Using GIS to Support Your Asset Management Program

Presented by:

Nicki Pozos, PhD, PE

PNWS AWWA 2010

carollo

Engineers...Working Wonders With Water™

Asset management is about effectively managing your infrastructure

A method of managing assets over the course of their life cycles in the most cost-effective manner while maintaining desired level of service goals

AM is about making optimal long-term planning decisions about your assets

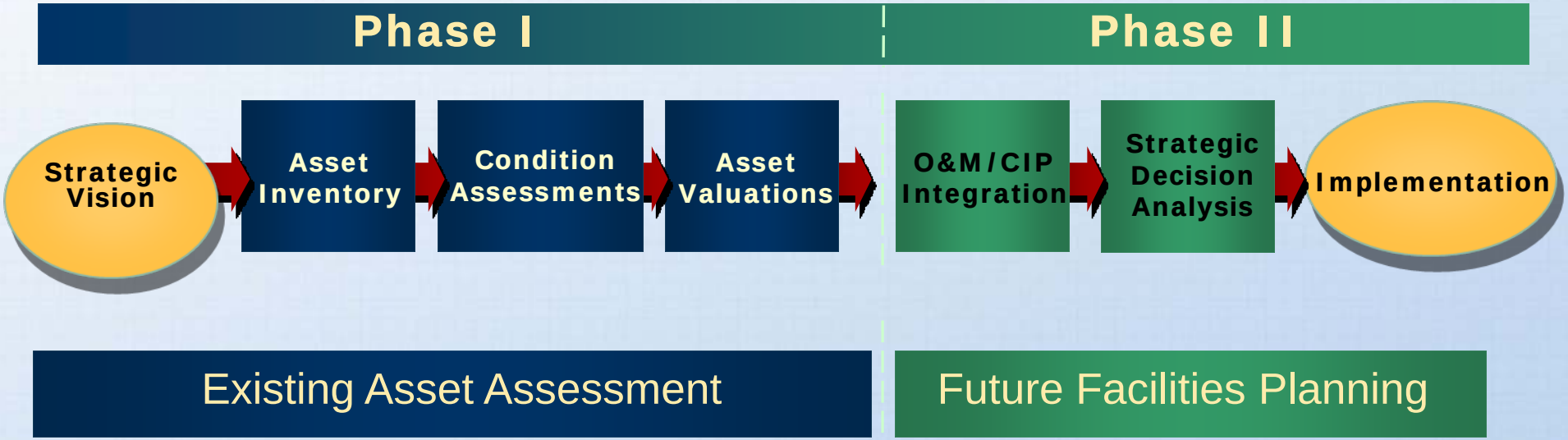
- What to repair or replace
- When to repair or replace
- How much it will cost

Today we will be talking about using GIS to support pipeline AM

Effective AM of pipelines is important

1. Pipe failures hurt customers, increase costs, and damage the environment
2. Repair and replacement activities can be prioritized to reduce risk and cost
3. Pipelines wear out, so financial plans for pipeline replacement are needed

AM is a multi-step process



We are not just here to talk about data management, but how to use GIS data to make good decisions

Utilities face significant challenges in develop a pipeline AM program

1. Large volume of data
2. Data are incomplete
3. Analytical methods not understood
4. Information systems have not been implemented
5. Business processes have not been established
6. Limited budget to implement the program

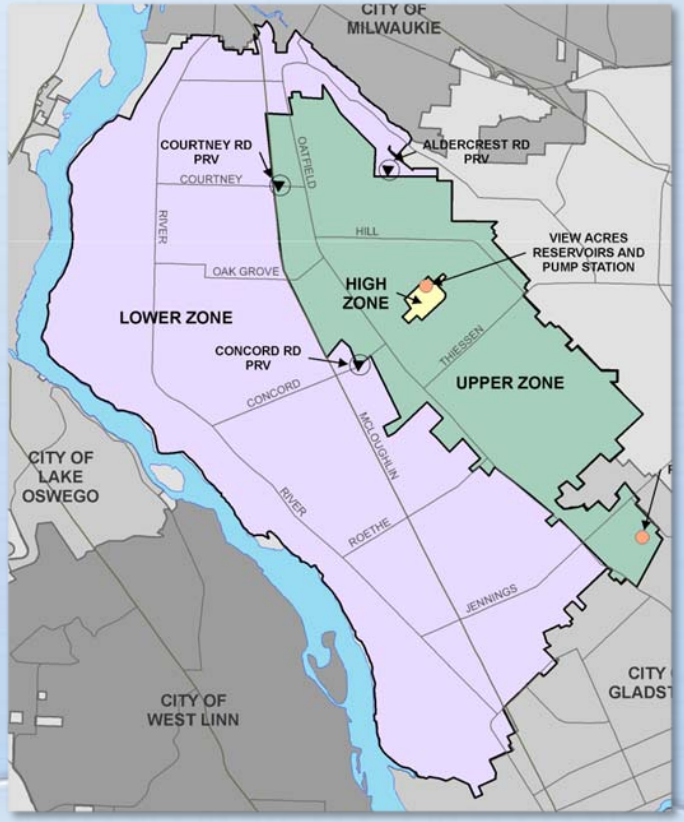
Utilities can choose an appropriate approach given their budget and the availability of system data

1. Oak Lodge Water District
2. Yorba Linda Water District
3. City of Scottsdale

The three case studies we will discuss today represent increasing levels of AM investment

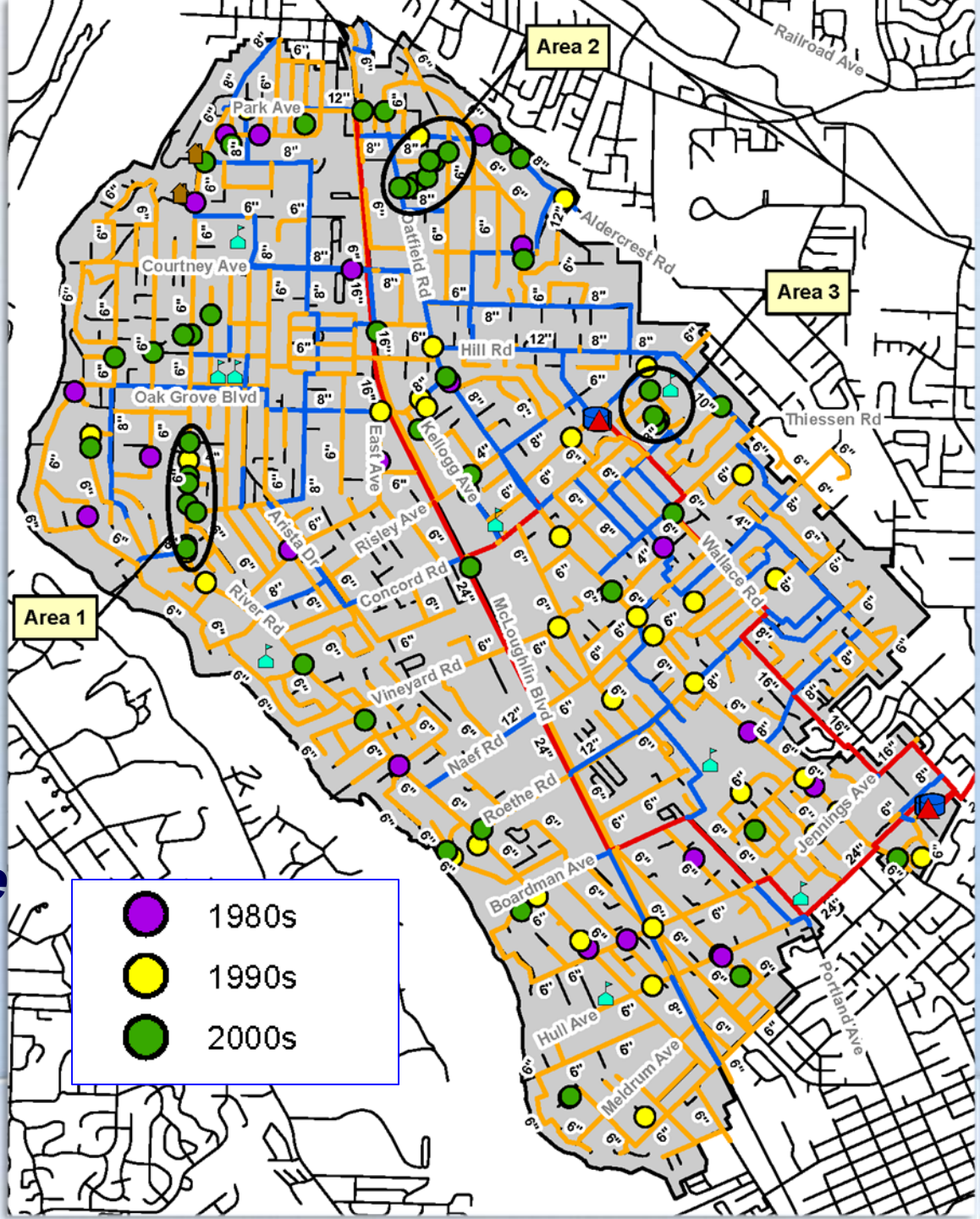
Oak Lodge Water District is an example of a minimal investment yielding useful data

