Developing Risk Assessment Protocols for Six Iconic Willamette River Bridges

Western Bridge Engineers Seminar
September 10, 2015
Reno, Nevada

Speakers

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Multnomah County

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David Evans and Associates, Inc.

Agenda

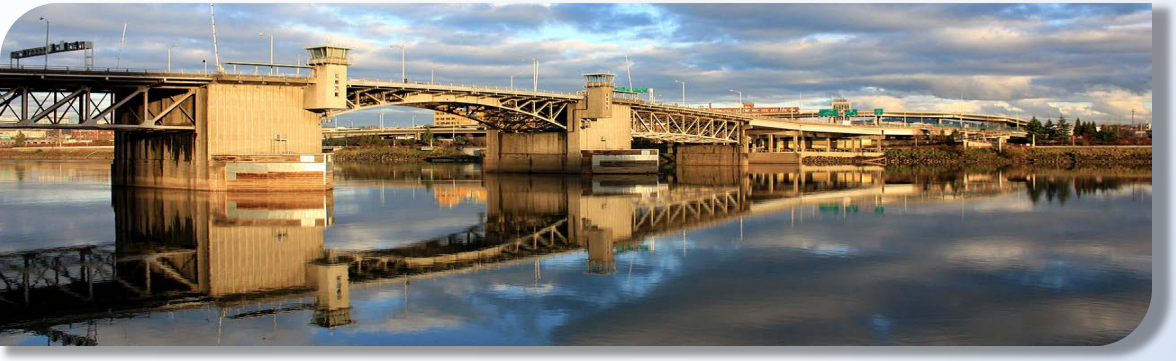
- Background
  - Purpose, objectives, client involvement
- Custom Process and Roadmap
  - Phased approach
- Reporting and Results Summary

CIP Purpose

- Action plan for 2015-2034
- Maintain County's bridge investment
- Provide safe and reliable connections
- Prepare for expected earthquakes
- Durable decision process
- Comprehensive technical assessment

Broadway Bridge

Burnside Bridge



Morrison Bridge

Hawthorne Bridge

County Mission

The Multnomah County Board of Commissioners **plans** for the needs of a dynamic community, **provides** leadership to ensure quality services, **prioritizes** the needs of our most vulnerable and promotes a healthy, safe and prosperous community for all.

adopted June 2, 2011

County Values

- **Social Justice**
- **Health**
- **Public Safety**
- **Integrity**
- **Stewardship**
- **Creativity and Innovation**
- **Sustainability**

adopted June 2, 2011

Applying County Values in the Bridge CIP

- Inform project development criteria
- Model for applying the Equity Lens
  - People, Place, Process, Power, and Purpose
  - Develop broad criteria
  - Openly engage stakeholders
  - Consider needs of all multi-modal user groups
  - Deliver future projects with equity in mind toward creating small business capacity-building opportunities

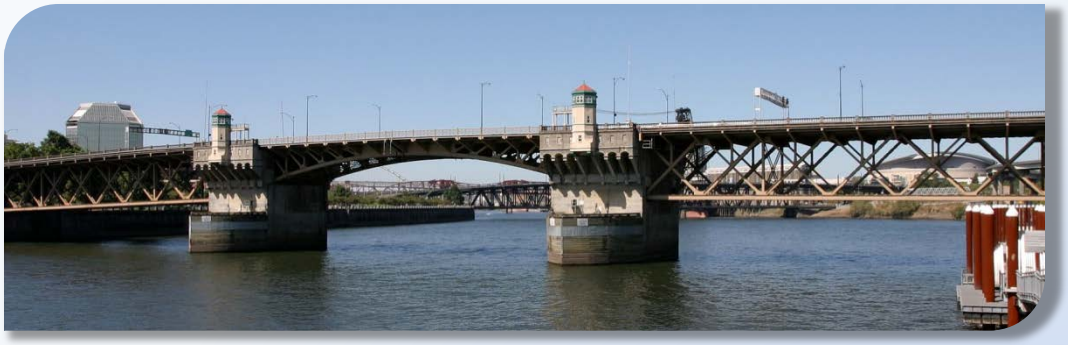
Regional Seismic Threat

- 37% probability of a magnitude 8+ Cascadia Subduction Zone earthquake in the next 50 years
- Large scale fatalities and injuries
- Billions in economic loss

Source: Vincent/Wang presentation to BCC on 10/21/14

County Bridge Seismic Vulnerabilities

- Downtown bridges are highly vulnerable to major earthquakes
- Seismic retrofitting is possible, but very expensive
- Burnside Bridge is a designated Lifeline Route over the Willamette River

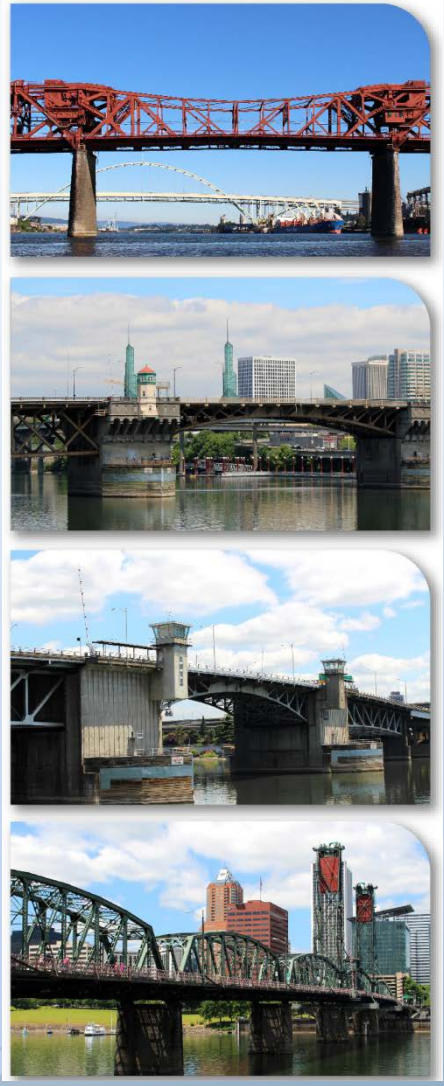


Burnside Bridge

Source: Cannon/Drahota presentation to BCC on 11/6/14

Summary of Results

- 56 capital projects in 20 years
- Preservation and maintenance - $650M
- Seismic resiliency - $650M
- Priority for Burnside Bridge as a designated regional lifeline route



Key Questions

- How should we compare and prioritize projects with widely varying needs and objectives?
- How should we forecast needs over 20 years?
- How do we ensure that investment decisions are durable over time?
- How do we incorporate future flexibility into the prioritization process?

