REDUCING THE COST OF HIGHWAY MAINTENANCE – WITHOUT COMPROMISING YOUR LEVEL OF SERVICE

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Mackinac Bridge, Michigan, USA
OVERVIEW

• The Current Reality
• Definitions
• Case Studies
  • Auckland Harbor Bridge
  • Bridge Strengthening Program
• Summary
• Acknowledgements
• Questions

Kicking Horse Canyon Park Bridge, Canada
THE CURRENT REALITY: GENERAL PRINCIPLES
Life in the 21st Century....

- Asset Resilience
- Asset Redundancy

Budgets Squeezed!

- Asset Demand
- Environmental Outcomes
- Health & Safety Outcomes
Logical solution...

• More problems = more $$$
• But can we challenge that?
  • Yes!
CASE STUDY ONE: AUCKLAND HARBOR BRIDGE
Location
Gallery
Key Statistics

- Lanes: 8 (with tidal flows)
- Length: 0.6 mile 1.1 km
- Type: Box Truss
- Clearance: 142 feet / 43m
- Opened: 1959
- Traffic: 160,000 vpd
- Nickname: “Coathanger”
Key Issues

• Sensitive marine environment
• Load restrictions
• Huge surface area
  • 125,000 sq m / 1.35 M sq ft
  • Requires protection
  • Significant painting program ($0.5M per annum)
Existing Painting Program
Key Issues

• Increasing load demands
  • Already little redundancy

• Pending environmental restrictions
  • Resource consent related
  • Dust containment “structure” required

• Current maintenance cost expected to increase....
With issues come opportunities!

• When challenged, we are forced to think differently
• Was there another way to deliver an improved LoS at the same cost, or
• Deliver the same LoS at a lower cost?
Solution

• Robust maintenance strategy which:
  • Reviewed and challenged existing coatings
    • Type
    • Application intervals
    • Required protection
  • Different scenarios assessed
    • NPV analysis
  • Optimum strategy identified
NPV Analysis

