# Leveraging Infrastructure Management Systems

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**Infrastructure Management Group**
**Engineering Services**

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# PRESENTATION AGENDA

- Engineering's Asset Management Strategy and Framework
- Integrated Infrastructure Management System
- Multiple Criteria Decision Making
- Pilot Project with Streets Pavement Assets
- Moving Forward



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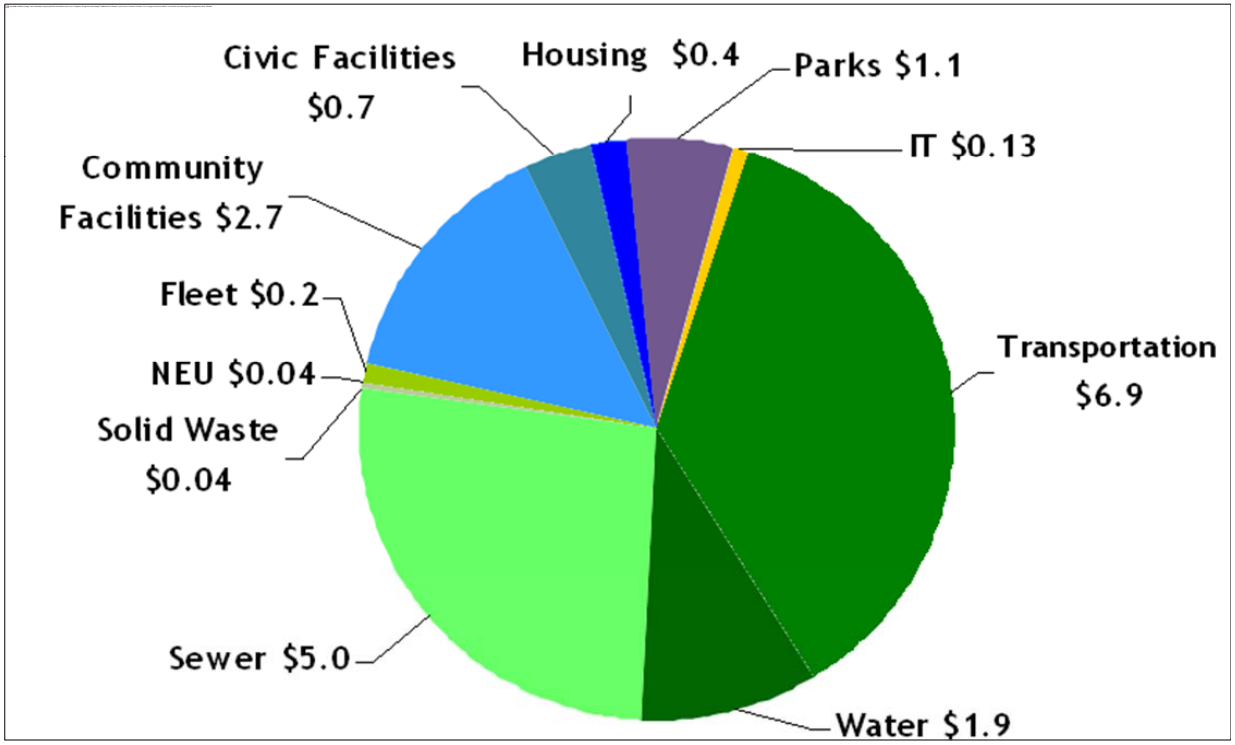
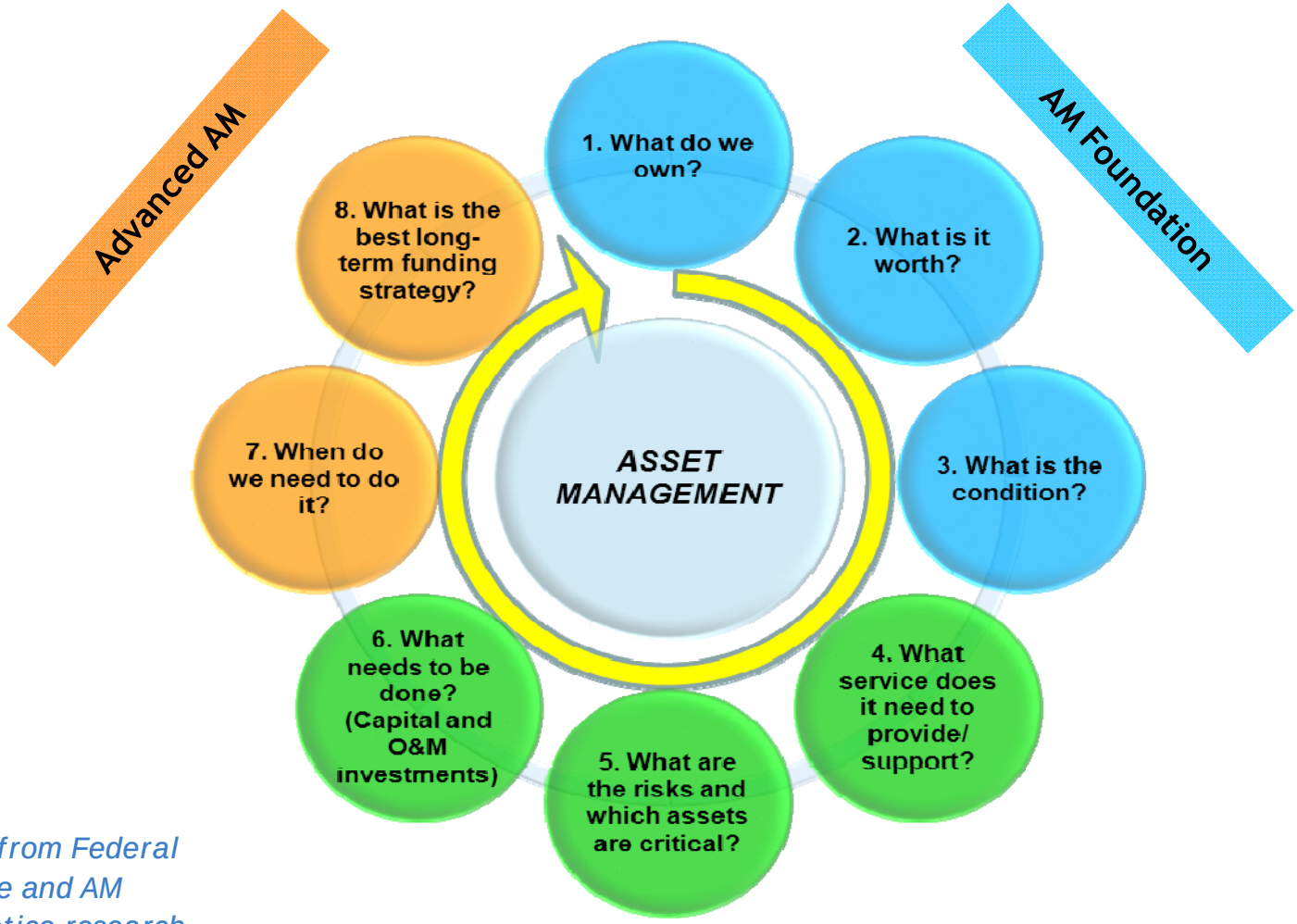
# CITY OF VANCOUVER OVERVIEW

- Population 603,500 (2011)
- 115 km$^2$
  - Constrained land base, built out, redevelopment
- $14B of Public Works assets
  - About 74% of City-wide asset pool



