



# City of Longview

1525 Broadway  
Longview, WA 98632  
[www.ci.longview.wa.us](http://www.ci.longview.wa.us)

## Agenda

### Public Works SubCommittee

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Monday, May 1, 2023

5:00 PM

Public Works Conference Room  
1<sup>st</sup> Floor, City Hall

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1. **CALL TO ORDER**
2. **ROLL CALL**
3. **APPROVAL OF MEETING NOTES**  
23-001109 Notes from April 3, 2023
4. **OLD BUSINESS**  
23-001113 Water System Continued
5. **NEW BUSINESS**
6. **PUBLIC COMMENT**
7. **ADJOURNMENT - Next meeting June 5th**



# City of Longview

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Longview, WA 98632  
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## Minutes

### Public Works SubCommittee

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Monday, April 3, 2023

5:00 PM

Public Works Conference Room,  
1<sup>st</sup> Floor, City Hall

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1. **CALL TO ORDER**

*The meeting was called to order at 5:08 pm.*

2. **ROLL CALL**

*Present: Councilmember Ruth Kendall; Councilmember Christopher Ortiz; Public Works Director Ken Hash*

*Not in attendance: Councilmember Hillary Strobel*

*Staff: Karl Enyeart, City Engineer; Chris Collins, PW Maintenance Manager; Brian Steveson, Utility Manager; Nancy Vandehey, Admin*

*Guest: Erik Halverson*

3. **MEETING NOTES**

**23-000995 Meeting notes from March 20, 2023**

*There were no changes.*

4. **OLD BUSINESS**

5. **NEW BUSINESS**

**23-000997 Water System**

*Karl Enyeart reviewed WAC 246-290, highlighting some sections of interest. He shared the Department of Health water webpage showing Water System Data for Longview. The group watched a video on the water system failures in Jackson, Mississippi. The inventory of water meters was explained and reviewed. There was a spreadsheet for costs of pipes for 100 year replacement, showing a 2% inflation increase. Assets replacement schedule versus the budget allowances as set today were shared. The preventive maintenance schedule spreadsheet shows the FTE shortfalls. A comparison chart of employees to Portland and Kelso was reviewed. Karl wrapped it up with a summary of where we go from here.*

6. **PUBLIC COMMENT**

*None*

7. **ADJOURNMENT - Next meeting May 1st**

*Meeting was adjourned at 6:35 pm.*

# PW COMMITTEE MEETING 5-1-23

## Agenda Summary:

WAC 246-290

Video:

Water hammer

<https://www.youtube.com/watch?v=xoLmVFAFjn4>

water main breaks

<https://www.youtube.com/watch?v=P9dnaq1Xi3w>

<https://www.youtube.com/watch?v=EgSnCUg-OD0> I like this one more than one above.

EPA Document

Deteriorating Buried Infrastructure Management Challenges and Strategies

**HTML has links - PDF has Authentication****Complete Chapter**[HTML](#)[PDF](#)

Including dispositions

**Chapter 246-290 WAC | [Show Dispositions](#)****Last Update: 3/9/22****GROUP A PUBLIC WATER SUPPLIES****WAC Sections****PART 1.****GENERAL PROVISIONS**

|                      |                     |                    |                                           |
|----------------------|---------------------|--------------------|-------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-001</b> | Purpose and scope.                        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-002</b> | Guidance.                                 |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-010</b> | Definitions, abbreviations, and acronyms. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-020</b> | Applicability.                            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-025</b> | Adoption by reference.                    |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-030</b> | General administration.                   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-035</b> | Water system ownership.                   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-040</b> | Engineering requirements.                 |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-050</b> | Enforcement.                              |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-060</b> | Variances, exemptions, and waivers.       |

**PART 2.****PLANNING AND ENGINEERING DOCUMENTS**

|                      |                     |                    |                                               |
|----------------------|---------------------|--------------------|-----------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-100</b> | Water system plan.                            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-105</b> | Small water system management program.        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-106</b> | Duty to provide service.                      |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-107</b> | Place of use expansion.                       |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-108</b> | Consistency with local plans and regulations. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-110</b> | Project report.                               |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-120</b> | Construction documents.                       |

|                      |                     |                    |                                                                |
|----------------------|---------------------|--------------------|----------------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-125</b> | Project report and construction document submittal exceptions. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-130</b> | Source approval.                                               |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-131</b> | Emergency sources and supplies.                                |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-132</b> | Interties.                                                     |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-135</b> | Source water protection.                                       |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-140</b> | Existing system as-built approval.                             |

## PART 3.

## DESIGN OF PUBLIC WATER SYSTEMS

|                      |                     |                    |                                         |
|----------------------|---------------------|--------------------|-----------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-200</b> | Design standards.                       |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-220</b> | Drinking water materials and additives. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-221</b> | Water demand design criteria.           |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-222</b> | Water system physical capacity.         |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-230</b> | Distribution systems.                   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-235</b> | Finished water storage facilities.      |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-250</b> | Treatment design.                       |

## PART 4.

## WATER QUALITY

|                      |                     |                    |                                                                                     |
|----------------------|---------------------|--------------------|-------------------------------------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-300</b> | Monitoring requirements.                                                            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-310</b> | Maximum contaminant levels (MCLs) and maximum residual disinfectant levels (MRDLs). |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-315</b> | State action levels (SALs) and state maximum contaminant levels (MCLs).             |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-320</b> | Follow-up action.                                                                   |

