



# Performance Investigation of Different Large Diameter Water Pipe Materials

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# Disclaimer

All pipe materials have advantages and limitations, and can deteriorate over time. Many project specific factors, operations and maintenance procedures of a specific utility, and site and soil conditions around the pipe affect pipe performance. Not all of these factors were considered in the literature used this presentation, or considered in the limited utility survey responses received. Therefore, this presentation cannot be used as basis for selection or rejection of any specific pipe material, and/or to make any design decisions on a project, which is responsibility of design professionals.

# Outline

- Introduction and Background
- Pipe Materials
- Objectives
- Methodology
- Results
- Considerations for pipe material selection
- Conclusions

# Introduction and Background

- Water distribution and transmission networks form essential components of water supply systems
- Study done by the Center for Underground Infrastructure Research and Education (CUIRE)
- Focus is on large diameters (24 in. and larger) for water applications

# Pipe Materials

- High-density Polyethylene (HDPE) Pipe
- Polyvinyl Chloride (PVC) Pipe
- Cast Iron Pipe (CIP)
- Bar-wrapped Pipe
- Ductile Iron Pipe (DIP)
- Steel Pipe
- Prestressed Concrete Cylinder Pipe (PCCP)
- Other ( Reinforced Concrete, Asbestos Cement)

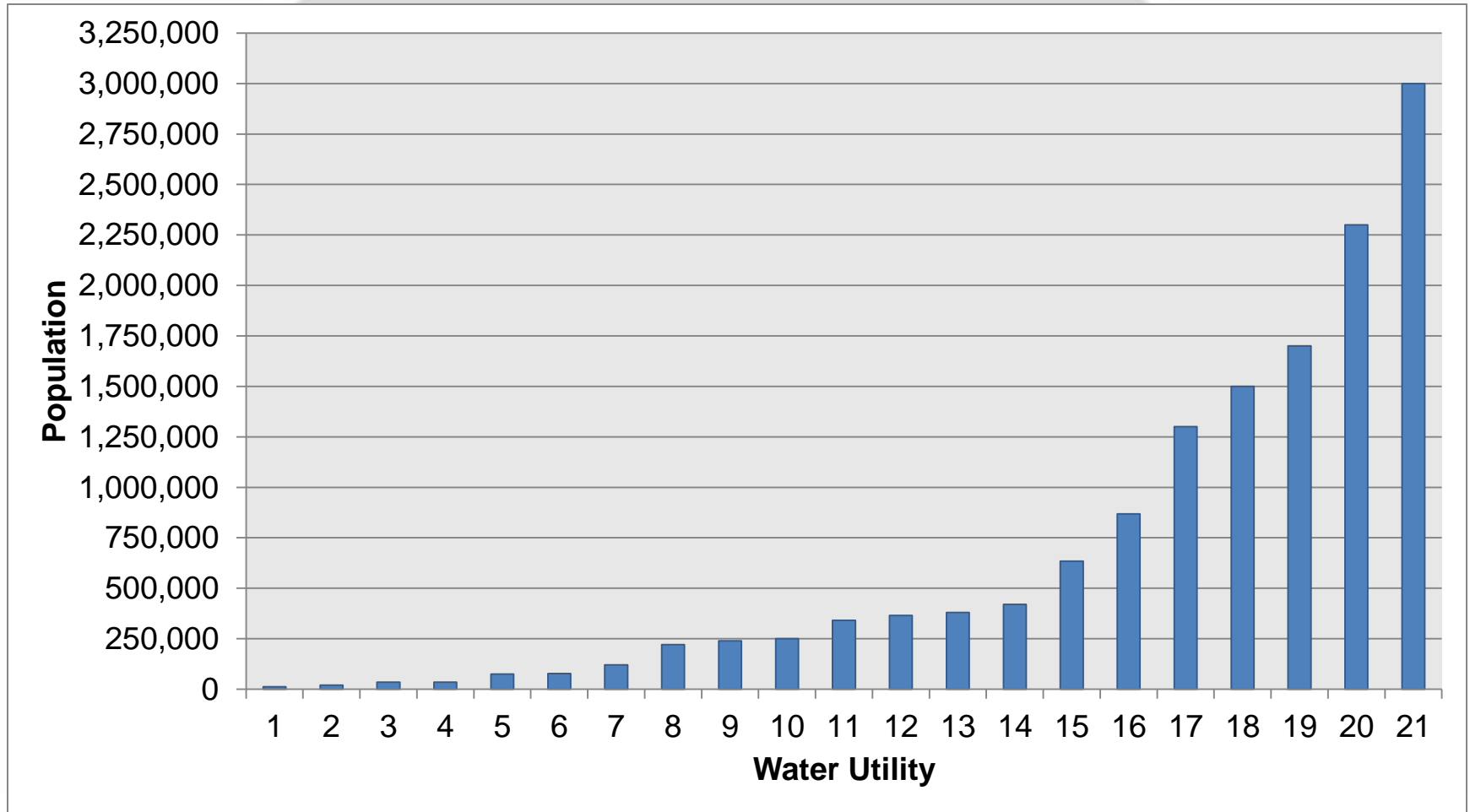
# Objectives

- Find details of pipe material inventory in different diameter ranges (24-in. to 36-in., 42-in. to 48-in., and 54-in., and larger)
- Identify considerations for not using pipe material
- Calculate performance of individual pipe material

# Methodology

- Survey Questionnaire
- More than 300 surveys sent to U.S. water utilities
- Data received from water utilities is used to analyze performance of pipe materials

