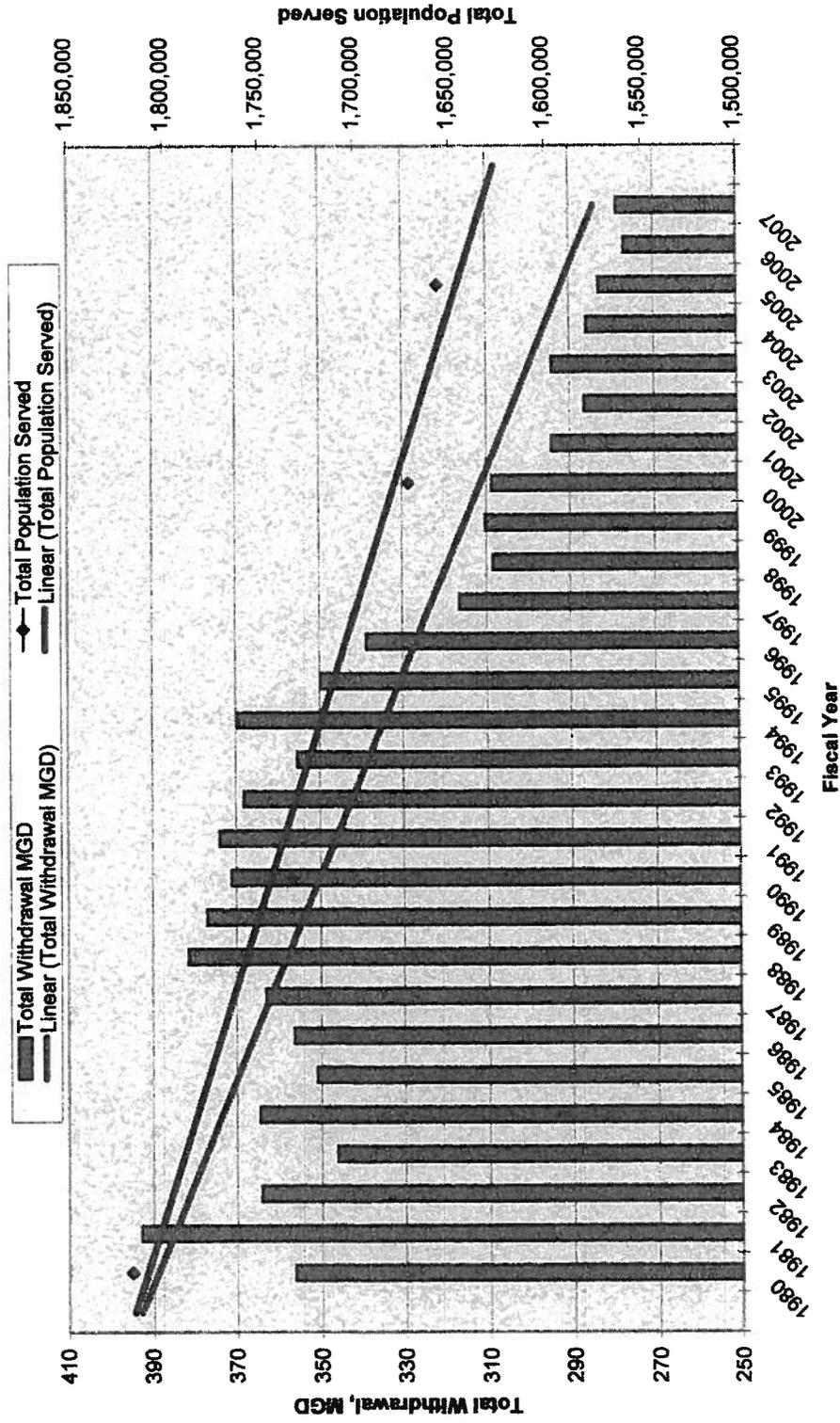
*** Non-revenue Water is the difference between water supplied and Billed Authorized Consumption. The percentage indicator Non-revenue Water by Volume is a basic financial performance indicator only, and not a reliable technical performance indicator. See Water Audit Summary for calculation of all IWA/AWWA Method performance indicators.

The proportion of large meter vs. small meter consumption for fiscal years 1997-2005 is skewed, erroneously showing large meters reducing as a percentage of the total consumption. This occurred since large meter accounts, once outfitted with AMR, were moved into small meter control day (meter reading) routes. Resuming in FY2006 a realistic breakdown of large meter billed consumption vs. small meter billed consumption is given.

Population Data for 1980, 1990 and 2000 are actual US Census Bureau data; 2005 is the US Census Bureau mid-term projection

Population for 2005 for BCWSA and Aqua America are estimates. Philadelphia's census year population peaked at 2,071,000 in 1950. Water delivery peaked at 370.1 MGD in 1955.

**Philadelphia Water Department
Water Withdrawals from the Delaware and Schuylkill Rivers vs. Population**



PHILADELPHIA WATER DEPARTMENT - OPERATIONS DIVISION
 WATER CONVEYANCE SECTION - LOAD CONTROL UNIT
 HYDRAULIC INVESTIGATIONS SQUAD

MASTER METER VERIFICATION - FISCAL YEAR 2007									
METER NAME	SCADA ACRONYM	METER TYPE	METER CLASSIFICATION	PIPE SIZE	RANGE in MGD	2% of RANGE	FY 2006 VERIFICATION DATE	RESULT	FREQUENCY
3rd & Spring Garden Rate	3SG-RATE	Transit time	Distribution System	30"	45	0.9	4/21/2007	-2%	once/year
Baxter WT Plant Effluent Rate	BAX-FW-R	Venturi	Treatment	120"	400	8			not done
Belmont WT Plant North Pretreat Rate	BF-PRET-N	Venturi	Treatment	48"	60	1.2			not done
Belmont WT Plant South Pretreat Rate	BF-PRET-S	Venturi	Treatment	48"	60	1.2			not done
Belmont WT Plant East Gravity Rate	BFE-GR	Venturi	Distribution System	48"	60	1.2	4/19/2007	-3%	once/year
Belmont WT Plant West Gravity Rate	BFW-GR	Venturi	Distribution System	48"	60	1.2	4/19/2007	-3%	once/year
Belmont High Service East Pump Rate	BHSD-BAE-R	Magnetic	Distribution System	24"	24	0.48	4/24/2007	-1%	once/year
Belmont High Service West Pump Rate	BHSD-BAW-R	Magnetic	Distribution System	24"	24	0.48	4/24/2007	1%	once/year
Belmont High Service Monument Pump Rate	BHSD-MR-R	Magnetic	Distribution System	20"	12	0.24	4/25/2007	-28%	once/year
Belmont Raw Water PS North Pump Rate	BRW-NVP-R	Venturi	Raw Water	48"	75	1.5	5/9/2007	-1%	once/year
Belmont Raw Water PS South Pump Rate	BRW-SVP-R	Venturi	Raw Water	48"	75	1.5	5/10/2007	11%	once/year
Bucks County Water & Sewer Authority Export Supply Meter	BUCK-SR	Magnetic	Large Customer	48"	30	0.6	8/25/2006 3/1/2007	-1% 1%	twice/year
Aqua PA, Cheltenham Interconnection Export Supply Meter	CHE-PSW-R	Magnetic	Large Customer	12"	5	0.1	8/31/2006 12/6/2006 3/9/2007 6/22/2007	-1% -1% -5% -6%	four times/year
Aqua PA, Trilicum Interconnection Export Supply Meter	TIN-PSW-R	Magnetic	Large Customer	16"	28	0.6	Not performed in FY2007 12/5/2006 3/5/2007 6/26/2007	Not performed in FY2007 0% 2% -2%	four times/year
Chestnut Hill Booster PS Pump Rate	CH-VP-R	Venturi	Distribution System	12"	5	0.1	3/28/2007	7%	once/year
Chew & Walnut DMA5 Inflow	CAW-DMA-R	Magnetic	Distribution System	8"	5	0.1	10/20/2006	-1%	once/year
East Park Reservoir #12 Valve Rate Out	CV12-R	Venturi	Distribution System	48"	60	1	10/26/2006	-1%	once/year
East Oak Lane PS Pump Rate A (NW)	EOL-NVP-R	Venturi	Distribution System	24"	15	0.3	12/12/2006	-3%	once/year
East Oak Lane PS Pump Rate B (SE)	EOL-SEVP-R	Venturi	Distribution System	24"	15	0.3	12/7/2006	-1%	once/year
East Oak Lane PS Pump Rate C (SW)	EOL-SWVP-R	Venturi	Distribution System	36"	30	0.6	12/8/2006	-3%	once/year
East Park Reservoir North Rate In	EPR-NIV-RIN	Magnetic	Distribution System	48"	45	0.9	4/27/2007	-2%	once/year
East Park Reservoir South Rate In	EPR-SIV-RIN	Magnetic	Distribution System	48"	45	0.9	4/27/2007	0%	once/year
East Park Booster PS East Pump Rate	EPB-EVP-R	Venturi	Distribution System	48"	75	1.5			not done
East Park Booster PS West Pump Rate	EPB-WVP-R	Venturi	Distribution System	48"	75	1.5	9/21/2006	-1%	once/year
East Park Reservoir #11 Valve Rate Out	EPR-ROUT	Venturi	Distribution System	54"	50	1	10/25/2006	-3%	once/year
Fox Chase Booster PS West Pump Rate (N)	FC-NVP-R	Venturi	Distribution System	20"	10	0.2	5/15/2007	11%	once/year
Fox Chase Booster PS East Pump Rate (S)	FC-SVP-R	Venturi	Distribution System	20"	10	0.2	5/15/2007	1%	once/year
Fox Chase Tank Rate In	FC-TK-RIN	Gentile	Distribution System	20"	5	0.1	8/25/2006	14%	once/year
Fox Chase Tank Rate Out	FC-TK-ROUT	Gentile	Distribution System	20"	5	0.1	8/25/2006	18%	once/year
Lardners Point PS Header 48 inch Rate	LPPS-48P-R	Venturi	Distribution System	48"	50	1			not done
Lardners Point PS Header 60 inch Rate	LPPS-60P-R	Venturi	Distribution System	60"	100	2	2/21/2007	3%	once/year
Lardners Point PS Header A Rate	LPPS-AP-R	Venturi	Distribution System	48"	50	1	2/22/2007	-28%	once/year
Lardners Point PS Header B Rate	LPPS-BP-R	Venturi	Distribution System	48"	50	1	2/22/2007	0%	once/year
Lardners Point PS Header C Rate	LPPS-CP-R	Venturi	Distribution System	48"	50	1	2/23/2007	-6%	once/year
Lardners Point PS Header D Rate	LPPS-DP-R	Venturi	Distribution System	48"	50	1			not done
Oak Lane Reservoir North Basin Effluent Rate	OLNB-ROUT	Venturi	Distribution System	48"	45	0.9	4/12/2007	3%	once/year
Oak Lane Reservoir South Basin Inflow Rate	OLSB-RIN	Venturi	Distribution System	48"	45	0.9	3/14/2007	-11%	once/year
Philadelphia Naval Business Center Rate	PNBC-GATE-RIN	Magnetic	Large Customer	12"	11	0.22	9/26/2006 3/6/2007	-2% 5%	twice/year
Queen Lane WT Plant Pretreatment Rate # 1	QL-PRET-R1	Venturi	Treatment	48"	60	1.2			not done
Queen Lane WT Plant Pretreatment Rate # 2	QL-PRET-R2	Venturi	Treatment	48"	60	1.2			not done
Queen Lane WT Plant Pretreatment Rate # 3	QL-PRET-R3	Venturi	Treatment	48"	60	1.2			not done
Queen Lane WT Plant Pretreatment Rate # 4	QL-PRET-R4	Venturi	Treatment	48"	60	1.2			not done
Queen Lane Gravity Rate # 1	QLF1-G-R	Magnetic	Distribution System	48"	60	1.2	9/26/2006	0%	once/year
Queen Lane Gravity Rate # 2	QLF2-G-R	Magnetic	Distribution System	48"	60	1.2	10/26/2006	-1%	once/year
Queen Lane Gravity Rate # 3	QLF3-G-R	Pitot	Distribution System	48"	60	1.2	10/27/2006	8%	once/year
Queen Lane Gravity Rate # 4	QLF4-G-R	Magnetic	Distribution System	48"	60	1.2	10/15/2006	3%	once/year
Queen Lane High Service Pump Rate	QLH-P-R	Venturi	Distribution System	36"	40	0.8	5/16/2007	1%	once/year
Queen Lane Raw Water PS North Pump Rate	QLRW-NMP-R	Magnetic	Raw Water	60"	160	3.2	Meter failed; to be replaced		once/year
Queen Lane Raw Water PS South Pump Rate	QLRW-SMP-R	Magnetic	Raw Water	60"	160	3.2	6/20/2007	-40%	once/year
Queen Lane Raw Water PS West Pump Rate	QLRW-WP-R	Venturi	Raw Water	48"	40	0.8	8/20/2007	2%	once/year
Roxborough Express Pump Rate	QLRX-P-R	Venturi	Distribution System	36"	40	0.8	Not performed in FY2007		once/year
Roxborough High Service PS Pump Rate "B" (N)	RHS-NVP-R	Venturi	Distribution System	24"	20	0.4	4/4/2007	-6%	once/year
Roxborough High Service PS Pump Rate "A" (S)	RHS-SVP-R	Venturi	Distribution System	24"	20	0.4	3/20/2007	8%	once/year
Somerton Standpipes Rate In	SM-SP-RIN	Gentile	Distribution System	30"	15	0.3	3/15/2007	8%	once/year
Somerton Standpipes Rate Out	SM-SP-ROUT	Gentile	Distribution System	30"	15	0.3	3/15/2007	3%	once/year
Torresdale High Duty PS Pump Rate E (#3A)(Penny)	THS-EVP-R	Venturi	Distribution System	24"	10	0.2	11/3/2006	7%	once/year
Torresdale High Duty PS Pump Rate 36" (#13)	THS-V13P-R	Venturi	Distribution System	36"	30	0.6	8/24/2006	-1%	once/year
Torresdale High Duty PS Pump Rate W (#3B)(Grant)	THS-WVP-R	Venturi	Distribution System	24"	10	0.2	11/2/2006	7%	once/year
Torresdale Low Duty PS Pump Rate (Venturi # 1)	TLD-V1P-R	Venturi	Distribution System	60"	80	1.6			not done
Torresdale Low Duty PS Pump Rate (Venturi # 5)	TLD-V5P-R	Venturi	Distribution System	42"	80	1.2			not done
Torresdale Low Duty PS Pump Rate (Venturi #6)	TLD-V6P-R	Venturi	Distribution System	60"	80	1.6	4/26/2007	-5%	once/year
Torresdale Raw Water PS North/East Pump Rate	TRW-EVP-R	Venturi	Raw Water	96"	210	4.2			not done
Torresdale Raw Water PS South/West Pump Rate	TRW-WVP-R	Venturi	Raw Water	96"	210	4.2			not done
Roxborough Standpipes Rate In	UR-SP-RIN	Gentile	Distribution System	36"	15	0.3	2/27/2007	-4%	once/year
Roxborough Standpipes Rate Out	UR-SP-ROUT	Gentile	Distribution System	36"	20	0.4	2/27/2007	1%	once/year
West Oak Lane PS Pump Rate	WOL-P-R	Venturi	Distribution System	30"	30	0.6	3/27/2007	2%	once/year