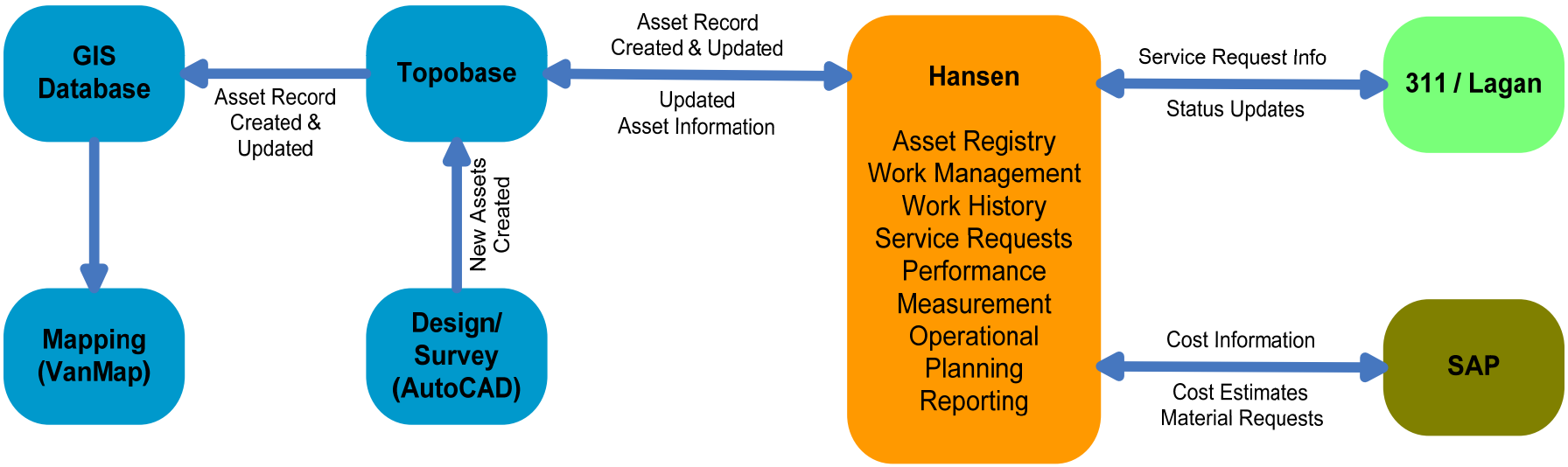
# ASSET MANAGEMENT STRATEGY




*Adapted from Federal Infraguide and AM best practice research*

# INTEGRATED INFRASTRUCTURE MANAGEMENT SYSTEM

## *- Asset Centric Approach*



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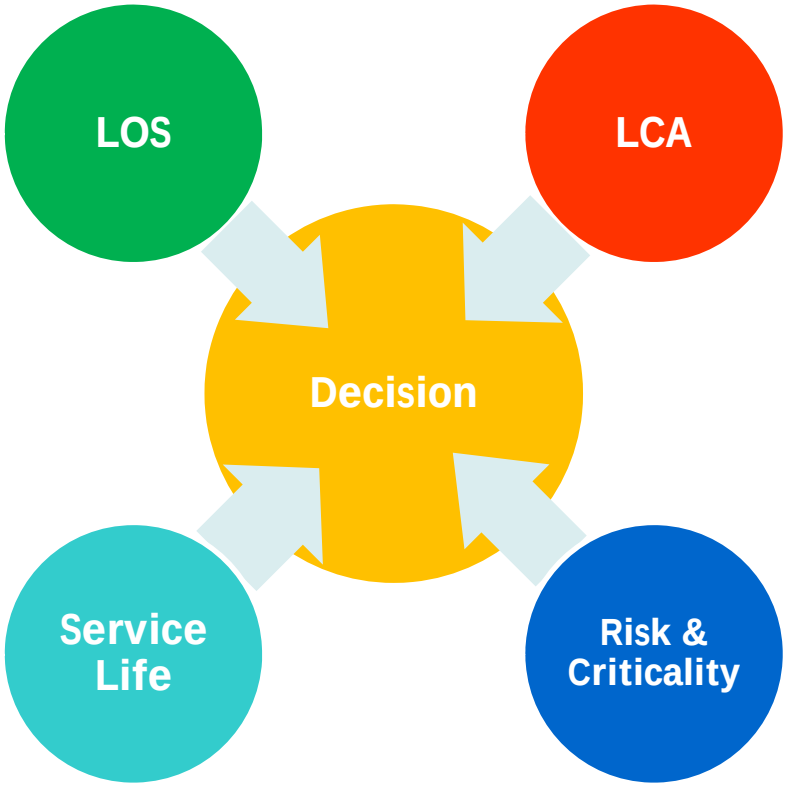
# DECISION MAKING FRAMEWORK EVOLUTION

## Then…

- **Asset decisions based on limited data**
- **Condition/Age Focus**

## Now…

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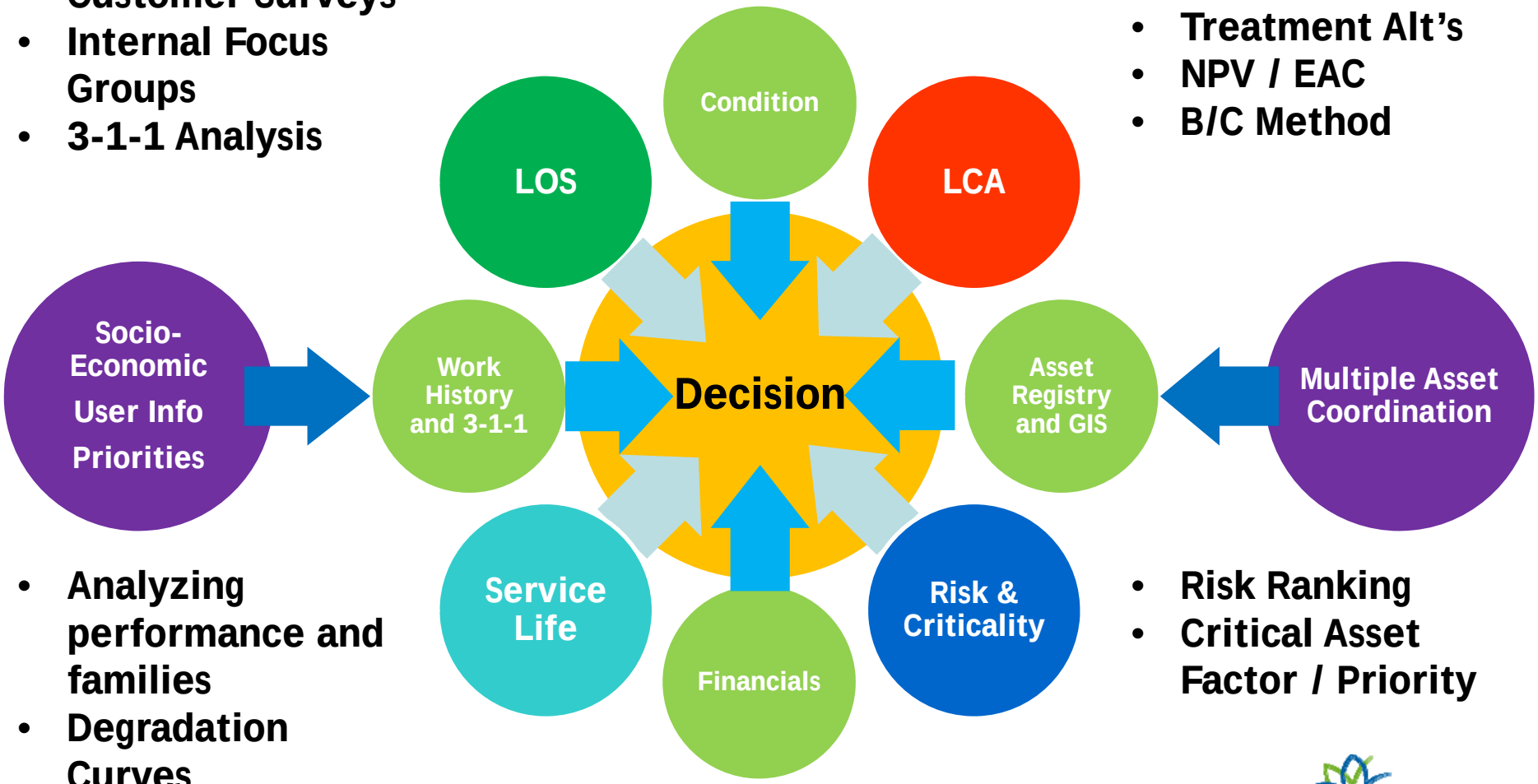
# MULTI-CRITERIA DECISION MAKING

- Customer Surveys
- Internal Focus Groups
- 3-1-1 Analysis

- O&M, Renewals
- Treatment Alt's
- NPV / EAC
- B/C Method




- Analyzing performance and families
- Degradation Curves

- Risk Ranking
- Critical Asset Factor / Priority



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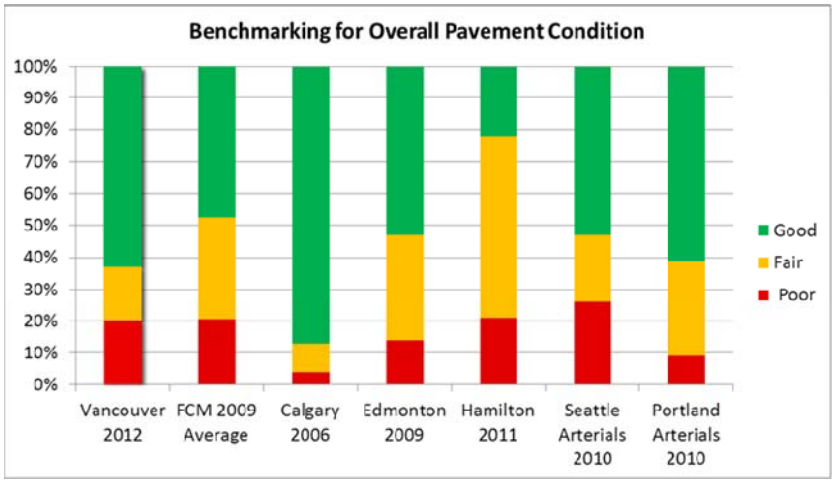
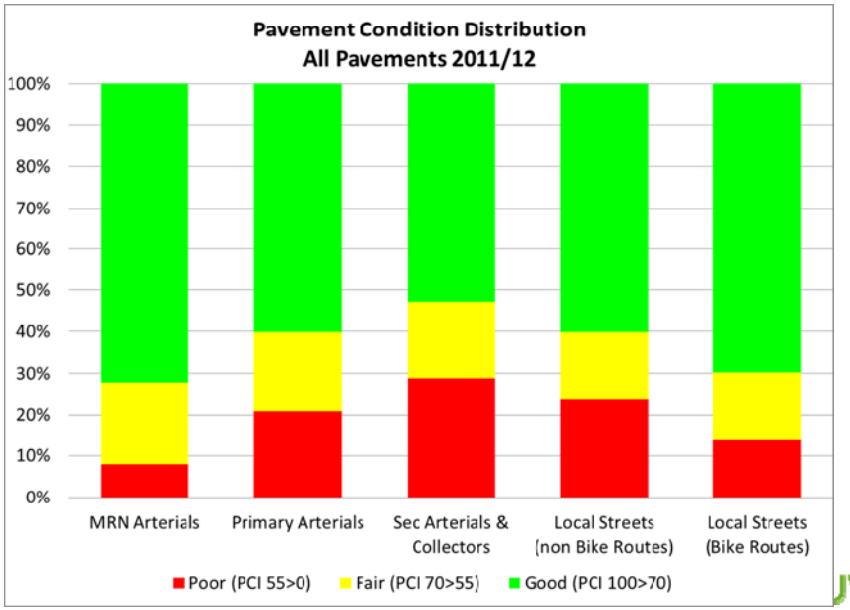
# PILOT PROJECT
## – *Streets Pavement Assets*