1. OLWD serves ~28,000 customers in Clackamas County, OR
2. Incorporated a limited asset management evaluation in their water master plan for minimal cost
   a. Condition assessment of aboveground infrastructure
   b. GIS evaluation of historical pipeline breakage data



GIS analysis revealed 3 pipeline areas for proactive replacement

Availability of pipeline breakage data in Excel format simplified the analysis

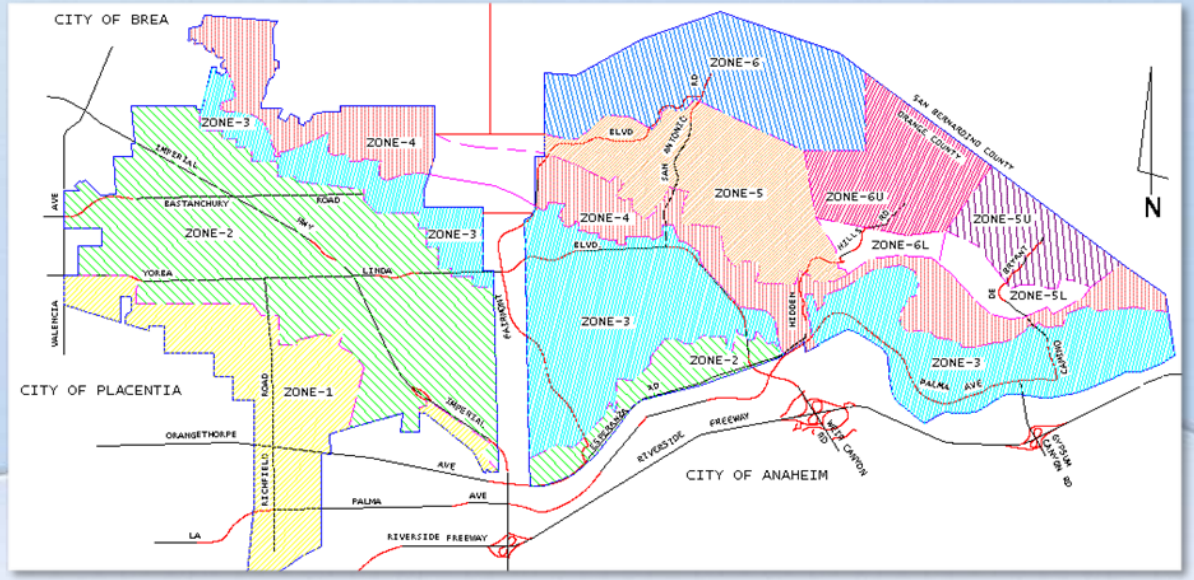


Proactive replacement offers several advantages over run to failure

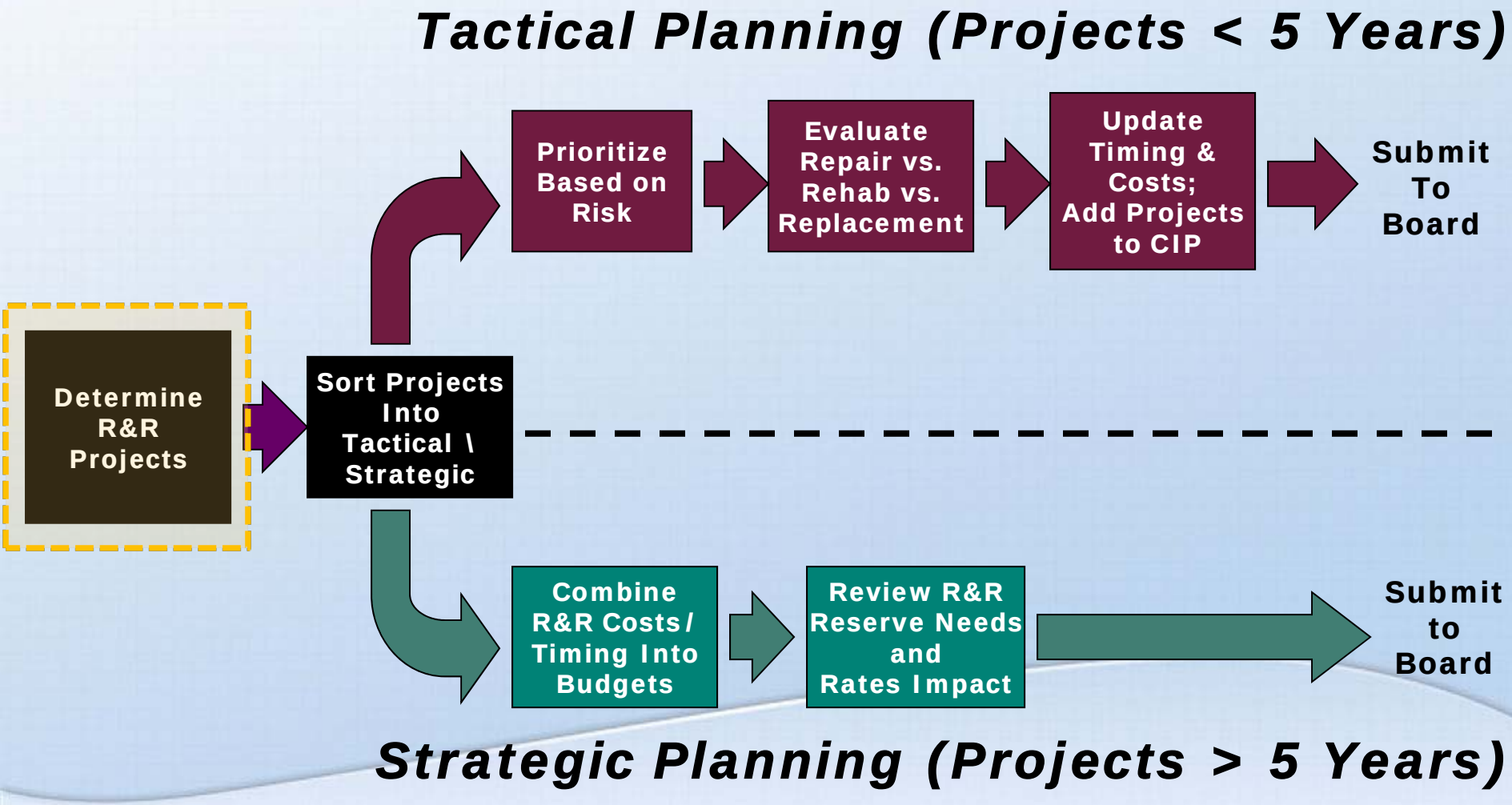
1. Avoid unplanned disruptions of a major roadway
2. Allow projects to be combined with other City maintenance projects
3. Costs planned ahead and incorporated into the CIP and rate structure

An AM study for Yorba Linda Water District focused on evaluating R&R budgeting needs

