FINAL ENGINEERING REPORT

BEXAR MET EVALUATION ENGINEERING SERVICES
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TCEQ

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EXECUTIVE SUMMARY

Background

This evaluation of Bexar Metropolitan Water District (District) describes the state of the District in terms of its operations, maintenance, and ultimately, the provision of water service to its customers. The primary objective of this engineering report is to review and analyze the water service, water quality, and water loss of the District based upon the benchmarks set forth by Texas House Bill (HB) 1565. According to Section 27 G (a) (6) through (9) of the Bill, the following issues are to be addressed:

> ISSUE 1: Capital Improvement Budget
> "A narrative summary of the District's infrastructure capital improvements budget and a comparison of the budget with the capital improvements budgets of other major water purveyors in the area, and recommendations for improving the District's long-range budget."
>
> ISSUE 2: Water Service Interruption
> "A compilation and analysis of customer water service interruptions during the preceding three years that resulted from inadequate infrastructure or other causes, and recommendations for preventing future service interruptions."
>
> ISSUE 3: Water Quality
> "A compilation and analysis of incidents in which contaminated water was supplied to customers of the District during the preceding three years, a description of measures taken by the District to prevent contamination, and recommendations for preventing future contamination."
>
> ISSUE 4: Unaccounted-For Water
> "A calculation of the annual volume of the District's unaccounted-for water, and recommendations for preventing future system leaks and related problems."

The District is a water provider in the vicinity of the City of San Antonio, Texas, that currently operates 21 separate Public Water Systems (PWSs) in Bexar, Comal, and Medina Counties. The initial charge of the District from the implementing legislation in 1945 was to "serve underserved communities in southern Bexar County." Since that time, the District has expanded its service area within and beyond Bexar County into other nearby counties.

Methodology

URS and its team, including Steve Walden Consulting and Susan K. Roth Consulting, were tasked with evaluating the District's performance from 2005 to 2007 (study period) and providing information and recommendations regarding the four issues listed above. URS began its evaluation by gathering records relevant to the District during the study period from the Texas Commission on Environmental Quality (TCEQ) Central Records, TCEQ Regional Records, the District's office, and the District's website. These data were supplemented with interviews of

District staff. The data were analyzed and compared against regulatory requirements as well as standard industry practice, and the results of this analysis are presented in this report. American Water Works Association (AWWA) standards are referenced in this report with the understanding that these standards provide guidance for public water systems, but they do not set enforceable requirements.

For further consideration of Issue 1, the URS team evaluated the District's capital improvement budget with a rigorous comparison to other water purveyors in the area. A preliminary screening matrix was developed to identify those entities that best fit the District’s organizational model. Qualitative and quantitative measures were used to compare the District's budget against the capital improvement budgets of three water purveyors: Lower Colorado River Authority – Hill Country Region, Aqua Water Supply Corporation, and North Alamo Water Supply Corporation. Based on this evaluation, URS developed comparisons and recommendations that are detailed in Section 4.2.

Conclusions

In developing these conclusions, URS weighed the District's operation and maintenance procedures against applicable regulatory requirements and the AWWA standards for Distribution Systems Operation and Management (17). These conclusions are also based in part on a comparison of the component systems within the District with each other to find trends pointing to probable problem areas.

Several conclusions relate to multiple issues, as noted parenthetically. The remaining conclusions are listed under the specific issue to which they relate.

ISSUES 1-4

- The District does not have an asset management plan that considers risks and alternatives, which is key to strategic capital improvement planning and budgeting. Such a plan would provide information about the age and condition of the District's existing infrastructure, and allow for informed decision-making regarding maintenance, repair, and replacement of facilities. It would provide insight for prioritization of upgrades and additions to the system and would aid in the consideration of alternatives. The absence of such a plan suggests that the current and prior capital improvement plans (CIPs) were developed without a quantified basis of relative need and cost for different system capital projects. (Issues 1, 2, 3 and 4)
- Inadequate work order data logging does not allow the District to properly track operations and maintenance or to use rapid trend analysis to address real-time distribution system problems, such as pressure drops or widespread dirty water complaints, in a timely manner. (Issues 1, 2, 3 and 4)
- Incomplete infrastructure inventory and system maps restrict the District’s ability to consider the system as a whole, identify problem areas, and prioritize issues that need to be addressed. (Issues 1, 2, 3 and 4)
- The District's current distribution system flushing practices meet TCEQ requirements to maintain disinfectant residuals while concurrently addressing

aesthetic water quality issues in the system. However, without a complete understanding of the distribution system, an aggressive flushing program can cause problems such as redistributing pockets of dirty water rather than eliminating them, or temporarily dropping pressure in the system due to conveyance limitations. An increase in unaccounted-for water was observed for the past 2 years, corresponding to the increase in system flushing. The District has begun to record unmetered water use such as flushing flows, but so far, documentation has been inconsistent. (Issues 2, 3 and 4)

<u>ISSUE 1</u>

- Based on a comparison to similar water purveyors in the area, the District has a relatively high debt ratio of 0.72. This ratio indicates that 72% of operations have been financed with debt, and the remaining 28% financed by equity. This ratio represents the challenges that the District faces by serving a number of small water systems scattered around the outskirts of a large metropolitan city.

<u>ISSUE 2</u>

- Water main breaks and drops in system pressure are the primary causes for service interruptions. Pressure fluctuations are likely caused by undersized distribution systems, excessive demand per connection in some systems, and the inability of the system to deliver flow demands during peak use periods.

<u>ISSUE 3</u>

- The overall health-based water quality of the District is acceptable in most of its component systems, with three notable exceptions:
  - Positive coliform tests have occurred sporadically in six systems, although no violations ensued. These results are likely caused by poor disinfection practices during repairs on main breaks and intrusion during low pressure events.
  - Chronic total trihalomethane (TTHM) exceedances and a subsequent violation occurred in Bulverde Hills.
  - A sole-source well in Canyon Park has been designated as "groundwater under the influence of surface water" (GUI), which represents an acute health risk with the potential to initiate a waterborne disease outbreak. Particularly troubling is the continued unresolved replacement or treatment of the Canyon Park well long after the District became aware of the risk by TCEQ correspondence and emails during April-June 2007. TCEQ's formal regulatory notice was not issued to the District until May 28, 2008, and based on Federal and State rules, the District has 18 months from the date of notification to resolve the issue. Nevertheless, proactive management could have worked to resolve the problem independent of regulatory pressure.
- Aesthetic water quality, including taste, odor and color, is a widespread and varied issue throughout the District. Some systems have a more obvious problem than others. Pressure fluctuation and poor distribution system flushing practices can create or compound these problems.

ISSUE 4

- Unaccounted-for water (apparent losses), including meter inaccuracies, billing errors, and unauthorized use, is a system-wide problem that cannot be quantified until record-keeping practices are improved. For example, authorized unmetered water use, such as distribution system flushing, fire fighting, and construction use, are not properly documented.
- Real water losses caused by leaks in the distribution system are occurring in areas with aging infrastructure and in relatively newer systems with certain types of pipe and soil conditions. The District lacks appropriate records; thus, the magnitude of these losses cannot be determined. The District also lacks a comprehensive leak detection and repair program; therefore, the amount of real water loss is not likely to decrease.

Recommendations

The following recommendations take regulatory requirements into consideration as well as AWWA standards in offering possible solutions to issues addressed in HB 1565.

Several recommendations address multiple issues, as noted parenthetically. The remaining recommendations are listed under the specific issue which they address.

ISSUES 1-4

- Develop and implement an asset management plan that considers risks and alternatives as a basis for developing a strategic capital improvement plan and budget. This plan should be used to make informed decisions regarding maintenance, repair, and replacement of facilities and to prioritize upgrades and additions to the system, considering multiple alternatives to select functional and cost-effective options. (Issues 1, 2, 3 and 4)
- Complete and maintain an infrastructure inventory and system map for use in developing the asset management plan. A comprehensive system map is also useful for planning and scheduling of routine maintenance, distribution system flushing, and other operational activities. (Issues 1, 2, 3 and 4)
- Develop and implement a work order system that allows the District to properly track operations and maintenance and for rapid trend analysis to address real-time distribution system problems, such as pressure drops or widespread dirty water complaints, in a timely manner. Educate District staff on the use of this system, and ensure its use District-wide. (Issues 1, 2, 3 and 4)
- Develop and implement a systematic distribution system flushing program that considers the condition of the system, its hydraulic capacity, types of treatment, water quality implications, and water conservation. Minimize and record all water used during this effort. (Issues 2, 3 and 4)
- Bring undersized and otherwise substandard distribution systems into compliance with regulatory requirements and AWWA standards. Consider adding peripheral storage and pump stations to meet peak water demand resupply needs. Consider creating redundancy of water supply by interconnecting systems within the District or using interconnections to other water purveyors where water supply or

delivery issues are creating health and/or conveyance problems. (Issues 2, 3 and 4)

- Educate District staff and the public about existing water conservation regulations and enforce those regulations to curtail excessive demand during peak use periods. (Issues 2 and 4)

ISSUE 1

- Reduce the debt ratio/debt burden on the system. The District should consider selling assets in areas with limited growth potential or in areas where the cost to serve is excessive, providing an appropriate buyer can be found. Revenue from a sale could be used to finance the necessary improvements in the remaining service areas. At a minimum, the District needs to do a better job of evaluating the design adequacy and cost-to-revenue profile of any system considered for future purchase.

ISSUE 3

- Quickly resolve the acute and chronic health risk issues that are currently unresolved, and ensure that maintenance crews adequately disinfect water lines after construction and maintenance.

ISSUE 4

- Develop and implement a method of tracking all authorized water use, including a standardized method of documentation. Coordinate with all District water users, municipal public works departments, and area fire departments.
- Develop and implement a comprehensive leak detection and repair program that includes goals for loss reduction and an action plan to respond if the goals are not met. Incorporate information gathered during this effort into the infrastructure inventory to keep accurate records of the condition of the system.

1.0 INTRODUCTION

The Bexar Metropolitan Water District (District) is a water provider in the vicinity of the City of San Antonio, Texas, which currently operates 21 separate Public Water Systems (PWSs) in Bexar, Comal, and Medina Counties. This District provides water service to an area covering approximately 185 square miles within those three counties. The 21 PWSs are divided into five service areas, which are used to divide resource allocations and staff responsibilities, but which are not interconnected water distribution systems. Most of the 21 systems have internally isolated water sources and distribution systems. Two PWSs, Timberwood and Hill Country, have a connecting pipeline, although according to District staff, the valve between the systems remains closed. There are no other known connections between the District's systems.

The water sources that supply these systems vary, and are comprised of groundwater and surface water including the Edwards Aquifer (Balcones Fault Zone Aquifer), Middle Trinity Aquifer, Carrizo Aquifer, Guadalupe River, and the Medina River. While the District owns a robust portfolio of water resources, many of the individual systems are short of supply during peak demand periods in part due to geographic separation from surplus District water sources.

According to facility inventories provided by the District (10), nearly all of the systems meet TCEQ regulatory requirements for production, storage and pump capacities. There are a few systems with deficiencies, such as insufficient elevated storage or pressure tank capacity while several systems have significant excess in water production capacity. Specific information comparing the reported system capacities of the District's five service areas are summarized in Section 4.1, comparing them to regulatory requirements. Detailed information on the capacities of the 21 separate systems is provided in Appendices B through E.

The District did not provide any records that showed the age and condition of the existing water distribution system. According to District staff, the infrastructure is of widely varying ages and designs (14). The Southside PWS was the original system, acquired in 1945. Castle Hills became a part of the District in 1956. Fifteen PWSs were incorporated into the District during the 1990s. Some systems were not developed according to commonly accepted design standards and have water line sizes significantly smaller than current standards require.

2.0 METHODOLOGY

This evaluation describes the state of the District in terms of its operations, maintenance, and ultimately, the provision of water service to its customers. The primary objective of this engineering report is to review and analyze the water service, water quality, and water loss of the District based upon the benchmarks set forth by Texas HB 1565. According to Section 27 G (a) (6) through (9) of the Bill, the following issues are to be addressed:

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"A calculation of the annual volume of the District's unaccounted-for water, and recommendations for preventing future system leaks and related problems."

URS and its team, including Steve Walden Consulting and Susan K. Roth Consulting, were asked to evaluate the District's performance from 2005 to 2007 (study period) and to provide information and recommendations for these four issues.

URS began its evaluation by gathering records relevant to the District during the study period from Texas Commission on Environmental Quality (TCEQ) Central Records, TCEQ Regional Records, the District's office, and the District's website. Documents considered in this evaluation included: Comprehensive Compliance Investigation (CCI) Reports; Consumer Confidence Reports (CCR); Notices of Violation (NOV), including chemical, microbial, and surface water treatment (turbidity and disinfection byproducts); notice of change in infrastructure or processes; notice of contaminant exceedances (inorganic, organic, residual disinfectant, disinfection byproducts, unregulated contaminants, lead and copper, total coliform, fecal coliform, and secondary constituents); communications with customers, including "Boil Water" notices and customer complaints; and additional communications between TCEQ and the District. Additional documents such as District reports to the Bexar Metropolitan Water District Oversight Committee, the District's Water Service Regulations, and capital improvement plans and budgets were also gathered. A diligent effort was made to ensure that all available information was collected for analysis, but there are still gaps in the data. Due to a significant turnover in personnel at the District, some information, such the ages of the existing infrastructure, has been lost. District representatives provided URS with reports, databases, AutoCAD drawings, GIS shapefiles, system inventories, and schematics. Finally, interviews were conducted to fill information gaps and to clarify discrepancies in the data. Several individual staff interviews were held in conjunction with the management evaluation team. Additionally, a group interview was conducted with the managers of several District departments (Production, Regulatory and Compliance, Customer Service, Maintenance and Construction, Water Resources, Engineering and Planning, and Data Management) to bring closure to the search and verify that the compiled data were as current and accurate as possible. This compilation of data was analyzed and compared against regulatory requirements as well as standard industry practice. The results are presented in this report.

