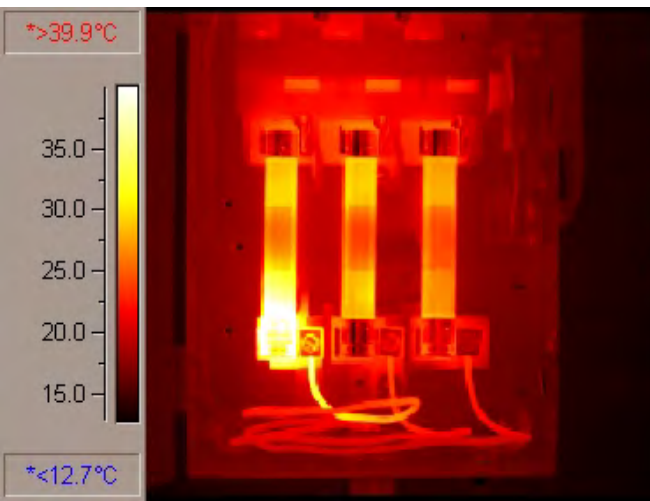


Health Based Asset Management



Proactive and Reactive Approaches

Physical
Routine Screenings

Symptoms
Targeted Diagnostics

Emergency
Targeted Diagnostics



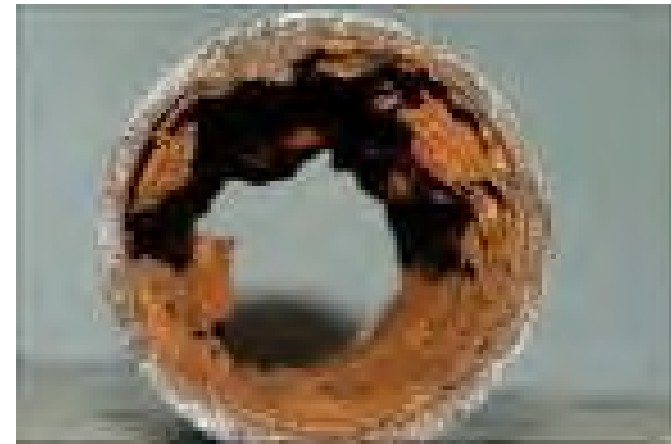


What is the health of the assets ?



Is it important to know ? How do we assess ?

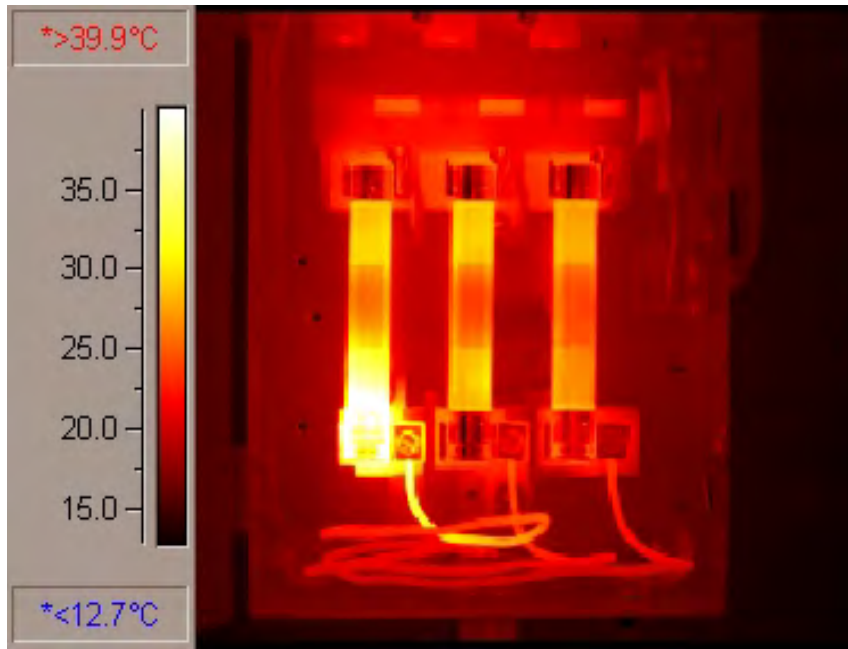
What is the health of the Assets ?



Is it important to know ? How do we assess ?

Asset Health

Find & repair these problems or let them fail ?



Fuse Box



Aerial Electrical Cable



Reactive & Proactive Approaches

Reactive: Run to failure – Break / Fix

Preventive: Scheduled tasks that minimize risk of failure.

