Smart Management for Small Water Systems

Understanding Criticality: Reduce Risk & Optimize Operations

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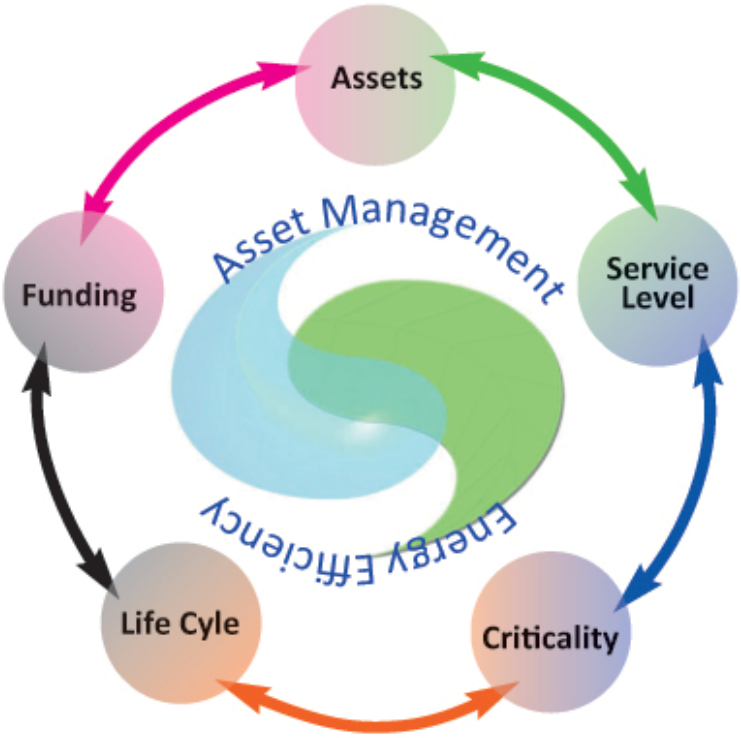
Asset Management

- Asset management is maintaining a desired level of service for what you want your assets to provide at the lowest life-cycle cost. Lowest life-cycle cost refers to the best appropriate cost for rehabilitating, repairing or replacing an asset.

  - US EPA

Asset Management Overview



- Five core components
- All interact/overlap
- All important
- Asset Management Planning Strongly Encouraged