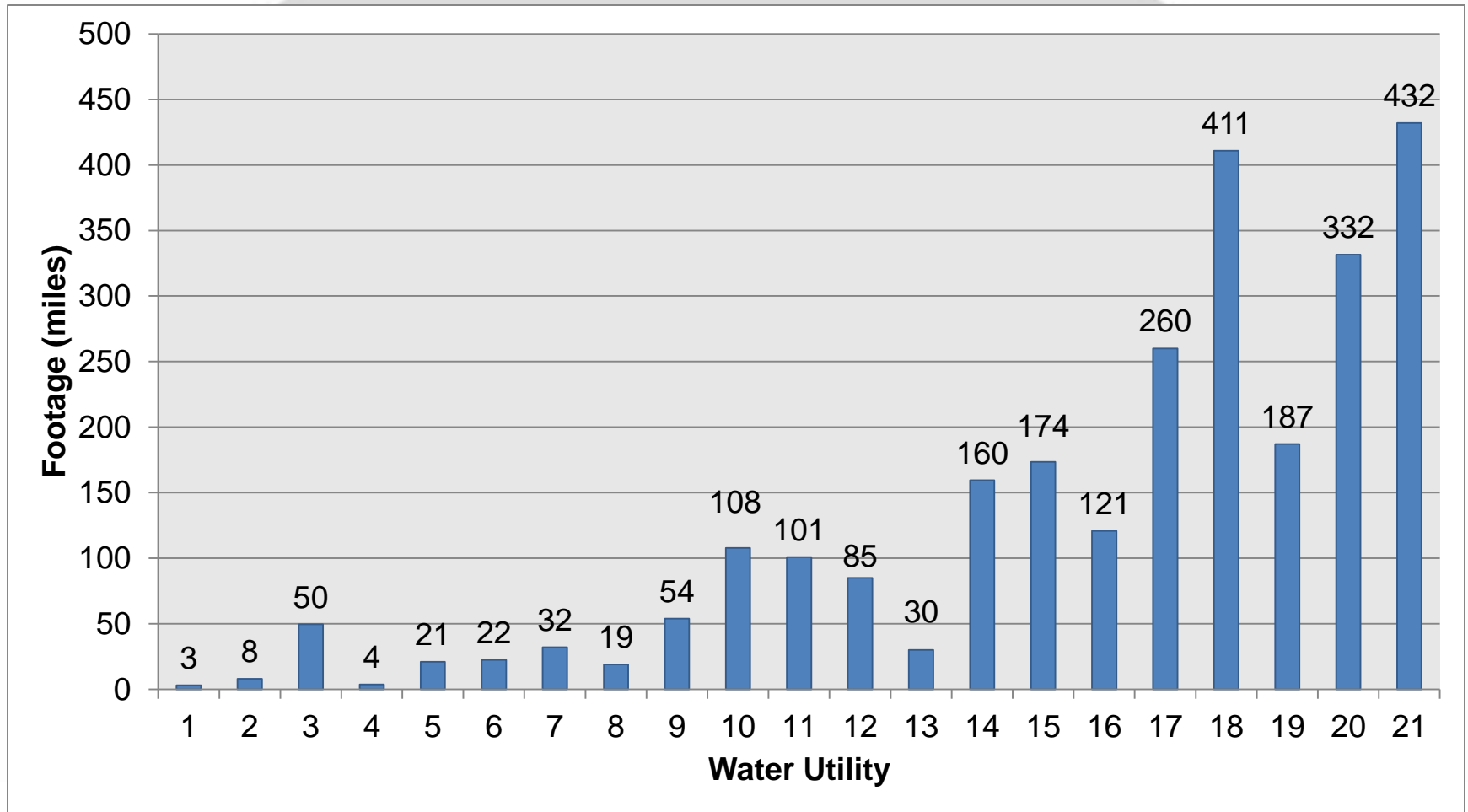
# Population Served by Water Utilities



Based on 21 Water Utilities

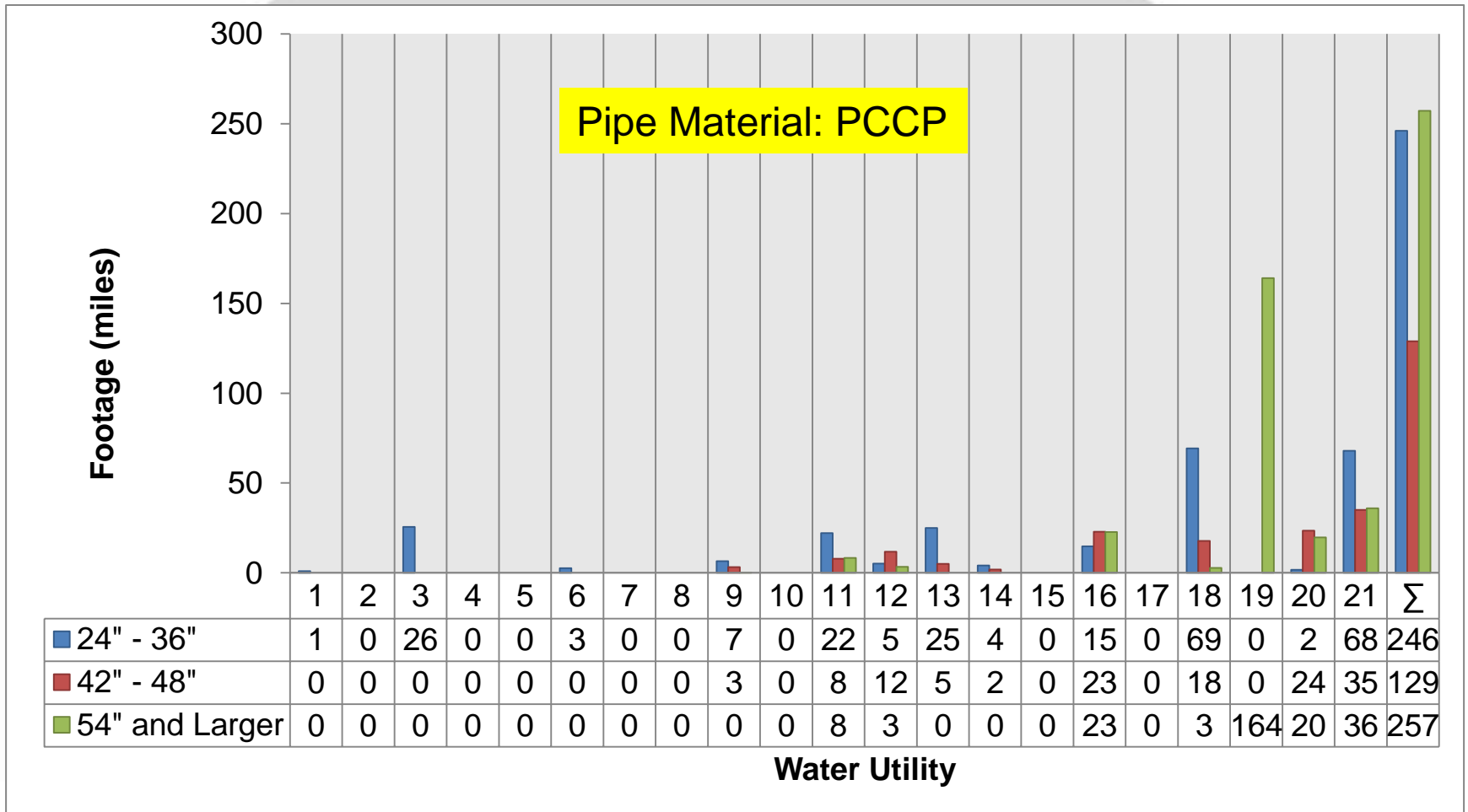


# Total Length of Water Pipelines



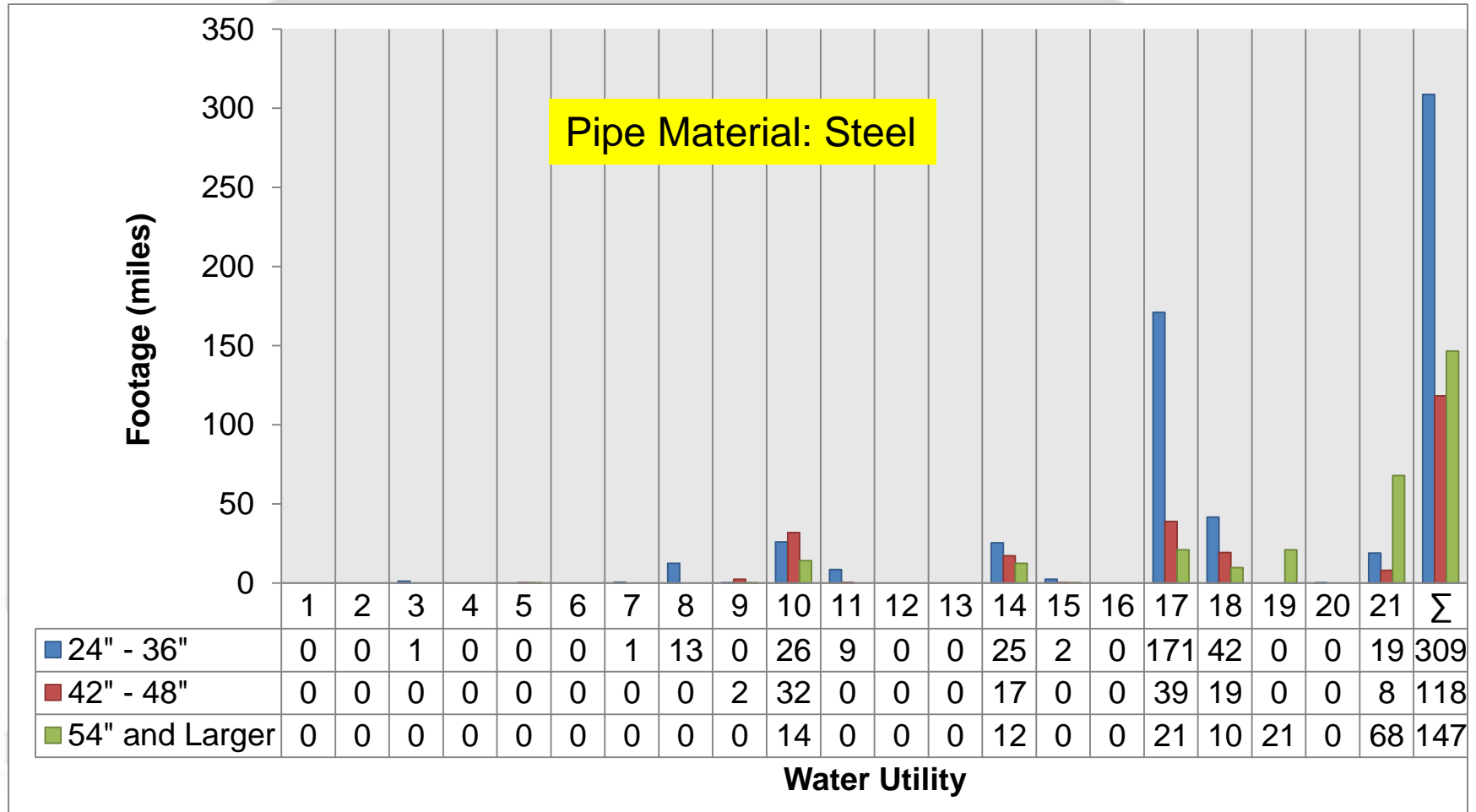
Based on 21 Water Utilities