A general evaluation of the District's performance related to the four issues addressed in HB 1565 is provided in Section 3, along with recommendations for improvements for each issue. A summary of the District's compliance with regulatory capacity requirements within each of the five service areas is provided in Section 4.1. Specific, detailed information regarding the performance of each of the 21 component systems in the District is included in Appendices B through E. The appendices include area maps, system descriptions, a comparison of each system's compliance with regulatory capacity requirements, and evaluations of how each system addresses water service interruptions, water quality, and water loss in light of regulatory requirements and industry standards. American Water Works Association (AWWA) standards are referenced in this report with the understanding that these standards provide guidance for public water systems, but they do not set enforceable requirements.

For further consideration of Issue 1, the URS team evaluated the District's capital improvement budget with a rigorous comparison to other water purveyors in the area. System information and area demographics were investigated for 14 widely varying water purveyors in the area. A preliminary screening matrix was developed to identify those entities that best fit the District’s organizational model. Additional financial data were collected from the final list of three water purveyors: Lower Colorado River Authority – Hill Country Region, Aqua Water Supply Corporation, and North Alamo Water Supply Corporation. Qualitative and quantitative measures were used to compare the District's budget against the capital improvement budgets of the three selected entities. Based on this evaluation, URS developed comparisons and recommendations that are detailed in Section 4.2.

3.0 DISTRICT EVALUATION

3.1 Issue 1 – Capital Improvement Budget

> "A narrative summary of the District's infrastructure capital improvements budget and a comparison of the budget with the capital improvements budgets of other major water purveyors in the area, and recommendations for improving the District's long-range budget."

URS's evaluation of the District's Capital Improvements Plan (CIP) is based on the District's most current draft of the 5-year prioritized CIP, which shows projects identified by service area, PWS, and type of project (6). The project types were categorized for simplification: Regulation (projects addressing regulatory requirements); Relocation and Growth (projects warranted by construction and new growth); and Upgrade and Rehabilitation (projects addressing the improvement of existing infrastructure). These categories were used to determine the percentage of the proposed 5-year budget that was allocated for each type of project.

Additional insight was gained during interviews with the District's department managers. These interviews revealed that the District possesses little information regarding the age and condition of its distribution systems. Some staff members had experiential knowledge of the system, but with the turnover of personnel, much of this historic knowledge has been lost. The District provided URS with the most current GIS and AutoCAD drawings of the infrastructure, and after careful review, URS confirmed that the drawings were incomplete and contained little information about the age and condition of the systems (11). Two PWSs had no infrastructure at all represented in those files.

A report submitted to the Bexar Metropolitan Water District Oversight Committee included information regarding certain shortcomings of the District's work order system (18). URS discussed the work order system with District managers during an interview, and the problems were confirmed. District staff provided URS with a spreadsheet extracted from the database that included all work order activity that occurred during the study period. This spreadsheet contained the address, PWS number, activity codes, initiation date, completion date, and comments for each work order. URS used this spreadsheet extensively for this evaluation, but only the general nature of the work order system, the lack of specificity of the activity codes, and the lack of tracking ability within the data is considered in the evaluation of the District's CIP (5).

URS's evaluation of the District's 5-year CIP showed that nearly 50% of the proposed budget was allocated to upgrading and rehabilitating the existing infrastructure. The remaining funds were divided with about 30% providing for new growth and the remaining 20% allocated to addressing regulatory requirements. It is unclear if this allocation of funds is appropriate, what priorities or considerations were used to create it, or how it addressed key District infrastructure issues. According to the District's department managers who were interviewed for this evaluation, there has been no formal asset management plan in place to guide prioritization and scheduling of replacement of system infrastructure or new asset purchases. The absence of such a plan suggests that the current and prior capital improvement plans were developed without a quantified basis of relative need and cost for different system capital projects.

Two handbooks provided by the U.S. Environmental Protection Agency (EPA) for rural water districts, entitled *Asset Management: A Handbook for Small Water Systems* (20) and *Strategic Planning: A Handbook for Small Water Systems* (21), describe the integrated nature of asset management and strategic planning. Asset management is described as "a planning process that ensures that you get the most value from each of your assets and have the financial resources to rehabilitate and replace them when necessary." Strategic planning "utilizes asset management to evaluate your system's current physical situation, and it also evaluates your system's financial and managerial situation" to allow informed decision-making about maintenance, repair, and replacement of facilities. It provides insight for prioritization of upgrades and additions to the system and aids in the consideration of the widest possible range of alternatives over a long-term timeframe rather than simply choosing the "quick fix."

The District lacks a number of basic components necessary to implement such an asset management plan. A complete inventory of the District's water distribution system does not currently exist. The District currently is conducting a project to map the infrastructure using a geographic information system (GIS). However, this project is not yet complete and is only capturing the location and basic information about the infrastructure. Detailed information such as the age, type, condition, and maintenance history of underground pipes is needed to fully support an asset management plan (11).

The AWWA standard for Distribution Systems Operation and Management 4.3.3.1 defines the need for system information to plan for maintenance requirements. According to AWWA, "The utility shall have a program for evaluating and upgrading existing portions of the distribution system as required. The program shall include provisions for maintaining records to access the physical condition of the pipes." The standard goes on to say that current system maps along with maintenance records of leaks and breaks are needed. AWWA Standard 4.2.10.1 specifies the level of detail that should be collected in the field during maintenance operations: "At a minimum, the data collected on a leak or break report shall include pipe location, pipe material, pipe size, apparent type of leak or break, visual assessment of surrounding soil type (sand, clay, etc.), pipe's depth, and best assessment of saturation conditions of the soil prior to the break or proximity to water table" (16).

An integral component of a successful asset management plan is a work order system that is used to collect detailed information about maintenance operations and incorporate the data into the system inventory. This allows for a complete assessment of existing infrastructure to make informed decisions about rehabilitation, replacement, and additions necessary to serve existing and future customers. While the District has a work order system currently in place to collect detailed information about ongoing maintenance, the structure of the data entry process and the procedures to gather the information do not appear to be effective.

One shortcoming of the District's system is the general nature of the activity codes used. When the Customer Service Department enters a "Leak at Meter" code, a maintenance crew adds comments to the work order. These comments may indicate that no leak was found or that a water main break was indeed the problem. However, no adjustment in the coding is made after the service call is completed. Without consistent coding that fully describes the activity, the conditions encountered, the process taken to resolve the problem, and the end result, tracking and evaluating the process is not feasible. It is unclear whether the current system can be adjusted for complete integration with a new asset management plan. The work order system and the infrastructure inventory must be fully integrated to take optimal advantage of information collected in the field regarding the condition of the system.

A detailed assessment of the District's CIP budget in comparison with three other water purveyors (Lower Colorado River Authority – Hill Country Region, Aqua Water Supply Corporation, and North Alamo Water Supply Corporation) was included as part of this evaluation (Section 4.2). The assessment determined that the District has a relatively high debt ratio of 0.72. This ratio indicates that 72% of operations have been financed with debt, and the remaining 28% financed by equity. Based on *Moody's Water and Sewer Outlook* (February 2000), the median debt ratio for the water utility industry is 0.43. This median is based on data collected on Moody's rated water systems. The District's debt ratio of 0.72 is considered "moderately high" and should be reduced over time (23). This ratio represents the challenges that the District faces by serving a number of small water systems scattered around the outskirts of a large metropolitan city. The District is investing a significant amount of money in its systems relative to similar water purveyors.

Strategic planning supported by an asset management plan and a comprehensive work order tracking system could help the District determine whether the amount of funding currently being allocated to system rehabilitation and upgrades is appropriate, if it is focused on the right issues or if more funding is required. An added benefit of such a comprehensive process is that the District would have the ability to "fully consider the widest possible range of alternatives over a long-term time frame and not just choose the 'quick fix' (21)."

3.1.1 Issue 1 – Conclusions

Based upon the information provided by the District, including the 5-year CIP, the work order spreadsheet, GIS shapefiles, and information gathered during the interview process, the following conclusions have been developed regarding the District's long-range budget development process.

1. Inadequate work order data logging does not allow for proper record-keeping of operations and maintenance.

2. Incomplete infrastructure inventory and system maps restrict the District's ability to consider the system as a whole, identify problem areas, and prioritize issues needing to be addressed.

3. The District does not have an asset management plan that considers risks and alternatives, which is key to strategic capital improvement planning and budgeting. Such a plan provides information about the age and condition of the District's existing infrastructure and allows for informed decision-making regarding maintenance, repair, and replacement of facilities. It provides insight for prioritization of upgrades and additions to the system

and aids in the consideration of alternatives. The absence of such a plan suggests that the current and prior capital improvement plans were developed without a quantified basis of relative need and cost for different system capital projects.

4. Based on a comparison to similar water purveyors in the area, the District has a relatively high debt ratio of 0.72. This ratio indicates that 72% of operations have been financed with debt and the remaining 28% financed by equity. This ratio represents the challenges that the District faces by serving a number of small water systems scattered around the outskirts of a large metropolitan city.

3.1.2 Issue 1 – Recommendations

The following improvements to the process used in the development of the District's long-range budget are recommended. Specific recommendations regarding the District's budget, based on a comparison to other water purveyors, are included in Section 4.2.

1. Reduce the debt ratio/debt burden on the system. The District should consider selling assets in areas with limited growth potential or in areas where the cost to serve is excessive, providing an appropriate buyer can be found. Revenue from a sale could be used to finance the necessary improvements in the remaining service areas. At a minimum, the District needs to do a better job of evaluating the design adequacy and cost-to-revenue profile of any system considered for future purchase.

2. Develop and implement an asset management plan that considers risks and alternatives as a basis for developing a strategic CIP and budget. This plan should be used to make informed decisions regarding maintenance, repair, and replacement of facilities. It should also be used to prioritize upgrades and additions to the system, considering multiple alternatives to select functional and cost-effective options.

3. Complete and maintain an infrastructure inventory and system map for use in developing the asset management plan.

4. Develop and implement a work order system that allows the District to properly track operations and maintenance. Educate District staff on the use of this system, and ensure its use District-wide.

3.2 Issue 2 – Water Service Interruptions

> "A compilation and analysis of customer water service interruptions during the preceding three years that resulted from inadequate infrastructure or other causes, and recommendations for preventing future service interruptions."

According to AWWA standards for Distribution Systems Operation and Management, a water service provider "shall have a system to document all planned and unplanned service interruptions. The utility shall have an annual goal to continually reduce unplanned service interruptions." This evaluation assesses how well the District is accomplishing that standard and whether measures have been taken to reduce the number of service interruptions experienced by its customers (16). As discussed previously, the work order tracking system currently in place is not adequate to provide such an assessment.

To analyze the District's water service interruptions and its response to problems, URS used the spreadsheet extracted from the District's work order database. The information included in the spreadsheet allowed work orders to be sorted using multiple criteria. The most applicable activity codes for the evaluation of water service interruptions were separated and sorted by PWS. This enabled an analysis based on the number of work orders issued within a PWS for those activity codes. It was also possible to view trends in activities, correlating water main breaks with the "CHECK FOR LEAK AT METER" activity code, which covers all service calls not related to a specific complaint such as dirty water or low pressure. The comments included in the spreadsheet were difficult to assess, with comments from the Customer Service Department, the response crew, and any follow-up information, all included in one cell. Therefore, only a basic analysis was done, using location, activity, and dates.

The information compiled from the work order spreadsheet was then assessed, and the results were compared to AWWA standards to determine whether the District's practices regarding water service interruptions were in alignment with those standards.

For the purposes of this report, water service interruptions are considered to be either unplanned interruptions in service or pressure fluctuations that affect normal water service. Water service interruptions can occur due to construction, maintenance, or leaks in aging infrastructure. Pressure fluctuations are caused by a lack of interconnected systems and redundant sources, undersized distribution systems, and excessive demand per connection in some systems.

Specific information about each of the 21 PWSs in the District is provided in Appendices B through E. The results are varied, and few trends can be determined based on the inconsistency of the records. According to a “Disruption of Service Action Plan” included in a District report to the Oversight Committee, one work order activity code 4005, "CHECK FOR LEAK AT METER" is used to track service interruptions internally. In the document, it describes the practice as "fatally flawed" due in part to the fact that "the system does not provide for identifying the length of loss of service, whether it was planned or unplanned, or how long those connections were off line (18)."

During the analysis, URS looked at activity code 4005, supplemented with additional data from the District's work order spreadsheet; specifically activity codes 4001, "MAIN MAINTENANCE" and LOWPSI, "LOW PRESSURE COMPLAINTS." Since activity code 4005 is a general code covering multiple activities, comparing it to the more specific activities allowed URS to recognize trends. For example, trends were apparent when a work order was logged to address a main break, as a large number of corresponding service calls under activity code 4005 were also noted. This gave the URS team a broader perspective of service interruptions by relating the trends in individual complaints to more general occurrences such as water main breaks. Low pressure complaints were also compared to main maintenance to see if any correlations were noticeable (5).