- 2100 km Streets
  - 121 km Regional Arterial
  - 243 km Arterial / Collector
  - 1058 km Local Streets
  - 650 km Lanes
- $4 Billion Replacement Value
  - Surface Valuation - $750 M
- Annual Rehab Budget ~$10 Million
- Network PCI ~ 70
- Age ~ 34 Years



# PILOT PROJECT
## – *Level of Service*

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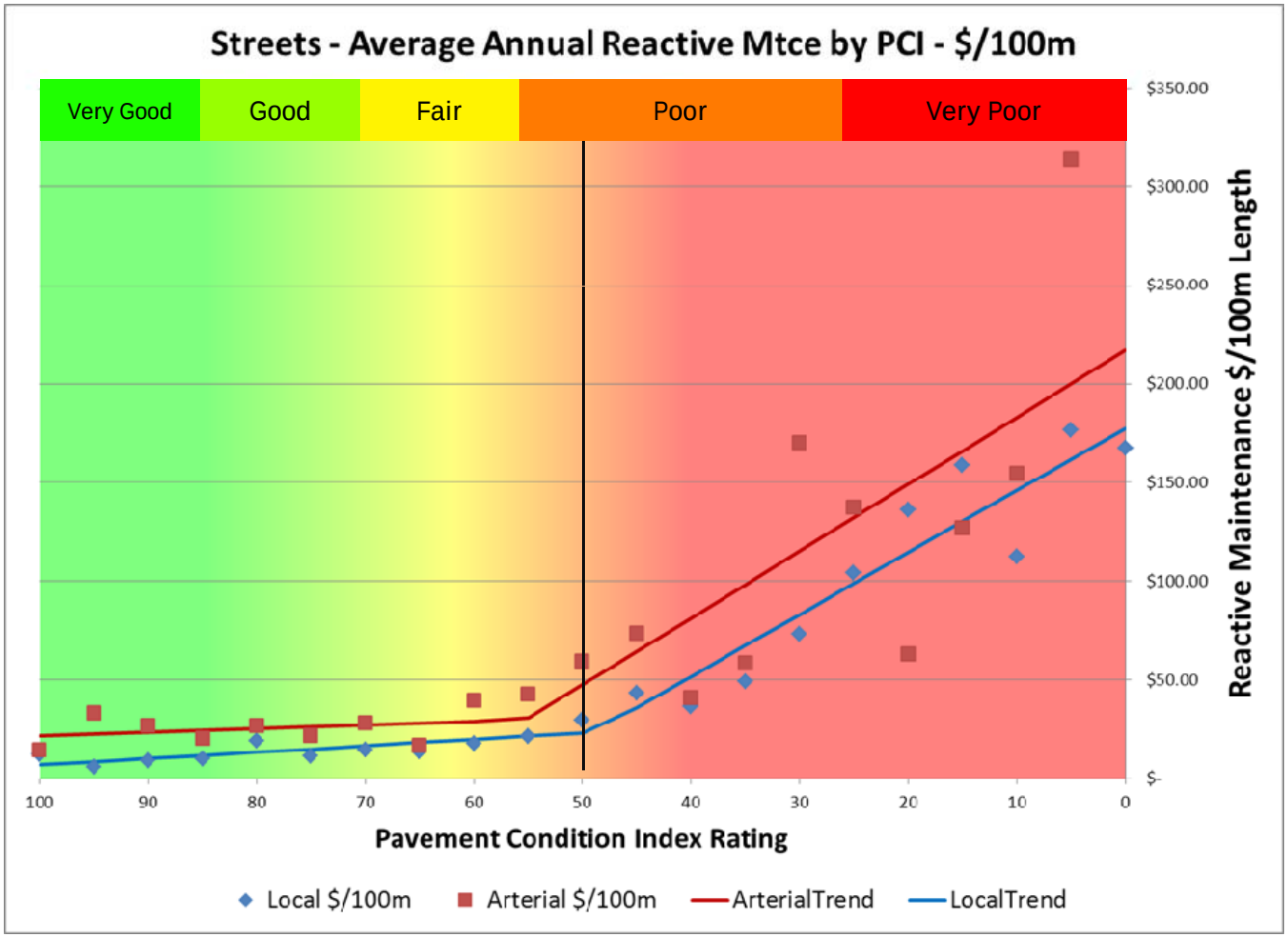
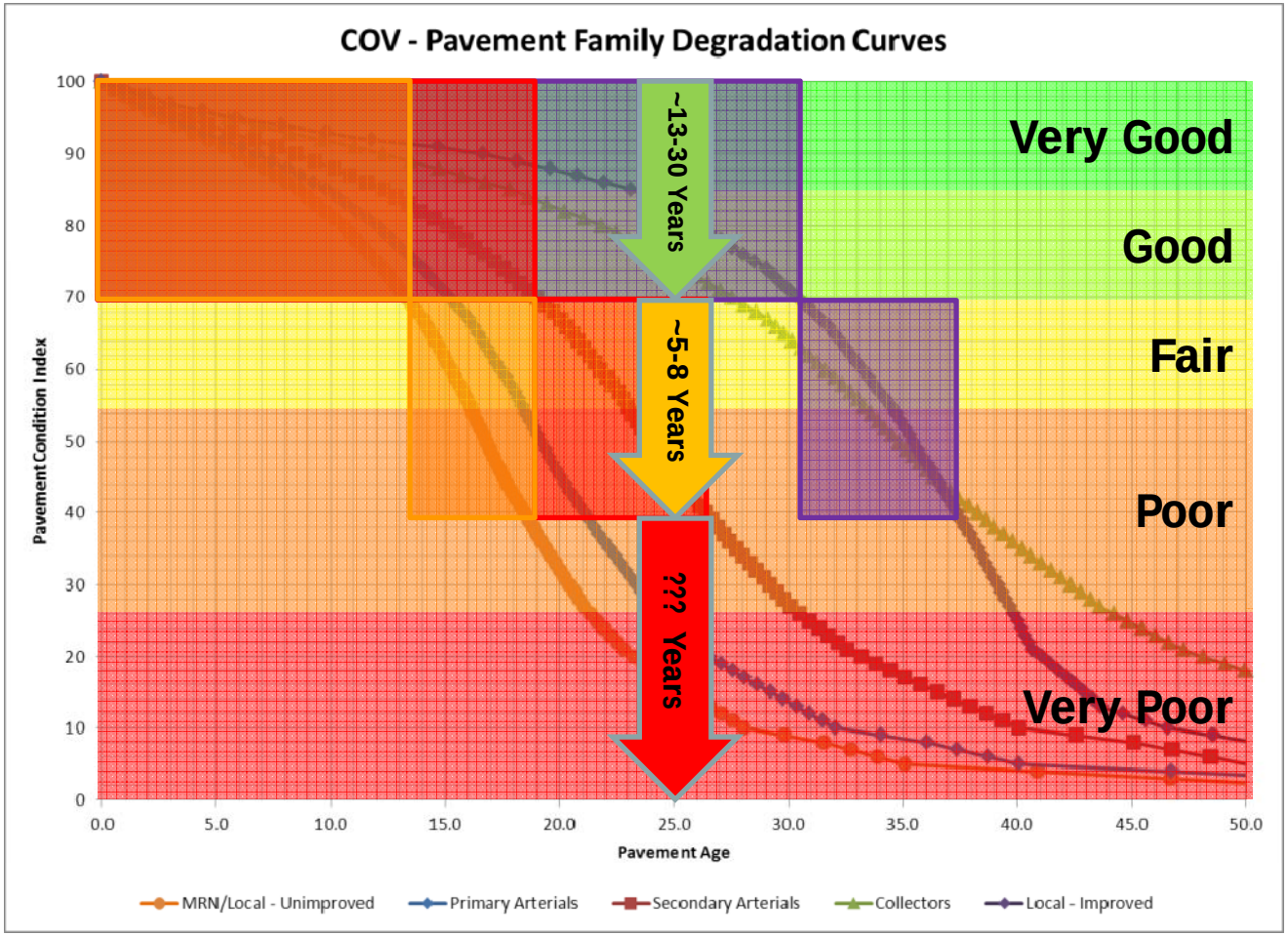


# PILOT PROJECT
## – *Service Life*



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# PILOT PROJECT
*– Life Cycle*

- Focus on “next action” vs “cradle to grave” life cycle – optimize OM&R
- Evaluated Treatment Alternatives (EAC)
- Determined Treatment Windows (LOS, Service Life, EAC treatment costs)
  - Economic cut-offs
  - Performance cut-offs
  - Service Level implications