# Footage of Water System



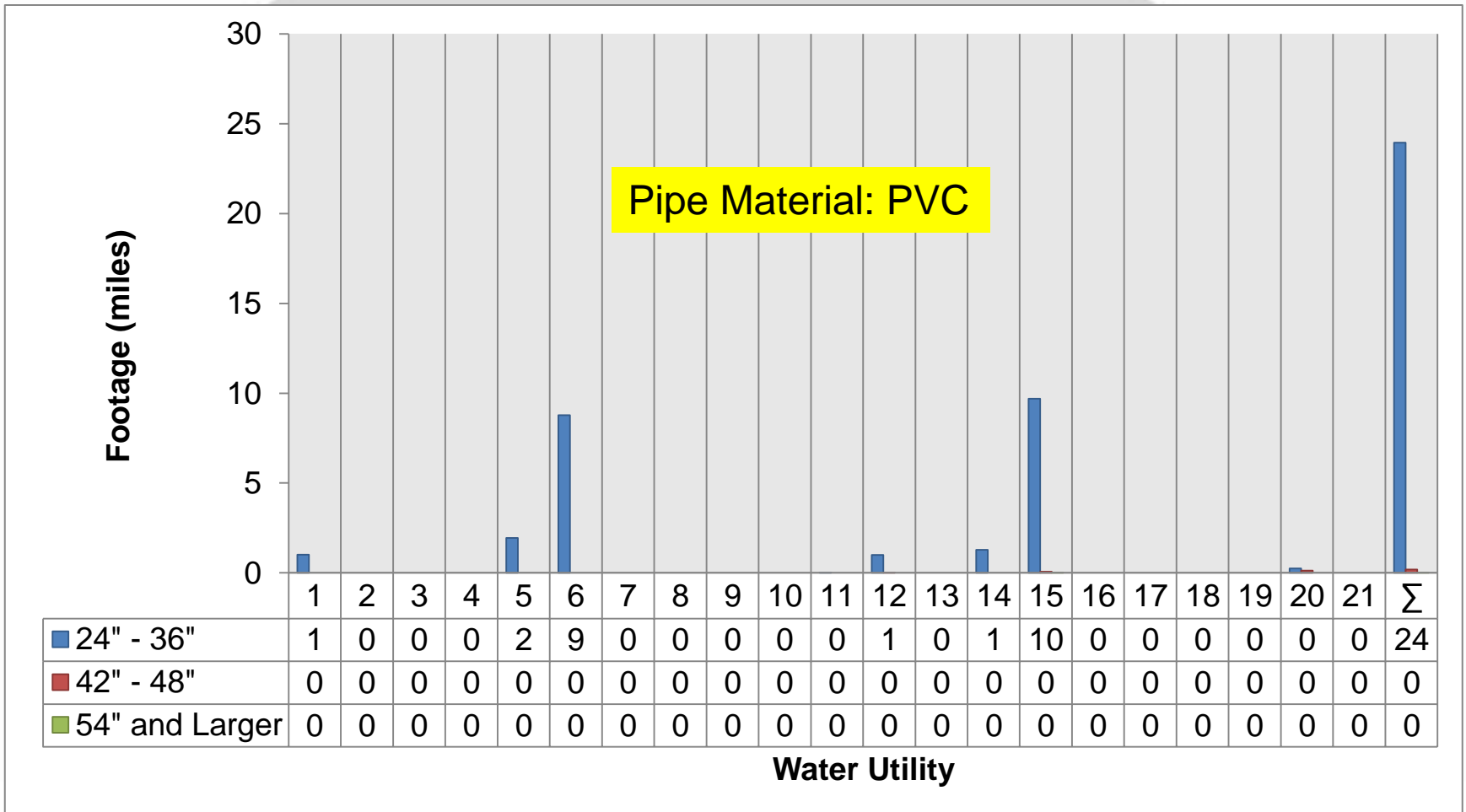
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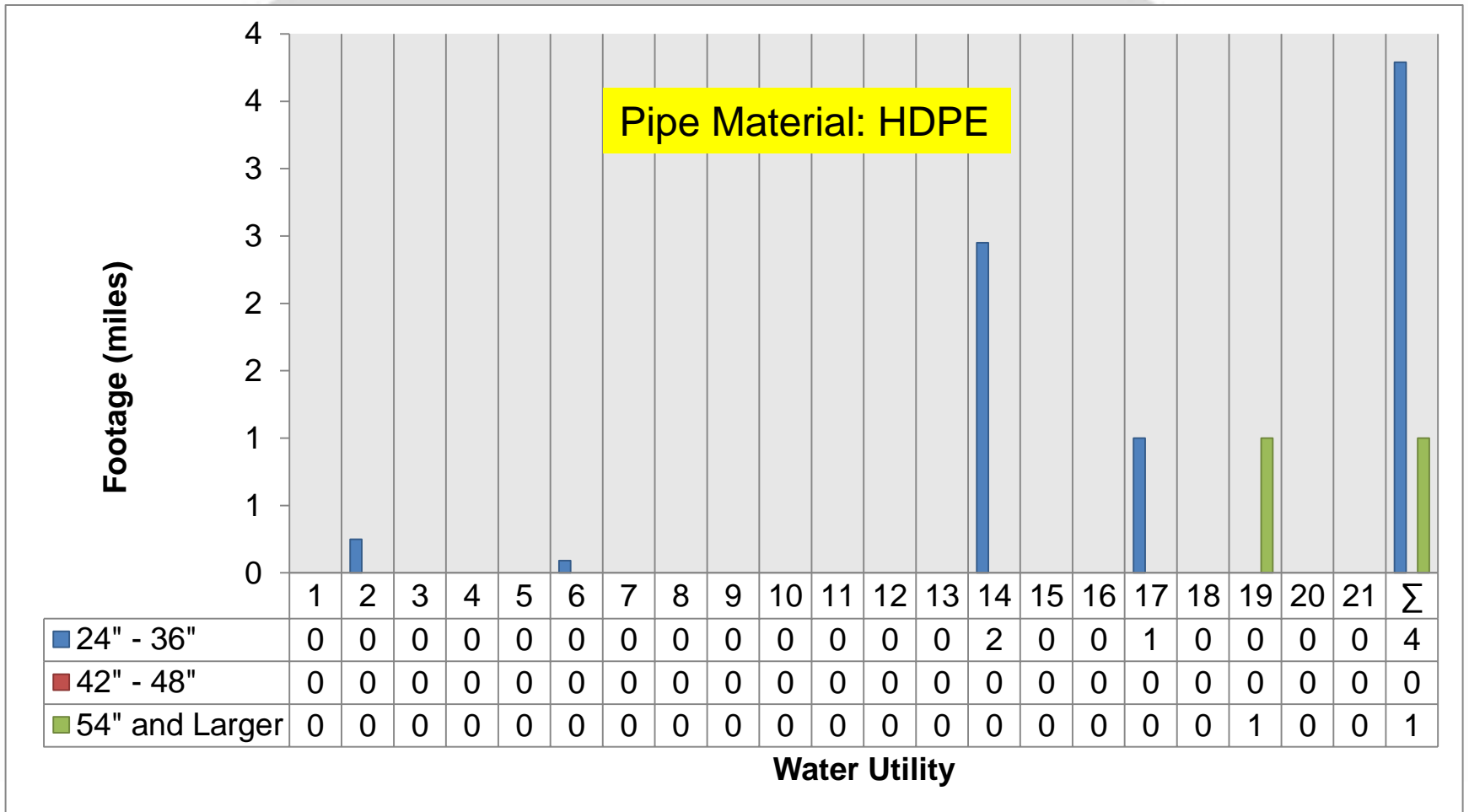
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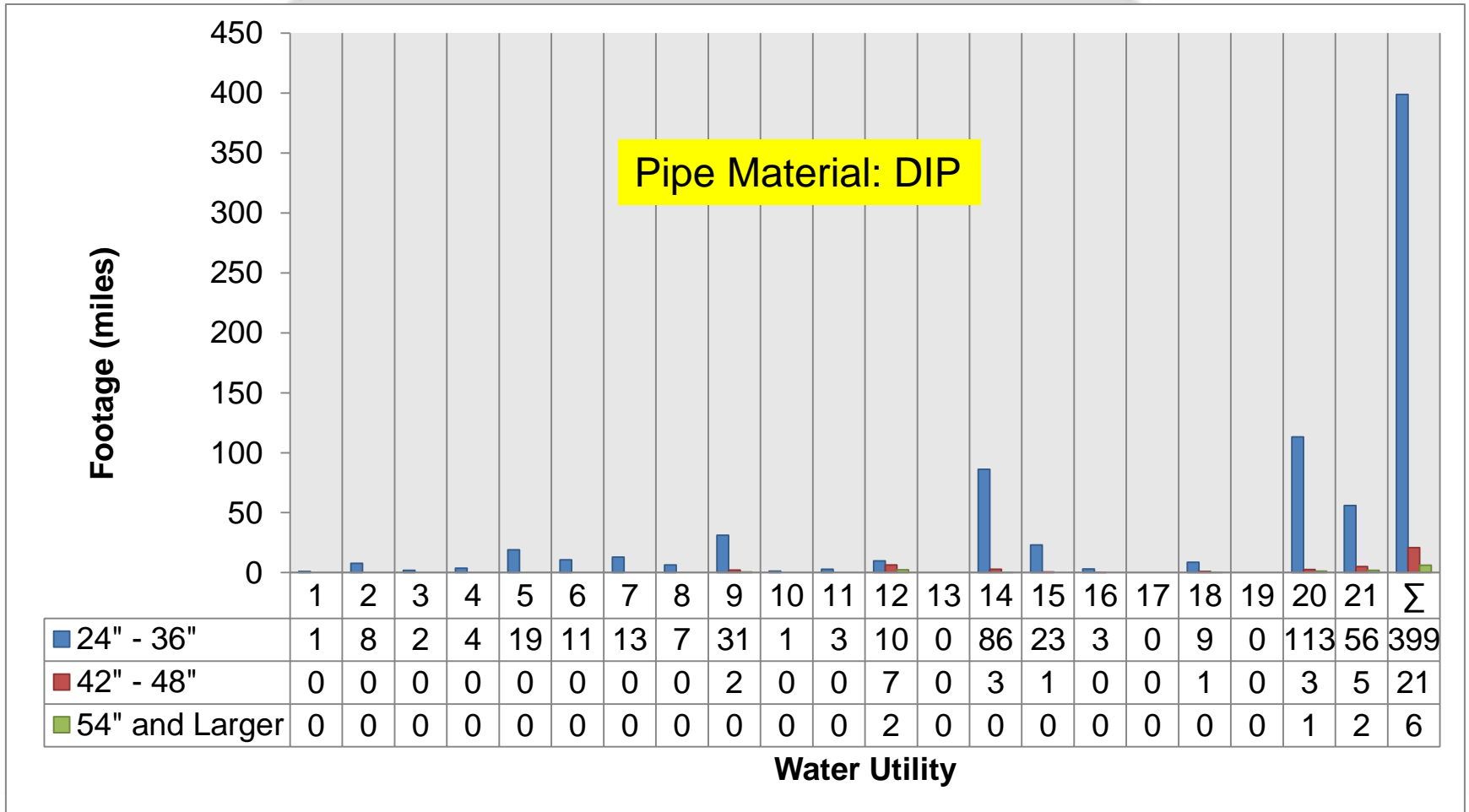
Based on 21 Water Utilities