Although the District was not able to provide information regarding the age of each of its component systems, it did provide a list of dates when each system was acquired and their general ages. Some ages were specific, based on construction plans, whereas others were simply designated as "Old" (14). URS compiled data from the District's work order spreadsheet for the study period and ranked the systems based on the aggregate of the three activity codes, and that ranking was considered along with the system's size (number of connections) and age. Any trends between relatively large numbers of service interruptions and age or size were noted. To make fair comparisons between PWSs of widely varying sizes, the number of work orders occurring in a PWS was normalized by considering the number of work orders which occurred per 1,000 connections.

The following assessment divides the analyses into two separate parts to reflect the two major reasons for service interruptions experienced by the District.

3.2.1 Issue 2A – Service Interruptions Due to Main Breaks

URS's comparison of PWS service interruptions due to main breaks showed that the five systems with the most work orders per 1,000 connections associated with service interruptions were generally the larger systems in the Southside, Hill Country, and Northwest Service Areas. Four of the five PWSs with the most service interruptions due to main breaks ranked within the five largest systems. No correlation was noted between this type of service interruption and age, although it may be noteworthy that four of the five PWSs with the most interruptions were acquired in the 1990s (5, 14).

Aging infrastructure can lead to water main breaks, but newer systems can experience problems due to environmental conditions or poorly constructed pipelines. A study performed in 2006 by the Water Science and Technology Board of the National Research Council entitled *Drinking Water Distribution Systems: Assessing and Reducing Risks* (19) found that many issues contribute to pipe failure, including corrosion, pipe misalignment, and pressure fluctuations. Table 3-1 summarizes the most common causes of pipe failure for various types of pipe materials.

Table 3-1. Most Common Problems that Lead to Pipe Failure for Various Pipe Materials (19)

Pipe Material (Common Sizes)	Problems
PVC and Polyethylene (4 to 36 inches)	Excessive deflection, joint misalignment and/or leakage, leaking connections, longitudinal breaks from stress, exposure to sunlight, too high internal water pressure or frequent surges in pressure, exposure to solvents, hard to locate when buried, damage can occur during tapping
Cast/Ductile Iron (46 to 4 inches) (lined and unlined)	Internal corrosion, joint misalignment and/or leakage, external corrosion, leaking connections, casting/manufacturing flaws
Steel (4 to 120 inches)	Internal corrosion, external corrosion, excessive deflection, joint leakage, imperfections in welded joints

Table 3-1. Most Common Problems that Lead to Pipe Failure for Various Pipe Materials (Continued) (19)

Pipe Material (Common Sizes)	Problems
Asbestos-Cement (4 to 35 inches)	Internal corrosion, cracks, joint misalignment and/or leakage, small pipe can be damaged during handling or tapping, pipe must be in proper soil, pipe is hard to locate when buried
Concrete (12-16 to 144-168 inches) (prestressed or reinforced)	Corrosion in contact with groundwater high in sulfates and chlorides, pipe is very heavy, alignment can be difficult, settling of the surrounding soil can cause joint leaks, manufacturing flaws

An inventory of the distribution system in conjunction with an asset management plan that includes information about pipe type, age, and condition would facilitate a proactive infrastructure rehabilitation and replacement program and should reduce the occurrences of water main breaks and associated service outages.

3.2.2 Issue 2B – Service Interruptions Due to Pressure Fluctuations

In contrast to service interruptions due to main breaks, the systems with the highest occurrences of low pressure complaints were generally the smaller systems. Four of the five PWSs with the most work orders per 1,000 connections associated with low pressure complaints were ranked in the bottom third of the PWSs based on number of connections. Two of the five PWSs with the most work orders for this type of service interruption are in the Hill Country Service Area, while the remaining three are in the Northwest Service Area.

Pipe sizes within a distribution system play a role in pressure fluctuations. A system with insufficient pipe sizes to deliver flow demands during peak use periods experiences drops in pressure due to restricted flows. The Texas Administrative Code (TAC) 30 TAC 290.44(c) specifies minimum pipe sizes for distribution systems based on the number of connections (Table 3-2). "The minimum waterline sizes are for domestic flows only and do not consider fire flows. Larger pipe sizes shall be used when the licensed professional engineer deems it necessary (24)."

Table 3-2. Specified Pipe Sizes (24)

Maximum Number of Connections	Minimum Line Size (inches)
10	2
25	2.5
50	3
100	4
150	5
250	6
>250	8 and larger

Based on limited information available from the District, Table 3-3 shows that many of the older systems and some of the newer ones have pipe sizes significantly smaller than the minimum sizes called for by TAC. Undersized distribution systems should be brought into compliance with regulatory requirements and AWWA standards (11).

Table 3-3. District Pipe Sizes (11, 14)

PWS Name	Year PWS Acquired	Number of Connections 2008	Minimum Allowable Waterline (inches)	Minimum Existing Waterline (inches)
Hill Country				
Castle Hills	1956	2,671	8	4
Hill Country	1995	12,850	8	4
Timberwood	1997	4,592	8	3
Bulverde Hills	1999	317	8	2
Oakland Estates	1999	165	6	2
Woods of Spring Branch	1999	31	3	2.5
HEB Bulverde	2000	10	2	6
Northeast				
Northeast	1994	14,597	8	2
Northwest				
Geronimo Forest	1999	161	6	6
Chaparral	1995	471	8	2
Meadow Wood Acres	2002	245	6	2
North West	1994	14,928	8	6
North San Antonio Hills	1997	185	6	6
Elm Valley	1997	244	6	2
Country Oaks	1998	113	5	No info
Texas Research Park	1994	1,004	8	8
Canyon Park	1999	112	5	8
Mountain Laurel	2004	31	3	6
Anaqua Springs	2005	65	4	No info
West View	1999	198	6	6
Southeast & Southside				
Southside	1945	34,335	8	2

Some of the smaller systems in the Northwest Service Area experience a higher number of pressure complaints than their neighboring systems. Interconnecting systems within the District or using interconnections to other water purveyors could alleviate some of the pressure issues.

The District is implementing a relatively new distribution system flushing program to address regulatory requirements and to remediate dirty water complaints. In cases where the distribution system is undersized, this flushing practice can add flow demands that the systems are incapable of handling, which can in turn lead to low pressure complaints. Specific policies regarding flushing practices should be developed to consider the distribution system sizes and water conservation, avoiding unnecessary water use to curtail excessive demand during peak use periods and thus avoiding unnecessary service interruptions.

The District's current work order data system does not allow for rapid trend analysis to address real-time distribution system problems such as service outages or pressure drops in a timely manner. If work orders were easily tracked, with detailed information provided from the field, water main breaks causing widespread service interruptions would be recognized more quickly and remediated in a timely manner by correlating low pressure complaints to known water main breaks.

3.2.3 Issue 2 – Conclusions

Based upon the information provided by the District, including the work order spreadsheet, GIS shapefiles, AutoCAD drawings, and information gathered during the interview process, the following conclusions have been developed regarding the District's response to water service interruptions.

1. The District does not have an asset management plan that considers risks and alternatives, which is key to strategic capital improvement planning and budgeting. Such a plan would provide information about the age and condition of the District's existing infrastructure and allow for informed decision-making regarding maintenance, repair and replacement of facilities. It would also provide insight for prioritization of upgrades and additions to the system and aid in the consideration of alternatives.

2. Incomplete infrastructure inventory and system maps restrict the District's ability to consider the system as a whole, to identify problem areas, and to prioritize issues needing to be addressed.

3. Inadequate work order data logging does not allow the District to properly track operations and maintenance, or to use rapid trend analysis to address real-time distribution system problems such as low pressure complaints in a timely manner.

4. Water main breaks and drops in system pressure are the primary causes for service interruptions. Pressure fluctuations are likely caused by undersized distribution systems, excessive demand per connection in some systems, and the inability of the system to deliver flow demands during peak use periods.

5. The District's current distribution system flushing practices meet TCEQ requirements to maintain disinfectant residuals while concurrently addressing aesthetic water quality issues in the system. However, without a complete understanding of the distribution system, an aggressive flushing program can cause problems such as a temporary drop in system pressure due to conveyance limitations.

3.2.4 Issue 2 – Recommendations

The following improvements to the District's response to water service interruptions are recommended.

1. Develop and implement an asset management plan that considers risks and alternatives as a basis for developing a strategic CIP and budget. This plan should be used to make

informed decisions regarding maintenance, repair and replacement of facilities, and to prioritize upgrades and additions to the system, considering multiple alternatives to select functional and cost-effective options.

2. Complete and maintain an infrastructure inventory and system map for use in developing the asset management plan. A comprehensive system map is also useful for planning and scheduling routine maintenance, distribution system flushing, and other operational activities.

3. Develop and implement a work order system that allows the District to properly track operations and maintenance and for rapid trend analysis to address real-time distribution system problems such as pressure drops or widespread dirty water complaints in a timely manner. Educate District staff on the use of this system, and ensure its use District-wide.

4. Bring undersized and otherwise substandard distribution systems into compliance with regulatory requirements and AWWA standards. Consider adding peripheral storage and pump stations to meet peak water demand resupply needs. Consider creating redundant water supply by interconnecting systems within the District or using interconnections to other water purveyors where water supply or delivery issues are creating health and/or conveyance problems.

5. Develop and implement a systematic distribution system flushing program that considers the condition of the system, its hydraulic capacity, types of treatment, and water quality implications.

6. Educate District staff and the public about existing water conservation regulations and enforce those regulations to curtail excessive demand during peak use periods.

3.3 Issue 3 – Water Quality

> "A compilation and analysis of incidents in which contaminated water was supplied to customers of the District during the preceding three years, a description of measures taken by the District to prevent contamination, and recommendations for preventing future contamination."

Public drinking water systems in Texas are regulated by the TCEQ under TAC Title 30 Chapter 290 Subchapter F. Included in these regulations are water quality standards for drinking water, the purpose of which are to "assure the safety of public water supplies with respect to microbiological, chemical and radiological quality" (25). These standards comply with the requirements of the Federal "Safe Drinking Water Act," 42 USC §300f et seq., and the "Primary Drinking Water Regulations" which have been promulgated by EPA.

Water quality issues are generally broken into two categories; health-based (primary) and aesthetic (secondary). Health-based water quality issues deal with real or potential health hazards, define by the TAC as a "cross-connection, potential contamination hazard, or other situation involving any substance that can cause death, illness, spread of disease, or has a high probability of causing such effects if introduced into the potable drinking water supply."

Aesthetic issues deal with constituents in the water that affect the taste, odor or color of the water, but pose no health risk (24).

To identify general and specific water quality issues that existed in the District during the study period, URS gathered all relevant records from TCEQ and the District. These records included correspondence between TCEQ and the District, NOVs, inspection reports, lab results, and all other pertinent data. All these data were analyzed and condensed into tables to assess the significance of the data. In addition to those records, the work order spreadsheet was used to assess aesthetic water quality issues (5). The work order system includes an activity code for dirty water complaints, which allowed URS to determine how many complaints occurred in each PWS. The number of complaints was normalized by considering the number of complaints occurring per 1,000 connections, allowing for a reasonable comparison between PWSs of varying sizes.

The information compiled from records and the work order spreadsheet was then assessed, and the results were compared to regulatory requirements and AWWA standards to determine whether the District's practices regarding water quality were in alignment with those regulations and standards.

Figure 3-1 provides a summary of PWS water-quality information gathered during the evaluation of the District for the specified study period. The figure is organized by service area and contains information on health-based (primary) and aesthetic (secondary) constituents. An explanation is provided below for each of the columns included in the figure. A legend is provided on the figure to describe the color coding.

Coliform Bacteria

Water systems should ideally not have any positive coliform samples. Positive samples indicate the possibility of contamination in the distribution system. In Figure 3-1, Coliform Bacteria covers both total coliform and fecal coliform. If a coliform positive result was reported for a compliance sample, repeat samples were taken within 24 hours of receiving the report from the lab. If the number of positive samples exceeded the MCL, a TCEQ NOV was issued to the PWS. The Coliform MCL for the PWS is population-dependent. The number recorded in the Coliform Bacteria column is the number of positive total coliform and fecal coliform samples during the study period. Highlighting indicates if one or more coliform bacteria exceedance violations were issued to the PWS.

TTHM

Total trihalomethanes (TTHM) is a disinfection byproduct that is a potential health hazard, that can have harmful effects over an extended period of time. The TTHM MCL is 0.080 mg/L (reported on the CCR as 80 ppb); a violation is issued if the TTHM level annual average exceeds the MCL. The highest level sampled above the MCL is recorded in the TTHM column and highlighted if one or more violations were issued to the PWS during the study period.