Cells shown in dotted shading identify flowmeters that cannot be physically verified via pitot rod instrumentation

Philadelphia Water Department						
Composite Water System Input Adjustments - Fiscal Year 2007						
Month	Number of days	Original SCADA System data unedited daily average water system input based on SCADA A history morning	Monthly total system input volume based on original (unedited) total delivery - MG	Average daily system input volume based on edited SCADA B history report- MGD*	Monthly total system input volume based on edited SCADA B history report- MG	Difference
July'06	31	274.2	8500.9	274.7	8514.2	0.4
Aug'06	31	273.7	8484.4	276.6	8575.1	2.9
Sep'06	30	253.5	7603.6	254.0	7619.8	0.5
Oct'06	31	253.0	7843.8	252.0	7811.1	-1.1
Nov'06	30	247.6	7428.3	245.6	7366.9	-2.0
Dec'06	31	246.8	7649.3	243.2	7540.2	-3.5
Jan'07	31	245.7	7616.3	241.4	7484.5	-4.3
Feb'07	28	273.9	7669.8	268.3	7513.7	-5.6
Mar'07	31	261.0	8090.3	255.1	7907.9	-5.9
Apr'07	30	248.8	7464.3	244.0	7321.0	-4.8
May'07	31	251.6	7800.9	247.9	7684.8	-3.7
Jun'07	30	265.6	7967.9	260.9	7827.8	-4.7
Sum	365		94119.8		93167.0	952.8
Average			257.9		255.3	2.6

*Adjustments are based upon several factors including regular master meter verification testing, mass balance comparisons of flows into and out of water treatment plants, operational histories at facilities and instrumentation history.

City of Philadelphia Water Billing Account Codes

Codes

4	Regular	R	5/8
W	Well	Z	3/4
A	PHA	Q	1
G	Federal Government	Y	1-1/4
E	Board of Education	P	1-1/2
P	Commonwealth of PA	X	2
Y	Fire Meter	O	3
Z	City of Philadelphia	W	4
H	Special Handling	N	6
S	Schedule	V	8
C	Charity	E	10
D	Senior Citizen	T	12
N	Hospitals and Universities	H	14
1	Water and Sewer		
2	Water Only		
4	Sewer Only		
5	Water Only Bill Outside of City		

Account Codes

Account Type	Account Description	Type	
41N	Regular Water and Sewer 6 inch meter	Commercial	
41O	Regular Water and Sewer 3 inch meter	Residential	
41P	Regular Water and Sewer 1-1/2 inch meter	Residential	
41Q	Regular Water and Sewer 1 inch meter	Residential	
41R	Regular Water and Sewer 5/8 inch meter	Residential	
41V	Regular Water and Sewer 8 inch meter	Commercial	
41W	Regular Water and Sewer 4 inch meter	Commercial	
41X	Regular Water and Sewer 2 inch meter	Residential	
41Z	Regular Water and Sewer 3/4 inch meter	Residential	
42O	Regular Water Only 3 inch meter	Residential	
42P	Regular Water Only 1-1/2 inch meter	Residential	
42Q	Regular Water Only 1 inch meter	Residential	
42R	Regular Water Only 5/8 inch meter	Residential	
42X	Regular Water Only 2 inch meter	Residential	
42Z	Regular Water Only 3/4 inch meter	Residential	
45Q	Regular Water Only Bill Outside of City 1 inch meter	Residential	
45R	Regular Water Only Bill Outside of City 5/8 inch meter	Residential	
45Z	Regular Water Only Bill Outside of City 3/4 inch meter	Residential	
A1Q	Philadelphia Housing Authority Water and Sewer 1 inch meter	Residential	
A1R	Philadelphia Housing Authority Water and Sewer 5/8 inch meter	Residential	
A1W	Philadelphia Housing Authority Water and Sewer 4 inch meter	Residential	
A1X	Philadelphia Housing Authority Water and Sewer 2 inch meter	Residential	
C1N	Charity Water and Sewer 6 inch meter	Commercial	
C1O	Charity Water and Sewer 3 inch meter	Commercial	
C1P	Charity Water and Sewer 1-1/2 inch meter	Commercial	
C1Q	Charity Water and Sewer 1 inch meter	Commercial	
C1R	Charity Water and Sewer 5/8 inch meter	Commercial	
C1W	Charity Water and Sewer 4 inch meter	Commercial	
C1X	Charity Water and Sewer 2 inch meter	Commercial	
C1Z	Charity Water and Sewer 3/4 inch meter	Commercial	

City of Philadelphia Water Billing Account Codes

C2O	Charity Water Only 3 inch meter	Commercial	
C2Q	Charity Water Only 1 inch meter	Commercial	
C2R	Charity Water Only 5/8 inch meter	Commercial	
C2X	Charity Water Only 2 inch meter	Commercial	
D1Q	Senior Citizen Water and Sewer 1 inch meter	Residential	
D1R	Senior Citizen Water and Sewer 5/8 inch meter	Residential	
D1Z	Senior Citizen Water and Sewer 3/4 inch meter	Residential	
D2Q	Senior Citizen Water Only 1 inch meter	Residential	
D2R	Senior Citizen Water Only 5/8 inch meter	Residential	
E1N	Board of Education Water and Sewer 6 inch meter	Commercial	
E1O	Board of Education Water and Sewer 3 inch meter	Commercial	
E1W	Board of Education Water and Sewer 4 inch meter	Commercial	
E1X	Board of Education Water and Sewer 2 inch meter	Commercial	
H1O	Special Handling Water and Sewer 3 inch meter	Commercial	
H1X	Special Handling Water and Sewer 2 inch meter	Commercial	
H2B	Special Handling Water Only - Bucks Co. Water/Sewer Authority	Commercial	
N1N	Hospitals and Universities Water and Sewer 6 inch meter	Commercial	
N1W	Hospitals and Universities Water and Sewer 4 inch meter	Commercial	
N2R	Hospitals and Universities Water Only 5/8 inch meter	Commercial	
Y1N	Fire Meter Water and Sewer 6 inch meter	Commercial	
Y1V	Fire Meter Water and Sewer 8 inch meter	Commercial	
Y2N	Fire Meter Water Only 6 inch meter	Commercial	
Y2V	Fire Meter Water Only 8 inch meter	Commercial	
Y2W	Fire Meter Water Only 4 inch meter	Commercial	
Y2X	Fire Meter Water Only 2 inch meter	Commercial	
Z1O	City of Philadelphia Water and Sewer 3 inch meter	Commercial	
Z1P	City of Philadelphia Water and Sewer 1-1/2 inch meter	Commercial	
Z1Q	City of Philadelphia Water and Sewer 1 inch meter	Commercial	
Z1R	City of Philadelphia Water and Sewer 5/8 inch meter	Commercial	
Z1W	City of Philadelphia Water and Sewer 4 inch meter	Commercial	
Z1X	City of Philadelphia Water and Sewer 2 inch meter	Commercial	
Z2R	City of Philadelphia Water Only 5/8 inch meter	Commercial	

CITY OF PHILADELPHIA - BILLED WATER CONSUMPTION FOR FISCAL YEAR 2007

July 1, 2006 - June 30, 2007

(ccf = 100 cubic feet)

Listing taken from Monthly Billing Summary Report

Meter Size	5/8	3/4	1	1 1/2	2	3	4
	Number	CCF	Number	CCF	Number	CCF	Number
Jul-06	457,652	4,346,768	173	192	5678	217,046	2062
Aug-06	456,144	3,551,525	167	2147	5666	189,300	2080
Sep-06	456,471	3,436,420	163	1942	5648	177,152	2056
Oct-06	455,831	3,791,145	149	1806	5642	203,602	2051
Nov-06	456,359	3,267,526	142	1726	5606	177,956	2040
Dec-06	455,256	3,186,809	139	1953	5601	162,497	2042
Jan-07	456,237	3,600,367	127	1667	5583	184,102	2036
Feb-07	457,731	3,353,828	124	1598	5575	166,181	2037
Mar-07	458,714	3,306,416	123	1477	5568	169,174	2035
Apr-07	459,512	3,071,940	122	1395	5552	156,049	2037
May-07	458,880	3,085,556	120	994	5570	156,000	2036
Jun-07	456,168	3,190,841	91	4745	5533	171,079	2034
Total CCF	41,169,141	23,462	2,130,138	4	1,844,455	4,259,580	13
MOD.	5,486,955	1,640	87,222	4	24,528	30,396	9
Ave CCF	8	14	32	75	140	332	584
Cum. CCF	41,169,141	41,192,603	43,322,741	45,167,196	49,426,776	54,148,815	60,659,246
% of total	54.27%	0.03%	2.81%	2.43%	5.62%	6.22%	8.56%
Cum. % >>	54.27%	54.30%	57.11%	59.54%	65.16%	71.38%	79.96%
Cum. % <<	100.00%	45.73%	45.70%	42.89%	40.46%	34.84%	28.62%
Average # of Accounts	457,246	137	5,602	2,044	2,533	1,165	930

AVERAGE BILLED WATER CONSUMPTION PER CUSTOMER ACCOUNT (CCF PER ACCOUNT)

Meter Size	5/8	3/4	1	1 1/2	2	3	4
Jul-06	9	11	38	89	184	460	669
Aug-06	8	13	33	74	161	297	607
Sep-06	8	12	31	74	151	301	727
Oct-06	8	12	36	93	159	328	809
Nov-06	7	12	32	71	146	299	550
Dec-06	7	14	29	69	104	291	529
Jan-07	8	13	33	89	149	545	543
Feb-07	7	13	30	73	136	302	527
Mar-07	7	12	30	71	140	265	509
Apr-07	7	11	28	69	132	268	490
May-07	7	8	28	66	128	263	516
Jun-07	7	52	31	62	111	287	521
Average	8	15	32	75	140	332	583
Maximum	9	52	38	93	164	545	809
Minimum	7	8	28	62	104	263	490
Std. Deviation	0.8	11.2	3.0	9.4	18.2	83.7	96.1

Note: Billed Consumption represents data that is output from the Customer Billing System and, due to billing adjustment activities, may differ from Customer Metered Consumption, which is the input data to the Customer Billing System. Data from the "Accountability Trend" worksheet through FY2005 includes adjustments.

CITY OF PHILADELPHIA - BILLED WATER CONSUMPTION FOR FISCAL YEAR 2007
July 1, 2006 - June 30, 2007
 (ccf = 100 cubic feet)

Listing taken from Monthly Billing Summary Report

Number	CCF	Number	CCF	Number	CCF	Number	CCF	Total #	Total CCF	Ave CCF	Monthly % of Year	Month
332	634,125	70	249,121	30	379,605	3	292,239	470,637	7,885,934	17	10.4%	Jul-06
331	616,890	70	241,069	30	363,859	3	241,189	471,112	6,694,098	14	8.8%	Aug-06
329	602,979	70	254,546	30	392,296	3	177,328	469,421	6,708,207	14	8.8%	Sep-06
325	543,106	70	224,607	28	400,234	3	168,406	488,736	7,085,736	15	9.3%	Oct-06
327	589,722	68	198,258	28	343,289	3	138,805	469,218	6,097,795	13	8.0%	Nov-06
324	488,982	69	195,064	28	383,878	3	192,983	488,113	5,854,393	13	7.7%	Dec-06
324	463,566	67	163,883	28	301,455	3	141,081	470,053	6,566,100	14	8.7%	Jan-07
324	446,458	65	186,084	28	324,878	3	158,907	470,533	6,959,733	13	7.9%	Feb-07
324	406,856	64	183,480	27	563,402	3	144,784	471,512	6,062,088	13	8.0%	Mar-07
326	386,676	64	144,861	28	372,140	3	137,914	472,288	5,614,977	12	7.3%	Apr-07
325	462,096	64	153,230	28	318,577	3	183,428	471,686	5,599,044	12	7.4%	May-07
322	481,311	63	167,898	28	387,830	3	215,756	468,903	5,850,054	12	7.7%	Jun-07
3916	617,215	13	2,352,081	5	4,531,443	9	2,192,822	641,212	76,858,159	135.6	***	Total CCF
	1,563	804	2,925	341	13,289	38	60,912	641,212	76,858,159	13	Ave CCF	
	66,781,813		69,133,894		73,665,337		75,858,159					
	8.07%		3.10%		6.97%		2.89%				% of total	
	88.04%		91.14%		97.11%		100.00%					
	20.04%		14.96%		8.86%		2.89%					
	326		67		28		3	470,101				

*** Does not include adjustment for sewer only accounts. See "Accountability Trend" worksheet, cell AA32 for average daily value.