Predictive/Health-Based:
Systematic monitoring to assess machine health



Annual Maintenance Cost Per Horsepower

Predictive \$7-9

Health Monitoring

Preventive \$11-13

Reactive \$17-18

Benefit: \$\$\$\$\$ / Reliability

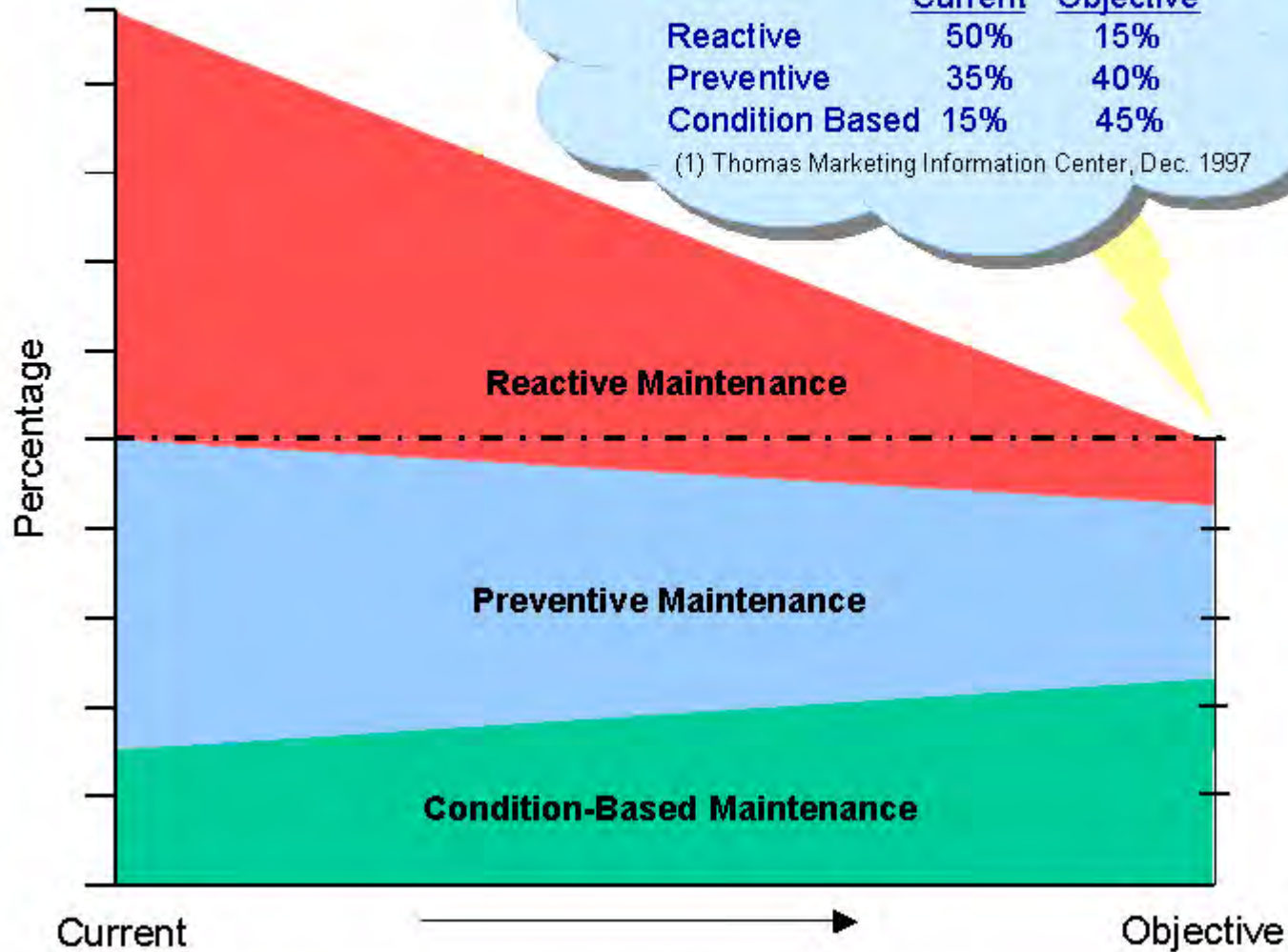
Right Balance

A survey⁽¹⁾ disclosed the following objectives:

- Reduce total maintenance by 50%
- Shift the proportion of maintenance:

	<u>Current</u>	<u>Objective</u>
Reactive	50%	15%
Preventive	35%	40%
Condition Based	15%	45%

(1) Thomas Marketing Information Center, Dec. 1997





Asset Failures

Effective Maintenance programs are guided by the consequences of asset failure.

