

Role of Research in Infrastructure Rehabilitation/Renewal

Decision Process

水道施設の更新決定プロセスにおける研究の重要性

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Role of Research in Infrastructure Rehabilitation/Renewal Decision Processes

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Outline

- Need for Infrastructure Rehabilitation/Renewal
- Importance and role of AwwaRF research
- Overview of AwwaRF Research
- Benefits of AwwaRF research



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THE AGING INFRASTRUCTURE

- High percentage of water distribution systems are reaching reliable life span
- Leaking and unreliable distribution systems are economically unacceptable
- The next 10 to 30 years will require major financial investments



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Variables that Impact the Infrastructure Failure Rate

- Predominant pipe materials
- Average age of pipe
- Corrosion rate
- Range/percentage of pipe sizes
- Number of appurtenances
- Building/population density



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Variables that Impact the Infrastructure Failure Rate

- Depth of water mains/seismic zones
- Condition of pipe gaskets
- Soil conditions
- System operations
- Operating pressures
- Other unique variables



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U.S. Situation

- 880,000 miles (1,626,600 km) of pipe (>6 in)
- Estimated replacement value - \$348 billion
- Condition of piping – 28% excellent, 43% good, 26% fair, 3% poor
- Type of piping – 48% cast iron, 19% ductile iron, 15% AC



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U.S. Situation

- Estimated annual replacement rate – 4400 miles (8,150km)
- Value of replacement rate - \$1.74 billion
- Cost of water losses - \$2.8 billion
- Replacement rate too low (<1 percent) – **up to 200 years to complete!**



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U.S. Water Main Break Data

- 0.27 breaks/mile/year (1994)
- Common causes
 - Materials/deterioration – 55 %
 - Weak joint – 35 %
 - Earth movement/settling – 30 %
 - Freezing – 30 %
 - Internal corrosion – 25 %
 - Corrosive soils – 25 %
 - Construction in area – 25 %



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U.S. PRICE TAG*

- Period between 2000 and 2019
- Drinking water - \$11.6 to 20.1 billion per year
- Wastewater - \$13.0 to 20.9 billion per year
- Household bills from 0.5 percent of household income to 0.6-0.9



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* U.S. Congressional Budget Office

THE IMPORTANCE OF RESEARCH

- Infrastructure replacement very costly
- Infrastructure decisions have long-term ramifications (50 to 100 years)
- Planning/financing decisions require the most comprehensive and practical knowledge available
- Provides assurance of correct decisions



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The Role of Awwa Research Foundation

- Primary focus on practical application of research
- Research involves international collaborative partners
- Knowledge/information available to AwwaRF subscribers



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Research Areas in Infrastructure Rehabilitation/Renewal Decision Processes *

- Information Collection - 20 projects (\$8.6 million)
- Rehabilitation/Renewal technologies – 8 projects (\$2.7 million)
- Decision-making and Planning – 15 projects (\$4.4 million)

*Through 2004



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Information Collection

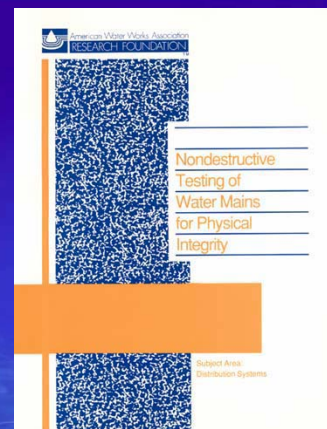
- Location
- Condition Assessment
- Long-term performance prediction



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Example of AwwaRF Reports

- **Nondestructive, Noninvasive Assessment of Underground Pipelines**
 - Reviewed nondestructive evaluation (NDE) methods for water pipes.

