VDOT'S BRIDGE PRESERVATION PROGRAM

Virginia Concrete Conference, 2012

RICHMOND, VA

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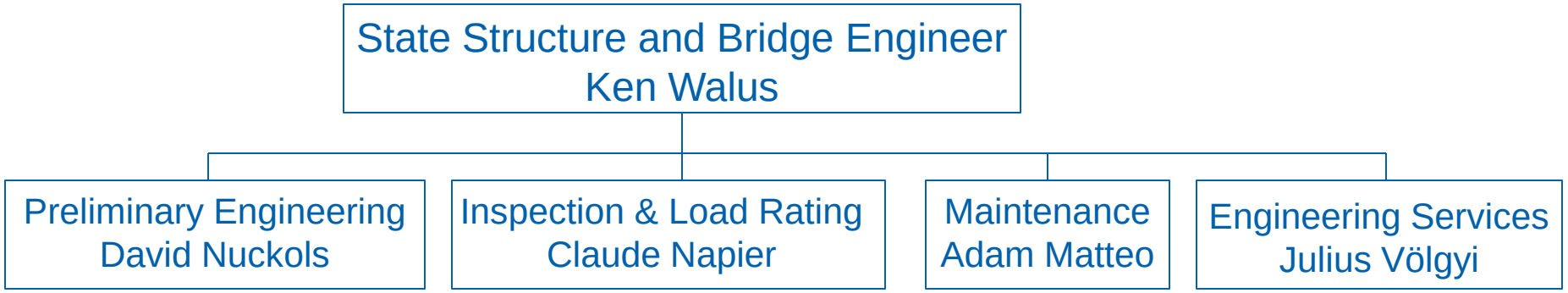
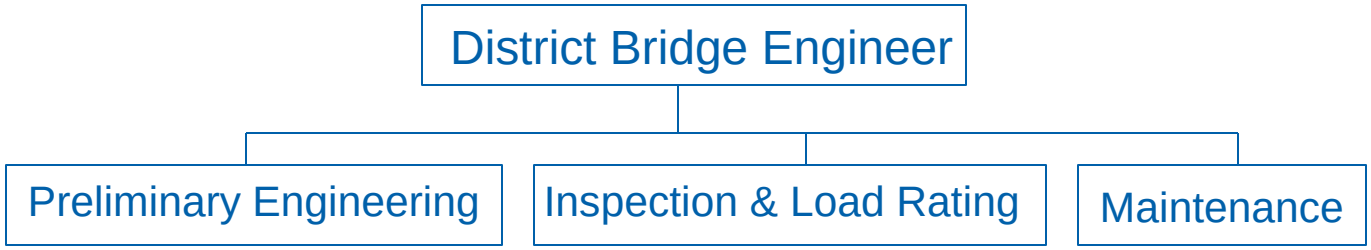
VDOT Structure and Bridge Division

The Structure and Bridge Division has the same organizational structure in the Central Office and the Districts