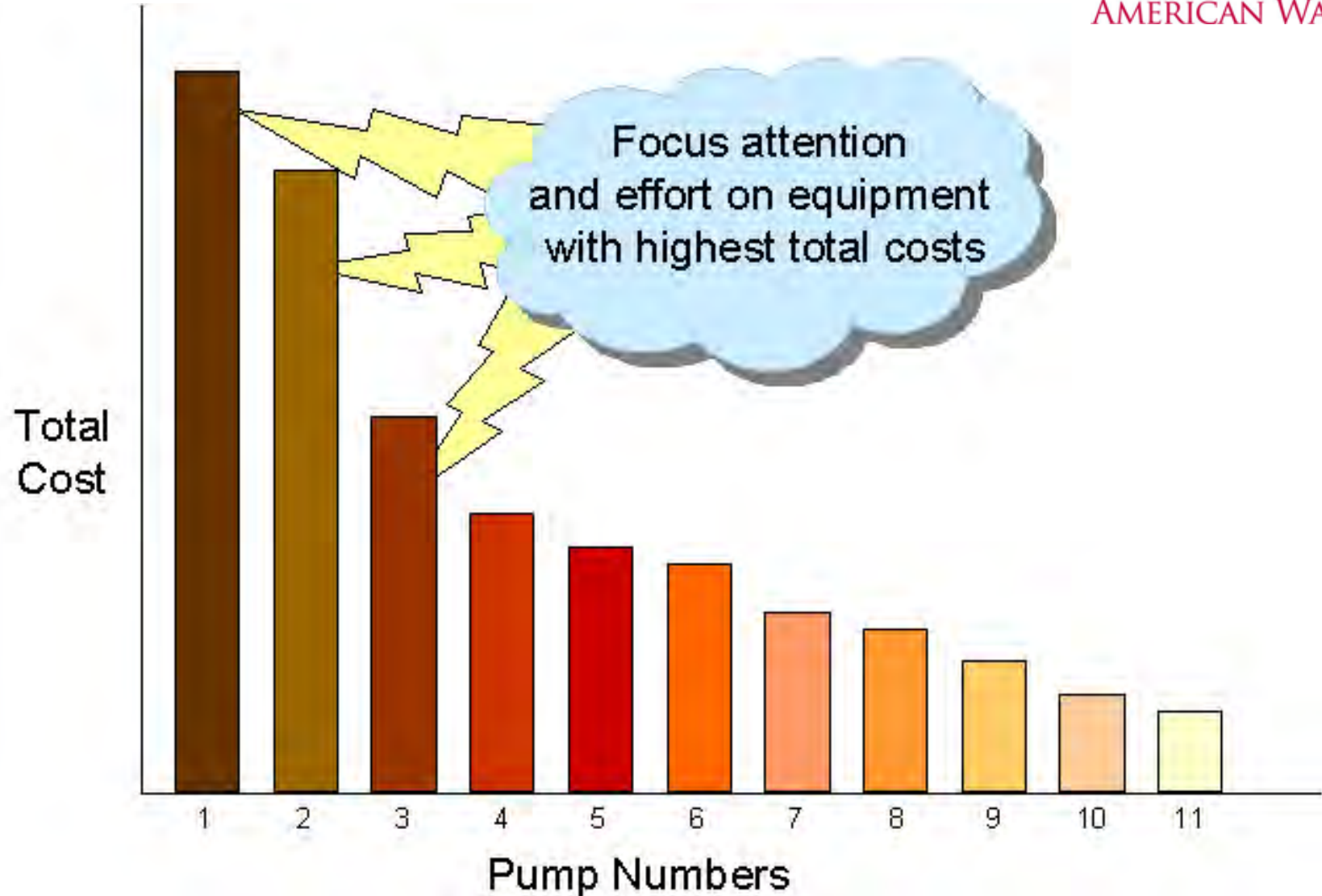
- Safety & Environmental
- Operational
- Economical



