# Strengthening Municipal Road Programs: National Benchmarking Trends and Advanced Prioritization and Scenario Evaluations Tools for Roads AM Planning

AMONTario Sponsored Webinar

February 25, 2026

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# Speakers

| Chris Lombard | Donghui Lu | Luke Zhao | Moustafa |
|---|---|---|---|
| AECOM, Asset Management Practice Lead, Canada | AECOM, Asset Management Manager, Ontario | AECOM, Sr. Asset Management Consultant | City of Ottawa, Senior Engineer, Road Renewal |

# Agenda

1. Roads AM Emerging Trends In Canada
2. Roads AM Innovations & Case Studies
   - Project Prioritization
   - Funding Allocation & Scenario Evaluation
   - Lifecycle Modeling
3. The Way Forward
4. Q&A

# Transportation AM Emerging Trends & Takeaways

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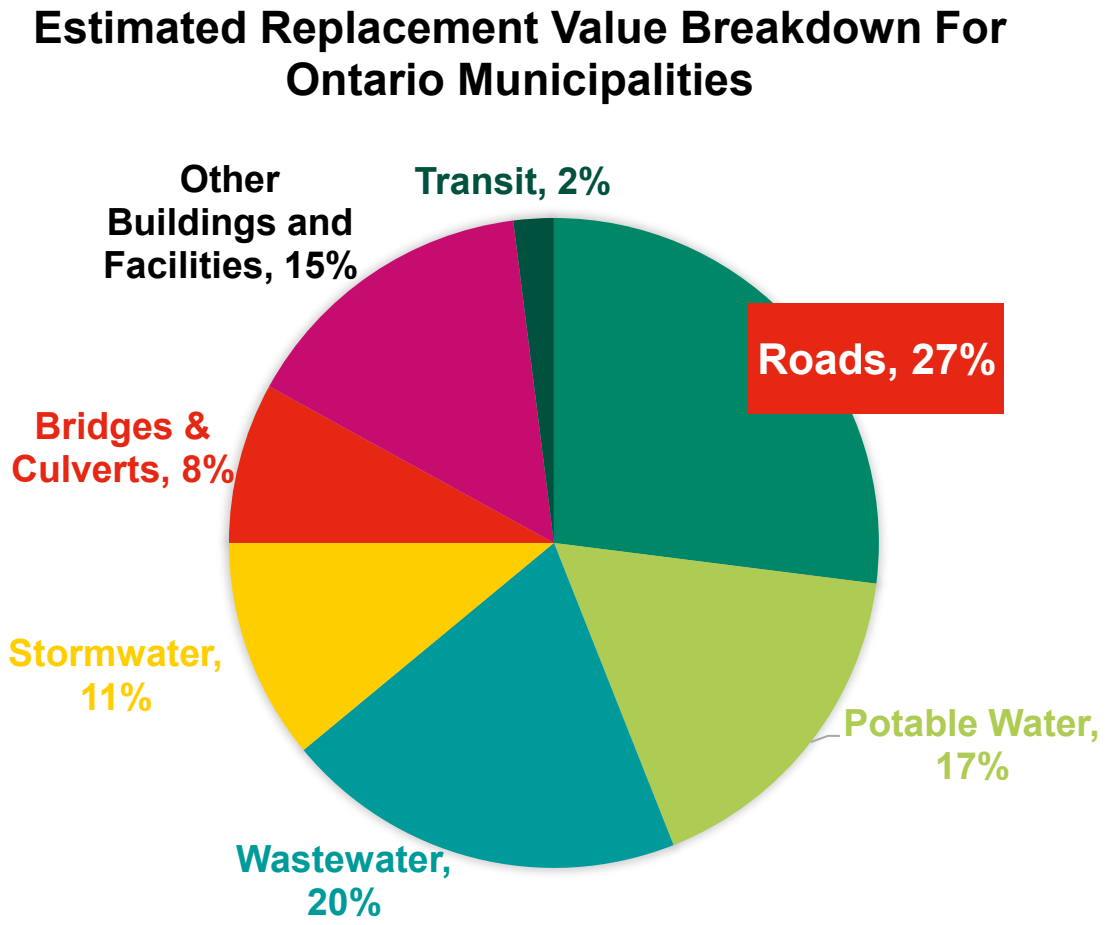
# Introduction to Roads Infrastructure in Ontario




Source: Financial Accountability Office of Ontario (FAO), 2021

- **Largest asset class** for most municipalities.
- **Compete for limited funding within the municipal tax base -** vying with parks & recreation, facilities, housing, and other essential municipal services.
- **Critical to daily life** - connects people to jobs, services, and communities.
- **Aging infrastructure** with limited reinvestment => growing backlog and rising risk.
- **Evolving expectations -** Complete streets, climate resilience, EV, equity, and multimodal mobility.

# Background – Data Sources

CIBI (https://www.nationalbenchmarking.com/)

Key trends identified from **5-Year** Canadian Infrastructure benchmarking - Transportation data

**1997** – Pilot study including 4 cities

**2001** – Major expansion to include 35 cities in W/ WW/ SW

**2019** –Expanded to include **transportation benchmarking**

**2023** – Expanded to include green infrastructure benchmarking

**2025** – Integrated with Solid Waste Benchmarking

**Present** – 50+ Municipalities

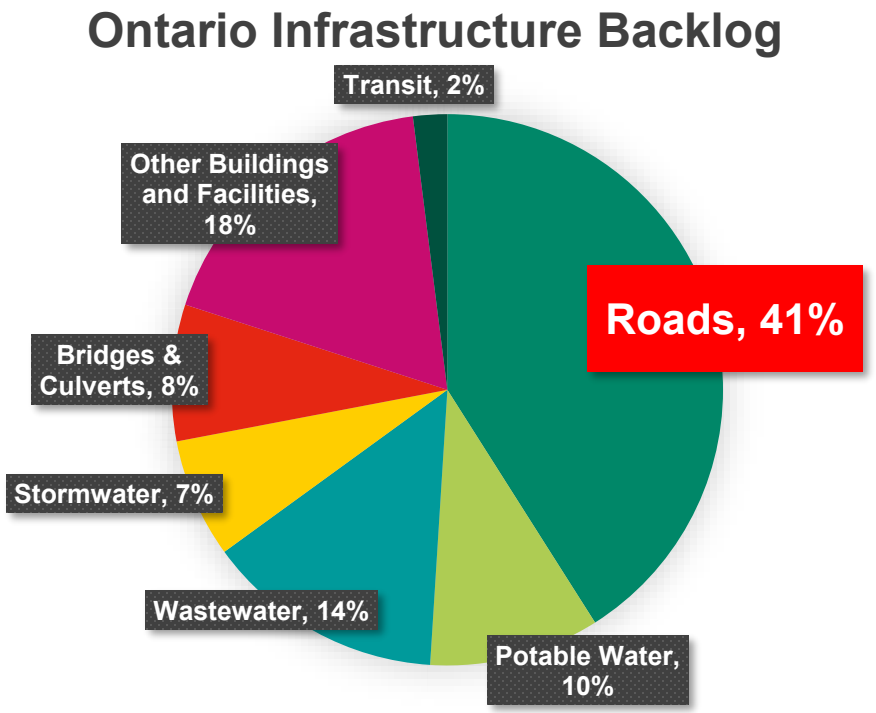
Ottawa

City of Ottawa **National Survey** on challenges and current practice on road renewal across Canada


1. General information (2 questions in total)
2. Current Prioritization Practices (14 questions in total)
3. Pavement Rehabilitation Practices (9 questions in total)
4. Additional comments

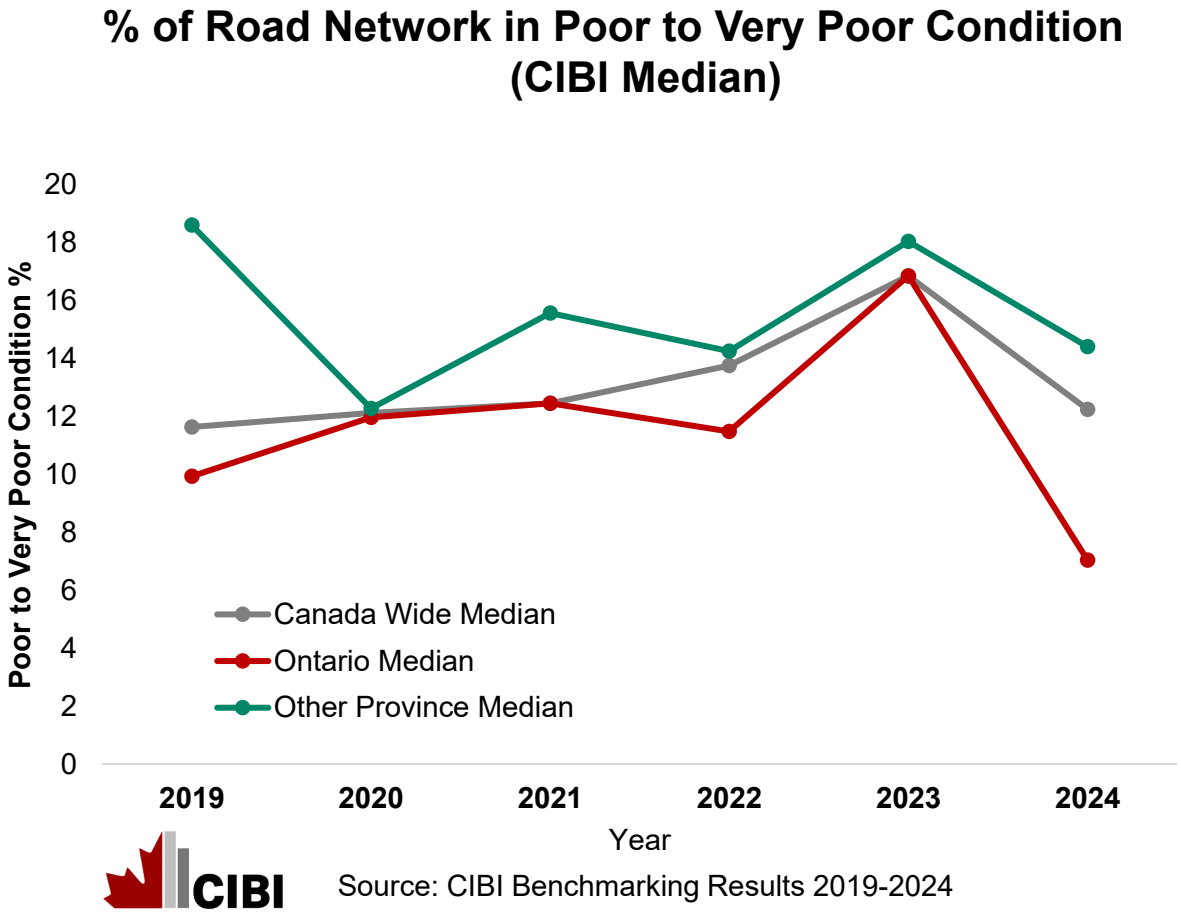
# Trend 1: Increasing Backlog => Demanding More Mature Prioritization