## PART 5.

## WATER SYSTEM OPERATIONS

|                      |                     |                    |                                     |
|----------------------|---------------------|--------------------|-------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-415</b> | Operations and maintenance.         |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-416</b> | Sanitary surveys.                   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-420</b> | Reliability and emergency response. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-451</b> | Disinfection of drinking water.     |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-453</b> | Corrective action under the GWR.    |

|                      |                     |                    |                                                         |
|----------------------|---------------------|--------------------|---------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-455</b> | Operation of chemical contaminant treatment facilities. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-460</b> | Fluoridation of drinking water.                         |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-470</b> | Uncovered finished water storage facilities.            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-480</b> | Recordkeeping and reporting.                            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-485</b> | Recordkeeping and reporting for groundwater systems.    |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-490</b> | Cross-connection control.                               |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-496</b> | Metering requirements.                                  |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-500</b> | Severability.                                           |

## PART 6.

## SURFACE WATER TREATMENT

## Subpart A - Introduction and General Requirements

|                      |                     |                    |                                                        |
|----------------------|---------------------|--------------------|--------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-601</b> | Purpose of surface water treatment.                    |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-620</b> | Applicability of surface water treatment requirements. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-630</b> | General requirements.                                  |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-632</b> | Treatment technique violations.                        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-634</b> | Follow-up to treatment technique violations.           |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-636</b> | Determination of disinfectant contact time (T).        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-638</b> | Analytical requirements.                               |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-639</b> | SWTR records.                                          |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-640</b> | Determination of GWI sources.                          |

## Subpart B - Requirements for Filtered Systems

|                      |                     |                    |                                                                          |
|----------------------|---------------------|--------------------|--------------------------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-650</b> | Compliance requirements for filtered systems.                            |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-652</b> | Filtration technology and design criteria for existing filtered systems. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-654</b> | Treatment criteria for filtered systems.                                 |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-660</b> | Filtration.                                                              |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-662</b> | Disinfection for filtered systems.                                       |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-664</b> | Monitoring for filtered systems.                                         |

[HTML](#) [PDF](#) **246-290-666** Reporting for filtered systems.

[HTML](#) [PDF](#) **246-290-668** Watershed control.

#### Subpart C - Requirements for Systems Installing Filtration Facilities

[HTML](#) [PDF](#) **246-290-670** Compliance requirements for existing unfiltered systems installing filtration.

[HTML](#) [PDF](#) **246-290-672** Interim treatment requirements.

[HTML](#) [PDF](#) **246-290-674** Interim monitoring and reporting.

[HTML](#) [PDF](#) **246-290-676** Filtration technology and design criteria.

[HTML](#) [PDF](#) **246-290-678** Reliability for filtered systems.

#### Subpart D - Requirements for Other Unfiltered Systems

[HTML](#) [PDF](#) **246-290-686** Compliance requirements for unfiltered systems.

[HTML](#) [PDF](#) **246-290-690** Criteria to remain unfiltered.

[HTML](#) [PDF](#) **246-290-691** Criteria for unfiltered systems with a "limited alternative to filtration" to remain unfiltered.

[HTML](#) [PDF](#) **246-290-692** Disinfection for unfiltered systems.

[HTML](#) [PDF](#) **246-290-694** Monitoring for unfiltered systems.

[HTML](#) [PDF](#) **246-290-696** Reporting for unfiltered systems.

### PART 7. REPORTING

#### Subpart A - Public Notification and Consumer Information

[HTML](#) [PDF](#) **246-290-71001** Public notification.

[HTML](#) [PDF](#) **246-290-71002** Public notice content.

[HTML](#) [PDF](#) **246-290-71003** Public notification distribution.

[HTML](#) [PDF](#) **246-290-71004** Public notification mandatory language.

[HTML](#) [PDF](#) **246-290-71005** Special public notification requirements.

[HTML](#) [PDF](#) **246-290-71006** Public notice for contaminants with a SAL and other unregulated contaminants.

[HTML](#) [PDF](#) **246-290-71007** Public notification special provisions.

#### Subpart B - Consumer Confidence Reports

[HTML](#) [PDF](#) **246-290-72001** Purpose and applicability of the consumer confidence report requirements.

|                      |                     |                      |                                                                                |
|----------------------|---------------------|----------------------|--------------------------------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72002</b> | Reporting dates.                                                               |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72003</b> | Report contents—Source water.                                                  |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72004</b> | Report contents—Definitions.                                                   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72005</b> | Report contents—Information on detected contaminants.                          |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72006</b> | Report contents—Information on Cryptosporidium, radon, and other contaminants. |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72007</b> | Report contents—Compliance with National Primary Drinking Water Regulations.   |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72008</b> | Report contents—Variances and exemptions.                                      |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72009</b> | Report contents—Additional information.                                        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72010</b> | Report contents—Required additional health information.                        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72011</b> | Report delivery and recordkeeping.                                             |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72012</b> | Regulated contaminants.                                                        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-72013</b> | Report contents—Groundwater systems.                                           |

#### PART 8.

#### WATER USE EFFICIENCY

|                      |                     |                    |                                           |
|----------------------|---------------------|--------------------|-------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-800</b> | Purpose and applicability.                |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-810</b> | Water use efficiency program.             |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-820</b> | Distribution system leakage standard.     |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-830</b> | Water use efficiency goal setting.        |
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-840</b> | Water use efficiency performance reports. |