Cost



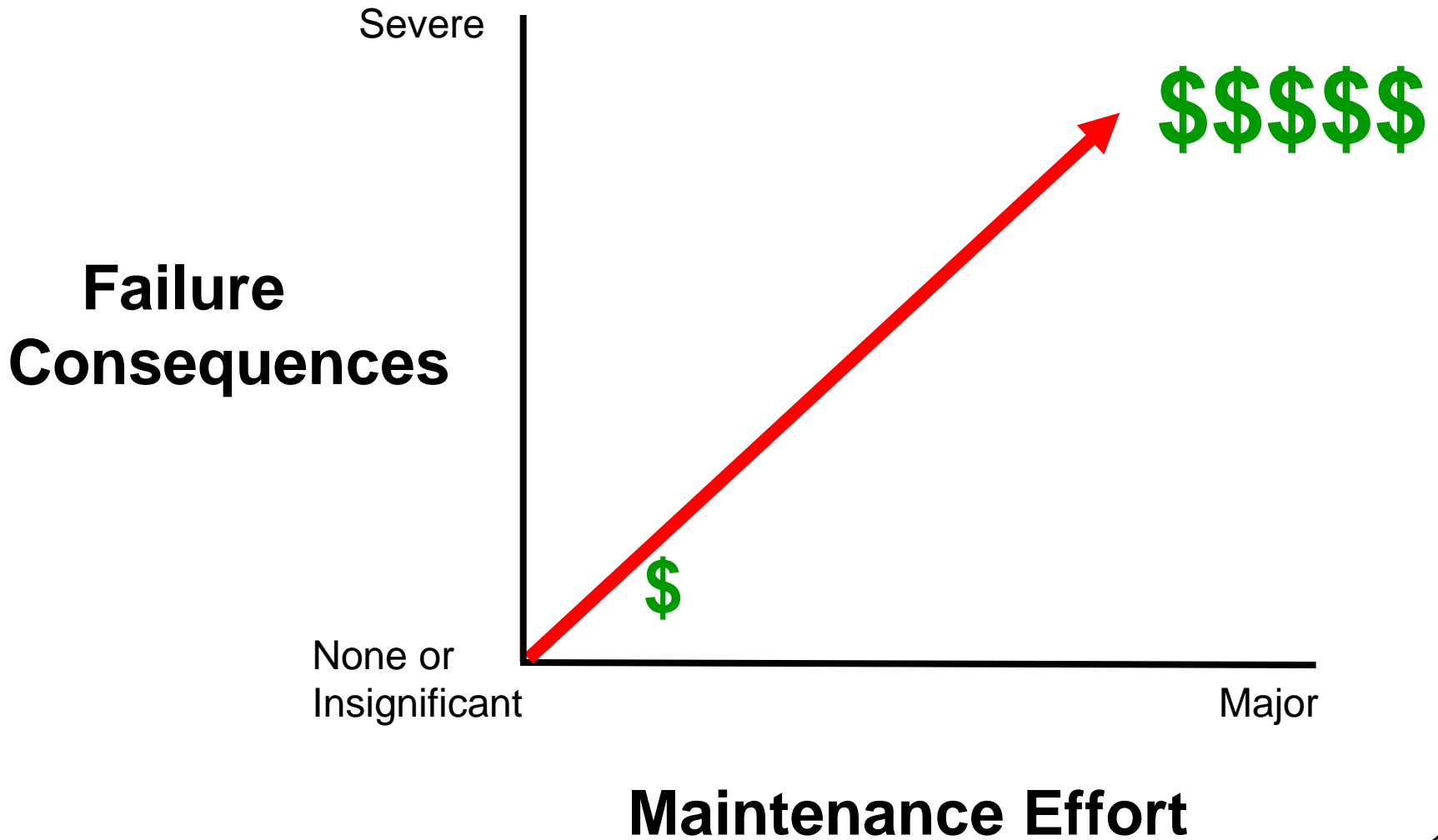
AMERICAN WATER



Asset Failures



AMERICAN WATER





Asset Maintenance / Failure Matrix

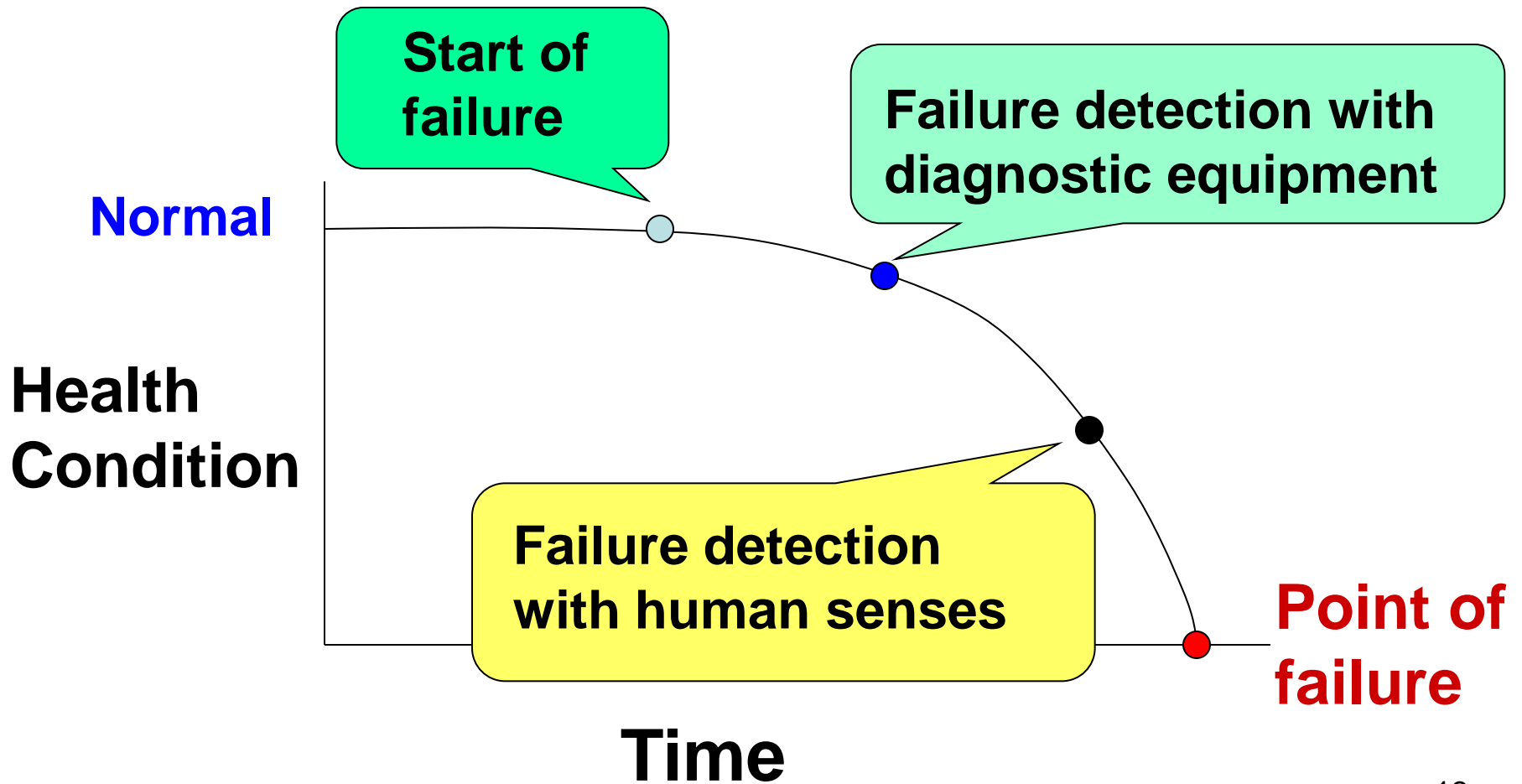
Failure Consequences	Severe	1 Crisis Maintenance (Reactive)	2 *Reliability Focused Maintenance (Proactive)
	None or Insignificant	3 Adequate Maintenance (Reactive)	4 Excessive Maintenance (Proactive)
		Maintenance Effort	
			Major