Central Office



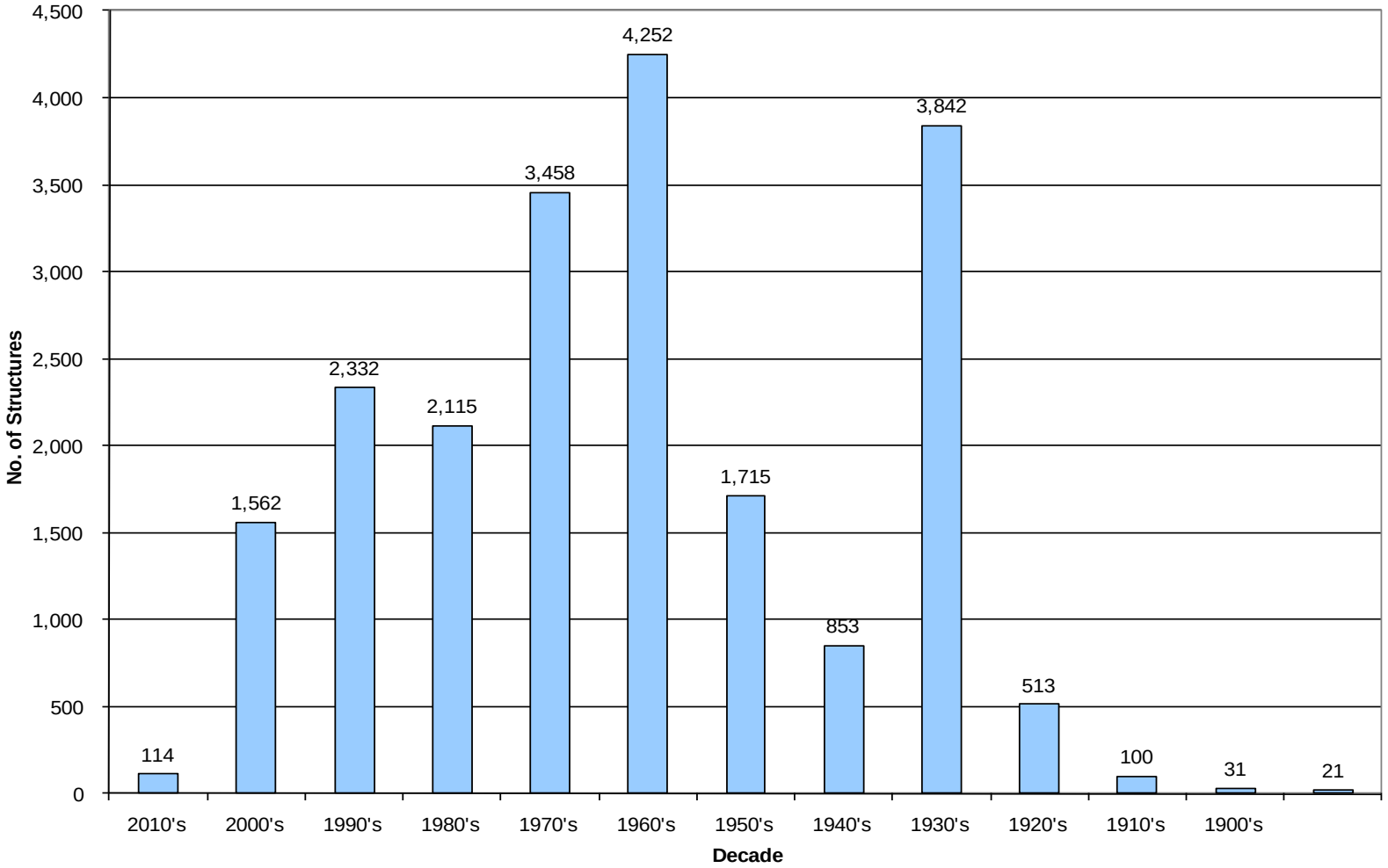
9 District Offices



The Challenge