#### FEES

|                      |                     |                    |                                                               |
|----------------------|---------------------|--------------------|---------------------------------------------------------------|
| <a href="#">HTML</a> | <a href="#">PDF</a> | <b>246-290-990</b> | Water system evaluation and project review and approval fees. |
|----------------------|---------------------|--------------------|---------------------------------------------------------------|

# DETERIORATING BURIED INFRASTRUCTURE MANAGEMENT CHALLENGES AND STRATEGIES

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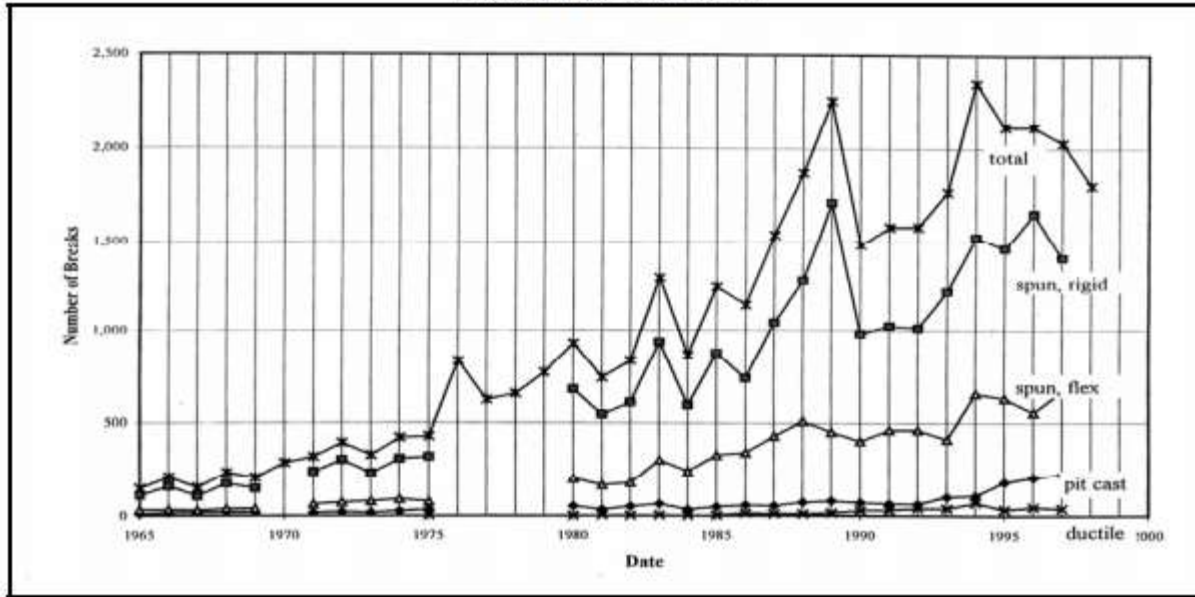
**Exhibit No. 2**  
**Timeline of Pipe Technology in the U.S. in the 20<sup>th</sup> Century**

| MATERIAL                  | JOINT    | Corrosion Protection |               | 1900's | 1910's | 1920's | 1930's | 1940's | 1950's | 1960's | 1970's | 1980's | 1990's |
|---------------------------|----------|----------------------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                           |          | INTERIOR             | EXTERIOR      |        |        |        |        |        |        |        |        |        |        |
| Steel                     | Welded   | None                 | None          |        |        |        |        |        |        |        |        |        |        |
| Steel                     | Welded   | Cement               | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron (pit cast)      | Lead     | None                 | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron                 | Lead     | None                 | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron                 | Lead     | Cement               | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron                 | Leadline | None                 | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron                 | Leadline | Cement               | None          |        |        |        |        |        |        |        |        |        |        |
| Cast Iron                 | Rubber   | Cement               | None          |        |        |        |        |        |        |        |        |        |        |
| Ductile Iron              | Rubber   | Cement               | None          |        |        |        |        |        |        |        |        |        |        |
| Ductile Iron              | Rubber   | Cement               | PE Encasement |        |        |        |        |        |        |        |        |        |        |
| Asbestos Cement           | Rubber   | Material             | Material      |        |        |        |        |        |        |        |        |        |        |
| Reinforced Conc. (RCP)    | Rubber   | Material             | Material      |        |        |        |        |        |        |        |        |        |        |
| Prestressed Conc. (PCCP)  | Rubber   | Material             | Material      |        |        |        |        |        |        |        |        |        |        |
| Polyvinyl Chloride        | Rubber   | Material             | Material      |        |        |        |        |        |        |        |        |        |        |
| High Density Polyethylene | Fused    | Material             | Material      |        |        |        |        |        |        |        |        |        |        |
| Molecularly Oriented PVC  | Rubber   | Material             | Material      |        |        |        |        |        |        |        |        |        |        |