**Roads** represent the largest share of backlog in Ontario, Canada




Source: Financial Accountability Office of Ontario (FAO), 2021

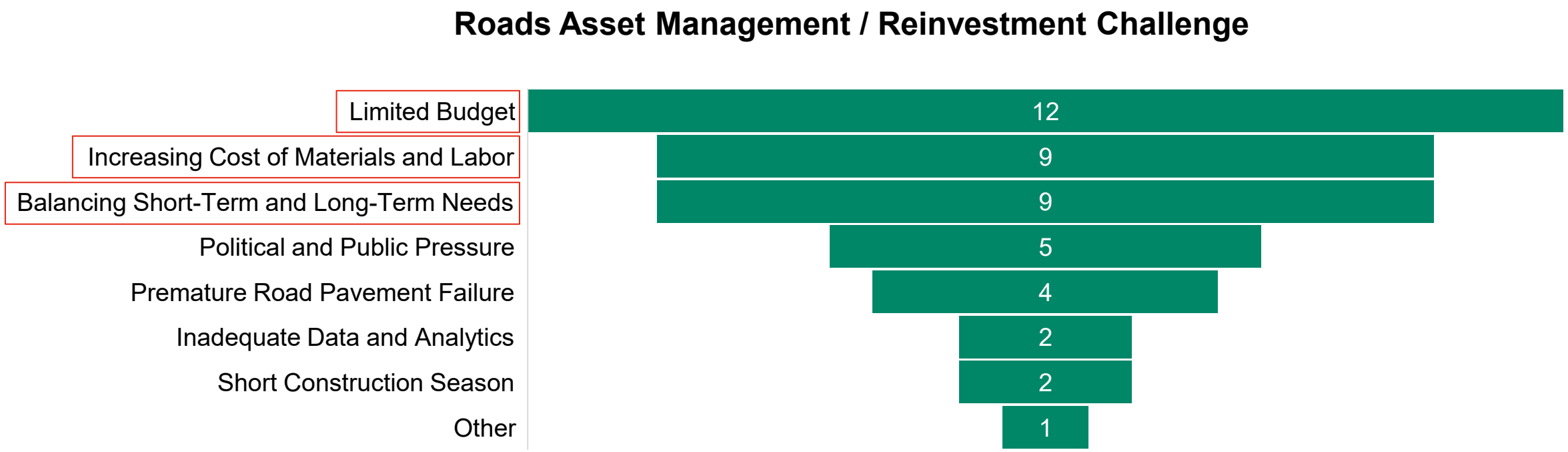
*Note: Backlog means infrastructure in need of Rehabilitation or Renewal*




CIBI

Source: CIBI Benchmarking Results 2019-2024

# Current Status – Top Roads AM Challenges




*Source: CIBI Group Survey & Ottawa Investment Prioritization Study for the Annual Road Renewal Programs Survey; data from **13 municipal respondents** across Canada, 2024*

# Current Status - Prioritization Approach's Level of Maturity

### Level 1. Developing

- Basic prioritization used, mostly reactive
- Repeatable but not consistently documented

### Level 2. Defined

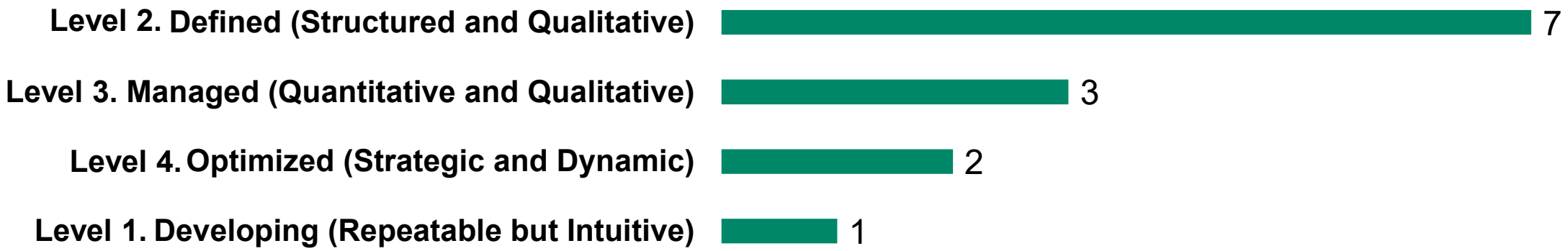
- Structured process with clear criteria
- Primarily qualitative but applied consistently

### Level 3. Managed

- Combines qualitative and quantitative metrics
- Prioritization supports data-informed decisions

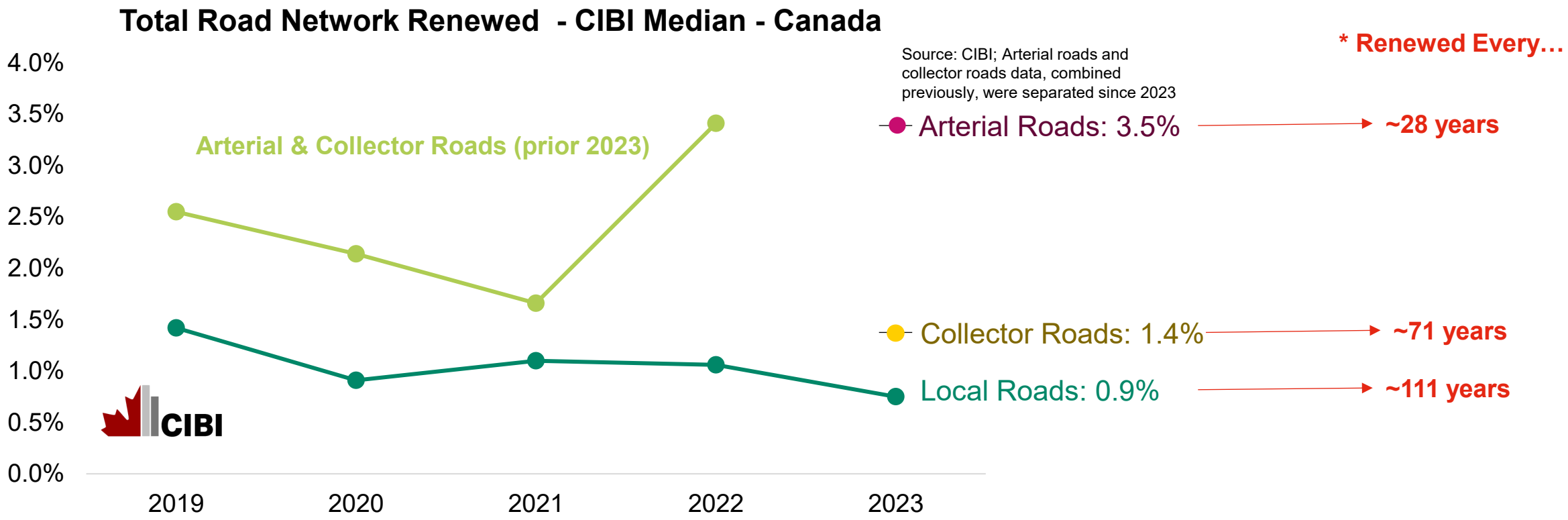
### Level 4. Optimized

- Fully aligned with strategic goals and adaptable to change
- Dynamic modeling and scenario testing used regularly