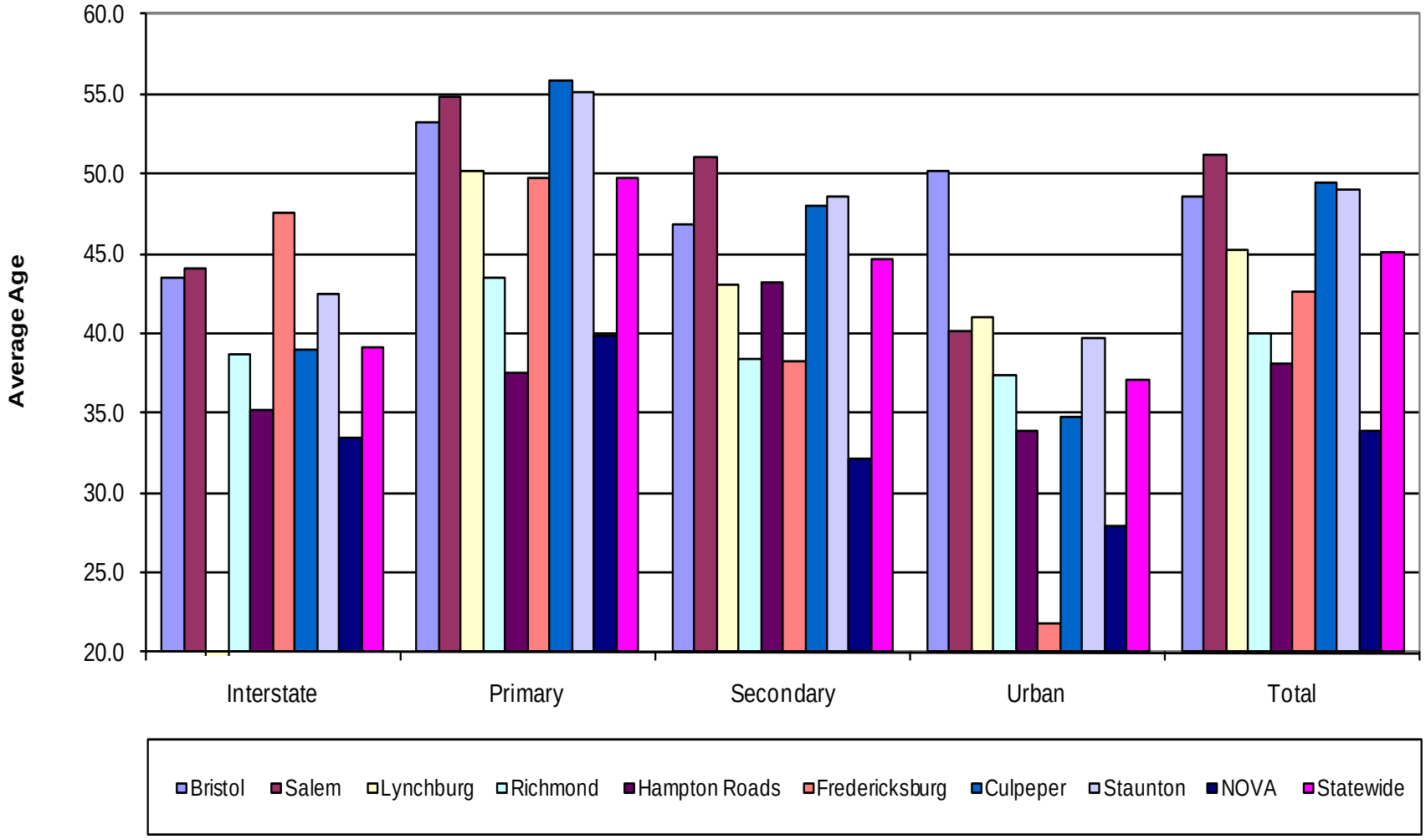
There isn't enough money to meet all the needs of Virginia's aging Bridges and Culverts

