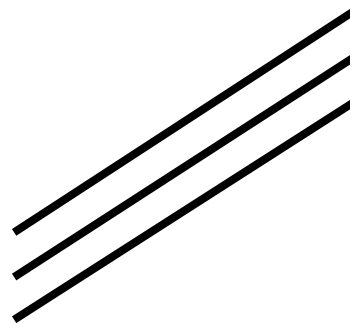
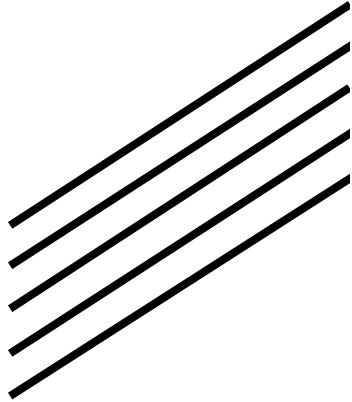


1997 Pipeline Operations and Maintenance Cost Study

September 1997

AMERICAN
CONCRETE
PRESSURE PIPE
ASSOCIATION



Introduction and Methodology

The American Concrete Pressure Pipe Association (ACPPA) retained AWP Research, Herndon, Virginia to collect information on the relative historical performance of various pipe materials. After evaluating several potential research methodologies, ACPPA and AWP selected a survey-based approach to maximize the amount of data collected at minimal impact to the participating water utilities.

AWP designed a one-page survey instrument which was distributed in early-May 1997, to a sample of about 110 utilities located throughout the U.S. and Canada. Each utility was contacted by an ACPPA member prior to survey distribution to confirm their interest and willingness to participate. A second mailing was sent in early-June to all non-respondents as a reminder for their participation. A total of 47 responses were received and tabulated.

This report presents detailed statistical analysis resulting from that study.



Utility Operations Information

Using the current installed number of miles of 16-inch or greater pipeline, average O&M costs per mile were computed for each pipe product.

Taking an average cost per mile across the five years examined, shows Prestressed Concrete Cylinder Pipe, AWWA C301 to have the lowest average O&M cost per mile (\$117.80), followed closely by concrete pressure pipe overall (\$158.60), C303 (\$162.60) and C300 (\$167.00). Ductile iron is the next-closest, with an average cost of \$326. Cast iron and steel post the highest average costs, each above \$602 per mile. Responses are illustrated in Exhibit 1.

Though the majority of respondents (85.1%) are U.S.-based, Ontario, Canada ties with Florida as the most common respondent location, each indicated by five responses. As listed in Exhibit 2, the survey sample is comprised of responses from 25 states and provinces.

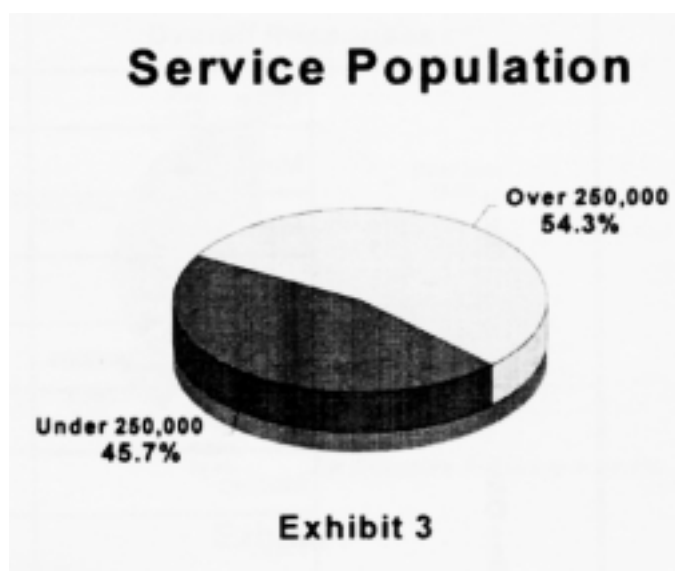


Exhibit 2: Respondent Location	
State/Province	No. Responses
Florida	5
Ontario, Canada	5
Texas	4
Kentucky	3
Missouri	3
Pennsylvania	3
Illinois	2
Michigan	2
New Hampshire	2
New Jersey	2
Ohio	2
Arkansas	1
Connecticut	1
District of Columbia	1
Georgia	1
Iowa	1
Maine	1
Minnesota	1
New York	1
Oklahoma	1
Rhode Island	1
Tennessee	1
Virginia	1
New Brunswick, Canada	1
Alberta, Canada	1

Responses were about equally divided when respondents describe the approximate size of their service population. As illustrated in Exhibit 3, 45.7% serve a population of less than 250,000; 54.3% serve a population of greater than 250,000.