AVERAGE BILLED WATER CONSUMPTION PER CUSTOMER ACCOUNT (CCF PER ACCOUNT)

Number	CCF	Number	CCF	Number	CCF	Number	CCF	Total #	Total CCF	Ave CCF	Monthly % of Year	Month
1,910	3,559	12,854	97,413	17								
1,864	3,587	12,129	80,396	14								
1,833	3,636	13,077	69,109	14								
1,671	3,209	14,294	56,135	15								
1,803	2,918	12,280	46,288	13								
1,495	2,927	13,710	64,328	13								
1,431	2,446	10,766	47,927	14								
1,378	2,555	11,603	52,969	13								
1,255	2,957	20,867	48,261	13								
1,186	2,263	13,291	45,971	12								
1,422	2,394	11,378	61,143	12								
1,495	2,665	13,851	71,920	12								
1,562	2,910	13,323	60,912	13								
1,910	3,636	20,867	97,413	17								
1,186	2,263	13,291	45,971	12								
236.4	464.6	2,493.8	15,087.9	1.4								

Average Large Meter Consumption 227 ccf equals 5,662 gal/day

Note: Billed Consumption represents data that is output from the Customer Billing System and, due to billing adjustment activities, may differ from Customer Metered Usage, which is the input data to the Customer Billing System. Data from the "Accountability Trend" worksheet through FY2005 includes adjustments.

Large Meters, 1-inch & up	Total #	Total CCF
	12,812	3,537,184
	12,801	3,140,428
	12,787	3,269,845
	12,756	3,272,785
	12,717	2,828,543
	12,718	2,665,591
	12,689	2,964,066
	12,678	2,604,307
	12,675	2,754,195
	12,654	2,441,852
	12,686	2,532,494
	12,644	2,654,468
	34,666	566,566
	71	
	152,617	227
		46.70%
		12,718
		Total
		276
		245
		256
		257
		222
		210
		234
		205
		217
		193
		200
		210
		227
		276
		193
		25.1

City of Philadelphia-Summary of Billed Water Consumption Trends For Fiscal Years 1998-2007

Average Billed Water Consumption Per Customer Account In Hundred Cubic Feet (CCF)

Meter Size, In.	5/8	3/4	1	1 1/4	1 1/2	2	3	4	6	8	10	12	Billed Consumption for Year, MGD*
Fiscal Year 1998	9	18	41	45	85	163	393	683	1,693	2,903	10,972		193.9
Fiscal Year 1999	9	18	38	65	85	174	365	656	1,727	2,911	5,886	13,995 ^v	186.7
Fiscal Year 2000	9	18	39		96	160	362	731	1,776	3,365	13,165	320	185.8
Fiscal Year 2001	8	16	38		87	154	312	620	1,920	2,399	10,862	2,038	181.7
Fiscal Year 2002	8	16	37		83	149	269	577	1,620	2,662	12,900	189	177.6
Fiscal Year 2003	8	13	36		79	148	278	560	1,590	2,850	11,937	65,983	183.4
Fiscal Year 2004	8	15	34		77	138	319	548	1,579	2,577	11,490	43,811	176.9
Fiscal Year 2005	8	16	33		77	143	301	527	1,524	3,282	19,917	39,687	161.6
Fiscal Year 2006	8	12	33		76	152	343	592	1,755	3,696	12,685	53,802	163.3
Fiscal Year 2007	8	15	32		75	140	332	583	1,562	2,910	13,323	60,912	155.5

Number Of Accounts (Average Of Twelve Monthly Counts)

Meter Size, In.	5/8	3/4	1	1 1/4	1 1/2	2	3	4	6	8	10	12	Total Accounts, Fiscal Year End
Fiscal Year 1998	459,940	5,405	6,986	35	2,125	2,362	1,080	932	404	77	19		478,609
Fiscal Year 1999	460,534	2,980	6,860	28	2,106	2,344	1,085	933	404	72	19	1	477,582
Fiscal Year 2000	459,952	1,222	6,841		2,090	2,358	1,098	935	402	69	22	1	475,142
Fiscal Year 2001	460,572	978	6,882		2,125	2,470	1,129	955	405	70	26	3	475,818
Fiscal Year 2002	459,881	684	6,776		2,140	2,518	1,140	947	404	69	27	3	474,657

City of Philadelphia-Summary of Billed Water Consumption Trends For Fiscal Years 1998-2007

Fiscal Year 2003	459,236	377	6,617		2,136	2,538	1,198	968	403	70	29	3	473,973
Fiscal Year 2004	458,639	322	6,261		2,111	2,535	1,134	959	390	67	30	5	472,453
Fiscal Year 2005	457,944	254	5,990		2,098	2,519	1,154	953	361	66	30	4	471,373
Fiscal Year 2006	457,845	197	5,787		2,073	2,517	1,166	955	338	69	30	3	470,980
Fiscal Year 2007	457,246	137	5,602		2,044	2,533	1,185	930	326	67	28	3	470,101

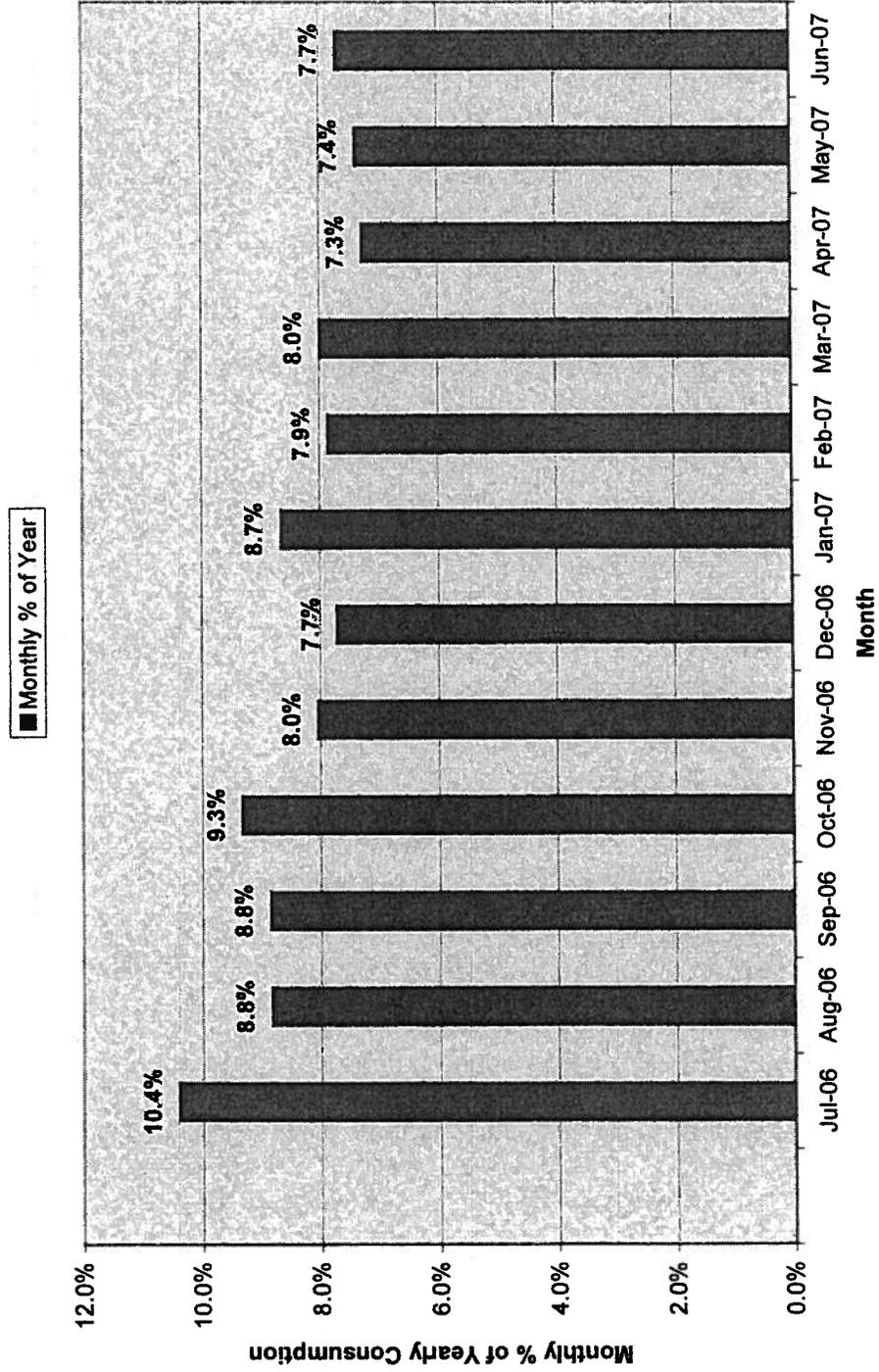
Percent Of Total Billed Water Consumption

Meter Size, In.	5/8	3/4	1	1 1/4	1 1/2	2	3	4	6	8	10	12	
Fiscal Year 1998	56.72%	1.34%	3.93%	0.02%	2.50%	5.32%	5.87%	8.81%	9.46%	3.10%	2.92%		
Fiscal Year 1999	56.89%	0.73%	3.62%	0.02%	2.49%	5.64%	5.48%	8.46%	9.65%	2.91%	1.51%	0.16%	
Fiscal Year 2000	54.49%	0.31%	3.67%	0%	2.77%	5.23%	5.51%	9.47%	9.87%	3.20%	3.92%	0.00%	
Fiscal Year 2001	53.08%	0.21%	3.63%	0%	2.55%	5.27%	4.88%	8.19%	10.77%	2.32%	3.97%	0.09%	
Fiscal Year 2002	57.09%	0.16%	3.77%	0%	2.69%	5.66%	4.62%	8.14%	9.87%	2.76%	5.22%	0.01%	
Fiscal Year 2003	55.67%	0.07%	3.51%	0%	2.47%	5.48%	4.62%	7.92%	9.36%	2.90%	5.10%	2.89%	
Fiscal Year 2004	55.80%	0.07%	3.16%	0%	2.45%	5.27%	5.43%	7.90%	9.25%	2.61%	5.09%	2.96%	
Fiscal Year 2005	55.65%	0.06%	3.02%	0%	2.40%	5.48%	5.28%	7.64%	8.37%	3.28%	6.27%	2.55%	
Fiscal Year 2006	53.42%	0.04%	2.91%	0%	2.36%	5.78%	6.03%	8.52%	8.95%	3.80%	5.75%	2.43%	
Fiscal Year 2006	54.27%	0.03%	2.81%	0%	2.43%	5.62%	6.22%	8.58%	8.07%	3.10%	5.97%	2.89%	

Fiscal Year: July 1 of the previous year-June 30th of the current year

*Does not include adjustment for sewer only accounts - see ACCOUNTABILITY TREND worksheet

**Philadelphia Water Department - Water Revenue Bureau
Fiscal Year 2007 - Monthly Frequency Distribution of Customer Billed Consumption**