- $1.7 Billion total maintenance need statewide
- Replacement value of the inventory is $52.4 Billion
- Approximately 60% of Virginia's inventory is 40 years old or older
- Structures built prior to 2007 were designed for 50 year life
- Replacement value of all structures 40 years or older is $18.7 Billion
- Structures designed for 50 years may need to be to kept functional for 100 years or more, perhaps even as long as 150 years
- 4719 structures with a minimum General Condition Rating of 5 (almost ¼ of the entire inventory)
- Approximately 21,000 structures in the inventory, 19,390 of which are VDOT-maintained (by comparison, Florida has 6,644 structures)
- 1,537 structures with a min. General Condition Rating of 4 or less
- Maintenance budgets are about 2/3 needs



*** County Bridges added to the VDOT Inventory during this period with unknown construction dates (Assumed year built equaled year added to system)**

Structures Built – by Decade



Average Age of Structures – by Highway System

General Condition Ratings

DEFINITIONS

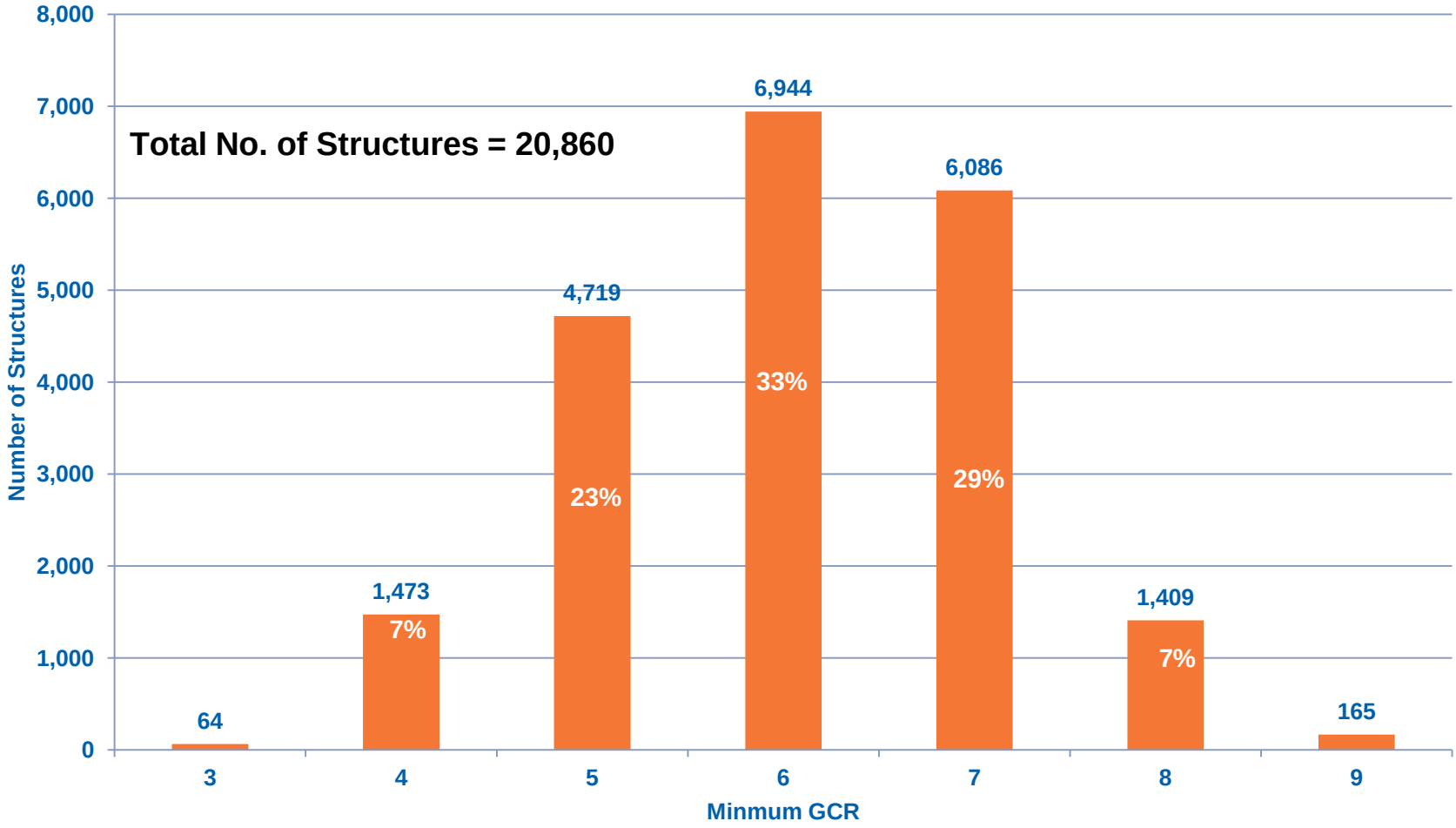
9 EXCELLENT CONDITION
8 VERY GOOD CONDITION
7 GOOD CONDITION
6 SATISFACTORY CONDITION
5 FAIR CONDITION
4 POOR CONDITION
3 SERIOUS CONDITION
2 CRITICAL CONDITION
1 "IMMINENT" FAILURE CONDITION
0 FAILED CONDITION

GENERAL CONDITION RATINGS ARE PROVIDED AT EACH INSPECTION FOR:

- **DECK**
- **SUPERSTRUCTURE**
- **SUBSTRUCTURE**
- **CULVERT**

The General Condition Rating is an imperfect index, but it can provide good broad-based information about an inventory.

Number of Structures by Minmum GCR



Approximately 200 structures per year go from “5” to “4” and become Structurally Deficient

The Solution

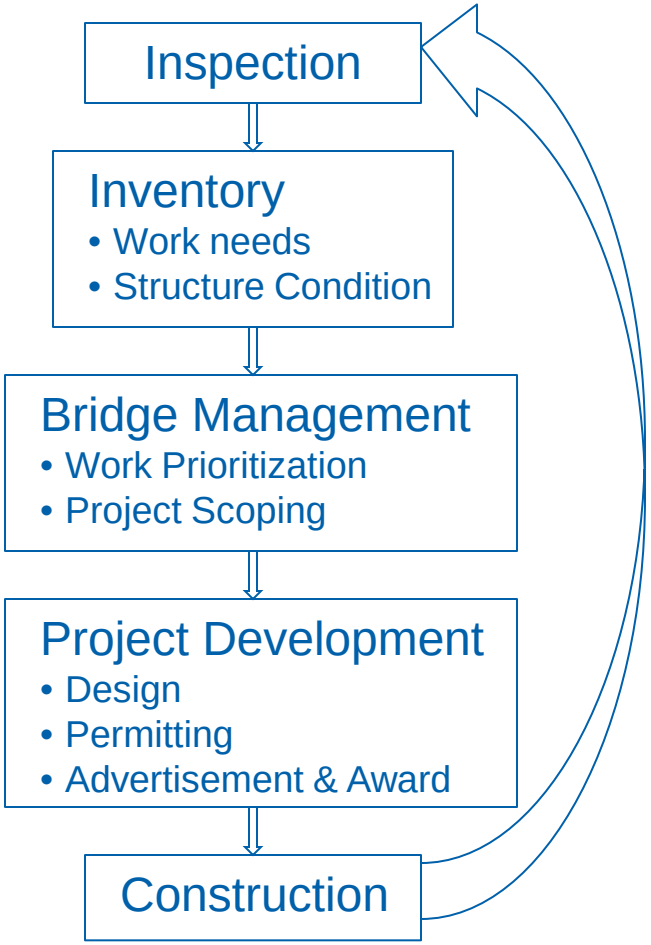
Whine until we get more money?

