The Right Money, On the Right Mains, At the Right Time

Tacoma's Strategic Main Replacement Strategy through Economic Modeling

PNWS-AWWA SECTION CONFERENCE

TACOMA, WA

APRIL 26, 2018

TACOMA WATER

TACOMA PUBLIC UTILITIES

OUTLINE

1. **BACKGROUND**
2. **PROJECT SELECTION**
   - **Historical Practice**
   - **Current Practice**
   - **Industry Practice**
3. **PROJECT ECONOMICS**
   - **Economic Model**
   - **Assumptions**
   - **GIS and the Multiple Asset Decision (MAD) Module**
4. **EXAMPLE PROJECT**

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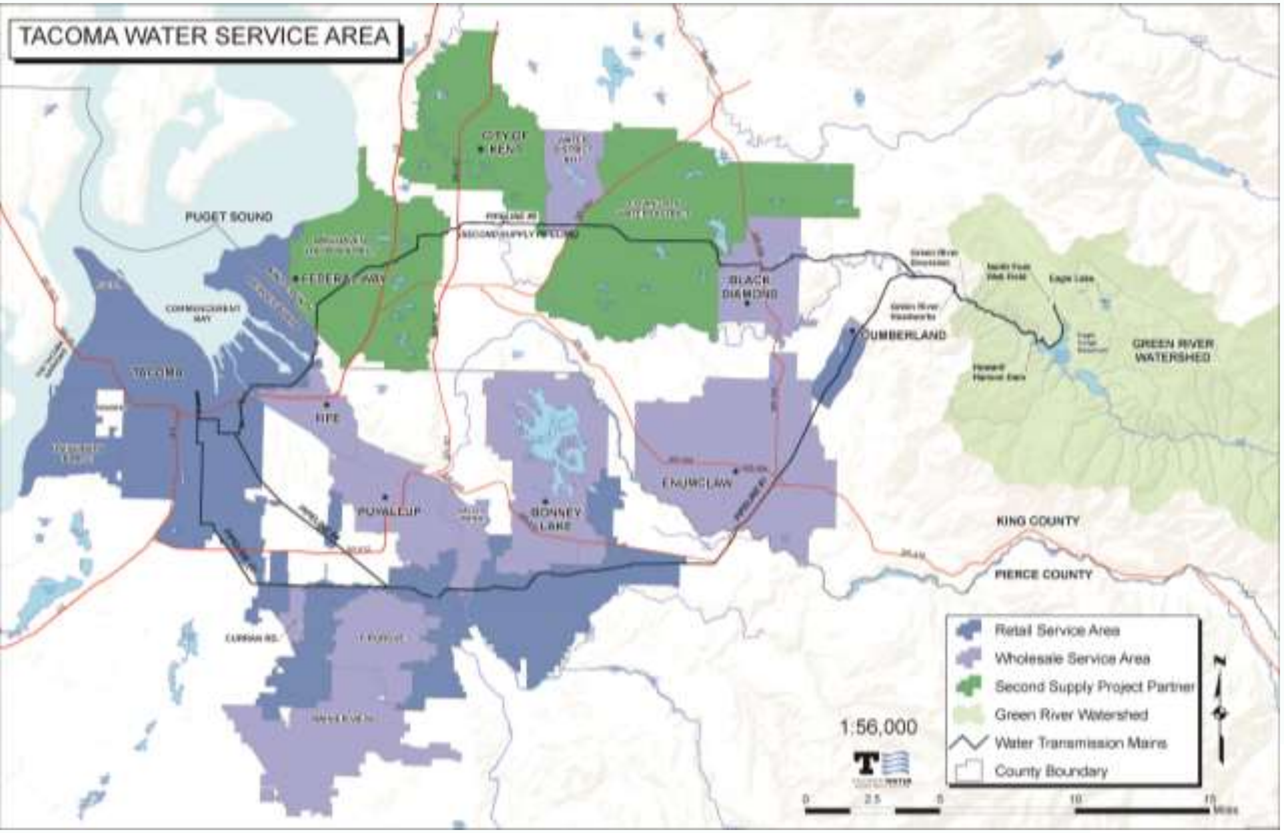
ABOUT TACOMA WATER

Customers

Direct Service to approximately:
101,000 connections / 320,000 population
Peak Day Demands in excess of 100 MGD



Sources of Supply

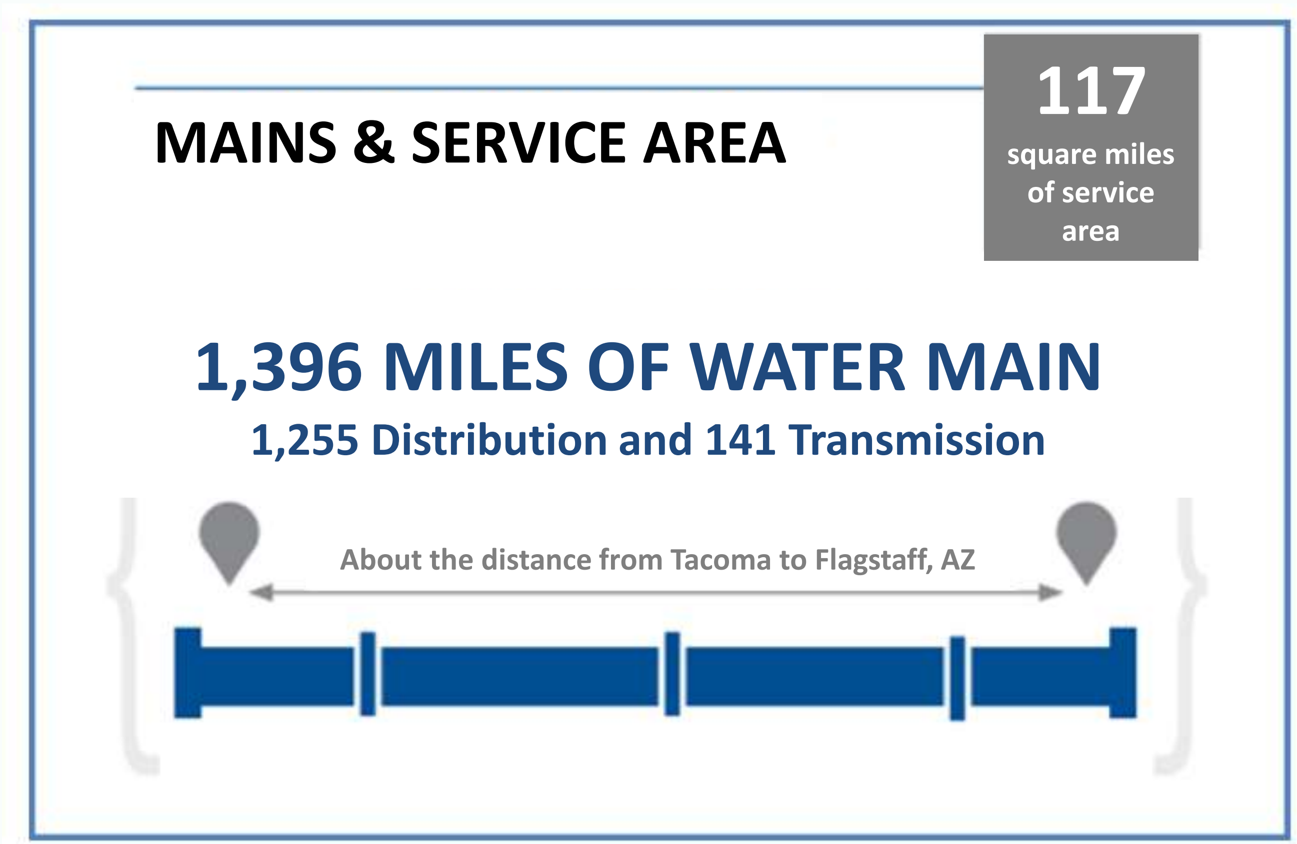
Green River:

- Previously Unfiltered
- 150 MGD Filtration Facility completed 2015
- 73 MGD capacity prior to 2005 completion of Second Supply Pipeline

20 Major Groundwater Wells:

- Up to 55 MGD capacity
- South Tacoma Wellfield has 13 wells with current approximate capacity of 45 MGD

COMPOSITION OF DISTRIBUTION SYSTEM



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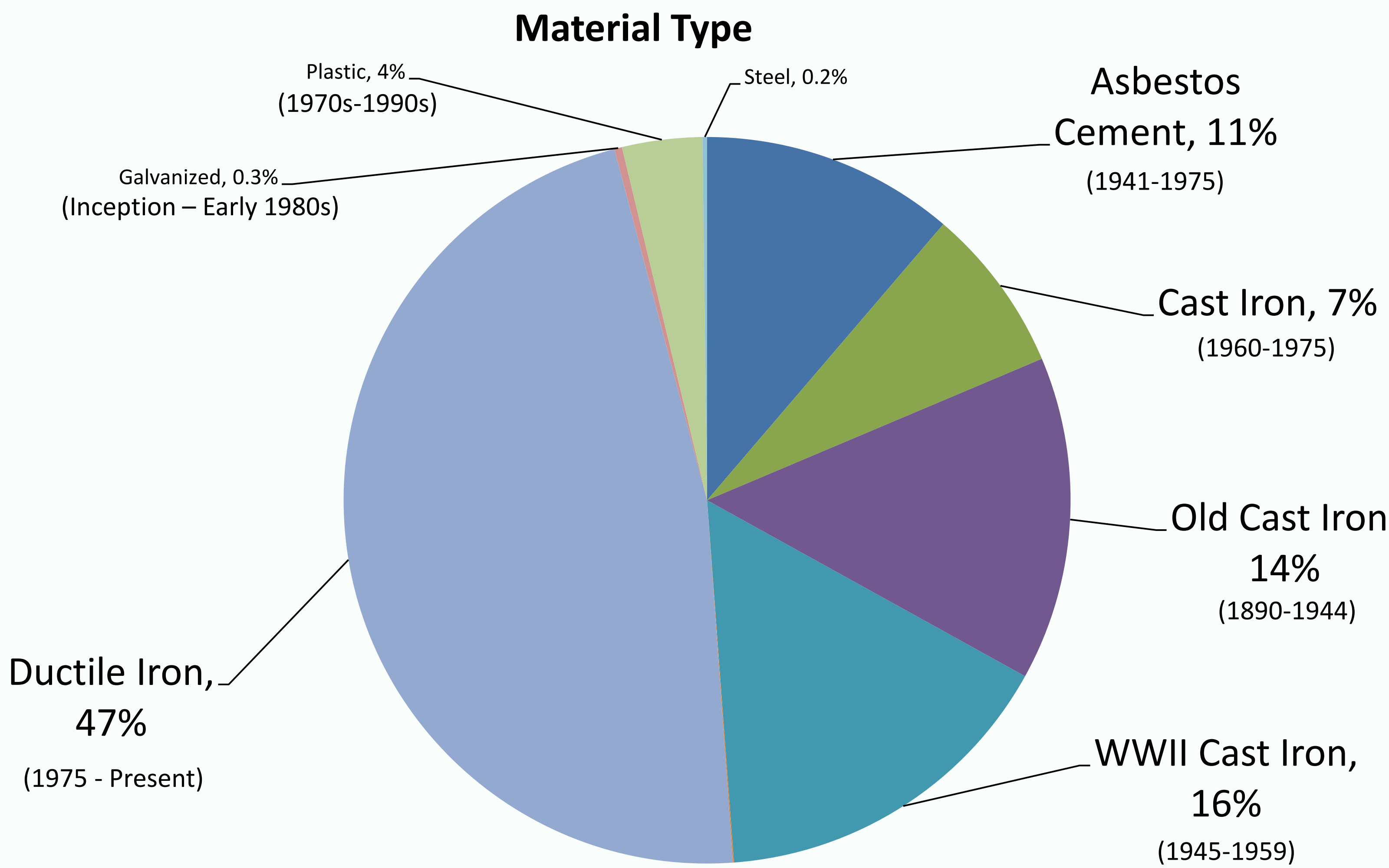
COMPOSITION OF DISTRIBUTION SYSTEM



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MAIN REPLACEMENT PROGRAM 1995-2018

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Project Selection

Historical Practice

- **100-year main replacement cycle**
- **All asbestos cement and galvanized steel pipe are considered to be at the end of their useful life**
- **All main breaks are considered to have the same detrimental impact**
- **Take advantage of project partnering opportunities**