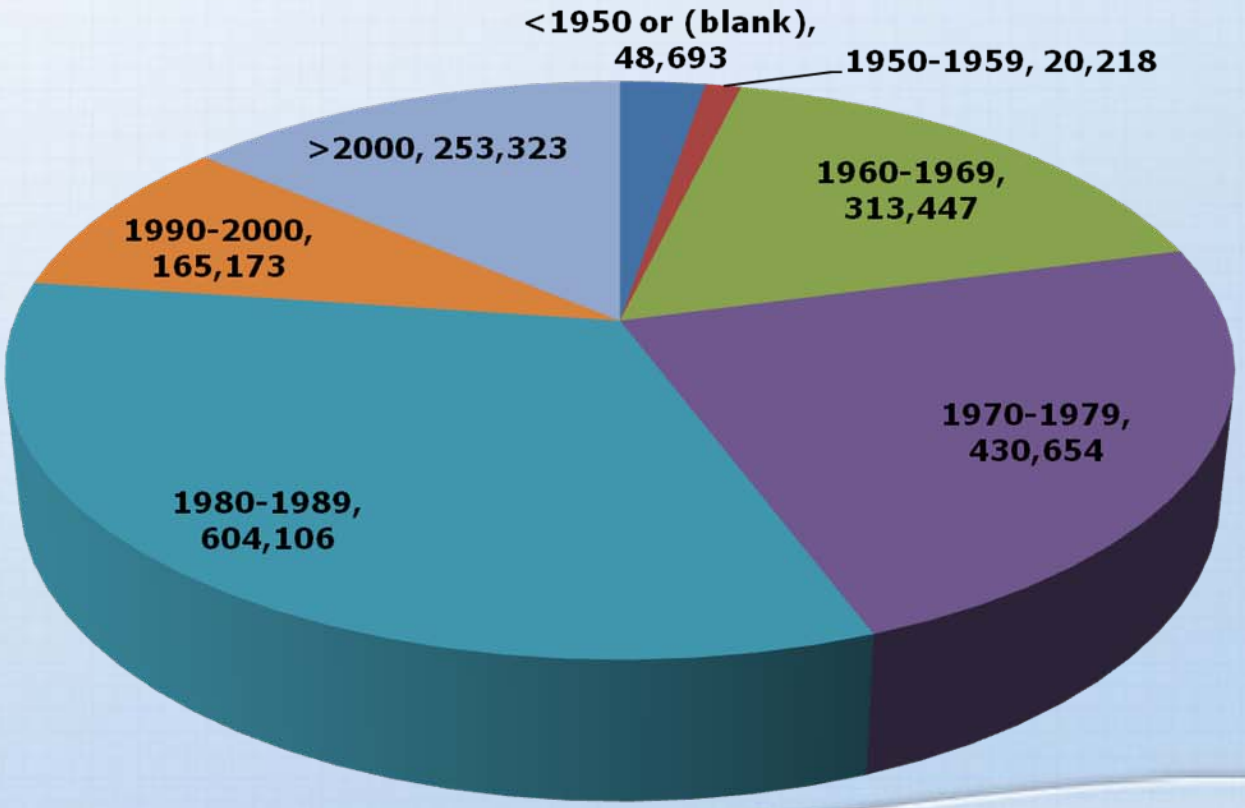
1. Independent AM study focused both above and below ground assets
2. Pipeline analysis based on existing pipeline age and material data supplemented with a criticality evaluation



The project was designed to fulfill two major needs



Pipeline age and material data from their existing GIS formed the foundation of the analysis