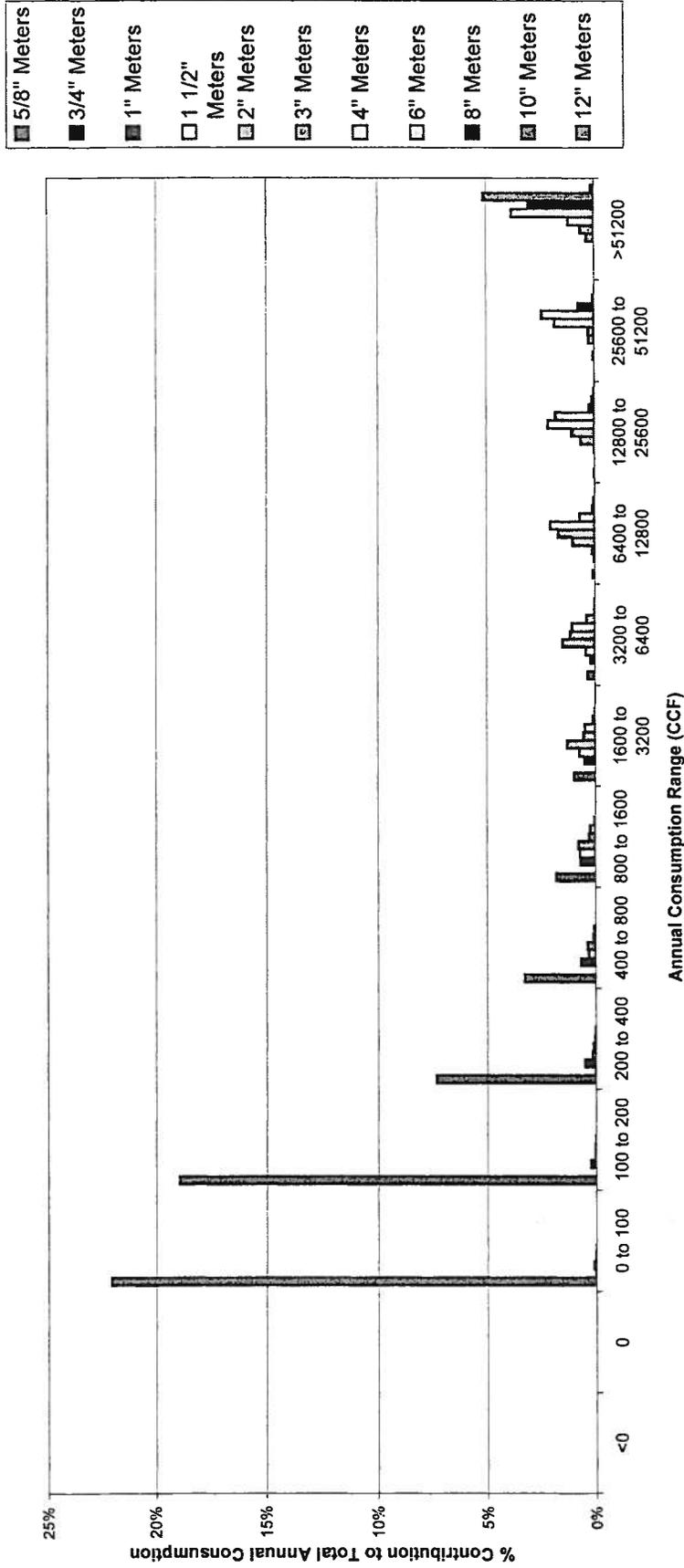


**Philadelphia Water Department - Water Revenue Bureau
Fiscal Year 2006 - Monthly Customer Billed Consumption Volumes
From Customer Billing System Data Mining Analysis**

Listing taken from yearly billing system data mining analysis by WSO, Inc.

Monthly Customer Billed Consumption, hundred cubic feet (ccf)															
Month	Blank	5/8"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	Total	%
June 05	11	839,286	740	36,221	0	35,770	102,418	118,532	131,784	189,252	91,035	93,656	0	1,638,705	
July 05	233	2,741,846	1,826	175,283	0	128,943	302,990	252,554	458,003	441,258	222,885	318,352	8,288	5,060,102	6.57
August 05	354	5,035,735	3,716	312,275	0	222,034	578,330	573,242	904,593	897,821	388,207	463,278	7,787	9,395,372	12.22
September 05	34	3,967,981	3,400	208,368	0	176,173	438,802	414,440	715,742	742,200	314,345	430,608	9,381	7,122,464	9.27
October 05	385	3,418,047	2,423	195,568	0	164,463	426,857	371,497	636,542	630,593	292,807	354,316	6,489	6,501,777	8.46
November 05	23	3,387,233	2,833	175,787	0	186,812	384,280	333,159	490,113	510,295	285,036	323,341	8,840	6,067,532	7.90
December 05	18	2,873,111	1,821	156,300	0	128,630	325,449	197,233	416,706	545,150	189,518	193,204	8,490	5,035,630	6.55
January 06	18	4,325,844	1,209	214,489	0	197,148	485,356	436,507	645,609	601,851	314,754	333,635	8,730	7,565,150	9.85
February 06	5	3,133,515	2,064	158,391	0	134,650	344,688	354,743	514,991	489,808	198,442	404,527	8,860	5,746,714	7.48
March 06	5	3,724,110	2,263	190,419	0	177,481	439,749	373,830	570,742	580,822	239,513	282,419	8,885	6,570,018	8.55
April 06	0	3,011,575	2,054	159,138	0	143,424	368,358	316,395	513,144	547,866	305,489	314,515	8,803	6,691,761	7.41
May 06	39	3,458,143	2,446	185,357	0	171,639	408,310	388,705	570,393	674,745	207,255	353,757	9,229	6,484,018	8.34
June 06	116	2,881,942	2,480	162,645	0	152,220	375,581	361,874	518,786	554,875	281,678	368,860	25,486	5,686,633	7.40
July 06	29	4,343,360	1,877	220,116	0	193,354	484,595	563,791	652,683	675,940	298,076	394,876	9,788	7,836,585	
Total, ccf	1,230	41,667,082	28,185	2,296,020	0	1,981,587	4,877,540	4,350,179	6,955,364	7,196,984	3,240,729	4,140,942	121,349	76,827,174	100
% of Total	0.002	84.23	0.04	2.99	0.00	2.54	6.35	5.66	9.05	9.97	4.22	5.39	0.16	100	
Total, MGD	0.9	37,167.0	21.1	1,717.4	0.0	1,458.8	3,648.4	3,253.9	5,202.6	5,383.3	2,424.9	3,087.4	90.8	57,466.7	
Total, MGD	0.003	85.4	0.1	6.7	0.0	4.0	10.0	8.9	14.3	14.7	6.6	8.5	0.2	151.4	
Small Meter (5/8", 3/4") Total, MGD	85.4	% of Total	54.3%												
Large Meter (1" and larger) Total, MGD	72.0	% of Total	45.7%												

**Philadelphia Water Department - Water Revenue Bureau
Fiscal Year 2006 Customer Billed Consumption by Frequency of Consumption Ranges**



**Philadelphia Water Department - Water Revenue Bureau
Fiscal Year 2006 Analysis of Customer Billing System Adjustments and Negative Consumption Values**

Month	Total Customer Billed Consumption (ccf) by Meter Size Classification - For Accounts Registering Positive Consumption Values											
	5/8	3/4	1	1 1/2	2	3	4	6	8	10	12	Total
July-05	2,834,444	1,659	176,908	130,379	305,485	266,285	463,614	222,885	318,382	8,289	5,197,318	
August-05	4,994,674	3,218	316,152	221,014	578,058	583,008	905,602	903,080	388,207	484,042	7,787	9,365,348
September-05	3,743,118	3,449	211,861	177,637	474,375	436,127	738,278	679,812	314,345	430,808	9,381	7,301,018
October-05	3,512,247	2,423	199,650	165,198	431,875	377,257	671,277	630,583	294,843	354,316	8,489	6,647,968
November-05	3,437,519	2,633	182,904	157,053	386,491	363,139	502,069	511,904	285,658	323,341	8,840	6,161,631
December-05	2,847,032	1,821	166,180	128,067	326,003	271,975	467,177	546,726	186,135	259,142	8,490	5,209,748
January-06	4,367,872	2,287	216,987	197,998	487,915	444,029	653,146	606,065	314,754	333,635	8,730	7,653,418
February-06	3,167,986	2,101	163,109	139,512	352,388	399,423	524,823	501,011	212,098	406,361	8,860	5,977,682
March-06	3,789,074	2,462	198,114	178,011	442,723	373,889	579,812	584,999	239,527	283,055	8,985	6,680,861
April-06	3,129,134	2,299	181,700	144,338	376,248	337,863	515,713	576,677	308,873	314,515	8,203	5,874,163
May-06	3,597,387	2,446	187,255	173,821	410,463	373,497	576,392	676,392	353,558	353,757	9,229	6,993,073
June-06	3,012,607	2,480	170,027	152,724	380,285	361,154	529,789	554,875	281,678	368,960	25,466	5,840,046
Total	42,463,894	29,776	2,549,947	1,986,783	4,962,319	4,587,639	7,127,967	7,321,402	3,291,184	4,210,124	121,349	76,402,063

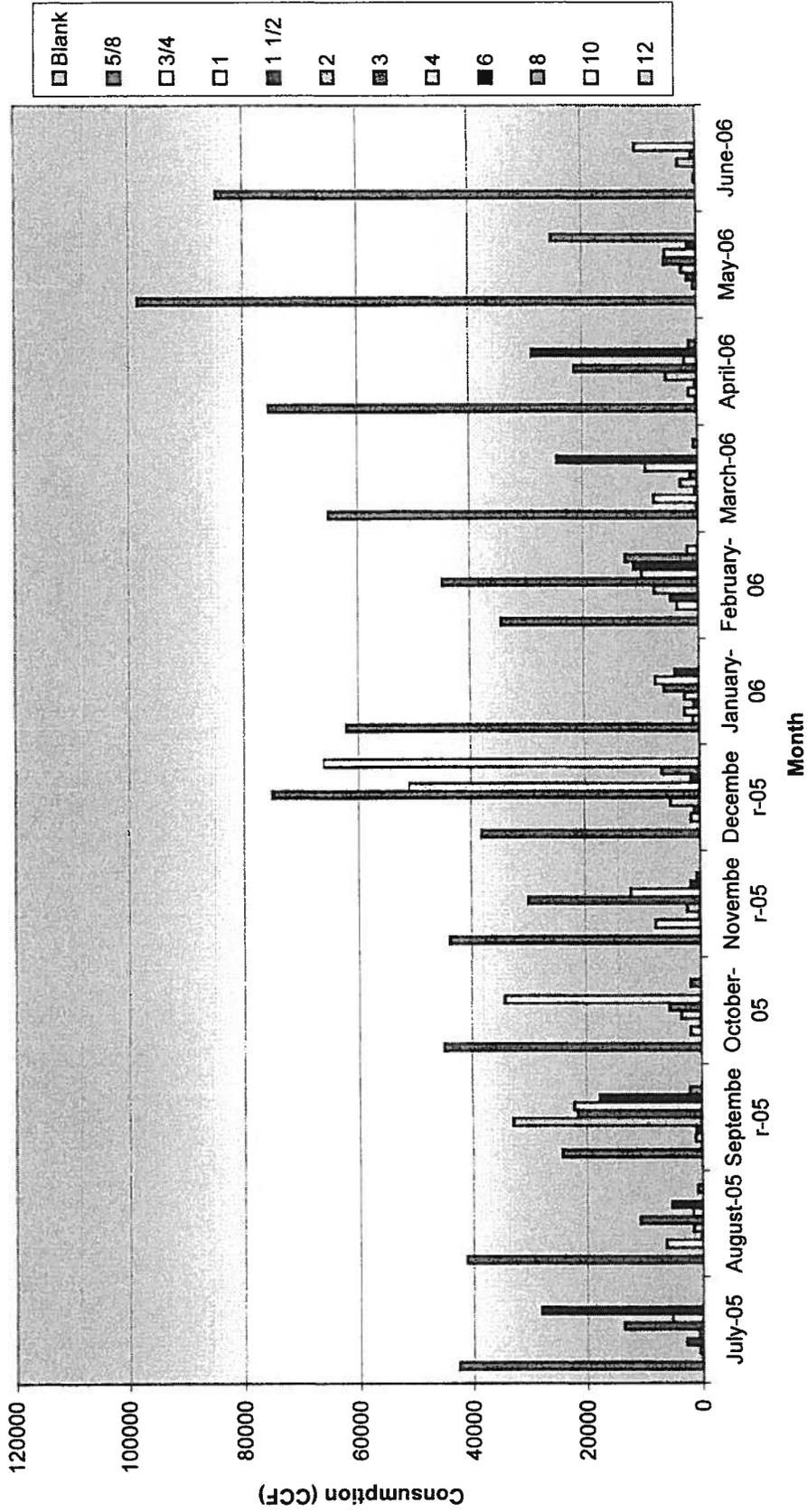
Month	Total Customer Billed Consumption (ccf) by Meter Size Classification - For Accounts Registering Negative Consumption Values											
	5/8	3/4	1	1 1/2	2	3	4	6	8	10	12	Total
July-05	-42,567	-33	-502	-2,847	-543	-13,578	-5,292	-27,930	0	0	0	-83,290
August-05	-41,139	0	-6,303	-286	-1,553	-10,787	-1,512	-5,269	0	-764	0	-67,893
September-05	-24,173	-49	-1,078	-888	-32,867	-21,432	-22,116	-17,612	-2,033	0	0	-122,268
October-05	-45,001	0	-1,861	-115	-3,444	-5,546	-34,252	0	-1,836	0	0	-92,068
November-05	-43,863	0	-7,817	-194	-2,273	-29,931	-12,095	-1,689	-622	0	0	-98,484
December-05	-39,131	0	-1,513	-983	-2,099	-74,895	-50,960	-1,576	-6,617	-65,938	0	-246,702
January-06	-62,028	-1,078	-2,498	-850	-2,559	-6,062	-7,537	-4,214	0	0	0	-86,826
February-06	-34,471	-7	-3,718	-4,882	-7,710	-44,810	-9,832	-11,203	-12,556	-1,834	0	-131,203
March-06	-65,067	-179	-7,695	-580	-2,972	-1,301	-9,270	-24,467	-14	-646	0	-111,991
April-06	-75,425	-245	-1,459	-392	-5,453	-21,295	-2,201	-28,811	-1,354	0	0	-136,865
May-06	-98,263	0	-582	-1,738	-2,666	-5,691	-5,544	-1,647	-25,303	0	0	-141,434
June-06	-84,562	0	-361	-317	-799	-10,645	0	0	0	0	0	-89,640
Total	-454,710	-1,561	-35,387	-13,151	-79,278	-336,226	-171,146	-124,418	-60,485	-89,182	0	-1,427,161