**Local Patching**
- $90/m2
- 10 Year Service Life
- EAC (4%) - $11.10/yr

**Thin Lift Overlay**
- $15/m2
- 10+ Year Service Life
- EAC (4%) – $1.85/yr



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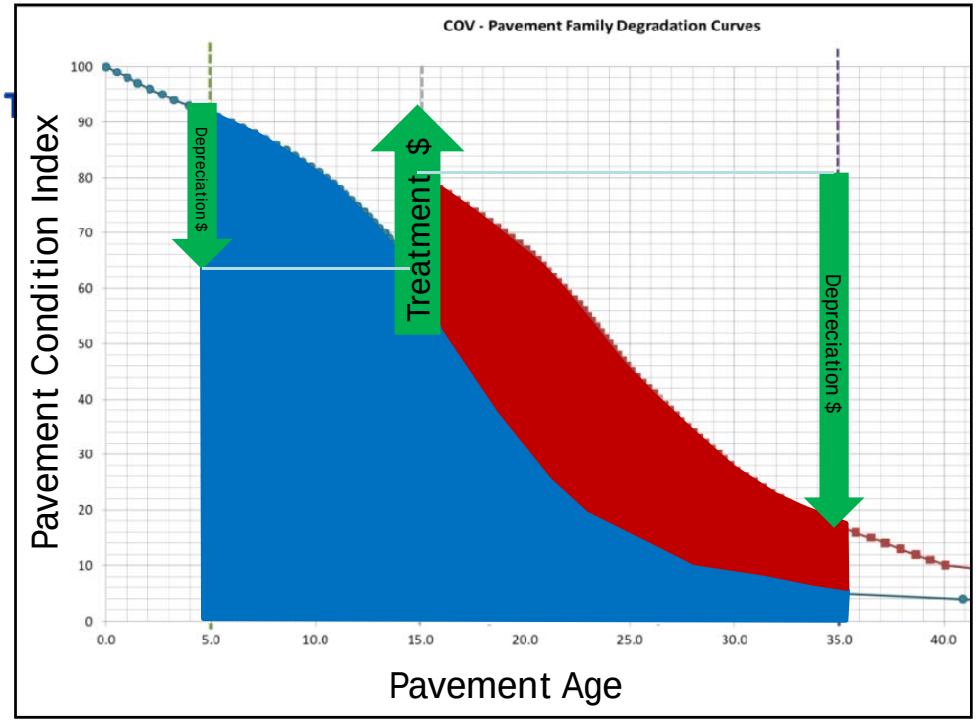
# PILOT PROJECT
## – *Life Cycle Benefit-Cost Theory*

- Established Asset Base – Forward Looking Analysis
- Multiple treatment options
- Quality of Service over time
- Total Cost for each option
- Optimize performance and life cycle costs



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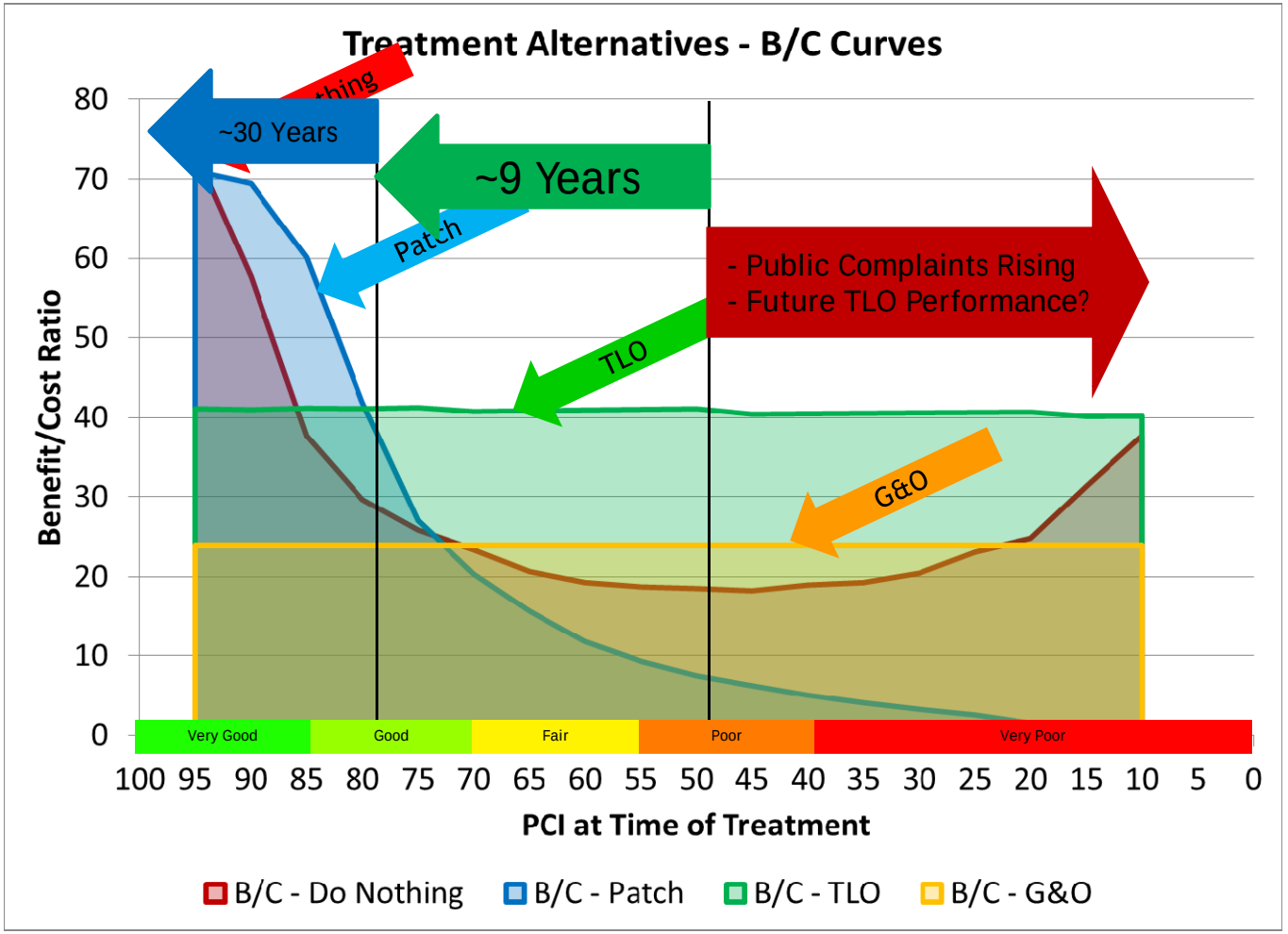
# PILOT PROJECT
## – *Life Cycle Benefit-Cost Theory*

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# PILOT PROJECT
*– Risk/Criticality*

- Understanding Priorities
- Risk and Criticality

| Risk | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | Insignificant | Minor | Moderate | Major | Catastrophic |
| Likelihood | Rare | L | L | M | M | H |
| | Unlikely | L | L | M | M | H |
| | Possible | L | M | H | H | H |
| | Likely | M | M | H | H | VH |
| | Almost Certain | M | H | H | VH | VH |


- Assessing a Risk Rating for Assets
- Relative / Global



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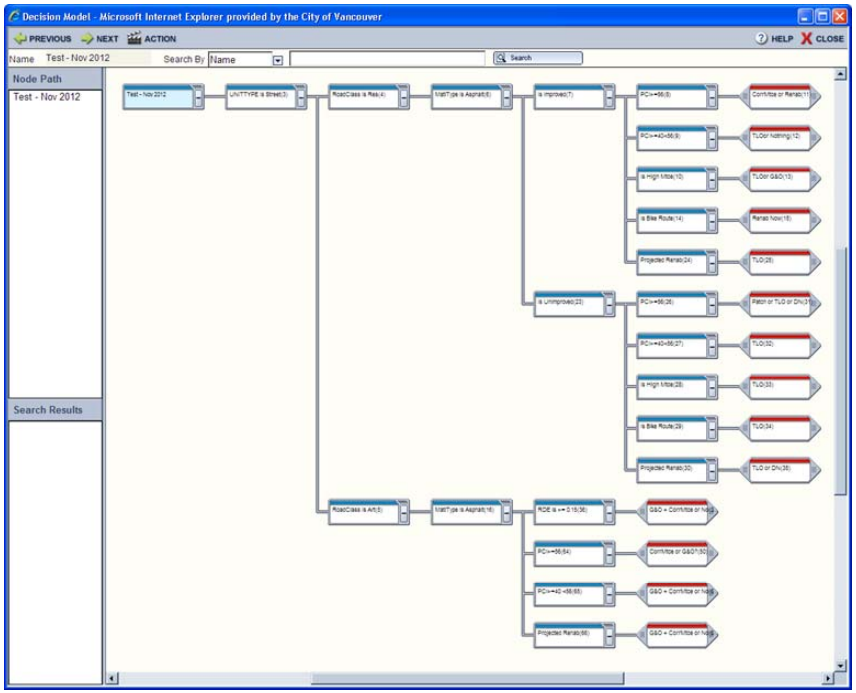
# BRINGING IT ALL TOGETHER
## – *Decision Modelling*

- Use criteria to identify needs
- Prioritize what to do
- Leverage our integrated IM System

*Applied our theory with the Hansen Advanced Asset Analysis tools*



# DECISION MODELLING

*- Hansen Advanced Asset Analysis*

## Technical Analysis

- Treatments / Timing
- Performance
- Economics
- Risk / Priorities

## Decision Tree

Result Node - Multiple Activities

- Benefit
- Cost
- Timing

**Recommended Treatments**

- Analysis Period
- Treatment Selection (B/C)
- Unconstrained Results

## Needs Analysis

- Constrained Results
- Funding Rules, Multi-Year
- B/C Ranking
- Unfunded Activities Deferred