Potential - Failure Curve

Reliability Centered Maintenance - John Moubray



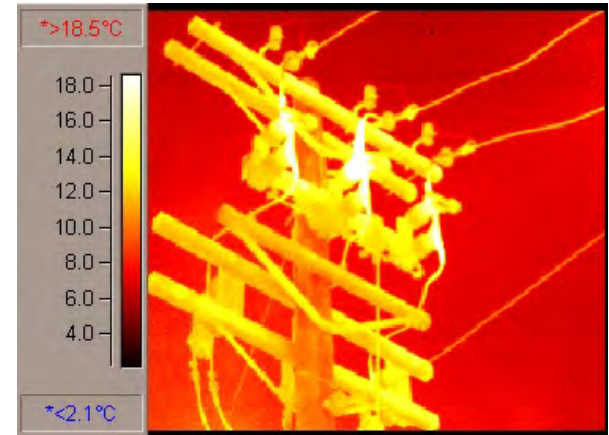
AMERICAN WATER





Health/Condition Assessment & Diagnostic Programs

- Instrument verification
- Infrared inspections
- Ultrasonic leak detection
- Vibration analysis
- Motor testing and inspection
- Motor starter inspections
- Protective relay testing
- Stationary battery testing
- Transformer inspection
- Insulating & Lubricating oil testing
- Wire-to-water efficiencies
- Precision alignment
- Power quality monitoring





Health/Condition Assessment Programs

- Tank Inspections
- Hydrant inspection & flushing
- Valve exercising
- Pipe inspections
- Pipe cleaning
- Corrosion monitoring
- Corrosion protection
- Large meter testing
- Hydraulic monitoring
- Leak monitoring
- Pressure & control valve PM's
- Backflow device testing



The Cheap Fix

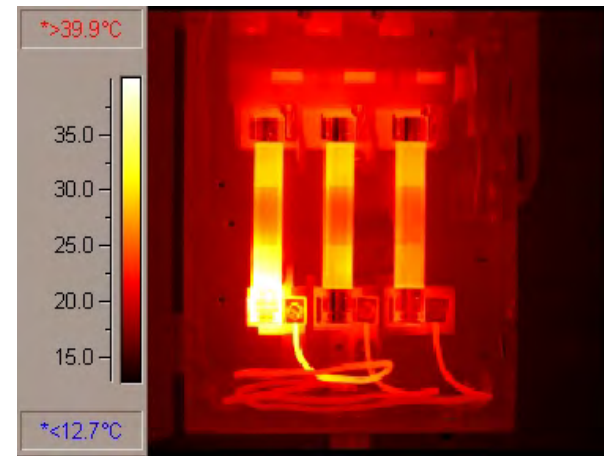
PAW Facilities: July - December, 1999

Repair cost if allowed to fail	\$117,000
Repair cost of scheduled repair	\$17,000
Difference	\$100,000