Month	Total Net Customer Billed Consumption (ccf) by Meter Size Classification											
	5/8	3/4	1	1 1/2	2	3	4	6	8	10	12	Total
July-05	2,791,877	1,626	176,406	127,532	304,942	252,709	458,322	441,258	222,685	318,382	8,289	5,104,028
August-05	4,953,535	3,716	308,849	220,748	576,505	572,219	903,980	897,821	388,207	483,278	7,787	9,297,659
September-05	3,718,945	3,400	210,783	176,749	441,488	414,690	716,161	742,200	314,345	430,808	9,381	7,176,750
October-05	3,467,246	2,423	197,789	165,093	428,431	371,711	637,025	630,583	292,807	354,316	8,489	6,555,903
November-05	3,393,656	2,633	175,087	156,859	384,218	333,208	489,974	510,295	285,036	323,341	8,840	6,063,147
December-05	2,808,901	1,821	154,667	128,084	320,904	197,080	418,227	545,150	189,518	193,204	8,490	4,984,046
January-06	4,325,844	1,209	214,489	197,148	485,356	437,967	645,609	601,851	314,754	333,635	8,730	7,566,592
February-06	3,133,515	2,094	159,391	134,650	344,688	354,513	514,891	488,808	199,442	404,527	8,860	5,746,479
March-06	3,724,007	2,283	190,419	177,431	439,751	372,588	570,742	560,532	239,513	282,419	8,985	6,588,870
April-06	3,053,709	2,054	180,241	143,946	370,795	316,568	513,512	547,868	305,489	314,515	8,803	5,737,498
May-06	3,499,124	2,446	186,673	172,083	407,797	367,806	570,724	674,745	207,255	353,757	9,229	6,451,639
June-06	2,928,025	2,480	169,666	152,888	390,355	519,144	554,875	281,678	368,960	25,466	8,490	5,740,805
Total	41,798,364	28,185	2,306,480	1,953,001	4,882,043	4,365,421	7,196,984	7,340,729	3,240,729	4,140,942	121,349	76,974,912

Potential Consumption without Adjustment	Potential Maximum Understatement of Total Billed Consumption		Small Meter Portion of Above Value	Large Meter Portion of Above Value
	2,711,521	5,062,871		
43,782,514	1,994,254	6,069,899	7,469,869	7,570,238
				3,382,124
				4,248,488
				121,349
				81,259,266
				4,281,453
				1,988,903
				2,312,560

The potential maximum adjustment is not likely to occur since many accounts are adjusted during the same fiscal year in which consumption was previously over-estimated. However, for accounts over-estimated in previous fiscal years, a full adjustment in the current year results in an under-statement of overall consumption. It is therefore assumed that only one-half of the potential maximum understated consumption actually results in apparent losses. This value is applied in the Detailed Water Audit. One half of 4,281,453 ccf = 1,601.3 MG

**Philadelphia Water Department - Water Revenue Bureau
 FY2006 - Cumulative Volumes of Negative Consumption Due to Billing Adjustments**



Automatic Meter Reading Deployment - Fiscal Year 2007

Meter Size Code	Meter Size	Total AMR units installed as of June 30, 2006	Total AMR units installed as of June 30, 2007	Change in number of AMR units	Number of non-AMR (conventional) accounts remaining	Total Accounts (AMR + Conventional) as of June 30, 2006	% AMR Complete as of June 30, 2007
R	5/8"	468,251	474,563	6,312	3,947	478,510	99.18%
Z	3/4"	0	0	0	99	99	
Q	1"	5,676	5,625	-51	209	5,834	96.42%
P	1-1/2"	2,027	2,036	9	83	2,119	96.08%
X	2"	2,442	2,502	60	142	2,644	94.63%
O	3"	823	1,069	246	184	1,253	85.32%
W	4"	389	774	385	174	948	81.65%
N	6"	177	229	52	115	344	66.57%
V	8"	26	36	10	32	68	52.94%
E	10"	2	8	6	24	32	25.00%
T	12"	2	2	0	2	4	50.00%
Small Meters		468,251	474,563	6,312	4,046	478,609	99.18%
Large Meters (1-inch to 12 th inch)		11,564	12,281	717	965	13,246	92.71%
All Meters		479,815	486,844	7,029		491,855	98.98%
Non-Billed AMR Accounts		19,755	23,060	3,305	Small Meter Accounts without AMR	4,046	
Billed AMR Accounts			486,844		Large Meter Accounts without AMR	965	
Total AMR Accounts			509,904		Total Accounts without AMR	5,011	

The initial major phase of the AMR installation occurred in 1997-1999 with the installation of roughly 85% of all residential (5/8-inch) accounts with new meters and meter reading devices.

Since 1999 installation has focused on Hard-to-Access residential accounts not picked up in the initial phase along with large meters and city properties. Meter reading devices must be fit to a variety of different large meter makes and models.

For Fiscal Year 2007 the meter reading success rate was 97.60% for all AMR accounts. The overall rate (AMR and manual reads) was 96.23%.

Water Revenue Bureau - Technical Operations Fiscal Year Report for 2007

Technical Operations, Meter Reading & Investigation Division
 Director of Technical Operations

Fiscal Year Backlog	Routes Scheduled	Routes Completed	Routes Deleted	Total Readings	Read Percent	Total No Resp	No Resp Percent	Can't Read	Can't Read Percent	Vacant	Vacant Percent	Total Accounts	Completed Backlog	Explain all backlog items
0	0	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0	
0	600	600	0	8,444	58.6%	3,600	25.0%	4,000	27.8%	0	0.0%	14,400	0	
0	600	600	0	8,444	58.6%	3,600	25.0%	4,000	27.8%	-	0.0%	14,400	0	
0	0	0	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0	Reads received outside of billing window

Commercial Iron (830)

Commercial Manual
 Combined Total

Phone In Readings

Reinspections

Return Mail

Iron Reads

Combined Totals Iron & Manual

# Visited	15,199	# Terminated	2,994	% Term.	19.6%	\$ Collected	\$340,380.04	Total with CEC	\$1,244,821.17
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# Received	86,901	# Completed	25,577	% Comp.	29.4%	\$ Collected	\$1,628,332.67
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Reads	5,482,882	Read Percent	96.24%	No Resp	60,836	No Resp Percent	1.06%	Non-Billed	152,068	Non-Billed Percent	2.67%	Total Accounts	5,695,996
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Total Readings	5,491,026	Read Percent	96.14%	Total No Resp	64,236	No Resp Percent	1.12%	Can't Read	4,000	Can't Read Percent	0.07%	Non-Billed	152,068	Non-Billed Percent	2.66%	Total Accounts	5,711,396
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Backlog
 Scheduled
 Completed
 Total Readings
 Can't Read

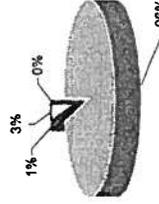
Total number of routes not completed FY 07
 Routes scheduled for FY 07
 Routes completed for FY 07
 Total readings commercial & manual
 Non-billed, blocked, no access, flooded etc.

Reinspection



■ Visited ■ Terminated

Combined Readings



■ Reads ■ No Resp. □ NB's □ Can't Reads

**Philadelphia Water Department - Water Revenue Bureau
Revenue Protection Program Fiscal Year 2007**

In Fiscal Year 2007 the Revenue Protection Program was able to dedicate only a fraction of the staff time to investigations as compared to recent years. This was due to the need for the program to focus on the development of the new SERVICELINK work order management system and training and preparation for the new Customer Billing System.

ACCOUNT STATUS	# OF ACCOUNTS	RECOVERED CCF	RECOVERED MG	RECOVERED MGD	BILLED - USAGE CHARGE	BILLED - SERVICE CHARGE
EC-1's	67	69,146	51.72	0.14	\$190,267.00	\$0.00
EC-2's	2	2,969	2.22	0.01	\$2,680.00	\$0.00
EC-3's	57	18,416	13.78	0.04	\$61,166.49	\$0.00
EC-4's	0	0	0.00	0.00	\$0.00	\$0.00
EC-5's	0	0	0.00	0.00	\$0.00	\$0.00
EC-9's	0	0	0.00	0.00	\$0.00	\$0.00
NB2's	0	0	0.00	0.00	\$0.00	\$0.00
NB3's	132	22,578	16.89	0.05	\$74,151.00	\$41,101.00
NB4's	0	0	0.00	0.00	\$0.00	\$0.00
NB5's	15	6,227	4.66	0.01	\$2,573.30	\$17,192.52
NB6's	7	260	0.19	0.00	\$868.29	\$29,955.52
NB8's	0	0	0.00	0.00	\$0.00	\$0.00
NB9's	129	14,908	11.15	0.03	\$45,397.00	\$35,266.00
Active accounts rejected in RWMI(1)	0	0	0	0.00	\$0.00	\$0.00
No accounts and/or permit problems(2)	11	1,837	20.04	0.05	\$5,019.05	\$13,546.00
Wrong Control Day(3)	0	0	0.00	0.00	\$0.00	\$0.00
Wrong Service Code	2	0	0.00	0.00	\$0.00	\$642.75
Zero Consumption	27	38,408	28.73	0.08	\$11,562.00	\$0.00
Sub-totals	449	174,749	130.71	0.36	\$393,684.13	\$137,703.79

Total Recovered Billed Revenue **\$531,387.92**
Total Recovered Billable Water, MGD **0.36**

- (1) Accounts rejected in RWMI: Meter rotates that are rejected by the billing system, WRB must correct.
 (2) No accounts and/or Permit problems: Accounts that were rejected by billing and never established.
 (3) Wrong Control Day(Meter Reading Route): Accounts billed to the wrong party due to Control Day error
 (4) Wrong Service Code: Accounts billed for the wrong service /meter size.

Estimated Accounts (EC)	No. of Accounts on 6/30/2007
EC-0: No Response - does not apply with AMR accounts	5,008
EC-1: Vacant - reported as such by a Meter Reader**	535
EC-2: Torn Down - reported as such by a Meter Reader**	70
EC-3: Hand Estimate - May be used if AMR not yet installed	6,785
EC-4: Non-registering Meter	20
EC-5: Missing Meter	2
EC-6: Off Line	0
EC-7: Meter Problem	0
EC-8: Seal Broken (shutoff)	1
EC-9: Blocked (no access to water meter)	3
Estimate code e	4,282
Estimate code p	13
Scheduled Accounts (listed in Service Code) - Meter temporarily removed**	
Total Estimated Accounts	16,719

Non-billed Accounts (NB)	No. of Accounts on 6/30/2007
NB1: Discontinuance Permit & Outstanding Balance	16
NB2: Transferred to a Different Account	908
NB3: Shutoff for Non-payment	18,790
NB4: Water from Another Source	0
NB5: No Water Service (Discontinued Property)	42,321
NB6: Service & Meter Permit (New property to be billed when occupied)	4,738
NB8: Suspended Billing	1,038
NB9: Vacant property with no activity for one year.	29,933
Total Non-Billed Accounts	97,744

**City of Philadelphia - Delinquency and Restoration Services
Record of Nonpayment Shutoffs and Restored Accounts**

	Totals FY2007	Totals FY2006	Totals FY2005	Totals FY2004	Totals FY2003	Totals FY2002	Difference FY2007 vs. FY2006
Accounts Received	71,846	68,424	79,162	79,573	74,356	78,799	3,422
Accounts Serviced	71,034	67,976	78,443	78,528	71,783	75,979	3,058
Accounts Shutoff	31,403	28,362	31,299	31,263	28,833	28,074	3,041
Accounts Shutoff and Locked			7,966				
Accounts Found Off	7,905	8,149	12,036	10,916	10,531		(244)
Accounts Restored: Shutoff Crews	21,930	20,122	20,959	21,111	21,414	18,723	1,808
Accounts Restored: Emergency Crews	1,959	2,377	2,117	2,463	2,895	3,993	(418)
Accounts Cancelled: WRB	14,083	7,321	8,518	8,514	9,532	7,921	6,762
Accounts Made Ready For Shutoff	5,303	3,705	6,331	5,696	5,946	5,305	1,598
Checks Collected: Number	16,096	14,774	14,943	15,491	15,404	14,766	1,322
Checks Collected: Amount	\$4,985,974	\$4,407,606	\$4,384,465	\$3,852,277	\$3,837,151	\$3,415,596	578,368
Digup Accounts Received	5,302	3,704	6,333	5,697	6,188	6,755	1,598
Regular Shutoff Crews	\$3,031	2,936	3,295	3,359	3,078	3,340	95
Digup Crews	1,082	855	1,110	996	1,289	1,248	227
USTRA Inspection Crews	1	2	21	23	86	115	(1)
USTRA Shutoff Crews			12	23	58	69	
AMR Digup Shutoff Crews	74	13	14	33	38	66	61
Days Computer System Unavailable	1	2	2	1	3		(1)
Heat Emergency Days	5	10	0	0	19	7	(5)
Snow Days	3	6	4	2	3	1	(3)
Illegal Restores Addressed	348						

Apparent Loss Due to Missing or Malfunctioning Customer Meters During Fiscal Year 2007

Water Lost Through Missing Meters Uncovered during Fiscal Year 2007

	Meter Size	# Identified	Typical Use per Size, gal/day	Unmetered Water, gallons	Average Daily Unmetered Water, mgd
Small Meters	5/8"	2253	187	153,850,900	0.422
Large Meters	1"	25	790	7,205,540	0.020
	1-1/2"	6	1,875	4,105,252	0.011
	2"	5	3,495	6,378,030	0.017
	3"	1	8,283	3,023,345	0.008
	4"	1	14,541	5,307,568	0.015
			Large Meters Total	26,019,735	0.071
	Total	2291		179,870,635	0.493

Water Lost Through Non-registering (Frozen or Stopped) Meters Uncovered during Fiscal Year 2007

Small Meters	5/8"	548	187	37,421,346	0.103
Large Meters	1"	14	790	4,035,102	0.011
	1-1/2"	6	1,875	4,105,252	0.011
	2"	7	3,495	8,929,242	0.024
	4"	3	14,541	15,922,704	0.044
	6"	2	38,944	28,428,840	0.078
				Large Meters Total	32,992,300
	Total	580		70,413,646	0.193

Water Lost Through Under-registration of Large Meters - Fiscal Year 2007*

Meter Size	Typical Use per Size, gal/day	2% Under-registration, gal/day	Ave. # of Accounts	# of Accounts Under-registering, taken as 5% except for 12"	Water Under-registered, 5% of accounts multiplied by the 2% error amount, gal/day
1"	790	16	5,602	280	4,423
1-1/2"	1,875	37	2,044	102	3,831
2"	3,495	70	2,533	127	8,852
3"	8,283	166	1,185	59	9,815
4"	14,541	291	930	46	13,520
6"	38,944	779	326	16	12,709
8"	72,564	1,451	67	3	4,862
10"	332,192	6,644	28	1	9,440
12"	1,518,732	30,375	3	1	30,375
			12,718		Gallons per day 97,826
					Gallons per year 35,706,656
					Mgd 0.098

*Under-registration of small meters is taken as a nominal 0.1% of small meter control day consumption since the most of the small meter population was replaced with new meters as part of the AMR installation from 1997-1999. Random testing of 30 small meters in FY2005 confirmed high accuracy.