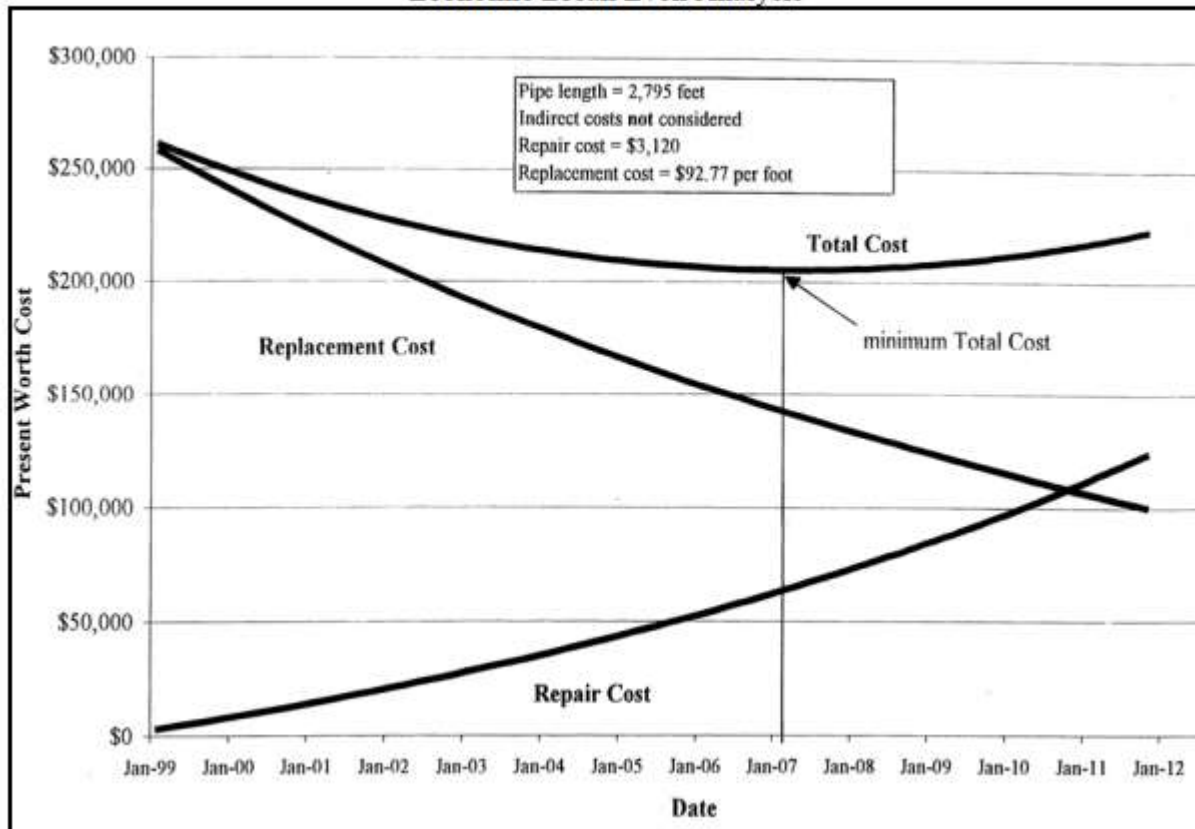
Commercially Available
Predominantly In Use

| Pipe Type | DECADE INSTALLED |         |         |         |         |         |         |           |           | TOTAL     |
|-----------|------------------|---------|---------|---------|---------|---------|---------|-----------|-----------|-----------|
|           | 1920             | 1940    | 1950    | 1960    | 1970    | 1980    | 1990    | 2000      | 2010      |           |
| AC        | 10,287           |         | 475     | 4,482   | 5,921   | 2,598   | 654     |           |           | 24,416    |
| CI        | 176,169          | 2,699   | 24,922  | 126,322 | 239,953 | 72,363  | 41,685  | 15,362    | 2,748     | 702,223   |
| DI        | 9,272            | 711     | 795     | 22,202  | 92,694  | 43,967  | 89,164  | 52,689    | 45,510    | 357,003   |
| CONC      | 5,342            |         |         |         | 18      |         |         |           |           | 5,360     |
| GALV      | 3,483            |         |         | 1,439   | 2,128   | 4,980   | 906     | 138       | 145       | 13,218    |
| STEEL     | 2,134            |         |         |         | 1,891   | 1,011   | 234     |           |           | 5,271     |
| OTHER     | 121              |         |         |         | 63      |         |         | 246       | 1,827     | 2,257     |
| COPPER    | 72               |         |         | 548     | 108     |         | 8       | 1,095     | 100       | 1,932     |
| PVC       |                  |         |         |         | 2,248   |         |         | 280       | 248       | 2,777     |
| TOTAL     | 206,881          | 3,410   | 26,191  | 154,993 | 345,024 | 124,919 | 132,650 | 69,810    | 50,579    | 1,114,458 |
|           | 206,881          | 210,291 | 236,483 | 391,476 | 736,500 | 861,419 | 994,069 | 1,063,879 | 1,114,458 |           |

**Exhibit No. 4**  
**Main Breaks Since 1965**



**Exhibit No. 5**  
**Economic Break Even Analysis**



**E. Regulations Affecting Buried Infrastructure**

**1. *Potential Health Effects***

In addition to this paper, other White Papers being prepared in response to the USEPA assessment of health risks and the need for distribution system regulation include:

- a. Contamination of New or Repaired Mains
- b. Permeation and Leaching
- c. Intrusion into Pipes
- d. Microbial Regrowth/Biofilms
- e. Covered Storage Vessels
- f. Decay of Water Quality in Pipe with Time
- g. Cross Connections
- h. Nitrification

## 2. *New Accounting Regulation*

The Governmental Accounting Standards Board (GASB) was formed in 1984 to develop and improve financial reporting rules for the 85,000 state and local governments in the United States. It operates under the auspices of the not-for-profit Financial Accounting Foundation, which oversees, funds, and appoints the members of the GASB, as well as the Financial Accounting Standards Board (FASB). GASB is not part of the government, federal or otherwise. Its rules are required in most states for financial reporting at the local and state level. GASB rules also are required to be followed when a state or local government's audit reports that it follows Generally Accepted Accounting Principles (GAAP). Bond covenants associated with government debt often require them to follow GAAP.