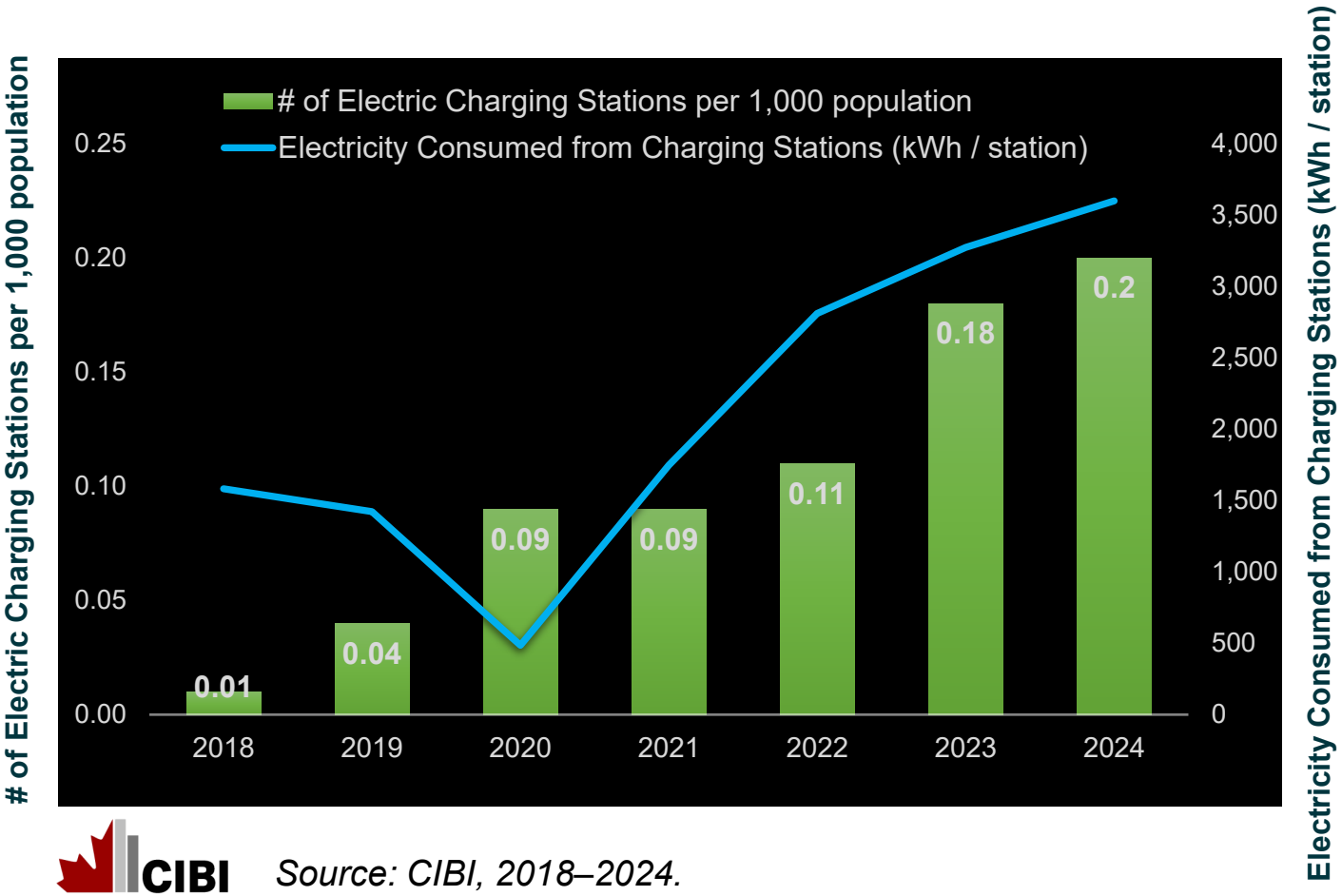



*Source: CIBI Group Survey & Ottawa Investment Prioritization Study for the Annual Road Renewal Programs Survey; data from **13 municipal respondents** across Canada, 2024*

# Trend 2: Local Roads are not Adequately Funded (*…or funded even worse than Arterials and Collectors)



# Trend 3: Electrical Vehicle Infrastructure




CIBI *Source: CIBI, 2018–2024.*

- Number of Electrical Vehicle (EV) chargers is rapidly increasing
- Electricity consumption per station rising
- Municipalities to integrate EV needs into Asset Management planning

**2026 Canadian EV Policy**:

- **Restarted national EV purchase incentives** after a temporary pause in 2025.
- Transition toward **100% ZEV new vehicle sales by 2035**
- **Charging Infrastructure Expansion** Programs (Federal funding)

**More Road Wear**

- EVs are **heavier** and wear out roads faster
- **Altered road designs**
- More **frequent** road asset **intervention** cycle

**Less Fuel Tax Revenue**

- Fewer gas vehicles means **lower fuel taxes**
- Cities need **new ways to fund** road work

# Key Takeaways

**Growing backlog** and **limited budgets** demand **more matured prioritization**

**Local roads** require more intentional prioritization and **strategic alignment**

**Climate Change** and **Electrification** are reshaping roads needs

Explore **alternative strategies** & **funding sources** to strengthen long-term sustainability.

# AM Innovations & Project Case Studies

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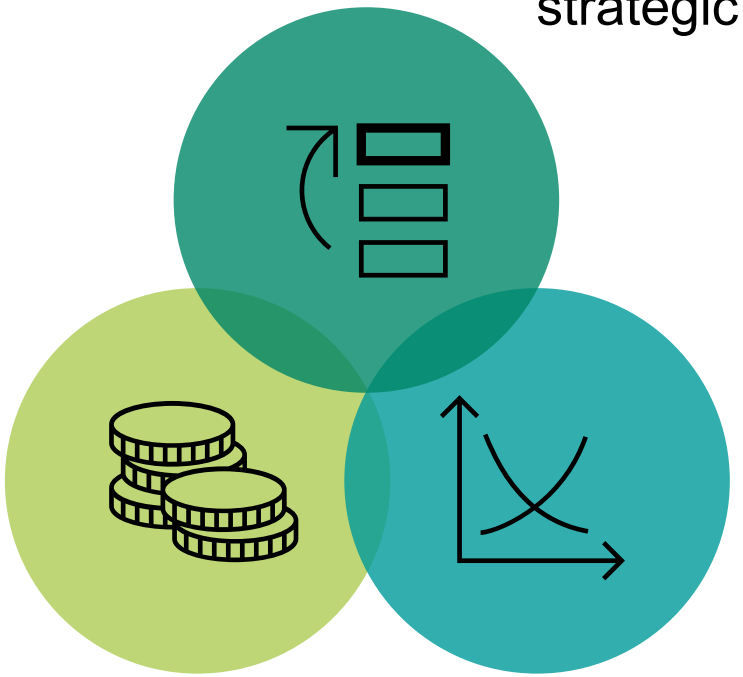
# The Three Focus Areas

## Project Prioritization

Deciding which projects to implement first, ensuring the most critical, cost-effective projects that align with strategic goals are funded.



## Funding Allocation

Determining how scarce resources are distributed across asst classes, functional classes, or lifecycle stages.

## Lifecycle Modelling

Predicting asset deterioration and determining optimal timing of maintenance, rehabilitation, and replacement to maximize return over the asset's life.

These three key areas are interdependent - weakness in any one area undermines the others. All three have to be addressed in an integrated way to extend asset life, reduce risk, and achieve more with limited budgets.

# Project Prioritization

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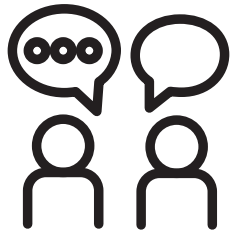
# Project Prioritization Typical Challenges

## Project Readiness

Ensuring all prerequisites are in place before delivery (e.g., culvert replacement, design plans, required engineering data, and coordination with underground services).

## Impact of Other Major Projects

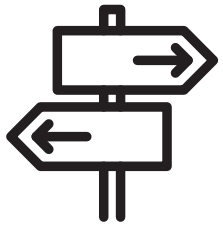
- Limited visibility can cause conflicts and delays
- Integrated corridors take longer to plan
- Nearby projects can dictate timing (traffic management)
- Utility cuts accelerate deterioration and add complexity



## Mismatch In Priority

Boundary roads in poor condition or with high traffic can face priority misalignment between adjacent jurisdictions due to different funding availability and program timelines.

# Project Prioritization Typical Challenges

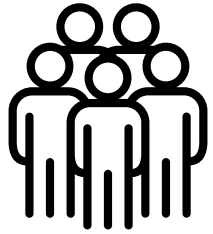


## Complex Trade-offs

Prioritizing projects must balance multiple factors: asset condition, risk of failure, safety, level of service impact, economic development, equity, regulatory compliance, etc.

## Lack of Clear Criteria

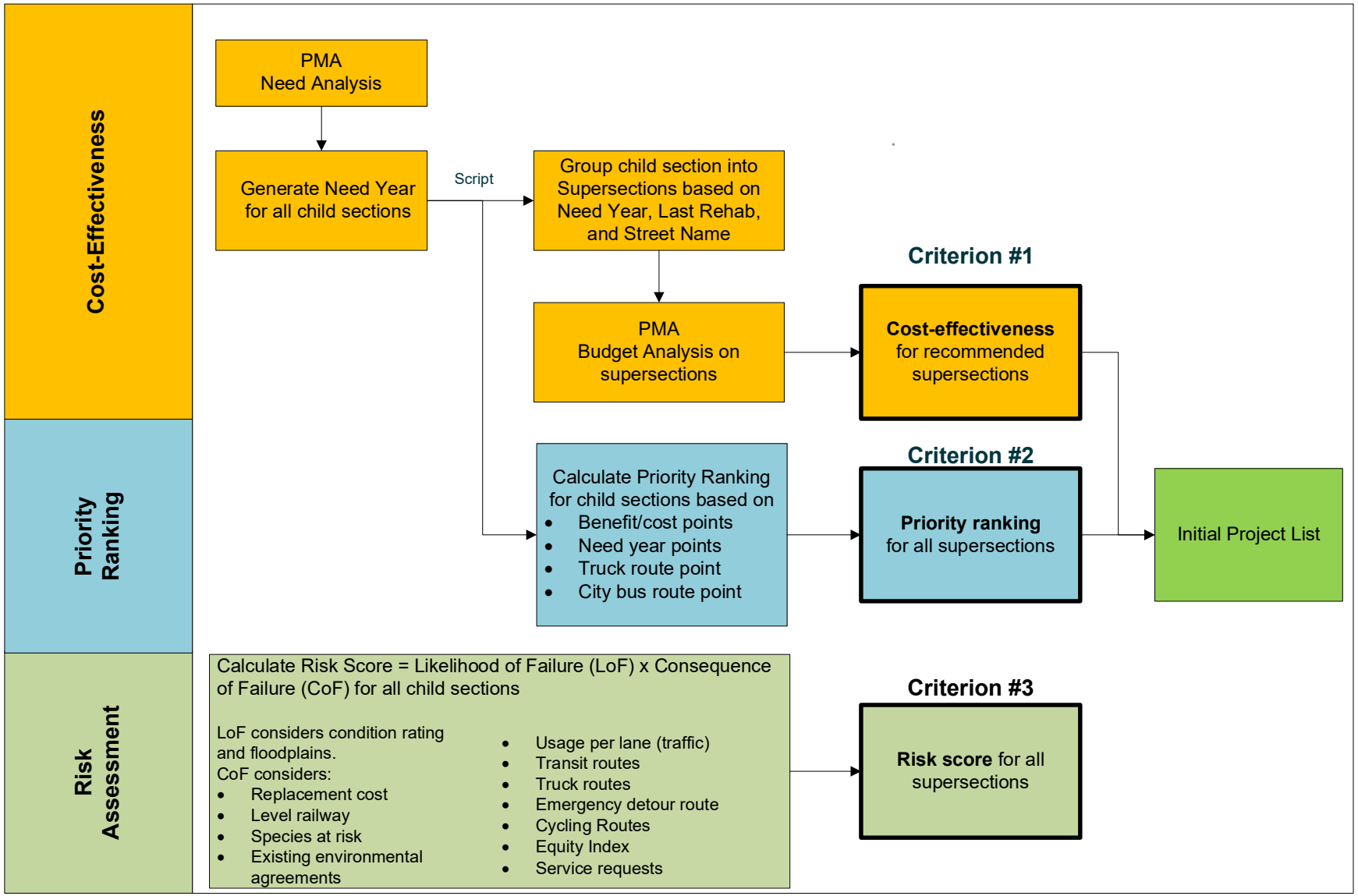
Without a standardized, transparent framework for ranking projects, selection can be ad-hoc or driven by subjective judgment. Different departments might use different methods, making it hard to compare.