Fiscal Year 2007 Customer Meter Size Changes

FROM		TO		FROM		TO		NUMBER	SIZE CHANGE	CODE	SIZE	FROM		TO		NUMBER	SIZE CHANGE
CODE	SIZE	CODE	SIZE	CODE	SIZE	CODE	SIZE					CODE	SIZE	CODE	SIZE		
R	5/8 inch	Q	1 inch			O	3 inch			R	5/8 inch					0	Downsize
R	5/8 inch	P	1-1/2 inch			O	3 inch	10	Upsize	Q	1 inch					7	Downsize
R	5/8 inch	X	2 inch			O	3 inch	7	Upsize	P	1-1/2 inch					5	Downsize
R	5/8 inch	O	3 inch			O	3 inch	4	Upsize	X	2 inch					6	Downsize
R	5/8 inch	W	4 inch			O	3 inch	2	Upsize	W	4 inch					6	Upsize
R	5/8 inch	N	6 inch			O	3 inch	0	Upsize	N	6 inch					0	Upsize
R	5/8 inch	E	10 inch					0	Upsize					Total		24	
			Total			W	4 inch	36		R	5/8 inch					2	Downsize
Z	3/4 inch	R	5/8 inch			W	4 inch	252	Downsize	Q	1 inch					3	Downsize
Z	3/4 inch	Q	1 inch			W	4 inch	8	Upsize	P	1-1/2 inch					0	Downsize
Z	3/4 inch	P	1-1/2 inch			W	4 inch	2	Upsize	X	2 inch					18	Downsize
Z	3/4 inch	X	2 inch			W	4 inch	0	Upsize	O	3 inch					23	Downsize
Z	3/4 inch	O	3 inch			W	4 inch	0	Upsize	N	6 inch					2	Upsize
			Total			W	4 inch	262		E	10 inch					0	Upsize
Q	1 inch	R	5/8 inch					181	Downsize					Total		48	
Q	1 inch	P	1-1/2 inch			N	6 inch	1	Upsize	R	5/8 inch					0	Downsize
Q	1 inch	X	2 inch			N	6 inch	12	Upsize	Q	1 inch					0	Downsize
Q	1 inch	O	3 inch			N	6 inch	1	Upsize	X	2 inch					0	Downsize
Q	1 inch	W	4 inch			N	6 inch	0	Upsize	O	3 inch					16	Downsize
			Total			N	6 inch	195		W	4 inch					15	Downsize
Y	1-1/4 inch	R	5/8 inch			N	6 inch	24	Downsize	E	10 inch					1	Upsize
Y	1-1/4 inch	Q	1 inch					20	Downsize					Total		32	
Y	1-1/4 inch	P	1-1/2 inch			V	8 inch	0	Upsize	R	5/8 inch					0	Downsize
Y	1-1/4 inch	X	2 inch			V	8 inch	1	Upsize	P	1-1/2 inch					0	Downsize
Y	1-1/4 inch	O	3 inch			V	8 inch	0	Upsize	O	3 inch					0	Downsize
Y	1-1/4 inch	W	4 inch			V	8 inch	0	Upsize	W	4 inch					6	Downsize
			Total			V	8 inch	45		N	6 inch					2	Downsize
P	1-1/2 inch	R	5/8 inch			V	8 inch	41	Downsize	E	10 inch					5	Upsize
P	1-1/2 inch	Q	1 inch					7	Downsize					Total		13	
P	1-1/2 inch	X	2 inch			E	10 inch	0	Upsize	N	6 inch					0	Downsize
P	1-1/2 inch	O	3 inch			T	12 inch	0	Upsize	W	6 inch					0	Downsize
P	1-1/2 inch	W	4 inch			T	12 inch	0	Upsize	V	8 inch					2	Downsize
			Total			T	12 inch	48						Total		10	Downsize
X	2 inch	R	5/8 inch					31	Downsize					Total		12	
X	2 inch	Q	1 inch					21	Downsize								
X	2 inch	P	1-1/2 inch					4	Downsize								
X	2 inch	O	3 inch					2	Upsize								
X	2 inch	W	4 inch					4	Upsize					Total Downsizings		695	
X	2 inch	N	6 inch					0	Upsize					Total Upsizings		81	
			Total					62									

**Philadelphia Water Department - Estimated Leakage Flowrates
Derived from the 2000/2001 Leakage Management Assessment Project**

Type of Leak or Break	Diameter	PWD Leakage Flow Rates @ 70 Psi				PWD Leakage Flow Rates @ 55 Psi			
		Unreported		Reported		Unreported		Reported	
		gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd
Fire Hydrant		3.5	0.005	3.5	0.005	3.1	0.004	3.1	0.004
Valve		6.9	0.010	6.9	0.010	6.1	0.009	6.1	0.009
<u>Customer Service Lines</u>									
Active	5/8"	6.9	0.010	6.9	0.010	6.1	0.009	6.1	0.009
Active	3/4"	6.9	0.010	6.9	0.010	6.1	0.009	6.1	0.009
Active	1"	6.9	0.010	6.9	0.010	6.1	0.009	6.1	0.009
Active	2" to 4"	13.9	0.020	13.9	0.020	12.3	0.018	12.3	0.018
Abandoned or Vacant Building	5/8"	13.9	0.020	13.9	0.020	12.3	0.018	12.3	0.018
Abandoned or Vacant Building	1"	13.9	0.020	13.9	0.020	12.3	0.018	12.3	0.018
Abandoned or Vacant Building	2" to 4"	13.9	0.020	13.9	0.020	12.3	0.018	12.3	0.018
<u>Water Mains</u>									
Joint Leak or Repair Band Leak	6"	10.4	0.015	10.4	0.015	9.2	0.013	9.2	0.013
Joint Leak or Repair Band Leak	8"	17.3	0.025	17.3	0.025	15.3	0.022	15.3	0.022
Joint Leak or Repair Band Leak	10" to 48"	27.8	0.040	27.8	0.040	24.6	0.035	24.6	0.035
Round (circumferential) crack	4"	34.7	0.050	69.4	0.100	30.7	0.044	61.5	0.089
Round (circumferential) crack	6"	55.5	0.080	111.1	0.160	49.2	0.071	98.4	0.142
Round (circumferential) crack	8"	76.3	0.110	152.6	0.220	67.6	0.097	135.2	0.195
Round (circumferential) crack	10"	93.8	0.135	187.6	0.270	83.1	0.120	166.2	0.239
Round (circumferential) crack	12"	111.1	0.160	222.2	0.320	98.4	0.142	196.9	0.283
Longitudinal crack or split bell	6"	69.4	0.100	138.9	0.200	61.5	0.089	123.1	0.177
Longitudinal crack or split bell	8"	93.8	0.135	187.6	0.270	83.1	0.120	166.2	0.239
Longitudinal crack or split bell	10"	111.1	0.160	222.2	0.320	98.4	0.142	196.9	0.283
Longitudinal crack or split bell	12"	138.9	0.200	277.8	0.400	123.1	0.177	246.1	0.354

Note: Quantities do not include the effects of different pipe materials
 International Leakage Management practices reference leakage rates at 70 Psi
 Philadelphia's average water pressure is 55 Psi

Unreported Leaks - discovered during leak survey work
 Reported Leaks - visible leaks; originated by complaint

**ESTIMATE OF PIPELINE WATER LOSSES DUE TO WATER MAIN BREAKS - FISCAL YEAR 2007
REPORTED MAIN BREAKS AND TRANSMISSION LEAKS**

MAIN BREAK OCCURRENCES			WATER LOSS - AWARENESS, LOCATION & RESPONSE ASSESSMENTS					TOTAL LOSS (gallons)
WATER MAIN SIZE (in)	BREAK TYPE	NUMBER OF BREAKS	AWARENESS PERIOD (24 Hr)			LOCATION PERIOD (.25 Hr)	RESPONSE PERIOD (3 Hr)	
			PRE-BREAK LOSS RATE (gal/day)	LOSS UNTIL AWARENESS (gallons)	BREAK LOSS RATE (gal/day)	LOSS DURING LOCATION ACTIVITY (gallons)	LOSS DURING RESPONSE ACTIVITIES (gallons)	
3	Joint/Hole	0		0	0	0	0	0
3	Circ.	1	1,800	1,800	18,000	188	2,250	4,238
3	Long/SB/BO	1		0	0	0	0	0
4	Joint/Hole	0	1,800	0	18,000	0	0	0
4	Circ.	5	8,900	44,500	89,000	4,635	55,625	104,760
4	Long/SB/BO	4	8,900	35,600	89,000	3,708	44,500	83,808
6	Joint/Hole	32	1,300	41,600	13,000	4,333	52,000	97,933
6	Circ.	318	14,200	4,515,600	142,000	470,375	5,644,500	10,630,475
6	Long/SB/BO	175	17,700	3,097,500	177,000	322,656	3,871,875	7,292,031
8	Joint/Hole	5	2,200	11,000	22,000	1,146	13,750	25,896
8	Circ.	97	19,500	1,891,500	195,000	197,031	2,364,375	4,452,906
8	Long/SB/BO	96	23,900	2,294,400	239,000	239,000	2,868,000	5,401,400
10	Joint/Hole	3	3,500	10,500	35,000	1,094	13,125	24,719
10	Circ.	2	23,900	47,800	239,000	4,879	59,750	112,529
10	Long/SB/BO	15	28,300	424,500	283,000	44,219	530,625	999,344
12	Joint/Hole	0	3,500	0	35,000	0	0	0
12	Circ.	17	28,300	481,100	283,000	50,115	601,375	1,132,590
12	Long/SB/BO	45	35,400	1,593,000	354,000	185,938	1,991,250	3,750,188
Distribution Main Total		816		14,490,400		1,509,417	18,113,000	34,112,817
						Average, MGD		0.093
18	Joint/Hole	0	3,500	0	35,000	0	0	0
16	Circ.	1	33,000	33,000	330,000	3,438	41,250	77,688
16	Long/SB/BO	3	45,000	135,000	450,000	14,083	168,750	317,813
20	Joint/Hole	0	3,500	0	35,000	0	0	0
20	Circ.	1	39,000	39,000	390,000	4,063	48,750	91,813
20	Long/SB/BO	1	49,000	49,000	490,000	5,104	61,250	115,354
24	Joint/Hole	1	3,500	3,500	35,000	365	4,375	8,240
24	Circ.	0	46,000	0	460,000	0	0	0
24	Long/SB/BO	0	54,000	0	540,000	0	0	0
30	Joint/Hole	0	3,500	0	35,000	0	0	0
30	Circ.	1	54,000	54,000	540,000	5,825	67,500	127,125
30	Long/SB/BO	3	61,000	183,000	610,000	19,063	228,750	430,813
36	Joint/Hole	0	3,500	0	35,000	0	0	0
36	Circ.	0	54,000	0	630,000	0	0	0
36	Long/SB/BO	0	61,000	0	730,000	0	0	0
42	Joint/Hole	0	3,500	0	35,000	0	0	0
48	Joint/Hole	1	3,500	3,500	35,000	365	4,375	8,240
48	Circ.	0	54,000	0	750,000	0	0	0
48	Long/SB/BO	4	61,000	244,000	1,000,000	41,867	500,000	785,867
54		0	0	0	0	0	0	0
60		0	0	0	0	0	0	0
Transmission Main Total		16		744,000		93,750	1,125,000	1,962,750
						Average, MGD		0.006
TOTAL		832		15,234,400		1,603,167	19,238,000	36,075,567
						Average, MGD		0.099

**ESTIMATE OF PIPELINE WATER LOSSES DUE TO WATER MAIN BREAKS - FISCAL YEAR 2007
REPORTED MAIN BREAKS AND TRANSMISSION LEAKS**