GASB Statement No. 34 (GASB 34) was modified in June 1999. It requires, for the first time, that governments begin including infrastructure assets on their balance sheets. After estimating the initial cost of each infrastructure asset and including that cost in the balance sheet, governments will be required to either depreciate those assets, or manage them using an asset management system. GASB 34 prefers that municipalities implement an asset management system referred to as the "modified approach" because it better models the way infrastructure should be treated. There are specific requirements for the implementation of the asset management system, and reporting that must be produced.

Whichever method is used, a fundamental requirement is a good inventory of assets. The inventory must include the actual or estimated historical cost of construction. The most straightforward method for valuing assets is depreciation, but this method ignores the extended life of the asset provided by continued maintenance. The modified approach incorporates the benefits, or value, of such maintenance activities. GASB 34 provides the following minimum guidelines as to what the modified approach should include:

- a. The assessed physical condition of infrastructure assets (governments must perform such assessments at least every three years, and disclose the results of at least the three most recent condition assessments).
- b. Descriptions of the criteria the government uses to measure and report asset condition.
- c. The condition level at which the government intends to maintain the assets.
- d. A comparison of the annual dollar amount estimated to be required to maintain and preserve the assets at the condition level established by the government with the actual expenses, for at least the last five years.

#### A. Recommendations for Extending Pipe Life

In order to minimize main failures and maximize the life of the assets, it is necessary to understand the failure mechanisms of pipe. These failure mechanisms, which are a result of either Operational/Physical or Chemical means, are identified in Exhibit No. 6.

**Exhibit No. 6**  
**Pipe Failure Mechanisms**

| Operational/Physical         | Applies to | Options | Chemical                   | Applies to | Options |
|------------------------------|------------|---------|----------------------------|------------|---------|
| Manufacturing defects        | M,P,C      | No      | Internal corrosion         | M,C        | Yes     |
| Improper design/installation | M,P,C      | No      | External corrosion - soil  | M,C        | Yes     |
| Geologic instability         | M,P,C      | No      | External corrosion - other | M,C        | Yes     |
| Higher operating pressures   | M,P,C      | Yes     | Leadite corrosion          | M          | Yes     |
| Hydraulic transients         | M,P,C      | Yes     | Leadite expansion          | M          | Yes     |
| Change in water temperature  | M          | Yes     | Material incompatibilities | M          | Yes     |
| Excessive external loads     | M,P,C      | No      | Gasket deterioration       | M,P,C      | Yes     |
| Damage from digging          | M,P,C      | No      | Material fatigue           | P          | No      |

M = Metallic (ductile iron and/or cast iron)

P = Plastic (PVC or HDPE)

C = Concrete (RCP or PCCP)

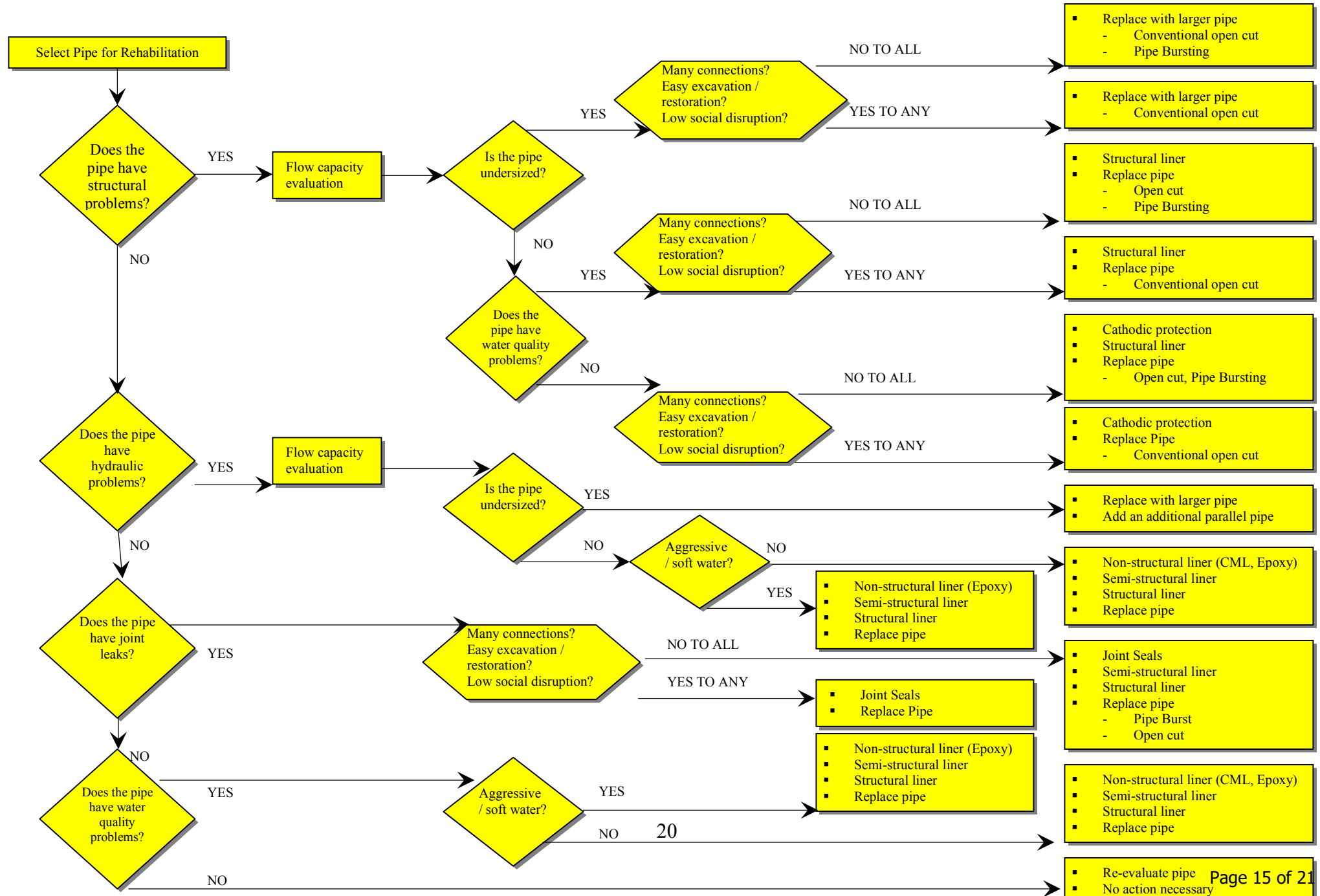
**Exhibit No. 7**  
**Operational Strategies for Reducing or Eliminating Pipe Failures**