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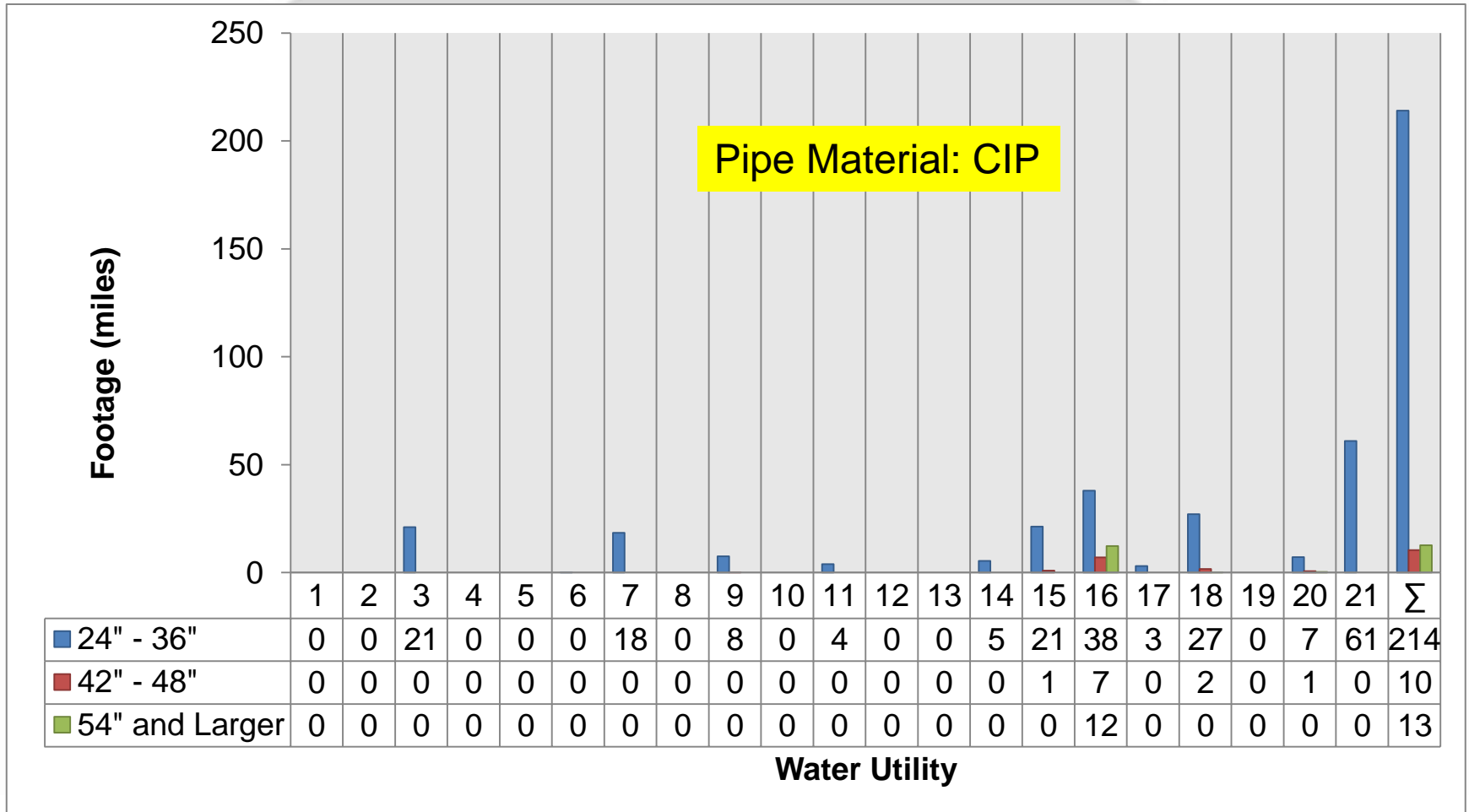
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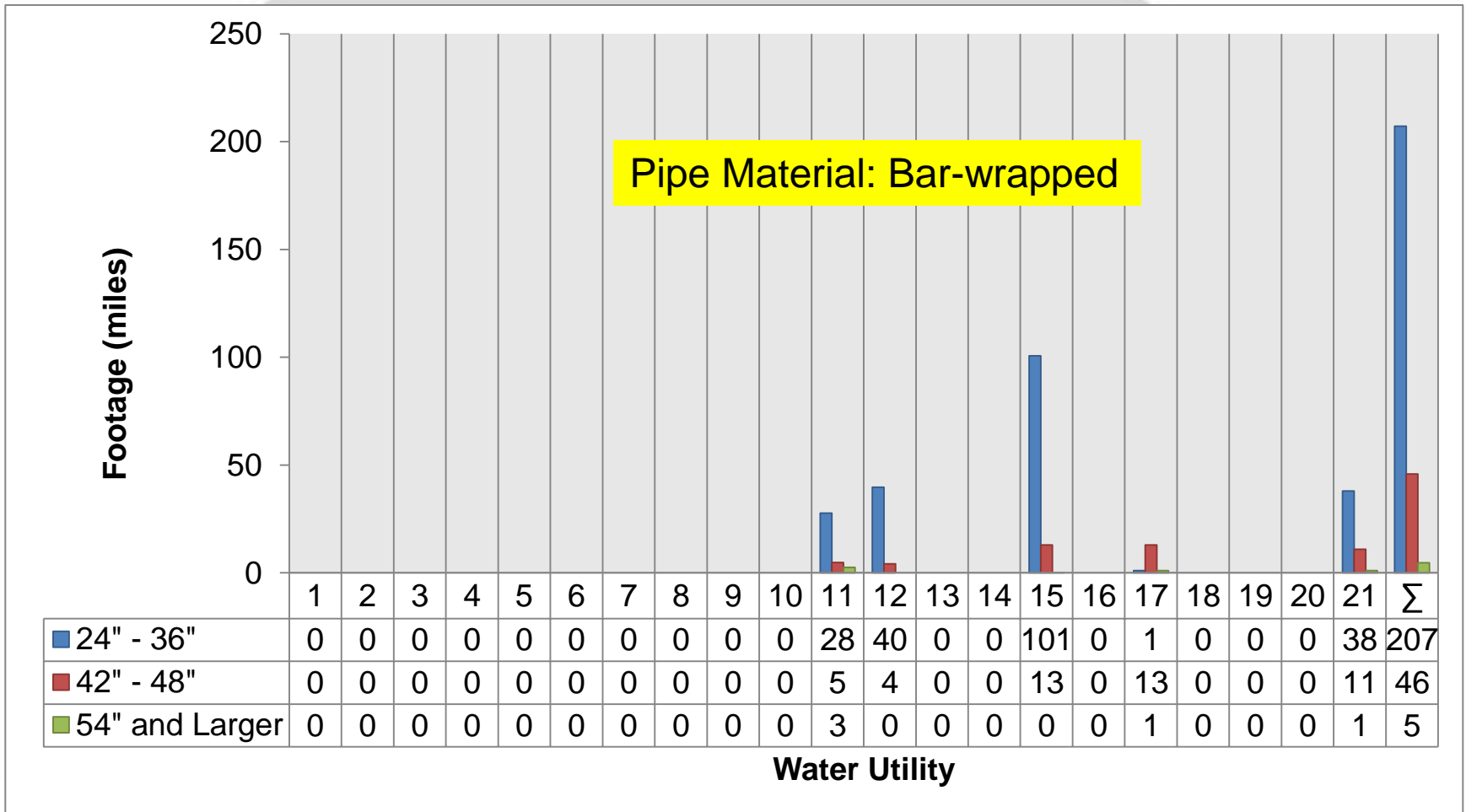
Based on 21 Water Utilities