Respondents reported a median total employment (including supervisors) of 191 people, of which a median of 43 are dedicated to pipeline operations and maintenance (O&M). As illustrated in Exhibit 4, responses vary considerably, ranging from a low of seven total staff to a high of 1,525.

Exhibit 4: Staffing				
		Overall	Service Under 250,000	Service Over 250,000
Total	Mean	285.3	126.4	411.9
	Median	191	65.5	276
	High	1525	780	1525
	Low	7	7	14
	Number of responses	45	20	25
Pipeline O&M	Mean	76.7	34.8	112.9
	Median	43	13	116
	High	328	300	328
	Low	0	0	3
	Number of responses	41	19	22

Examining respondents' job titles shows they are commonly in a management role within their utility. As listed in Exhibit 5, Director of

Operations, Chief Engineer, and General Manager are the most common titles, though there is a considerable variety in the responses.

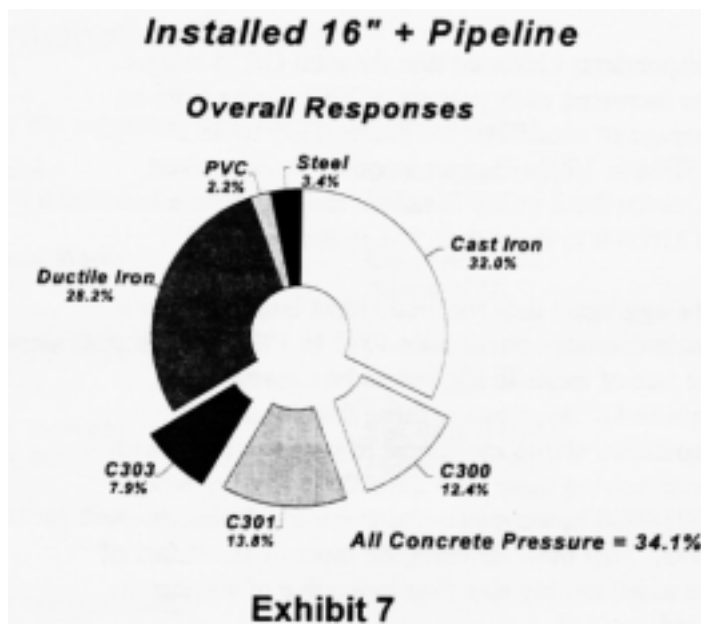
Exhibit 5: Job Titles	
Administrator of Environmental Engineering	General Manager of Waterworks
Assistant Director of Utilities	Manager Distribution Division
Chief Engineer	Manager Engineering Services
Chief Engineer	Manager of Planning Infrastructure
Chief Utility Engineer	Manager of Water Distribution
Civil Engineer III	Manager Water Engineering
Deputy Director Water and Sewer	Manager, Water Operations
Deputy Director, Water Dept.	Manager/District Engineer
Deputy Public Utilities Director	Operations Manager
Director of Engineering Services	Operations Manager
Director of Operations	Project Manager
Director of Operations	Registered Engineer
Director of Operations	Superintendent
Director Public Works and Water Resources	Superintendent of Public Works and Utilities
Director, Systems Operations	Transmission and Distribution Engineer
Engineer-Manager	Unit Supervisor
Engineering Executive	VP Operations and Engineering
Engineering Supervisor - Water	Water Resource Manager
Field Operations Supervisor	Water Resources Technologist
General Manager	Water Utility Director
General Manager and Chief Engineer	Waterworks Engineer

Installed Pipe

Respondents reported an average installed base of 1,141.7 miles of pipeline (all types). There is great variation between utilities, with responses ranging from a low of ten miles to more than 4,500 miles.

The installed base of 16-inch or larger pipeline is considerably smaller, averaging to 185.7 miles for the respondents overall. Responses range from six to nearly 1,500 miles. Responses are illustrated in Exhibit 6.