## Influence of Politics

Internal politics or urgent short-term issues can skew priorities. Elected officials might push to fund a new asset in their district over rehabilitating an existing asset elsewhere, regardless of technical rankings.

# Review of City of Ottawa Road Project Selection Framework



# Proposed Improvements

- **Risk Framework**:

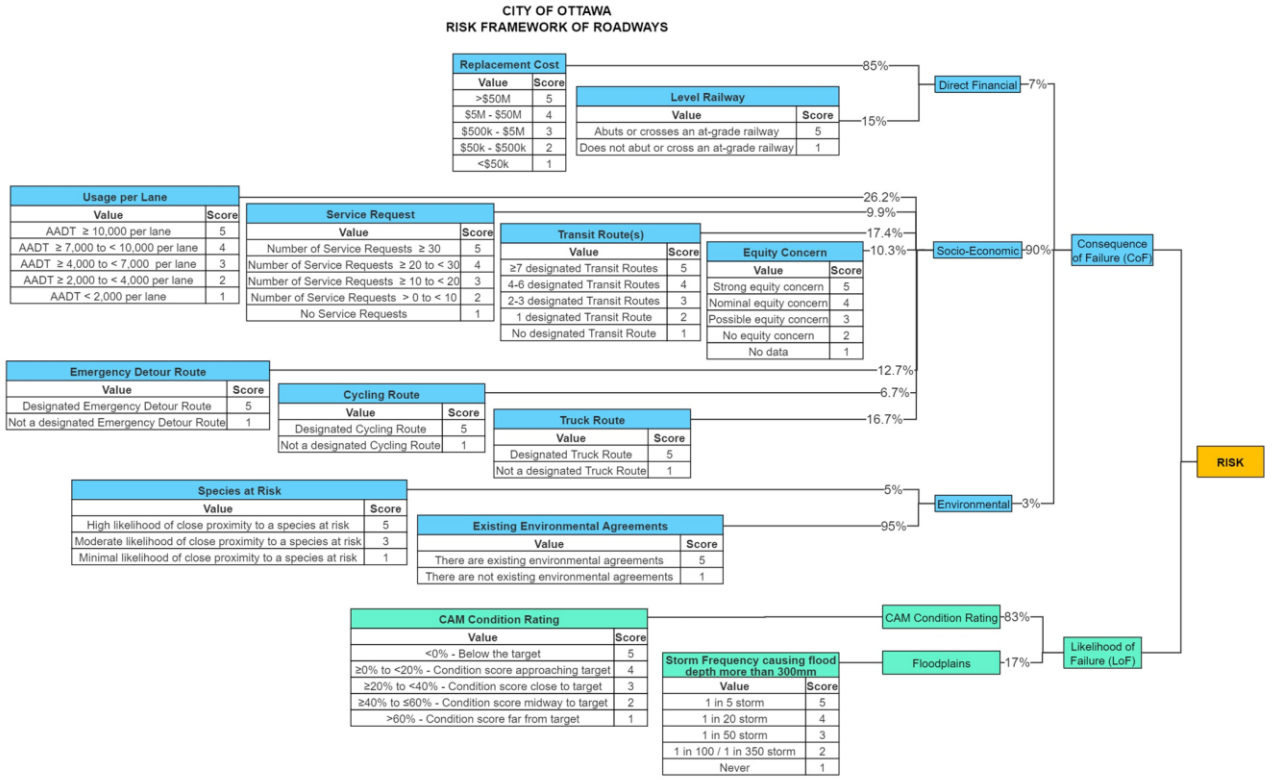
Risk assessment was not clearly integrated into the process. The selection based on risk was not formally adopted.

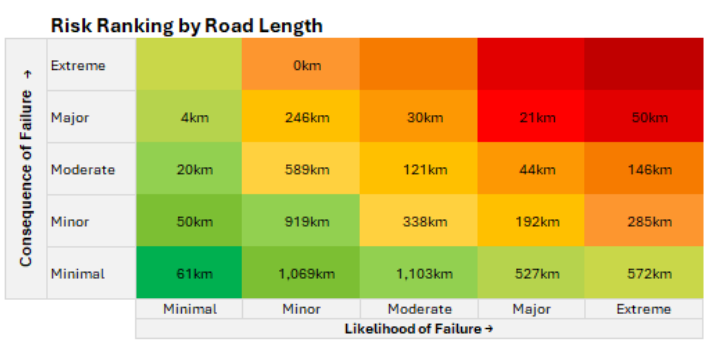
Risk assessment framework can be improved by

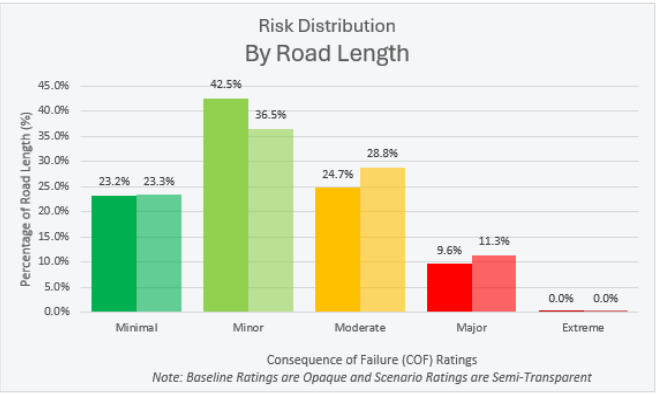
- Adding factors
- Refining weights (ongoing process)
- Adjusting scoring scale
- Improving visualization

Other Ideas

- Continuous vs discrete functions
- Sensitivity analysis tool



# Proposed Improvements

- **Criteria Refinement**:

  Priority Ranking and CE exhibit overlapping criteria, such as traffic, length, benefit, and cost, presenting an opportunity to streamline processes and improve efficiency.

| Cost Effectiveness | Priority Ranking | Risk Assessment |
|---|---|---|
| AADT | AADT | Usage per lane |
| Length | Length | Replacement cost |
| Benefit | Benefit | Level railway |
| Cost | Cost | Service request |
| Disbenefit | Need year (10) | Equity concern |
| | Bus route (1) | Transit route (14%) |
| | Truck route (1) | Truck route (15%) |
| | | Emergency detour route |
| | | Cycling route |
| | | Species at risk |
| | | Existing environmental agreements |
| | | Condition rating |

**Priority Ranking vs CE**

$$\textbf{Priority Ranking's Benefit/Cost} = \frac{AADT \times Section\ Length \times (85 - Predicted\ PQI)}{Rehab\ Cost\ from\ RM}$$

vs. Priority Ranking's Need Year (10 points)

$$\textbf{Cost Effectiveness} = \frac{AADT \times Section\ Length \times (Benefit - Disbenefit)}{Discounted\ Cost}$$

$$Benefit_{IY} = \sum_{Year=IY}^{Year=IY+Duration} \frac{After\ Rehabilitation\ PQI_{Year} - Do\ Nothing\ PQI_{Year}}{\left(1 + \frac{Discount\ Rate}{100}\right)^{(Year - Year\ 1)}}$$

$$Disbenefit_{IY} = \sum_{Year=Need\ Year+1}^{Year=IY} \frac{Minimum\ Acceptable\ PQI - Do\ Nothing\ PQI_{Year}}{\left(1 + \frac{Discount\ Rate}{100}\right)^{(Year - Year\ 1)}}$$