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Based on 21 Water Utilities

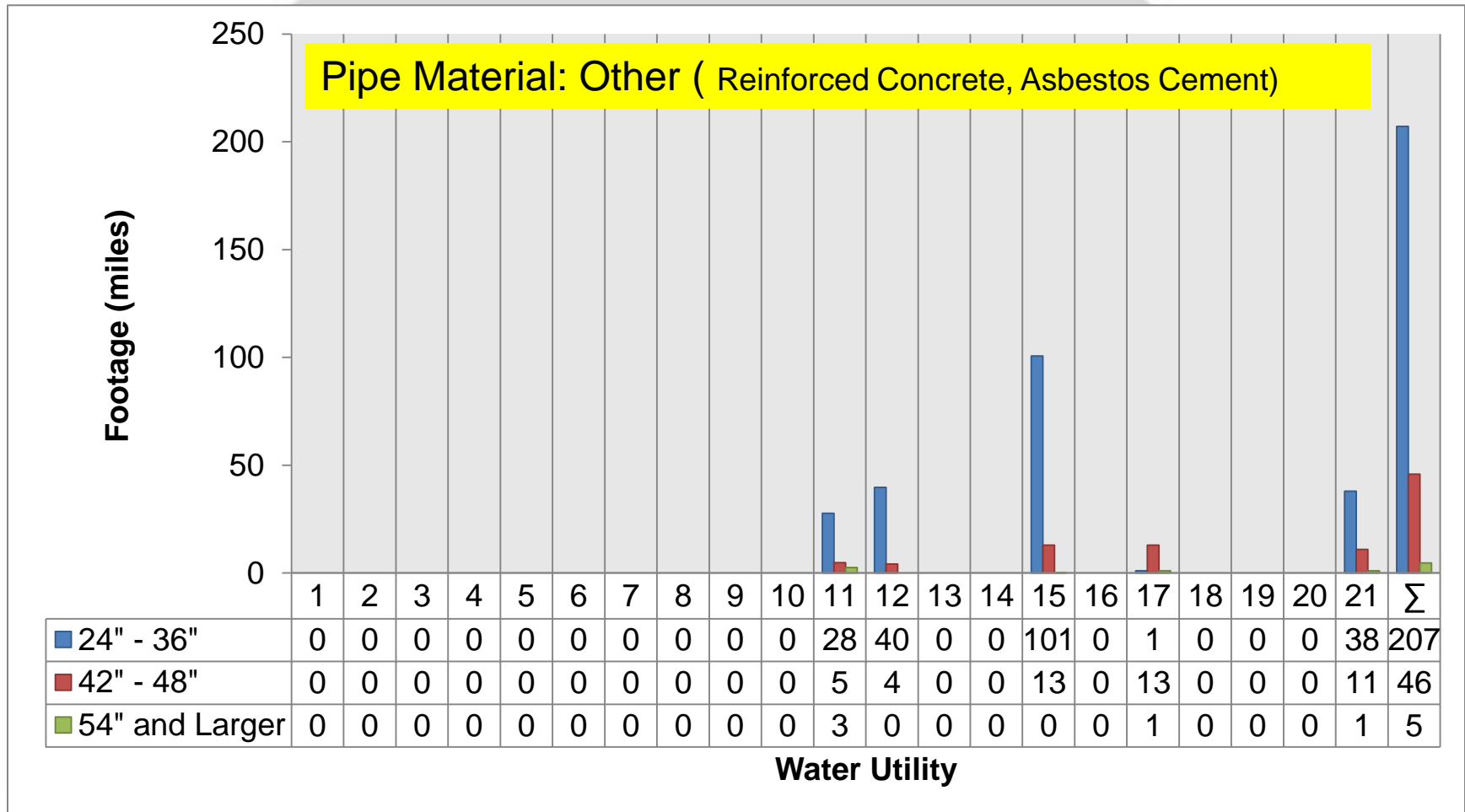
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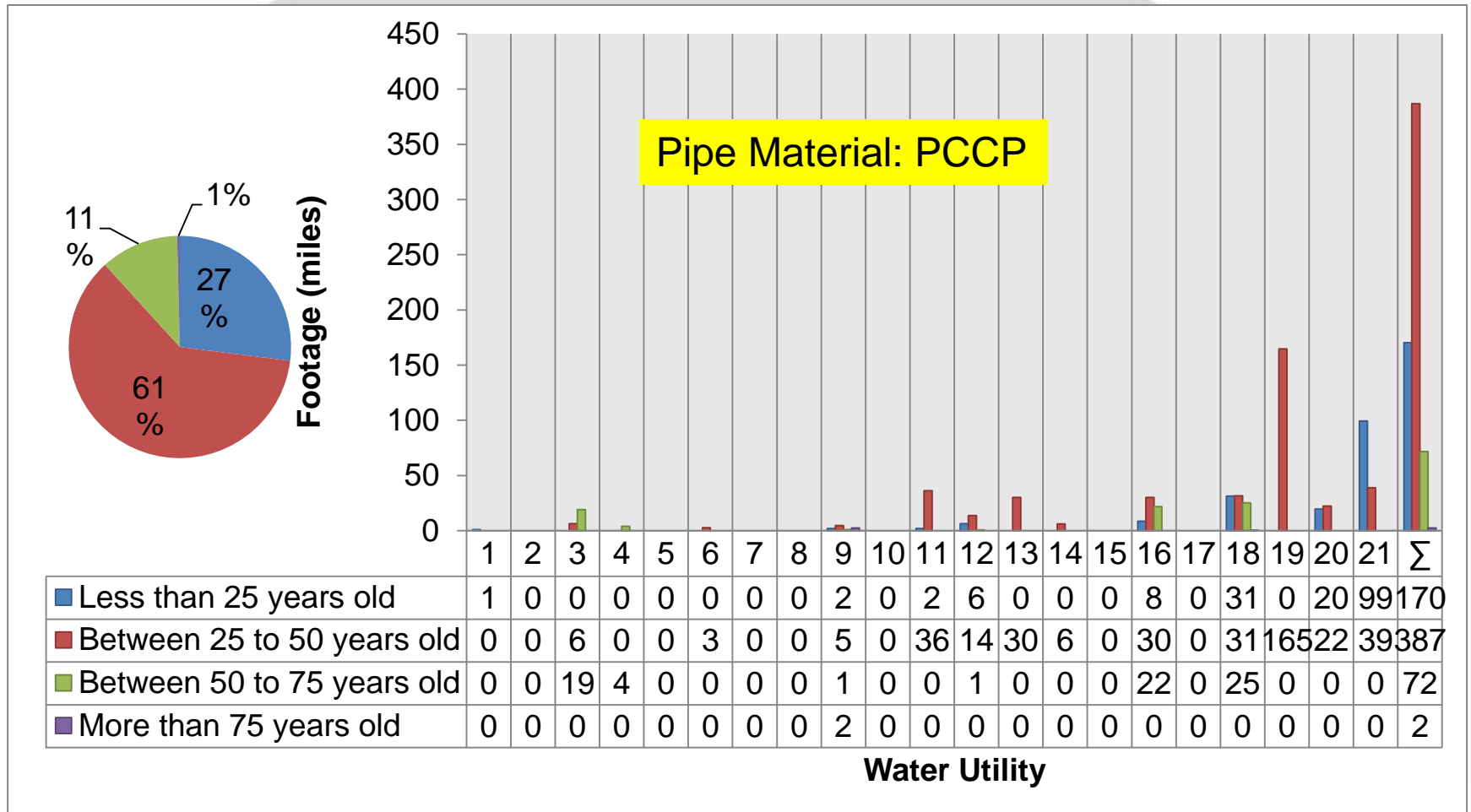
Based on 21 Water Utilities

# Summary

Pipe Material	Diameter Range			Total Footage (miles)
	24" – 36"	42" – 48"	54" and Larger	
HDPE	4	0	1	5
PVC	24	0	0	24
CI	214	10	12	236
Bar-wrapped	207	46	4	257
DI	399	21	6	426
Other	274	119	63	456
Steel	309	118	146	573
PCCP	246	129	257	632
Total	1,675	444	493	2,612