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Project Selection

Present Philosophy:

- **Use of Advanced Asset Management Principles**
  - Understanding and accounting for risk

Risk = Likelihood of Failure × Consequence of Failure

  - Managing assets to the Lowest Lifecycle Cost

- **Condition assessment utilized**
- **Strong emphasis on project coordination**
- **Consideration of economic development and timing of main replacement projects**
- **Asbestos cement mains are considered to have remaining life**

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CAPITAL PROJECT SELECTION & EXECUTION

Project Sources

A. Economic Model Analysis (Condition Assessment)

B. Coordinated, Planned Projects

C. Projects of Opportunity

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CAPITAL PROJECT SELECTION & EXECUTION

Project Sources

A. Economic Model Analysis (Condition Assessment)

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Project Economics

1) BlueWave Tool
2) Economic Model Data
3) Multiple Asset Decision (MAD) Module

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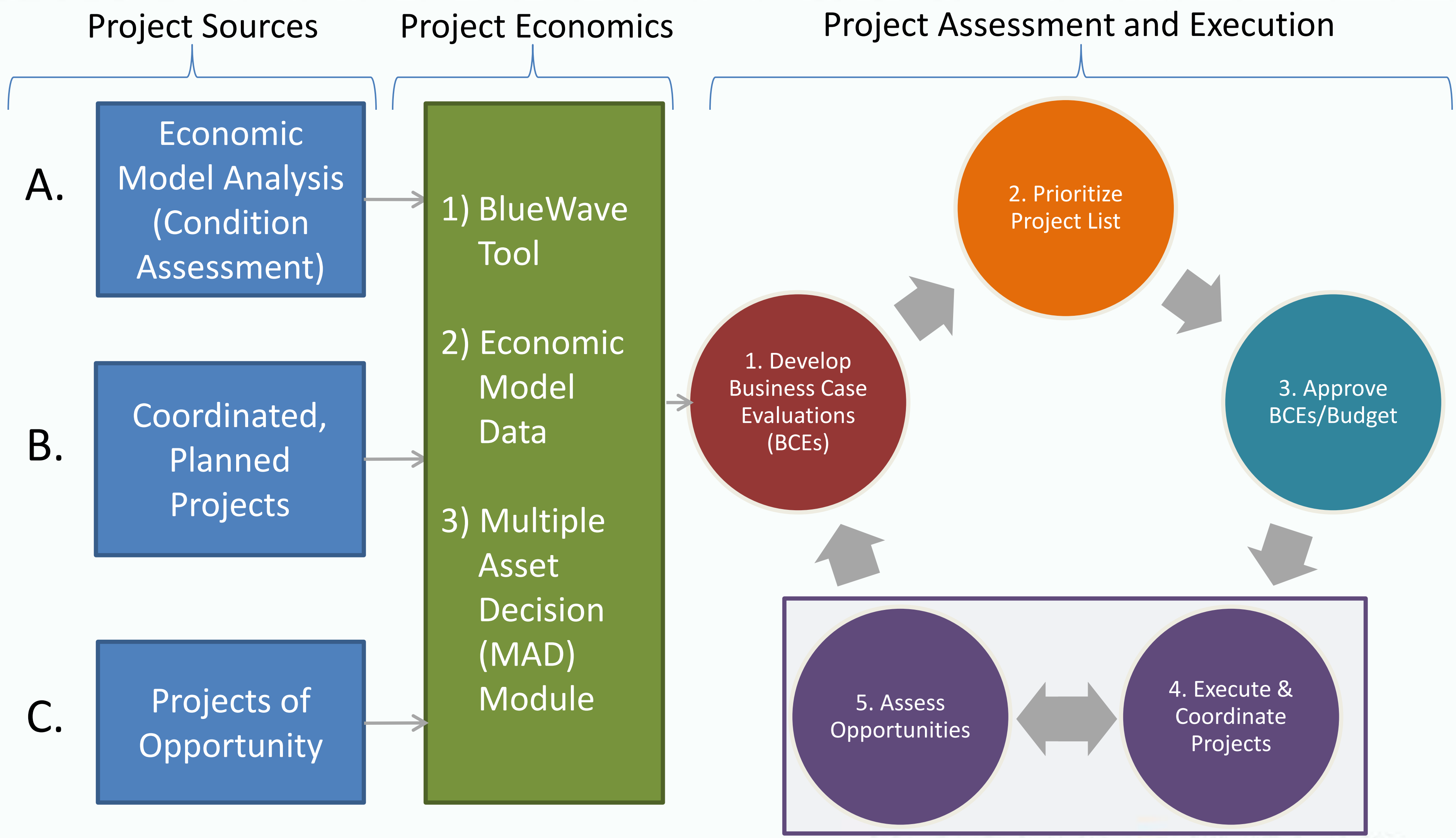
CAPITAL PROJECT SELECTION & EXECUTION



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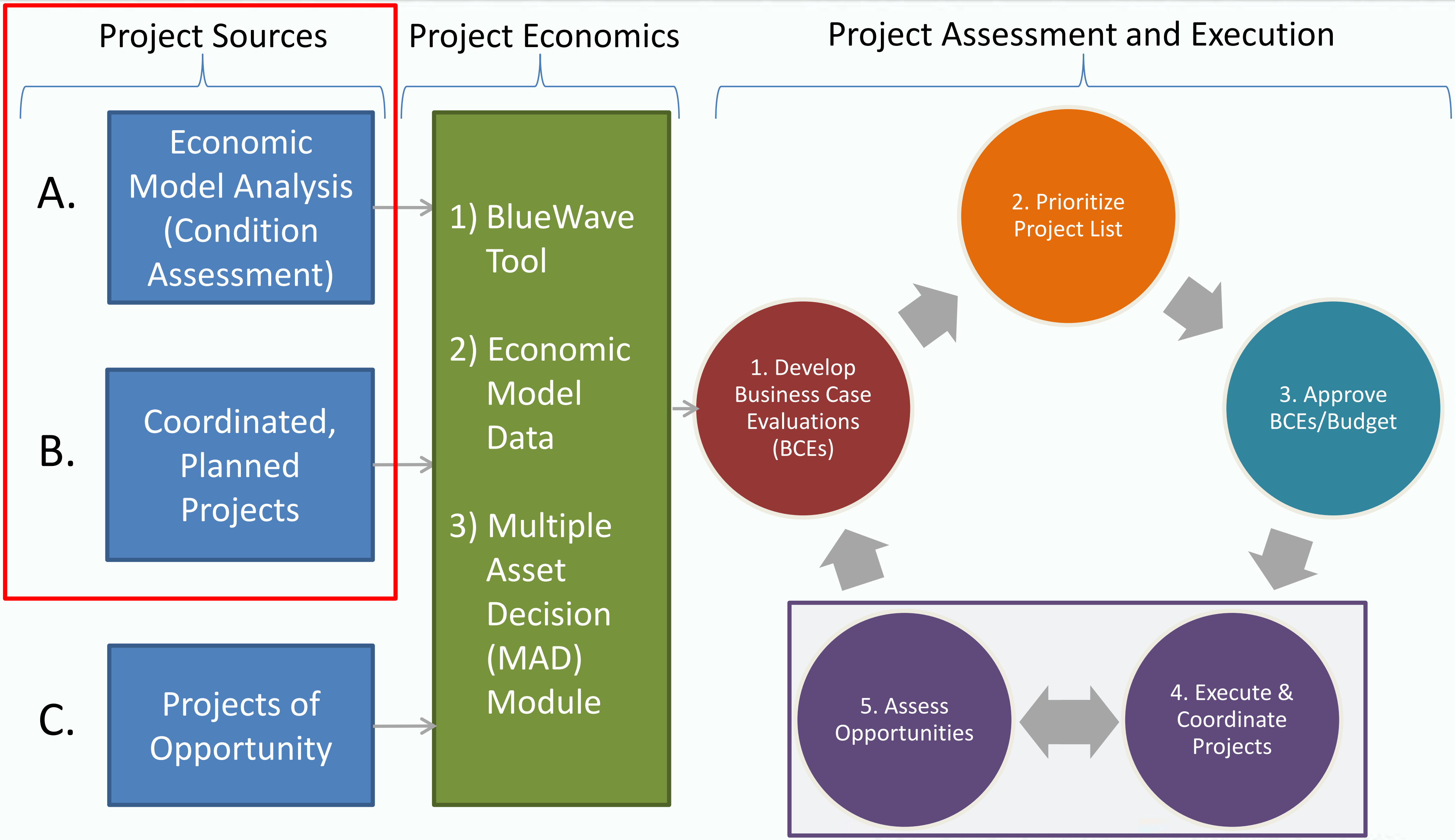
Project Selection

INDUSTRY PRACTICE:
WRF #4656 (draft)

Table 4.1
Participating Utility Risk Assessment Methods

Utility	Type of Assessment	Description
Tacoma Water	Monetized Risk Assessment	A detailed pipe-by-pipe economic model, with quantified likelihood and monetized consequence.
Manitowoc Public Utilities	Categorized Risk Assessment	A categorized risk assessment tool done as part of a previous master plan, with weighting factors and multiple likelihood and consequence factors.
City of Bozeman	Categorized Risk Assessment	A categorized risk assessment tool, with multiple likelihood and consequence factors.
Tualatin Valley Water District	CIP Prioritization	A detailed CIP prioritization tool, with a variety of detailed scoring for both likelihood and consequence factors; not system-wide.
City of Bend	Criticality Assessment only	A system-wide criticality assessment done as an add-on to a previous master plan; focused on hydraulic criticality.

CAPITAL PROJECT SELECTION & EXECUTION



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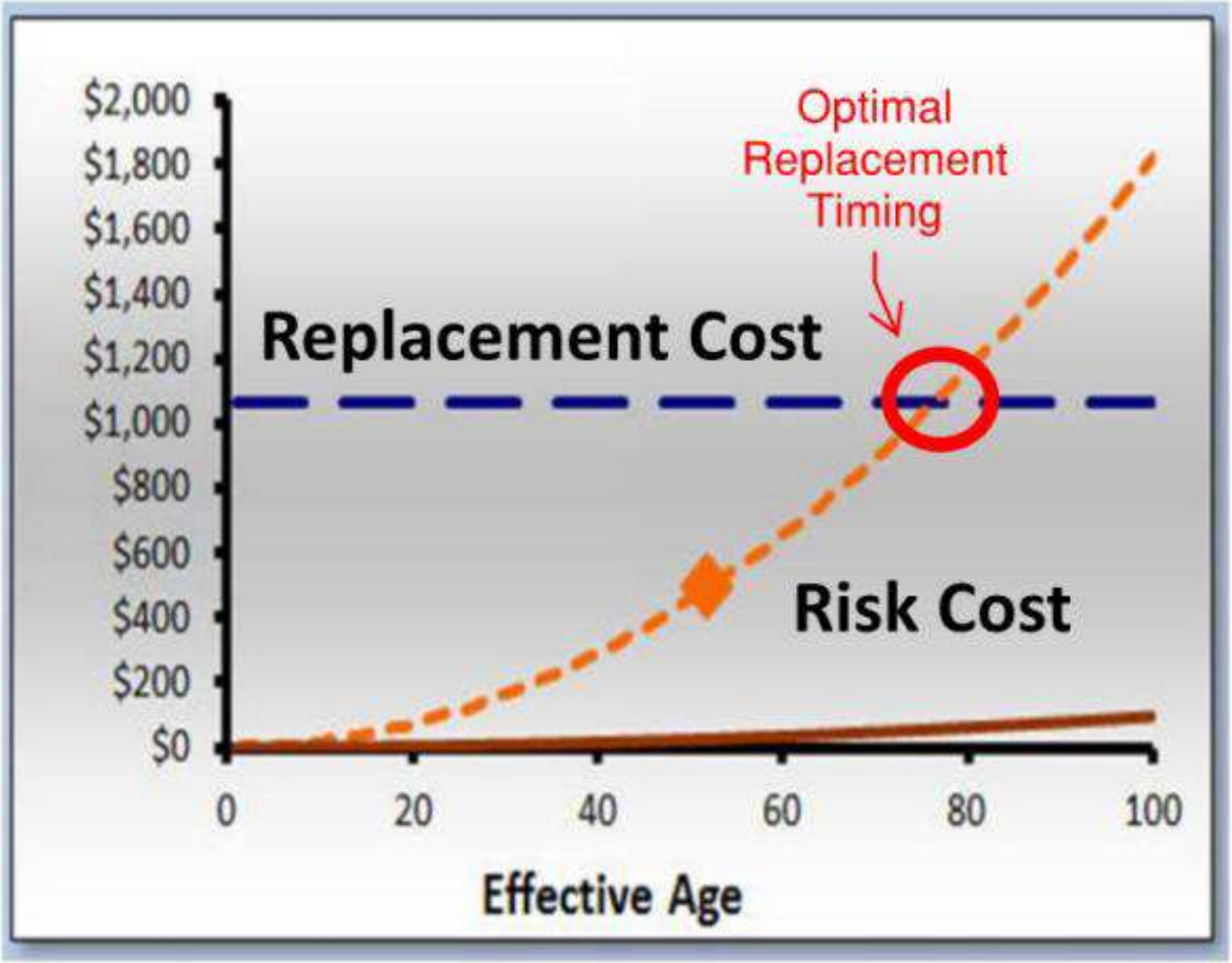
Path A: Economic Model Analysis