Cast iron, although no longer installed, is the single-most prevalent pipe material installed in 16-inch or greater diameters, representing (on average) 32% of the total installed base. Ductile iron follows at 28.2% and C301 Concrete Pressure Pipe at 13.8%. Aggregating C300, C301, and C303, however, shows concrete pressure pipe the most prevalent



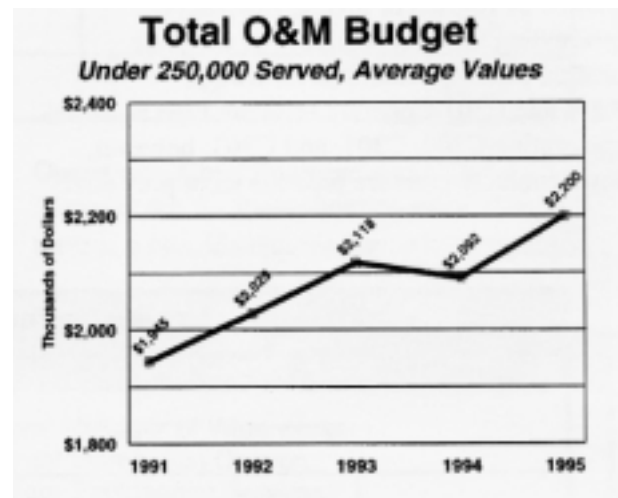
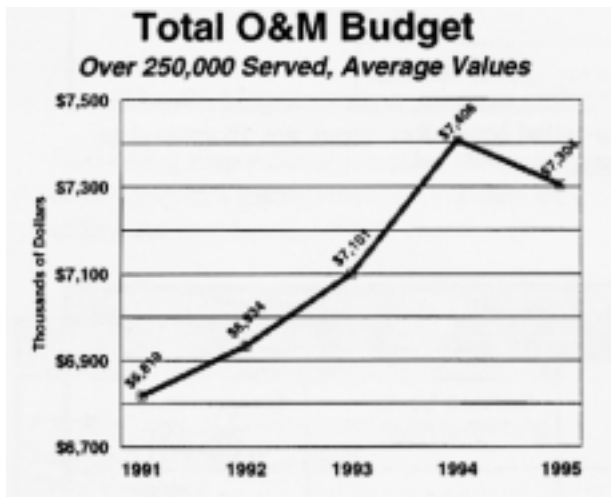
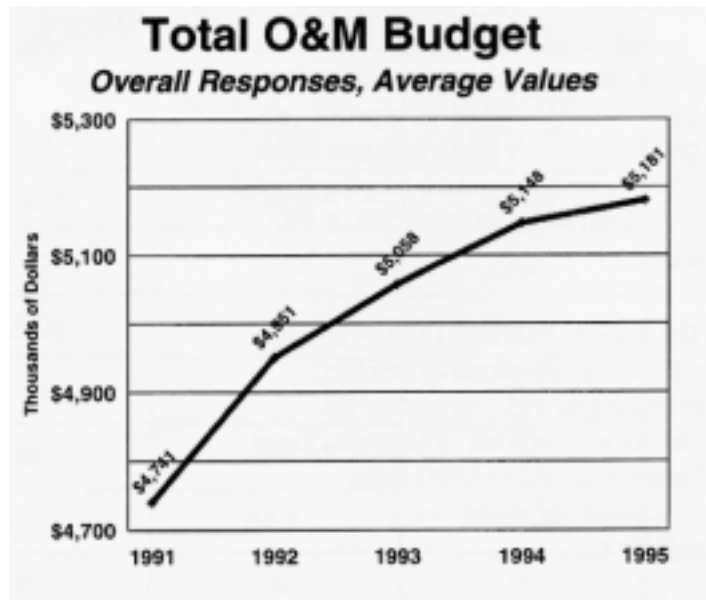
pipeline material, representing 34.1% of the installed base. Responses are illustrated in Exhibit 7.