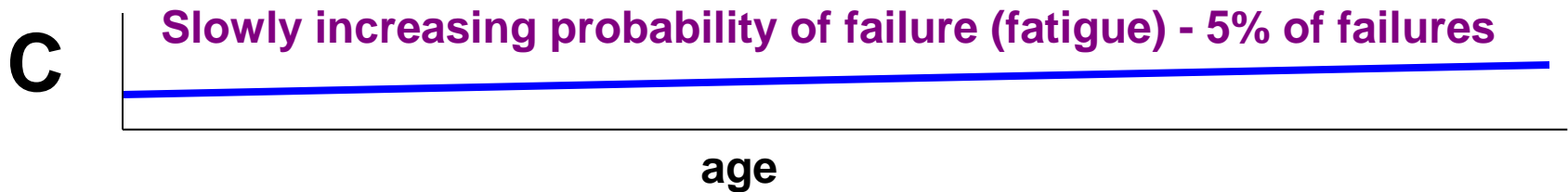
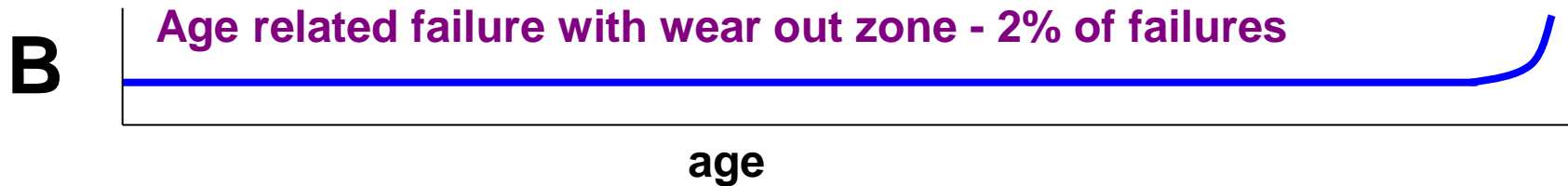
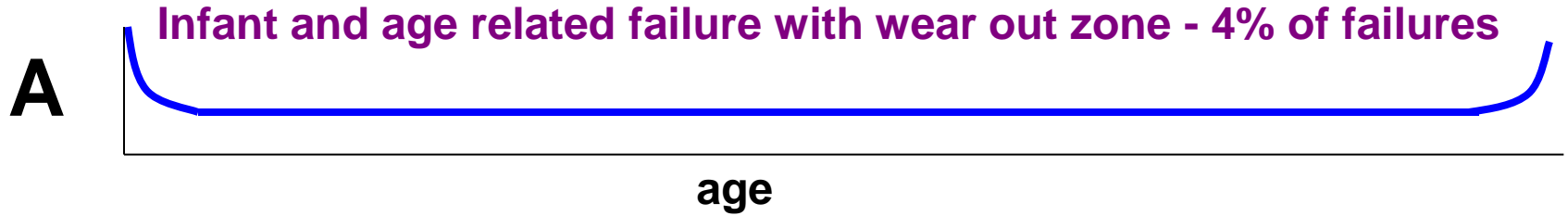
Benefit: Est. savings (avoided costs)



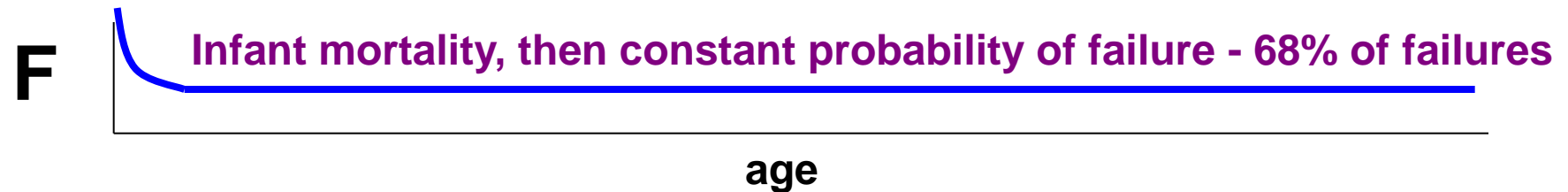
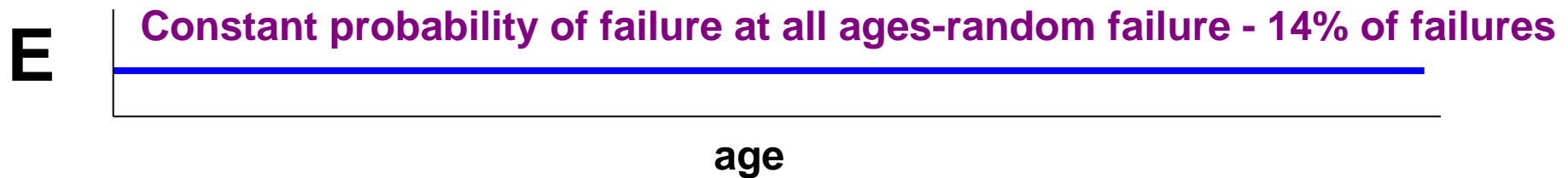
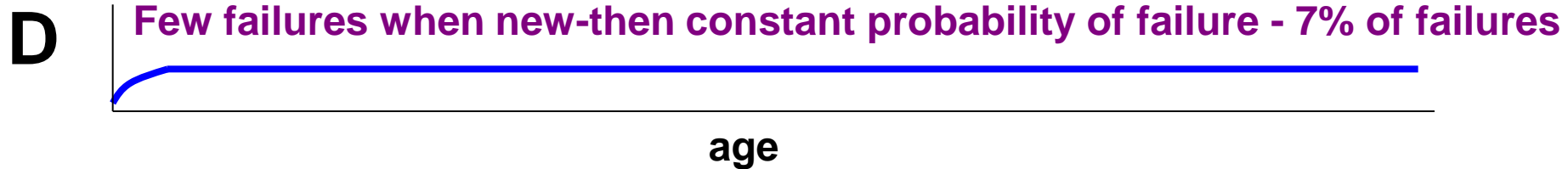
\$100,000