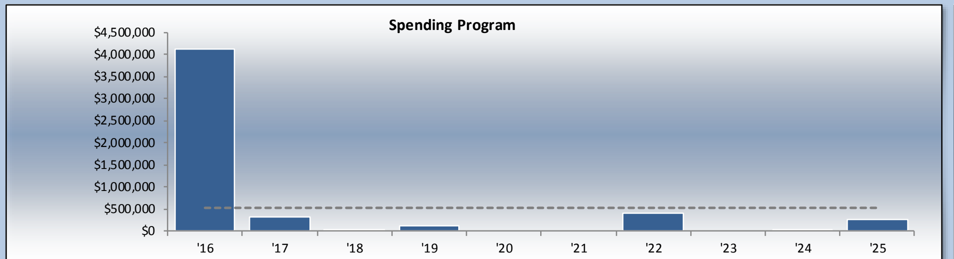


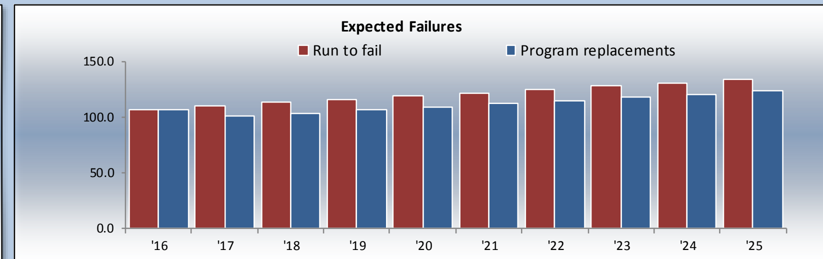
Economic Model Analysis

ASSET POPULATION CHARTS

RE-CALCULATE

UPDATE CHARTS





SAP ID	Asset ID	Project ID	Asset Class	Diameter	Material	Age	Length	Street Type	Pavement Type	Replacement Cost	Consequence Cost	Risk Cos	Years to Replaceme
NA	M-0000332	Unknown	Distribution	2	GLV	38	78	Unknown	Unknown	$12,402	$11,717	$425	0
NA	M-0000964	Unknown	Distribution	2	GLV	43	50	Unknown	Unknown	$8,024	$11,493	$305	0
NA	M-0001054	Unknown	Distribution	2	GLV	56	54	Residential	Asphalt Concrete Pavement	$10,854	$21,330	$790	0
NA	M-0001055	Unknown	Distribution	2	GLV	56	68	Residential	Asphalt Concrete Pavement	$13,627	$21,355	$993	0
NA	M-0001056	Unknown	Distribution	2	GLV	56	57	Residential	Asphalt Concrete Pavement	$11,457	$21,355	$835	0
NA	M-0001057	Unknown	Distribution	2	GLV	56	67	Residential	Asphalt Concrete Pavement	$13,561	$21,355	$988	0
NA	M-0001058	Unknown	Distribution	2	GLV	56	57	Residential	Asphalt Concrete Pavement	$11,457	$21,355	$835	0
NA	M-0001146	Unknown	Distribution	2	GLV	48	99	Unknown	Unknown	$15,741	$11,070	$644	0
NA	M-0001259	Unknown	Distribution	2	GLV	56	95	Unknown	Unknown	$15,078	$11,194	$728	0
NA	M-0001289	Unknown	Distribution	2	GLV	47	26	Unknown	Unknown	$4,064	$11,294	$166	0
NA	M-0001290	Unknown	Distribution	2	GLV	47	105	Unknown	Unknown	$16,616	$11,294	$679	0
NA	M-0001296	Unknown	Distribution	2	GLV	47	33	Residential	Asphalt Concrete Pavement	$6,666	$13,911	$292	0
NA	M-0001318	Unknown	Distribution	2	GLV	40	55	Residential	Asphalt Concrete Pavement	$11,055	$13,936	$375	0
NA	M-0001319	Unknown	Distribution	2	GLV	47	90	Unknown	Unknown	$14,273	$11,244	$581	0
NA	M-0001320	Unknown	Distribution	2	GLV	47	129	Unknown	Unknown	$20,509	$11,169	$829	0
NA	M-0001412	Unknown	Distribution	2	GLV	56	190	Unknown	Unknown	$30,210	$24,663	$3,213	0
NA	M-0001433	Unknown	Distribution	2	GLV	44	108	Residential	Asphalt Concrete Pavement	$21,684	$14,135	$822	0
NA	M-0001610	18115	Distribution	2	GLV	33	3	Unknown	Unknown	$2,140	$16,493	$67	0
NA	M-0001611	18115	Distribution	2	GLV	33	7	Unknown	Unknown	$2,140	$16,493	$67	0
NA	M-0003885	Unknown	Distribution	2	GLV	56	48	Residential	Asphalt Over Portland Cemen	$12,480	$16,668	$549	0
NA	M-0004348	17525	Distribution	2	GLV	35	28	Residential	Portland Cement Concrete	$8,009	$31,958	$385	0
NA	M-0103572	5508	Distribution	2	GLV	44	3	Residential	Bituminous Surface Oilmat	$2,560	$22,186	$120	0
NA	M-0008024	12226	Distribution	2	GLV	58	24	Unknown	Unknown	$3,816	$26,467	$451	0
NA	M-0008025	12226	Distribution	2	GLV	58	262	Unknown	Unknown	$41,681	$21,044	$3,918	0
NA	M-0102884	Unknown	Distribution	2	GLV	56	5	Unknown	Unknown	$2,140	$13,193	$90	0
NA	M-0008441	Unknown	Distribution	2	GLV	56	10	Residential	Gravel	$2,140	$13,984	$96	0
NA	M-0008442	Unknown	Distribution	2	GLV	56	5	Unknown	Unknown	$2,140	$13,193	$90	0
NA	M-0108117	Unknown	Distribution	2	GLV	56	5	Residential	Gravel	$2,140	$11,786	$81	0
NA	M-0008772	Unknown	Distribution	2	GLV	56	3	Residential	Gravel	$2,140	$11,786	$81	0
NA	M-0009234	1958-3A	Distribution	8	CI WW2	57	300	Highway	Asphalt Concrete Pavement	$96,297	$380,335	$3,163	0
NA	M-0009853	5253	Distribution	12	CI WW2	59	259	Highway	Asphalt Concrete Pavement	$98,829	$370,485	$2,855	0

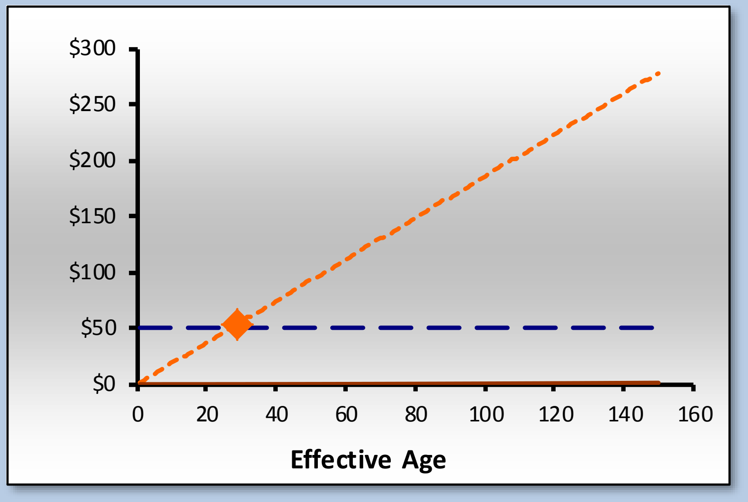
Economic Model Analysis

DISTRIBUTION MAINS

SAVE ASSET TO MAD | RELOAD ASSET

DEMOGRAPHICS	
Asset ID	M-0037610
Pipe diameter	2
Existing material code	GLV
Pipe length (ft)	1
Installation year	1987
Transmission Main Name	NA
Project Type	SDO
Project ID	19151
Pipe class	UNK
Approximate Location	BlueWave Link
Pressure Zone	346
Calculated Static Pressure	55.09041934
Jurisdiction	City of Tacoma
Road type	Collector
Pavement type	Bituminous Surface Oilmat
Effective age (yrs)	29

INTERVENTIONS	
Existing material	GLV
Replacement type	DI
Replacement cost, base	$2,000
Pavement Restoration	$560
Replacement cost, total	$2,560



RESULTS	
Age at replacement	29
Years To replacement	0
Year of replacement	2016
Benefit/cost ratio	1.09
Lifecycle cost of new asset	$51
Net benefit of replacement	$5
Assumed data?	No
Lifecycle of new asset	200

PROBABILITY OF FAILURE	
Breaks by project 1000'	0.27324591

Economic Model Analysis

How many years to replacement?

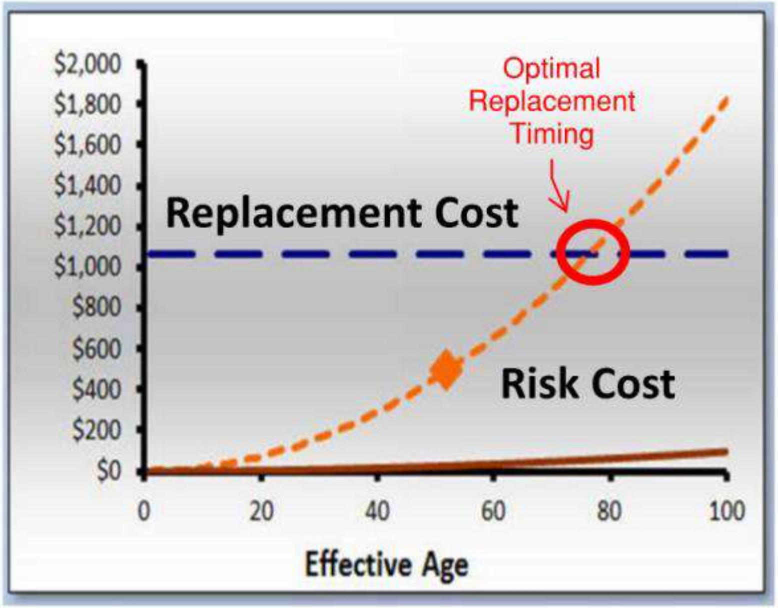
- **0 years = budget**
- **1-20 years = review for budgeting**

How do we prioritize equal years to replacement?

- **Consequence cost**
- **Coordinating projects**

How does condition assessment change years to replacement?