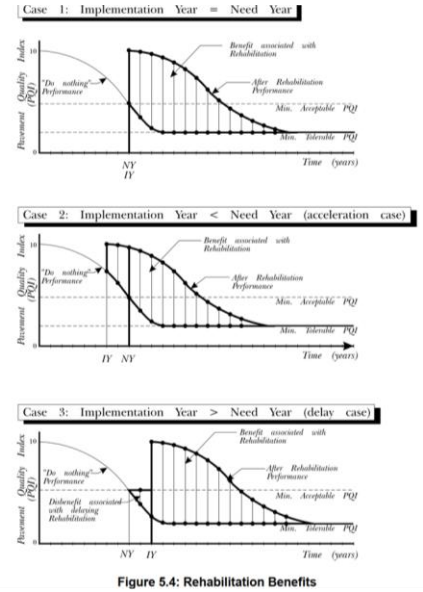
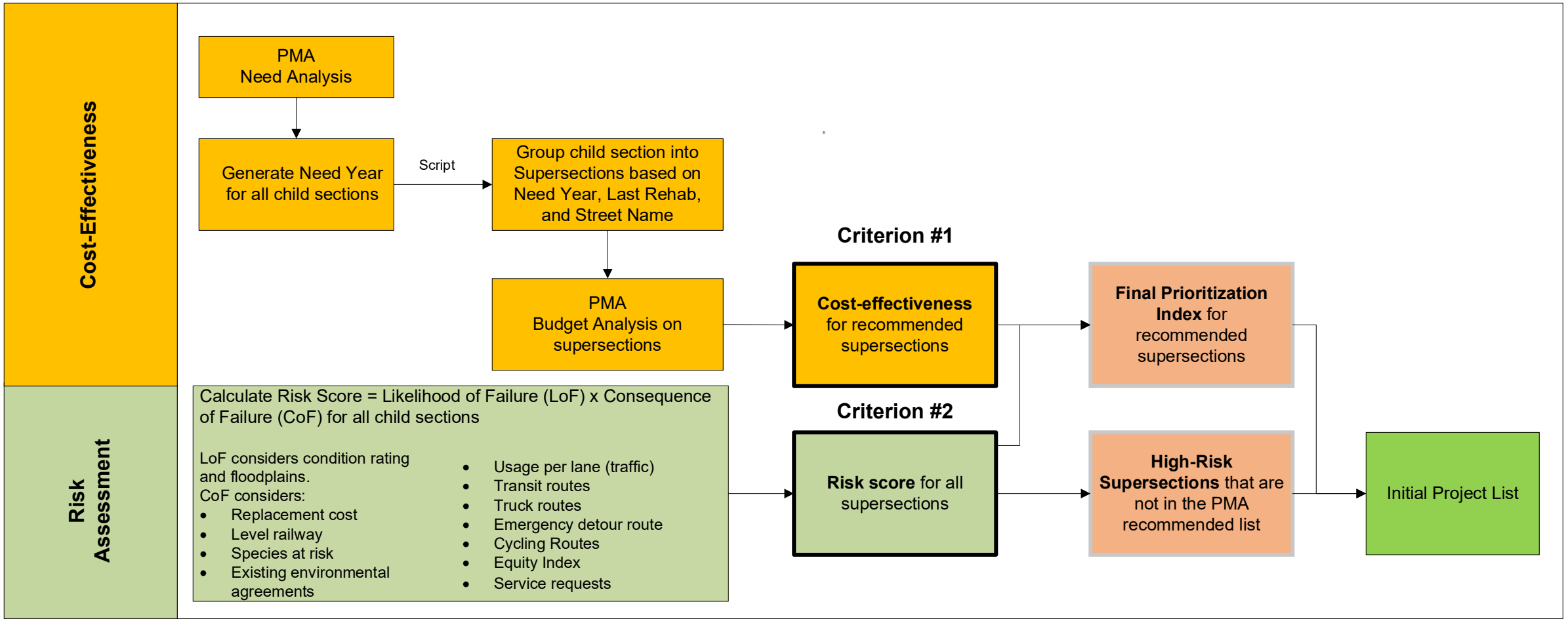
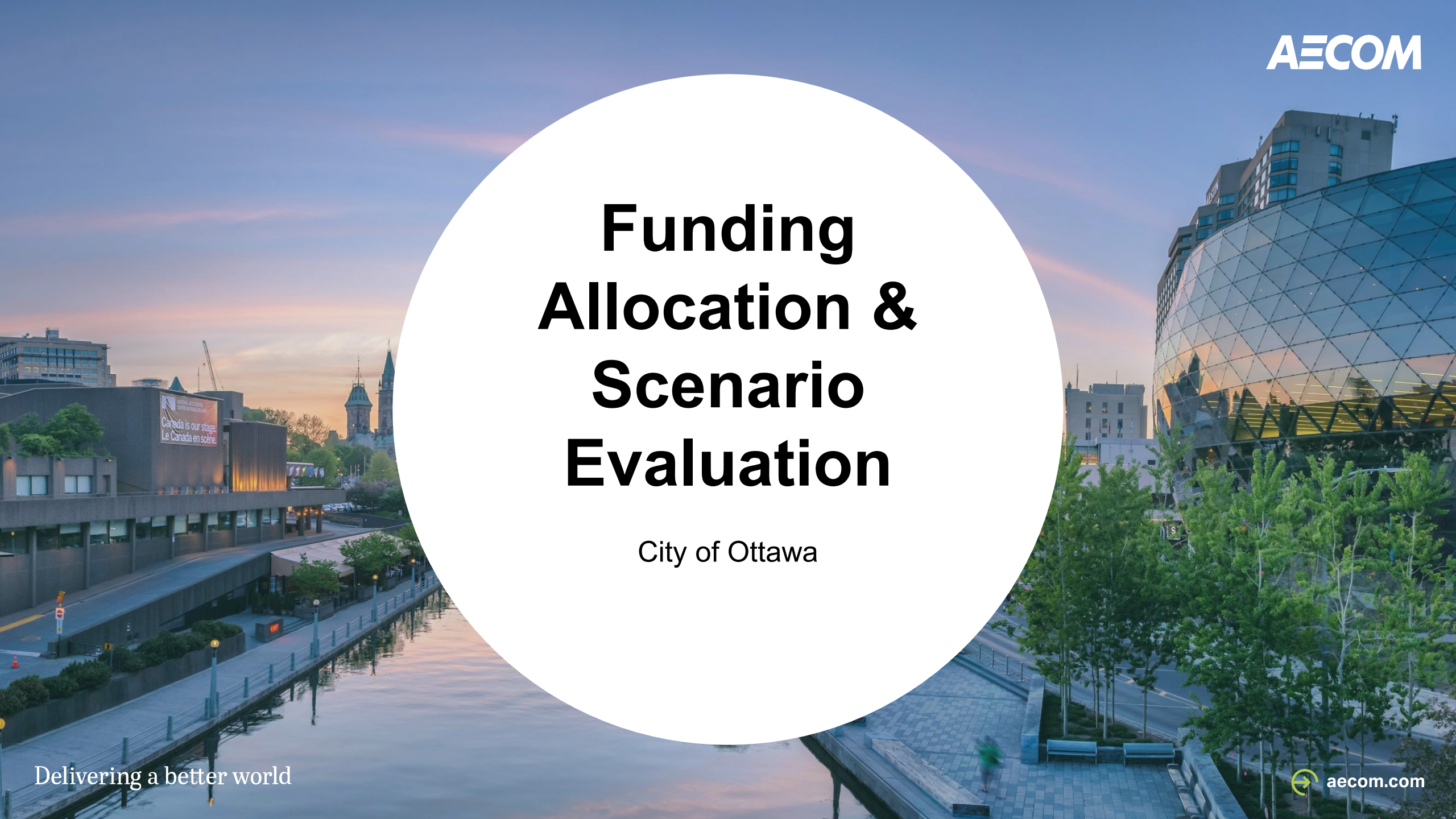



Figure 5.4: Rehabilitation Benefits

# Proposed Road Project Framework for the City of Ottawa




In addition, open up the process to scrutiny and input. When stakeholders understand the rationale behind project rankings, there is more support for sticking to the plan.




# Funding Allocation & Scenario Evaluation

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# Funding Allocation Typical Challenges

## Chronic Budget Constraints

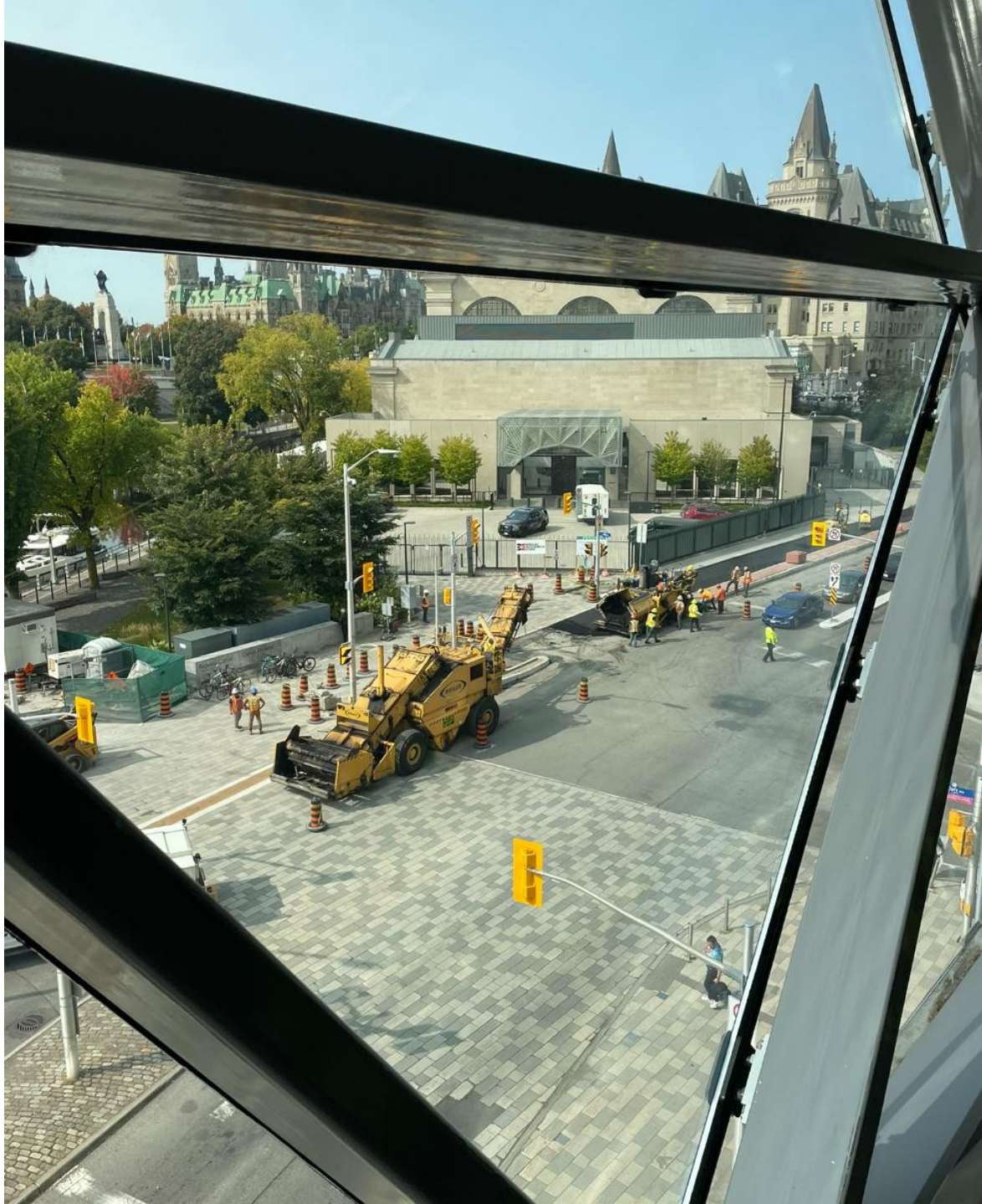
Many municipalities face shrinking or stagnant budgets even as assets age and deteriorate, creating a widening gap between needs and available funds.

