Municipal Bridge Prioritization

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Municipal Bridge Owners

- Municipal bridges
- Locally owned
- Non-state responsibility
  - Counties
  - Cities
  - Towns & Townships
  - Toll authorities
  - Other local agencies

Municipal Bridge Owners

- Responsibilities vary by state
  - Inspection
  - Maintenance
  - New construction

- Variety of structure inventories
  - Number of structures
  - Size and type of structures
  - Complexity of road network

3 categories…

Scale of Bridge Inventory

- Tabletop Size
  - Less than three dozen structures
  - Relatively simple types
  - Limited & multi-hat staff
  - Tabletop review
  - See the end from the beginning

Scale of Bridge Inventory

- Agency Size
  - Hundreds to thousands of structures
  - Complex structure types
  - Segregated but dedicated staff
    - Engineers
    - Inspection
    - Maintenance
    - Management
  - Multiple levels of management
  - Data driven metrics
  - Software and technology

Scale of Bridge Inventory

- Mid-range Size
  - Dozens to few hundred
  - Also consider complexity
  - Staff depth & experience
  - Long-term staff continuity
  - Non-technical management
  - Non-transportation demands
  - Challenges for planning
  - Getting handle on data

Bridge Data Evolution

- 1968 Federal Highway Act
- National Bridge Inspection Stds
- Good/Fair/Poor
- General Condition States
- Inventory Items
- Element Level
- Probabilistic models / scenarios
- Data intensive
- Challenging interpretation

Case study

Case Study: City of Roanoke, Virginia

- Incorporated municipality
- Full responsibility
- Broad Inventory
  - 105 structures
  - 30 < 25 feet length
  - 8 > 500 feet length
  - 3 arch bridges
  - 4 fracture critical
- Engineering Department
  - Knowledgeable staff
- Desire for data driven program

Roanoke Bridge Prioritization

- Forward looking plan
  - Establish priorities
  - Not reactionary mode
- Establish budgets
- Communication to leadership
- Data driven decision making
  - Best use of funding
  - Consistency

Roanoke Bridge Prioritization

- Goals for Prioritization
  - Available data
  - Priority score (Index)
  - Customized for local priorities
  - Spreadsheet based

- Overall approach
  - Customized structure score
  - Shortlist candidates (tabletop)
  - Evaluate alternatives
  - Develop long-term plan