- **Typically lowers years to replacement**
    - Increased failure multiplier added to model
- **Of 68,000 – which pipes should be assessed first?**
    - Critical crossings (highway, railroad, etc.)
    - Pipes for which the failure multiplier reduces years to replacement to 20 years or less
    - Pipes in areas with more breaks
    - Lack of records



CONDITION ASSESSMENT FAILURE MULTIPLIER		
Degradation Percent		Failure Multiplier
0.0	7.5	1.0
7.5	15.0	1.1
15.0	30.0	1.5
30.0	1000.0	2.0

Path B: Coordinated, Planned Projects

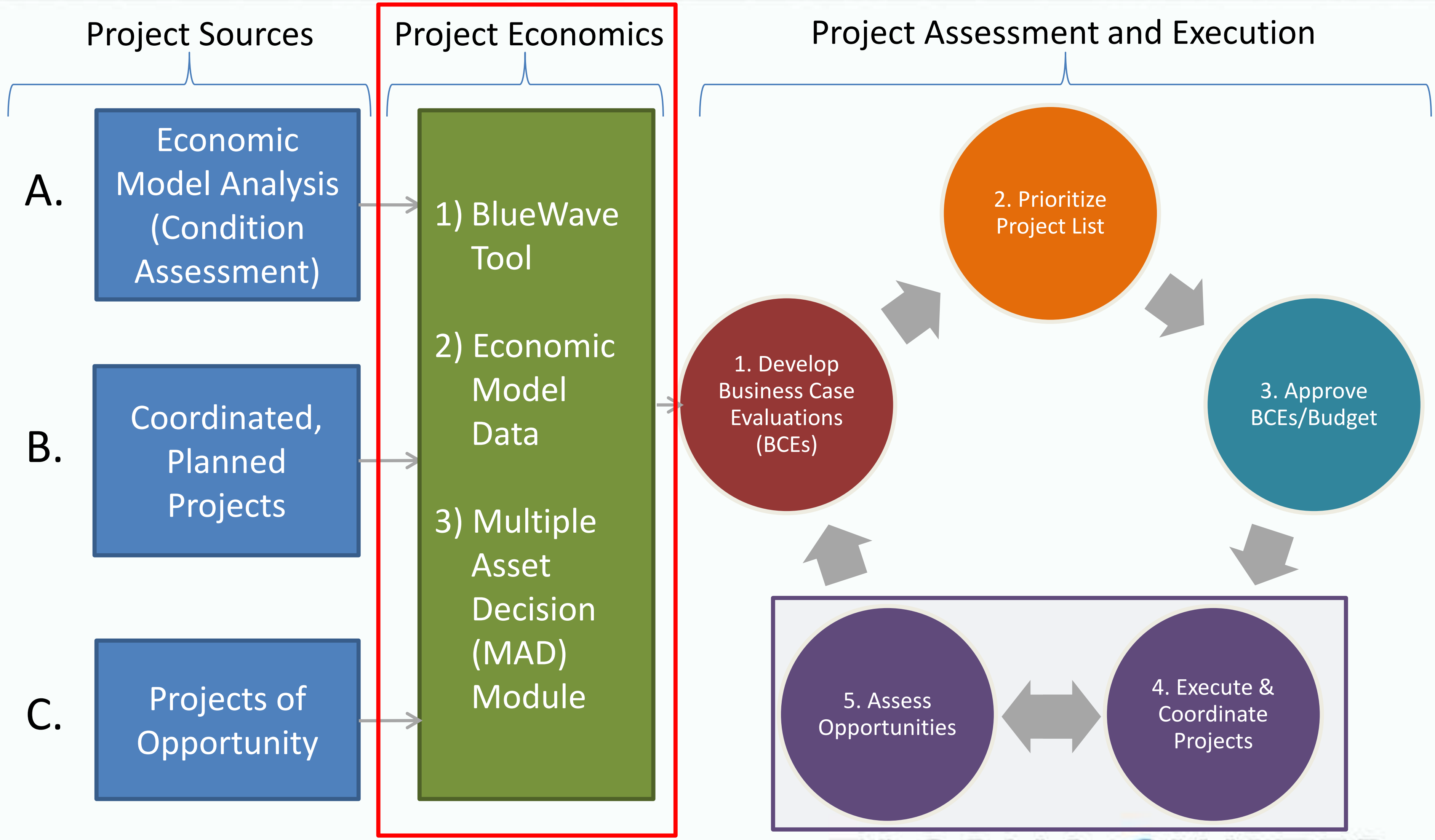
How do we become aware of these projects?

- City contacts
- Long range planning documents

Do we always participate in projects we become aware of?

- No – depends on Business Case Evaluation (BCE)

CAPITAL PROJECT SELECTION & EXECUTION



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ASSUMPTIONS

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Assumptions of Economic Model

Replacement Size
Replacement Type
Road Type Multiplier
Boring Requirements
Pipe Removal Costs
Replacement Cost

- Internal Labor
- Open Cut Costs
- Boring Costs

Landscape Restoration

- Endangered Species Act Restoration
- Landscape Restoration

Pavement Restoration
Condition Assessment Failure Multiplier

- Condition Assessment Multiplier
- Corrosive Soils Multiplier
- Failure History Multiplier

Customer Outage Calculations

Minor Scenario
Major Scenario
Catastrophic Scenario
Streams
Wetlands
Lakes & Ponds
Stream Fishery Type
Types of Crossings
Program Inputs
Special Pipe Feature

- Casing
- Polyethylene Wrap
- Cathodic Protection
- Deep Bury
- Wrapped Pipe
- Elevated Pipe
- Elevated Roadway Above

Assumptions of Economic Model

Most important/impactful assumptions:

Discount Rate

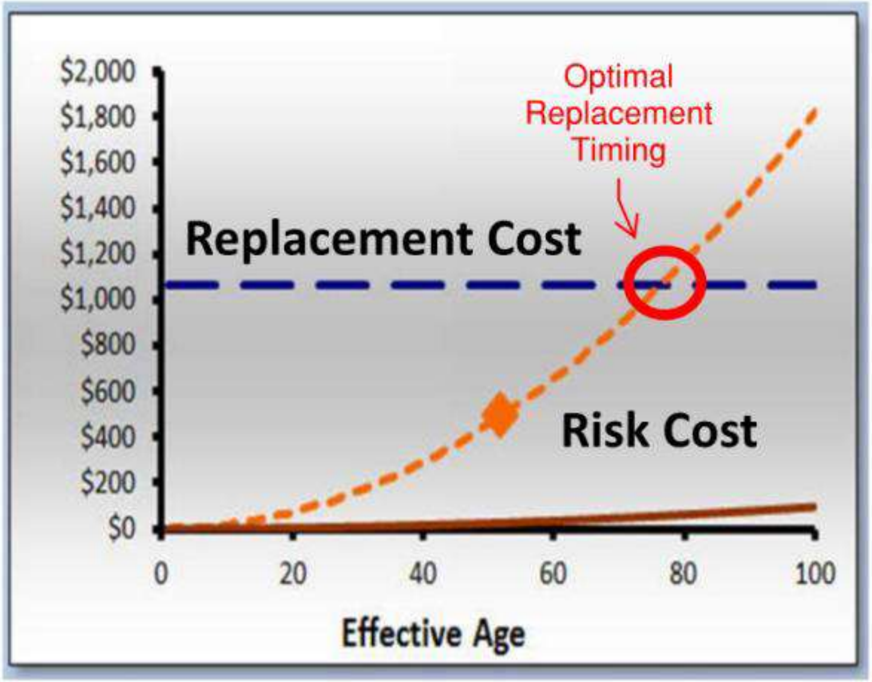
Likelihood of Failure

- **Failure Multipliers**
- **Pipe Failure Rates**

Consequence Cost

- **3 Scenarios**
- **Pipe Casings**
- **Critical Areas**

Replacement Costs



Risk = likelihood × consequence

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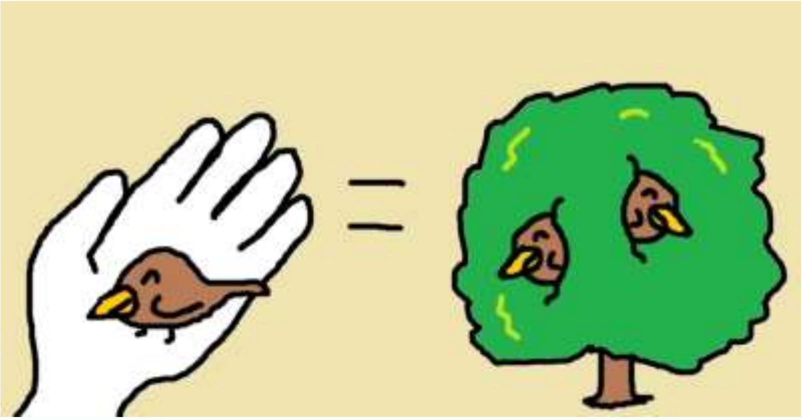
Assumptions of Economic Model

Discount Rate

- **Set by Rates & Financial Planning**
- **The annual rate at which future cash flows are "discounted" in order to convert those cash flows into present day dollars. The real discount rate DOES account for inflation in itself, and so is lower than the "nominal" discount rate. (Tacoma Water Glossary definition)**
- **1.94%**



Likelihood of Failure

Consequence Cost

Replacement Cost

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Assumptions of Economic Model

Discount Rate

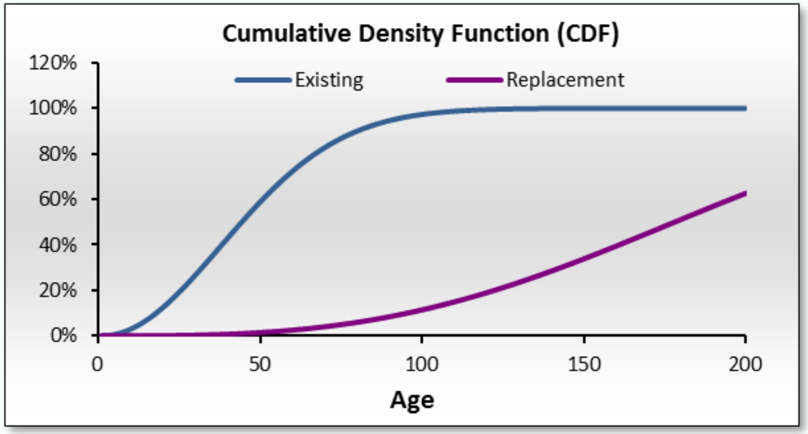
Likelihood of Failure

- **Failure Multipliers**
  - Condition assessment multiplier
  - Corrosion multiplier
  - Failure history multiplier
- **Pipe Failure Rates**
  - Historical observed rates for each material class
  - Fitted to Weibull curve

Consequence Cost

Replacement Cost

CONDITION ASSESSMENT MULTIPLIER	
Condition Assessment	1.10
Corrosive Soils	1.50
Failure History	1.00
CA Multiplier Used	1.65



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Assumptions of Economic Model

Discount Rate

Likelihood of Failure

Consequence Cost

- **3 Scenarios**
  - Minor, major, and catastrophic breaks
- **Pipe Casings**
  - Special pipe features (adjusts risk)
- **Critical Areas**
  - Crossings (highway, railroad, bridge, stream, wetland)
  - Contaminated soils
  - Corrosive soils
  - Erosion
  - Steep slopes

Replacement Cost

Existing Failure Scenario Tree

78.0%	Minor leak or break	$17,439
20.0%	Major leak or break	$35,349
2.0%	Catastrophic break	$325,900

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Assumptions of Economic Model