## Budget Analysis



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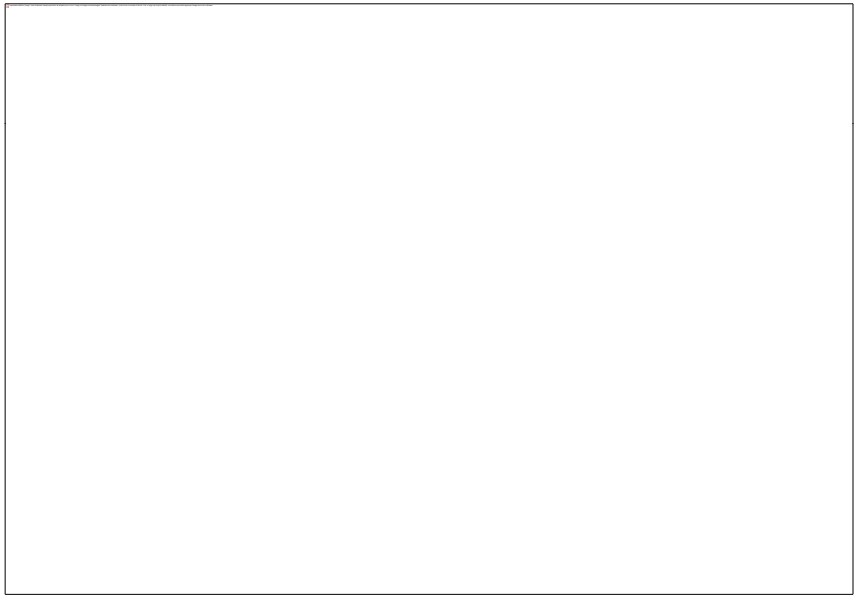
# DECISION MODELLING
*- Candidates*

- Asset Data





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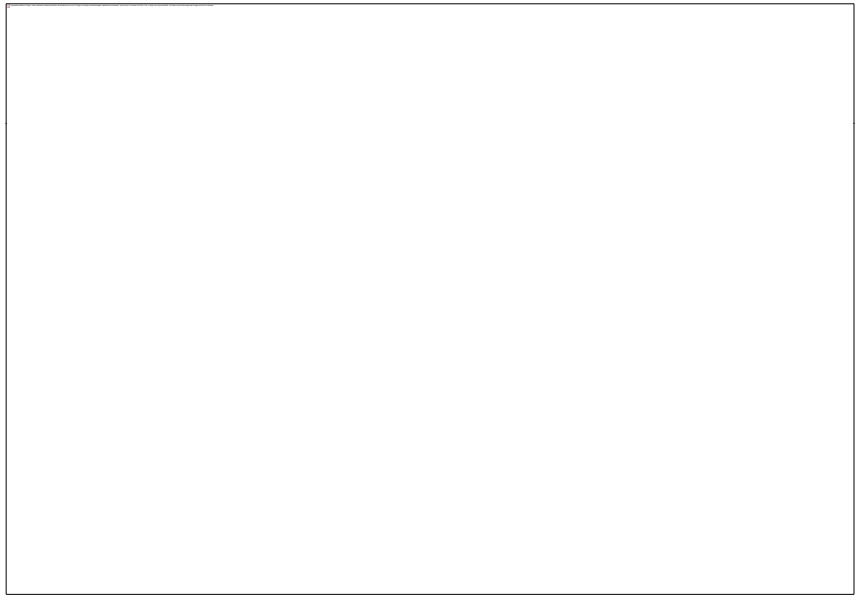
# DECISION MODELLING
*- Candidates*

- Asset Data
- Preventative Mtce (Crack Sealing)





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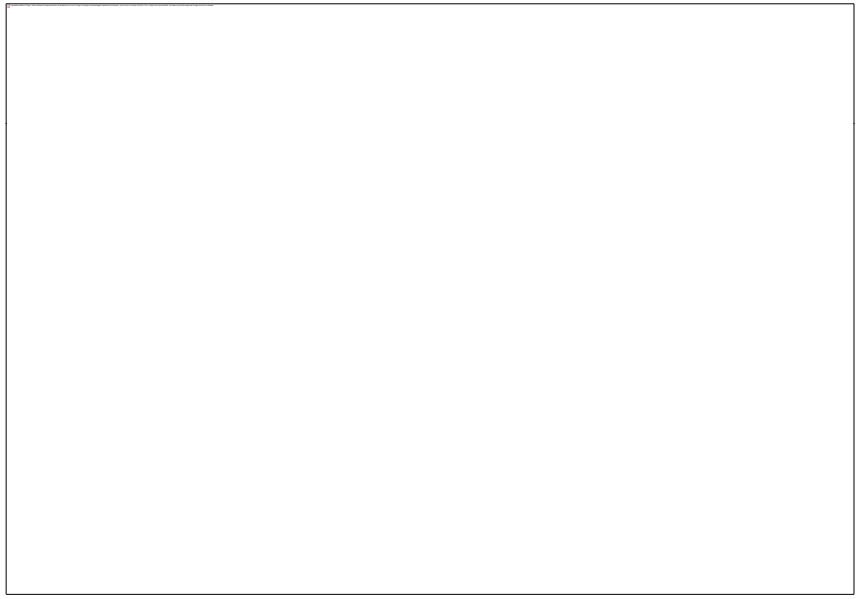
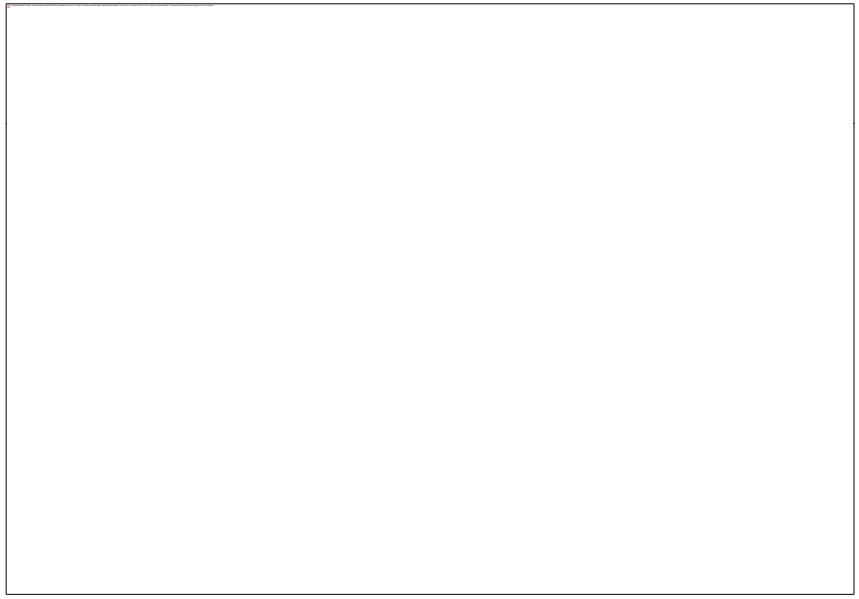
# DECISION MODELLING
*- Candidates*

- Asset Data
- Preventative Mtce (Crack Sealing)
- Corrective Mtce (Patching)



# DECISION MODELLING
*- Candidates*

- Asset Data
- Preventative Mtce (Crack Sealing)
- Corrective Mtce (Patching)
- Rehabilitation (Paving)
  - Coordination with Utilities