BexarMet Public Water System (PWS)		Health-Based (Primary)			Aesthetics (Secondary)
		Coliform[4,5]	Total Trihalomethanes (TTHM)[7]	Groundwater Under the Influence of Surface Water (GUI)[8]	Dirty Water[9,10]
Number	Name	Number of Positive Samples	Max. Sample above MCL (ppb)	Presence	W.O. per 1000 Connections
Hill Country Service Area					
0150045	Castle Hills	1			16
0150054	Hill Country	5	190[11]		37
0150270	Timberwood				83
0460013	Bulverde Hills		135		93
0460166	Oakland Estates				56
0460196	Woods of Spring Branch				189
0460228	HEB Bulverde				
Northeast Service Area					
0150084	Northeast	12	113		19
Northwest Service Area					
0150052	Geronimo Forest				
0150053	Chaparral	1			24
0150072	Meadow Wood Acres				32
0150171	North West	8			9
0150205	North San Antonio Hills				
0150265	Elm Valley				44
0150430	Country Oaks				69
0150497	Texas Research Park				
0150532	Canyon Park			X	
0150545	Mountain Laurel				
0150549	Anaqua Springs				
1630039	West View				61
Southeast & Southside Service Area					
0150249	Southside	28			22

TABLE COLOR CODE
TTHM Violation (one or more NOV)
GUI Presence

1. Definitions:
   MCL = Maximum Contaminant Level (highest permissible level of a contaminant in drinking water)
   NOV = Notice of Violation from TCEQ
   ppb = Parts per Billion
   Positive Sample = Water sample with positive coliform result
   TTHM = Total Trihalomethanes MCL = 0.080 mg/L (reported on the CCR as 80 ppb)
   W.O. = Work order logged in the District's database
2. This table represents data for the 3 years covered by this report (2005-2007).
3. Only data that were obtained during this evaluation of the District are represented on this table.
4. In this table both total coliform and fecal coliform are included under Coliform.
5. In the Coliform column, the number of positive coliform samples are shown. No PWS exceeded the MCL for total or fecal coliform.
6. As required by TCEQ, the District performed repeat samples for all positive results, and all repeat samples tested negative for Coliform.
7. Maximum TTHM level above MCL are shown and violations are highlighted. Violations are issued when the annual average of the TTHM level exceeds the MCL.
8. Aesthetic issues ("dirty water") deal with constituents in the water that affect the taste, odor or color of the water, but pose no health risk.
9. Only Work Orders logged under activity code 4024, "DIRTY WATER COMPLAINTS", are included under Aesthetics (W.O. per 1,000 connections).
10. TTHM exceedance based on water quality sampling and analysis initiated by PWS customer

Figure 3-1. Summary of Water Quality Issues in the District 2005-2007

GUI

Groundwater Under the Influence of Surface Water (GUI) has severe health implications, mainly due to the potential bacterial contamination of the source water. If a well is classified as GUI, it must be treated as surface water to eliminate the risk of supplying improperly treated water to consumers. The GUI column indicates the presence of this condition.

Dirty Water

These data were collected from the District's work order tracking database by activity code. Activity code 4024 "DIRTY WATER COMPLAINT" is the activity code used when assessing and tracking customer complaints with regard to secondary constituents affecting taste, odor, and color. Aesthetic water quality issues have no adverse health effects associated with them.

The number of complaints per 1,000 connections for the three year study period is included in the "Dirty Water" column.

3.3.1 Issue 3A – Health-Based Water Quality

The overall health-based water quality of the District is acceptable in most of its component systems, with three notable exceptions:

- The sole-source well in Canyon Park has been designated as GUI, which represents an acute health risk with the real potential to initiate a waterborne disease outbreak;
- Chronic TTHM exceedances and a subsequent violation occurred in Bulverde Hills, and
- Positive coliform tests have occurred sporadically in six systems, although no violations ensued. These results are likely caused by poor disinfection practices during repairs on main breaks and intrusion during low pressure events.

3.3.1.1 <u>Groundwater Under the Influence of Surface Water (GUI)</u>

The most significant risk to consumers that the District faces is the sole-source well in Canyon Park that has been identified as GUI. This well represents an acute health risk with the potential to initiate a waterborne disease outbreak. Particularly troubling is the continued unresolved replacement or treatment of the Canyon Park well long after the District became aware of the risk by TCEQ correspondence and emails during April-June 2007. TCEQ’s formal regulatory notice was not issued to the District until May 28, 2008, and based on Federal and State rules, the District has 18 months from the date of notification to resolve the issue. Nevertheless, proactive management could have worked to resolve the problem independent of regulatory pressure. The GUI designation requires that the District either replace the water source or implement additional treatment of the water from the existing source. This particular well is the only water source for the system that it serves and is currently treated only with chlorination. Due to the surface water particulate contaminants present, disinfection alone cannot be counted on to eliminate possible pathogenic organisms. According to the definition in 30 TAC 290

Subchapter F, a GUI is regulated "subject to the same requirements as surface water," which would call for additional treatment methods (24). The District is currently working on a solution; however, until one is implemented, the risk remains.

3.3.1.2 Total Trihalomethanes (TTHM)

Another water quality problem the District is experiencing is the occurrence of high levels of TTHMs. Three systems, Hill Country, Bulverde Hills, and Northeast, have exceeded the MCLs at least once during the study period. Only Bulverde Hills has had a persistent problem, and it is the only system that has received an NOV for this issue. The presence of high levels of TTHMs poses a long-term health risk rather than an acute risk to consumers. The District is in the process of implementing a treatment regimen to resolve this issue.

3.3.1.3 Positive Coliform Tests

30 TAC 290.109(b) sets the MCLs for microbial contaminants based on detection of particular contaminants or fecal indicator organisms. A public water system is required to perform regular monitoring of distribution system samples. The number of samples required per month is dependent on the population served by the system (25). Most of the 21 PWSs within the District are required to collect fewer than 40 samples per month. The MCL for those systems is defined as "when more than one sample is coliform positive." Four PWSs (Hill Country, Northeast, Northwest and Southside) have a population large enough to require 40 or more samples per month. For those systems, the MCL is defined as "when more than 5.0% of samples collected in a month are coliform positive" (25). Water systems should ideally not have any positive coliform samples. A positive coliform result is an indicator of possible contamination in the water system, usually attributed to either backflow (from leaks and/or cross connections) or incomplete disinfection of lines after repairs/construction to the distribution system.

The four largest PWSs in the District (Hill Country, Northeast, Northwest and Southside) have recurring incidents of positive coliform samples. These sporadic microbial contamination events may be attributed to either low or no pressure events that triggered backflow from leaks and cross connection or to poor disinfection practices following repairs of the distribution system.

In a study performed by the Water Science and Technology Board of the National Research Council entitled *Drinking Water Distribution Systems: Assessing and Reducing Risks*, the physical integrity of a system is defined as "the ability of the distribution system to act as a physical barrier that prevents external contamination from affecting the quality of the internal, drinking water supply." Described in the report are three main ways that the physical integrity of a water system can be lost. The first is when components in the system fail because of corrosion due to chemical reactions between pipes and the soil around them, causing small holes, leaks, and other damage, breaching that physical barrier. The second contributor is when important system components such as backflow prevention devices or sealed covers for storage reservoirs are missing, either because they were never installed, or because they were accidentally or intentionally removed. Finally, improper material handling, unsanitary construction and maintenance practices, and incomplete disinfection processes can allow system contamination to occur (19).

A water provider must be able to detect and eliminate these potential sources of contamination to maintain the integrity of the public water system. This study provided a list of methods that could be used to detect a loss in physical integrity, shown in Table 3-4.

Table 3-4. Methods for Detecting Loss in Physical Integrity (19)

Component	Mechanism of Integrity Loss	Detection by
Pipe	Permeation	VOC testing, investigate customer complaints about taste/odor
	Structural failure (leak)	Leak detection, investigate customer complaints
	Structural failure (break)	Investigate customer complaints, pressure monitoring
	Improper installation	Inspection
	Unsanitary activity	Inspection, water quality testing
Fitting and Appurtenance	Structural failure	Inspection, pressure monitoring, investigation of customer complaints, leak detection, detection of operational failures
	Improper installation	Inspection
	Unsanitary activity	Inspection
Storage Facility Wall, Roof, Cover, Vent, Hatch	Structural failure (crack, hole)	Inspection, water quality testing
	Absence of	Inspection, water quality testing
	Improper installation	Inspection
	Unsanitary activity	Inspection, water quality testing
Backflow Prevention Devices	Absence of	Inspection, investigate customer complaints
	Improper installation	Inspection, investigate customer complaints
	Operational failure	Inspection, investigate customer complaints

An asset management plan would allow for informed decision-making regarding maintenance, repair, and replacement of facilities. District records show that many of the older systems and some of the newer ones have pipe sizes significantly smaller that the minimum sizes called for by the TAC. It is possible that substandard construction materials and/or poor installation practices were used in these systems as well. Distribution systems that were not constructed in compliance with regulatory requirements and industry standards should be brought into compliance with all applicable requirements and standards. A complete infrastructure inventory and integrated work order tracking system would improve the District's ability to quickly recognize real-time distribution system problems such as pressure drops or widespread dirty water complaints. A complete mapping system would also facilitate a proactive approach to finding and eliminating risks to the system.

3.3.2 Issue 3B – Aesthetic Water Quality

Aesthetic water quality parameters are described in two categories in the AWWA standards for Distribution Systems Operation and Management; "color and staining" and "taste and odor" (16). These are often referred to as dirty water. In a document entitled *Consumer Confidence Reports,* which water systems provide to their customers each year, the statement is made that, "the taste and odor constituents are called secondary constituents and are regulated by the State of Texas.

…Many constituents (such as calcium, sodium, or iron) which are often found in drinking water can cause taste, color, and odor problems."   It also states that these constituents are not a cause for health concern (1).

AWWA standards for aesthetic water quality parameters describe how a utility should respond to these issues. AWWA has three minimum components for an action plan to address both color and staining problems and taste and odor complaints.

> "The utility shall have an action plan to address color and staining (taste and odor) problems. The action plan, at a minimum, shall include:
> 1. An inquiry call system in place that can differentiate between color and staining (taste and odor) problems and other inquiries, and track them.
> 2. Trained personnel who can handle customer inquiry calls over the phone, can explain system problems that are known, and can collect pertinent information for response personnel.
> 3. Communication of inquiry information to a response team for a timely resolution. Review of inquiry records for data trends to identify problem areas of distribution system" (16).

One method that is commonly used to address complaints about aesthetic water quality is to flush dirty water from the water distribution system in the vicinity of multiple customer complaints, usually using fire hydrants. 30 TAC 290.46(l) requires that all dead-end mains be flushed monthly, but it also states that "other mains shall be flushed as needed if water quality complaints are received from water customers or if disinfectant residuals fall below acceptable levels" (24). An interview with District department managers and staff revealed that the District has recently implemented an "aggressive" distribution system flushing program, similar to one described in AWWA Standard 4.1.8 for System Flushing:

> "The utility shall develop and implement a systematic flushing program that meets the needs of the utility, taking into consideration the condition of the system, hydraulic capacity, treatment, water quality, and other site-specific criteria. At a minimum, the flushing program shall incorporate the following items:
> 1. The program addresses a preventative approach to distribution system flushing, including occasional spot flushing to address localized problems or customer concerns and routine flushing to avoid water quality problems.
> 2. The utility shall perform system flushing at the velocity appropriate to address water quality concerns.
> 3. The utility has written procedures addressing all activities associated with system flushing, water quality, monitoring, frequency, locations and duration, as well as adherence to all regulatory requirements" (16).

This type of systematic flushing program requires a complete understanding of the distribution system as a whole. The District's lack of a complete system map hinders its ability to develop a program as effective as the one described in these standards. Without taking the system's hydraulic capacity into consideration, pressure problems caused by excessive flow demands on a system unable to convey those demands can be created while attempting to address water quality issues.

3.3.3 Issue 3 – Conclusions

Based upon the information gathered from TCEQ and the District, the work order spreadsheet, and information gathered during the interview process, the following conclusions have been developed regarding the District's response to water quality issues.

1. The District does not have an asset management plan that considers risks and alternatives, which is key to strategic capital improvement planning and budgeting. Such a plan would provide information about the age and condition of the District's existing infrastructure and allow for informed decision-making regarding maintenance, repair, and replacement of facilities. It would provide insight for prioritization of upgrades and additions to the system and aid in the consideration of alternatives.

2. Inadequate work order data logging does not allow the District to properly track operations and maintenance, or to use rapid trend analysis to address real-time distribution system problems such as pressure drops or widespread dirty water complaints in a timely manner.

3. Incomplete infrastructure inventory and system maps restrict the District's ability to consider the system as a whole, identify problem areas, and prioritize issues needing to be addressed.

4. Aesthetic water quality, including taste, odor and color, is a widespread and varied issue throughout the District. Some systems have a more obvious problem than others. Pressure fluctuation and poor distribution system flushing practices can create or compound these problems.

5. The District's current distribution system flushing practices meet TCEQ requirements to maintain disinfectant residuals while concurrently addressing aesthetic water quality issues in the system. However, without a complete understanding of the distribution system, an aggressive flushing program can cause problems such as redistributing pockets of dirty water rather than eliminating them, or temporarily dropping pressure in the system due to conveyance limitations.

3.3.4 Issue 3 – Recommendations

The following improvements to the District's response to water quality issues are recommended.

1. Quickly resolve the acute and chronic health risk issues that are currently unresolved and ensure that maintenance crews adequately disinfect waterlines after construction and maintenance.

2. Bring undersized and otherwise substandard distribution systems into compliance with regulatory requirements and AWWA standards. Consider adding peripheral storage and pump stations to meet peak water demand resupply needs. Consider creating redundant water supply by interconnecting systems within the District or using interconnections to other water purveyors where water supply or delivery issues are creating health and/or conveyance problems.