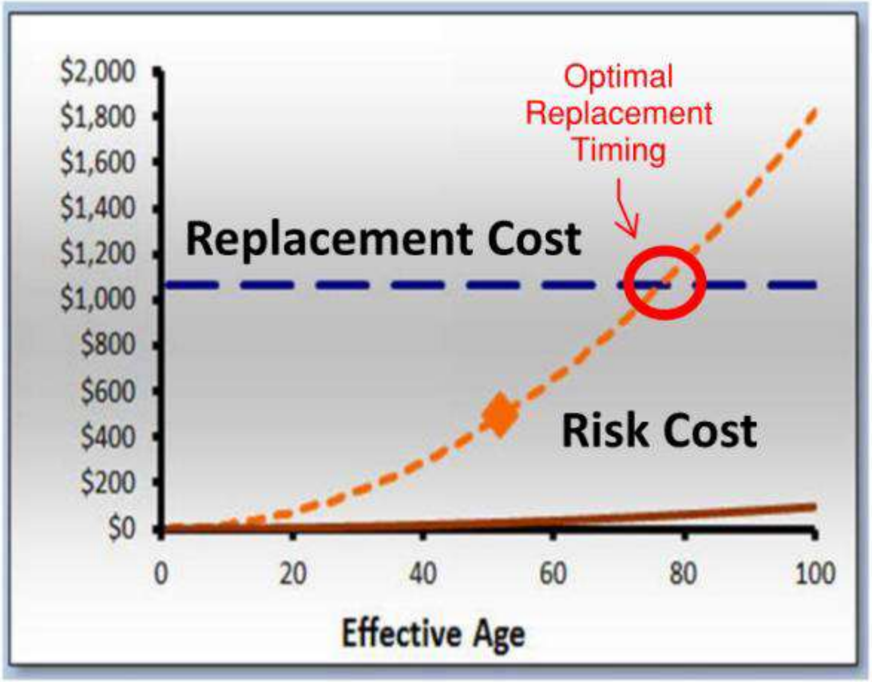
Discount Rate

Likelihood of Failure

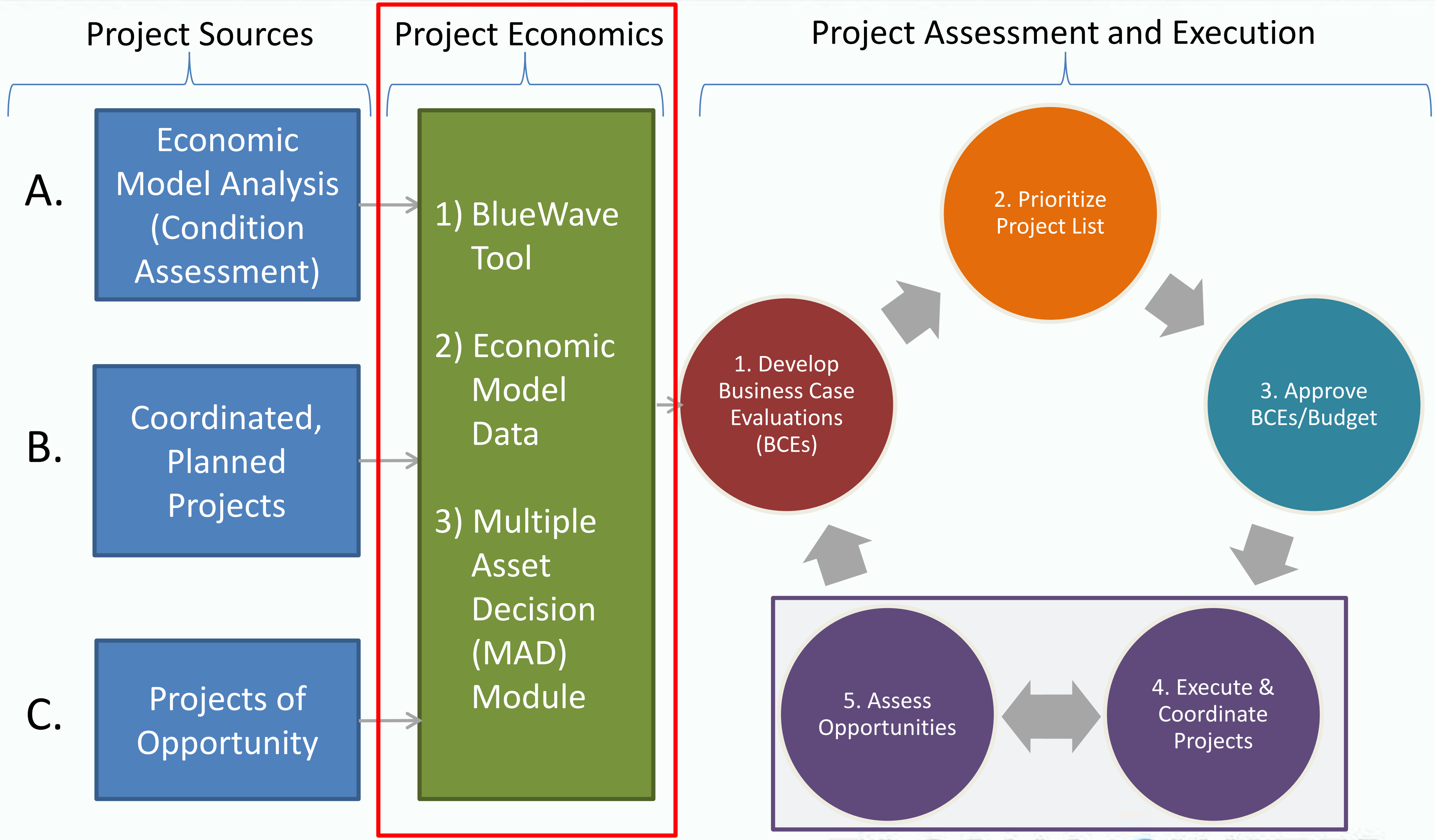
Consequence Cost

Replacement Costs

- Internal Labor
- Open Cut Costs
- Landscape Restoration
- Endangered Species Restoration
- Pavement Restoration (All Types)
- Pipe Removal Costs
- Moratorium Fees/Duration



CAPITAL PROJECT SELECTION & EXECUTION



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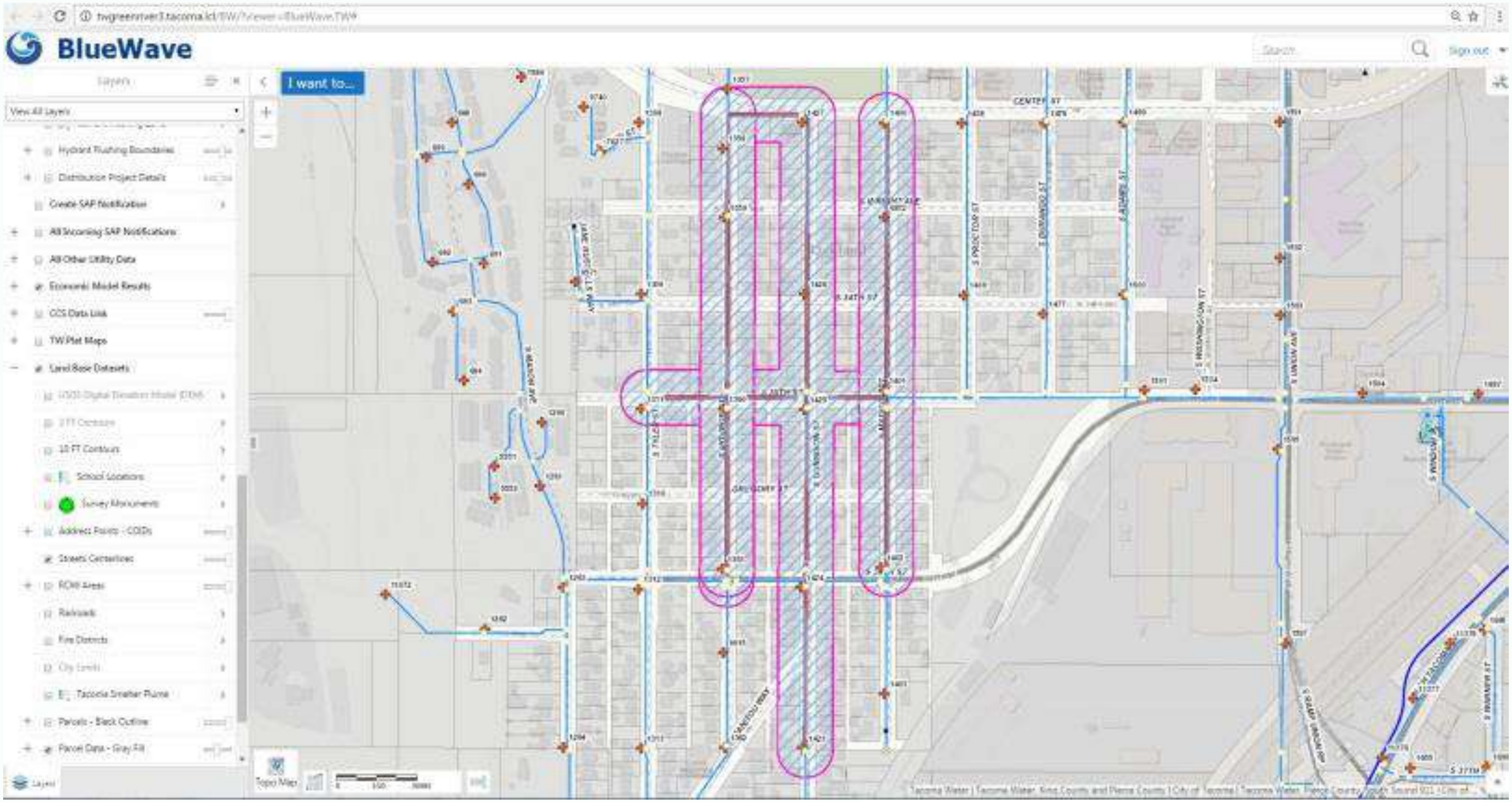
Project Economics: BlueWave Selection Tool



Multiple Asset Decision (MAD) Module

Identified projects are selected in BlueWave and imported into the MAD module.

Does the MAD module take into account the economic model?

- Yes – data is used directly.

What does the MAD module output?

- Net present value (NPV) of completing a project
- Project cost and budget request
- Optimal replacement year

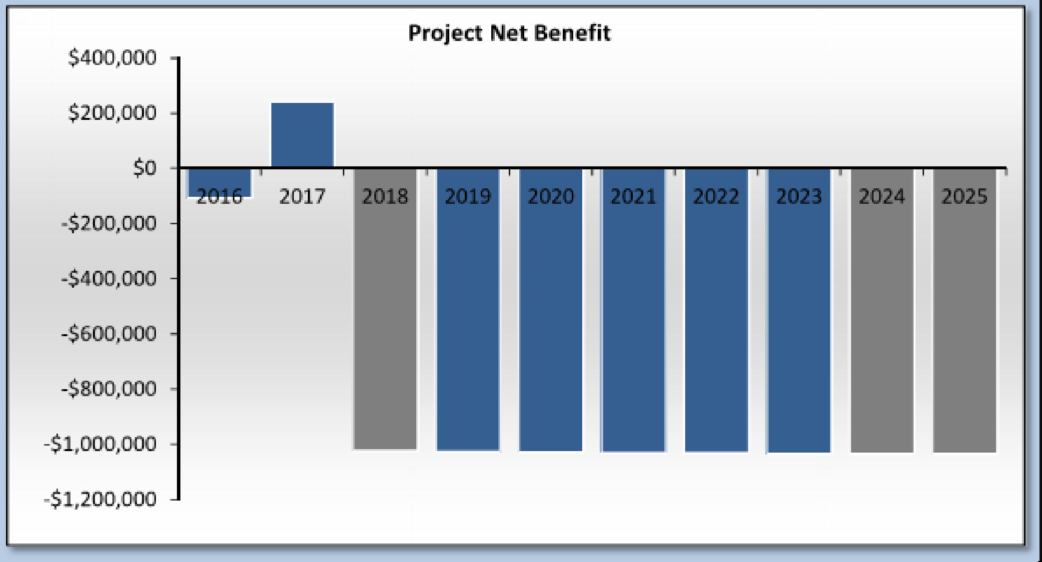
Project Economics: Multiple Asset Decision (MAD) Module

MAD MODULE OUTPUT: MadisonMonroeGunnison 2017

SAVINGS DUE TO RESTORATION OPPORTUNITY	
Year of restoration opportunity (#)	2017
Restoration savings (%)	100.0%
Restoration savings ($)	$377,207
Moratorium cost ($)	$24,000
Moratorium duration years (#)	25
Avoided moratorium risk savings ($)	$446,222
Failure Multiplier	4.00
Duration of Risk Savings Benefit (Yrs)	124
Risk Savings	$462,558

PROJECT SAVINGS DUE TO EFFICIENCY	
Efficiency savings (%)	35%
Efficiency savings ($)	$672,754

PROJECT RESULTS	
Optimal project year	2017
Project cost in optimal year	$1,249,400
Optimal project net benefit	$240,963
Opportunity project year	Same As Optimal
Project cost in opportunity year	Same As Optimal
Opportunity net benefit	Same As Optimal
2016 benefit/cost ratio	N/A



COST-BENEFIT TABLE	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Deviation cost	$1,690,150	$1,680,501	$1,670,773	$1,660,967	$1,651,081	$1,641,118	$1,631,076	$1,620,957	$1,610,760	$1,600,485
Efficiency savings	$672,754	$659,951	$647,391	$635,071	$622,985	$611,129	$599,499	$588,090	$576,898	$565,919
Restoration savings	$0	$370,029	$0	$0	$0	$0	$0	$0	$0	$0
Moratorium savings	$446,222	$437,730	$0	$0	$0	$0	$0	$0	$0	$0
Risk Savings	$462,558	$453,756	$0	$0	$0	$0	$0	$0	$0	$0
Net Benefit	-$108,616	$240,963	-$1,023,382	-$1,025,896	-$1,028,096	-$1,029,989	-$1,031,577	-$1,032,867	-$1,033,861	-$1,034,566

ASSET DEMOGRAPHICS

Material	TOTALS	DI	CI WW2	CI OLD	CI	AC	PLS	GLV	STL	COP	PVC	OTHER
Length	6,976.12	24.93	5,384.54	1,566.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Original Failure Probability	23.64%	0.00%	20.88%	2.76%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Modified Failure Probability	94.56%	0.01%	83.53%	11.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Generated 9/22/2016

Multiple Asset Decision (MAD) Module

What are inputs to the MAD module?