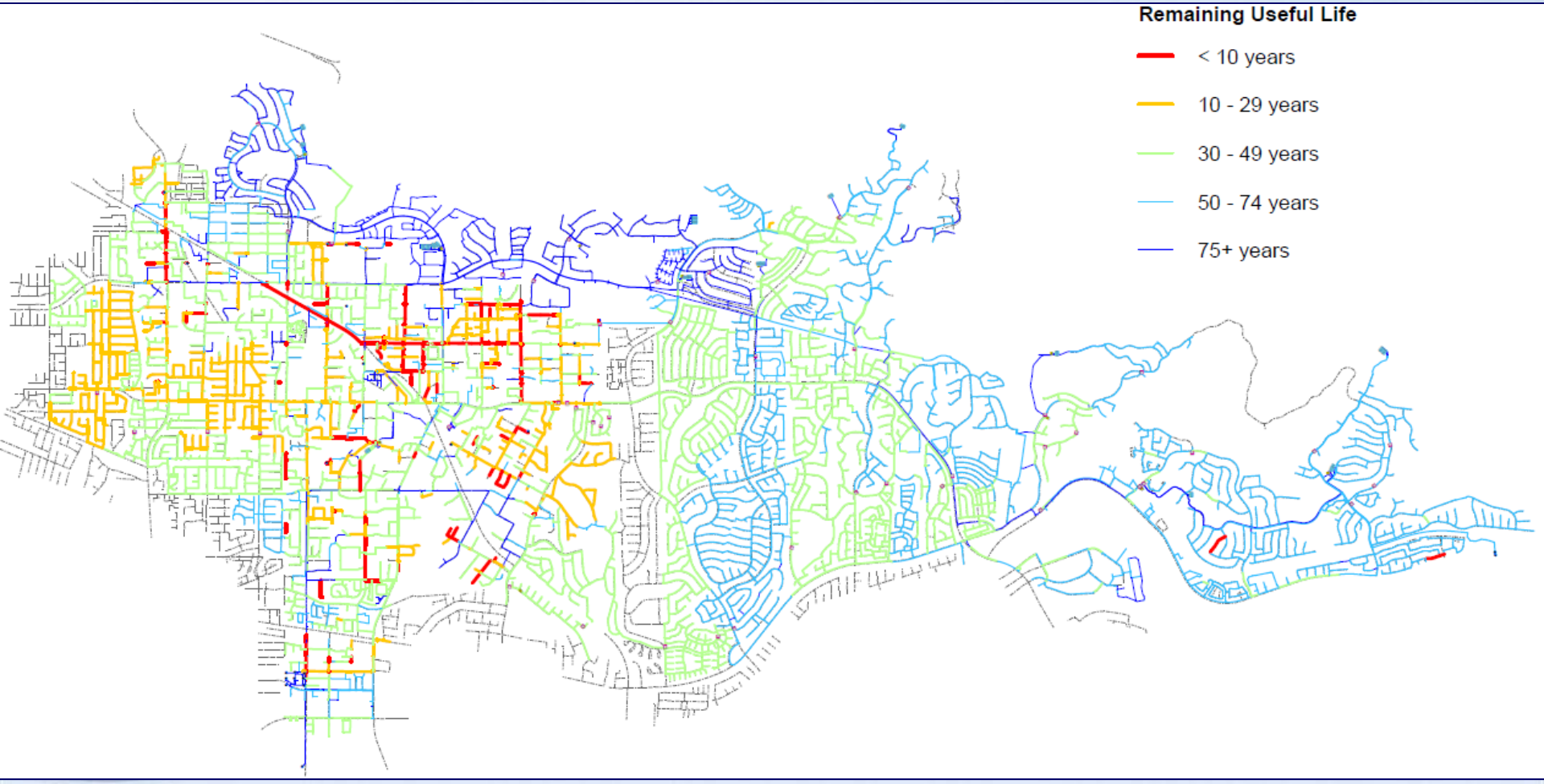


Over half of YLWD's pipelines have been installed since 1980

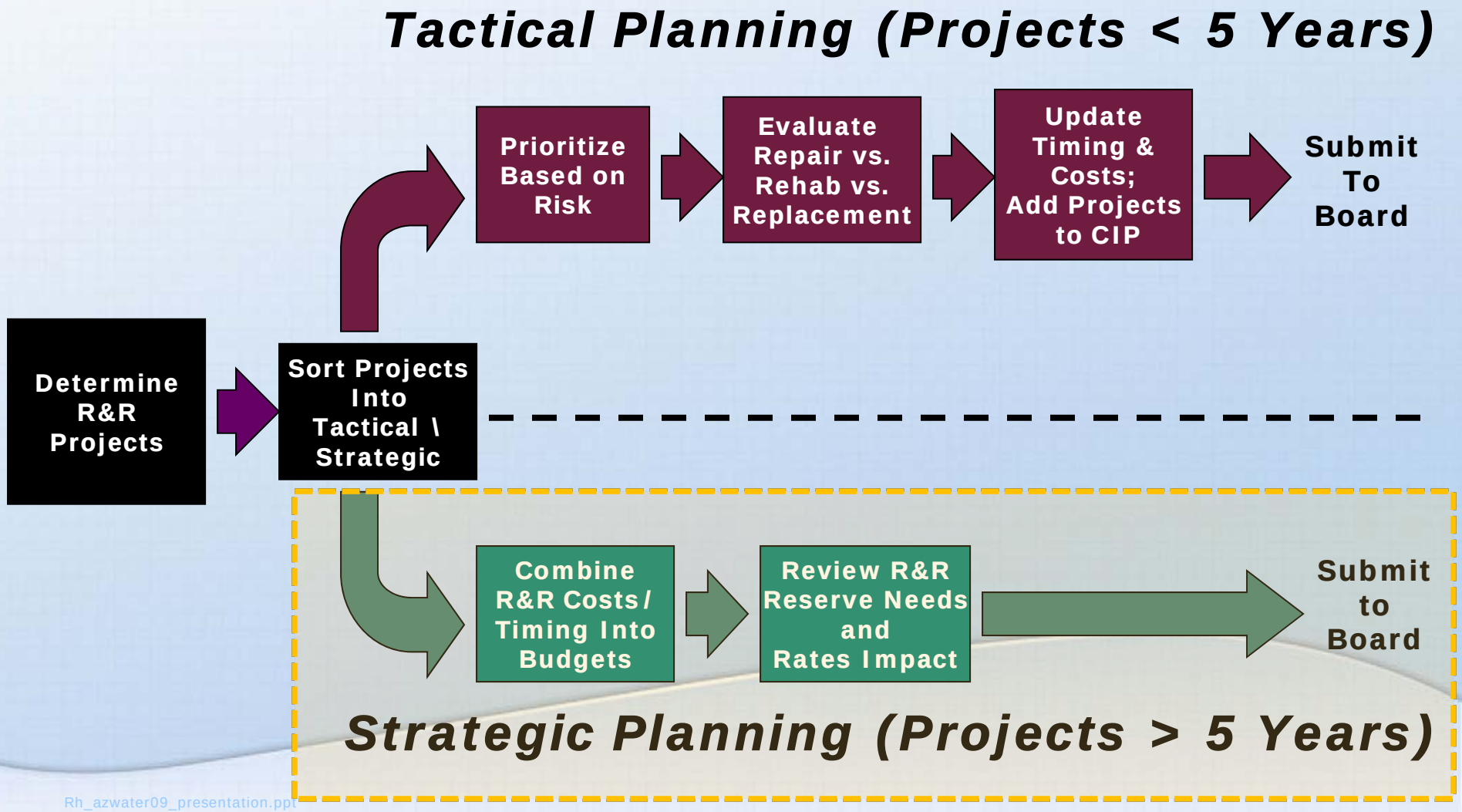
Standard Estimated Useful Life (EUL) values were used for various pipeline materials

Material	Estimated Useful Life (years)
Asbestos Cement Pipe (ACP)	60
Cast Iron Pipe (CIP)	50
Cement Mortar lined & Coated Steel Pipe (CMLC)	115
Ductile Iron Pipe (DIP)	70
Galvanized Steel Pipe (GALV)	40
Polyvinyl Chloride Plastic (PVC)	40
Reinforced Concrete Pipe (RCP)	60
Steel Cylinder Pipe (SCP)	70
Unknown Material (UNK)	60

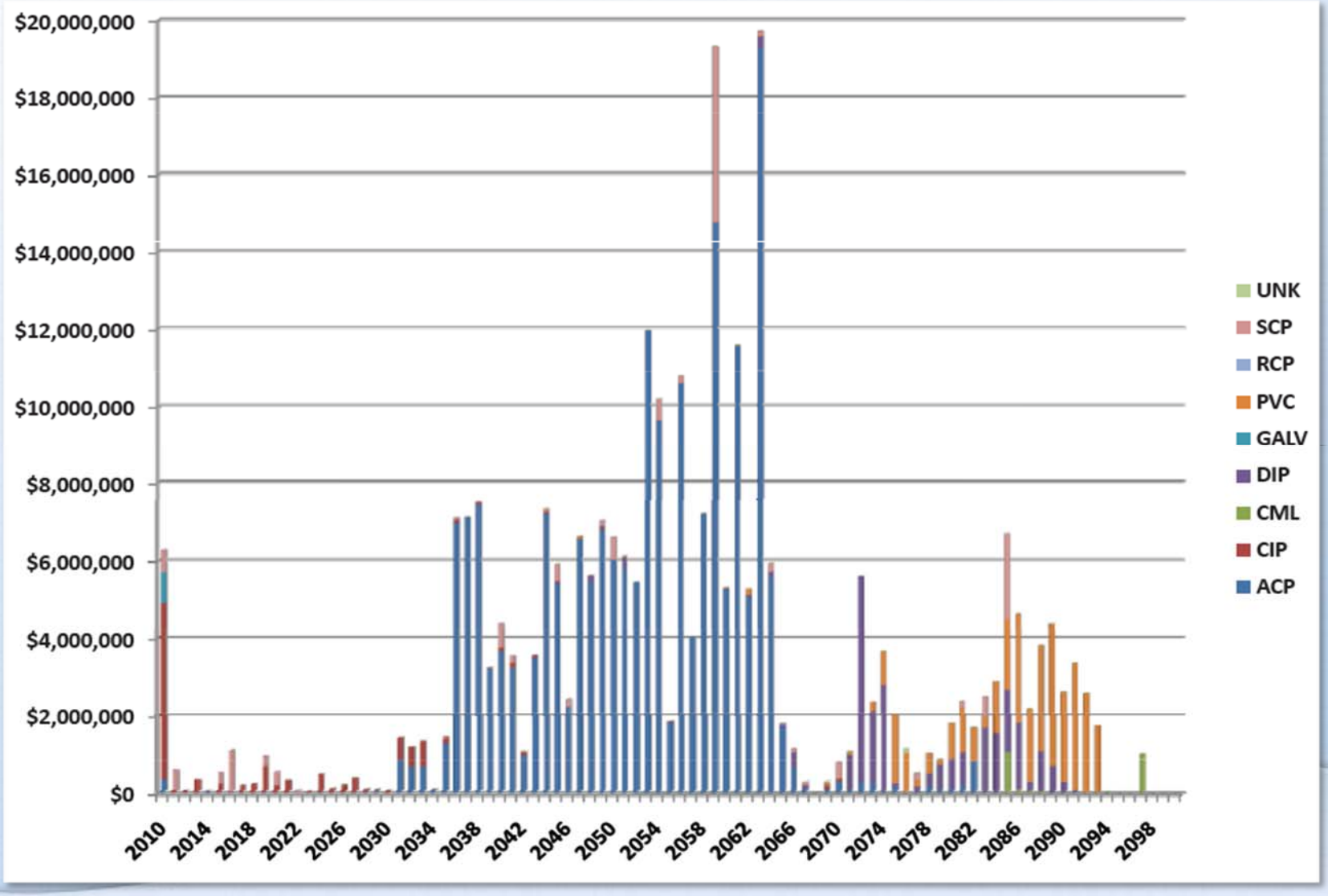
Pipeline age, material, and EUL were used to calculate the Remaining Useful Life (RUL)



