

City of Houston

Summer 2008

Utility Maintenance Branch - Maintenance and Repair of  
The Water Distribution System

Research Paper

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## The Water Distribution System

### Introduction

From the time we awake in the morning until we lay down to rest at night, every Houstonian benefits from services provided by the City of Houston's Public Utilities Division, Utilities Maintenance Branch (UMB) of the Public Works and Engineering Department. The 2.14 million citizens of Houston, Texas take this water service for granted, not taking into consideration the complexity of the process that is in place to maintain this vast system. There are approximately 6,037 miles of water distribution lines, with over 407,226 residential connections and 444,530 commercial water connections. This system requires surveillance, technical investigations, extensive emergency repair, system rehabilitation and preventive maintenance. Along with Drinking Water Operations, UMB works extensively to ensure proper operation of the distribution system. The mission statement of the Public Utilities Division is "To be the nation's leading Public Utility, champion for the environment, providing reliable service of exceptional quality to the most satisfied customers in the nation."

The Utilities Maintenance Branch is comprised of three sections: Systems Maintenance, Engineering Services, Technical Services-Wastewater. We will expound upon its responsibility for the maintenance, repair and preventative maintenance of the water distribution system.

### **Components of the Distribution System**

The City of Houston's Public Works and Engineering Department's Utilities Maintenance Branch is responsible for the maintenance and repair of approximately 6,037 miles of distribution lines and its components of the distribution system. It consists of a combination of mains, service lines, meters, hydrants, and valves.

#### **Main Lines**

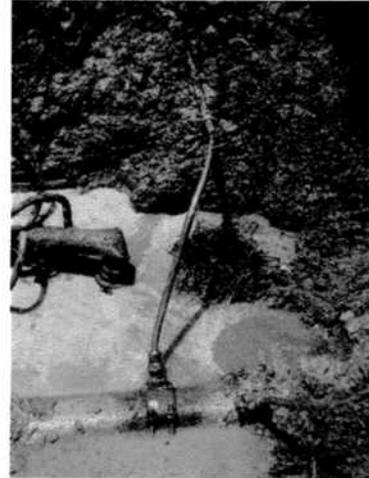
Main lines are smaller versions of transmission lines ranging from two to sixteen inches in diameter. "Adequate main sizing provides the necessary carrying capacity and



pressure required to meet fire protection, commercial, industrial, and residential needs for safety and health requirements." Within residential communities, main lines vary in size from two inches to sixteen inches in diameter.

### Service Lines

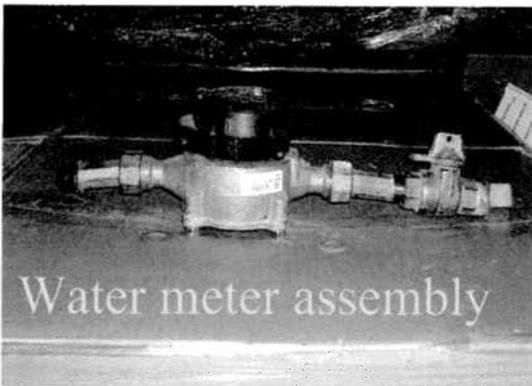
Water is supplied to customers by tapping into the main line and connecting copper service lines. Residential service lines typically range from three-quarters (3/4) inch to two (2) inches in diameter. Lines of two to four inches in diameter are



mainly used for commercial areas and residential areas with larger homes and high rises.

### Meters

Water Customer Service monitors a customer's personal water usage through the use of water meters. These meters are maintained by the UMB-System Maintenance Section. Systems Maintenance maintains the functional parts of meters from 5/8<sup>ths</sup> to two inches.