3. Develop and implement a systematic distribution system flushing program that considers the condition of the system, its hydraulic capacity, types of treatment, water quality implications, and water conservation. Minimize and record all water used during this effort.

4. Develop and implement an asset management plan that considers risks and alternatives as a basis for developing a strategic CIP and budget. This plan should be used to make informed decisions regarding maintenance, repair and replacement of facilities, and to prioritize upgrades and additions to the system, considering multiple alternatives to select functional and cost-effective options.

5. Complete and maintain an infrastructure inventory and system map for use in developing the asset management plan. A comprehensive system map is also useful for planning and scheduling of routine maintenance, distribution system flushing, and other operational activities.

6. Develop and implement a work order system that allows the District to properly track operations and maintenance and for rapid trend analysis to address real-time distribution system problems such as pressure drops or widespread dirty water complaints in a timely manner. Educate District staff on the use of this system, and ensure its use District-wide.

3.4 Issue 4 – Water Loss

> "A calculation of the annual volume of the District's unaccounted-for water, and recommendations for preventing future system leaks and related problems."

To analyze the District's unaccounted-for water and its response to problems, URS used the District's Operations report, showing system input (production) and billed consumption for each PWS for each year of the study period. These data were supplemented with a report provided by the District showing the District's documented unbilled water use for 2006 and 2007. The information included in these reports was used to calculate unaccounted-for water by subtracting the documented water consumption from the system input. Additional insight was gained during an interview with District department managers. These results were compared to AWWA standards to determine whether the District's practices regarding water loss were in alignment with those standards.

The International Water Association (IWA) and AWWA have developed a set of definitions to help water utilities gain a better understanding of the problem of water loss. These definitions, shown in Table 3-5, will be used in this report for clarity. Water loss, unlike billed, authorized consumption, is not revenue producing. Apparent water losses are due to unauthorized use, metering inaccuracies and data errors. Real water loss is considered to be the volume of water that is lost through leaks, and overflows in system reservoirs and leaks and breaks in the distribution system up to the point of customer metering (17). This evaluation considers these two types of loss individually. Gaining an understanding of all of the District's water losses has important implications on the financial wellbeing of the District.

Table 3-5. Components and Definitions of the IWA/AWWA Water Balance (17)

Water Balance Component	Definition
System Input Volume	The annual volume input to the water supply system
Authorized Consumption	The annual volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are authorized to do so
Water Losses	The difference between System Input Volume and Authorized Consumption, consisting of Apparent Losses plus Real Losses
Apparent Losses	Unauthorized Consumption, all types of metering inaccuracies and data handling errors
Real Losses	The annual volumes lost through all types of leaks, breaks and overflows on mains, service reservoirs and service connections, up to the point of customer metering
Revenue Water	Those components of System Input Volume which are billed and produce revenue
Non-Revenue Water (NRW)	The difference between System Input Volume and Billed Authorized Consumption

Water loss is an increasing problem in the District. Based on water production and consumption reports and unbilled water consumption logs provided by the District, the amount of unaccounted-for water District-wide was 15% in 2005, 16.5% in 2006, and 26% in 2007. This was determined by subtracting documented consumption from system input volumes (water produced or purchased by the District) including a small amount of unbilled consumption that was documented through the work order system in 2006 and 2007 (8, 9). When the individual systems in the District were analyzed, it became apparent that some had much greater losses than others, with four systems (two in the Hill Country Service Area and two in the Northwest Service Area) exceeding 50% loss in 2007.

3.4.1 Issue 4A – Apparent Water Loss

Apparent water losses in the District include unauthorized consumption, metering inaccuracies, and data errors, as defined in Figure 3-2.

Interviews with District department managers and staff revealed that errors in data entry (i.e., incorrect system numbers being assigned to customers) caused some anomalies in the records provided by the District. One PWS in particular has results that simply are not possible, showing consumption exceeding production by a large margin (8).

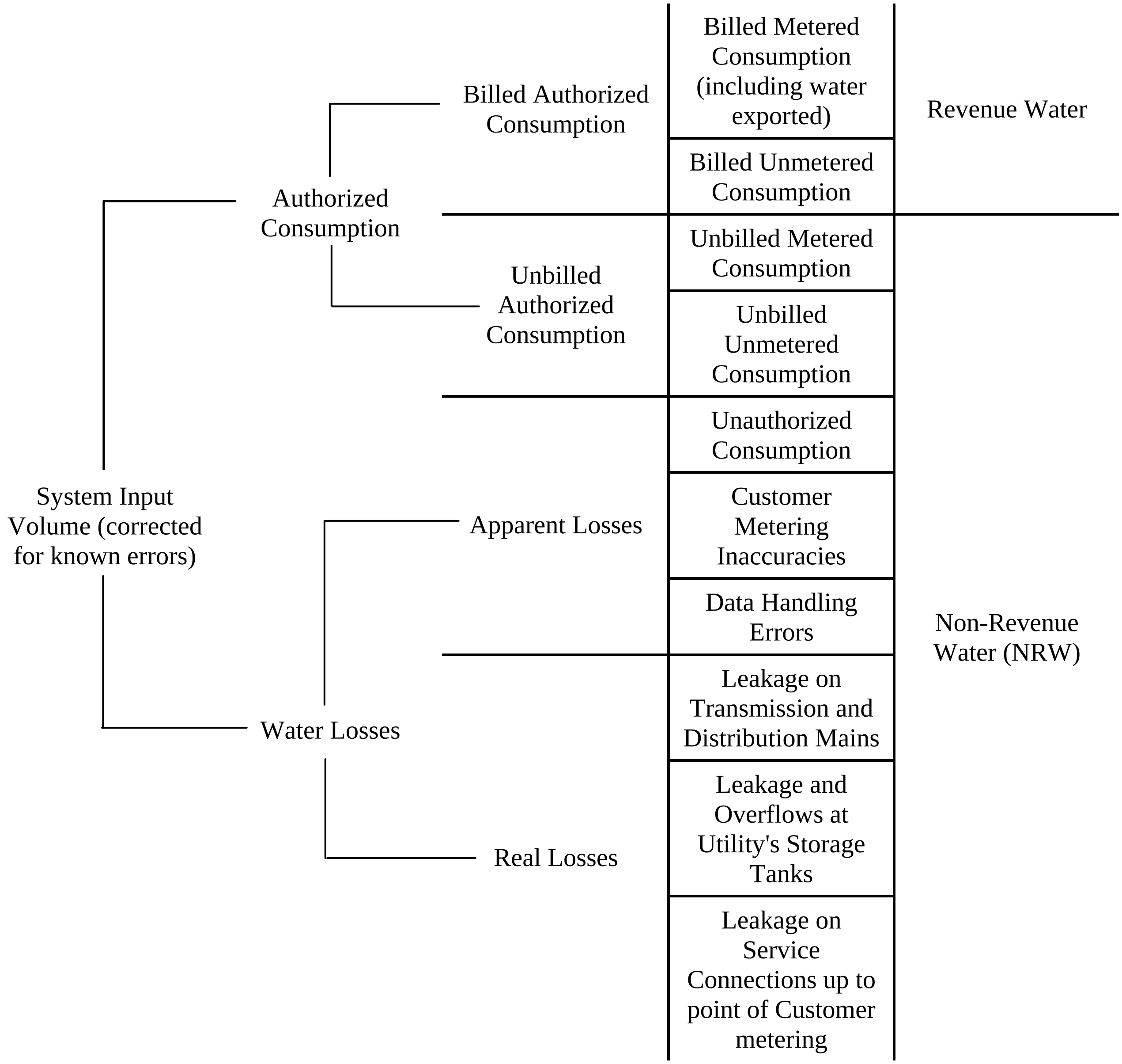

Figure 3-2. IWA/AWWA Water Balance
(All data in Volume for the period of reference, typically one year) (17)

According to District staff, very little coordination currently exists among authorized water users. Water users internal to the District include construction and maintenance crews, the water quality department, and the production department. External authorized users include public works departments of multiple cities and counties and multiple fire departments. District staff calculate the amount of water used when entering data into the work order system, but no written procedures were provided to URS by the District showing the types of calculations used. Until formal, written procedures are developed and implemented by all authorized water users, losses will continue to be poorly documented. Sample forms developed by the Texas Water

Development Board for reporting water used during flushing and water used by fire departments are included in Appendix A, Figures A-1 and A-2 (22).

When questioned about the significant increases in unaccounted-for water during the study period, District staff explained that an "aggressive" distribution system flushing program was formally implemented in 2008, but was being practiced in 2006 and 2007. This program meets TCEQ requirements to maintain disinfectant residuals while concurrently addressing aesthetic water quality issues in the system. The District provided a Monthly Unmetered Water Loss Summary for 2006 and 2007, showing significant increases in documented water use during "WATER QUALITY FLUSHING" for most of the 21 systems (9). These uses are considered unbilled, authorized consumption which are not revenue producing, but are expected in a water system. It is unclear whether all water used during water quality flushing is documented. According to staff, water use during unscheduled flushing to address specific water quality complaints is often not documented. Although water quality flushing is important, it would be appropriate to consider water conservation as much as possible. A more clearly defined, systematic distribution system flushing program that considers the condition of the system, its hydraulic capacity, types of treatment, water quality implications, and water conservation would specify the most appropriate amount of water needed to accomplish the desired goal.

3.4.2 Issue 4B – Real Water Loss

Real water losses include leaks and overflows at storage reservoirs, and leaks and breaks in the distribution system up to the point of customer metering, as shown in Figure 3-2 (17).

The AWWA standard for Distribution Systems Operation and Management 4.2.4 discusses how a utility should address water losses.

> “4.2.4.1 Water loss. The utility shall have an annual goal for the amount of water loss. The utility shall have documentation defining what is included in this calculation.
> 4.2.4.2 Response program. The utility shall have an action plan to respond if the goals are not met.
> 4.2.4.3 Leakage. The utility shall have a method of estimating (quantifying) leakage on an annual basis" (16).

According to documentation provided by the District, water losses due to leaks in the distribution system are occurring in areas with aging infrastructure as well as in relatively newer systems (8, 9, 14). Leaks and breaks in the distribution system are caused by multiple factors, including age, pipe material, installation practices, and soil conditions. Since the documentation of apparent water loss is lacking, it is difficult to determine the magnitude of real water losses. It would be prudent for the District to determine its apparent losses so that it can concentrate its efforts effectively on reducing real losses.

One effective method to reduce real loss is with a comprehensive leak detection and repair program with goals for loss reduction. District documents mention such a program, but incomplete infrastructure inventory and system maps restrict the District’s ability to consider the system as a whole, to identify problem areas, and to prioritize issues needing to be addressed.

The District does not have an asset management plan that provides the necessary information about the age and condition of its existing infrastructure. In addition, inadequate work order data logging does not allow the District to properly track operations and maintenance. Complete records of pipe and environmental conditions encountered in the field by maintenance crews would allow staff to define a plan of action that would address existing problems effectively. A calculation sheet developed by the Texas Water Development Board is included in Appendix A, Figure A-3, providing helpful calculations which can be used for tracking real water loss by estimating leak rates through various known hole sizes (22).

The AWWA standard for Distribution Systems Operation and Management 4.2.10.1 says that:

> "The utility shall have a standardized system for recording and reporting pipeline leak or break information. At a minimum, the data collected on a leak or break shall include pipe location, pipe material, pipe size, apparent type of leak or break, visual assessment of surrounding soil type (sand, clay, etc.), pipe's depth, and best assessment of saturation conditions of the soil prior to break or proximity to water table" (16).

Leak detection and repair alone will not eliminate all real water loss. District records show that a number of systems have pipe sizes below standard requirements. It could be assumed that these and/or other systems were constructed using substandard installation practices as well, leading to water losses. These systems need to be identified and brought into compliance with regulatory requirements and AWWA standards. An asset management program would help to determine what areas of the District need infrastructure rehabilitation or replacement to reduce excessive water losses.

3.4.3 Issue 4 – Conclusions

Based upon the reports provided by the District and information gathered during the interview process, the following conclusions have been developed regarding the District's response to water loss.

1. Unaccounted-for water (apparent losses), including meter inaccuracies, billing errors and unauthorized use, is a system-wide problem that cannot be quantified until record-keeping practices are improved. For example, the District does not properly document authorized unmetered water use such as distribution system flushing, fire fighting, and construction use.

2. The District's current distribution system flushing practices meet TCEQ requirements to maintain disinfectant residuals while concurrently addressing aesthetic water quality issues in the system. However, without a complete understanding of the distribution system, an aggressive flushing program can cause problems such as redistributing pockets of dirty water rather than eliminating them, or temporarily dropping pressure in the system due to conveyance limitations. An increase in unaccounted-for water was observed for the past 2 years, corresponding to the increase in system flushing. The District has begun to record unmetered water use such as flushing flows, but so far documentation has been inconsistent.

3. Real water losses due to leaks in the distribution system are occurring in areas with aging infrastructure as well as in relatively newer systems with certain types of pipe and soil conditions. The District lacks appropriate records, thus the magnitude of these losses cannot be determined. The District also lacks a comprehensive leak detection and repair program; therefore, the amount of real water loss is not likely to decrease.

4. Inadequate work order data logging does not allow the District to properly track operations and maintenance.

5. Incomplete infrastructure inventory and system maps restrict the District’s ability to consider the system as a whole, to identify problem areas, and to prioritize issues needing to be addressed.