Attacking the Problem

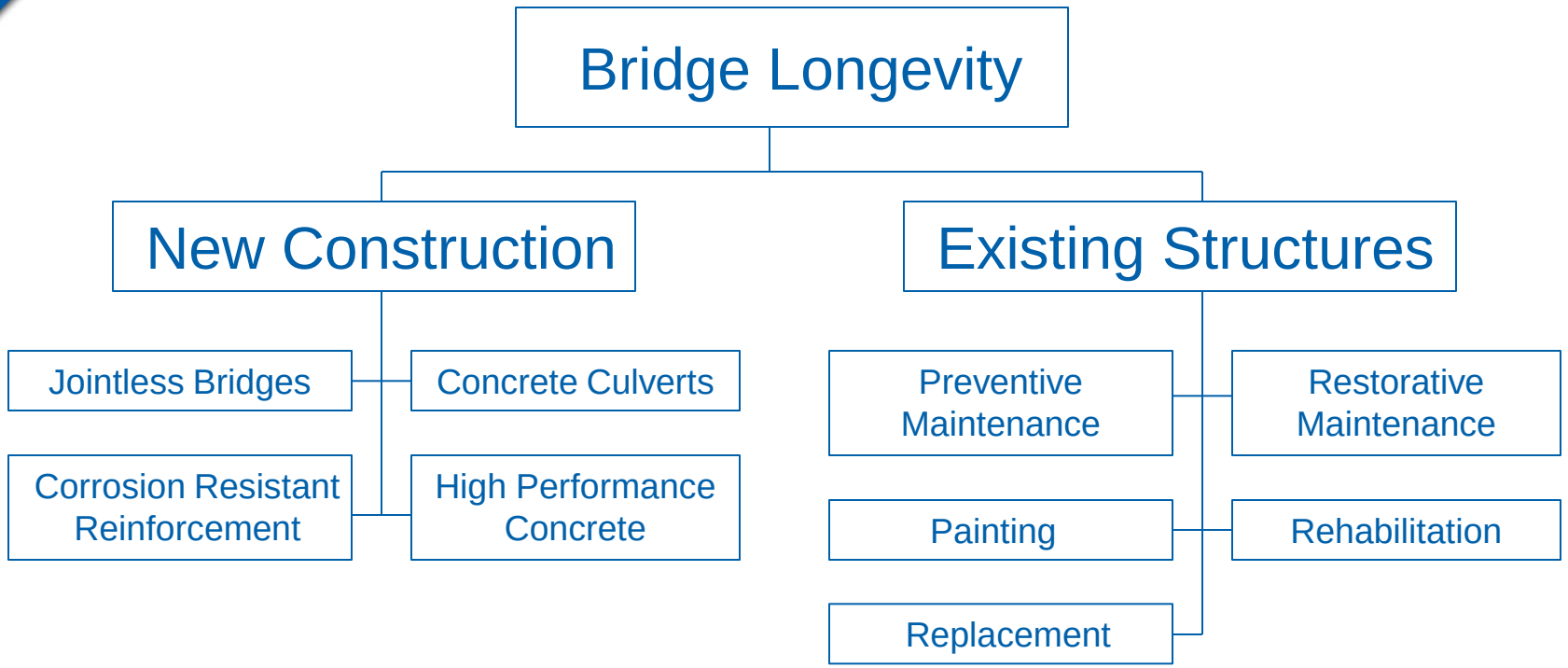
Spend Resources as wisely as possible to extend the life of the inventory