Bridge CIP Development Process

Apply County Values

- Equity Lens
- Establish Performance Criteria
- Workshops:
  - Proj. Definition
  - Programmatic
  - Perf. Attribute

Conduct Engineering Assessment

- Knowledge
- Inspect Bridges
- Evaluate Needs
- Develop Remedies
- Establish Costs

Establish Project Bundles

- Similar Work
- Urgency of Need
- Efficiencies

Prioritize Projects

- Assess Project Performance
- Calculate Cost of Inaction
- Consider Costs

Finalize Plan

- Implement Bridge CIP

Technical Reviews

Project Component	Site Inspection	Desktop Review
Mechanical & Electrical	✓	
Roadway Approaches	✓	✓
Bridge Structural	✓	✓
Hydrological	✓	
Bridge Deck, Sidewalk, & Railing	✓	✓
Paint System		✓
Seismic Resiliency		✓
Bike, Pedestrian, & Transit	✓	✓
Environmental		✓

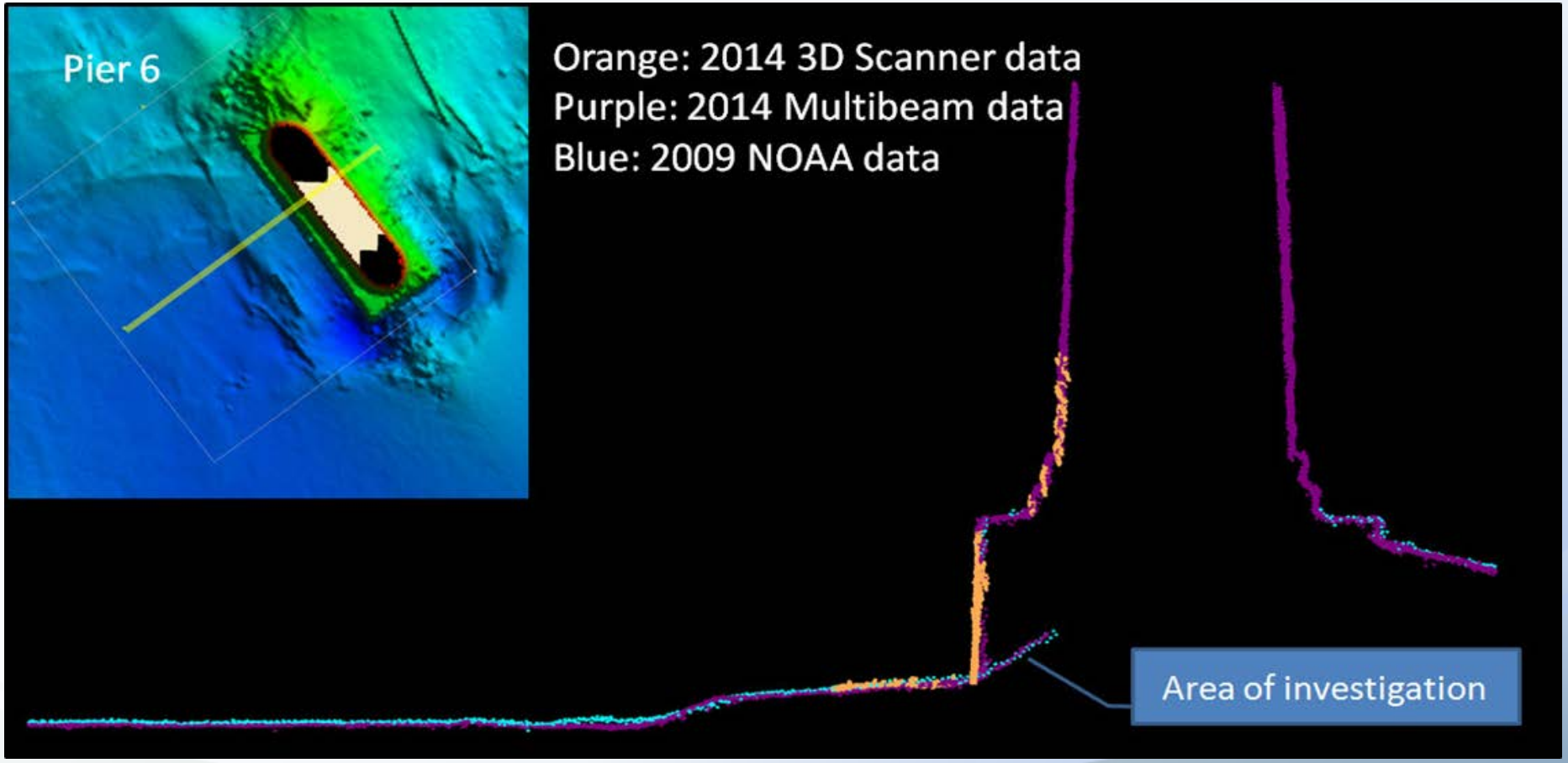
Conduct Engineering Assessment

Assess existing conditions:

- Bridge inspections & operational tests
- Interviews with County staff
- Stakeholder input