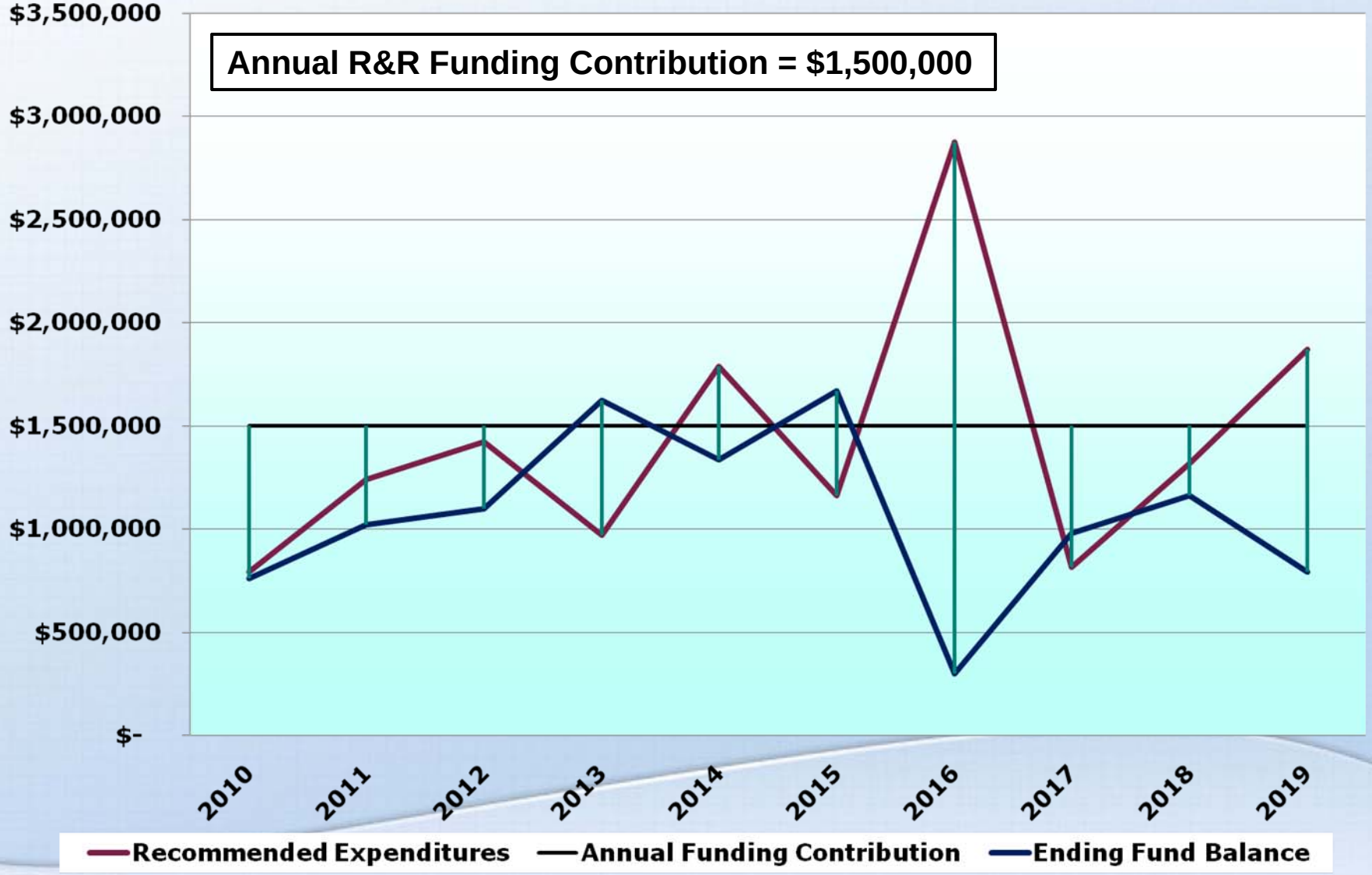
Long-term R&R needs were developed into R&R budgets



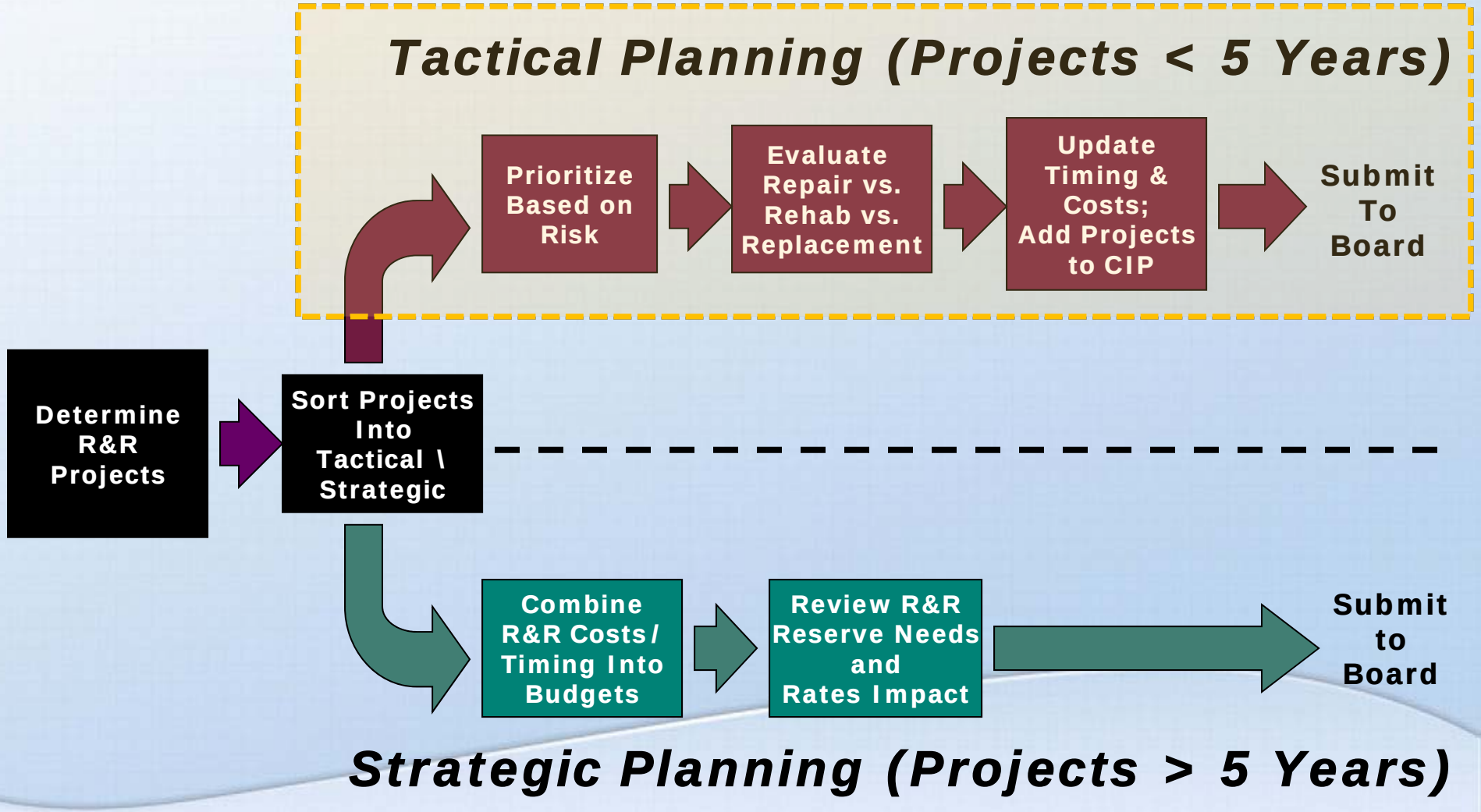
RULs were used to estimate future replacement costs and timing



An appropriate level of annual R&R funding was developed



Risk was then evaluated to prioritize short-term CIP projects



The risk assessment is based on a combination of vulnerability and criticality

1. Risk = Vulnerability x Criticality
2. Vulnerability: <u>Likelihood</u> of asset failure
   a. Criteria aligned with asset condition and/or attributes (e.g. age)
   b. Probability of failure
3. Criticality: <u>Consequence</u> of asset failure
   a. Criteria aligned with level of service goals
   b. Parameters of public health and safety, effect on customers, environment, & cost