## Fragmented Funding Sources

Infrastructure funding typically comes from multiple sources (taxes, grants, user fees), often each with restrictions on use. These silos make it challenging to optimally allocate money where it's most needed, since funds cannot always be pooled freely.

## Identify the Best Use of Limited Funds

Balancing budget allocation requires optimizing asset performance while ensuring fair distribution across regions and users. Establishing a scenario evaluation tool greatly supports decision-making by testing trade-offs between efficiency, fairness, and long-term sustainability.



# Funding Allocation Choices: What Paths We Can Take

📈 **Current Budget & Spend a Bit More** – Maintain / increase / decrease budget

🎯 **Target Road Conditions** – Meet a higher / maintain existing service level

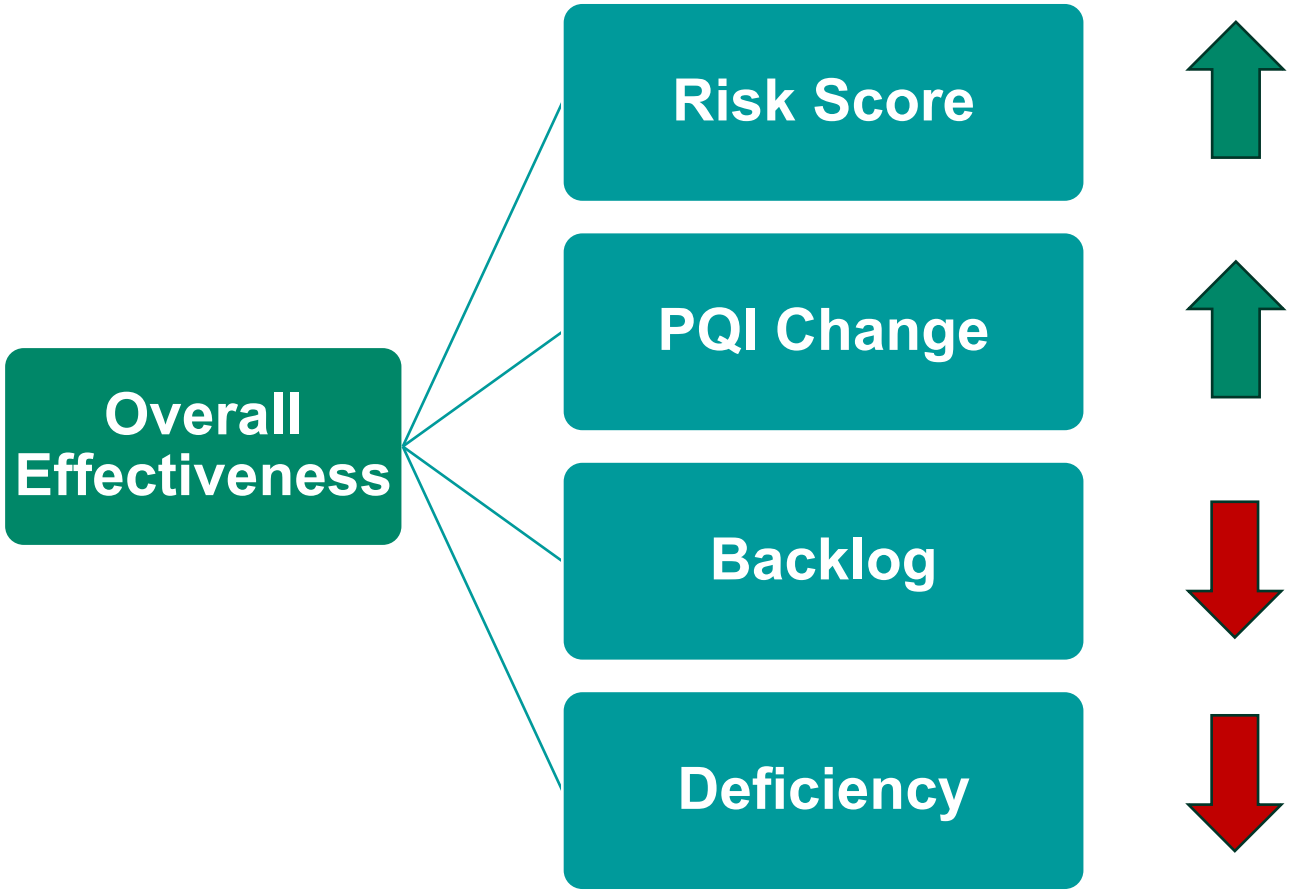
🚀 **Invest Big Early** – Large upfront investment

🏘️ **Focus More on Specific Category** – Shift funding by asset class / region

In total, 14 scenarios were set up and analyzed.

# Funding Scenario Evaluation

- **Multiple metrics were identified and evaluated. The final four metrics determine the overall effectiveness.**
- **Weightings were assigned through pairwise analysis.**



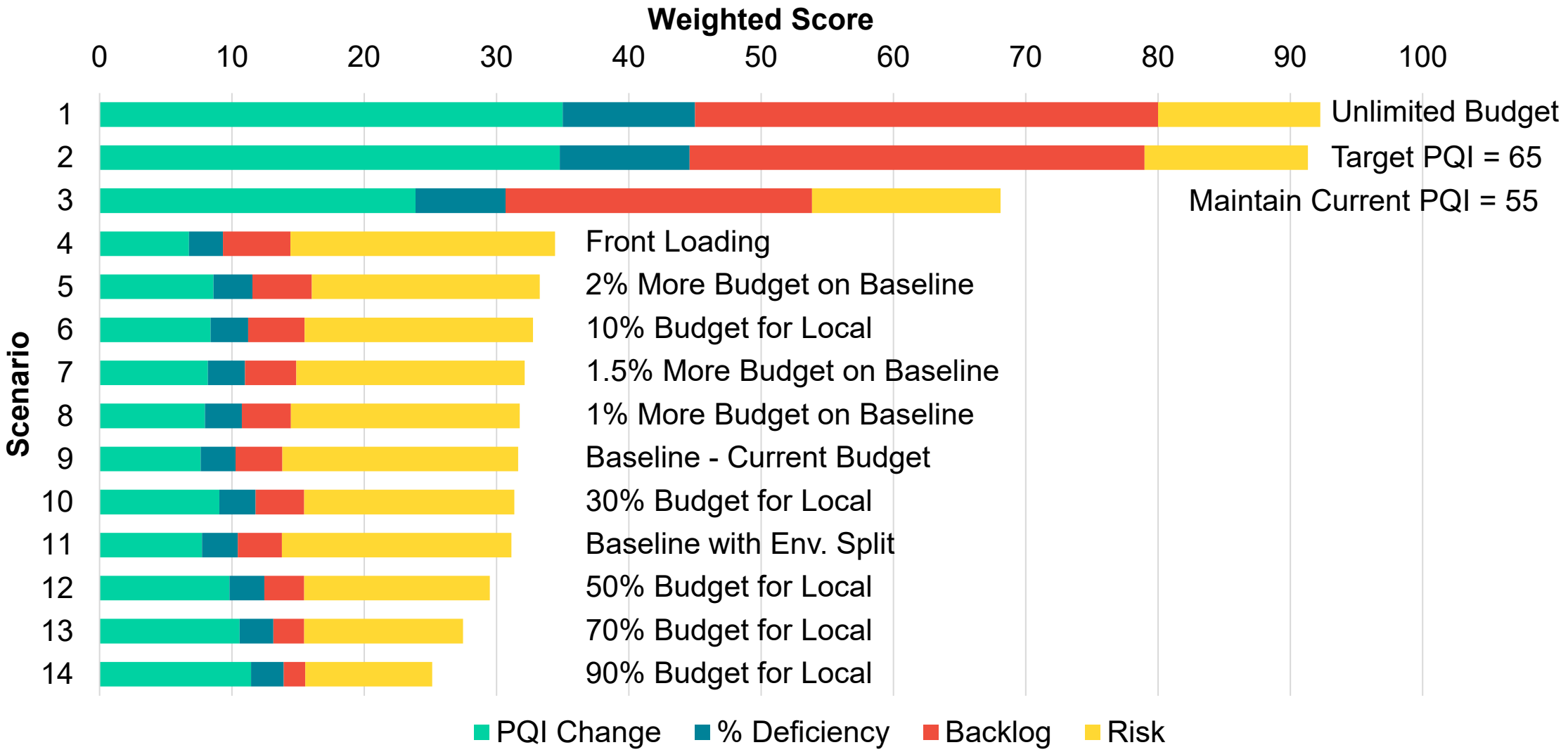

Are we reducing the risk of road failures?

Is the overall road condition getting better or worse over time?

How much money will we need later to fix roads if we delay investment?

How many roads fall below minimum acceptable condition levels?