Site Survey

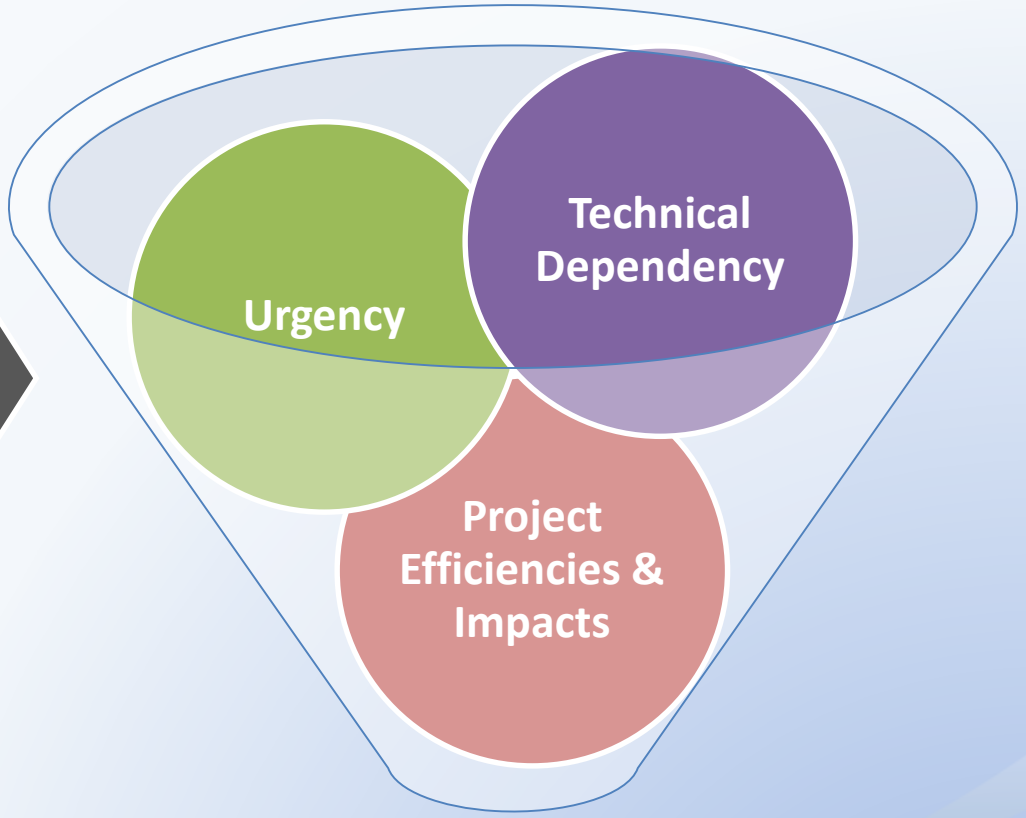
Hydrographic Survey – Identify scour pockets / pitting



Establish Bridge CIP Projects

400 Bridge Needs and Deficiencies

200 Logical Groupings



56 Capital Projects

Cost-Benefit Prioritization

Factors that drive a project's priority:

- Urgency
- Consequence of inaction
- Alignment with County values
- Cost
- Available funding

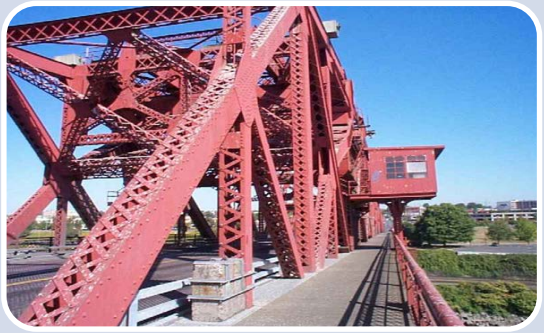
Importance Factor Equation

$$I_{T=x} = O_{prob,T=x} \times \left[1 + \frac{(ESC_{T=x} + ADC_{T=x} + IC_{T=x})}{DC_{init}}\right] \times PerfD_{T=x}$$

Definitions of Terms:

1. **Occurrence Probability (likelihood of need)**
2. **Consequence of Inaction (financial impacts)**
   - Escalation Costs ($ESC_{T=x}$)
   - Additional Direct Cost ($ADC_{T=x}$)
   - Indirect Cost ($IC_{T=x}$)
   - Direct Cost (DC_{init})
3. **Performance Delta (owner and user benefits over time)**

Occurrence Probabilities



Mag. 9.0 earthquake failure

37% chance in next 50 years

Bridge deck failure

Rehab. = 90%
Replace = 30%

Mechanical failure

Dependent on bridge

Consequence of Inaction

Minor Deck Rehabilitation: Initial Direct Construction Cost = $350,00

		T = 0 to 5 yrs	T = 6 to 10 yrs	T = 11 to 15 yrs	T = 16 to 20 yrs
1	Occurrence Probabilities:	20%	60%	90%	100%
	Cost Risk Probabilities:	90%	80%	60%	35%