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Rehabilitation/Renewal Technologies

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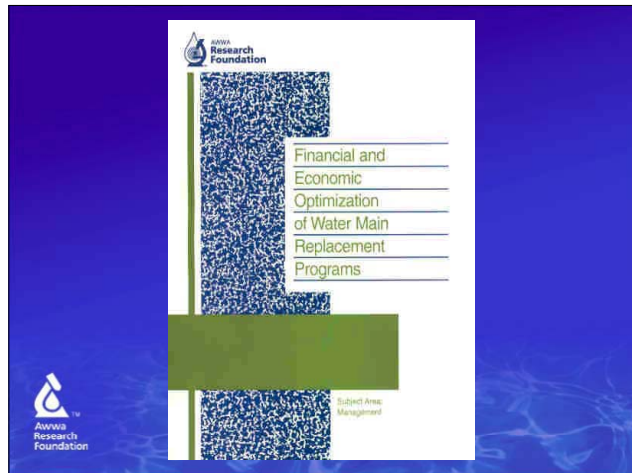
Example of AwwaRF Reports

- **Demonstration of Innovative Water Main Renewal Techniques**
 - Demonstrated and evaluated various trenchless technologies
 - Identified conditions under which each technology can best be applied under North American conditions

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Decision-making and Planning

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Examples of AwwaRF Reports

- **Decision Support System for Distribution System Piping Renewal**
 - Guidance for water utilities
 - A comprehensive decision support system

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Examples of AwwaRF Reports

- **Guidance Manual: Water Main Evaluation Rehabilitation/Replacement**
 - Analysis of utility leak and break patterns
 - Assessing water main condition
 - Economics of distribution system rehabilitation
 - Water distribution system inventory
 - Developing a rehabilitation planning system
 - Ten point scoring system

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How Water Utilities Benefit from AwwaRF Research

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Water Main -Philadelphia



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AwwaRF Subscribers Benefiting

- **Philadelphia Water Department (PWD)**
 - The oldest distribution system in the U.S.
 - Saving from the AwwaRF ten point scoring system: >\$1 million per year

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AwwaRF Subscribers Benefiting

- Portland Water Bureau - \$250,000 – 500,000/year for main replacement
- St. Louis - \$100,000 to 200,000/year for main replacement
- Houston - \$200,000 – 2,000,000 from main rehabilitation



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Summary

- Infrastructure deterioration a global concern
- Rehabilitation/Renewal of the infrastructure is costly
- Applied research is critical to ensure correct long-term planning decisions
- AwwaRF leader in sponsoring applied research on infrastructure



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QUESTIONS

- Who will ultimately “bank role” the renewal or replacement (federal, provinces, higher water rates, i.e., consumers, lottery)?
- What level of resources are necessary to renew/renovate the infrastructure in a reasonable period of time?



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**Infrastructure Research
= Insurance for Making
the Correct Decisions**



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Thank You!



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Infrastructure Rehabilitation/Renewal Decision Processes AwwaRF Projects

Information Collection

- a) Condition Assessment
 - 1. Water Utility Experience with Plastic Service Lines (#414). Published in 1992 – Order No. 90593.
 - 2. Nondestructive Testing of Water Mains (#507). Published in 1992 – Order No. 90601.
 - 3. Electromagnetic Inspection of Prestressed Concrete Pressure Pipe (#2564). Published in 2001 – Order No. 90854.
 - 4. Nondestructive, Noninvasive Assessment of Underground Pipelines (#355). Published in 2002 – Order No. 90873.
 - 5. Workshop on Non-Interruptive Condition Assessment Inspection Devices for Water Transmission Mains (#2871). Ongoing.
 - 6. Testing and Condition Assessment of Joints in Water Distribution Pipelines (#2689). Ongoing.
 - 7. Techniques for Monitoring Structural Behavior of Piping Systems (#2612). Ongoing.
 - 8. Installation, Condition Assessment, and Reliability of Service Lines, Connections and Fittings (#2927). Ongoing.