### Fire Hydrants/Valves

The Main purpose of fire hydrants is for fire fighting. Other important uses for hydrants include flushing to eliminate color, odor, and taste. Most fire hydrants in the city's water distribution system have a hydrant valve. In the state of Texas they must be connected



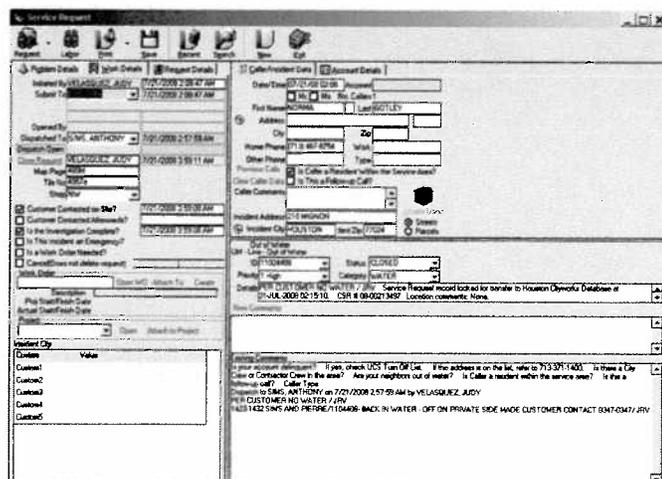
to a main line of six inches in size. Valve bonnets are color coded as to indicate the size of main that it is connected to: YELLOW = 6

inches; WHITE = 8 inches; GREEN = 10 - 16 inches; ORANGE 20 - 24 inches; ORANGE/ORANGE = greater than 24 inches and high pressure. Valves are used to control and isolate the flow of water. In the Systems Maintenance Section valves are used for isolation in the course of various types of repairs.

**Maintenance and Repair**

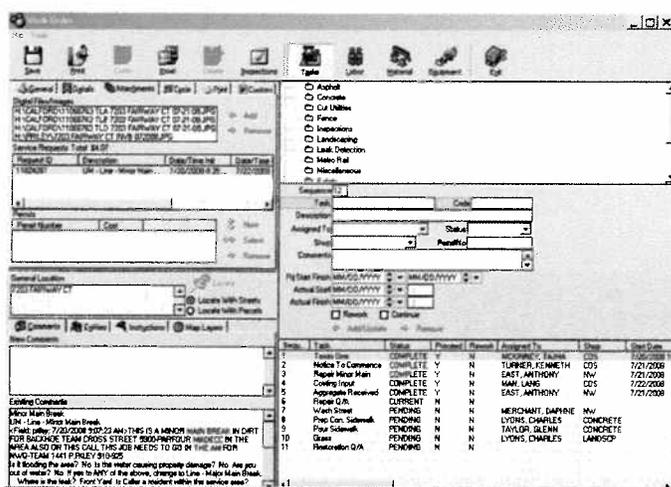
3-1-1 is a system initially used to create a customers request for service. It is interfaced with the Infrastructure Management System (IMS) thus allowing UMB to immediately respond to the customers concerns.

To address the customers' issue, a service request is generated through IMS. This generated service



request is electronically dispatched to an investigator

allowing him/her to address the customer's concerns in a timely manner. It is the duty of the investigator to go out and address the customer's concerns or issues and determine the severity of the problems and whether it is a public or private matter. Private problems are the responsibility of the customer, while public problems require maintenance by UMB. After the complaint has been investigated and a work order is created the Utilities Maintenance Branch's Supervisors/Planners respond to the complaint. It is



his/her responsibility to plan the repair operation keeping in mind the severity, urgency, the personnel and equipment needed to complete the repair. In

doing so, the Supervisor/Planner assures that all permits such as Texas One calls, street cut and sidewalk permits, and all necessary extensions are obtained and attached to the work order.

The members of a repair team consist of a team leader and two utility workers (sometimes more workers are needed depending on the scope and severity of the job). Members of a repair team are trained and have at least three years of

experience in construction and/or plumbing. Before leading a team, a team leader is trained for two to five year within the System Maintenance Section of the Utilities Maintenance Branch on various aspects of safety, excavation and scope of work. In addition, each member of the repair team is issued Personal Protective Equipment that is required when working in a construction area or during an excavation.

Prior to starting a repair, teams must isolate a line in order to work safely and efficiently. Line isolation requires the turning off of water supply between a minimum



of two points in the distribution line. In some cases repair teams may have difficulty locating a valve. In the event valves cannot be located, valve personnel are called to assist with process of isolation. Also, there are instances in which the valve is buried. A special unit is required to complete the task of uncovering the valve. The Vactor Truck is a specially designed vehicle which has a high pressure hose and vacuum. By utilizing this equipment, this allows an obstructed valve to become exposed.