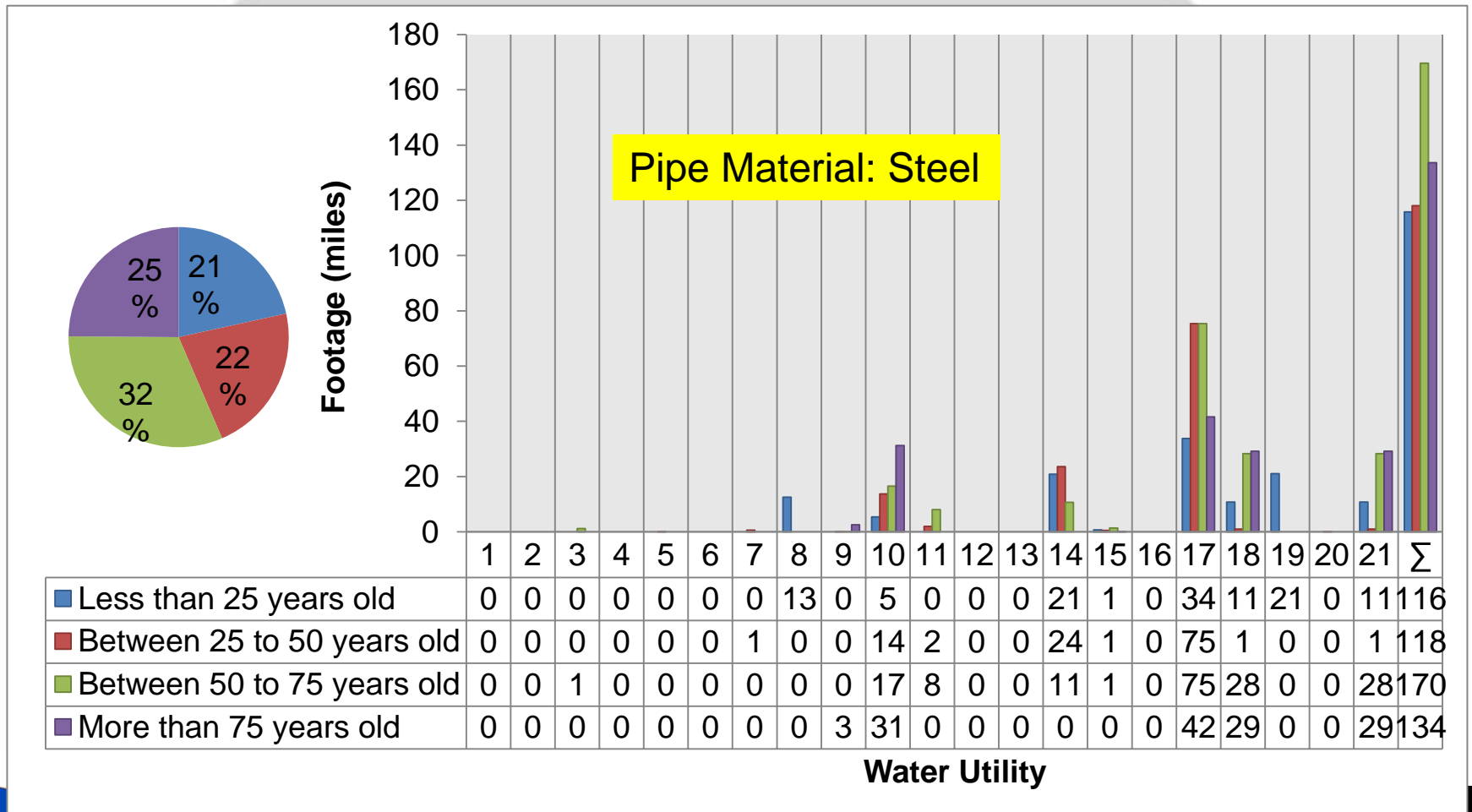
Based on 21 Water Utilities

# Relationship between Inventory and Age

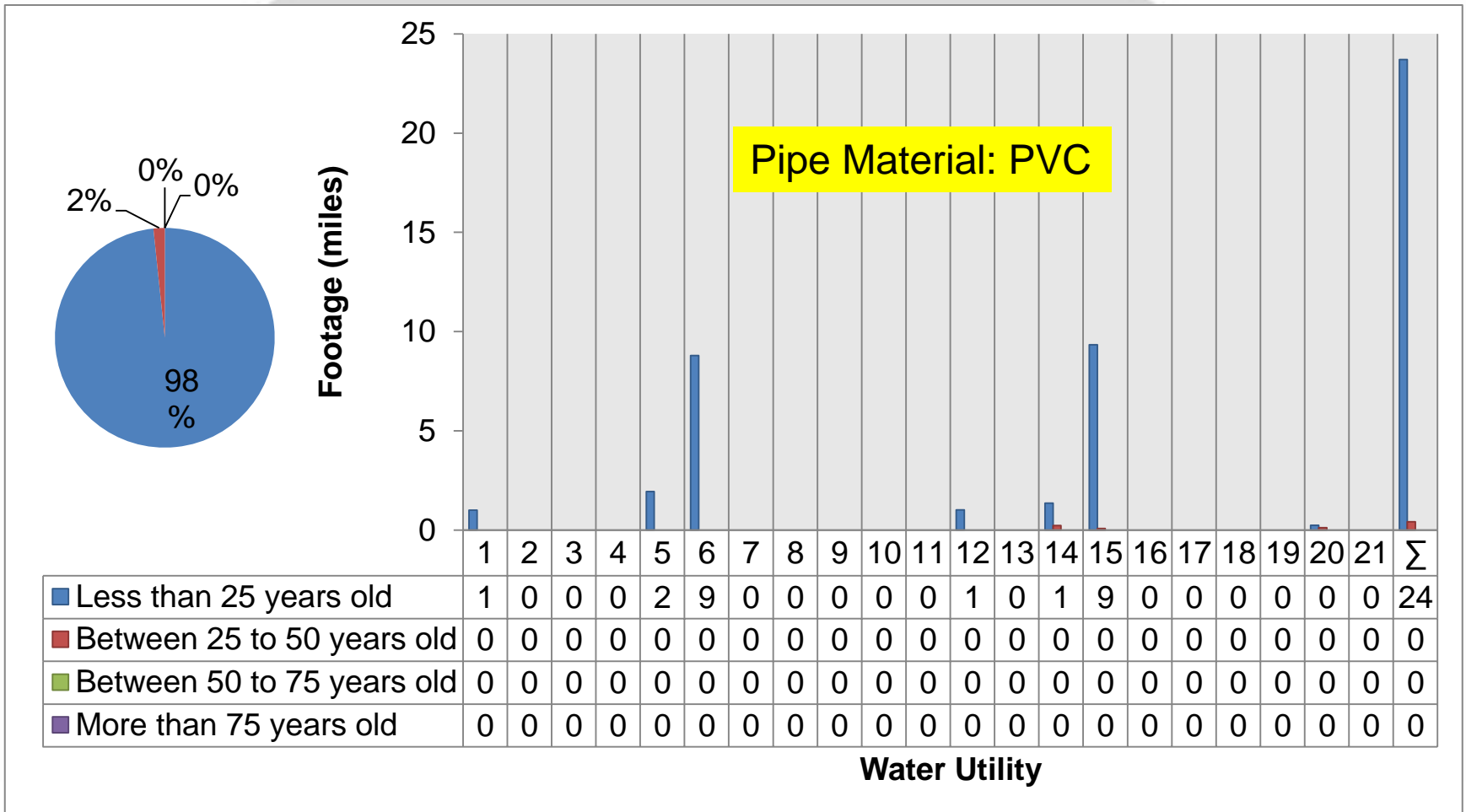


Based on 21 Water Utilities

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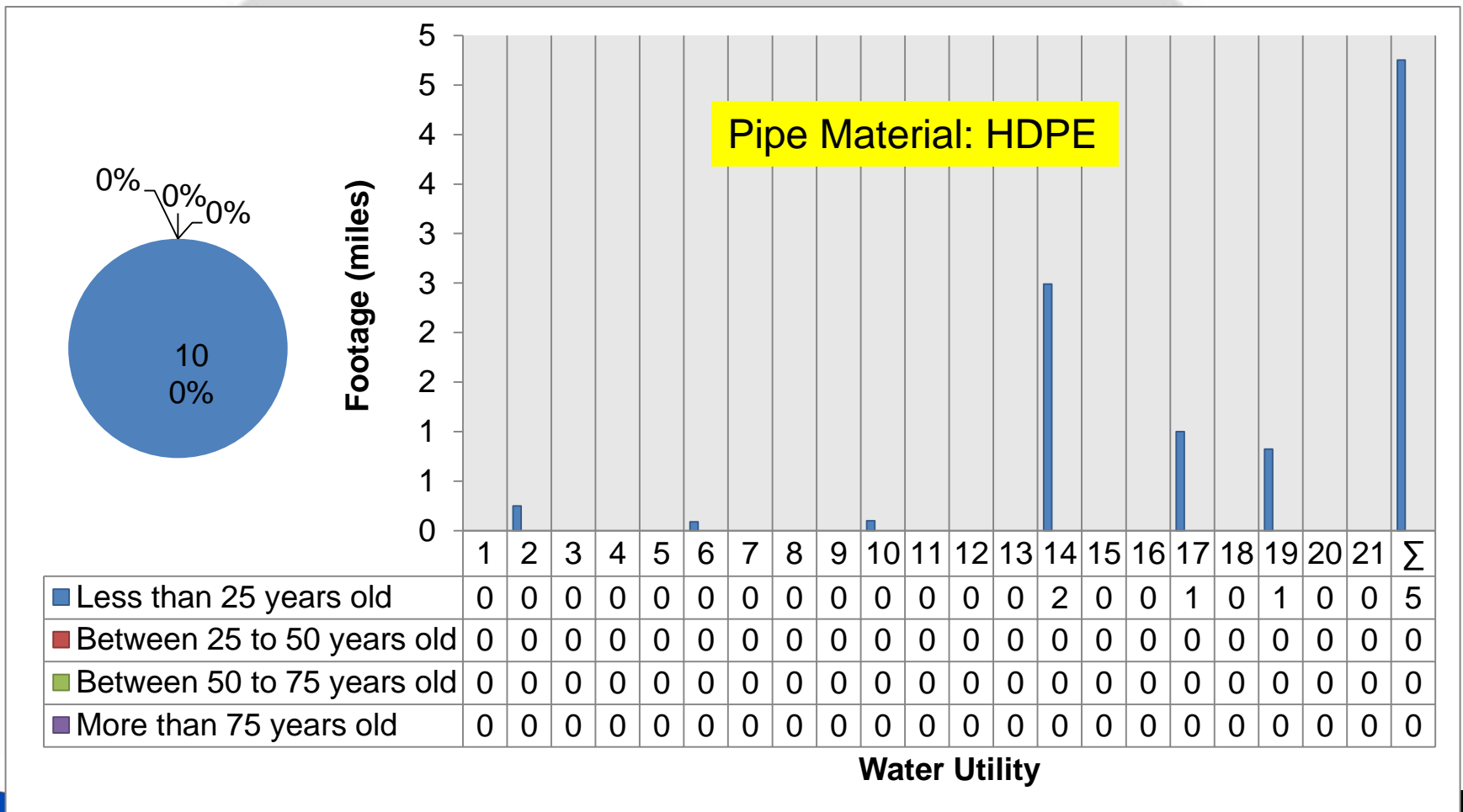


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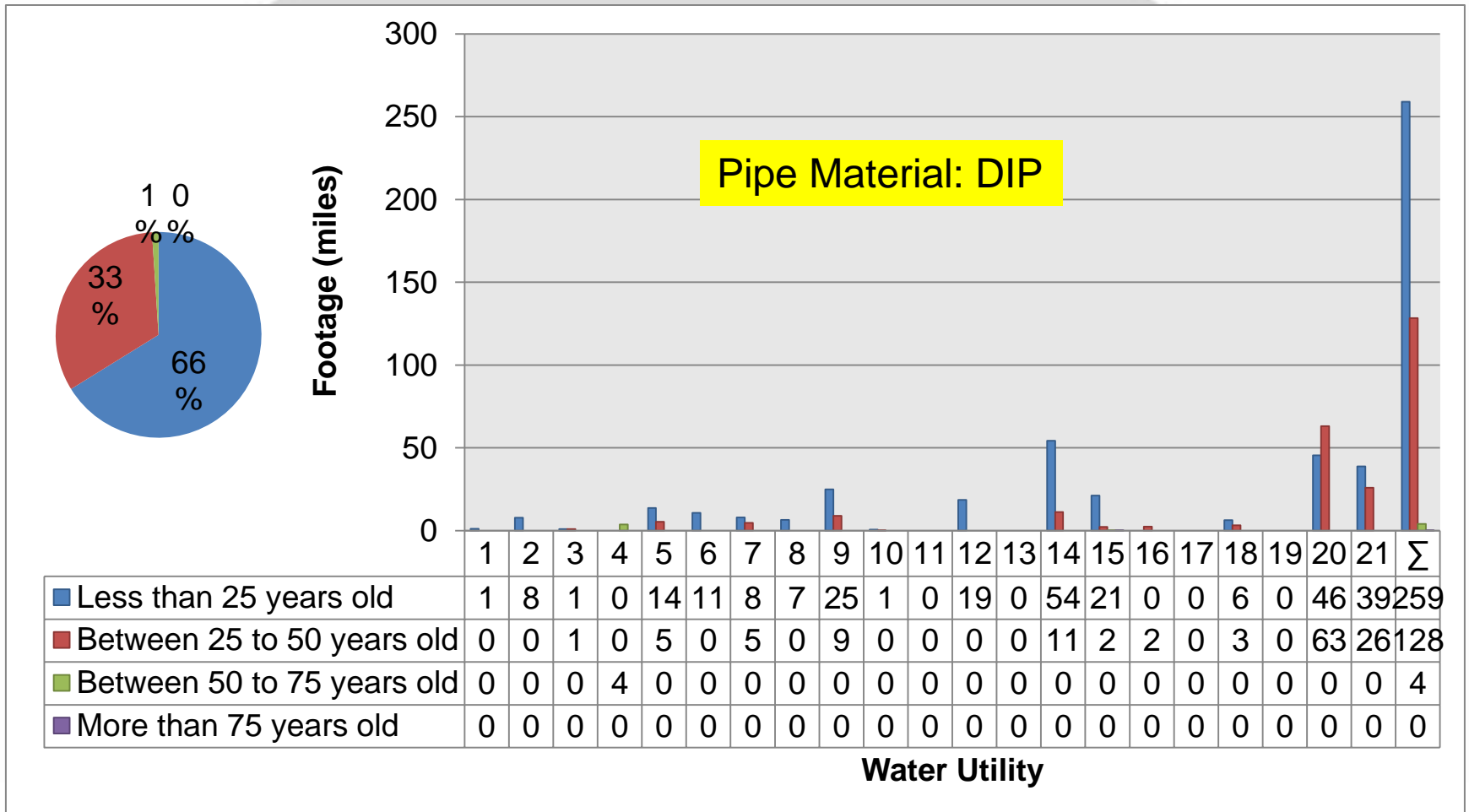