| Failure Mechanism           | Strategy                                           | Potential   |
|-----------------------------|----------------------------------------------------|-------------|
| Higher operating pressures  | Redistribution of pressure zones                   | Low         |
| Hydraulic transients        | Surge control and operator training                | Medium/High |
| Change in water temperature | Blending with ground water sources, where possible | Low         |
| Internal corrosion          | Cleaning and lining                                | High        |
| External corrosion - soil   | Cathodic protection                                | Medium      |
| External corrosion - other  | Cathodic protection                                | Medium      |
| Leadite corrosion           | Replace the joint only                             | Low         |
| Leadite expansion           | Replace the joint only                             | Low         |
| Material incompatibilities  | Install dielectrics at corporation stops           | Medium      |
| Gasket deterioration        | Replace the joint only                             | High        |

#### 4. Cost Considerations

- The exact nature of the problem(s) to be solved.
- The hydraulic and operating pressure requirements for the rehabilitated main.
- The materials, dimensions, and geometry of the water main.
- The types and locations of valves, fittings, and service connections.
- The length of time in which the main can be taken out of service.
- Site-specific factors.

## Exhibit No. 8 Rehabilitation Decision Tree



### Exhibit No. 9

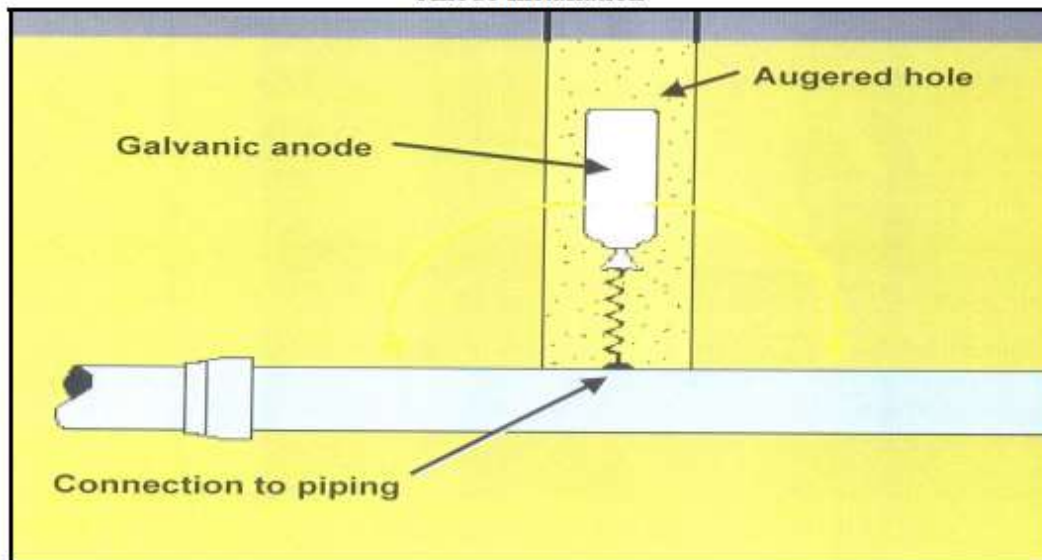
#### Summary of Applicable Technology and Recommended Use