- b) Long-term Performance Prediction
 - 1. Performance of Prestressed Concrete Pipe (#724). Published in 1994 by the U.S. Bureau of Reclamation
 - 2. Investigation of Grey Cast Iron Water Mains to Develop a Methodology for Estimating Service Life (#280). Published in 2000 – Order No. 90787.
 - 3. Long-Term Performance Prediction for Polyvinyl Chloride Pipe (#2879). Ongoing.
 - 4. Performance and Life Expectancy of Elastomeric Components in Contact With Potable Water (#2932). Ongoing.
 - 5. Life Cycle Analysis of Epoxy Lining (#2941). Ongoing.
 - 6. Long-Term Performance Prediction of PE Pipe (#2975). Ongoing.
 - 7. Impact of Petroleum-Based Hydrocarbons on PE/PVC Pipes and Pipe Gaskets (#2946). Ongoing.
 - 8. Long-Term Performance of Ductile-Iron Pipe (#3036). Ongoing.

- c) Location
 - 1. Innovative Techniques for Lead Service Line Location (#813). Published in 1995 – Order No. 90601.
 - 2. New Techniques for Precisely Locating Buried Infrastructure (#2524). Published in 2001 – Order No. 90859.
 - 3. Multi-Utility Buried Pipes and Appurtenances Location Workshop (#2882). Completed in 2002. Published by UKWIR.
 - 4. Development of Advanced Buried Infrastructure Tracer Wire (#3050). Ongoing.

Rehabilitation/Renewal Technologies

1. Assessment of Existing and Developing Water Main Rehabilitation Practices (#314). Published in 1990- Order No. 90572.
2. Demonstration of an Innovative Water Main Rehabilitation Technique: In Situ Epoxy Lining (#808). Published in 1995 - Order No. 90667.
3. Demonstration of Innovative Water Main Renewal Techniques (#255). Published in 1999 - Order No. 90768.
4. Lead Pipe Rehabilitation and Replacement Techniques (#465). Published in 2000- Order No. 90789.
5. Investigation of Pipe Cleaning Methods (#2688). Published in 2003 - Order No. 90938.
6. Non-Disruptive Tools for Remaking Connections After Pipe Rehabilitation (#2872). Ongoing.
7. Guidelines to Minimizing Downtime During Pipe Lining Operations (#2956). Ongoing.
8. Technology for Horizontal Directional Drilling (#2967). Ongoing.

Decision-making and Planning

1. Water Main Evaluation for Rehabilitation/Replacement (#54). Published in 1985 –Order No. 90509.
2. Criteria for Renovation or Replacement of Water Treatment Facilities (#323). Published in 1991 – Order No. 90563.
3. Quantifying Future Rehabilitation and Replacement Needs of Water Mains (#265). Completed in 1998
4. Financial and Economic Optimization of Water Main Replacement Programs (#462). Published in 2001 – Order No. 90821
5. Capital Planning Strategy Manual (#2520). Published in 2001 – Order No. 90838
6. Water Treatment Plant Infrastructure Assessment Manager (#460/2921). Published in 2001 – Order No. 90843.
7. Synthesis Document on Distribution System Infrastructure (#2629). Published in 2001 – Order No. 90846
8. Prioritizing Water Main Replacement and Rehabilitation (#459). Published in 2002 – Order No. 90898.
9. Decision Support System for Distribution System Piping Renewal (#2519). Published in 2002 – Order No. 90892.
10. Costs of Infrastructure Failure (#2607). Published in 2002 – Order No. 90918.
11. Main Break Prediction, Prevention, and Control (#461). Closed.
12. Synthesis Documents on Infrastructure Integrity (#2772). Ongoing.
13. Risk Management of Large Water Transmission Mains (#2883). Ongoing.
14. Dynamic Influences on the Deterioration Rates of Individual Water Mains (#3052). Ongoing.
15. Development of Consensus Performance and Cost Targets for Water Pipeline Inspection Technologies: A Workshop (#3065). Ongoing.