6. The District does not have an asset management plan that considers risks and alternatives, which is key to strategic capital improvement planning and budgeting. Such a plan would provide information about the age and condition of the District's existing infrastructure and allow for informed decision-making regarding maintenance, repair, and replacement of facilities. It would provide insight for prioritization of upgrades and additions to the system and aid in the consideration of alternatives.

3.4.4 Issue 4 – Recommendations

The following improvements to the District's response to water loss are recommended.

1. Develop and implement a method of tracking all authorized water use, including a standardized method of documentation. Coordinate with all District water users, municipal public works departments, and area fire departments.

2. Develop and implement a systematic distribution system flushing program that considers the condition of the system, its hydraulic capacity, types of treatment, water quality implications, and water conservation. Minimize and record all water used during this effort.

3. Educate District staff and the public about existing water conservation regulations and enforce those regulations to curtail excessive demand during peak use periods.

4. Bring undersized and otherwise substandard distribution systems into compliance with regulatory requirements and AWWA standards. Consider adding peripheral storage and pump stations to meet peak water demand resupply needs. Consider creating redundant water supply by interconnecting systems within the District or using interconnections to other water purveyors where water supply or delivery issues are creating health and/or conveyance problems.

5. Develop and implement an asset management plan that considers risks and alternatives as a basis for developing a strategic CIP and budget. This plan should be used to make informed decisions regarding maintenance, repair and replacement of facilities, and to prioritize upgrades and additions to the system, considering multiple alternatives to select functional and cost-effective options.

6. Complete and maintain an infrastructure inventory and system map for use in developing the asset management plan. A comprehensive system map is also useful for planning and scheduling of routine maintenance, distribution system flushing, and other operational activities.

7. Develop and implement a work order system that allows the District to properly track operations and maintenance. Educate District staff on the use of this system, and ensure its use District-wide.

8. Develop and implement a comprehensive leak detection and repair program that includes goals for loss reduction, and an action plan to respond if the goals are not met. Incorporate information gathered during this effort into the infrastructure inventory to keep accurate records of the condition of the system.

4.0 INFRASTRUCTURE SYSTEM AND ASSETS

4.1 Evaluation of Reported System Capacities

The District currently operates 21 PWSs throughout its service area. 30 TAC 290.38(63) defines a PWS as a "public water system for the provision to the public of water for human consumption through pipes or other constructed conveyances (24)."

URS evaluated the current reported capacities of the District's PWSs on the basis of the rules and regulations established by TCEQ in 30 TAC Chapter 290, Subchapter D. Included in these regulations are capacity requirements based on the number of connections, system configuration, water source(s) and other variables. For the purposes of this study, the PWSs have been evaluated individually (Appendices B through E) as well as regionally within each service area. The District is made up of five service areas: Northwest, Hill Country, Northeast, Southeast, and Southside. The Southeast and Southside Service Areas were evaluated together because a single PWS is covered by the two service areas.

4.1.1 Hill Country Service Area

The Hill Country Service Area is comprised of seven PWSs. Appendix B, Exhibit B-1 shows the location for each PWS within this service area.

- Castle Hills (PWS No. 0150045);
- Hill Country (PWS No. 0150054);
- Timberwood (PWS No. 0150270);
- Bulverde Hills (PWS No. 0460013);
- Oakland Estates (PWS No. 0460166);
- Woods of Spring Branch (PWS No. 0460196); and
- HEB-Bulverde (PWS No. 0460228).

Information regarding the number of connections, production capacity, total storage, pressure storage, and pump capacity is summarized for these PWSs in Table 4-1. The capacity requirements for the Hill Country Service Area are satisfied by a majority of the PWSs; however, the pump and pressure storage capacities for Bulverde Hills fall below the regulatory capacity minimum requirements, according to the calculations. Further assessment, based on the actual system configuration could determine otherwise.

Table 4-1. Hill Country Capacity Summary

Name of PWS	PWS No.	No. of Connections	Capacity Calculation Basis (30 TAC 290.45)	Production Capacity Required (gpm)	Production Capacity Provided (gpm)	Total Storage Required (gallons)	Total Storage Provided (gallons)	Ground Storage (gallons)	Elevated Storage (gallons)	Pressure Tanks (gallons)	Pump Capacity Required (gpm)	Pump Capacity Provided (gpm)	Pressure Storage Required (gallons)	Pressure Storage Provided (gallons)
Castle Hills	0150045	2,671	(b)(1)(D)(i),(ii),(iii)c, (iv)a	1,603	5,591	534,200	2,250,000	1,000,000	1,250,000	0	1,603	3,400	534,200 [6]	1,250,000
Hill Country	0150054	12,850	(b)(1)(D)(i),(ii),(iii)a, (iv)a	7,710	14,840	2,570,000	11,376,700	4,876,700	6,500,000	0	25,700	35,370	1,285,000 [6]	6,500,000
Timberwood	0150270	4,592	(b)(1)(D)(i),(ii),(iii)c, (iv)a	2,755	3,713	918,400	3,621,686	1,121,686	2,500,000	2,000	2,755	5,200	918,400 [6]	2,500,000
Bulverde Hills	0460013	317	(b)(2)(E),(F)(ii),(G)(ii)	190	347 [1]	63,400	161,000	161,000	0	5,000	403 [2]	190 [3]	6,340	5,000 [3]
Oakland Estates	0460166	165	(b)(1)(C)(i),(ii),(iii)b, (iv)a	99	175	33,000	187,000	27,000	160,000	0	99	300	33,000 [6]	160,000
Woods of Spring Branch	0460196	31	(b)(1)(B)(i),(ii),(iii),(iv)	19	50	6,200	8,600	8,600	0	2,300	62	100	620	2,300
HEB - Bulverde	0460228	10	(b)(2)(E),(F)(ii),(G)(ii)	6	34 [4]	2,000	164,800	164,800	0	220	56 [5]	720	200	220

The following assumptions are based on a TCEQ CCI dated January 25, 2005:

[1] Includes only purchased surface water since this system is primarily sourced by surface water, and all normal, daily water use is delivered under pressure by the CLWSC. Only emergency water use is supplied by the wells in the system.

[2] Service pump peaking factor based on maximum daily demand of (463,920 mgd / 1440) * 1.25, although this does not meet the minimum 1,000 gpm requirement. Maximum Daily Usage date is September 17, 2004.

[3] Although the pump capacities appear to be deficient, it is assumed that the pump capacity and pressure requirements are satisfied by the pressure under which the surface water is delivered. This is not reflected in the 2005 CCI.

The following assumptions are based on a TCEQ CCI dated October 15, 2007:

[4] Includes well production (28 gpm) and surface water purchased from CLWSC (6 gpm based on December 2007 metered use, according to correspondence with TCEQ dated January 3, 2008).

[5] Service pump peaking factor based on maximum daily demand of (64,000 mgd / 1440) * 1.25, although this does not meet the minimum 1,000 gpm requirement. Maximum Daily Usage date is August 23, 2007.

[6] "Pressure Storage Required" indicates either the elevated storage requirement related to high service pump capacity or pressure storage capacity, whichever is greater.

GROUNDWATER

(1) 30 TAC 290.45(b)(1)(B) fewer than 50 connections with ground storage.
Must meet all of the following:

(i) Well capacity	0.6 gpm per connection
(ii) Total storage (ground and elevated only)	200 gal per connection
(iii) High service pumps	2 gpm per connection total
(iv) Pressure tank	20 gal per connection

(2) 30 TAC 290.45(b)(1)(C) 50 to 250 connections.
Must meet all of the following:

(i) Well capacity	0.6 gpm per connection
(ii) Total storage (ground and elevated only)	200 gal per connection
(iii) High service pumps (HSP) – **one of the following**:	
a. 2 or more pumps	2 gpm per connection total
b. Elevated storage	200 gal per connection **and**
2 or more pumps	0.6 gpm per connection total
c. Elevated storage and wells	No pumps required
(iv) Pressure storage – **one of the following**	
a. Elevated storage	100 gal per connection
b. Pressure tanks	20 gal per connection

(3) 30 TAC 290.45(b)(1)(D) more than 250 connections.
Must meet all of the following:

(i) Well capacity – 2 or more wells	0.6 gpm per connection total Or interconnect
(ii) Total storage (ground and elevated only)	200 gal per connection
(iii) High service pumps (HSP) – **one of the following**:	
a. 2 or more pumps	2 gpm per connection total
b. 2 or more pumps at each pump station or pressure plane	Minimum 1,000 gpm, and ability to meet peak hourly demands with largest pump out of service.

(3) 30 TAC 290.45(b)(1)(D)
(iii) High service pumps (HSP) continued

c. Elevated storage	200 gal per connection **and**
2 or more pumps at each pump station or pressure plane	0.6 gpm per connection total
d. Elevated storage and wells	No pumps required
(iv) Pressure storage – **one of the following**	
a. Elevated storage	100 gal per connection
b. Pressure tanks	20 gal per connection

(4) 30 TAC 290.45(b)(1)(F) Mobile home park with more than 100 connections.
Must meet all of the following:

(i) Well capacity	0.6 gpm per connection total
(ii) Total storage (ground and elevated only)	200 gal per connection
(iii) High service pumps (HSP) 2 or more pumps	2 gpm per connection total
(iv) Pressure storage – Pressure tanks	20 gal per connection

SURFACE WATER

(5) 30 TAC 290.45(b)(2)
Must meet all of the following:

(E) Total storage (ground and elevated only)	200 gal per connection
(F) High service pumps (HSP) – **one of the following**:	
(i) 2 or more pumps at each pump station or pressure plane	2 gpm per connection total
(ii) 2 or more pumps at each pump station or pressure plane	Minimum 1,000 gpm, and ability to meet peak hourly demands with largest pump out of service.
(iii) Elevated storage	200 gal per connection **and**
2 or more pumps at each pump station or pressure plane	0.6 gpm per connection total
(G) Pressure storage – **one of the following**	
(i) Elevated storage	100 gal per connection
(ii) Pressure tanks (only for systems with <2500 connection)	20 gal per connection

4.1.2 Northeast Service Area

The Northeast Service Area has only one PWS, Northeast (PWS No. 150084), to serve the area. Appendix C, Exhibit C-1 shows the location of this PWS. Information for this PWS regarding production capacity, total storage, pressure storage and pump capacity is summarized in Table 4-2. The Northeast PWS serves 14,597 connections. The capacity requirements for the Northeast PWS are satisfied as shown in Table 4-2.

Table 4-2. Northeast Capacity Summary

Northeast PWS No. 0150084 Calculation Basis 30TAC290.45 (b)(2)(F)(ii), (G)(i) Number of Connections: 14,597	Production Capacity (gpm)	Total Storage [7] (gallons)	Ground Storage (gallons)	Elevated Storage (gallons)	Pressure Tanks (gallons)	Pump Capacity (gpm)	Pressure Storage (gallons)
Required	9,626 [1]	2,919,400	-	-	-	3,376 [6]	1,588,100 [2]
Provided	14,730 [3]	6,000,000	3,000,000 [4]	3,000,000	0	4,900 [5]	3,000,000

The following assumptions are based on a TCEQ CCI dated December 15, 2005:

[1] Includes 868 gpm provided as wholesale (1,284 connections).

[2] Includes pressure storage required for the 1,284 wholesale connections.

[3] Includes wells (12,250 gpm) and purchased surface water (2,480 gpm max).

[4] Ground storage capacity is based on the 3,000,000 gallon storage tank at the surface water treatment plant used exclusively for the District.

[5] Service pump capacity is based on the surface water treatment plant pumps (2,450 gpm each) used exclusively for the District.

[6] Service pump peaking factor based on maximum daily demand of (3,889,000 mgd / 1440) * 1.25 and assumes that only surface water is pumped. Well production serves the higher elevations using gravity flow. Maximum Daily Usage date is November 6, 2005 from TCEQ CCI dated August 8, 2007.

[7] "Total Storage" includes "Ground Storage" and "Elevated Storage."

<u>SURFACE WATER</u>

30 TAC 290.45(b)(2)

Must meet all of the following:

(E) Total storage (ground and elevated only)	200 gal per connection
(F) High service pumps (HSP) – **one of the following**:	
(i) 2 or more pumps at each pump station or pressure plane	2 gpm per connection total
(ii) 2 or more pumps at each pump station or pressure plane	Minimum 1000 gpm, and ability to meet peak hourly demands with largest pump out of service.
(iii) Elevated storage	200 gal per connection **and**
2 or more pumps at each pump station or pressure plane	0.6 gpm per connection total
(G) Pressure storage – **one of the following**	
(i) Elevated storage	100 gal per connection
(ii) Pressure tanks (only for systems with <2500 connection)	20 gal per connection

4.1.3 Northwest Service Area

Northwest Service Area is comprised of 12 PWSs. Appendix D, Exhibit D-1 shows the location for each PWS within this service area. Information regarding the number of connections, production capacity, total storage, pressure storage, and pump capacity is summarized for these PWSs in Table 4-4.

- Geronimo Forest (PWS No. 0150052);
- Chaparral (PWS No. 0150053);
- Meadow Wood Acres (PWS No. 0150072);
- Northwest (PWS No. 1500171);
- North San Antonio Hills (PWS No. 150205);
- Elm Valley (PWS No. 0150265);
- Country Oaks (PWS No. 0150430);
- Texas Research Park (PWS No. 0150497);
- Canyon Park (PWS No. 0150532);
- Mountain Laurel (PWS No. 150545);
- Anaqua Springs (PWS No. 150549); and
- West View (PWS No. 1630039).