- Replace joints in a timely manner
- Spend money on the most cost-effective actions
  - Make data-driven decisions when selecting interventions
  - Constantly evaluate new materials and methods
- Don’t pursue a “worst first” approach
  - Emphasize preventive maintenance
  - Balance spending
- Perform high quality work
- Utilize state bridge crews
- Address highway systems with largest impact to commerce and the public

Bridge Maintenance Requires Bridge Management



VDOT uses Pontis for structure inventory and modeling of needs


Bridge Longevity
New Construction
Existing Structures
Jointless Bridges
Concrete Culverts
Corrosion Resistant Reinforcement
High Performance Concrete
Preventive Maintenance
Restorative Maintenance
Painting
Rehabilitation
Replacement

Maintenance Activities

Examples of Preventive Maintenance

- Bridge Cleaning (washing and/or sweeping)
- Deck Sealing
- Sealing Joints
- Thin Deck Overlays
- Removing Large Debris in Channels
- Cleaning Culverts
- Spot and Zone Painting

VDOT has a system preservation agreement with FHWA to fund these activities

Preventive maintenance has been shown to be the most cost-effective of all bridge maintenance activities for sustaining the lives of structures

Maintenance Activities

Examples of Restorative Maintenance

- Painting (Overcoating or Re-Coating)
- Rigid Deck Overlays
- Reconstructing/Closing Joints
- Superstructure Repairs (Type B patching, etc.)
- Substructure Repairs (including shotcrete, bearings, other elements)
- Joint removal
- Fatigue Retrofitting
- Scour Repairs
- Cathodic Protection
- Electrochemical Chloride Extraction
- Replace timber decks

Much of this work is “reactive” in nature but needs to be performed to sustain our inventory

Maintenance Activities

Rehabilitation

- Generally work of a major nature
- Deck replacement
- Superstructure replacement
- Culvert lining

Replacement

- Part of the maintenance cycle
- Includes replacement of foundations
- Often coincides with a need for widening or geometric improvement
- Many projects are funded through the Dedicated Bridge Fund

Codifying “Best Practices”

Chapter 32 has recently been adopted – available online

- Acts as a primer for those not familiar with bridge maintenance
- Provides strict rules where appropriate
- Provides guidelines where appropriate
- Explains and provides guidance on funding
- Provides guidance on decision processes
- Provides a schedule for preventive maintenance activities
- Is based on both practical experience and studies
- Future revisions will include additional elements such as:
  - Standard details
  - Contract templates for maintenance work
  - Standard Special Provisions
  - Design Aids
  - Additional culvert and timber bridge guidance

What Constitutes “Best Practices”

Fundamental Principals

- Keep the roof dry and clean
  - Replace or eliminate joints
  - Timely installation of overlays
  - Timely spot or zone painting
  - Maintain drains in a functional condition
  - Sweep and wash bridges
- Perform repairs in a timely manner
- Evaluate new technologies and implement the good ones
  - Sponsor studies
  - Utilize research performed by others
  - Try new materials and methods
- Utilize appropriate materials
  - Avoid asphalt overlays
  - Use approved patching materials

Fundamental Principals, continued:

- Utilize proven technologies
- Perform quality work
  - Treat maintenance work the same as new construction
  - Test and monitor material installation, particularly for concrete
  - Provide adequate inspection
  - Utilize controls where possible
- Distribute resources appropriately. Chapter 32 suggests:
  - Preventive Maintenance – 15% (Program 604)
  - Painting – 10% (Program 604)
  - Restorative Maintenance – 25% (Program 604)
  - Rehabilitation/Small Structure Replacement – 50% (Program 604)
- Maximize available resources
  - Utilize available funding (state and federal)
  - Plan and perform work for best efficiency (multiple structure contracts)