Criticality was based on four factors

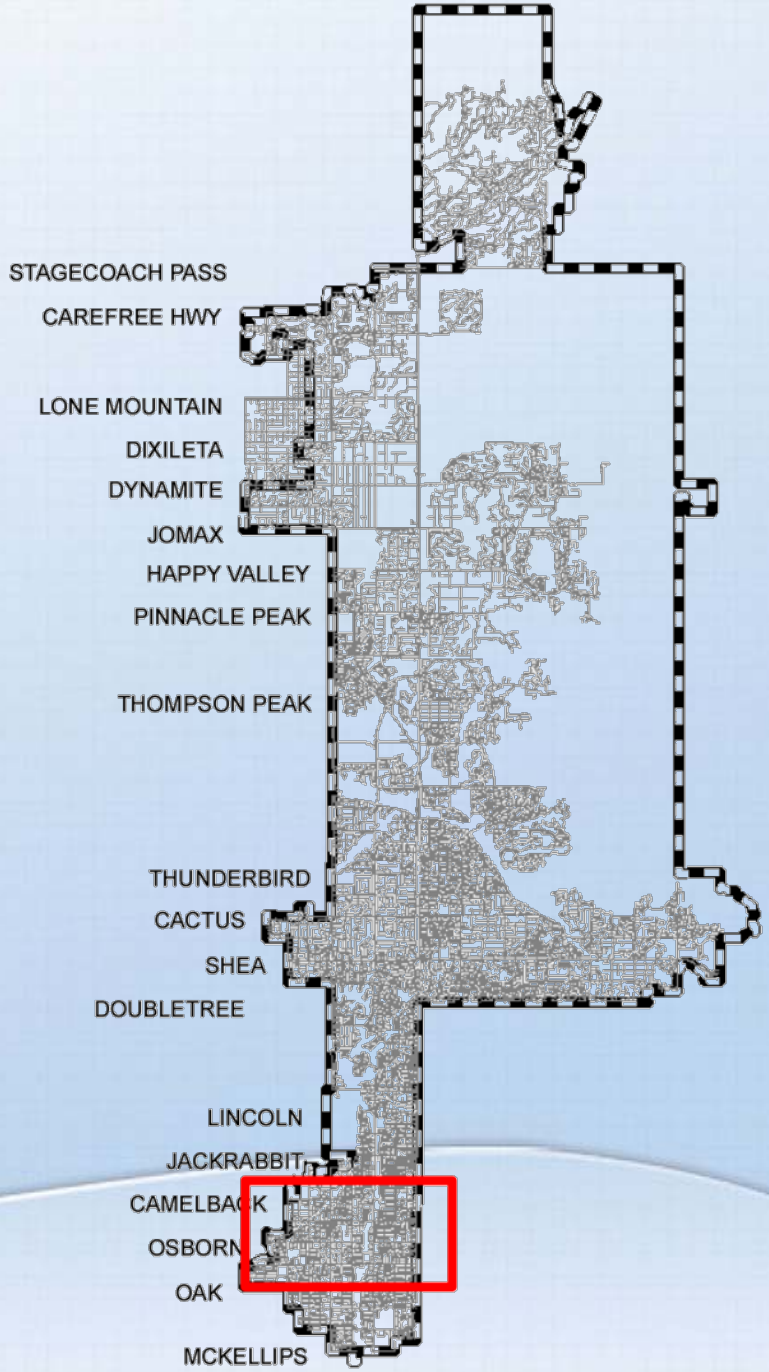
Level of Service / Criticality Category	Weight	Negligible = 1	Low = 4	Moderate = 7	Severe = 10
Health and Safety for Public and Employees	**30%**	No injuries or adverse health effects	No lost-time injuries or medical attention	Lost-time injury or medical attention	Loss of life
		Pipes 10” and smaller	Pipes smaller than 24”	Pipes within 1000ft of critical facilities; Pipes 24” and larger	No pipes
Financial Impact	**15%**	Absorbed within budget line item < $5,000	Absorbed within current budget and under GM signature $5,000 to $75,000	Requires Board approval $75,000 to $150,000	May require new borrowing, or impact rates > $150,000
		Pipes 8” and smaller	Pipes 16” and smaller	Pipes 30” and smaller	Pipes larger than 30”
Impact on Environment or Regulatory Compliance	**25%**	100% compliance with permits & no impact on environment	Violation but no enforcement action &/or minor impact on environment	Violation with minor enforcement action &/or moderate impact on environment	Enforcement action with fines &/or major impact on environment
		No pipes	All pipes	Pipes in Santa Ana River drainage	Pipes in protected natural habitat
Service Delivery and Effect on Customers / Public Confidence	**30%**	No impacts on service delivery or customers	Minor disruption	Short-term impact &/or substantial disruption	Long-term impact &/or area-wide disruption
		Pipes 6” and smaller	Pipes 8” and smaller	Pipes 16” and smaller	Pipes larger than 16”

The resulting risk for water system piping is shown in GIS

Critical pipelines include those serving schools, hospitals, and medical facilities, as well single points of failure

The City of Scottsdale took their pipeline AM to the next level

1. Developed much of the GIS data as part of this study
2. Used more extensive analysis to develop system-specific useful life values
3. Developed supporting business processes



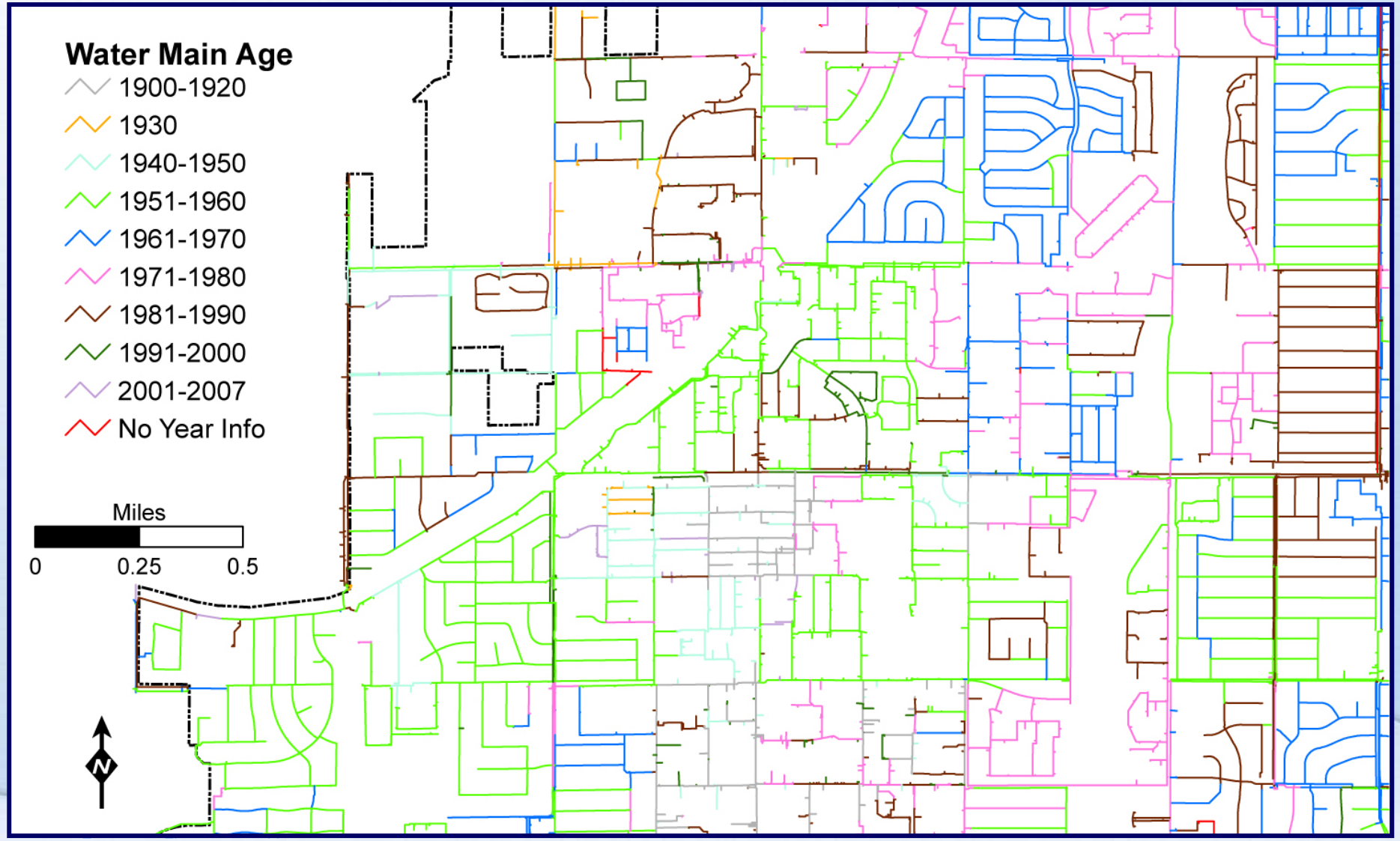
The steps in the Scottsdale study were similar to YLWD

1. Gather data and enter in GIS
2. Assign vulnerability (probability of failure)
3. Develop system-specific EUL values
4. Determine pipe importance (criticality)
5. Assign risk of failure
6. Plan for repair, replacement
7. Quantify cost
8. Develop business programs to support AM