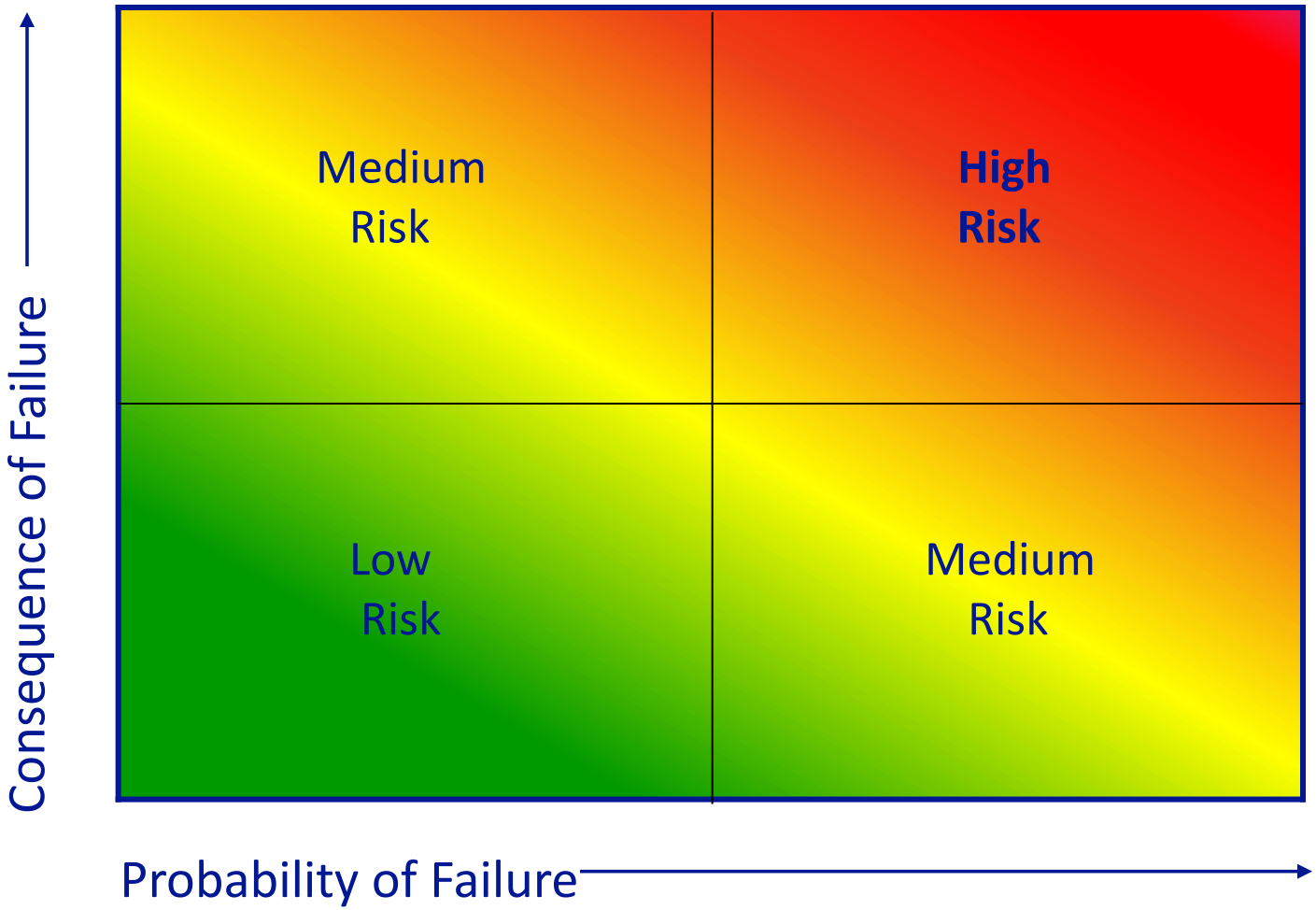
Criticality Overview

- Criticality assesses risk
  - Probability of Failure
  - Consequence of Failure
- Criticality = probability * consequence
- Focus on level of service & compliance

A few words about risk

- Ever-present
- Even new infrastructure is a balance of risk of failure vs. costs & other constraints
- Risk cannot be eliminated
- Can be reduced/planned for

Criticality - Graphically



Failure

- How have assets failed in past?
- How can assets fail in the future?
- What can reduce the probability of failures?

Probability of Failure

- Failure does not mean “broken”
- Answer: “How can this asset fail to deliver what it is intended to deliver?”
- Examples –
  - Environmental Changes
  - Regulatory Changes
  - Capacity Loss/degradation
  - Power Loss
  - Quality or Quantity declines
  - Interaction with Community

Environmental Changes

- Common occurrence in many small water supplies
- Previously compliant water source is polluted
- Nitrates
- Blue green algae

Image from KS Dept. of Health & Environment

Regulatory Changes

- Maximum Contaminant Level 2018 = 50
- Maximum Contaminant Level 2025 = 5
- Your treated water = 25
- Attempt to ensure new infrastructure meets potentially lower limits

Capacity Loss/Degradation

- Equipment no longer performs as designed
  - Often slow-moving problem
- Pipe tuberculation
- Pump wear
- Well screen clogging
- Slow meters

Image from Echologics

Power Loss

- Electrical power can fail

- Site-specific options
  - Do nothing
  - Second power feed
  - Backup generation

Image from eBay

- Backup generators
  - Mobile – move between various facilities
  - Permanent
  - Run all equipment or partial

Quality or Quantity Declines

- Declining water tables
  - Decreased pumping rates
  - Increased salt content
- Surface water changes
  - Taste & Odor
  - Salt levels
  - pH
  - Turbidity

Interaction with Community

- Systems can be both over & undersized, leading to failures
- Growing population
  - May not meet water demands
- Shrinking population
  - May have stagnant water
  - May not meet financial goals/policies
- Economic & technological changes
  - Growth/decline industrial & commercial use
  - Most uses are getting more efficient

Redundancies

- Redundant (Oxford Dictionaries):
  - “able to be omitted without loss of meaning or function”
  - “(of a component) not strictly necessary to functioning but included in case of failure in another component.”

- Is not only “like for like”

Partial Redundancies

- Recognize if repetitive equipment is fully or partially redundant
- Unknown if top picture is fully redundant
- Bottom may be partially redundant (may not meet service levels at all times).
  - Are all pumps the same capacity?
  - What is required for peak flows?