# Scenario Ranking Score



# Scenario Ranking Tool

AECOM

Ottawa

**Project:** Investment Prioritization Study for the Annual Road Renewal Programs

**Deliverable:** Ottawa Road Scenario Evaluation Tool (ORSET)

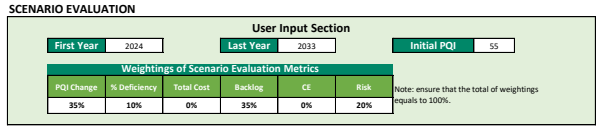
**Project #:** 60731668

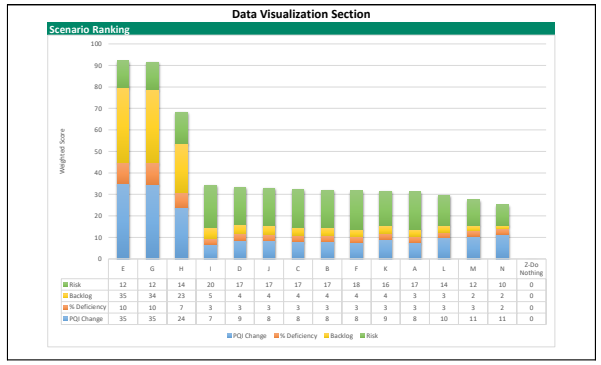
**Version:**

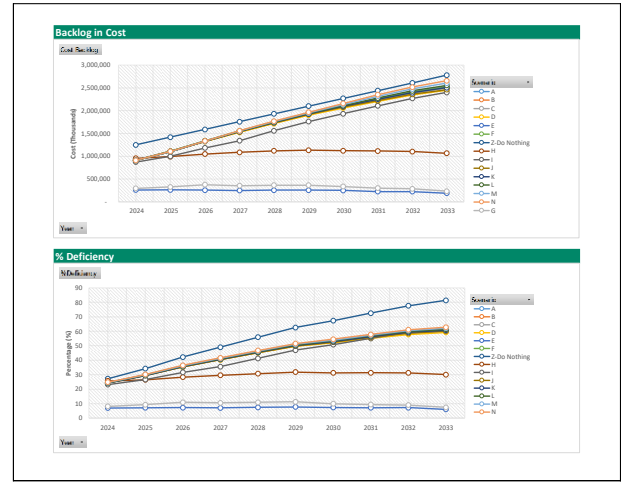
| | |
|---|---|
| 0 | (2025-01-08) |
| 1 | (2025-02-24) |
| | |

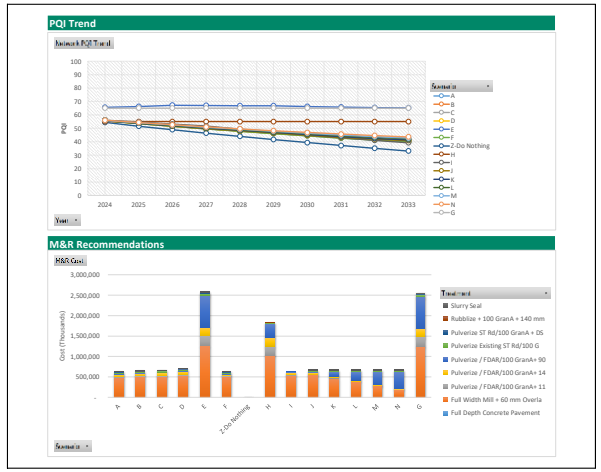
**Introduction:**

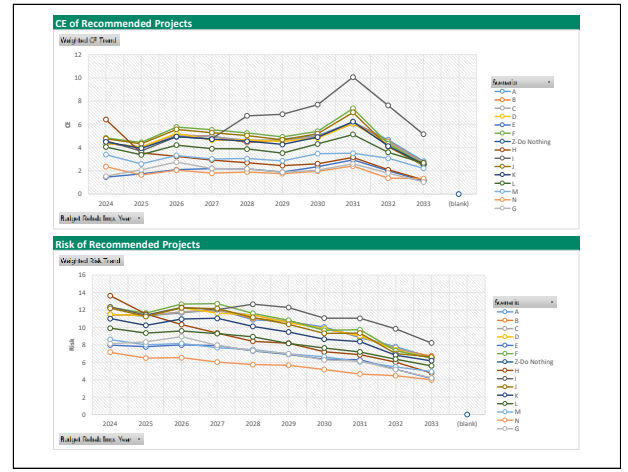
| | |
|---|---|
| Instructions | *The tab to show the data preparation and data updating steps* |
| Scenario Details | *This Tab is left with users to enter additional information for the scenarios evaluated for future reference.* |
| I_Scenarios | *The main tab to review the effectiveness of scenario; graphs include scenario ranking, PQI Trend, M&R Recommendations, Backlog (cost and lane-length), and CE and Risk of planned projects.* |
| II_Projects | *The tab to perform in-depth review and ranking of recommended projects for all the scenarios.* |
| M_PQI&Def | *The tab to review the yearly PQI and Network %Deficiency for all the scenarios.* |
| M_M&R_Rec | *The tab to review M&R treatment costs for all the scenarios.* |
| M_Backlog | *The tab to review the yearly backlog in lane-length and cost for all the scenarios.* |
| M_CE&Risk | *The tab to review the yearly weighted CE and Risk Score of the recommended projects for all the scenarios.* |
| xxx | *The hidden intermediate tabs used for calculations and graphs.* |




- Streamlined data import and refresh process
- Flexible configuration of metric weightings and analysis periods
- Easy customization of visualizations and report-ready printouts

# Key Takeaways

## Current Budget & Spend a Bit More

- 1-2% Budget Increase on Baseline: Only limited improvements seen in PQI change and backlog reduction.
- Env. Split: Minimal impact observed across all performance metrics.

## Invest Big Early

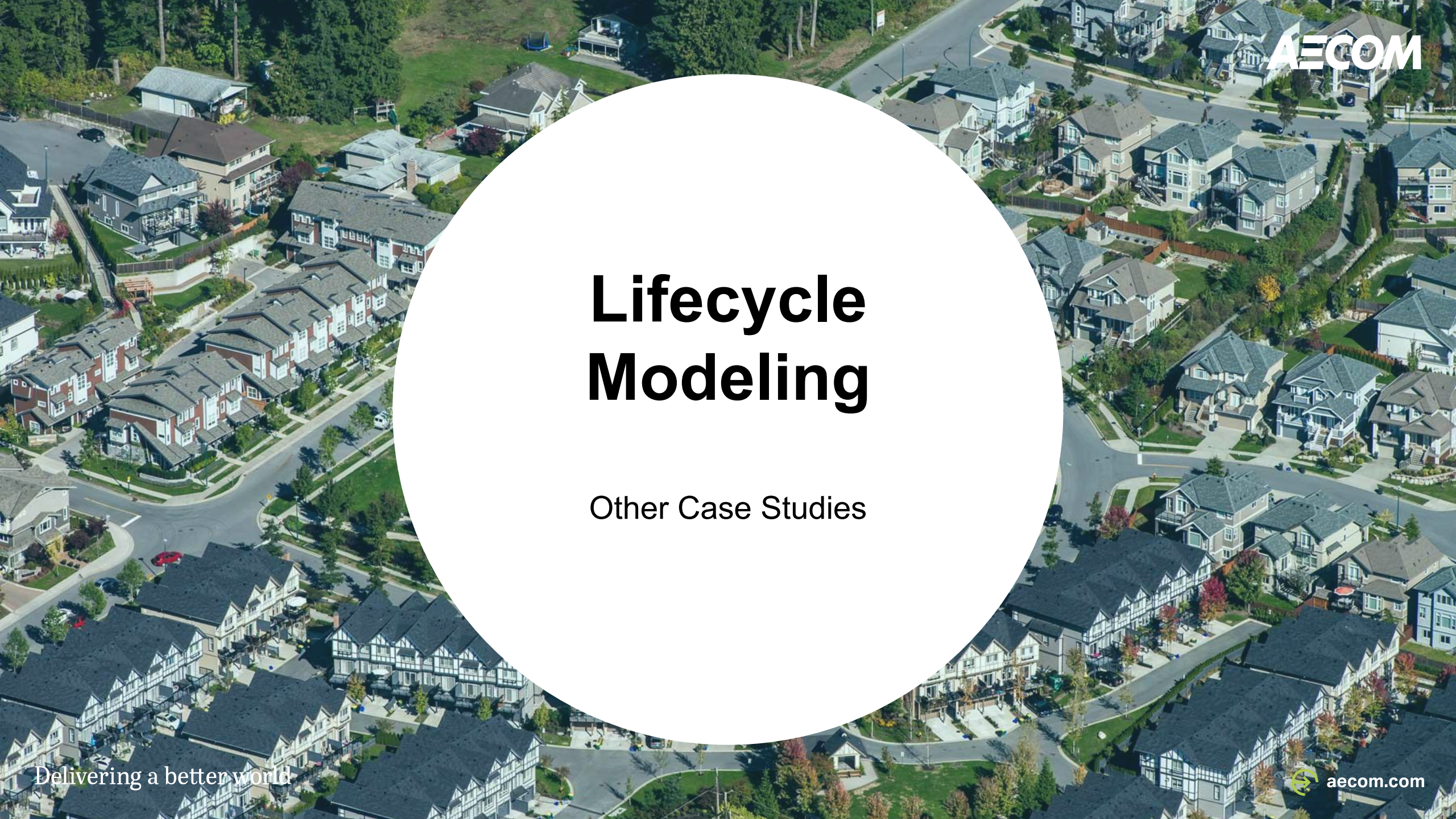
- Among constrained budget scenarios, front-loading shows the highest ranking with most risk reduction.

## Target Road Conditions

- Maintaining or Increasing the current PQI service level results in high network performance but requires significantly more funding.

## Focus More on Local Roads

- Allocating additional funding to local roads can improve overall network PQI; however, it leads to a higher arterial backlog and leaves more high-risk sections unaddressed, making it unfavorable to allocate more than ~10% of the budget to local roads.



# Lifecycle Modeling

Other Case Studies

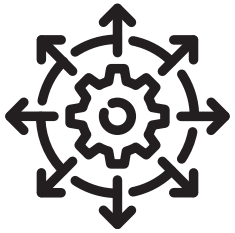
# Lifecycle Modeling Typical Challenges

## Data Gaps

Many agencies struggle with incomplete or outdated asset data. Without knowing what assets you have or their true condition, it's difficult to model future condition.