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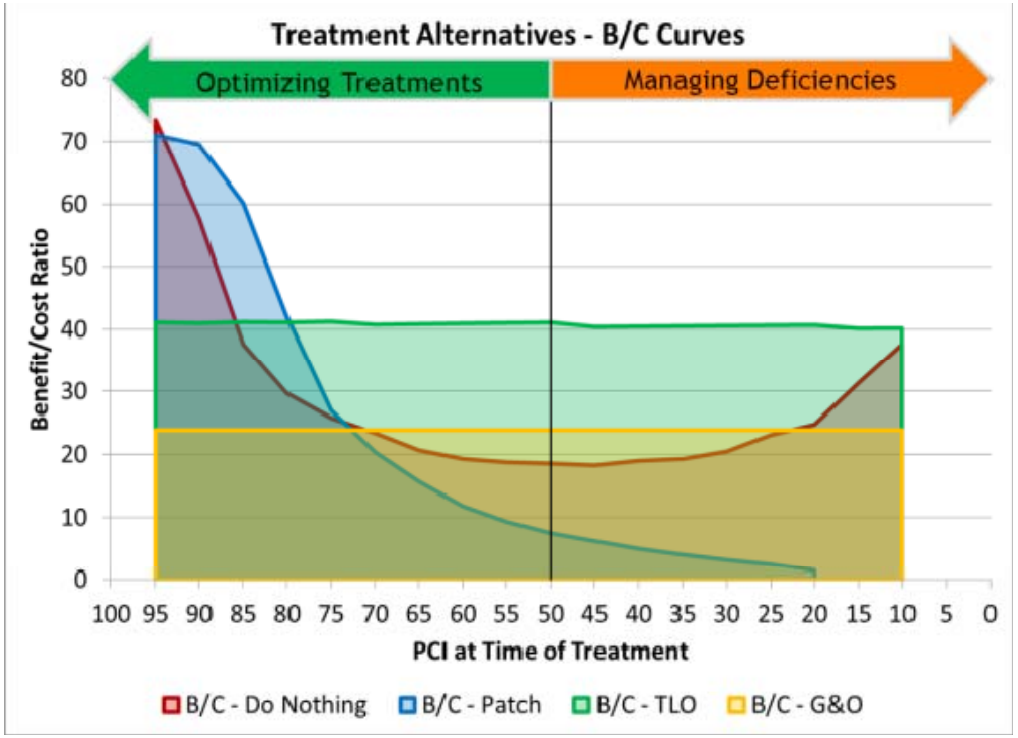
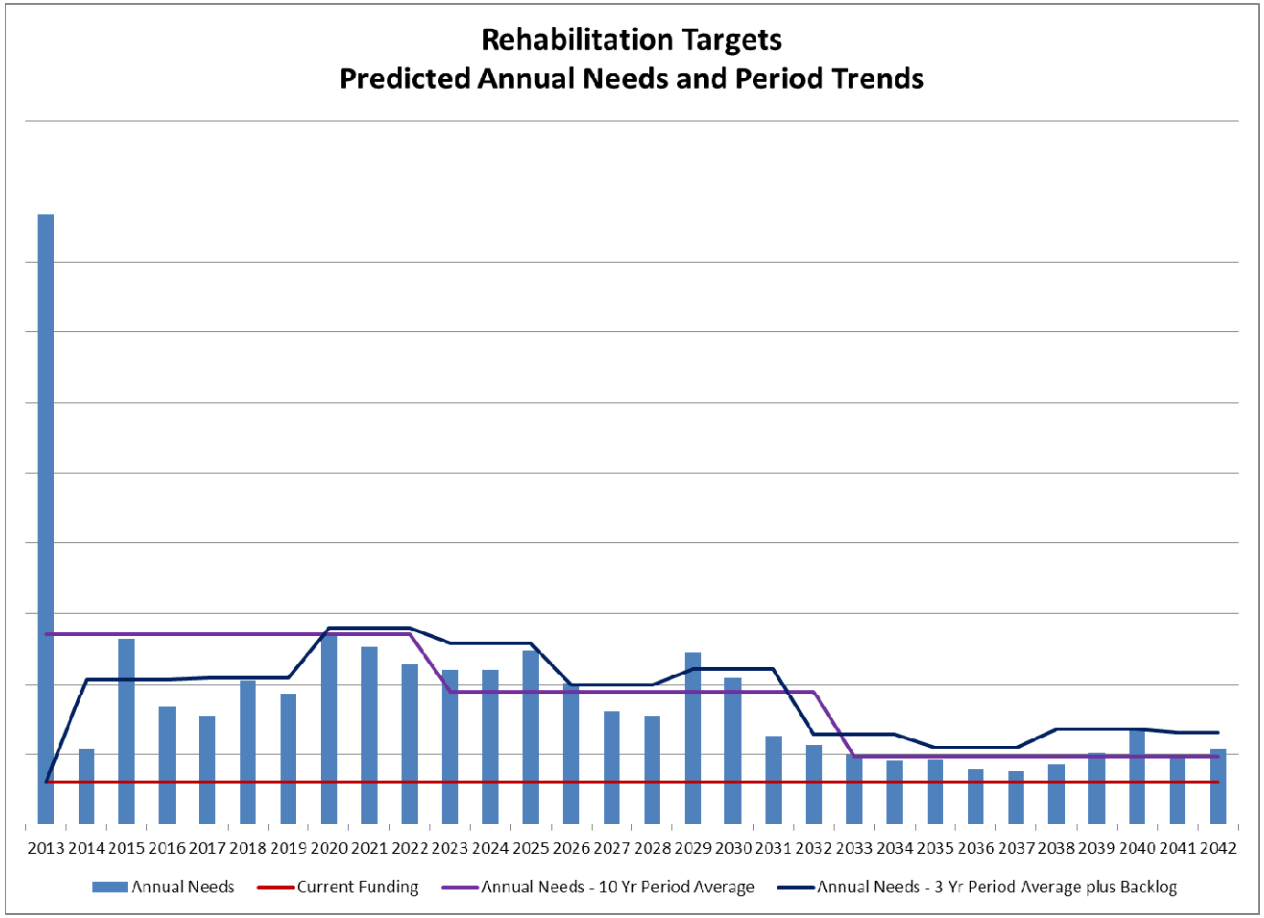
# DECISION MODELLING
*- Funding Choices/Impacts*

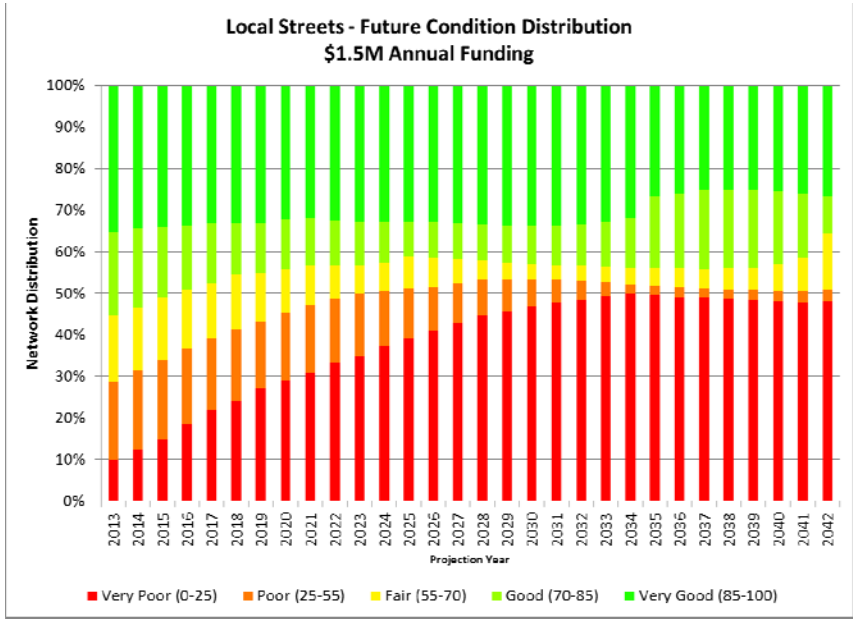
- Decision process for each asset
- Optimize treatments for the network
- Competing for funding with other priorities
- Inform/show impacts of funding choices

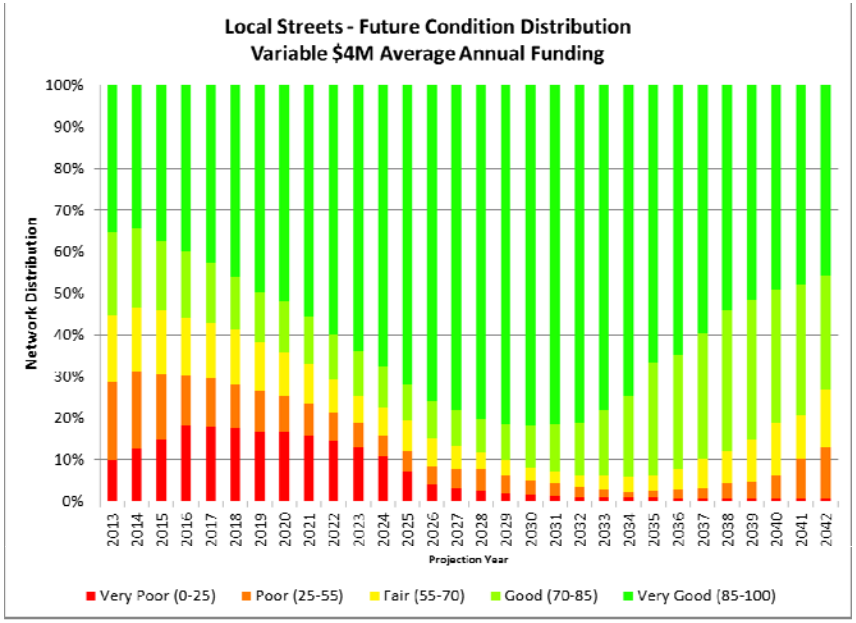


# DECISION MODELLING
## *- Needs Analysis*



# DECISION MODELLING
## *- LOS/Condition Projections*



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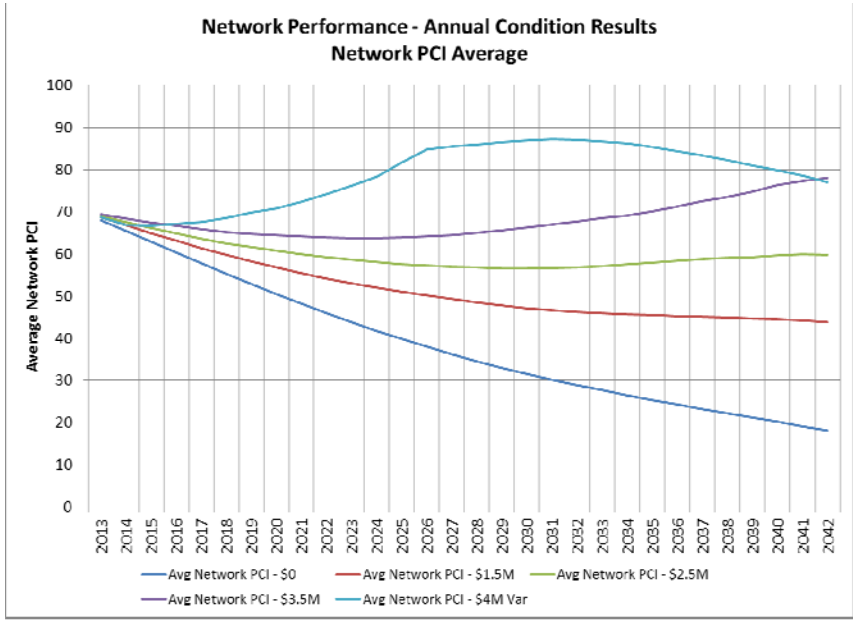