Partial Redundancies

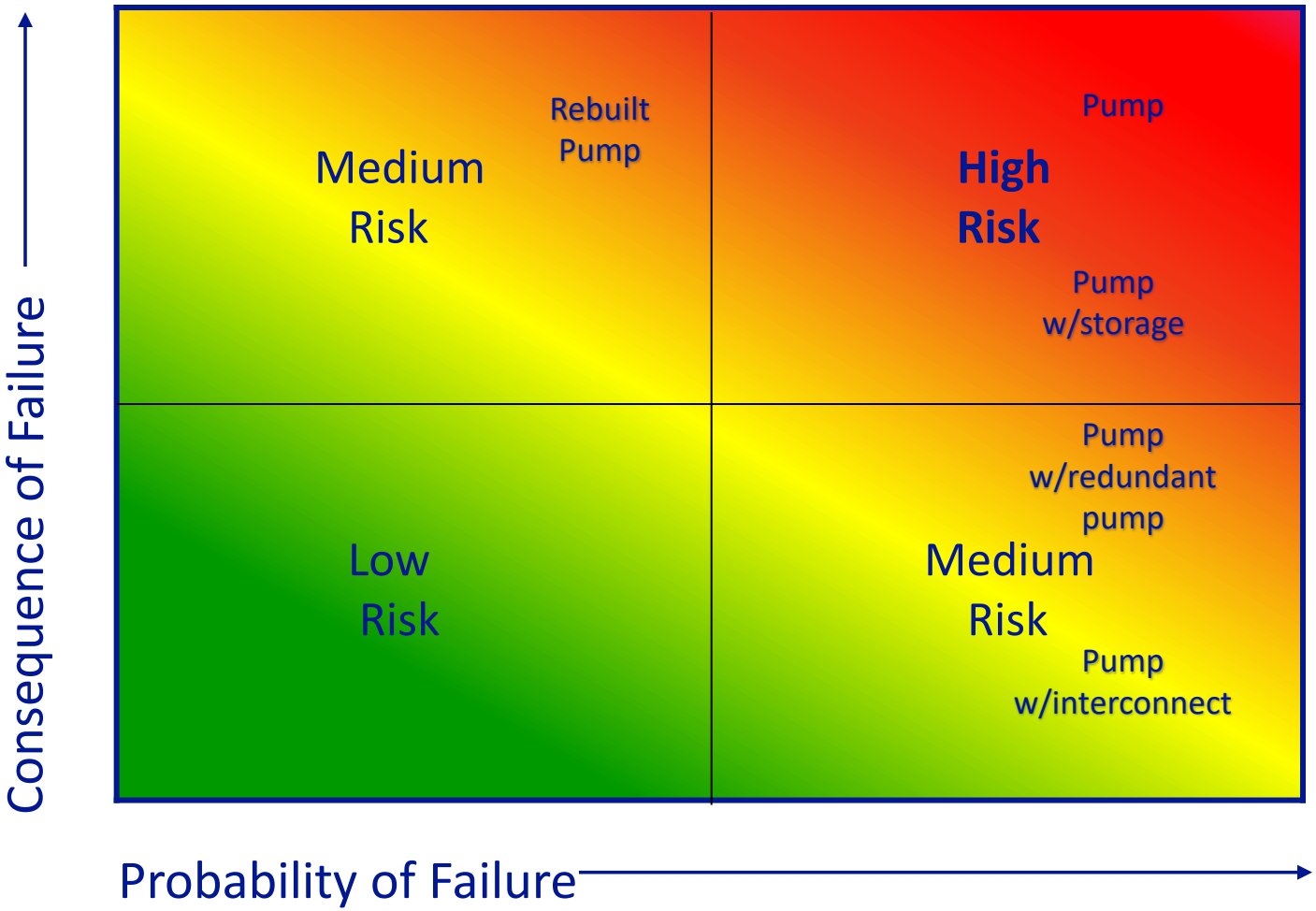
- Generally
  - Limit maximum capacities
    - i.e., 1 million gallon/day drops to 600,000 gal/day
  - May meet average demands
    - Plan response for failure in peak demand
      - i.e. customer communication – no irrigation
  - Leave no or little redundancy after first failure
  - Full redundancy may be economically unfeasible

Non “like for like” redundancy

- Complex water systems may have numerous redundancies that are not like for like

- Examples:
  - Emergency supply interconnects
  - Elevated storage backs up pumping units
  - “straight pipe” replaces broken meter
  - “Hand” operation on control system
  - Raw water supplies with varying quality