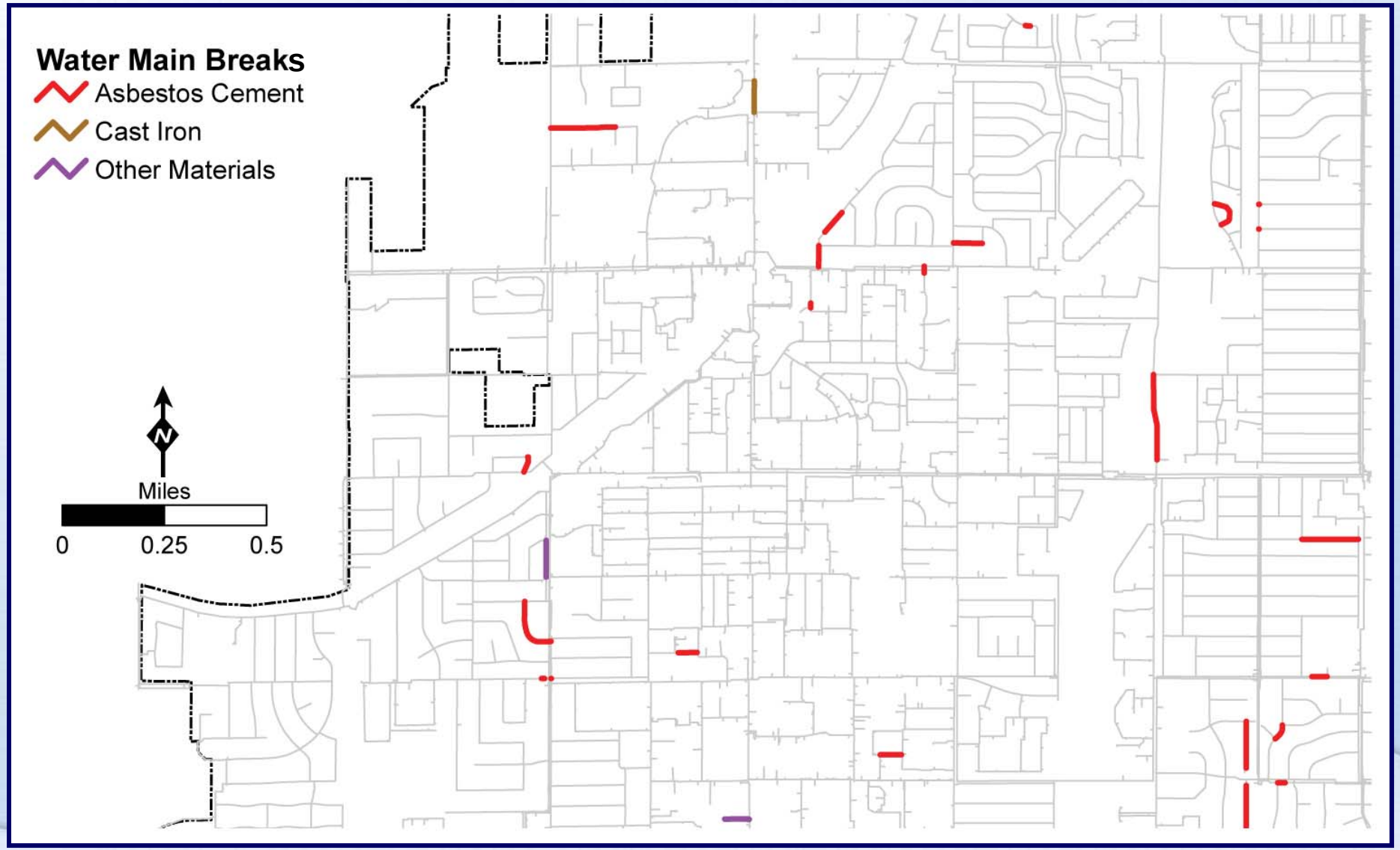
The first step was gathering data and entering it into the City's GIS

1. Pipe diameter, age, material, linings
2. Soils, loads, vegetation
3. Construction methods
4. Inspection results
5. Failure events
6. Complaints
7. Maintenance activities
8. Nearby construction activity
9. Costs

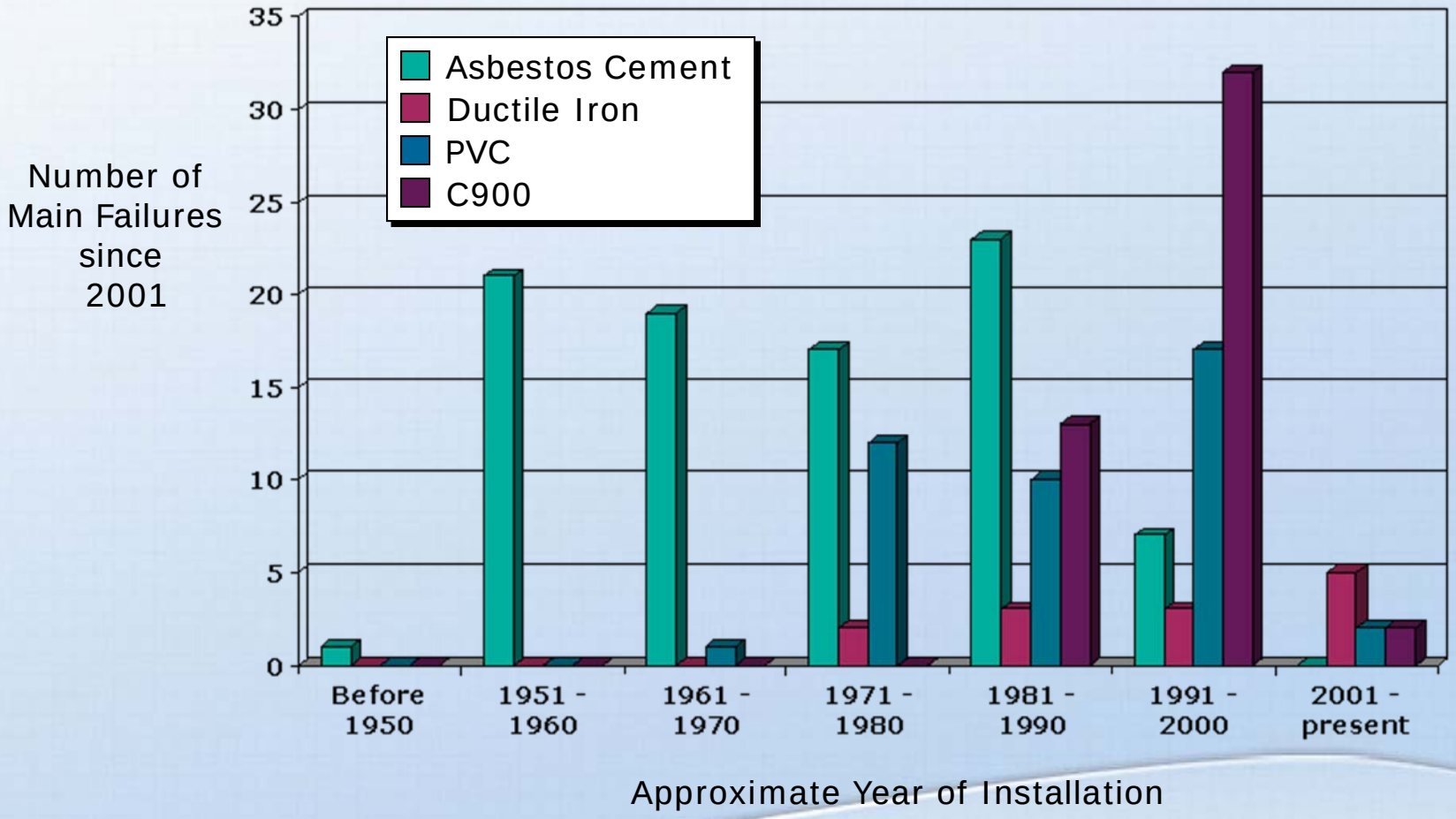
Once entered in GIS, data can be easily visualized and manipulated