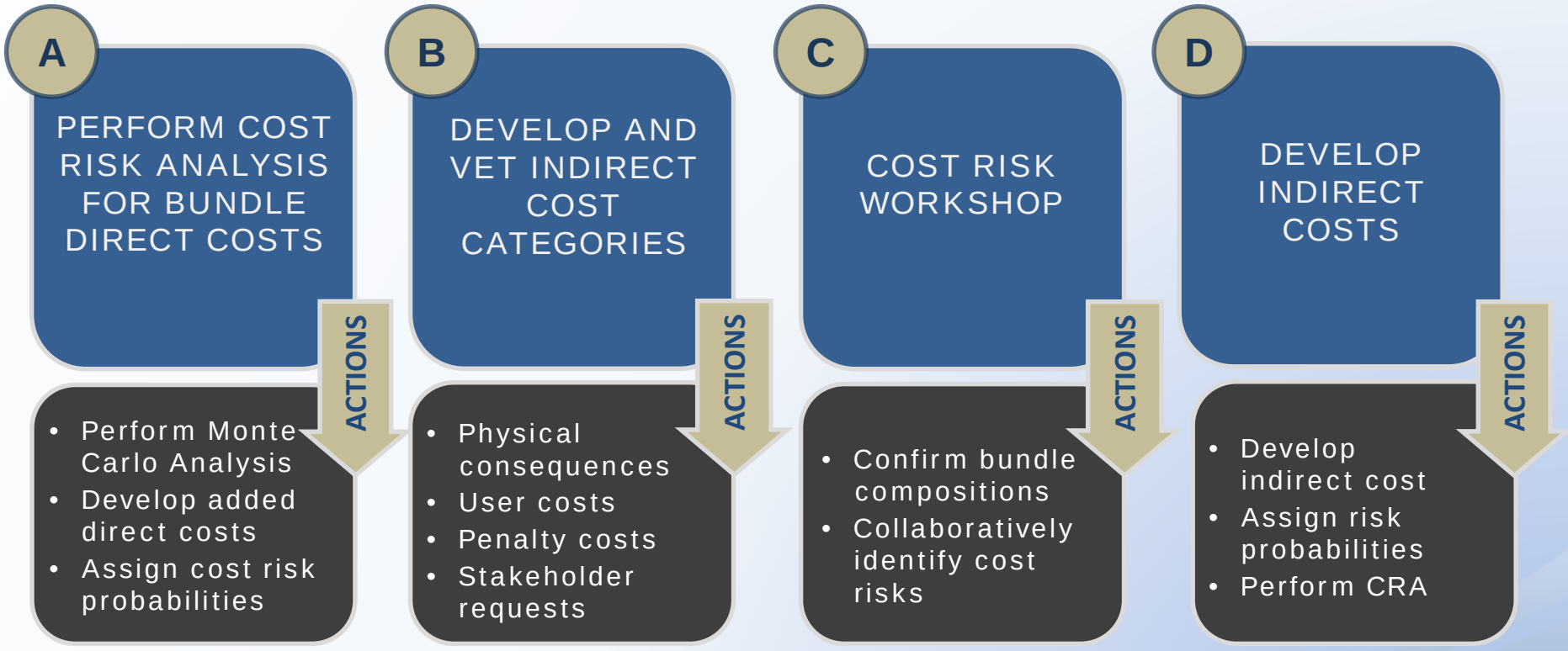
		T = 0 to 5 yrs	T = 6 to 10 yrs	T = 11 to 15 yrs	T = 16 to 20 yrs
2	Direct cost change (after the 2014 construction value)	$ 200,000	$ 500,000	$ 3,300,000	$ 6,500,000
	Comments on direct cost change:	Initial increases are primarily for barrier rail rehabilitation. Later time step increases reflect a shift from driving surface rehabilitation to potential full replacement where not already			
3	Escalation cost (of the 2014 construction value):	$ 114,952	$ 371,981	$ 669,948	$ 1,015,373
4	Indirect costs (after the 2014 construction value)	$ -	$ -	$ -	$ -
	Comments on indirect costs:				
5	Time cost change subtotal (escalation, direct and indirect):	$ 314,952	$ 871,981	$ 3,969,948	$ 7,515,373

Performance Attribute Ratings

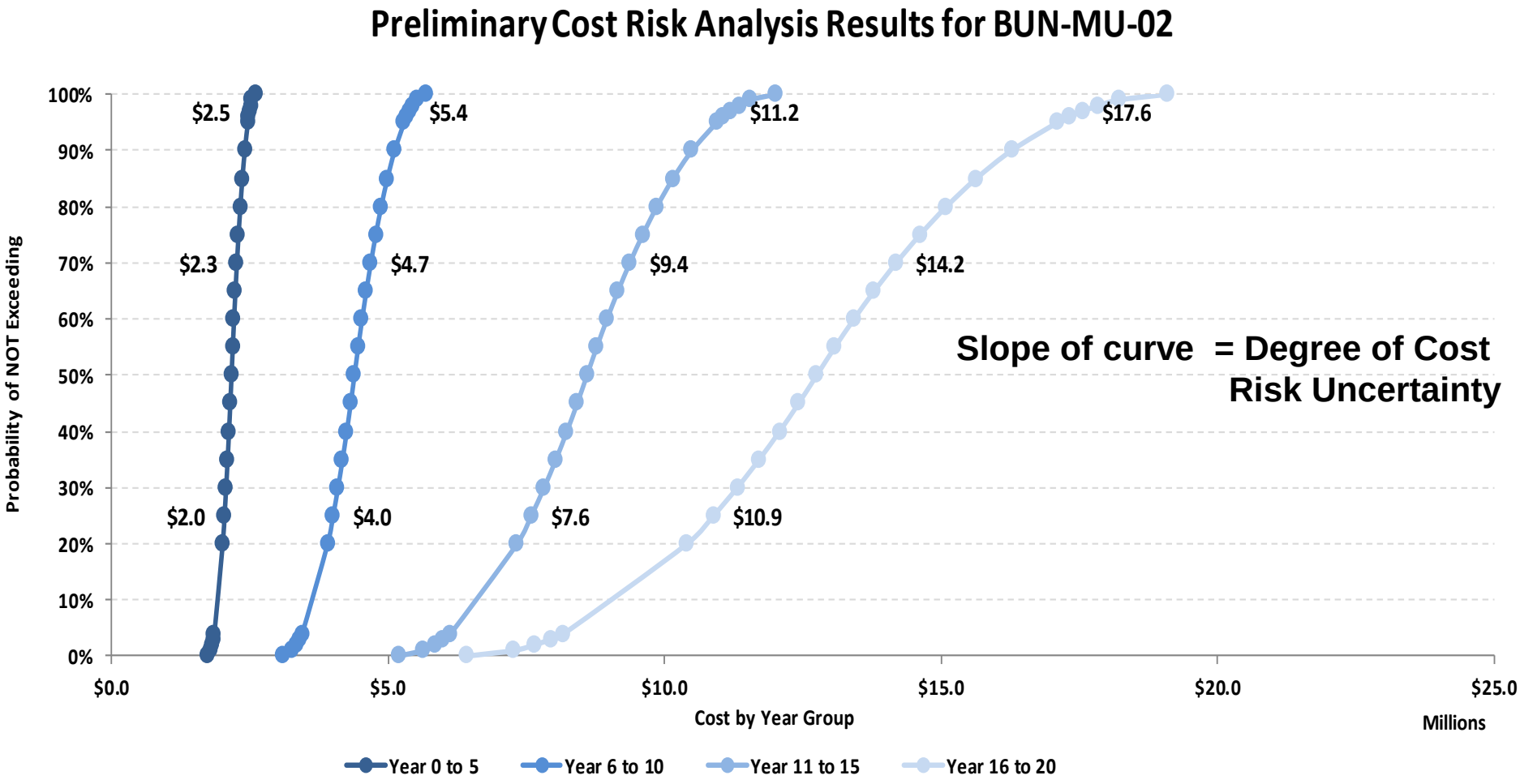
Attribute	Baseline Score ("do nothing")	Score at T = 0-5 yrs	Score at T = 6-10 yrs	Score at T = 11-15 yrs	Score at T = 16-20 yrs
Moveable Operations	0	0	0	0	0
Regional Alignment	-1	1	1	1	1
Structural Integrity					2
Emergency Preparedness					0
Maintenance					2
User Safety					2
Livable Community	-1	1	2	2	2
Social Justice	-1	0	0	1	1
Sustainability	-1	1	1	1	1
Traffic Operations	-1	1	1	1	1