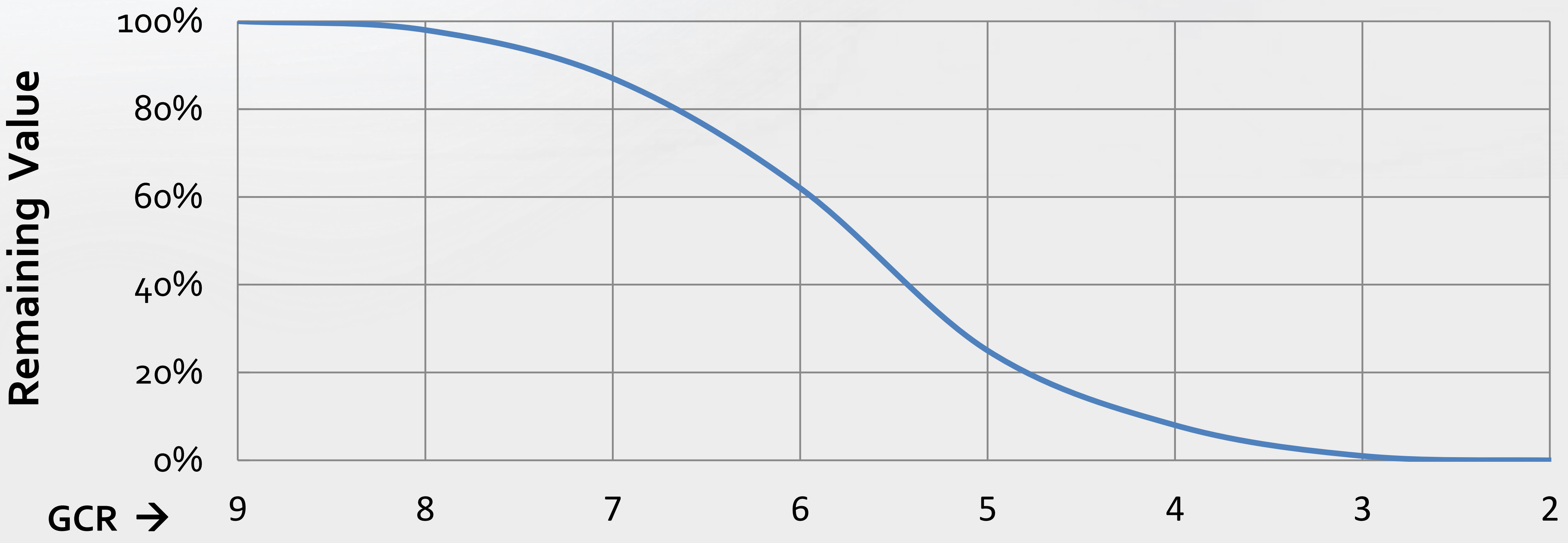
Roanoke Bridge Priority Index

- Single value (sufficiency rating, health index)
- Scale from 0 (low priority) to 1 (high priority)
- Give higher priority to:
  - Structures in poor condition
  - Larger structures
  - Structures carrying more traffic
  - Structures with posted weight restriction

$$Priority\ Index = 1 - \frac{Condition\ Ratio}{Importance\ Factor} \geq 0$$

Roanoke Bridge Priority Index – Condition Ratio

- General Condition Rating (as Asset Value)



Roanoke Bridge Priority Index – Condition Ratio

- Components
  - Deck (30% total score)
  - Superstructure (45% total score)
  - Substructure (25% total score)

GCR			Cond Ratio
4	30% x 0.08	=	0.02
5	45% x 0.25	=	0.11
6	25% x 0.62	=	0.16
	Total	=	0.29

Condition Ratio

Roanoke Bridge Priority Index

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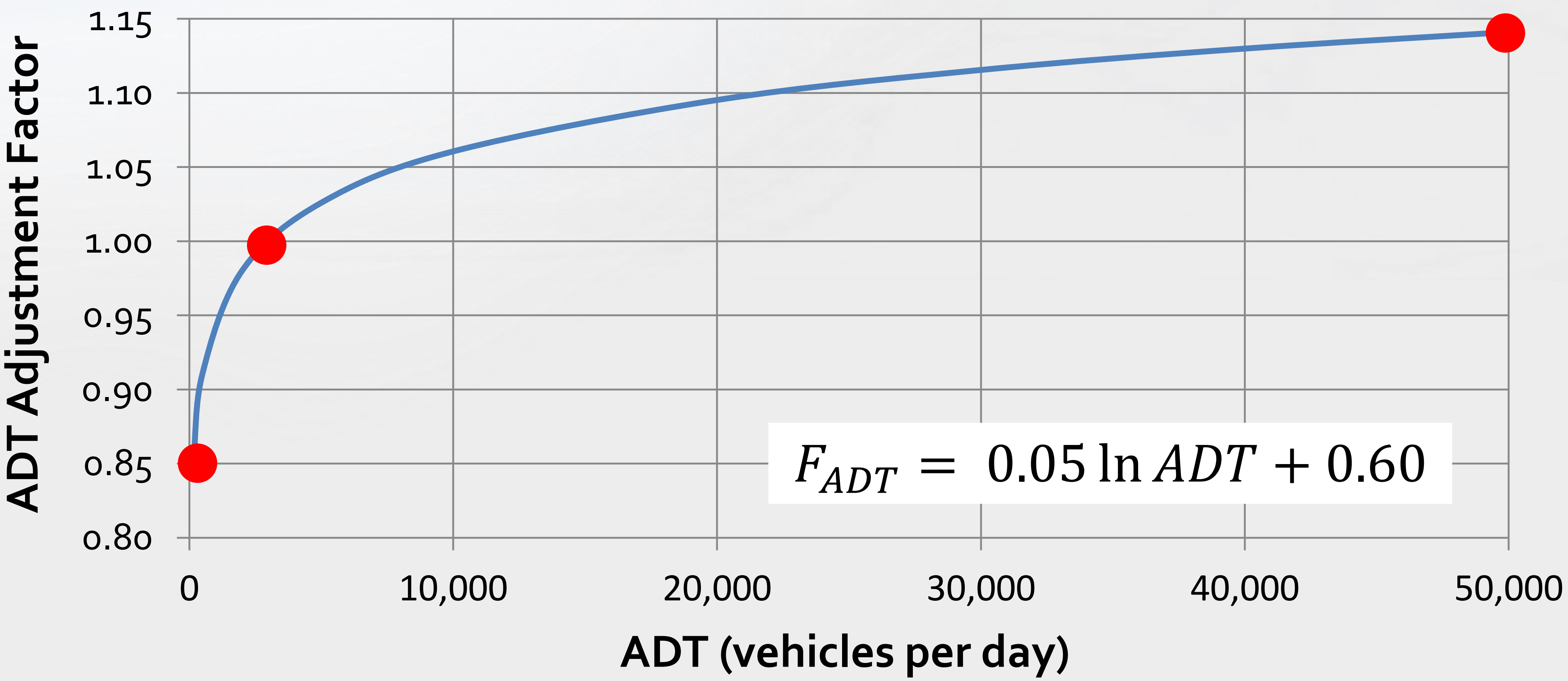
Roanoke Bridge Priority Index – Importance Factor