TRANSMISSION MAIN LEAK OCCURRENCES			WATER LOSS - AWARENESS		LOCATION & RESPONSE ASSESSMENTS			TOTAL LOSS (gallons)
WATER MAIN SIZE (In)	LEAK TYPE	NUMBER OF LEAKS	AWARENESS PERIOD (14 Days)		LOCATION PERIOD (.25 Hr)	RESPONSE PERIOD (3 Hr)		
			LEAK LOSS RATE (gal/day)	LOSS UNTIL AWARENESS (gallons)	LEAK LOSS RATE (gal/day)	LOSS DURING LOCATION ACTIVITY (gallons)	LOSS DURING RESPONSE ACTIVITIES (gallons)	
16	Joint/Hole	5	3,500	245,000	3,500	182	2,188	247,370
16	Circ.	0	33,000	0	33,000	0	0	0
16	Long/SB/BO	1	45,000	630,000	45,000	469	5,625	636,094
20	Joint/Hole	4	3,500	196,000	3,500	146	1,750	197,896
20	Circ.	1	39,000	546,000	39,000	408	4,875	551,281
20	Long/SB/BO	0	49,000	0	49,000	0	0	0
24	Joint/Hole	2	3,500	98,000	3,500	73	875	98,948
24	Circ.	0	46,000	0	46,000	0	0	0
24	Long/SB/BO	0	54,000	0	54,000	0	0	0
30	Joint/Hole	5	3,500	245,000	3,500	182	2,188	247,370
30	Circ.	0	54,000	0	54,000	0	0	0
30	Long/SB/BO	1	61,000	854,000	61,000	635	7,625	862,260
36	Joint/Hole	0	3,500	0	3,500	0	0	0
36	Circ.	0	54,000	0	54,000	0	0	0
36	Long/SB/BO	0	61,000	0	61,000	0	0	0
42	Joint/Hole	0	3,500	0	3,500	0	0	0
48	Joint/Hole	5	3,500	245,000	3,500	182	2,188	247,370
48	Circ.	0	54,000	0	54,000	0	0	0
48	Long/SB/BO	1	61,000	854,000	61,000	635	7,625	862,260
54	Joint/Hole	0	3,500	0	3,500	0	0	0
60	Joint/Hole	0	3,500	0	3,500	0	0	0
Transmission Leaks Total		25	3,913,000			2,911	34,938	3,950,849
							Average, MGD	0.011

Fiscal Year 2007 Transmission Main Leak Repair Locations (16-inch diameter & Larger)

	Completed	Complete Location	Repair Action	Size	
1	8/15/2006	FRONT & GODFREY	Recaulked joint	30	Joint/Hole
2	8/31/2006	200 N. 21st St.	Repaired hole	48	Joint/Hole
3	10/10/2006	1300 BAINBRIDGE ST	Repair clamp	30	Long/SB/Hole
4	10/16/2006	LOMBARD ST & S BROAD ST	Replaced coupling	48	Joint/Hole
5	10/26/2006	CHEW AV AND E WALNUT LA	Replaced valve	16	Joint/Hole
6	11/17/2006	6400 GREENE ST	Repaired joint	20	Joint/Hole
7	11/30/2006	1400 ARCH ST	Repaired joint	30	Joint/Hole
8	11/30/2006	GERMANTOWN AV & E COULTER ST	Renewed bonnet	20	Joint/Hole
9	12/4/2006	9000 TORRESDALE	Recaulked joint	24	Joint/Hole
10	12/22/2006	3500 FOX ST	Repaired split	48	Long/SB/Hole
11	12/23/2006	33RD ST & MARKET	Repaired hole	24	Joint/Hole
12	12/23/2006	TASKER ST & S 33RD ST	Replaced bell	16	Long/SB/BO
13	1/3/2007	E. Side RIDGE AV, 521' N. of SCOTTS LA	Replaced hacensack sleeve	16	Joint/Hole
14	1/22/2007	COTTMAN AV & RISING SUN AV	Recaulked joint	20	Joint/Hole
15	1/25/2007	EMLN ST AND W ALLENS LA	Replaced valve	16	Joint/Hole
16	1/26/2007	EMLN ST & W ALLENS LA	Replaced coupling	16	Joint/Hole
17	2/10/2007	24 W GIRARD AV	circumferential	20	Circumferential
18	3/29/2007	6000 WISSAHICKON AV	Recaulked joint	20	Joint/Hole
19	4/7/2007	1400 ARCH ST	Replaced coupling	30	Joint/Hole
20	4/12/2007	N FRONT ST AND W GIRARD AV	Recaulked joint	30	Joint/Hole
21	5/2/2007	N FRONT ST & W GIRARD AV	Recaulked joint	30	Joint/Hole
22	6/4/2007	1300 W GLENWOOD AV	Recaulked joint	48	Joint/Hole
23	6/14/2007	5700 CEDAR AV	Recaulked joint	48	Joint/Hole
24	6/15/2007	54TH & CHESTER	Replaced valve	16	Joint/Hole
25	6/27/2007	CHRISTIAN ST & S 57TH ST	Recaulked joint	48	Joint/Hole

Water Main Break Repairs by Month														Breaks per 1000 miles of pipe	
	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Avg.		Total
1965	49	37	29	35	41	96	189	119	43	43	36	33	62.5	750	237.3
1966	29	29	29	33	53	78	174	188	65	43	27	40	65.7	788	249.4
1967	49	33	34	29	35	123	127	64	58	40	23	64	56.6	679	214.9
1968	31	44	22	41	59	98	338	139	68	36	36	46	79.8	958	303.2
1969	58	54	39	45	68	189	170	62	48	53	34	51	72.6	871	275.6
1970	49	33	42	36	28	174	287	163	59	48	71	42	86.0	1,032	326.6
1971	61	36	27	44	64	88	168	146	56	44	40	54	69.0	828	262.0
1972	49	49	30	53	63	87	71	112	51	33	33	26	54.8	657	207.9
1973	55	41	29	46	73	95	165	79	36	28	32	71	62.5	750	237.3
1974	51	52	56	35	57	105	120	73	36	34	33	46	58.2	698	220.9
1975	59	43	44	62	72	81	93	91	42	49	50	77	63.6	763	241.5
1976	47	43	30	47	49	135	289	106	81	41	27	69	80.3	964	305.1
1977	26	44	34	45	105	154	439	435	149	69	64	68	136	1,632	516.5
1978	55	57	37	68	83	211	169	181	127	36	65	69	97	1,158	366.5
1979	42	56	40	55	58	95	164	184	172	87	71	48	89	1,070	338.6
1980	55	62	49	63	43	98	85	148	74	42	37	46	67	802	253.8
1981	59	54	69	51	61	180	273	160	77	33	54	59	94	1,130	357.6
1982	67	36	37	35	63	189	154	178	83	75	46	37	83	1,000	316.5
1983	66	65	58	53	64	86	149	84	50	52	39	68	70	834	263.9
1984	78	55	35	67	56	150	259	109	49	27	49	56	83	990	313.3
1985	45	33	33	39	63	68	221	153	56	33	27	47	68	816	258.2
1986	40	39	29	50	69	139	147	64	43	31	14	22	57	687	217.4
1987	22	38	37	36	55	77	92	106	45	26	24	37	50	595	188.3
1988	39	40	41	46	57	84	253	121	67	40	43	65	75	896	283.5
1989	75	77	18	56	37	111	98	50	37	33	35	55	57	682	215.8
1990	43	44	38	53	74	245	227	90	85	43	31	51	85	1,024	324.1
1991	51	50	32	29	79	61	134	44	35	39	51	44	54	649	205.4
1992	35	37	25	42	46	87	139	84	29	34	28	34	52	620	196.2
1993	51	16	15	24	44	70	74	86	62	47	34	54	48	577	182.6
1994	58	37	32	43	49	112	419	229	117	61	76	84	110	1,317	416.8
1995	65	65	30	50	57	94	134	143	75	38	30	48	69	829	262.3
1996	70	66	47	30	75	199	218	96	48	41	37	42	81	969	306.6
1997	41	35	29	42	82	61	180	46	33	39	26	44	55	658	208.2
1998	40	18	22	27	54	66	50	26	37	30	31	38	37	439	138.9
1999	46	33	32	27	48	68	226	38	39	32	22	27	53	636	201.3
2000	55	38	27	32	49	95	202	191	64	22	47	27	71	849	268.7
2001	32	25	23	33	61	165	178	43	47	39	30	30	59	706	223.4
2002	54	43	30	41	52	36	128	38	31	24	13	35	44	525	166.1
2003	50	50	19	47	50	160	217	172	84	42	26	39	80	956	302.5
2004	50	27	27	41	35	91	200	178	62	36	34	36	68	817	258.5
2005	33	26	32	39	54	107	129	119	62	36	41	42	60	720	227.8
2006	60	61	40	47	54	127	67	47	46	28	46	37	55	660	219.0
2007	32	54	37	35	67	81	90	231	58	49	49	49	69	832	276.0
Min	22	16	15	24	28	36	50	26	29	22	13	22	37	439	
Max	78	77	69	68	105	245	439	435	172	87	76	84	136	1,632	
Avg.	50	43	34	43	58	115	181	119	63	41	38	48	69	833	
Avg. % of Total	6.0%	5.2%	4.1%	5.2%	7.0%	13.8%	21.8%	14.3%	7.5%	4.9%	4.6%	5.7%		100.0%	

CITY OF PHILADELPHIA - WATER DEPARTMENT

WATER MAIN BREAKS & CAPITAL PROGRAM MAIN REPLACEMENT DATA

Fiscal Year	Water Main Breaks*			Miles of Pipeline Replaced		
	Total	Leadite**	%Leadite	Funding***	Total	Leadite
1980	861	102	11.8%	\$6,557,000	13.14	0.41
1981	1,086	101	9.3%	\$6,625,000	13.83	0.00
1982	932	108	11.6%	\$7,243,000	12.06	0.61
1983	778	146	18.8%	\$9,945,000	9.00	0.61
1984	798	105	13.2%	\$6,500,000	18.89	0.65
1985	816	115	14.1%	\$9,975,000	16.09	1.34
1986	685	121	17.7%	\$7,100,000	13.97	2.02
1987	590	119	20.2%	\$8,400,000	14.22	2.22
1988	892	105	11.8%	\$13,900,000	17.58	4.59
1989	680	90	13.2%	\$13,700,000	20.24	4.13
1990	1,018	76	7.5%	\$13,000,000	18.67	6.25
1991	648	62	9.6%	\$3,800,000	4.74	0.00
1992	617	59	9.6%	\$15,600,000	18.07	3.86
1993	577	60	10.4%	\$18,200,000	16.88	1.06
1994	1,316	105	8.0%	\$14,800,000	14.26	3.44
1995	829	74	8.9%	\$11,800,000	13.99	2.23
1996	968	66	6.8%	\$20,000,000	22.10	4.43
1997	661	50	7.6%	\$21,000,000	22.21	4.65
1998	440	38	8.6%	\$21,990,000	26.23	4.32
1999	616	55	8.9%	\$22,200,000	25.07	3.04
2000	848	95	11.2%	\$23,150,000	25.60	3.25
2001	701	59	8.4%	\$16,500,000	20.10	3.30
2002	521	69	13.2%	\$20,850,000	22.00	2.60
2003	955	88	9.2%	\$24,100,000	21.90	1.73
2004	802	79	9.9%	\$22,300,000	18.80	1.00
2005	716	67	9.4%	\$9,250,000	7.80	0.67
2006	660	77	11.7%	\$16,980,000	14.30	2.80
2007	816	79	9.7%	\$16,610,000	14.30	1.00
Total	21,827	2,370			476.04	66.21
Ave.	778	85	10.9%		17.10	2.42
Max.	1,316	146	20.2%		26.23	6.25

*Years 1980-1984 are calendar year main break data

** Roughly 300 miles of rupture-prone leadite joint pipeline were installed from 1946-1955

*** Funding figures include budgeted amounts for 1980-1985; expenditures for all other years

CITY OF PHILADELPHIA

QUANTITY OF LEAKAGE ABATED THROUGH THE LEAK DETECTION PROGRAM

All quantities in Million Gallons per Day, MGD

Fiscal Year	Crews Assisted by Severn Trent - Pitometer Pipeline Services				Leak Detection Crews			Grand Total	Leak Survey Mileage*
	Survey (Unreported)	Referral (Reported)	Sewer Infiltration	Total	Survey (Unreported)	Referral (Reported)	Total		
1980	2.435	2.098	0	4.533			0	4.533	
1981	1.729	2.541	0.908	5.178			0	5.178	
1982	5.628	2.414	5.728	13.77			0	13.77	
1983	16.047	1.922	0.013	17.982	0.833	0.585	1.418	19.4	
1984	4.474	2.241	0	6.715	2.59	0.51	3.1	9.815	
1985	8.54	3.954	0	12.494	1.86	0.64	2.5	14.994	
1986	7.393	6.639	0	14.032	6.421	1.684	8.105	22.137	
1987	3.013	5.01	0	8.023	5.03	0.47	5.5	13.523	
1988	6.123	8.137	0	14.26	4.345	1.665	6.01	20.27	
1989	9.232	4.012	0	13.244	5.66	8.245	13.905	27.149	1,240
1990	3.935	2.865	0	6.8	7.835	9.115	16.95	23.75	1,204
1991	5.594	1.338	0	6.932	10.42	12.705	23.125	30.057	1,106
1992	4.614	1.53	0	6.144	6.27	13.705	19.975	26.119	977
1993	3.883	1.333	0	5.216	7.56	10.91	18.47	23.686	1,003
1994	1.643	2.363	0	4.006	4.93	14.146	19.076	23.082	616
1995	1.02	2.236	0	3.256	13.93	24.96	38.89	42.146	1,126
1996	1.233	1.082	0	2.315	9.52	9.605	19.125	21.44	1,146
1997	1.371	1.983	0	3.354	4.71	5.135	9.845	13.199	1,402
1998	0.912	0.812	0	1.724	3.68	7.295	10.975	12.699	1,072
1999	1.07	0	0	1.07	3.145	16.535	19.68	20.75	1,396
2000	0.04	0	0	0.04	6.075	19.35	25.425	25.465	1,371
2001	0	0	0	0	9.175	17.945	27.12	27.12	1,690
2002	0	0	0	0	4.616	23.055	27.671	27.671	1,313
2003	0	0	0	0	6.023	32.413	38.436	38.436	1,421
2004	0	0	0	0	8.167	27.766	35.933	35.933	1,160
2005	0	0	0	0	10.913	25.171	36.084	36.084	1,278
2006	0	0	0	0	5.031	24.121	29.152	29.152	1,113
2007	0	0	0	0	2.011	25.653	27.664	27.664	1,024