It's the CHANGE in the Ratings that matter!

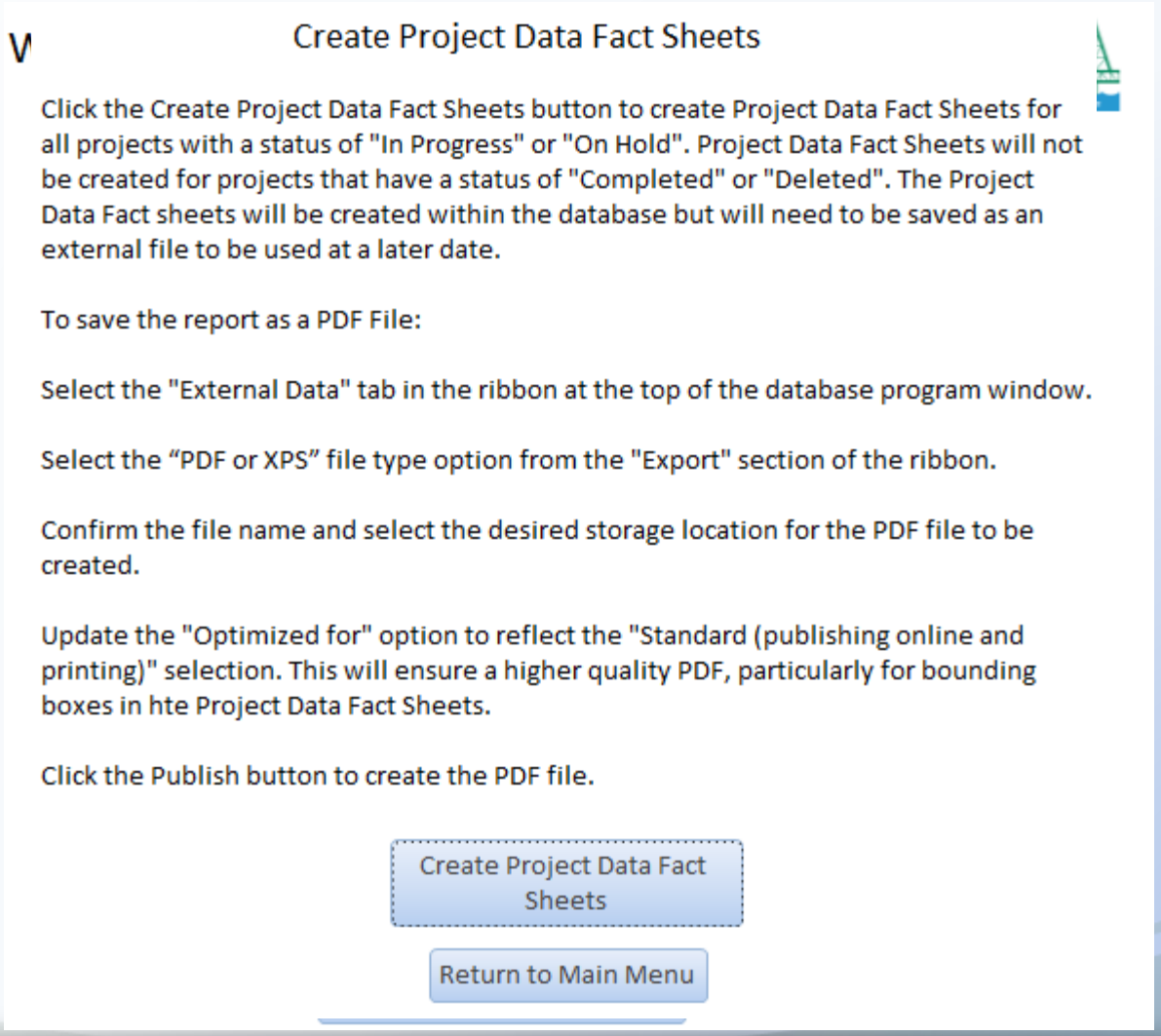
Summary of Cost Risk Analysis



Direct Cost Risk Analysis



Database


Create Project Data Fact Sheets
Click the Create Project Data Fact Sheets button to create Project Data Fact Sheets for all projects with a status of "In Progress" or "On Hold". Project Data Fact Sheets will not be created for projects that have a status of "Completed" or "Deleted". The Project Data Fact sheets will be created within the database but will need to be saved as an external file to be used at a later date.
To save the report as a PDF File:
Select the "External Data" tab in the ribbon at the top of the database program window.
Select the “PDF or XPS” file type option from the "Export" section of the ribbon.
Confirm the file name and select the desired storage location for the PDF file to be created.
Update the "Optimized for" option to reflect the "Standard (publishing online and printing)" selection. This will ensure a higher quality PDF, particularly for bounding boxes in hte Project Data Fact Sheets.
Click the Publish button to create the PDF file.
Create Project Data Fact Sheets
Return to Main Menu

Project Data Fact Sheet Example

Project Summary Information: Rall Wheel Rehabilitation							
Bridge Names(s):	Broadway			Project ID#:	BUN-BR-02	Project Status:	In Progress
Project Rank:	3	Primary Category of Work	Mechanical	Performance Attribute Total Score	45	Importance Score	TI-1 48.03