| Scenario 1 | Actual Year | % Area Maintained of Texas Bridge | Plant Option | % Area Maintained of Operation | Plant Option | Area (m²) | % Area Maintained of Extensions | Plant Option | Area (m²) | % Area Maintained of Viaduct | Plant Option | Area (m²) | % Area Maintained of Viaduct | Plant Option | Area (m²) | % Area Maintained of Viaduct | Plant Option | Area (m²) | % Area Maintained of Viaduct |
|------------|-------------|----------------------------------|--------------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|-------------------------------|--------------|----------|
| 1          | 1.50%       | Spot MCU                         | 650          | 1.00%                         | Spot MCU     | 657      | 1.00%                         | Spot MCU     | 760      | 1.00%                         | Spot MCU     | 760      | 1.00%                         | Spot MCU     | 760      | 1.00%                         | Spot MCU     | 760      |
| 2          | 1.50%       | Spot MCU                         | 758          | 1.25%                         | Spot MCU     | 757      | 1.25%                         | Spot MCU     | 760      | 1.25%                         | Spot MCU     | 760      | 1.25%                         | Spot MCU     | 760      | 1.25%                         | Spot MCU     | 760      |
| 3          | 1.50%       | Spot MCU                         | 856          | 1.50%                         | Spot MCU     | 857      | 1.50%                         | Spot MCU     | 760      | 1.50%                         | Spot MCU     | 760      | 1.50%                         | Spot MCU     | 760      | 1.50%                         | Spot MCU     | 760      |
| 4          | 1.50%       | Spot MCU                         | 955          | 1.75%                         | Spot MCU     | 957      | 1.75%                         | Spot MCU     | 760      | 1.75%                         | Spot MCU     | 760      | 1.75%                         | Spot MCU     | 760      | 1.75%                         | Spot MCU     | 760      |
| 5          | 1.50%       | Spot MCU                         | 1,007        | 2.00%                         | Spot MCU     | 1,007    | 2.00%                         | Spot MCU     | 760      | 2.00%                         | Spot MCU     | 760      | 2.00%                         | Spot MCU     | 760      | 2.00%                         | Spot MCU     | 760      |
| 6          | 1.50%       | Spot Tarmarast                   | 1,106        | 2.25%                         | Full Thermast | 1,106   | 2.25%                         | Spot MCU     | 760      | 2.25%                         | Spot MCU     | 760      | 2.25%                         | Spot MCU     | 760      | 2.25%                         | Spot MCU     | 760      |
| 7          | 1.50%       | Spot Tarmarast                   | 1,207        | 2.50%                         | Full Thermast | 1,207   | 2.50%                         | Spot MCU     | 760      | 2.50%                         | Spot MCU     | 760      | 2.50%                         | Spot MCU     | 760      | 2.50%                         | Spot MCU     | 760      |
| 8          | 1.50%       | Spot Tarmarast                   | 1,308        | 2.75%                         | Full Thermast | 1,308   | 2.75%                         | Spot MCU     | 760      | 2.75%                         | Spot MCU     | 760      | 2.75%                         | Spot MCU     | 760      | 2.75%                         | Spot MCU     | 760      |
| 9          | 1.50%       | Spot Tarmarast                   | 1,409        | 3.00%                         | Full Thermast | 1,409   | 3.00%                         | Spot MCU     | 760      | 3.00%                         | Spot MCU     | 760      | 3.00%                         | Spot MCU     | 760      | 3.00%                         | Spot MCU     | 760      |
| 10         | 1.50%       | Spot Tarmarast                   | 1,510        | 3.25%                         | Full Thermast | 1,510   | 3.25%                         | Spot MCU     | 760      | 3.25%                         | Spot MCU     | 760      | 3.25%                         | Spot MCU     | 760      | 3.25%                         | Spot MCU     | 760      |
| 11         | 1.50%       | Spot Tarmarast                   | 1,611        | 3.50%                         | Full Thermast | 1,611   | 3.50%                         | Spot MCU     | 760      | 3.50%                         | Spot MCU     | 760      | 3.50%                         | Spot MCU     | 760      | 3.50%                         | Spot MCU     | 760      |
| 12         | 1.50%       | Spot Tarmarast                   | 1,712        | 3.75%                         | Full Thermast | 1,712   | 3.75%                         | Spot MCU     | 760      | 3.75%                         | Spot MCU     | 760      | 3.75%                         | Spot MCU     | 760      | 3.75%                         | Spot MCU     | 760      |
| 13         | 1.50%       | Spot Tarmarast                   | 1,813        | 4.00%                         | Full Thermast | 1,813   | 4.00%                         | Spot MCU     | 760      | 4.00%                         | Spot MCU     | 760      | 4.00%                         | Spot MCU     | 760      | 4.00%                         | Spot MCU     | 760      |
| 14         | 1.50%       | Spot Tarmarast                   | 1,914        | 4.25%                         | Full Thermast | 1,914   | 4.25%                         | Spot MCU     | 760      | 4.25%                         | Spot MCU     | 760      | 4.25%                         | Spot MCU     | 760      | 4.25%                         | Spot MCU     | 760      |
| 15         | 1.50%       | Spot Tarmarast                   | 2,015        | 4.50%                         | Full Thermast | 2,015   | 4.50%                         | Spot MCU     | 760      | 4.50%                         | Spot MCU     | 760      | 4.50%                         | Spot MCU     | 760      | 4.50%                         | Spot MCU     | 760      |
| 16         | 1.50%       | Spot Tarmarast                   | 2,116        | 4.75%                         | Full Thermast | 2,116   | 4.75%                         | Spot MCU     | 760      | 4.75%                         | Spot MCU     | 760      | 4.75%                         | Spot MCU     | 760      | 4.75%                         | Spot MCU     | 760      |
| 17         | 1.50%       | Spot Tarmarast                   | 2,217        | 5.00%                         | Full Thermast | 2,217   | 5.00%                         | Spot MCU     | 760      | 5.00%                         | Spot MCU     | 760      | 5.00%                         | Spot MCU     | 760      | 5.00%                         | Spot MCU     | 760      |
| 18         | 1.50%       | Spot Tarmarast                   | 2,318        | 5.25%                         | Full Thermast | 2,318   | 5.25%                         | Spot MCU     | 760      | 5.25%                         | Spot MCU     | 760      | 5.25%                         | Spot MCU     | 760      | 5.25%                         | Spot MCU     | 760      |
| 19         | 1.50%       | Spot Tarmarast                   | 2,419        | 5.50%                         | Full Thermast | 2,419   | 5.50%                         | Spot MCU     | 760      | 5.50%                         | Spot MCU     | 760      | 5.50%                         | Spot MCU     | 760      | 5.50%                         | Spot MCU     | 760      |
| 20         | 1.50%       | Spot Tarmarast                   | 2,520        | 5.75%                         | Full Thermast | 2,520   | 5.75%                         | Spot MCU     | 760      | 5.75%                         | Spot MCU     | 760      | 5.75%                         | Spot MCU     | 760      | 5.75%                         | Spot MCU     | 760      |
| 21         | 1.50%       | Spot Tarmarast                   | 2,621        | 6.00%                         | Full Thermast | 2,621   | 6.00%                         | Spot MCU     | 760      | 6.00%                         | Spot MCU     | 760      | 6.00%                         | Spot MCU     | 760      | 6.00%                         | Spot MCU     | 760      |