- Discount Rate (%)
- Failure Multiplier
- Year of Restoration Opportunity
- Restoration Savings (%)
- Duration of Risk Savings Benefit
- Efficiency Savings (%)
- Minimum Project Cost
- Moratorium Cost ($)
- Moratorium Duration Years
- Optimal Project Year

SAVINGS DUE TO RESTORATION OPPORTUNITY	
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Multiple Asset Decision (MAD) Module

Most important/impactful assumptions:

Failure Multiplier

Restoration Savings (%)

Efficiency Savings (%)

Minimum Project Cost

Moratorium Cost

Moratorium Duration

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Assumptions of MAD Module

Failure Multiplier

- **Increases near term main failure probability**

MAD Table 1. Failure Multiplier Criteria

Multiple Asset Decision (MAD) Module Assumptions

Updated: 2/12/2016

Row	Criteria	Failure Multiplier
1	Subsection of AC Mains Within Project Limits Shows Fair/Poor Pipe Condition	1.50
2	AC Mains Near (But Not Within) Project Limits Shows Fair/Poor Pipe Condition	2.00
3	Permeable Pavements Installed Above Cast Iron Main	4.00
4	Major Utility Replacement Under or Along Length of Main (AC, Cast Iron, Galvanized)	4.00
5	Minor Utility Replacement Near Main (AC, Cast Iron, Galvanized)	2.00

* User to manually input selected values into MAD Module based on project characteristics.

+ See MAD Module Assumptions for clarifications and reasoning.

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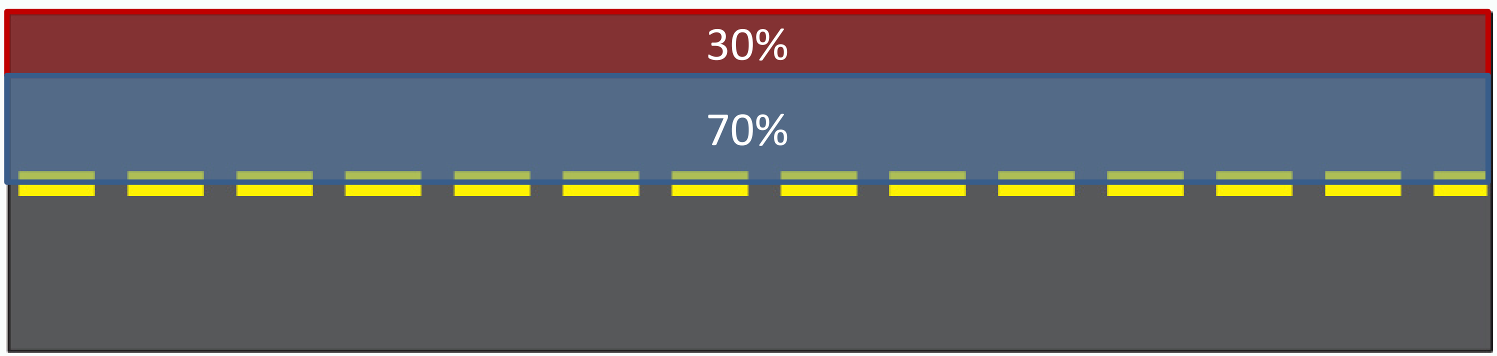
Assumptions of MAD Module

Restoration Savings (%)

- **% restoration costs that Tacoma Water will not have to pay (typically due to project partners)**



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Assumptions of MAD Module

Efficiency Savings (%)

- % of non-restoration project costs saved

MAD Table 2. Efficiency Tables
Multiple Asset Decision (MAD) Module Assumptions

Updated: 2/12/2016

2.A Economy of Scale

Length of Project (LF)	Efficiency Savings Percent
N/A	0%
0 - 100	0%
100 - 300	5%
300 -1000	10%
1000 +	15%

2.B Project Partners

# of Partners (other than Tacoma Water)	Efficiency Savings Percent
N/A	0%
0	0%
1	25%
2	35%
3 +	45%

* Sum applicable economy of scale value and project partners value for total efficiency savings.
+ See MAD Module Assumptions for clarifications, reasoning, and minimum project cost evaluation.

Assumptions of MAD Module

Minimum Project Cost

- **Assumed minimum $/LF of project**

MAD Table 3. Minimum Project Cost

Multiple Asset Decision (MAD) Module Assumptions

Updated: 2/12/2016

			Project Length (LF)			
			0 - 100	100 - 300	300 -1000	1000 +
Jurisdiction	**Road Type**	**Restoration Costs**	**Minimum Project Cost($/LF)**			
Federal Way	Highway/Arterial	Full	$400.00	$375.00	$350.00	$325.00
Federal Way	Highway/Arterial	Minimum	$375.00	$350.00	$325.00	$300.00
Federal Way	Residential	Full	$350.00	$325.00	$300.00	$275.00
Federal Way	Residential	Minimum	$325.00	$300.00	$275.00	$250.00
Tacoma	Highway/Arterial	Full	$300.00	$275.00	$250.00	$225.00
Tacoma	Highway/Arterial	Minimum	$250.00	$225.00	$200.00	$175.00
Tacoma	Residential	Full	$275.00	$250.00	$225.00	$200.00
Tacoma	Residential	Minimum	$250.00	$225.00	$200.00	$175.00

* MAD Module project costs to reasonably comply with applicable minimum project cost from table.

+ See MADA Module Assumptions for clarifications, reasoning, and minimum project cost evaluation.

Assumptions of MAD Module

Moratorium Cost ($)

- **Additional cost not in economic model**
- **Includes**
  - Mitigation fees for cutting into new pavement,
  - Extended paving requirements for cutting into new pavement, and
  - Added costs for repairing a more expensive road
- **Shown as *benefit* of completing project**

Moratorium Duration

- **Number of years for which a moratorium cost persists (moratorium period)**
- **Typically 3-7 years**

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Net Benefit

How is it calculated?

- Net Benefit = Benefits – Costs

Do we do projects with negative Net Benefit?

- Benefit Cost Ratio of 0.90
- Use best judgement for 0.80-0.90
- Assumes 90% confidence in economic model
- Triple Bottom Line assessment

What is included in Net Benefit calculation?

- All materials, labor, pavement restoration costs, taxes, A&G
- Not included: contingency

How is Net Benefit shown?

- Alternative vs. Status Quo

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Future Work

- FINALIZE LONG TERM MAIN REPLACEMENT STRATEGY SUMMARY DOCUMENT
- INCORPORATE VALVES, HYDRANTS, AND SERVICES INTO THE MODEL
- COMPLETE MAIN REPLACEMENT UTILITY SURVEY
- OPTIMIZE CONDITION ASSESSMENT SELECTION
- INCORPORATE LEVEL OF SERVICE INTO THE MODEL
    - FIRE FLOW
    - PRESSURE
    - MAIN BREAKS
- INCORPORATE ALTERNATIVE MAIN REPLACEMENT METHODS (LININGS, ETC.)

Thank You

Ryan Flynn
Tony Lindgren
Tonya Dixon
Ali Polda
Seth Doull
Jonathan Schlaudraff
Andy Simpson
Keith Burdette
Corey Bedient
Michael Washington
Danial Broussard
Jodi Collins
Jenn Laughlin
Lyna Vo
Frank Blaha

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Thank You

American Water Works Association
Pacific Northwest Section

2017 PNWS-AWWA EXCELLENCE IN ENGINEERING BEST PLANNING PROJECT

Tacoma's Economic Model Team:

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Seth Doull
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QUESTIONS?

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Strategic Main Replacement Program:

$32 million+
60+ Business Cases
One Economic Model
“The right money, on the right mains, at the right time.”

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BACKUP SLIDES

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AWARDS:

American Water Works Association Pacific Northwest Section

2017 PNWS-AWWA
EXCELLENCE IN ENGINEERING
BEST PLANNING PROJECT

TACOMA POWER TACOMA WATER TACOMA RAIL
TACOMA PUBLIC UTILITIES

TQ QUALITY STARTS WITH U

2017 TPU TOTAL QUALITY
MOST IMPORTANT LEGACY AWARD

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HOW LONG DOES DUCTILE IRON PIPE LAST?

Variable by environment and corrosiveness of soils

DIPRA (ductile iron pipe research association)

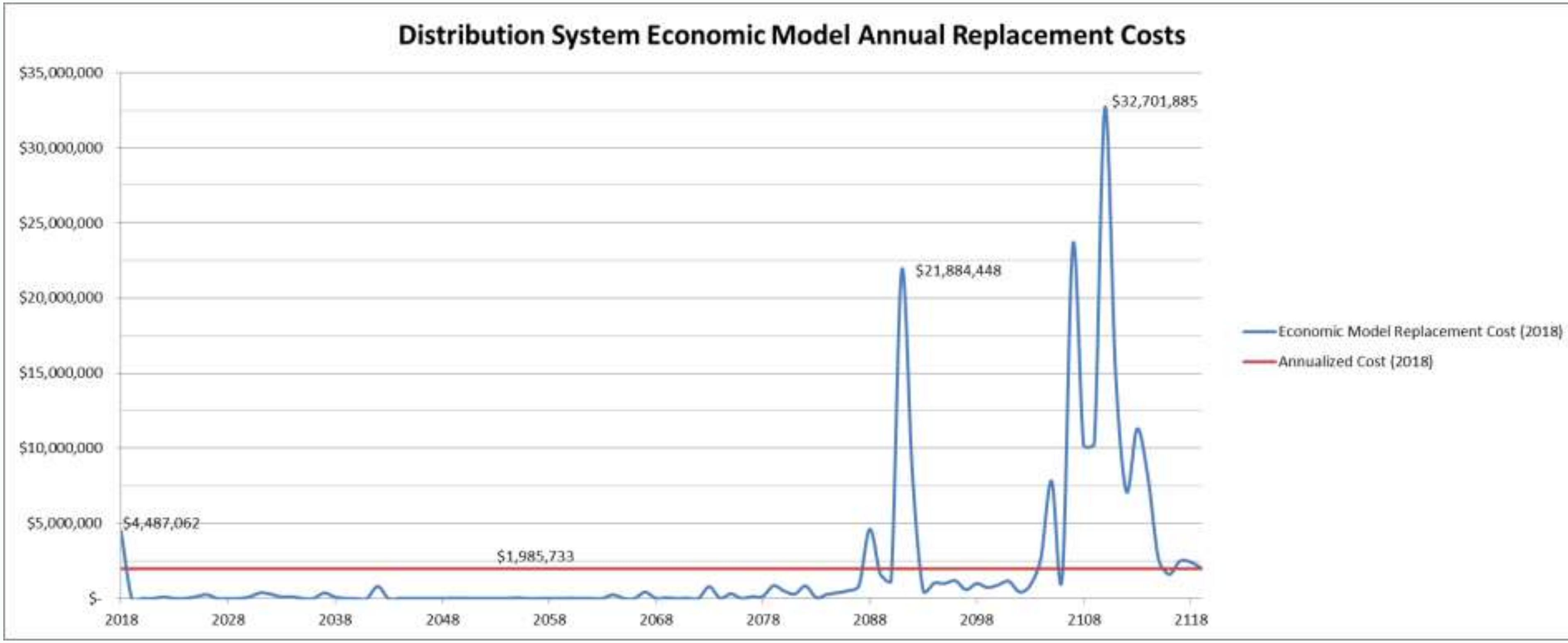
- **In the year 1455 AD cast iron pipe was installed in Siegerland, Germany.**
- **In 1664 more than 15 miles of cast iron pipe was installed to provide water to Versailles (King Louis XIV), lasted more than 330 years**

- **Evidence of cast iron lasting at least 100 years**
  - 567 North American cities
  - 150+ years in some places (27 North American cities, 2 as installed as early as 1816)
- **Design service life is typically at least 105 years**