Based on 21 Water Utilities

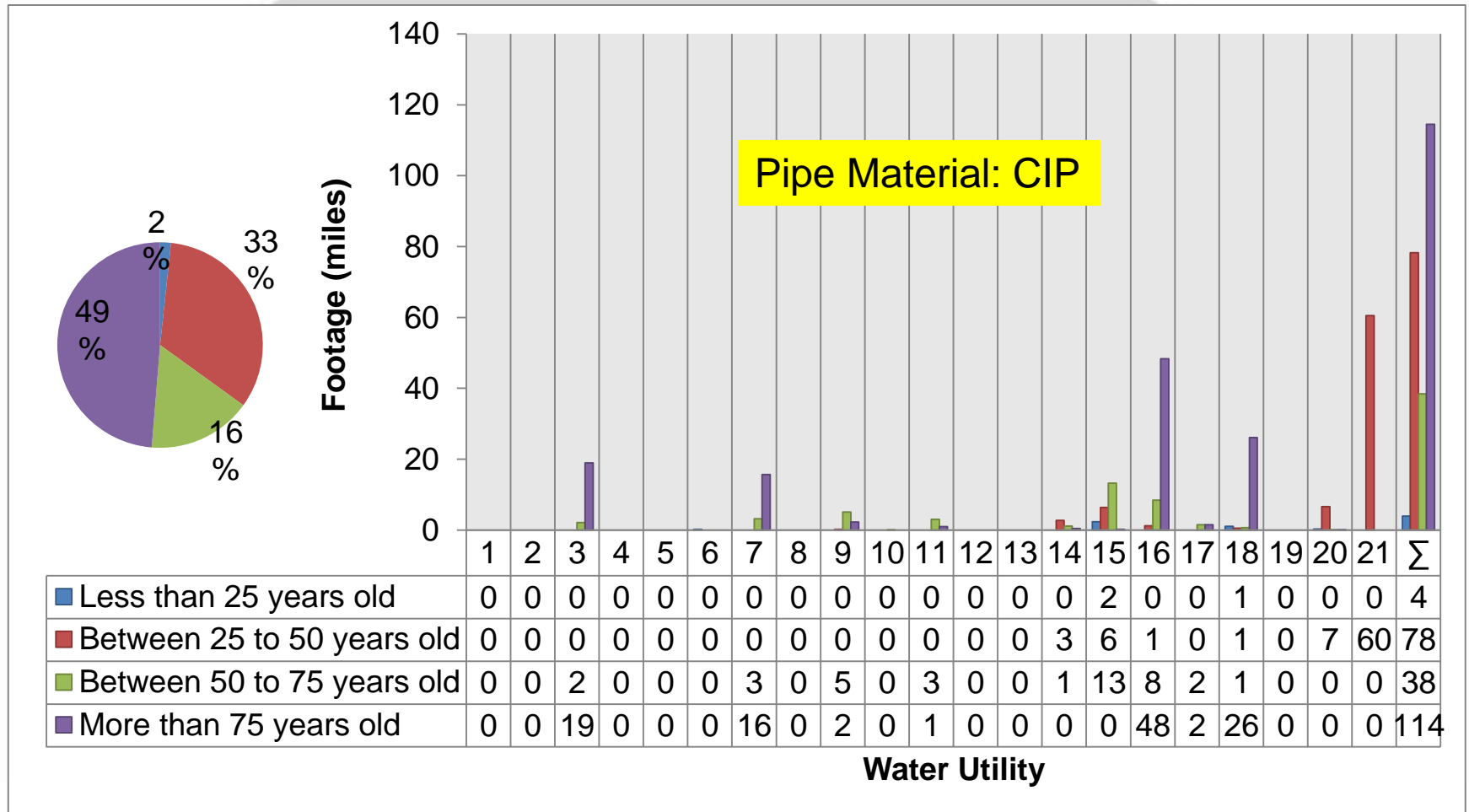
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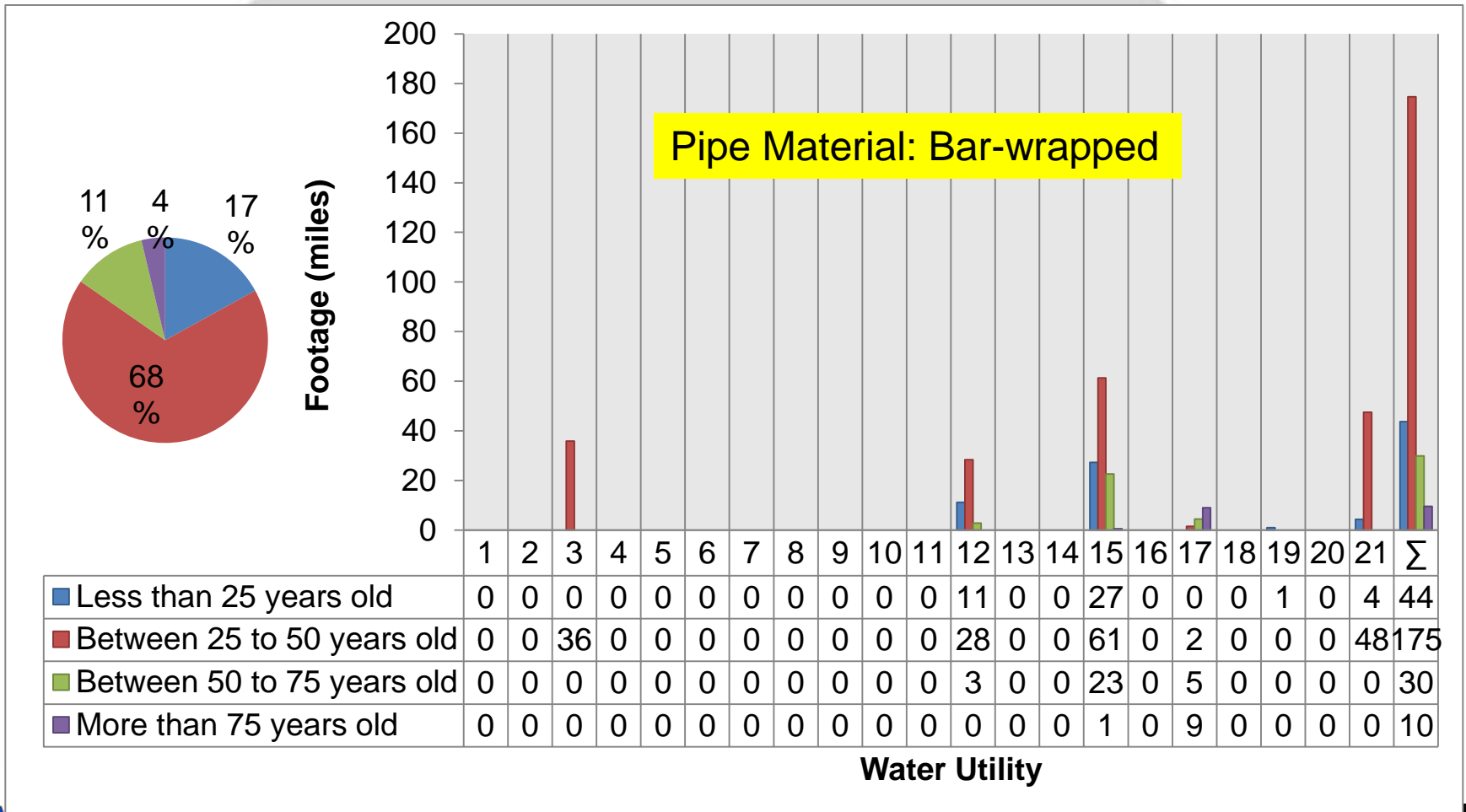