As shown in Table 4-3, the majority of the PWSs satisfy the capacity requirements with the exception of Country Oaks, a mobile home park. An alternate production capacity requirement of 0.31 gpm per connection based on daily records of water use was approved by the TCEQ, according to correspondence from TCEQ date July 28, 2005. Pump capacity appears to be deficient for Country Oaks. However, further analysis based on the system configuration is necessary to verify. Meadow Wood Acres provides 103% of the minimum requirement for total storage for that area; however, additional storage might be needed to serve future growth.

Table 4-3. Northwest Capacity Summary

Name of PWS	PWS No.	No. of Connections (May 2008)	Capacity Calculation Basis (30 TAC 290.45)	Production Capacity Required (gpm)	Production Capacity Provided (gpm)	Total Storage Required [1] (gallons)	Total Storage Provided (gallons)	Ground Storage (gallons)	Elevated Storage (gallons)	Pressure Tanks (gallons)	Pump Capacity Required (gpm)	Pump Capacity Provided (gpm)	Pressure Storage Required [2] (gallons)	Pressure Storage Provided (gallons)
Geronimo Forest	0150052	161	(b)(1)(C)(i),(ii),(iii)a, (iv)b	97	230	32,200	90,000	90,000	0	5,000	322	550	3,220	5,000
Chaparral	0150053	471	(b)(1)(D)(i),(ii),(iii)a, (iv)b	283	1,800	94,200	120,000	120,000	0	11,300	942	1,025	9,420	11,300
Meadow Wood Acres	0150072	245	(b)(1)(C)(i),(ii),(iii)a, (iv)b	147	500	49,000	50,500	50,500	0	10,000	490	810	4,900	10,000
Northwest	0150171	14,928	(b)(1)(D)(i),(ii),(iii)c, (iv)a	8,957	13,915	2,985,600	4,780,000	1,780,000	3,000,000	30,000	8,957	16,418	1,492,800	3,000,000
North San Antonio Hills	0150205	185	(b)(1)(C)(i),(ii),(iii)a, (iv)b	111	600	37,000	103,000	103,000	0	5,600	370	900	3,700	5,600
Elm Valley	0150265	244	(b)(1)(C)(i),(ii),(iii)a, (iv)b	146	468	48,800	92,500	92,500	0	11,000	488	1,800	4,880	11,000
Country Oaks	0150430	113	(g)(2)(B) [3], (b)(1)(F)(ii),(iii),(iv)	35	55	22,600	40,000	40,000	0	3,800	226	160 [4]	2,260	3,800
Texas Research Park	0150497	1,004	(b)(1)(D)(i),(ii),(iii)c, (iv)a	602	13,500	200,800	5,810,000	1,310,000	4,500,000	40,000	602	10,000	100,400	4,500,000
Canyon Park	0150532	112	(b)(1)(C)(i),(ii),(iii)a, (iv)b	67	1,500	22,400	65,000	65,000	0	5,000	224	1,900	2,240	5,000
Mountain Laurel	0150545	31	(b)(1)(B)(i),(ii),(iii),(iv)	19	230	6,200	60,000	60,000	0	2,500	62	1,250	620	2,500
Anaqua Springs	0150549	65	(b)(1)(B)(i),(ii),(iii),(iv)	39	725	13,000	330,000	330,000	0	2,500	130	940	1,300	2,500
West View	1630039	198	(b)(1)(C)(i),(ii),(iii)a, (iv)b	119	1,025	39,600	167,000	167,000	0	5,000	396	1,900	3,960	5,000

[1] "Total Storage" includes "Ground Storage" and "Elevated Storage."
[2] "Pressure Storage Required" indicates either the elevated storage requirement related to high service pump capacity or pressure storage capacity, whichever is greater.
[3] Approved alternate production capacity requirement of 0.31 gpm per connection based on daily records of water use, according to correspondence from TCEQ date July 28, 2005.
[4] "Pump Capacity" appears to be deficient for Country Oaks. However, further analysis considering the system configuration is necessary to verify this deficiency.

GROUNDWATER

(1) 30 TAC 290.45(b)(1)(B) fewer than 50 connections with ground storage.
Must meet all of the following:
(v) Well capacity — 0.6 gpm per connection
(vi) Total storage (ground and elevated only) — 200 gal per connection
(vii) High service pumps — 2 gpm per connection total
(viii) Pressure tank — 20 gal per connection

(2) 30 TAC 290.45(b)(1)(C) 50 to 250 connections.
Must meet all of the following:
(v) Well capacity — 0.6 gpm per connection
(vi) Total storage (ground and elevated only) — 200 gal per connection
(vii) High service pumps (HSP) – **one of the following**:
- a. 2 or more pumps — 2 gpm per connection total
- b. Elevated storage — 200 gal per connection **and**
  2 or more pumps — 0.6 gpm per connection total
- c. Elevated storage and wells — No pumps required

(viii) Pressure storage – **one of the following**
- a. Elevated storage — 100 gal per connection
- b. Pressure tanks — 20 gal per connection

(3) 30 TAC 290.45(b)(1)(D) more than 250 connections.
Must meet all of the following:
(v) Well capacity – 2 or more wells — 0.6 gpm per connection total Or interconnect
(vi) Total storage (ground and elevated only) — 200 gal per connection
(vii) High service pumps (HSP) – **one of the following**:
- d. 2 or more pumps — 2 gpm per connection total
- e. 2 or more pumps at each pump station or pressure plane — Minimum 1,000 gpm, and ability to meet peak hourly demands with largest pump out of service.

(3) 30 TAC 290.45(b)(1)(D)
(iii) High service pumps (HSP) continued
- f. Elevated storage — 200 gal per connection **and**
  2 or more pumps at each pump station or pressure plane — 0.6 gpm per connection total
- d. Elevated storage and wells — No pumps required

(viii) Pressure storage – **one of the following**
- c. Elevated storage — 100 gal per connection
- d. Pressure tanks — 20 gal per connection

(4) 30 TAC 290.45(b)(1)(F) Mobile home park with more than 100 connections.
Must meet all of the following:
(i) Well capacity — 0.6 gpm per connection total
(ii) Total storage (ground and elevated only) — 200 gal per connection
(iii) High service pumps (HSP) 2 or more pumps — 2 gpm per connection total
(iv) Pressure storage – Pressure tanks — 20 gal per connection

SURFACE WATER

(5) 30 TAC 290.45(b)(2)
Must meet all of the following:
(H) Total storage (ground and elevated only) — 200 gal per connection
(I) High service pumps (HSP) – **one of the following**:
- (i) 2 or more pumps at each pump station or pressure plane — 2 gpm per connection total
- (ii) 2 or more pumps at each pump station or pressure plane — Minimum 1,000 gpm, and ability to meet peak hourly demands with largest pump out of service.
- (iii) Elevated storage — 200 gal per connection **and**
  2 or more pumps at each pump station or pressure plane — 0.6 gpm per connection total

(J) Pressure storage – **one of the following**
- (i) Elevated storage — 100 gal per connection
- (ii) Pressure tanks — 20 gal per connection
  (only for systems with <2500 connection)

4.1.4 Southeast and Southside Service Areas

The Southeast and Southside Service Areas are served by one PWS, Southside (PWS No. 150249). Appendix E, Exhibit E-1 shows the location of this PWS in relation to the subdivisions in the area. The Southside Service Area supplies treated water through one major pipeline from the Medina Water Treatment Plant (WTP) to the Southeast Service Area; this pipeline provides approximately 95% of the water needed for that area. Although Southeast contains a few groundwater wells, they contribute minimally to the water needs of that area.

Information for this PWS regarding production capacity, total storage, pressure storage, and pump capacity is summarized in Table 4-4. The number of connections served by this PWS is 34,926, which is almost half of the total number served by the District (13). The capacity requirements for the Southeast-Southside Service Area are satisfied by this PWS; however, a redundant pipeline or emergency interconnect between the two service areas is not available. If a break occurred in this main pipeline, it would be difficult for the District to provide temporary water supply to a large number of customers.

Table 4-4. Southeast-Southside Capacity Summary

Southeast and Southside PWS No. 0150249 Calculation Basis 30 TAC 290.45 (b)(2)(F)(ii), (G)(i) Number of Connections: 34,926	Production Capacity (gpm)	Total Storage [1] (gallons)	Ground Storage (gallons)	Elevated Storage (gallons)	Pressure Tanks (gallons)	Pump Capacity (gpm)	Pressure Storage (gallons)
Required	21,456 [2]	6,985,200	-	-	-	22,564 [4]	3,532,600 [5]
Provided	42,909 [3]	27,643,000	22,793,000	4,850,000	7,500	47,198	4,850,000

The following assumptions are based on a TCEQ CCI dated July 28, 2005:

[1] "Total Storage" includes "Ground Storage" and "Elevated Storage."

[2] Includes 500 gpm provided as wholesale (400 connections).

[3] Includes wells (32,145 gpm) and purchased surface water (10,764 gpm).

[4] Service pump peaking factor based on maximum daily demand of (25,994,000 mgd / 1440) * 1.25
Maximum Daily Usage date is June 27, 2006 from TCEQ CCI dated May 22, 2007.

[5] Includes pressure storage required for the 400 wholesale connections.

Table 4-4. Southeast-Southside Capacity Summary (Continued)

SURFACE WATER	
30 TAC 290.45(b)(2)	
Must meet all of the following:	
(E) Total storage (ground and elevated only)	200 gal per connection
(F) High service pumps (HSP) – **one of the following**:	
(i) 2 or more pumps at each pump station or pressure plane	2 gpm per connection total
(ii) 2 or more pumps at each pump station or pressure plane	Minimum 1000 gpm, and ability to meet peak hourly demands with largest pump out of service.
(iii) Elevated storage	200 gal per connection **and**
2 or more pumps at each pump station or pressure plane	0.6 gpm per connection total
(G) Pressure storage – **one of the following**	
(i) Elevated storage	100 gal per connection
(ii) Pressure tanks (only for systems with <2500 connection)	20 gal per connection

4.2 Evaluation of Budget in Comparison to Other Water Purveyors

As part of the budgetary evaluation, URS created a list of 14 major water purveyors to compare with the District. A preliminary screening matrix was developed to identify those entities that best fit the District's organizational model. URS then conducted qualitative and quantitative analyses on the final list of three water purveyors (Lower Colorado River Authority – Hill Country Region, Aqua Water Supply Corporation, and North Alamo Water Supply Corporation) as well as the District. Comparisons and recommendations were developed on the basis of this evaluation process.

4.2.1 Water Purveyor List

URS conducted a review and analysis on a number of water purveyors located in the Texas Water Development Board (TWDB) Region L Water Planning Area. The list also included entities located in growing areas near the District's service area: Bexar, Comal, Medina, Atascosa, Wilson and Guadalupe Counties. The following entities were evaluated and compared to the District:

- San Antonio Water System (Bexar County);
- Atascosa Rural WSC (Bexar County);
- McCoy WSC (Atascosa County);
- Benton City WSC (Atascosa/Medina Counties);
- Canyon Lake WSC (Comal County);
- Canyon Regional Water Authority (Guadalupe County);
- Springs Hill WSC (Guadalupe County);
- Schertz-Seguin Local Government Corporation (Guadalupe County);
- Yancey WSC (Medina County);

- SS WSC (Wilson County); and
- Three Oaks WSC (Wilson County).

In addition to the above list of water purveyors, the following entities outside of the District's area were included in the analysis due to similar water utility characteristics. Refer to Appendix F, Exhibit F1 and F2 for maps depicting their locations relative to the District's service area.

- Lower Colorado River Authority – Hill Country Region (Burnet/Llano Counties);
- Aqua Water Supply Corporation (Bastrop County); and
- North Alamo Water Supply Corporation (Willacy County).

4.2.2 Overview of Types of Water Entities

Water purveyors can operate under numerous organizational structures, depending on whether they are a water district, water supply corporation, water authority, river authority, water system, or local government corporation.

An example of a water district is Bexar Metropolitan Water District. It was established in 1945 by the Texas Legislature as a governmental agency with the power to "control, conserve, protect, preserve, distribute and utilize" water within its service area. The District is an agency governed by a board of seven directors, elected by the citizens in each of their respective districts. The District functions as a self-governed agency independent of municipal and county governments. The agency has a diverse service area encompassing growing regions in the Greater San Antonio area. The District provides wholesale and retail service to over 260,000 people in Bexar, Medina, and Comal Counties.

Water supply corporations (WSCs) are legally chartered corporations operating under the laws of the State of Texas for the purpose of furnishing potable water and wastewater utility service for rural residents. They are also non-profit, member-owned and member-controlled corporations. Operating policies, rates, tariffs and regulations are formulated and implemented by a Board of Directors. The Directors represent district areas within the WSC and are elected by the WSC members. A WSC can issue debt through commercial paper and loans. Rate increases are also used to fund capital projects and daily operations of the system.

Water authorities, such as Canyon Regional Water Authority (CRWA), are subdivisions of the State of Texas created by the Texas Legislature. They represent a partnership of water supply corporations, cities and districts responsible for acquiring, treating, and transporting potable water. For example, CRWA is governed by a Board of Trustees, with two individuals representing each member entity on the Board.