Approximately 3,014 miles of pipeline exist in the PWD water distribution system

**PROACTIVE LEAKAGE SURVEY INVESTIGATIONS
PIPELINE MILEAGE & NUMBER OF UNREPORTED (SURVEY) LEAKS REPAIRED****

Fiscal Year	Mileage*	Customer Service Lines	Abandoned Service Lines	Water Mains	Fire Hydrants	Valves	Total
1987	N/A	198	109	37	36	22	402
1988	N/A	234	84	47	81	16	462
1989	1240	412	146	47	78	29	712
1990	1204	243	108	38	163	9	561
1991	1106	327	228	27	41	12	635
1992	977	237	137	27	52	9	462
1993	1003	400	60	20	40	6	526
1994	616	139	60	25	34	9	267
1995	1126	169	90	84	162	20	525
1996	1146	132	80	72	5	5	294
1997	1402	117	32	34	12	0	195
1998	1072	98	26	19	14	2	159
1999	1396	78	47	17	35	12	189
2000	1371	92	32	37	105	21	287
2001	1690	109	40	57	146	15	367
2002	1313	86	31	28	117	20	282
2003	1421	64	25	64	39	16	208
2004	1160	83	24	54	48	7	216
2005	1278	70	25	61	143	17	316
2006	1113	82	28	31	76	11	228
2007	1024	83	10	17	52	11	173

*The entire distribution system of Philadelphia consists of roughly 3,014 miles of pipeline

REPORTED (REFERRAL) LEAKS: DEPLOYMENT & REPAIRS**

Fiscal Year	Crew Deployment, days	Customer Service Lines	Abandoned Service Lines	Water Mains	Fire Hydrants	Valves	Total
1987	145.3	59	57	43	3	0	162
1988	300.3	71	93	84	5	2	255
1989	407.8	80	125	103	3	4	315
1990	393	66	130	73	17	23	309
1991	389.8	87	145	73	8	23	336
1992	538.2	122	132	85	9	14	362
1993	578.5	168	104	69	22	11	374
1994	686.3	118	85	147	26	17	393
1995	774.3	218	129	211	88	11	657
1996	648.5	114	69	76	6	3	268
1997	425.7	92	31	38	20	2	183
1998	370.1	65	78	64	16	2	225
1999	413.1	112	141	133	21	14	421
2000	414	160	73	150	46	19	448
2001	452.5	148	77	147	36	12	420
2002	606.7	136	82	131	32	19	400
2003	752.4	152	78	199	32	20	481
2004	844.2	208	78	151	33	11	481
2005	755.6	231	59	161	52	11	514
2006	701.2	197	29	124	39	3	392
2007	729.1	219	33	168	31	10	461

** Does not represent all leaks repaired by the Philadelphia Water Department

**City of Philadelphia Water Audit
Fiscal Year 2007 - July 1, 2006 to June 30, 2007
Estimated Water Loss Due to Leakage Incidents**

Section 1: The Nature of Leaks and Leak Repairs in Philadelphia

A. Leaks in Philadelphia's water distribution network occur primarily on customer service piping (over 60% of all leak incidents occur on these lines) water main joints and points of corrosion, valves and fire hydrants

Since many vacant and/or abandoned properties exist in the city, customer service pipe leaks are usually categorized as "active" or "abandoned". The term Vacant Broken Pipe, or VBP, is also used casually to define leaks on customer service piping on an apparently unoccupied residence. VBPs are considered part of the "abandoned" customer service pipe leaks.

B. Leaks in the city garner a response from PWD personnel in two primary manners: *Reported Leaks* originate via reports or complaints of leakage or leak-related symptoms, usually by customers. *Unreported Leaks* are those discovered by the PWD in their routine Leak Detection Surveys.

The Leak Detection Squad performs leak surveys or searches for unreported leaks. While the Leak Detection Squad identifies leaks they do not repair them. They refer virtually all of their findings to designated PWD repair crews or customers (via violation notices) for action to effect repairs.

The Leak Detection Squad also performs work to pinpoint certain Reported Leaks which have been referred to them (referrals) by repair crews who encounter difficulty in making repairs. By using leak correlators, the Leak Detection Squad can usually pinpoint the exact leak location for the repair crew.

C. Leakage Repair Data is gathered from complaint and work order tracking systems. Leak Repairs are conducted by Customers - who arrange for repairs conducted by private plumbers on service pipes that have been identified as leaking by the PWD; and the PWD - who handle all other leaks and intercede on customer service pipe leaks if customers are not timely or an emergency condition occurs.

Customers can apply for funding assistance via loans or grants to pay for repairs and the PWD operates an assistance program to this end. While providing a reasonable estimate of the number of leak repairs occurring in the city, the PWD information handling systems can benefit from improvements that might eventually be undertaken to provide better functionality and accountability to this tracking.

Section 2: Summary Data on Repaired Leaks - FY2007*

	Active Customer Service Pipe Leaks	Abandoned Customer Service Pipe Leaks	Valve Leaks	Hydrant Leaks	Dist. Main Leaks	Trans. Main Leaks	Total
Reported Leak Repairs							
Service Leaks Repaired via arrangements of customers**	850						850
Service leaks Repaired by customers via funding assistance of Plumbing Repair Program (HELP Loans)	441						441
Leak repairs by the Distribution Unit, with no Leak Detection Squad involvement*	990	0	106	28	230	27	1381
Other Distribution Unit repairs - referred from LD Squad	782	465	10	31	168		1456
Unreported Leak Repairs							
Leaks repaired by the Distribution Unit as reported and pinpointed by the Leak Detection Squad (Included in above data - excess numbers added to below total)	83	10	11	52	17	0	173
Totals	3,146	475	127	111	415	27	4,301

*The breakdown between active and abandoned customer service line leaks is not known for this category

**Used same number as FY2006; FY2007 data is not available

ESTIMATE OF DELIVERED WATER LOST DUE TO UNAUTHORIZED FIRE HYDRANT USE FOR HEAT RELIEF DURING THE SUMMER PERIOD FISCAL YEAR 2007

METHOD

Philadelphia allows certain uses of water taken from fire hydrants (with meter and backflow preventor attached) but also experiences unauthorized consumption from fire hydrants. In past years widespread openings of fire hydrants on hot summer days for heat relief was an extremely problematic occurrence. Fortunately this situation has greatly improved.

Philadelphia has largely regained control over the problem of mass fire hydrant openings by employing the use of Center Compression Locks (CCL). The CCL is a spring-loaded device installed inside the bonnet of the fire hydrant. The hydrant can only be opened by use of a special adapter, which requires the coil to be compressed. The adapter and hydrant wrench must stay on the hydrant in order to keep the hydrant open. Even in cases where the adapter is replicated illegally, the unauthorized user closes the hydrant when finished using the hydrant, halting the unauthorized flow of water and limiting the event to a temporary one.

Traditionally, the Philadelphia Water Department viewed unauthorized, heat-relief fire hydrant consumption occurring on days of peak temperature at or above 84 degrees F. Water delivered to distribution on these days was compared to the delivery on the summer days that were less than 84 degrees. The difference was taken as unauthorized fire hydrant consumption. Starting in FY2003, this method was modified to use 90 degrees F as the defining peak temperature. This reflects the better control that the CCL has exerted on this type of unauthorized hydrant consumption and has been verified by the analysis of peak water delivery volumes.

Because the City's fiscal year starts on July 1, an apportionment over two summer periods must be made to obtain an estimate of hydrant losses for the fiscal year.

STEP 1

"Average +90 Degree F Day Delivery of 7/1/2006 - 9/15/2006 period" minus "Average <90 Degree F Day Delivery of 5/15/2006 - 9/15/2006 period." This equals "Average Delivery lost on +90 Days from 7/1/2006 - 9/15/2006."

$(6030.5 \text{ MG}/21 \text{ Days}) - ((10,364 + 14,868.4)/(41 + 56)) = 287.167 - 260.128 = 27.039 \text{ MG for 21 days}$

STEP 2

"Average +90 Day Degree F Delivery of 5/15/2007 - 6/30/2007 period" minus "Average <90 Day Delivery of 5/15/2007 - 9/15/2007 period." This equals "Average Delivery lost on +90 Degree F Days from 5/15/2007 - 6/30/2007."

$(1,679 \text{ MG}/6 \text{ Days}) - ((10,403.7 + 15,616.6)/(41 + 60)) = 279.833 - 257.627 = 22.206 \text{ MG for 6 days}$

STEP 3

**ESTIMATE OF DELIVERED WATER LOST DUE TO UNAUTHORIZED FIRE HYDRANT USE
FOR HEAT RELIEF DURING THE SUMMER PERIOD FISCAL YEAR 2007**

Water Delivery lost from 7/1/2006 - 9/15/2006 plus Water Delivery lost from 5/15/2007 to 6/30/2007 represents the total estimated volume of water lost to unauthorized hydrant use due to hot weather. Dividing this amount by 365 gives it in MGD.

$$((27.039 \text{ MG/day} \times 21 \text{ days}) + (22.206 \text{ MG/day} \times 6 \text{ days}))/365 = 1.921 \text{ MGD}$$

YEARLY PROFILE - UNAUTHORIZED HYDRANT CONSUMPTION FOR HEAT RELIEF

Fiscal Year	Less than 84 deg. F		Equal or Greater than 84 deg. F		Difference of Ave. Mgd	Fraction of Year	Unauthorized Consumption from Fire Hydrants, Mgd
	Number of days	Ave. Delivery, Mgd	Number of days	Ave. Delivery, Mgd			
2000	53	283.30	53	305.45	23.15	53/366	
	79	277.43	16	293.26	15.835	16/366	4.06
2001	79	277.43	29	290.09	12.66	29/365	
	55	265.99	18	283.58	17.59	18/365	1.873
2002	55	265.985	51	284.908	18.923	51/365	
	47	259.436	21	269.576	10.14	21/365	3.227
	Less than 90 deg. F		Equal or Greater than 90 deg. F				
2003	83	264.478	35	295.617	31.139	35/365	
	101	261.313	6	287.783	26.470	6/365	3.421
2004	101	261.324	17	279.753	18.429	17/366	
	115	263.890	4	279.050	15.160	4/366	1.022
2005	115	263.890	5	277.020	13.130	5/365	
	96	262.294	5	278.960	16.666	5/365	0.408
2006	96	262.294	23	285.591	23.297	23/365	
	97	260.128	6	279.033	18.905	6/365	1.779
2007	97	260.128	21	287.167	27.039	21/365	
	101	257.627	6	279.833	22.206	6/365	1.921

**PHILADELPHIA WATER DEPARTMENT
REDUCTION OF WATER LOSS FROM HEAT RELIEF FIRE HYDRANT ABUSE
(As indicated by reduced peak water demand during summer months)**

Summer Year	Temperature (°F)		Total Precipitation inches	Number of days with measurable precipitation	Delivery - MGD		8 AM minimum useable water storage		# of Shutoff Fire Hydrant Customer Complaints
	Avg.	Max			Daily Avg.	Daily Max	Raw + Treated	% Treated only	
1993	78.2	101	8.7	22	359.4	463	696	54.4	10,402
1994	78.3	100	16.7	28	349.4	468	704	69.8	12,865
1995	78.5	103	4.7	22	339.2	470	653	61.3	16,881
1996	74.1	91	17.2	39	307.4	330	483	99.6	2,384
1997	74.1	98	8.4	19	306.8	400	562	61.5	4,587
1998	75.7	95	8.0	26	298.9	344	457	88.1	3,820
1999	77.1	100	7.7	18	303.3	399	541	68.2	4,650
2000	73.5	94	12.2	40	285.5	318	450	71.6	1,541
2001	76.8	101	8.2	24	280.6	334	457	66.4	2,245
2002	77.7	99	8.3	24	279.4	315	419	61.6	2,115
2003	76.2	97	13.4	45	268.8	303	391	76.1	673
2004	74.4	93	16.7	35	265.9	286	422	79.6	N/A
2005	77.8	98	10.2	30	271.7	300	441	65.6	N/A
2006	76.8	98	16.2	34	270.2	319	463	70.8	N/A
2007	76.1	97	10.4	31	264.7	301	397	75.6	N/A

Note: All Statistics are for 6/1 to 8/31 period. For example: 2007 data is from 6/1/2007 to 8/31/2007.