Logical Grouping Project ID #'s:	BR-MECH-03						
Bridge Num and Names(s):	06757 Willamette River, Broadway St [Broadway]						

Definition of Problem

The four Rall wheels, which remain from the bridge's original construction, support the weight of the movable portions of the Broadway Bridge. Due to their age and level of deterioration, they are nearing the end of their service life and require replacement. The tracks on which the wheels roll are not well aligned and are causing unnecessary wear on other portions of the structure and machinery. As a result, other portions of the structure will also need to be repaired as a byproduct of the rehabilitation work.

Description of Proposed Solution

The solution is to replace the Rall wheels and their supporting track. This requires raising each leaf of the bridge on jacks in order to pull off the existing wheel, replace the tracks, and install the new wheels. Other worn components on the bridge will be repaired based on further investigation during the design phase of the project. Strengthening of some connecting truss members will likely also be required during the Rall wheel replacement operation.

Project Justification

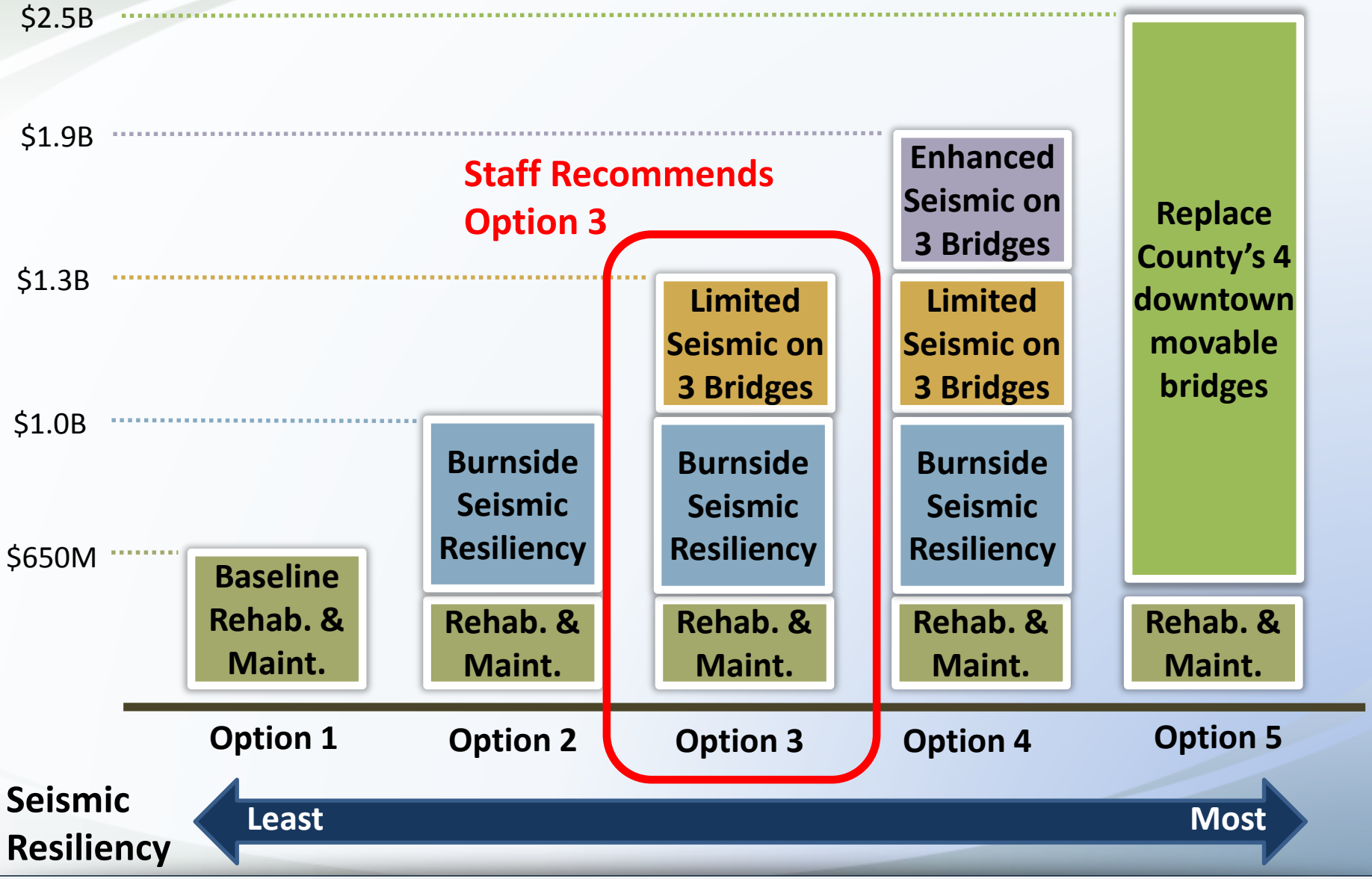
This work will align the bridge, which will decrease wear on the structure and operating machinery. This work increases the bridge's life span and reduces the likelihood of an unexpected failure.