Six Patterns of Failure



Six Patterns of Failure

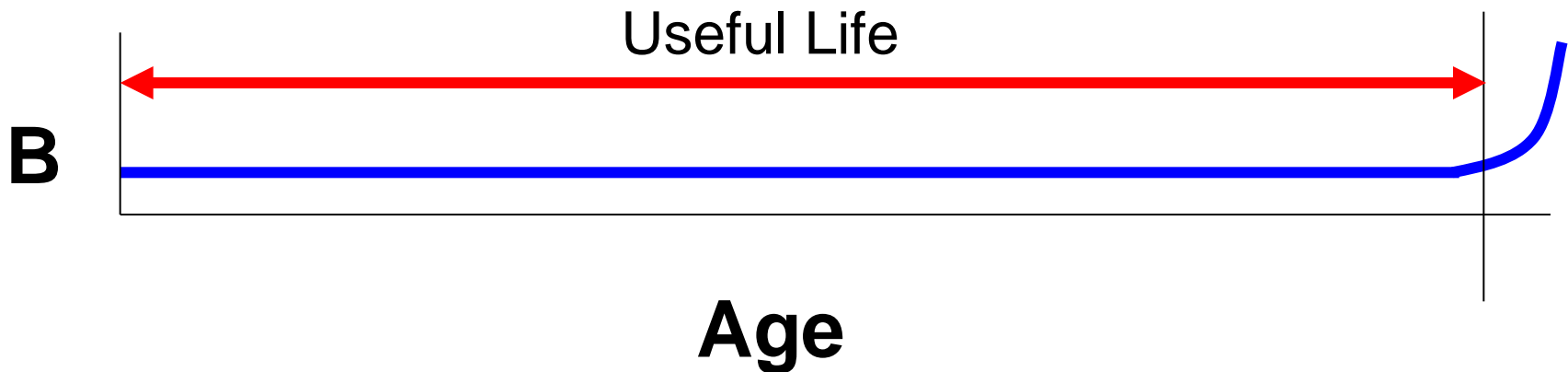




Failure Pattern “B”

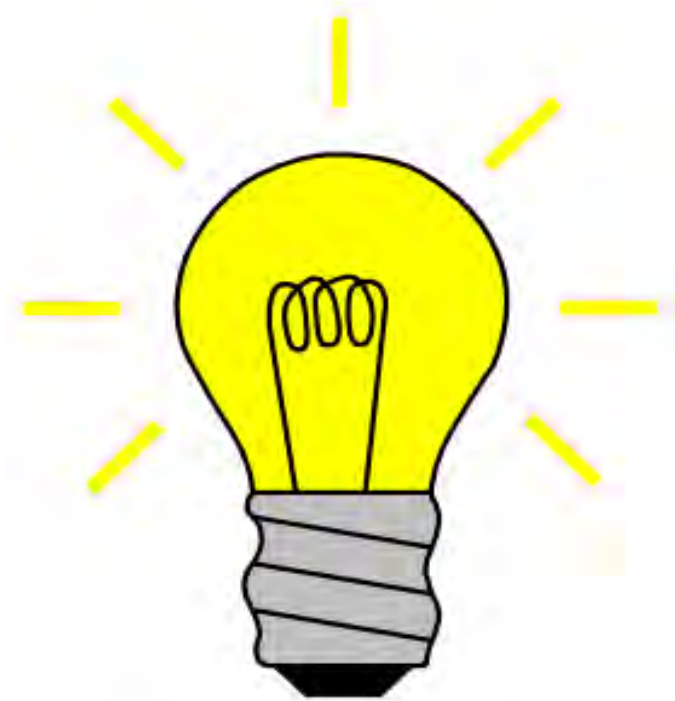
Constant probability of failure - failure at wear out zone