| Technology               | Recommended Application                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cement Mortar Lining     | <ul style="list-style-type: none"> <li>• Prevent scale formation, internal corrosion and reduce pipe roughness (improve Hazen Williams C-value).</li> <li>• Considered with hydraulic and wq problems when there are no structural and joint leaks and original pipe material is cast iron, ductile iron or steel.</li> <li>• Should not be considered when soft or acidic water is conveyed due to possible deterioration of CML.</li> </ul>                                                                                                   |
| Epoxy Resin Lining       | <ul style="list-style-type: none"> <li>• Protects original pipe against corrosion and provides an increased Hazen-Williams C-value.</li> <li>• Considered with hydraulic and water quality (WQ) problems when there are no structural and joint leak problems.</li> </ul>                                                                                                                                                                                                                                                                       |
| Conventional Slip Lining | <ul style="list-style-type: none"> <li>• Effective diameter of pipe is reduced, with a new pipe have a smooth interior surface.</li> <li>• Excavations are required for service connections, entrance pits and exit pits.</li> <li>• Various pipe materials (DI, PVC, HDPE and steel) may be used as new pipe. No strength is added to the host pipe in conventional slip lining.</li> </ul>                                                                                                                                                    |
| Close-Fit Slip-lining    | <ul style="list-style-type: none"> <li>• Classified as structural or semi-structural lining depending on the thickness of the liner. The inserted pipe add strength, prevents further internal corrosion and improves Hazen-Williams C-value.</li> <li>• Considered for hydraulic, joint leak and water quality problems with no structural problems are involved.</li> </ul>                                                                                                                                                                   |
| Cured in Place Pipe      | <ul style="list-style-type: none"> <li>• Compared to close-fit lining, the thickness of CIPP liner is typically less than a close-fit liner.</li> <li>• As with the close-fit liner, the loss of diameter is compensated for by an improved Hazen-William C-value.</li> <li>• As opposed to epoxy lining, CIPP also provides a certain measure of leakage protection.</li> <li>• Considered a semi-structural liner and is applicable for hydraulic, joint leak and water quality problems when no structural problems are involved.</li> </ul> |
| Pipe Bursting            | <ul style="list-style-type: none"> <li>• Pipe bursting is a structural lining technique and is considered suitable for CI, PVC, AC and thin wall steel pipes.</li> <li>• Pipe Bursting recommended for deep mains with sufficient cover to avoid heaving.</li> <li>• Host pipe should not have offset pipe joints or clamps with bolts.</li> <li>• Applicable for replacing pipes of the same diameter or larger.</li> <li>• Excavations are required for service connections, entrance pits and exit pits.</li> </ul>                          |

C. Preventative Technologies

Cathodic Protection is a technology for reducing corrosion of a metal water main by turning the entire main into the cathode of a galvanic or electrolytic corrosion cell. Normally, sacrificial anodes are used as the galvanic cell to minimize the effects of external corrosion on existing metal water mains, thus reducing water main breaks and extending the useful life of the mains. A sacrificial anode system does not stop the process of corrosion but rather redirects the corrosion from the water main to the anode. Exhibit No. 10 shows a typical installation of a galvanic anode. Sacrificial anode protection may be used in selective "hot spot" (highly corrosive soils) areas that have been located by soil-survey procedures. In corrosive soils, sacrificial anodes should be installed during the repair of water mains. Typically this would only increase the total cost of the repair by approximately \$200 - \$300 per break.

**Exhibit No. 10**  
**Anode Installation**



**Exhibit No. 11a****Comparison of Distribution Size Pipe Materials - Material Properties**

| <b>Material Property</b>   | <b>DI</b>                | <b>PVC</b>                | <b>HDPE</b>                |
|----------------------------|--------------------------|---------------------------|----------------------------|
| Tensile strength           | 60,000 psi               | 7,000 psi                 | 3,200 psi                  |
| Compressive strength       | 48,000 psi               | 9,000 psi                 | 1,600 psi                  |
| Yield strength             | 42,000 psi               | 14,500 psi                | 5,000 psi                  |
| Ring bending stress        | 48,000 psi               | none specified            | none specified             |
| Impact strength            | 17.5 ft-lbs/in           | 0.75 ft-lbs/in            | 3.5 ft-lbs/in              |
| Density                    | 441 lbs/ft <sup>3</sup>  | 88.6 lbs/ft <sup>3</sup>  | 59.6 lbs/ft <sup>3</sup>   |
| Modulus of elasticity      | 24,000,000 psi           | 400,000 psi               | 110,000 psi                |
| Temperature range          | < 150° F                 | < 140° F                  | -50 to 140° F under press. |
| Thermal expansion          | 0.07" per 10° F per 100' | 0.33" per 10° F per 100'  | 1" per 10° F per 100'      |
| Corrosion resistance (int) | Good - w/cement lining   | Excellent                 | Excellent                  |
| Corrosion resistance (ext) | Good - w/polywrap        | Excellent                 | Excellent                  |
| UV resistance              | Excellent                | Gradual strength decline  | Yes - w/carbon black       |
| Abrasion resistance        | Excellent                | Good                      | Good                       |
| Cyclic resistance          | Excellent                | Fair                      | Good                       |
| Permeation resistance      | Yes                      | No - solvents & petroleum | No - solvents & petroleum  |
| Scale & growth resistance  | Good                     | Excellent                 | Excellent                  |