NPV Analysis Table

| Total NPV: Current | $15B |
| Total NPV: for 20+ years | $15B | 0.05% |

OTECP 2016: 70 Years of Innovation & Beyond
Current Maintenance Strategy NPV > $30M over 30 years

New Maintenance Strategy NPV $13.6M over 30 years
The outcomes....

• New maintenance strategy that:
  • Achieved new environmental standards
  • Improved Health and Safety
  • Didn't require containment
  • Same risk profile
  • More cost effective than existing

Asset Managers Dream!
The Paradigm Challenging enablers....

- Asset management thinking:
  - Lifecycle costs
- Change in status quo
  - New environmental policies
- Supplier agnostic consultant
  - What’s best for client
  - Not best for supplier
- Materials and deterioration experts
- Asset performance data
CASE STUDY TWO:
BRIDGE STRENGTHENING PROGRAM

Sea to Sky Highway, Canada
Background
Problem Statement

• Ageing Bridge Stock
• Increased loadings
  • Volume
  • Mass
• Insufficient $$ for Resulting Strengthening / Replacement Program
But....

• How well are the bridges understood?

• In bridge design:
  • Material strength reduction factors
  • Worksmanship reduction factors
  • Loading multiplication factors
  • Estimates around deterioration rates and design life

• Time to ask the real question:
  • Perhaps there is some redundancy?
Methodology

• Understand in situ bridge performance
  • Stress gauges
  • Displacement gauges
  • Accelerometers
  • Add proof loading
  • Materials testing

• Revisit bridge strength
  • Review design vs actual
  • Identify redundancy
  • Program work accordingly
Result

• Redundancy identified!
  • Extend bridge life
  • Extend bridge loading
  • Reduce extent of strengthening work

• Resulting program
  • More affordable
  • More practical
  • Proactively managed risk (inspections)
The Paradigm Challenging enablers....

• Asset management thinking:
  • Level of service, deterioration modelling
  • Challenging design assumptions

• Change in status quo
  • New vehicle mass policy

• Materials and deterioration experts
SUMMARIZING
Life in the 21st Century....

• Asset Resilience
• Asset Redundancy

Budgets Squeezed!

• Network Demand
• Environmental Outcomes
• Health & Safety Outcomes
Logical solution...

• More problems = more $$$
• But we **can** we challenge that!
“If everyone is moving forward together, then success takes care of itself”

Henry Ford – American Industrialist
There are savings to be made

Gains from Asset Management

- Efficiency
- Effectiveness
- Governance

0% 10% 20% 30% 40% 50%
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QUESTIONS?

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