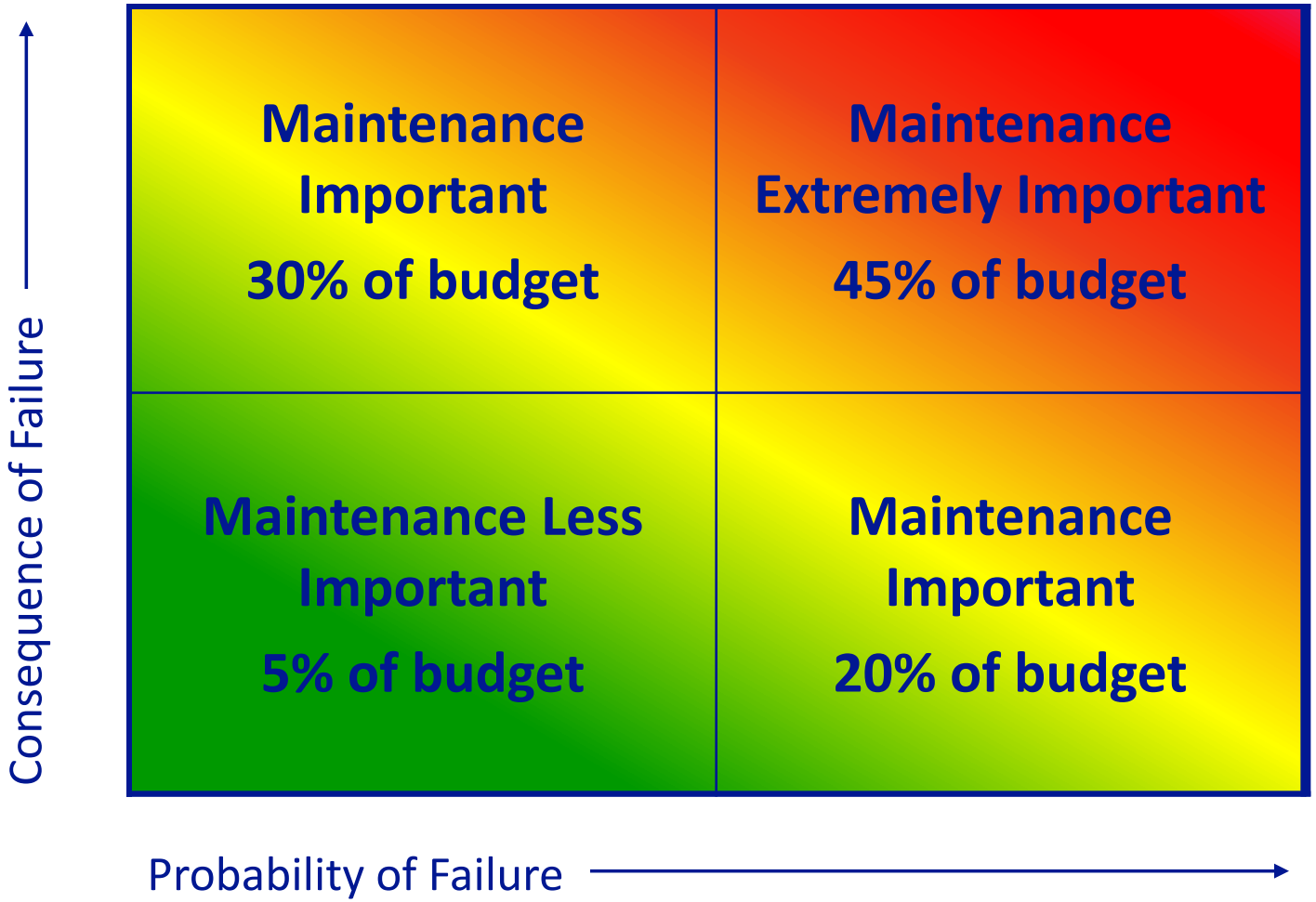
Criticality – Graphically with redundancy



Using Criticality to Inform Maintenance

- General theory
- Investment of time, resources, money & thought should be guided by criticality of utility's assets
- Rethink how things have been done

Criticality & Maintenance



Criticality & Maintenance in Practice

- Valve exercise
  - If less than recommended 1x/yr, have more frequent exercise on critical valves, less frequent on non-critical valves
  - Balance with:
    - Known condition
    - Outright replacement if problematic
    - Known end-life
    - Exercising nearby valves while there

Criticality & Maintenance in Practice

- Lubricated items
  - May not need frequent/scheduled lubricant replacement
- Balance
  - Value of frequent visits
  - Labor costs
  - Time spent on assets with known end-life
- Consider testing of lubricants in:
  - Equipment with large volumes and/or high price
  - Equipment difficult/dangerous to service

Criticality & Maintenance

- Whole system
  - Generally lack maintenance dollars & time
  - In aggregate maintenance of most critical assets, not most critical pump/valve, etc. is important
  - Determine where maintenance is likely to:
    - Reduce lifecycle costs to utility
    - Detect future problems
    - Improve emergency response
    - Increase knowledge of system
    - Maintain desired level of service

Smart Management for Small Water Systems

Thank you for participating today.
We hope to see you at a future workshop!

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