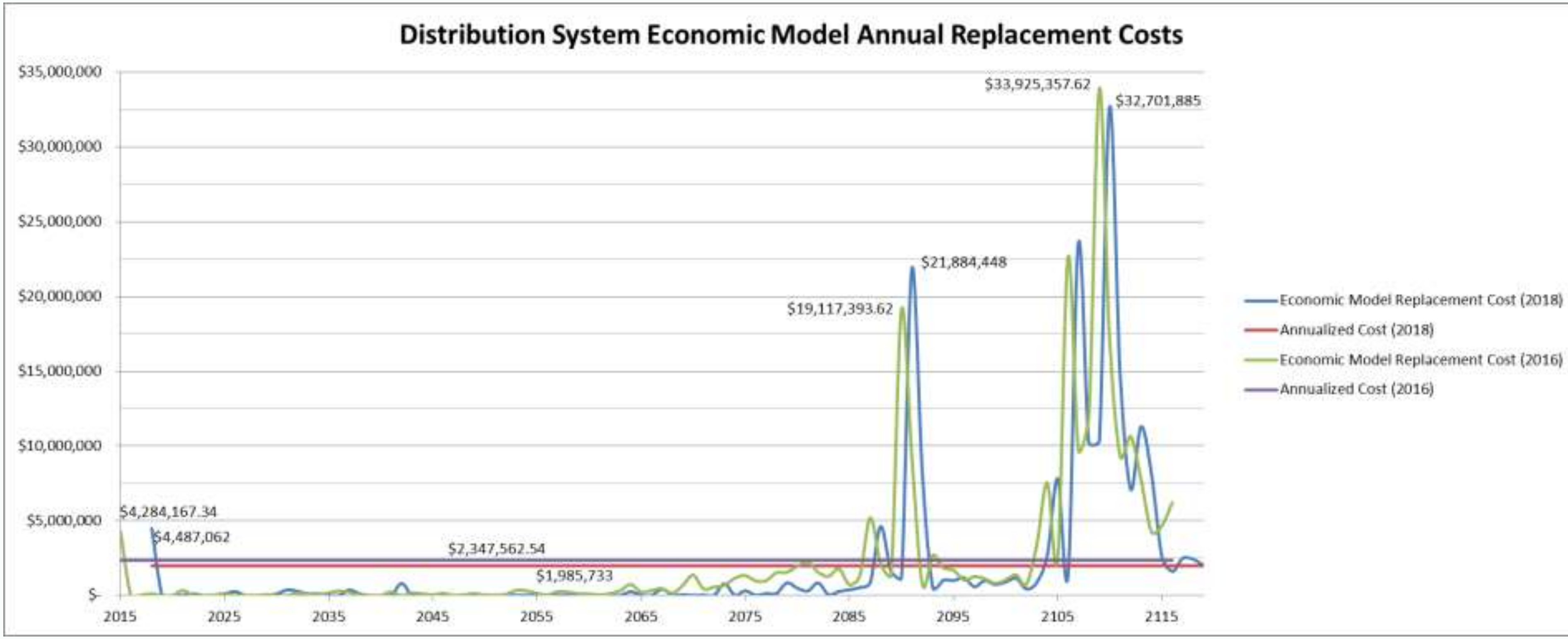
2017-2018 BUSINESS CASE #11

PROJECT OF OPPORTUNITY: MADISON, MONROE, AND GUNNISON - ENV. SERVICES PERMEABLE PAVEMENT AND SANITARY SEWER

100 Year Modeled Annual Replacement Cost



100 Year Modeled Annual Replacement Cost



Project Selection

INDUSTRY PRACTICE:

- **2017 AWWA Benchmarking Utilities**
  - Renewal and Replacement Percentage (Table 2-9D)

Percentile	Participating Utilities Annual Replacement %
75th	2.4%
Median	1.2%
25th	0.6%

(Tacoma ~0.44%)

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Project Selection

Water System Data	Tacoma Water
Distribution System Size (miles)	1,255
Annual Miles of Distribution Main Replacements (miles)	5.55
Annual Budget for Distribution Main Replacements	$7.7 M
Annual Distribution System Replacement Percentage (calculated)	0.44%
Annual Distribution System Pace of Replacement (years, calculated)	227
Method of Main Replacement Project Assessment/Selection	Risk Based Monetized Economic Model for Distribution Mains (Excel/Access)

ASSOCIATION OF METROPOLITAN WATER AGENCIES

INDUSTRY PRACTICE:
Future AMWA Survey

Key Principles – Biennial Budget

3 Paths to Project Selection, Same Economics

- **Economic Model & Condition Assessment**
  - 0-20 years outlook
  - Prioritize by partnering and consequence cost, if needed
- **Planned, Coordinated Projects**
- **Projects of Opportunity**

Net Benefit Analysis using MAD Module

- **Budget if: Benefits Cost Ratio ≥ 0.90**
- **Engineering Judgement if: Benefit Cost Ratio = 0.80-0.90**

Triple Bottom Line Assessment

Stay apprised of new break/cost data as system ages

Review Economic Model Assumptions Before Each Budget Cycle

Include basic probability assessment of each project likelihood

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Key Principles – 10 Year CIP

CIP Development

- **New CIP created every 2 years**
- **Replace a minimum amount of pipe each year**
  - Best practice is replace as you go
  - Project selection based on net benefit analysis and opportunities
- **Project future spending by assuming 300 year replacement rate**
  - Replace minimum of 0.33% of system annually
  - This is conservative (meaning to err on the side of less annual pipe replacements than more)
- **Assume:**
  - System growth of 6.5 miles per year
  - Existing distribution system is 1,255 miles in length
  - $1,000,000 per mile of pipe replacements
- **Base FRP, WDP, LID/Contract, and Proposition 3/A budgets off of historical values or known projects**

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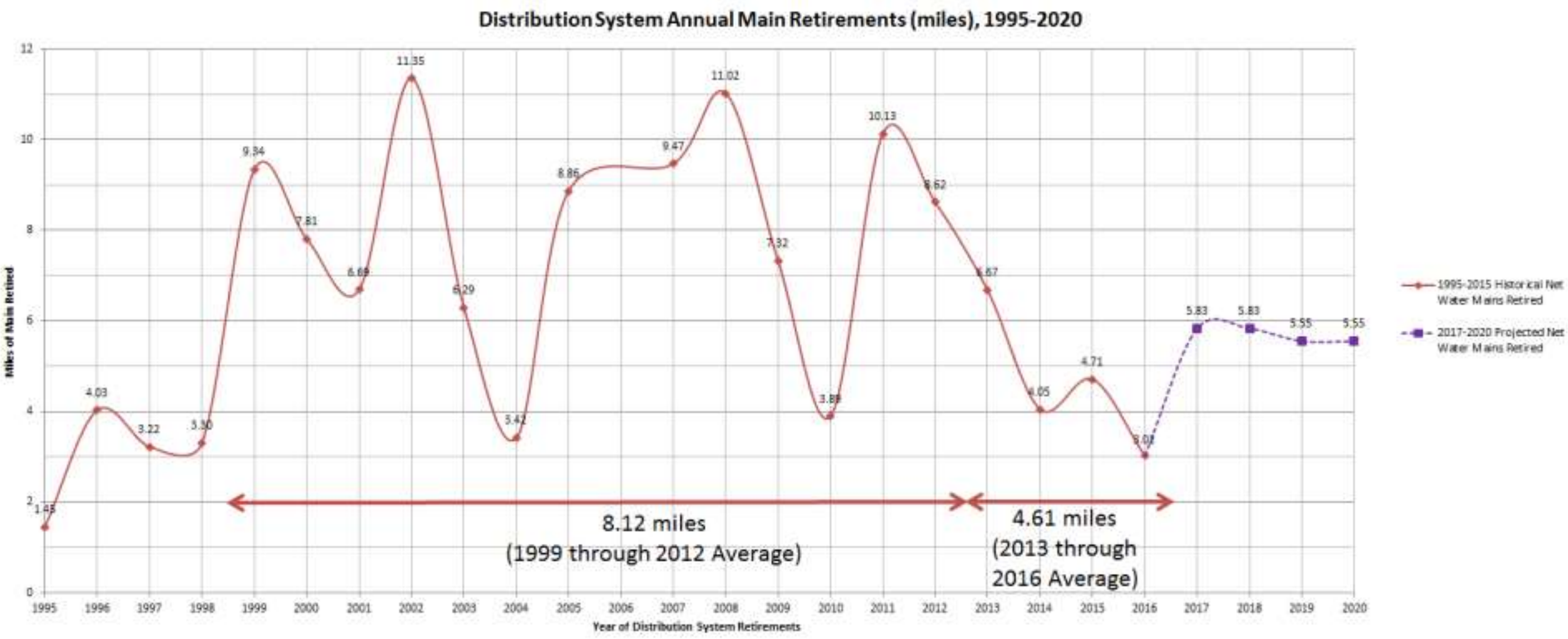
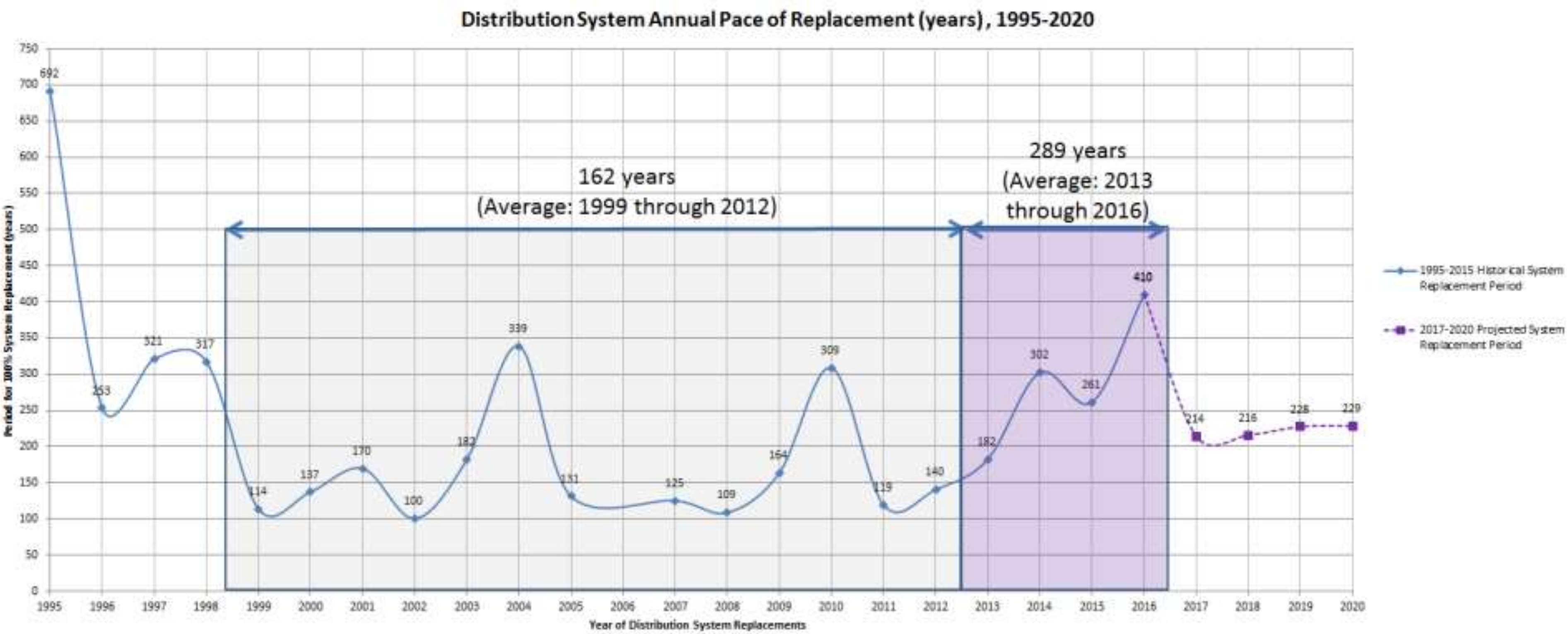
Annual Replacement Rate