### Exhibit No. 11b

#### Comparison of Distribution Size Pipe Materials - Pipe Properties

| Pipe Property                | DI                       | PVC                                                            | HDPE                         |
|------------------------------|--------------------------|----------------------------------------------------------------|------------------------------|
| Trade organization           | DIPRA                    | Uni-Bell                                                       | PPI                          |
| AWWA designation             | C151                     | C900 and C905                                                  | C906                         |
| Diameter range               | 3" - 64"                 | 4" - 12" (C900)<br>14" - 48" (C905)                            | 4" - 63"                     |
| Pressure range               | 350 psi                  | 100 psi - 200 psi                                              | 50 psi - 255 psi             |
| ID range (8")                | 8.425"                   | 7.76" - 8.33"                                                  | 6.918" - 8.136"              |
| Wall thickness range (8")    | 0.25"                    | 0.362" - 0.646"                                                | 0.265" - 1.182"              |
| Weight range (8")            | 21.1 lbs/ft              | 6.6 lbs/ft - 11.4 lbs/ft                                       | 5.1 lbs/ft - 11.06 lbs/ft    |
| OD nominal (8")              | 9.05"                    | 9.05"                                                          | 9.05"                        |
| Buoyant (8" 100 psi)         | No                       | Yes                                                            | Yes                          |
| Surge allowance              | 100 psi                  | 125 - 200% of press.<br>rating<br>None for 14" - 48"<br>(C905) | 50 - 100% of press. rating   |
| Surge potential (8" 100 psi) | 53.6 psi per 1 ft/sec <V | 17.6 psi per 1 ft/sec <V                                       | 9.8 psi per 1 ft/sec <V      |
| Integrity under vacuum       | Excellent                | Good                                                           | Poor                         |
| C-factor                     | 140                      | 150                                                            | 150                          |
| Standard pipe lengths (8")   | 18 ft or 20 ft           | 20 ft                                                          | 40 ft or 50 ft               |
| Type of joints               | Push-on or mechanical    | Push-on or mechanical                                          | Heat fused                   |
| Max joint deflection (8")    | 5°                       | 3°                                                             | Radius = 20 - 50 times<br>OD |
| Compatible w/DI fittings     | Yes                      | Yes                                                            | Yes - in DI sizes            |

### Exhibit No. 11c

#### Comparison of Distribution Size Pipe Materials - Operational Considerations

| Operational Consideration                          | DI         | PVC                                    | HDPE                                       |
|----------------------------------------------------|------------|----------------------------------------|--------------------------------------------|
| Ease of installation                               | Subjective | Subjective                             | Subjective                                 |
| Can be direct tapped                               | Yes        | Yes                                    | No                                         |
| Need for special installation equipment            | No         | No                                     | Yes                                        |
| Need for special bedding for typical installations | No         | Yes                                    | No                                         |
| Need for joint restraint                           | Yes        | Yes                                    | No                                         |
| Ability to locate underground                      | Excellent  | Poor - needs tracer wire               | Poor - needs tracer wire                   |
| Applicable for above ground installations          | Yes        | With opaque material for UV resistance | Yes - w/proper support                     |
| Applicable for aqueous installations               | Yes        | Yes                                    | Yes - but potential for flattening is high |
| Anticipated service life                           | 100 years  | 50 - 100 years                         | 50 years                                   |

### Exhibit No. 15

#### Data Requirements for a Detailed Management Plan

| Physical             | Exist | New | Performance                     | Exist | New | Commercial/Service    | Exist | New |
|----------------------|-------|-----|---------------------------------|-------|-----|-----------------------|-------|-----|
| Year of Installation | Y     | Y   | Complaint Frequency             | A     | Y   | Critical Customer     | Y     | Y   |
| Diameter             | Y     | Y   | Type of Complaint               | A     | Y   | Affect on Community   | Y     | Y   |
| Material             | Y     | Y   | Break Frequency                 | A     | Y   | No. of People Served  | A     | A   |
| Length               | Y     | Y   | Type of Break                   | A     | Y   | Length of Shutdown    | A     | A   |
| Location             | Y     | Y   | Reason for Break                | A     | Y   | Coordination w/Others | A     | A   |
| Interior Lining      | A     | Y   | Service (hydraulic)<br>Adequacy | Y     | Y   |                       |       |     |
| Exterior Protection  | A     | Y   | Fire Flow Adequacy              | Y     | Y   |                       |       |     |
| Joint                | A     | Y   |                                 |       |     |                       |       |     |
| Wall Thickness       | A     | Y   |                                 |       |     |                       |       |     |
| Soil conditions      | A     | A   |                                 |       |     |                       |       |     |
| Internal Condition   | A     |     |                                 |       |     |                       |       |     |
| External Condition   | A     |     |                                 |       |     |                       |       |     |

Y = yes, in all cases

A = as needed, or as available

### C. Data Management

There are three options to consider for maintaining the data that is recommended for a detailed management plan. The first option would be to utilize a simple personal computer spreadsheet or database. Although this would be the least costly solution, it would also be the most labor intensive. An important factor when implementing a computerized program is to assure, where possible, that the required data is entered in the course of doing daily business (a self populating database) thus minimizing duplication of data entry. A personal computer spreadsheet or database would likely not meet this criteria.

The other two software options would utilize either an infrastructure management software package or a computerized maintenance management system (CMMS). The two are similar, and vary mainly in that infrastructure management software is typically less flexible and more specifically geared to the municipal market, whereas CMMS software is more powerful and more customizable (and ultimately more costly). Again, the key with either is that they integrate with other software currently utilized by the utility and that they meet the needs of other operations, customer service, and maintenance tasks in addition to buried infrastructure management. For example, if a new main is being installed, and information is being entered into a utility's asset management system, this information needs to populate the database selected for use in managing buried infrastructure. A customer complaint that is recorded in a Customer Information System would be another example of information that needs to link with the buried infrastructure software. The other advantage that these types of software packages have over simple spreadsheets or databases is that they allow integration with Geographical Information System (GIS) software. The value of GIS is that it provides the necessary geographical information which should factor into decisions regarding pipe replacement. For example, if main replacement is warranted in a particular geographical area, it might be appropriate to replace other mains in the area to avoid future disruption to the customers and the community. Without GIS, it would be difficult to perform the same type of evaluation except possibly in very small systems.

### V. Implementation

- a. Data Collection & Buried Asset Inventory: The data necessary for a performance based management plan (see Exhibit No. 15) can be found in a variety of places that would include:
  - Distribution drawings
  - Work orders
  - Asset records
  - Customer Information Systems