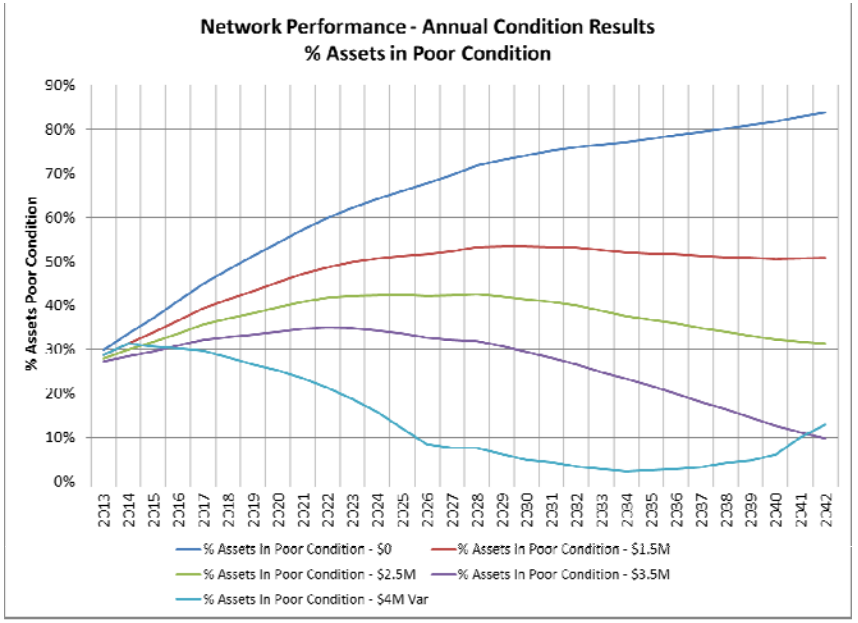




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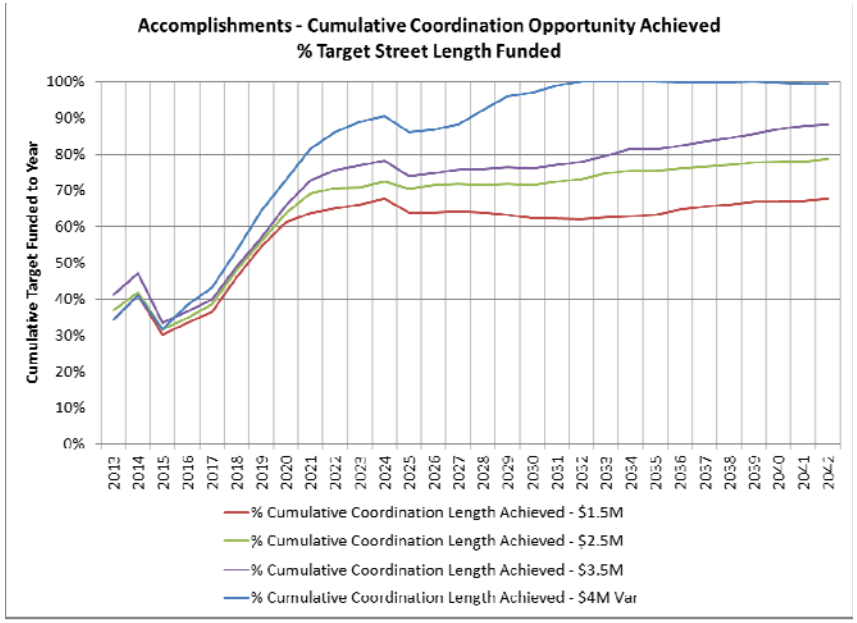


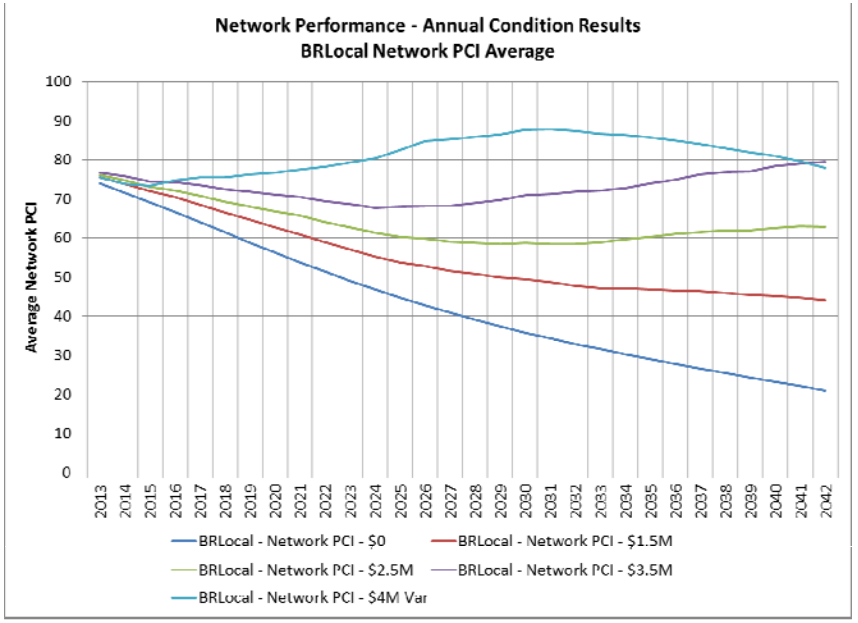




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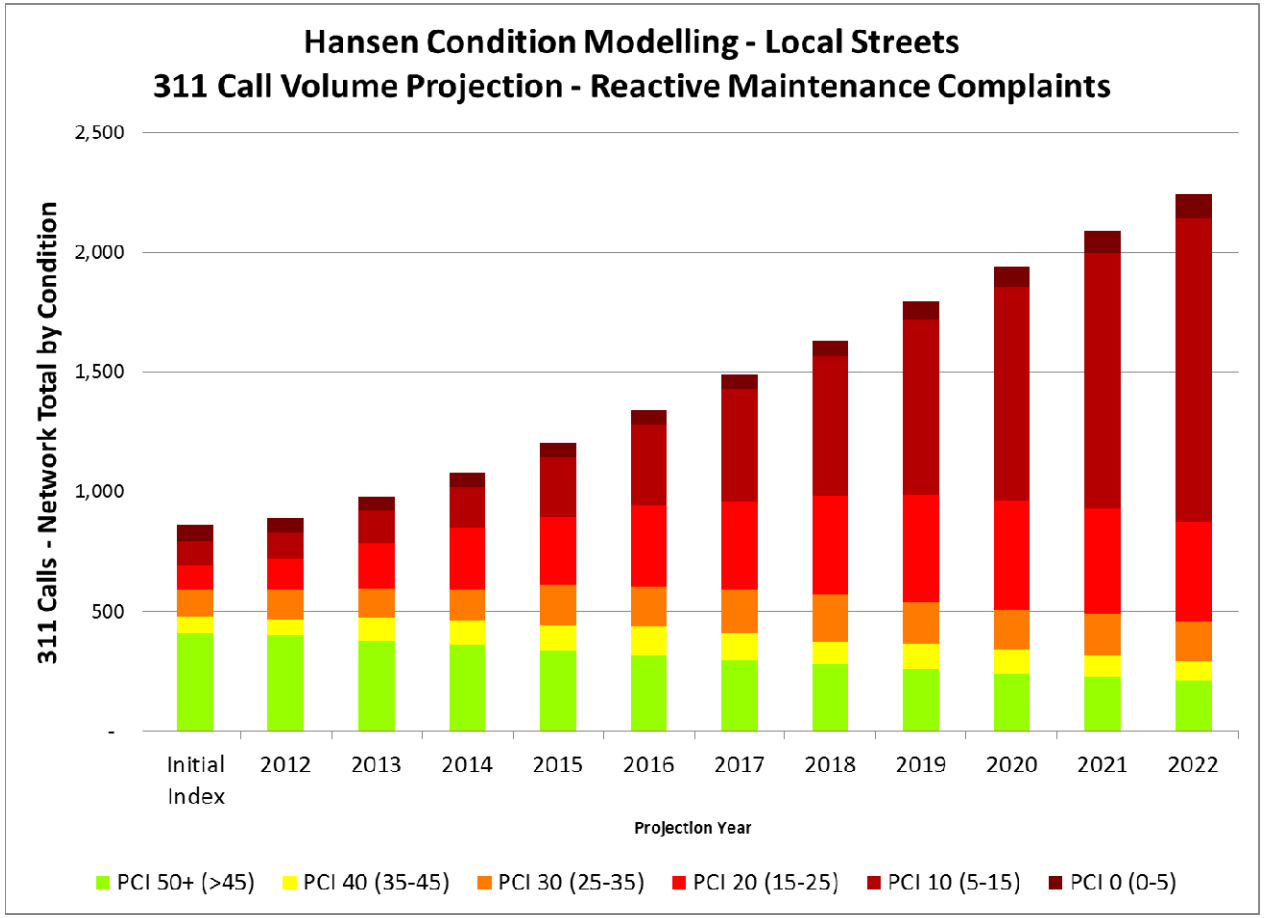
# DECISION MODELLING
## *- Customer Complaint Projections*