Data on pipeline breakages were used to evaluate vulnerability

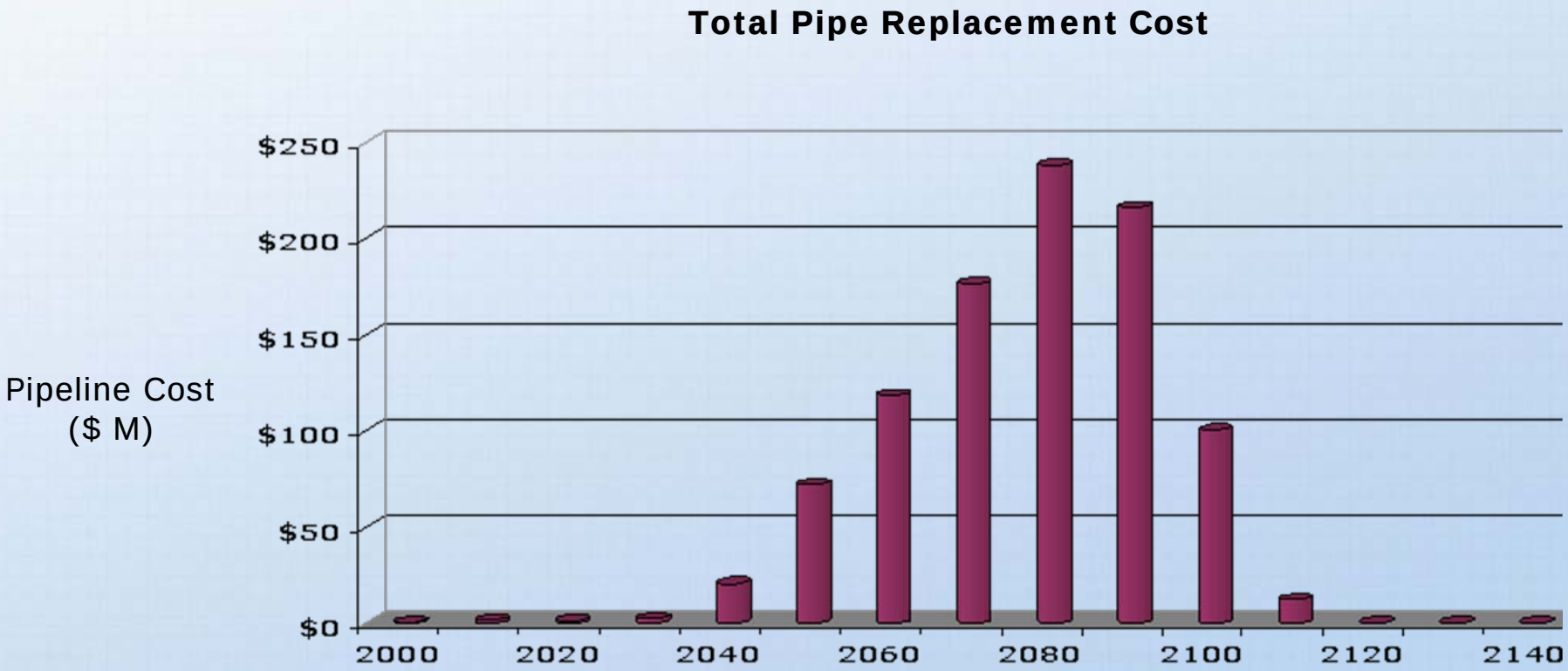


Pipeline failures were also used to indicate vulnerable materials



Failed pipelines did not correlate with pipeline age

The customized RUL values were used to develop cost projections



Risk ratings were developed and entered in GIS to support current and future CIP development

	Vulnerability				
	1	2	3	4	5
1	1384	26	4	1	5
2	0	0	0	0	0
3	376	6	1	1	1
4	72	1	0	0	1
5	0	0	0	0	0

Increasing Risk

Increasing Risk

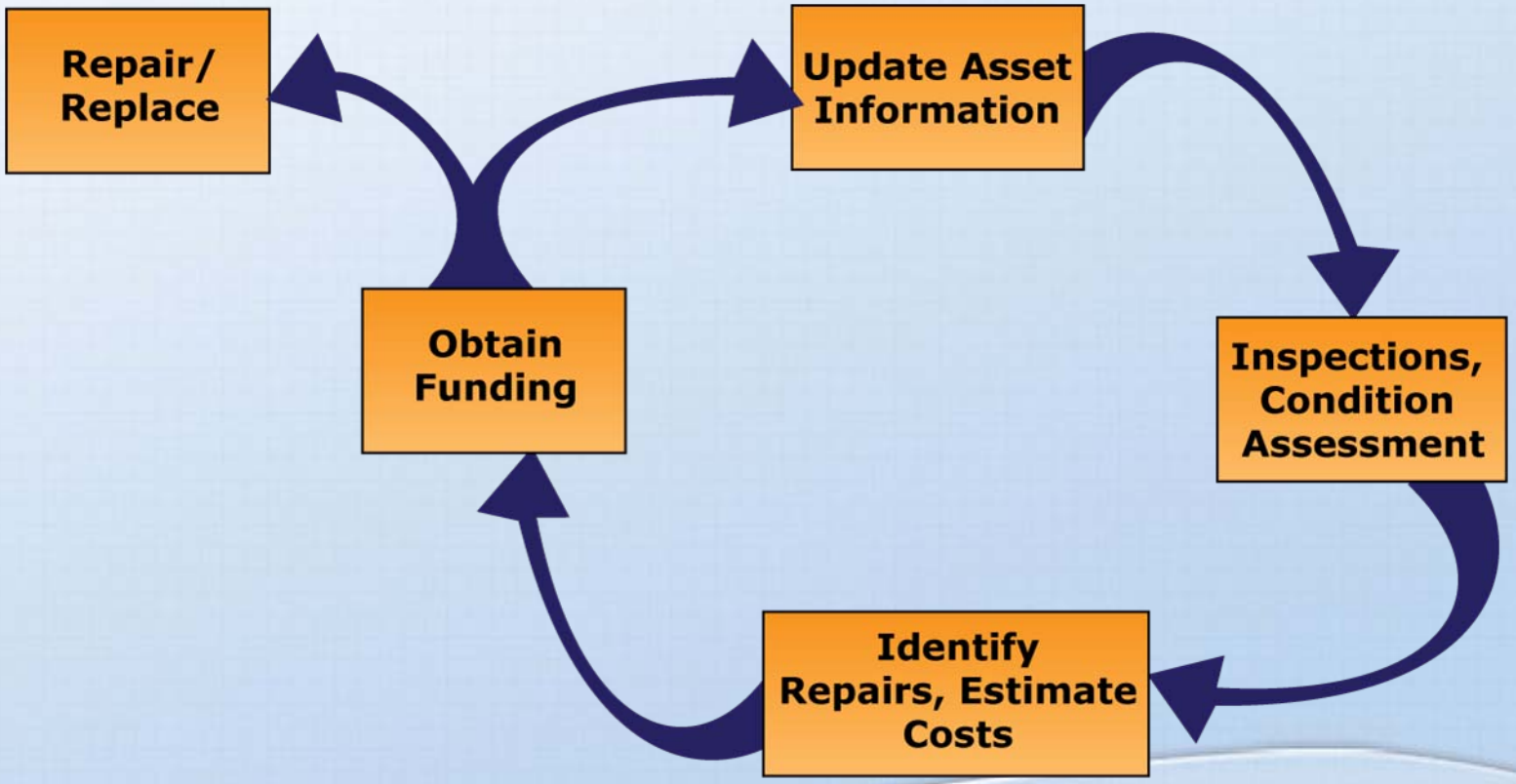
Miles of Scottsdale Water Mains in each Risk Category

The majority of the distribution system was found to have very low risk

AM business processes were also put into place to maintain the program

1. Improve asset data to improve vulnerability assessment
2. Conduct additional inspections to track condition
3. Use City's "Asset Management Dashboard" for Evaluations
4. Identify and plan for funding mechanisms
5. Repair and replace assets

The business processes support the ongoing AM process



Utilities can choose an appropriate approach given their budget and the availability of system data

1. GIS is a critical tool in AM of pipelines as both a data management and data analysis tool

2. It is possible to gain benefits from an AM program without major investment – AM approaches can be adapted to your budget and system