Exhibit 6: Installed Pipeline (miles)				
		Overall	Service Under 250,000	Service Over 250,000
Total	Mean	1,141.7	414.4	1,708.5
	Median	890	268.5	1375
	High	4533	1220	4,533
	Low	10	10	155.6
	Number of responses	45	20	25
16 inch or larger	Mean	185.7	42.5	303.7
	Median	105	37.5	220.3
	High	1,474	109.7	1,464
	Low	6	6	24
	Number of responses	45	20	25

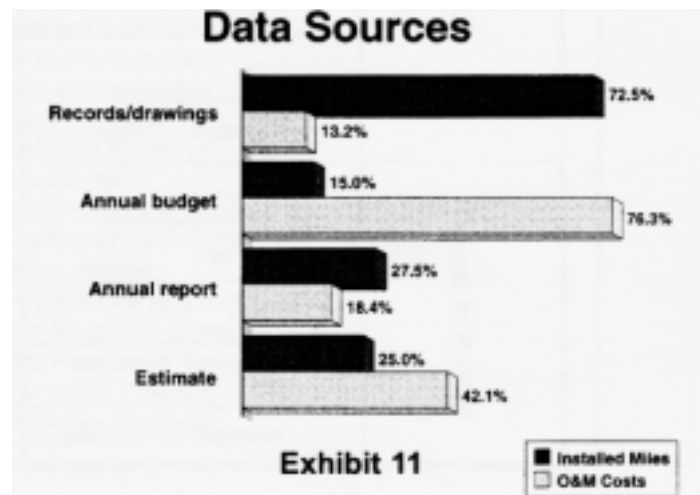
Operation and Maintenance Budget

Respondents indicated that the total O&M budget has increased each year since 1991, rising from an average of about \$4.7 million in 1991 to \$5.2 million in 1995. Budget amounts show marked variation from utility to utility, ranging from a low of \$16,000 to more than \$31 million in 1995.

The aggregate data for total O&M budgets show a marked upward trend from 1991 to 1995, though the rate of increase appears to be slowing (see Exhibit 8). Segmenting these data by service population shows more year to year variation, with those serving more than 250,000 reversing their 1991-1994 upward trend by posting a decline in 1995. That may, however, be more of an artifact of the small sample size than indicative of a systemic trend.



Sources Overall O&M cost data are derived predominantly from annual budgets, though a sizeable number (42.1%) indicated they developed these data through estimates. Installed mile data are mostly from records and drawings. Responses are illustrated in Exhibit 11.



Appendix: Participating Utilities

Note: An additional six utilities participated in the study but requested their names not be published.

City of Calgary Calgary, Alberta	City of Saint-John Saint John, New Brunswick	Dallas Water Utilities Dallas, TX
New Haven Regional Water Authority New Haven, CT	Pennichack Water Works Nashua, NH	City of Arlington Arlington, TX
Office of Engineering Services Washington, DC	Dover Public Works Dept. Dover, NH	Fort Worth Water Department Fort Worth, TX
Palm Beach County Water Utility Dept. West Palm Beach, FL	East Brunswick Township East Brunswick, NJ	San Patricio MWD Ingleside, TX
City of Cocoa Cocoa, FL	Elizabethtown Water Company Plainfield, NJ	City of Virginia Beach DPU Virginia Beach, VA
City of Hollywood Hollywood, FL	Monroe County Water Authority Rochester, NY	
Des Moines Water Works Des Moines, IA	Cincinnati Water Works Cincinnati, OH	
Illinois American Water Company Peoria, IL	City of Youngstown Waste Dept. Youngstown, OH	
Evanston Water Dept. Evanston, IL	City of Tulsa Tulsa, OK	
Paducah Water Works Paducah, KY	City of London London, Ontario	
Louisville Water Company Louisville, KY	Chatham Water Commission Chatham, Ontario	
Portland Water District Portland, ME	Brantford PUC Brantford, Ontario	
Saginaw - Midland Water Sup. Bay City, MI	Brockville PUC Brockville, Ontario	
Board of Water And Light Lansing, MI	Town of Markham Markham, Ontario	
St. Paul Water Authority St. Paul, MN	Lehigh County Authority Allentown, PA	
Water Service Department Kansas City, MO	City of Allentown Engineering Dept Allentown, PA	
St. Louis Water Division St. Louis, MO	Providence Water Supply Providence, RI	
Water and Light Dept. Columbia, MO	Memphis Dept. Public Works Memphis, TN	