Right-of-Way:	$0
Utility Reimbusement:	$0
Construction:	$10,438,050
Preliminary Engineering:	$2,492,676
Construction Engineering:	$2,492,676
Total Cost at Target Construction Time:	$15,423,401
Target Construction Time:	2015-2019

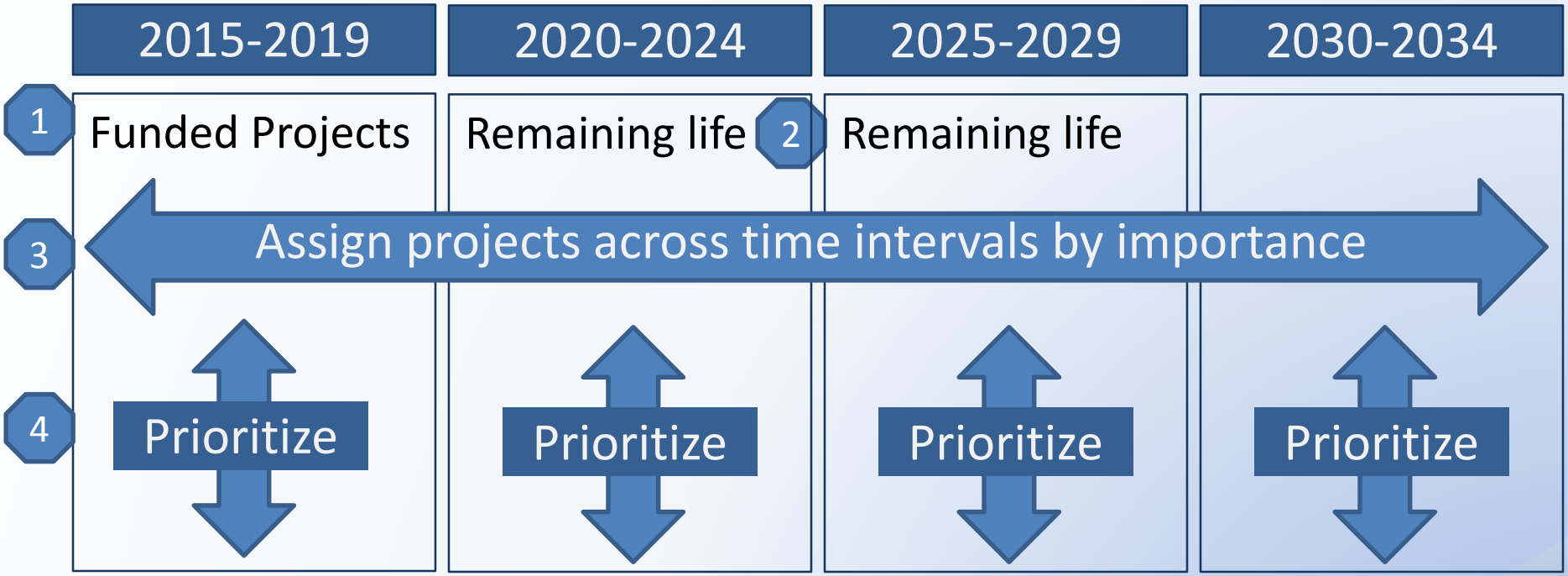
Notes:

None entered.