### Point Repair

There are two ways to address a water line issue; point repair or line replacement. After a leak is identified for a point repair and the appropriate permits are acquired, the team excavated the area to make the repair. Often, an open cut trench is dug in an effort to expose the pipe. According to the Occupational and Safety Health Act (OSHA), trenches greater than five feet deep must be protected from cave-ins by shoring, sloping, or using a trench-box.

Materials such as repair clamps or sleeves are used to make a point repair. Repair clamps and saddles are used to repair round breaks on water lines. The clamp sizes range



from two inches to twelve inches in diameter and from six to fifteen inches in length. Most line replacements take place when a leak is detected beneath a driveway or if there is a parallel break in a main line. Sleeves and Couplings are used to join segments of existing pipe to new pipe. PVC is used beneath driveways because it is very durable.

There are various types of materials used to join existing water to new water lines. In the distribution

system the existing section of asbestos-concrete pipe is removed and replaced with PVC and connected together using transition couplings. Flushing of the hydrant connected to the repaired or replaced line is required so that debris and air is removed from the line. Air inside a water line causes cracks in the distribution system leading to more repairs.

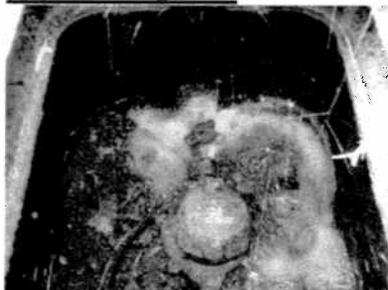
### Service Line Repair



A service line is a small diameter pipe (3/4" to 2") connecting the distribution system's main line to the customers plumbing. The combination of service lines and meters allow individual water usage to be monitored. Service lines are replaced with copper lines if repairs are necessary. Repairs to service lines occur when gaskets along tapping saddles become worn. Similar to the process of repairing a main line, a service line repair begins with excavation. Worn taps are replaced with new tapping saddles that are aligned with the tap on the main line. The copper service line is then attached to the saddle and connected to the water meter and personal plumbing of the customer.

Improper bedding and backfilling techniques after a repair may cause the repair to leak again. All excavations require backfilling and restoration upon completion of the project. Mainlines are bedded with limestone to a maximum of one-half the thickness of the diameter of the pipe. Compaction of the backfill provides better support to the underside of the pipe. Another twelve inches of backfill is then added to the top side of the pipe and the remainder of the trench is filled with white rock. According to the "Water and Wastewater Training Program" an "estimated 90% of underground pipe failures can be traced back to lack of proper bedding and initial backfill." If the customer's landscape is damaged in the process of the repair the City of Houston is responsible for the restoration of the property.

#### **Meter Repair**



The Utilities Maintenance Branch is responsible for the maintenance of the gaskets, spuds, and cut-off valves connected to meters of sizes from five-eighths inches to two inches.

#### **Preventative Maintenance**

In an effort to address safety, financial, and future concerns, the Utilities Maintenance Branch has setup an

aggressive preventative maintenance program. In order to address the safety concerns of the citizens of the city of Houston, all valves are on a cycle to ensure that they are operating for fire protection and other safety issues. In



order to offset unaccounted for water loss there is a program set forth to locate these non-visible leaks that can affect the city's revenue dramatically. The aspiration of this program is to move towards a global positioning valve system.

**Quality Assurance**

Systems Maintenance has set up a quality assurance measures that ensure customer satisfaction at all levels. Senior Inspectors, Inspectors, and Section Chiefs, along with Senior Management Staff ensure that all work meets specifications and guidelines in the Utilities Maintenance Branch's Field Policy Manual Requirements. Furthermore, the records manage section performs customer call-backs (approximately 100 per week) to determine customer satisfaction with the service that was provided.

**Conclusion**

The highest water quality rating is an achievement that can be attributed partly to the ongoing maintenance and repair of the knowledgeable employees of the Utilities Maintenance Branch. From the time 3-1-1 gets the information and relays it to the investigator and he/she responds, a work order is created, thus allowing the Supervisor/Planner to dispatch the correct equipment and teams to the job site. All these facets of the system must work succinctly in order to help maintain The City of Houston's high customer satisfaction and "Superior" rating, as given by the Texas Commission on Environmental Quality (see Texas Commission on Environmental Quality's Title 30, Texas Administrative Code, Subsection 290.47(a), Appendix A).

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