River authorities are conservation and reclamation districts created by the Texas Legislature. As an example, the Lower Colorado River Authority (LCRA) has no taxing authority and operates solely on utility revenues and fees generated from supplying water, electricity and community services. River authorities can also finance debt through issuing bonds and commercial paper. The LCRA Board of Directors is composed of 15 members based on their statutory district, and appointed to 6-year terms by the governor and confirmed by the Texas Senate. Their board meets regularly to set strategic corporate direction for the general manager and staff, to approve projects and large expenditures, and to review progress on major activities and issues.

San Antonio Water System (SAWS) is an example of a water system classified as a city-owned government corporation, which differs greatly from a water district or river authority. SAWS is governed by the San Antonio Water System Board of Trustees. The board consists of the Mayor and six members appointed by the City Council. Trustees must reside either within the area served by SAWS or within the corporate limits of the city. Each member is appointed for a 4-year term, and no member may serve more than two terms.

A local government corporation is an independent corporation that can acquire, construct, finance, and operate a water utility system. As an example, the Schertz-Seguin Local Government Corporation (SSLGC) was formed as a result of a mutual need by the cities of Schertz and Seguin for a new source of water. The SSLGC also has the authority to sell wholesale water to other communities.

4.2.3 Preliminary Screening of Water Purveyors

To narrow the initial list of 14 water purveyors, a matrix was developed (refer to Table 4-5) based on the following overall utility criteria:

- Wholesale and/or retail service;
- Number of groundwater wells;
- Number of surface water systems and/or interconnects to other water utilities;

Table 4-5. Preliminary Screening Matrix

Name of Entity	Primary Service Area of Entity (County)	Wholesale Service Provider	Retail Service Provider	No. of Groundwater Wells	No. of Surface WTPs/ Interconnects to Other WTPs	Capacity of Groundwater System (gpm)	Capacity of Surface WTP/ Interconnect to WTPs (mgd)	Total No. Wholesale Delivery Points	Total No. of Retail Connections	Population Served	Service Area (mi^2)	Density (population per mi^2)	Average per Capita Income in 2000 for County
BexarMet	Bexar	Yes	Yes	90	7	76,773	16	4	86,856	250,000	288	868.1	$18,363
SAWS	Bexar	Yes	Yes	126	1	119,444	0	7	349,000	1,280,684	1040	1231.4	$18,363
Atascosa Rural WSC	Bexar	No	Yes	2	1	2,600	0	0	3,200	11,000	67	164.2	$18,363
McCoy WSC	Atascosa	No	Yes	6	0	2,315	0	0	2,533	7,550	498	15.2	$14,276
Canyon Lake WSC	Comal	Yes	Yes	27	2	1,111	8.5	2	9,000	25,000	78	320.5	$21,914
Canyon Regional Water Authority	Guadalupe	Yes	No	0	2	0	20.5	11	0	N/A	1127	N/A	$18,430
Springs Hill WSC	Guadalupe	Yes	Yes	3	3	868	4.0	3	7,000	24,000	300	80.0	$18,430
Schertz-Seguin Local Govt. Corp.	Guadalupe	Yes	No	8	0	9,722	0	5	0	56,878	276	206.1	$18,430
Yancey WSC	Medina	No	Yes	6	0	4,130	0	0	1,800	5,088	30	169.6	$15,210
Benton City WSC	Medina	Yes	Yes	8	0	4,600	0	2	4,315	11,997	450	26.7	$15,210
SS WSC	Wilson	No	Yes	9	0	6,600	0	0	4,380	12,900	156	82.7	$17,253
Three Oaks WSC	Wilson	No	Yes	3	0	1,200	0	0	500	1,440	143	10.1	$17,253
LCRA - Hill Country Region	Burnet/Llano	Yes	Yes	17	8	1,012	2.0	0	4,099	10,247	411	24.9	$21,199
Aqua WSC	Bastrop	Yes	Yes	25	0	16,927	0	175	16,958	60,000	1,000	60.0	$18,146
North Alamo WSC	Willacy	Yes	Yes	3	6	5,556	22	8	34,500	140,000	973	143.9	$9,421

- Capacity of groundwater facilities;
- Capacity of surface water facilities;
- Number of wholesale delivery points;
- Number of retail connections for each system;
- Population served;
- Size of service area (mi^2);
- Density (population per square mile); and
- Average per capita income.

Although no other water purveyor is identical to the District, the criteria listed above helped characterize the scale and operational characteristics of the purveyors. The focus was primarily on entities that had comparable service operations, source water, number of retail connections, and density of service area.

Numerous entities did not possess similar service operations (both wholesale and retail), which initially eliminated them from the list. The list was further narrowed by selecting entities serving retail connections of 15,000 or greater.

As a result of the preliminary screening process, the following entities were considered for further analysis:

- Lower Colorado River Authority – Hill Country Region;
- Aqua Water Supply Corporation; and
- North Alamo Water Supply Corporation.

Reference Appendix F, Exhibits F-1 and F-2 for individual maps of service areas for the entities listed above. Although LCRA-Hill Country Region serves fewer than 5,000 retail connections, it was retained on the evaluation list to provide a diverse mix of purveyor organizational structures. A river authority is structured differently than a WSC.

SAWS met the preliminary screening criteria, but was not viewed as providing an appropriate comparison for the District due to the following:

- SAWS serves a population that is five times larger than that of the District;
- The governing structure of SAWS differs greatly from that of the District; the Board is an extension of the City of San Antonio and consists of the Mayor and six members appointed by the City Council;
- SAWS does not have as diverse a water supply as the District; SAWS consists of groundwater systems;
- The District's service area is approximately one-third the size of SAWS service area; and
- SAWS service area is becoming built-out and enclosed by the District. The District's customer base will continue to expand and will be faced with providing service to high-growth areas.

It is interesting to note that Aqua WSC and North Alamo WSC have a closer match of utility characteristics to the District. They both serve growing rural areas and have a number of groundwater wells scattered throughout their large service territory. Although North Alamo WSC has groundwater and surface water supplies (unlike Aqua WSC), the number of groundwater wells owned by Aqua WSC is significantly more than those owned by North Alamo WSC.

Another interesting data point noted in the matrix is the average per capita income of the customer base for the primary county of the water purveyor. The customers in Canyon Lake WSC have the highest level of average income; however, North Alamo WSC has the lowest average income per customer. Since its income level is almost half of the levels of other service areas, North Alamo WSC has better opportunities to qualify for grants and low-interest loans. When it comes to financing mechanisms, the District and LCRA can fund infrastructure projects by issuing bonds and commercial paper, whereas WSCs must rely on grants and loans as funding alternatives.

The District has been considered a rural water supplier for a number of years. Based on the density criteria for an entity's service area, the District shows a greater number of people per square mile than the other two rural WSCs. An explanation for this trend is most likely attributed to the District's proximity to a large metropolitan area with a high growth rate.

4.2.4 Evaluation of Water Purveyors

URS used qualitative and quantitative measures to effectively compare the District's budget with the capital improvement budgets of the final list of water purveyors. These measures provided an assessment of the core business processes and outlined the framework of recommended improvements.

4.2.4.1 Quantitative Budget Analysis

To conduct a quantitative analysis of budget expenditures by the District, URS collected additional financial data from the final list of water purveyors to calculate the operating ratio, debt ratio, debt service coverage, expense ratio and revenue per capita. This information for each of the water purveyors is listed below in Table 4-6.

Table 4-6. Summary of Budget Characteristics

Name of Entity	Operating Ratio	Debt Ratio	Debt Service Coverage	Expense Ratio	Revenue per Capita	Expense per Capita
District	1.3	0.72	1.28	0.81	$228	$212
LCRA-Hill Country	1.2	N/A	1.25	0.78	$260	$84
Aqua WSC	1.0	0.36	1.04	0.86	$170	$202
North Alamo WSC	1.8	0.04	6.12	0.90	$138	$82

Operating Ratio

The operating ratio demonstrates the relationship between operating revenues and operating expenses. A ratio of less than 1 indicates there is insufficient revenue to meet current expenses. All of the entities listed in the table above have operating ratios of 1 or greater; these organizations operate efficiently by keeping expenses low relative to revenue.

Debt Ratio

The debt ratio (total liabilities divided by total assets) measures the amount of debt being used by the organization. The District has the highest amount of debt financed by the organization. Their ratio of 0.72 represents 72% of operations have been financed with debt and the remaining 28% has been financed by equity. Based on *Moody's Water and Sewer Outlook* (February 2000), the median debt ratio for the water utility industry is 0.43. This median is based on data collected on Moody's rated water systems. The District's debt ratio of 0.72 is considered "moderately high" and should be reduced over time (23). This ratio represents the challenges that the District faces by serving a number of small water systems scattered around the outskirts of a large metropolitan city. However, North Alamo WSC has an extremely low debt ratio due to the grant funds they receive through Farmer's Home Association (FmHA), Texas Water Development Board (TWDB) and United States Department of Agriculture (USDA) to finance water infrastructure projects.

Debt Service Coverage

Debt service coverage refers to the ratio of net operating income to total debt service. Many successful water utilities have debt service coverage ratios greater than 1.0. It is recommended to have an amount of money budgeted in excess of operating expenses for cash management purposes. LCRA, Aqua WSC and North Alamo WSC demonstrate the importance of having additional funds for management purposes; they each have debt service coverage of greater than 1.0. North Alamo WSC has greater debt service coverage due to funding projects internally and minimizing the amount borrowed.

Expense Ratio

The expense ratio measures the amount of operating expenses compared to total expenses. A ratio greater than 0.5 indicates that most expenditures are for operations, which leaves the remaining balance for non-operating costs (e.g., debt service, capital improvements, etc.).

Revenue per Capita

The amount of revenue the entity receives per person should be tracked over time. If this ratio is steadily increasing, the entity's customer base will have to spend an increasingly higher percentage of their income for water service. The ratio also reflects the need for operating and capital revenue. If the ratio increases over time, the utility might need to reduce revenue requirements, by operating more efficiently, outsourcing and contracting and receiving contributed capital. LCRA shows the highest amount of revenue per capita, most likely due to the sprawl of the small customer base around the Highland Lakes in the Hill Country Region. North Alamo WSC has the lowest amount of revenue per capita; this is probably a result of the WSC taking advantage of grant funding through FmHA, TWDB and USDA for water infrastructure projects.

Expense per Capita

The amount of expense the entity incurs per person should be tracked over time. If this ratio is steadily increasing, then the entity may be required to increase rates to its customer base. The utility might need to reduce expenses by operating more efficiently or limiting expansions into low density areas. The District shows the highest amount of expense per capita, most likely due to the relatively low population density and discontinuous arrangement of its service area. North Alamo WSC has the lowest expense per capita; this is probably a result of the WSC taking advantage of grant funding through FmHA, TWDB and USDA for water infrastructure projects.

4.2.4.2 Qualitative Budget Analysis

The District is currently going through a rigorous process of adopting a more extensive CIP for both the current fiscal year and 5 years on the planning horizon. Prior to FY08, the District did not have a formal CIP in place. The District has established a project list for FY08 that is prioritized based on reason for improvement (i.e. regulation, upgrade, growth, relocation, and rehabilitation). Approximately $42 million dollars of improvements have been identified for this fiscal year. By further refining its CIP, the District can identify ways to balance the necessary capital improvements with appropriate debt levels.

Copies of CIP budgets from LCRA and Aqua WSC are provided in Appendix F, Attachments F1 and F2, respectively, as examples for the District to reference. Aqua WSC color-code its CIP items on the list to track when a project is deferred, under construction, or complete. Aqua WSC and North Alamo WSC actively seek out opportunities to receive grant funds and low-interest loans for infrastructure improvements. Aqua WSC also introduces small rate increases (approximately 5%) every other year or as needed to maintain the budget.

North Alamo WSC developed a 5-year CIP, but it continually revises its list of priorities based on the amount of grant funds and low-interest loans received through FmHA, TWDB, and USDA. It is a balancing act to complete projects while minimizing the amount of loans and system debt. Aqua WSC has a rule of thumb for capital projects: one-third of project costs are covered through capitalized depreciation, one-third are covered through the collection of impact fees, and the remaining amount is financed.

LCRA currently has a CIP budget for FY2009 of approximately $1,310,000 in capital expenditures for the Hill Country Region. All future capital for this regional system is revenue funded. LCRA made a business decision a few years ago to buy down the debt on the region. As a result, the Hill Country Region does not have any outstanding debt on its 17 water systems.

4.2.5 Recommendations

In summary, the following improvements to the District's long-range budget are recommended based on comparisons to other water purveyors:

1. Create a separate banking account for capitalizing the depreciation of assets; use this revenue to generate additional funds for infrastructure projects. Also, take advantage of collecting higher impact fees from developers.

2. Reduce debt ratio by decreasing total liabilities and increasing total assets. This can be accomplished by selling certain assets with limited growth potential or areas difficult to provide with water service to SAWS or other regional providers. The revenue collected from these assets can be used to finance the necessary improvements in the remaining service areas.

3. Increase debt service coverage by identifying additional revenue sources (grants, low-interest loans, small rate increases, etc.) and decreasing the amount of system debt.

4. Continue to prioritize CIP items on a quarterly and annual basis.

5. Refer to Aqua WSC and North Alamo WSC as good models. The District can take advantage of their knowledge of serving rural customers with groundwater systems scattered throughout their service areas (Appendix F).