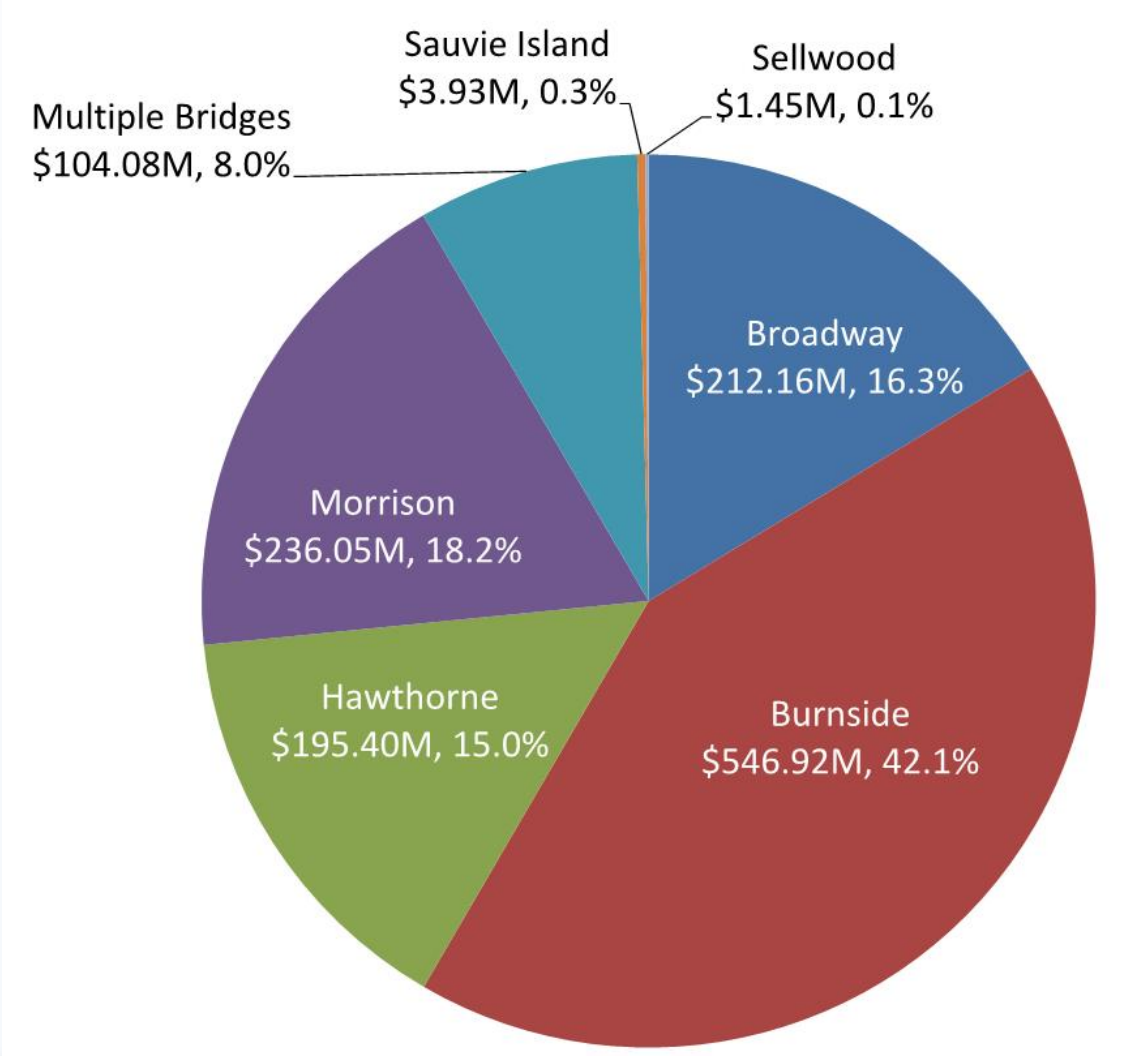
Seismic Investment Options



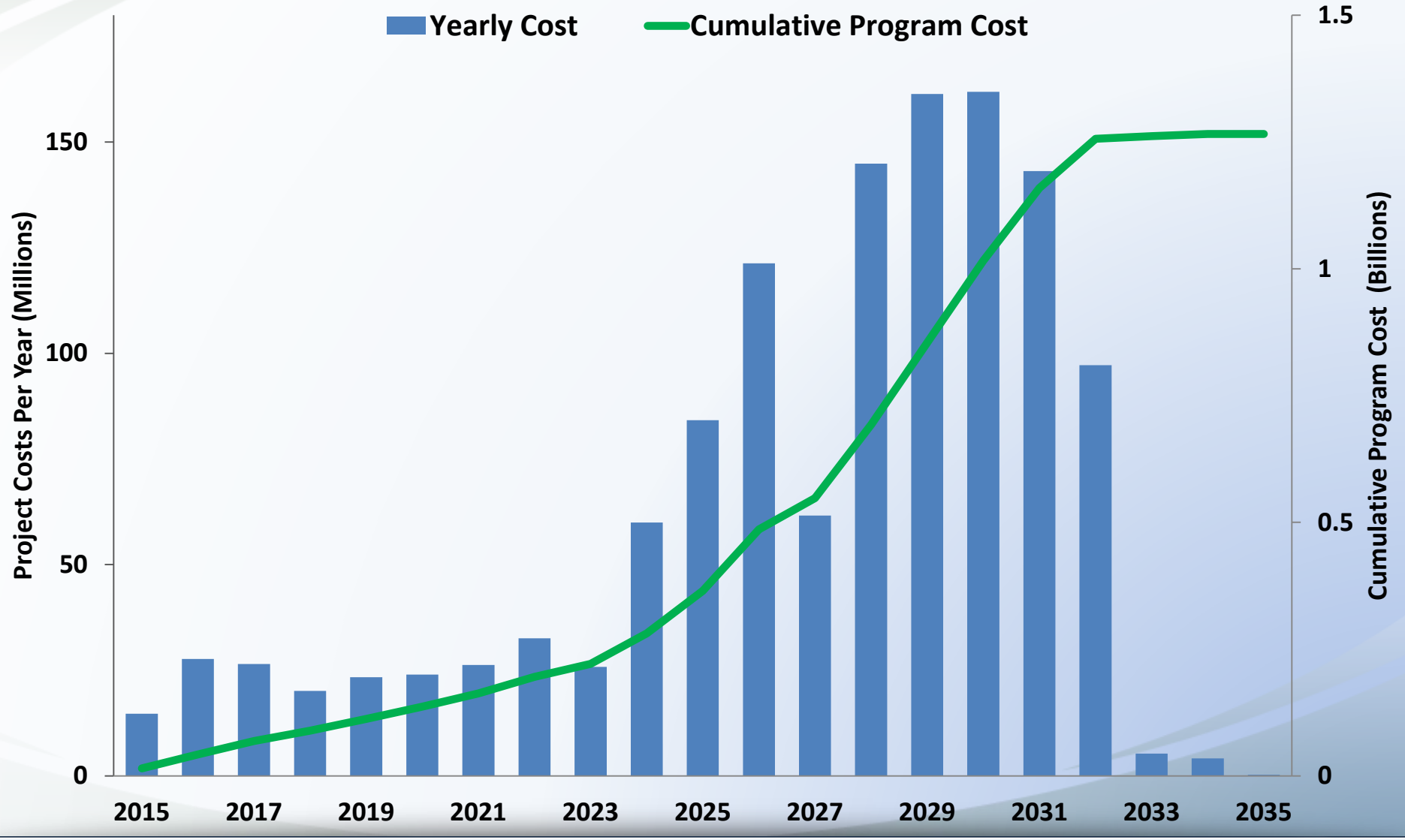
Prioritize Projects



Results by Bridge



Prioritization Results



Questions?

www.multco.us/bridges