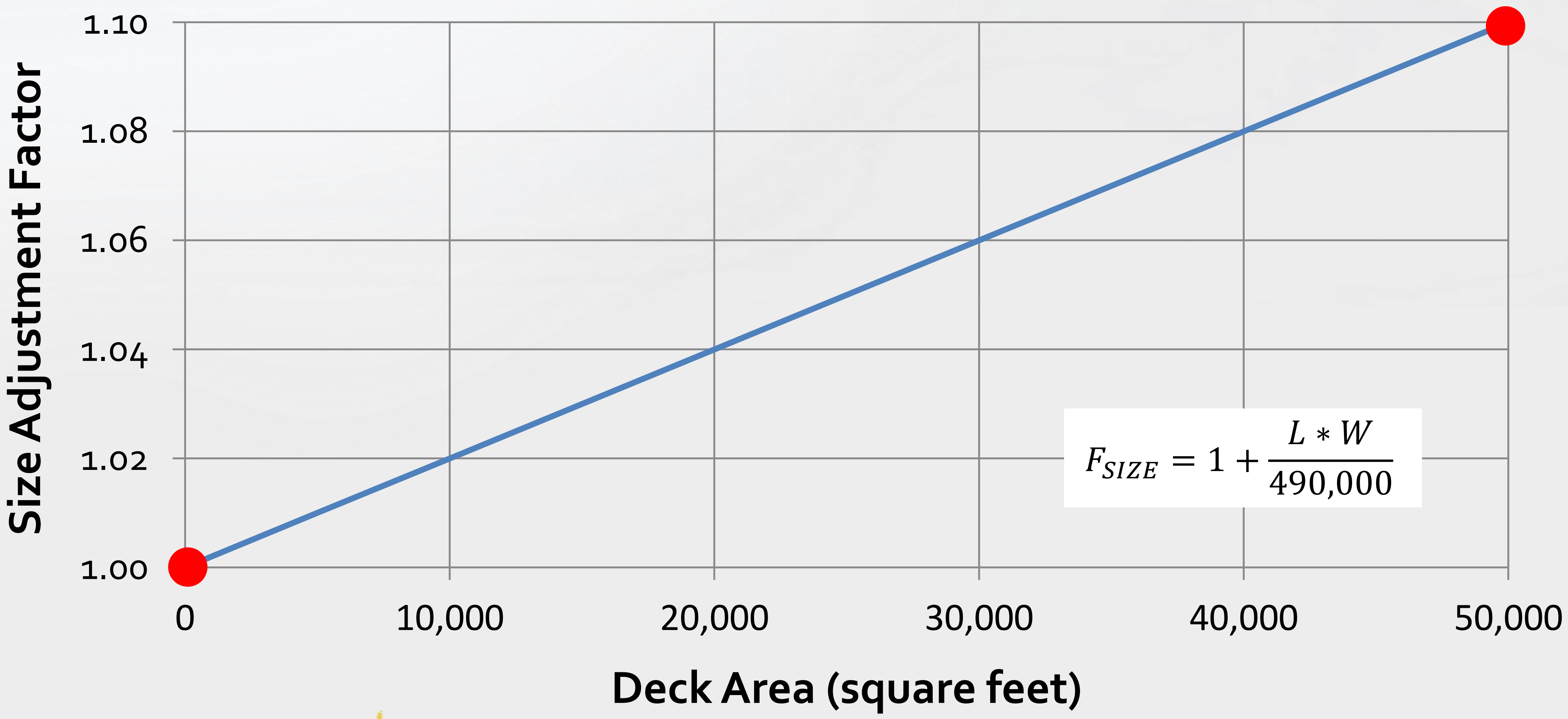
1. Average Daily Traffic
   – Federal Item 29
   – Higher ADT = higher factor
2. Bridge Size
   – Deck area (L x W)
   – Federal Items 49 & 52
   – Larger bridge = higher factor
3. Posting Status
   – Federal Item 70
   – Lower weight limit = higher factor