2% of failures

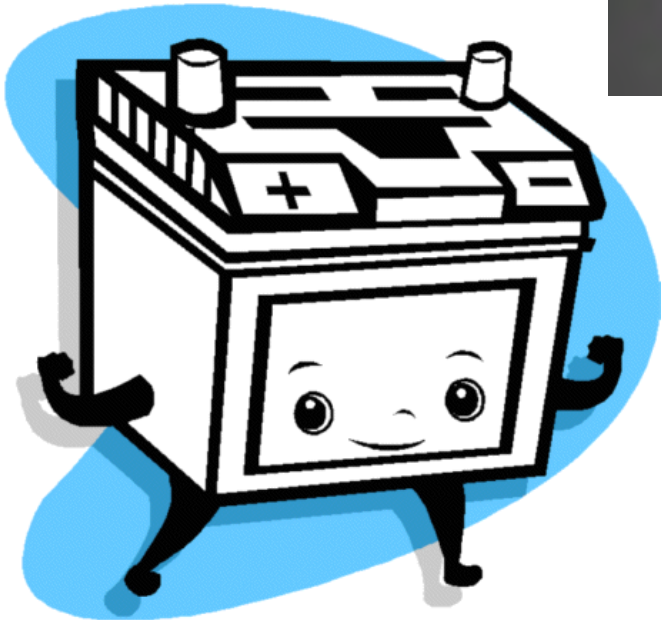
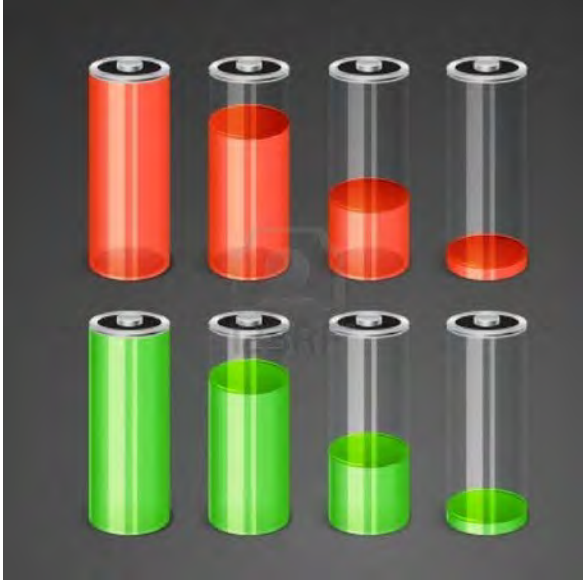




Lighting – Failure Pattern “B”



Battery – Failure Pattern “B”

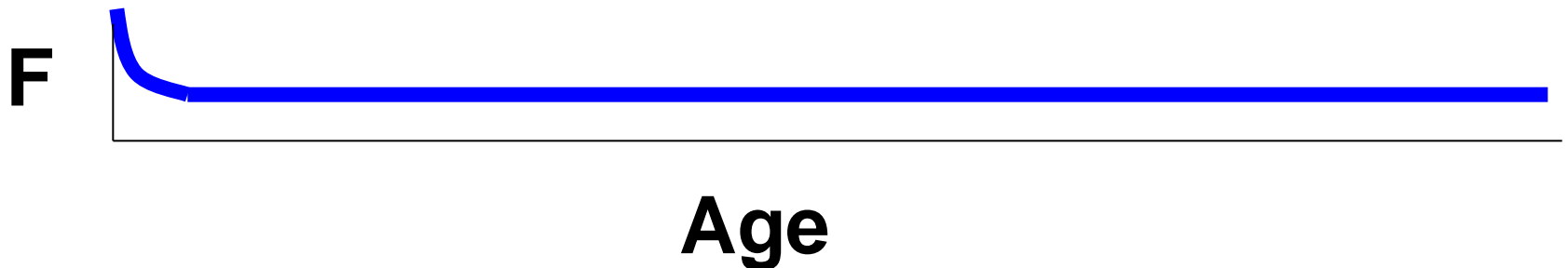




Failure Pattern “F”

Infant mortality, then constant probability of failure

68% of failures



Root Causes



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- **Characteristic of certain devices**
- **Poor design or manufacturing quality**
- **Incorrect installation or operation**
- **Unnecessary & excessively invasive maintenance**
- **Poor maintenance practices or workmanship**



Asset Health

Do You Want

**Extended Life?
Reliability?
Efficiency?
Quality?**





You Must Employ Health Based Programs