The Importance of Preventive Maintenance - Joints

The Importance of Preventive Maintenance - Joints

The Importance of Preventive Maintenance - Decks

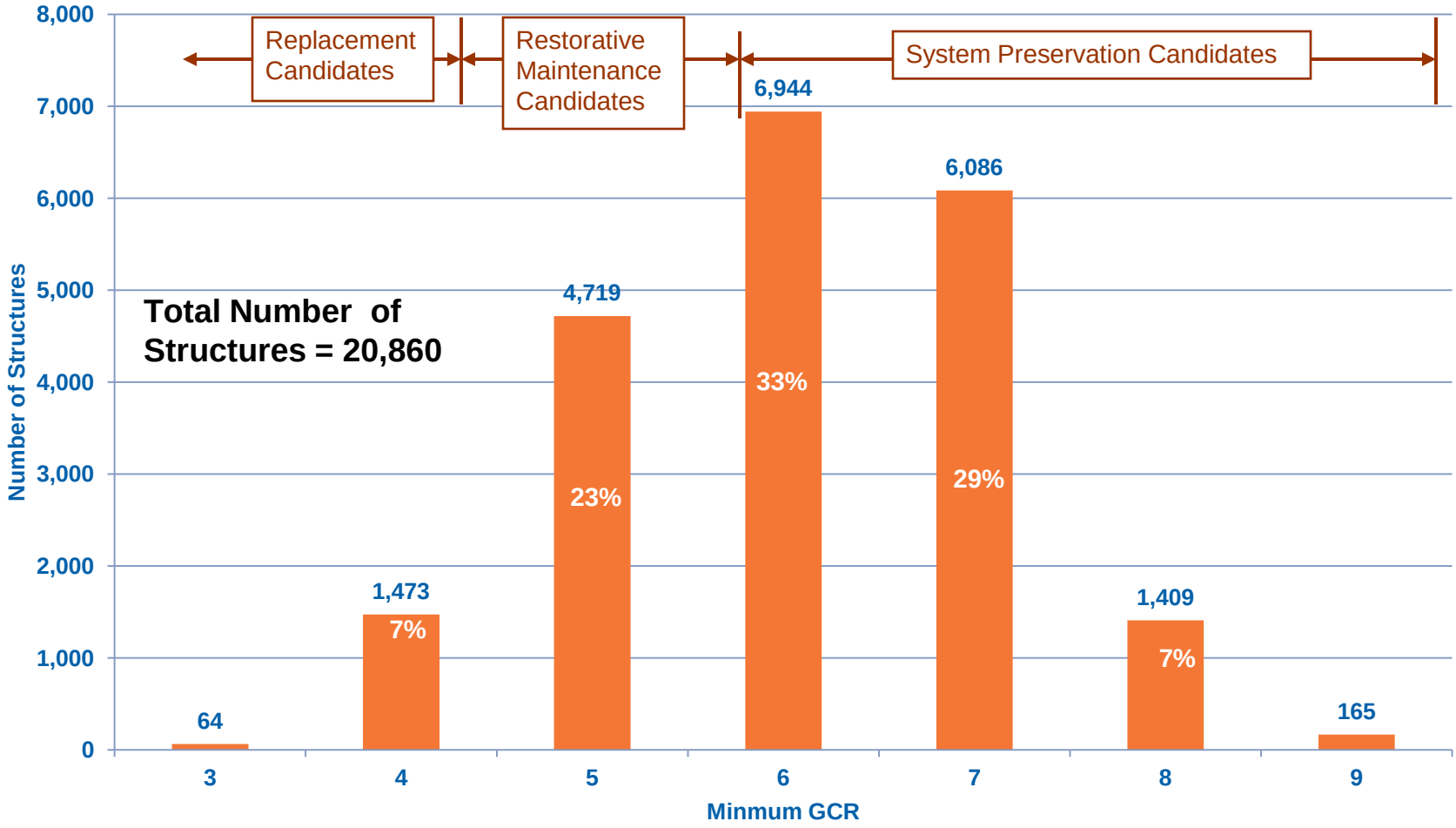
Preventive Maintenance

- Highest cost benefit ratio of the maintenance categories
- Most of the problems with bridge deterioration can be significantly reduced or avoided altogether with planned preventive maintenance
- FHWA agreement allows these activities to be billed as system preservation

Preventive Maintenance Proposed Activity Cycle

	Activity	Preferred Cycle (years)	Federally Eligible?
1	Bridge Deck Washing	1	Yes
2	Bridge Deck Sweeping	1	Yes
3	Seats & Beam End Washing	2	Yes
4	Cutting & Removing Vegetation	2	No
5	Routine Maintenance of Timber Structures	2	No
6	Scheduled Replacement of Compression Seal Joints	10	Yes
7	Scheduled Replacement of Pourable Joints	6	Yes
8	Cleaning & Lubricating Bearing Devices	4	No
9	Scheduled Installation of Thin Epoxy Overlay	15	Yes
10	Beam Ends Painting	10	Yes
11	Removing Debris from Culverts	5	Yes

Number of Structures by Minmum GCR



Approximately 200 structures per year go from “5” to “4” and become Structurally Deficient