$$Importance\ Factor = F_{ADT} * F_{SIZE} * F_{POSTING}$$

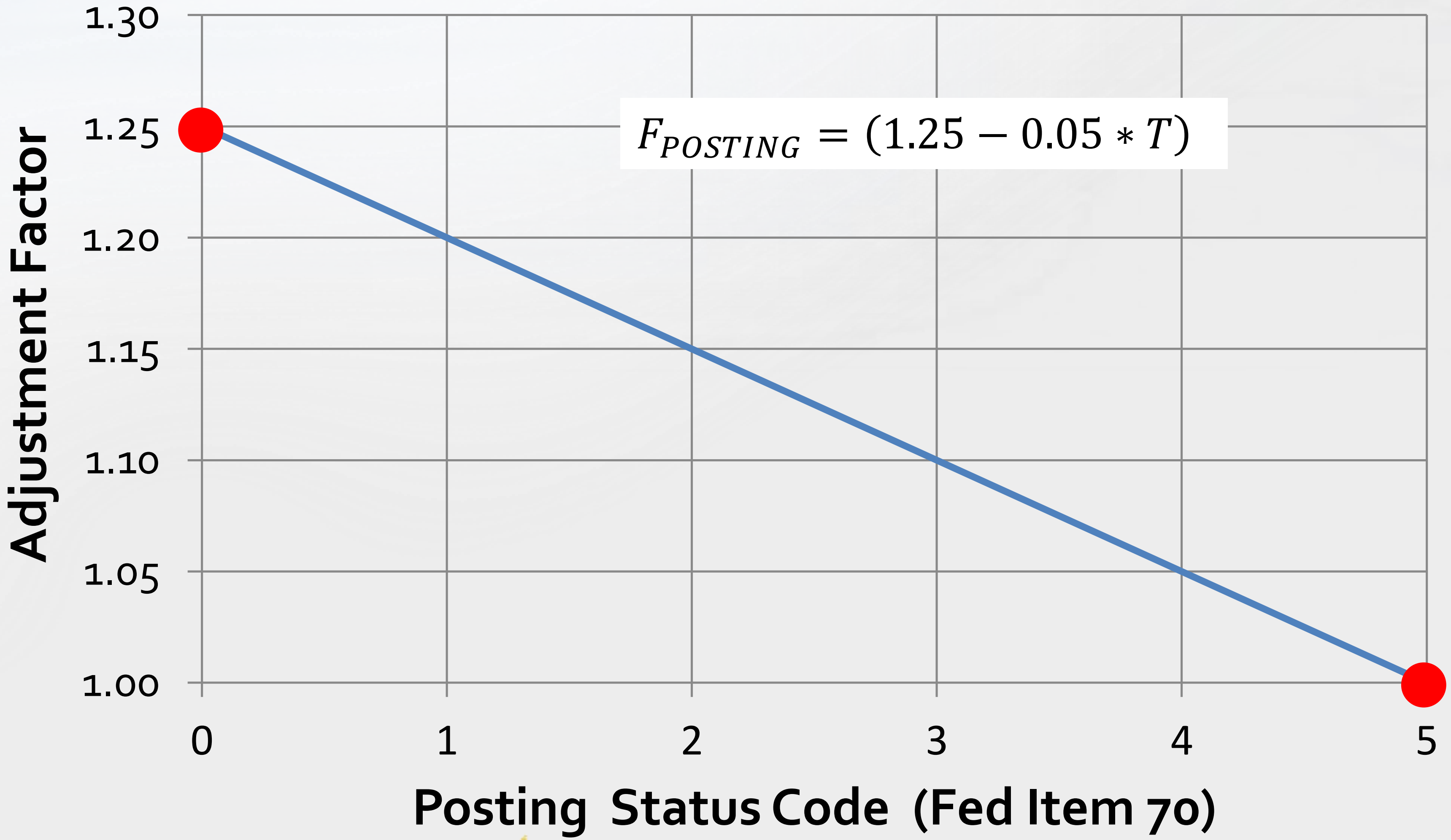
Adjustment Factor for ADT



Adjustment Factor for Size



Adjustment Factor for Weight Restriction



Item 70	Legal Loads
5	Not posted
4	< 10% under
3	20%
2	30%
1	40%
0	> 40% under

Roanoke Bridge Priority Index

$$Priority\ Index = 1 - \frac{Condition\ Ratio}{(F_{ADT} * F_{SIZE} * F_{POSTING})}$$

Shortlist

Str. No.	Name	Condition Ratio	Importance Factor	Priority Index
8055	Persinger Road over Murray Run	0.25	0.88	0.71
1822	Main Street over Roanoke River	0.34	1.16	0.70
1825	13th Street over NS Railway	0.34	1.08	0.68
8023	Cove Road over Peters Creek	0.29	0.91	0.68
8061	Hollins Road over Lick Run	0.36	1.07	0.66
0006	10th Street, NW over Trout Run	0.34	0.98	0.65
8014	Berkley Road over Glade Creek	0.52	1.37	0.62

Roanoke Bridge Priorities

- Data-driven Priority Index
- Shortlist of candidate projects
  - 0.60 PI threshold
  - Tabletop review
- Alternatives for each candidate
  - Judgement
- Recommendations
  - Replacement
  - Rehabilitation
  - Maintenance & Repair
- State of the Structure Report

City of Roanoke
Bridge Project Profile

ROANOKE

Structure Name	Route 221 (Main Street) over Roanoke River & NS Railway
State Str. Number	128-1822
Federal Str. ID	21732
Structure Type	Steel Two-Girder with Floorbeams
Year Built	1938
Total Length	880 ft
Total Width	54 ft out-out (40 ft curb-curb)
Weight Restriction	No
Avg Daily Traffic	9,500 (2009)

Community Importance

Structure 1822 carries Main Street over Roanoke River and Norfolk Southern Railway, and serves as a vital corridor connection between downtown and the southwestern part of the city. This route is utilized by school buses and emergency responders.

Bridge History and Condition