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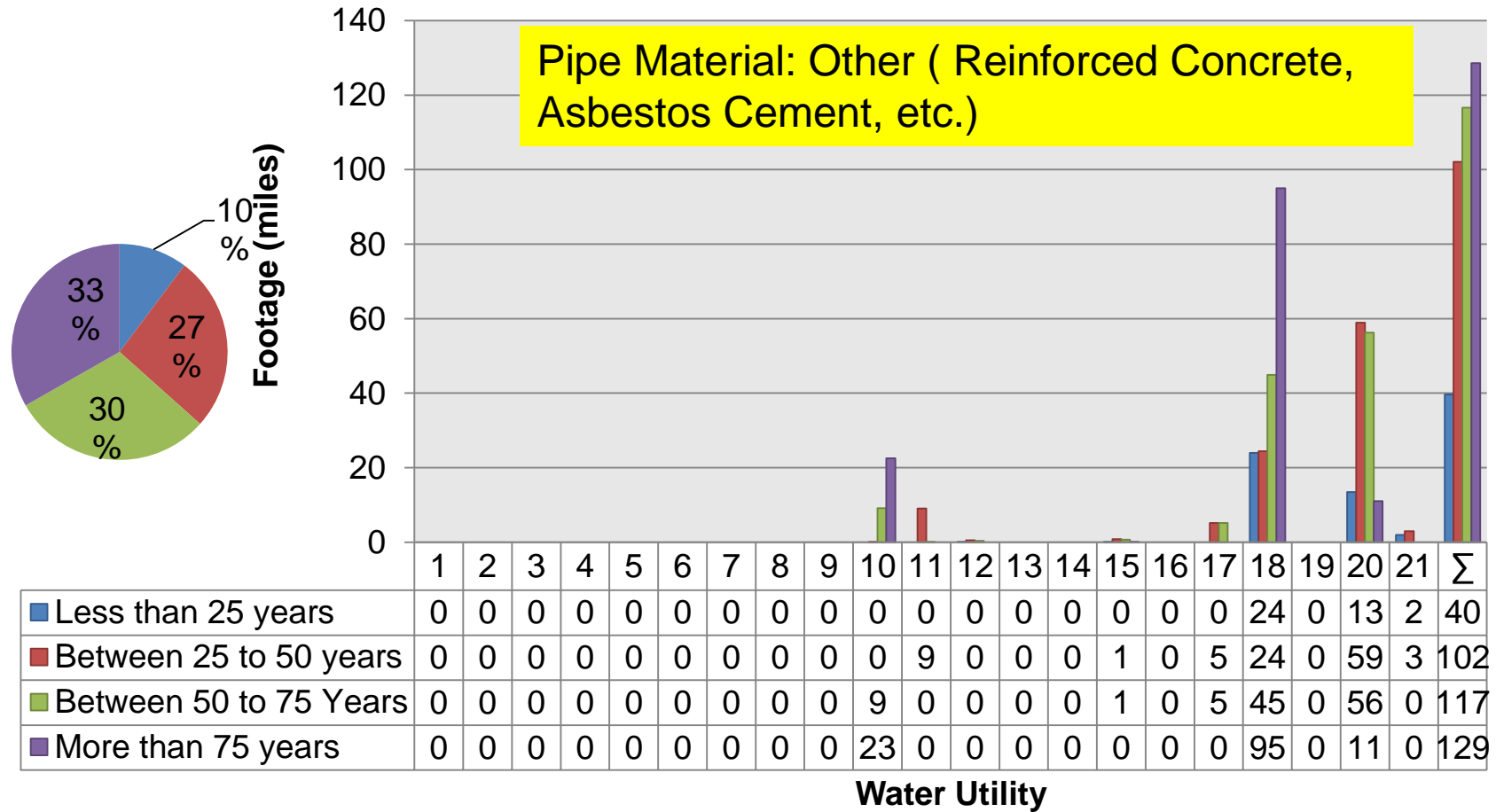




# Relationship between Inventory and Age



# Relationship between Inventory and Age



# Summary

Pipe Material	Inventory (miles)					Total Inventory (miles)
	Less than 25 years old	Between 25 to 50 years old	Between 50 to 75 years old	More than 75 years old	Unknown Age	
HDPE	5	0	0	0	0	5
PVC	24	0	0	0	0	24
CI	4	78	38	115	2	237
Bar-wrapped	44	175	30	10	0	258
Other*	40	102	117	128	71	457
DI	259	128	4	0	34	426
Steel	116	118	170	134	37	574
PCCP	170	387	72	2	1	632
Total	661	988	430	389	145	2,612

Based on 21 Water Utilities

# Considerations – PCCP

- Requires welder and contractor to perform repairs causing delay to get pipe back in service
- More susceptible to damage during installation
- Not economical

# Considerations – Steel

- High water table
- Not economical
- Difficult to tap or repair
- Unfamiliar with the pipe material and its usage

# Considerations – PVC

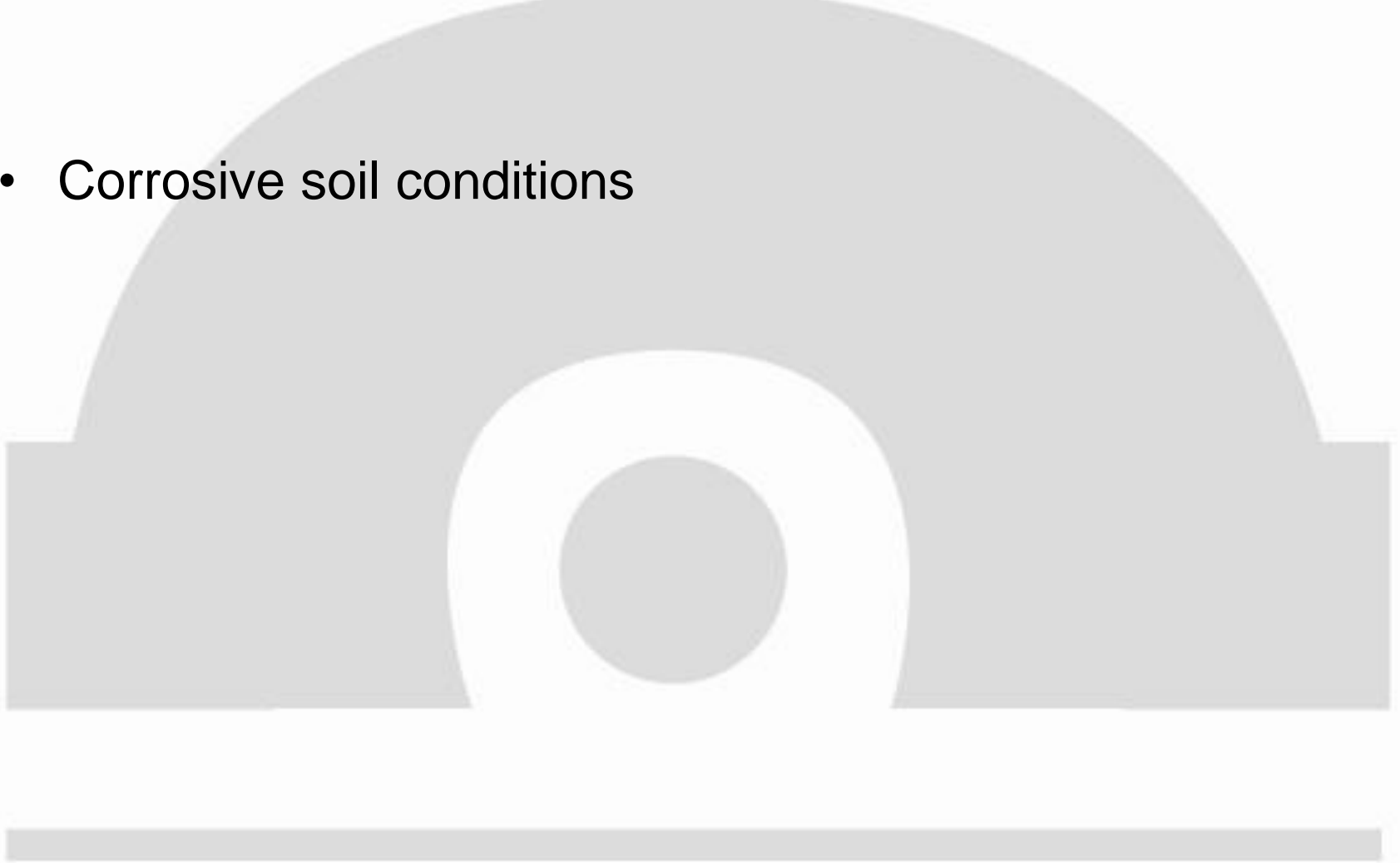
- Not suitable for high pressure and volume
- Not approved for large diameter

# Considerations – HDPE

- Hard to handle and install for 24” and larger pipe size
- Cost
- Thermal coefficient
- Difficult to repair

# Considerations – DIP

- Corrosive soil conditions





# Considerations – CIP

- Corrosion
- System age
- High cold weather failure rates
- No longer manufactured

Based on 21 Water Utilities

# Considerations – Bar-wrapped

- Not approved pipe material for diameters greater than 42”
- New to our department
- Not economical

# Performance of Pipe Materials

Pipe Material	Number of Failures	Total Length (in miles)	Performance (per 100 miles)
Other	4	50	8
PVC	2	22	9
Bar-wrapped	35	258	14
DI	38	270	14
PCCP	92	613	15
Steel	110	574	19
CI	57	200	29
HDPE	0	5	Not Available

# Conclusions

- A total of 21 water utilities serving a population of 13,892,502 having a combined footage of 2,611 miles for 24-in. and larger diameter sizes
- A total of 64% out of 2,611 miles is in between 24-in to 36-in. diameter range, 17% for 42-in. to 48-in. and remaining 19% for 54-in. and larger
- The maximum inventory for all 21 water utilities is in between 25 to 50 years of age which is 38% followed by less than 25 years of age which is 25%, between 50 to 75 years of age 17% and for more than 75 years of age 15%



Thank You!!!

For more information:

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