Annual Replacement Rate



NOTABLE DOLLAR VALUES

$7,706,430

- **Annual budget request for 2019-2020 biennium ($15,412,486 total)**

$2,450,923,844

- **Total distribution system replacement Cost (plant value)**

0.314%

- **Annual percent of plant value replaced**

318 years

- **Spending pace of replacement for complete system renewal**

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NOTABLE LENGTH VALUES

5.55 miles

- Annual main replacement pipe length for 2019/2020 biennium (11.1 miles total)

1,255 miles

- 2018 Total Distribution system total pipe length

0.44%

- Annual percent of total pipe length replaced

227 years

- Pipe length pace of replacement for complete renewal

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2017 Model Updates

Improved Economic Model calculations by adding:

- Tax
- A&G
- Pipe Casings

Reviewed Economic Model replacement costs/multipliers:

- Internal design costs
- Open cut pipe costs
- Pavement restoration costs
- Failure multipliers

Added BlueWave features and support:

- Moved Economic Model and MAD Module to production server
- Added pipe casing data
- Improved MAD Module project tracking (draft/published/archived status)
- Added Economic Model project reports creation
- Added Economic Model BlueWave analysis layers

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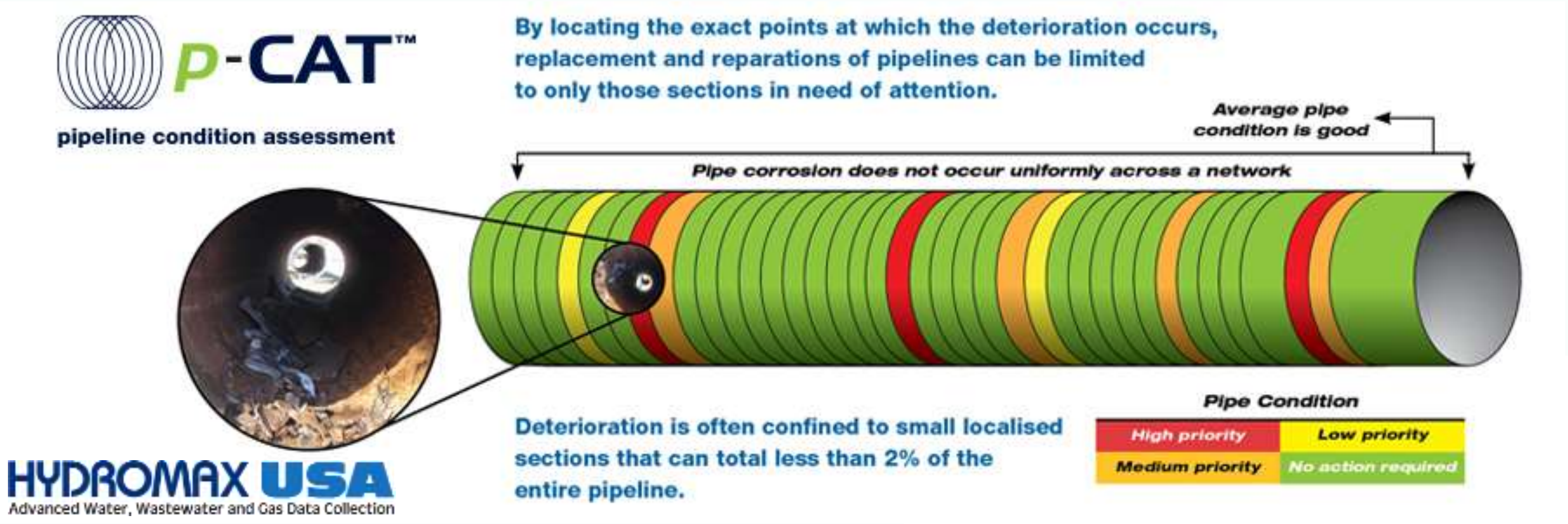
Technology

- **Pipe Linings**
- **Seismic Resilience**
- **Satellite Leak Detection**
- **Leak Detection Monitoring**
- **Advanced Condition Assessment**
    - Average vs. localized data



Project Selection

INDUSTRY PRACTICE:

- **2017 AWWA Benchmarking Utilities**

Table 2-9D Aggregate data for the system renewal and replacement indicators (%)—water transmission and distribution

	75th percentile	Median	25th percentile	Sample size
Water utilities	2.4%	1.2%	0.6%	28
Combined utilities—water operations	2.8%	1.7%	0.7%	34

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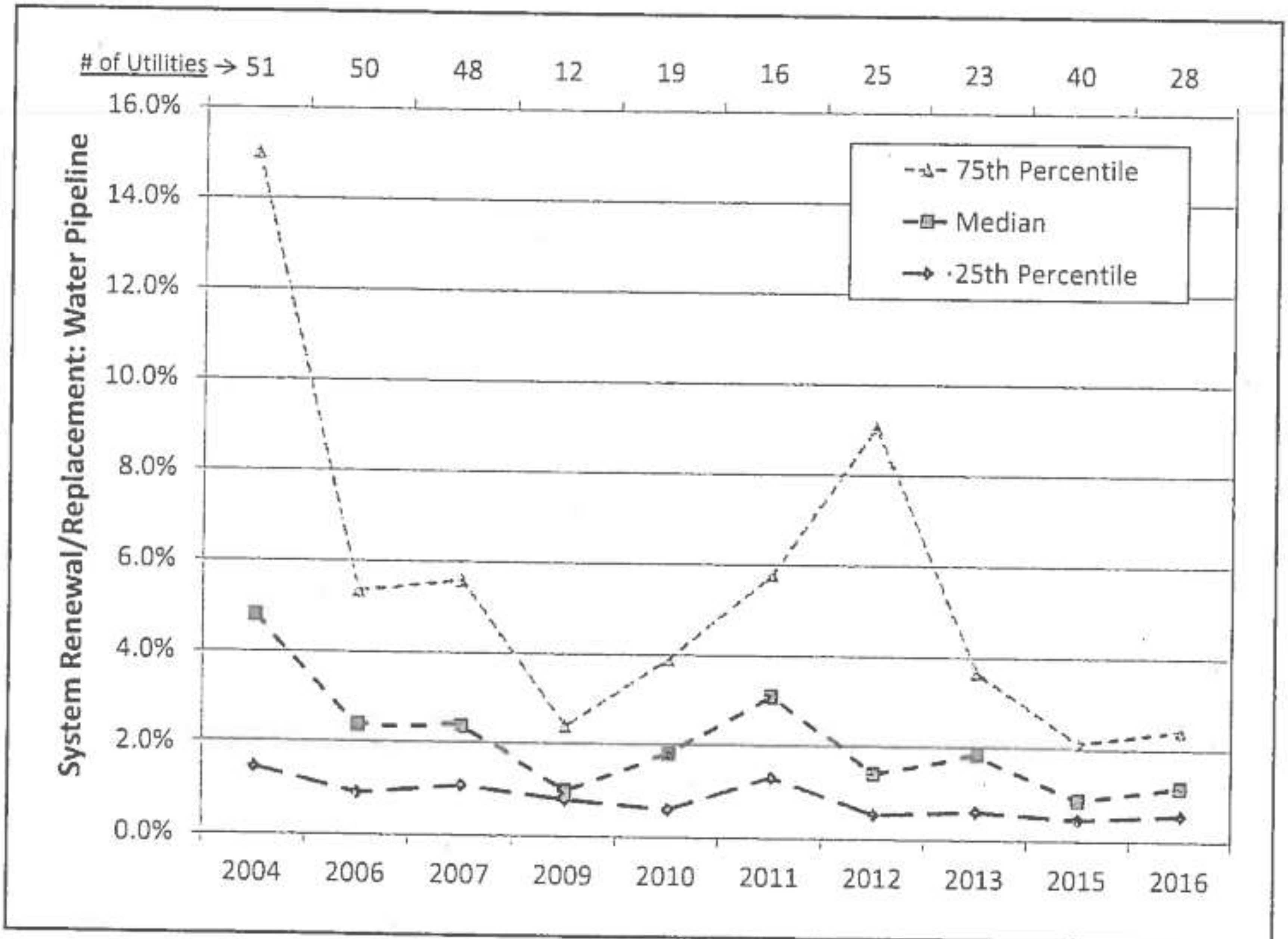

Figure 6-14 Water utility—system renewal/replacement: water pipeline

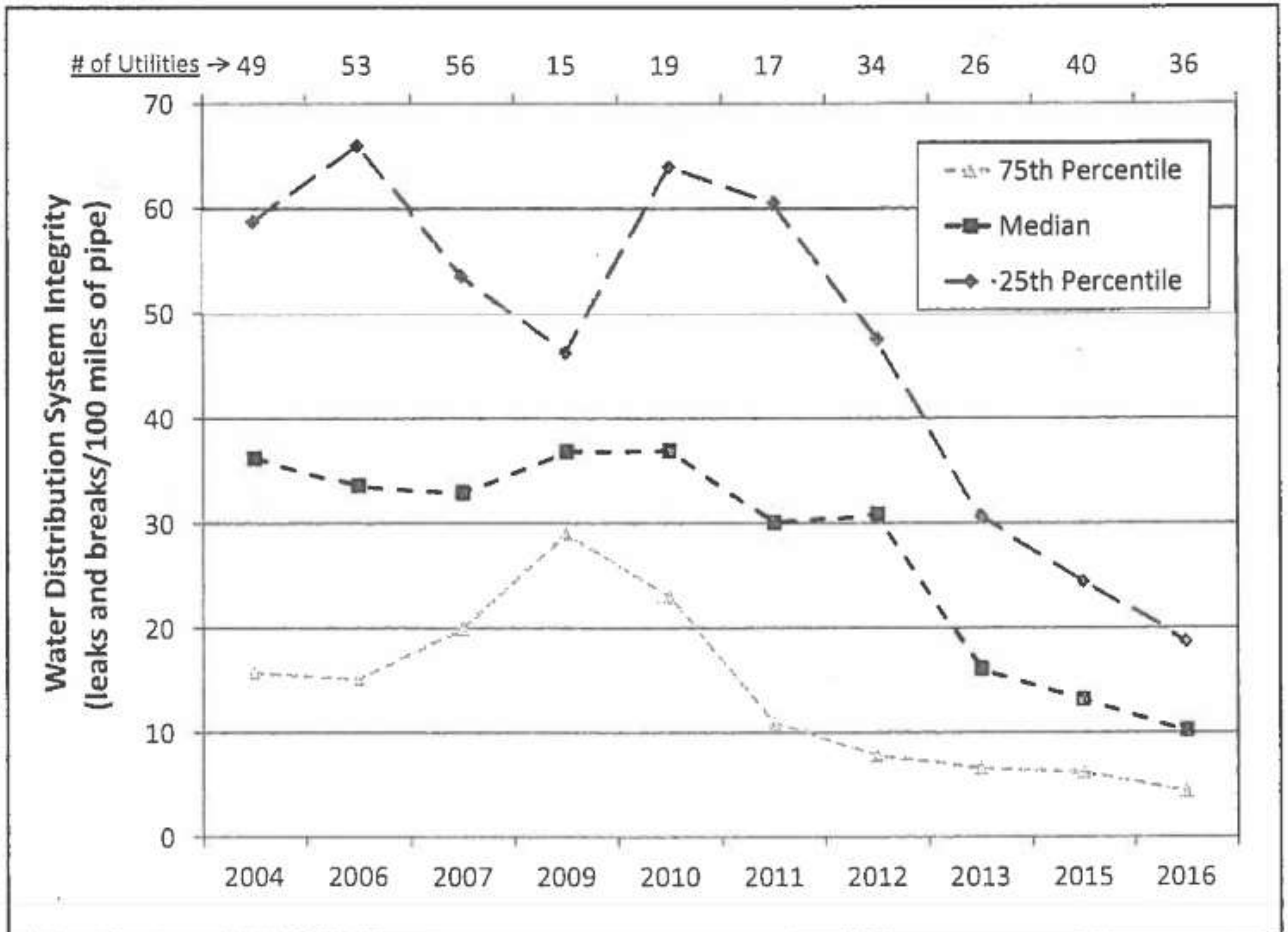

Figure 6-36 Water utility—water distribution system integrity (leaks and breaks/100 miles of pipe)

Big Picture Thinking

Work with our customers' best interests in mind

- Is there less maintenance required with more replacements?
- Do we have fewer main breaks with more replacements?
- Do rates change significantly if the replacement rate changes?
- Do we need to replace mains? If so, how many?
- Does water quality change with more replacements?