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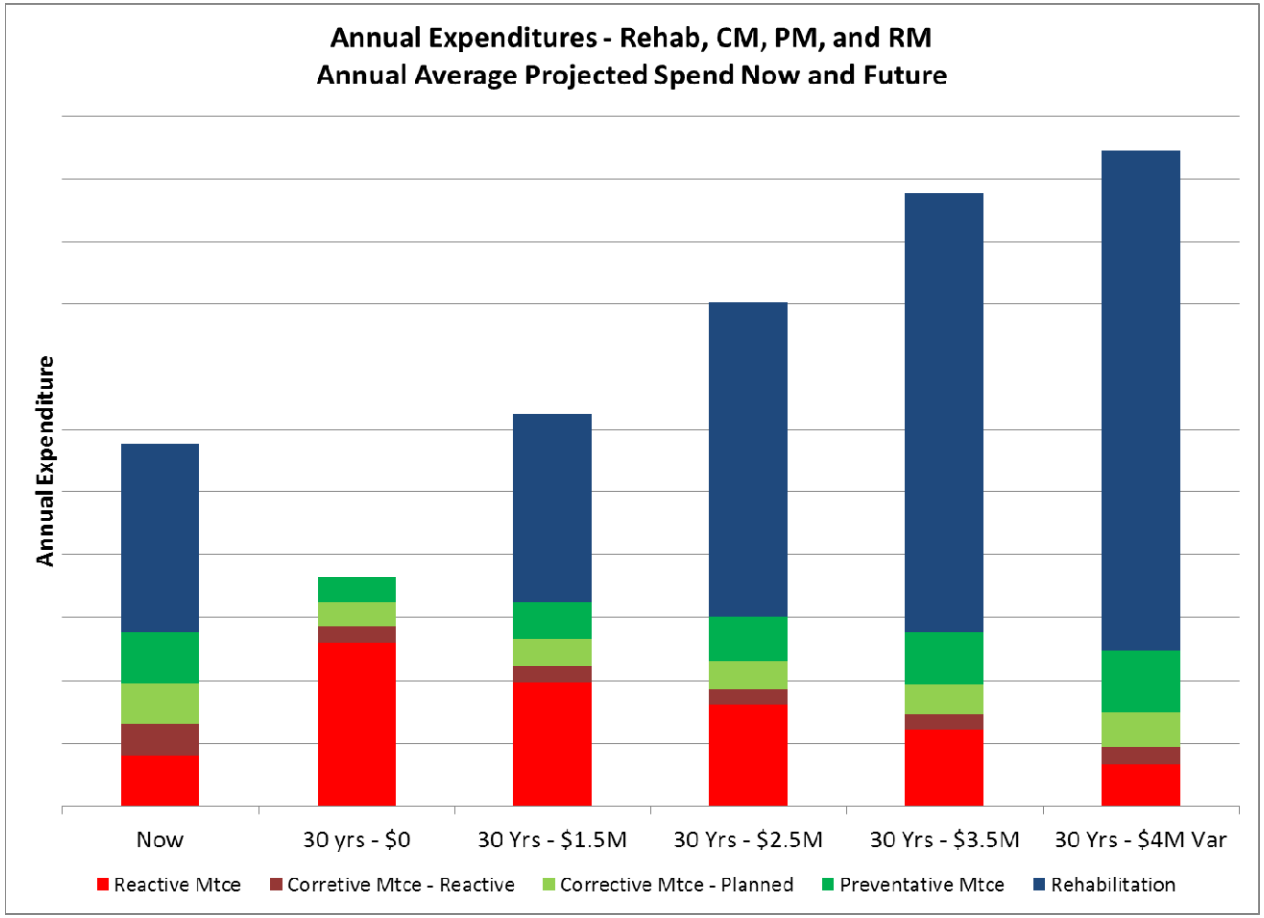
# DECISION MODELLING

## *- Financial Projections - Maintenance and Rehabilitation*



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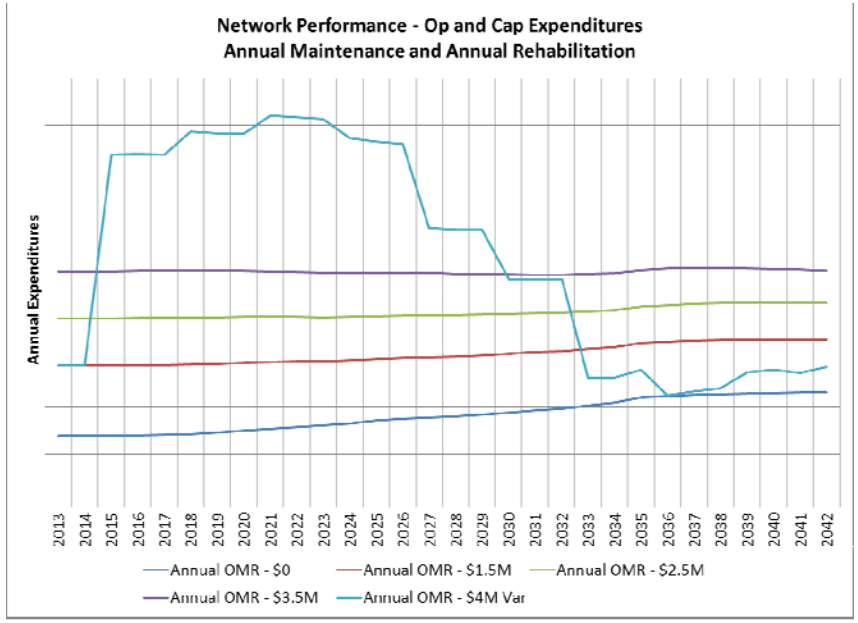
# DECISION MODELLING
## *- Life Cycle Costs*



# DECISION MODELLING
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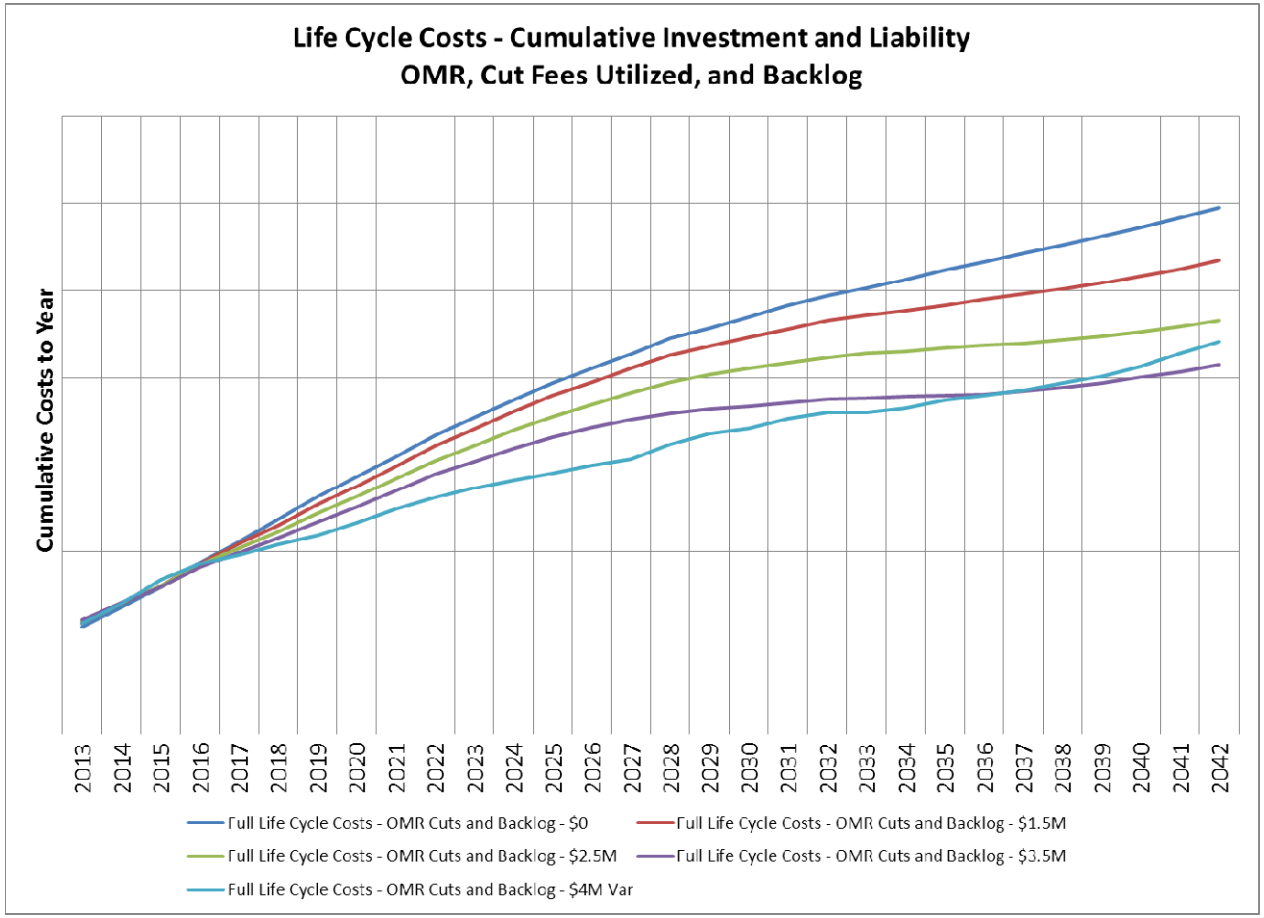




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# ASSET MANAGEMENT FRAMEWORK

*Leveraging IMS for Decision Support*

## Then…

- Limited network data
- Mainly subjective
- Expert opinion
- Perceived problems/priorities
- Manual review and coordination
- Silo approach
- Focus on priority

## Now…

- Consistent approach
- Centralized, accessible, reliable network data
- Centralized coordination
- Imbedded expertise
- Quantitative condition and maintenance information
- Multiple criteria approach

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# ASSET MANAGEMENT STRATEGY
*- Moving Forward*

- Developed the Framework
  - Tested the Structure and the Building Blocks
  - Demonstrate how AM can help support our decisions
  - Integrating Multi-Asset Coordination and Optimization
  - Updating Models and Strategies
- Extending to Sewer and Water
  - AM Plans (core review)
  - Detailed Analysis
- Spatial Analysis and Data Links

# CITY OF VANCOUVER – ASSET MANAGEMENT

## For more information:


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