## Issues with Decision Support Software

- Dependency on consultants for updates or analysis
- Limited training
- Inadequate customization
- Cost and maintenance



## Limited Integration with Other Systems

Lifecycle models may not link easily with GIS, work order, or financial systems, leading to siloed analysis and reduced usability.

# Lifecycle Modeling for Road Networks (1/2)

## Key Elements

### Input

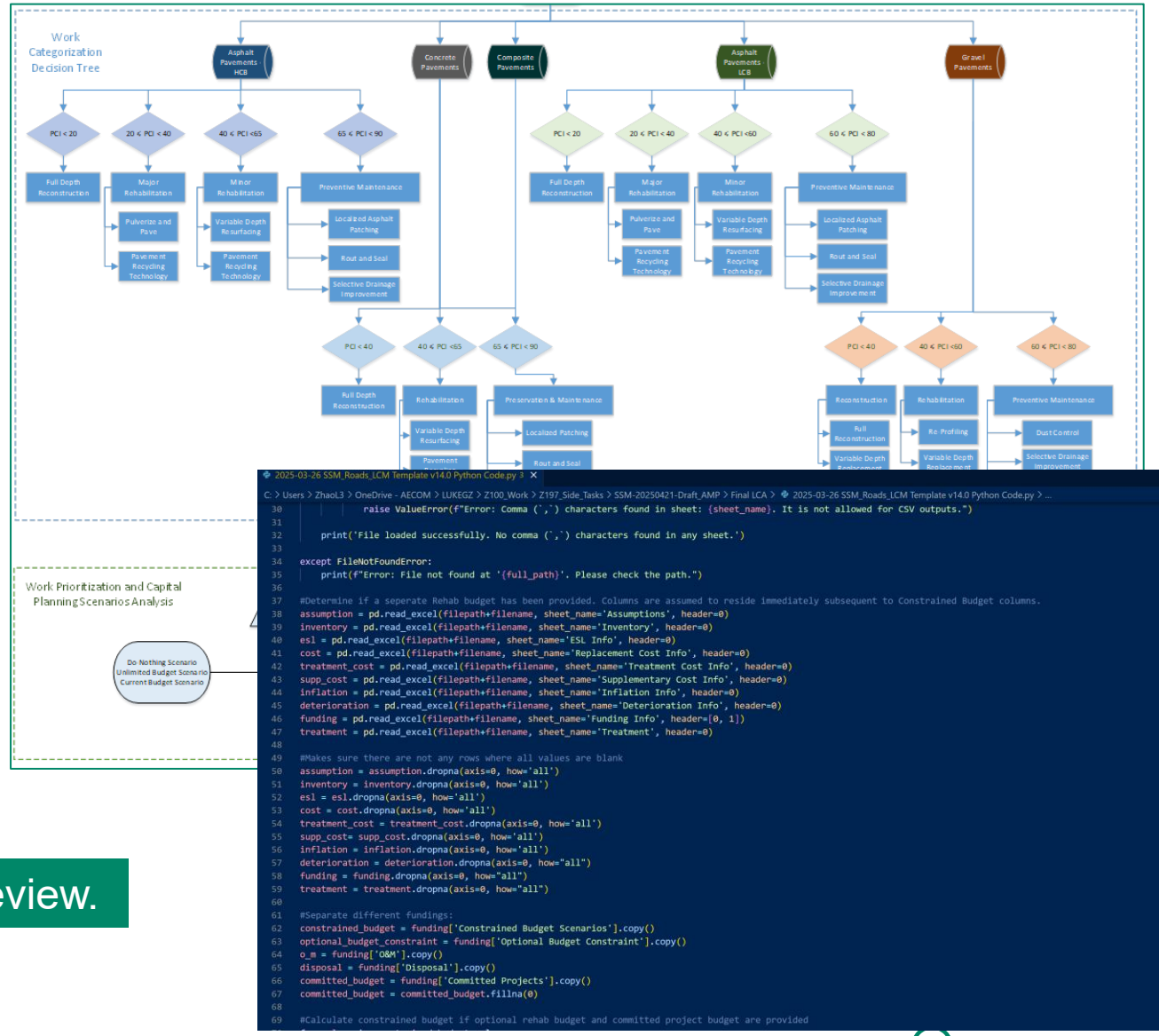
- Asset inventory
- Analysis period
- Inflation
- Treatment Type
- Treatment cost
- Trigger conditions
- Deterioration models
- Scenario setup, etc.

If these drift, the outputs drift.

### Prioritization

- Condition
- Replacement value
- Risk
- Defined ranking indicator
- Coordination with utilities and other projects

Needs periodic review.

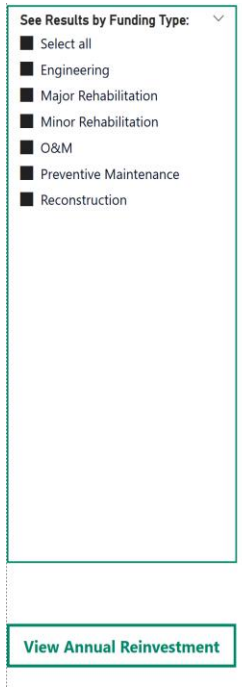


# Lifecycle Modeling for Road Networks (2/2)

## Key Elements

### Dashboard

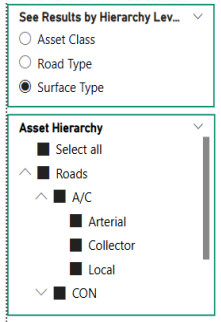
- Inventory
- Replacement Value
- Condition Forecast
- Capital Reinvestment Need
- Full Funding Need
- Annual trend
- Work program (Capital Project List)

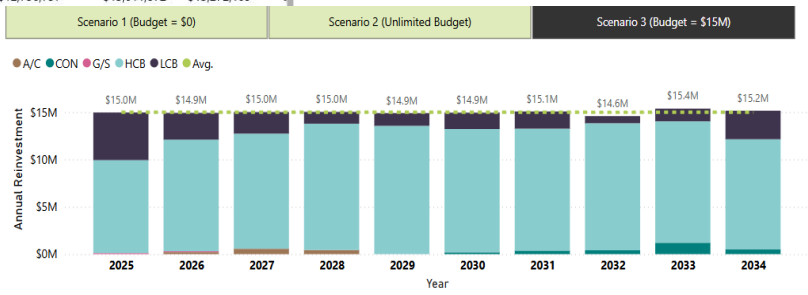


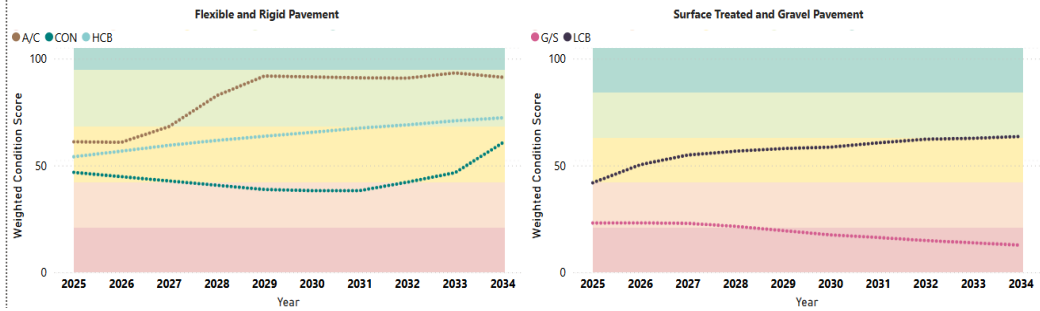


- Treatment timing and types come from the decision logic.
- If logic isn't refreshed, confidence erodes

| Funding Type | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|
| Engineering | $2,025,000 | $2,065,500 | $2,106,810 | $2,148,946 | $2,191,925 | $2,235,764 | $2,280,479 | |
| Major Rehabilitation | $2,355,016 | $4,276,899 | $4,148,379 | $4,583,841 | $2,611,308 | $7,198,392 | $5,857,959 | |
| Minor Rehabilitation | $8,509,589 | $6,908,795 | $6,164,916 | $6,471,673 | $8,061,228 | $5,589,507 | $6,270,191 | |
| O&M | $11,785,253 | $12,020,958 | $12,261,377 | $12,506,605 | $12,756,737 | $13,011,872 | $13,272,109 | |
| Preventive Maintenance | $0 | $145,688 | | | | | | |
| **Total** | **$24,674,858** | **$26,073,030** | | | | | | |




- Condition trends reflect deterioration assumptions.
- Small curve changes can shift long-term outlook.

# Key Takeaways – Road PMS Need  A “Recalibration” or “Modernization”

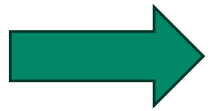
PMS recommended work program match what engineers end up delivering in the field?

**The Core Challenge**:

- Many municipalities have relied on an “advanced” PMS for >10 years.
- Underlying decision logic hasn’t been revisited creating a **black box** that is increasingly questioned.

**The Path to Defensible Decision**:

Black box



**Glass box**

- ❖ PMS maturity is high on paper
- ❖ The “engine” (i.e., decision logic, etc.) hasn’t been tuned
- ❖ Cracking confidence
- ❖ Need to modernize the foundation
- ❖ Require Operational Alignment

Reflect today’s practices & restore decision confidence:

- ❑ New Modern Software
- ❑ Refresh assumptions
- ❑ Update Deterioration curves
- ❑ Update Treatment types & logic

# The Way Forward

# The Way Forward

**It is Essential to have the Support of Senior Leadership and Politicians**

**We Need to Deepen our Insights into the Transportation AM Context and Challenges**

**The Complexity of the Challenge Is Demanding Smarter, and Broader Transportation AM Planning**

# Q&A

Thank you very much!

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