This structure was originally constructed in 1938 and has served the City for almost 75 years. A concrete overlay was constructed on the deck in 1987. A project in 1995 included bearing seat repair, deck repair, cantilever sidewalk support repair and shear joint repairs. Deck expansion joints were reconstructed and sidewalks on both sides of the bridge were replaced in stages from 2005 to 2007. The structure currently exhibits corrosion and section loss in structure steel members, deterioration of the concrete piers, failure of expansion bearings and joints, and deterioration of the concrete deck riding surface. The existing structure is fracture critical, and includes fatigue prone details.

Rehabilitation Alternatives

	Description	Advantage	Estimated Project. Cost
#1	Replacement of the existing superstructure and rehabilitation the existing substructure	• Less initial cost • Shorter construction duration • Less traffic impacts • Less railroad impacts	$9,000,000
#2	Complete Structure Replacement	• Greater service life • Less total life cycle cost • Reduced future substructure maintenance • Bridge widening possible • Improved pedestrian and bicycle access	$15,000,000

Preliminary Recommendation

The recommended project scope includes complete replacement of the existing bridge with a new structure (Alternative #2). This alternative provides the most effective rehabilitation and the lowest life-cycle cost. The new alignment will be very similar to the existing alignment. The new structure will incorporate features to minimize future maintenance and maximize the service life, such as jointless construction, corrosion resistant metals, and low permeability concrete. All work is anticipated to be on the existing right-of-way. Due to the two-girder existing structure type, the road will likely be closed during construction. The recommended funding allocation is $15,000,000.

Conclusions

- Implemented in 2011
- Data-driven planning
- Customized to local values
- Simple and easy to update
- Judgement still important
- Communication tool
  - City management
  - Data driven, systematic approach
  - Secure funding
- Proven success

QUESTIONS

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