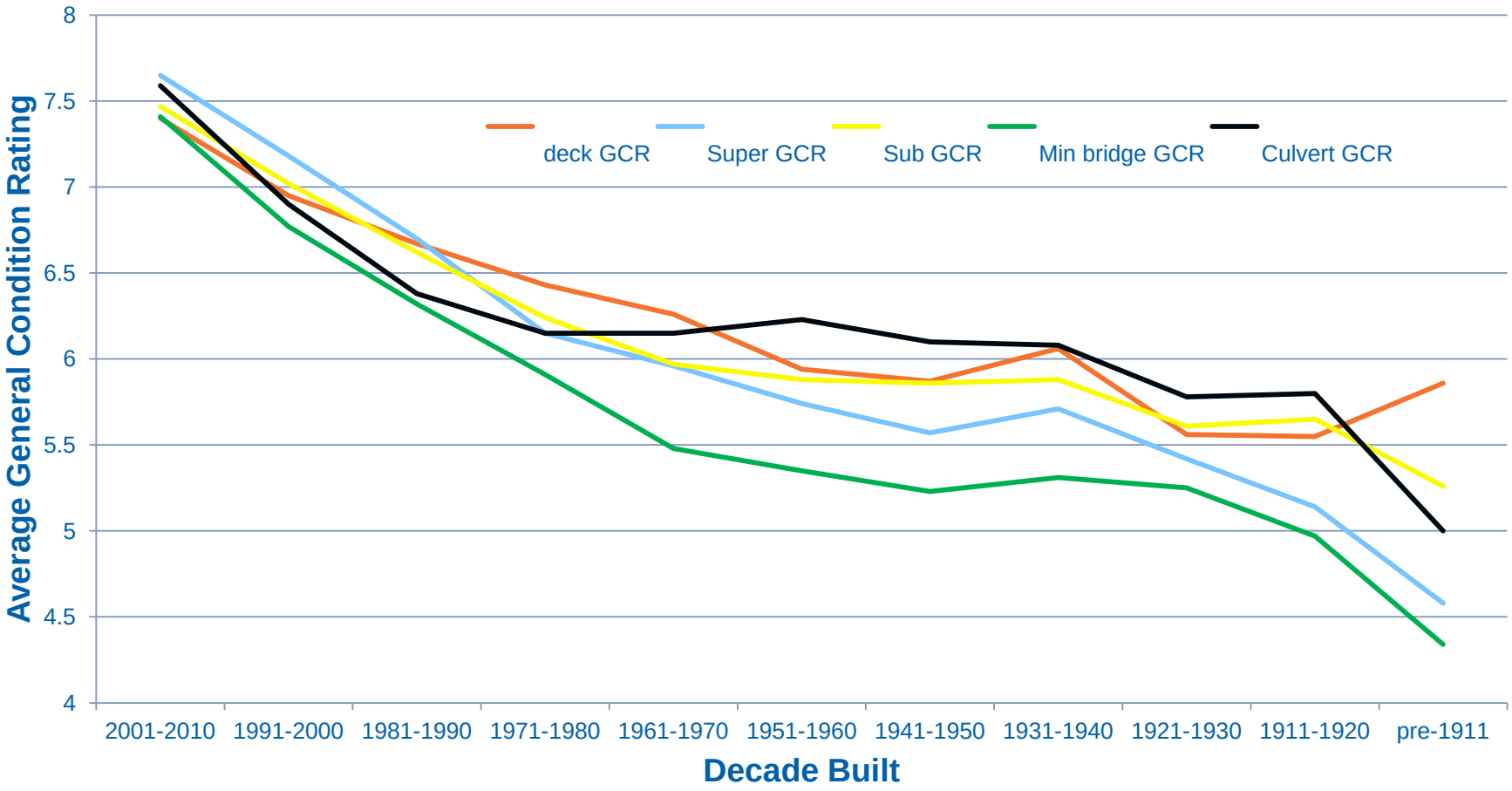
Using Data to Make Better Decisions

There are Several Active Studies with the Research Council

- **Coating Study**
  - Process review of how we recoat structures
  - Review enclosure/encapsulation requirements
  - New technologies for removing
  - Other coating systems and application methods available in the market
  - Meeting with the transportation industry and surveying other industries
- **Waterproofing membrane (monitoring effort)**
- **Low permeability asphalt such as Rosphalt**
- **Asphalt Plug Joints**
- **Deterioration rates of structures (data mining)**
  - Looks at past performance of structures and the longevity of interventions
  - Developing cost/benefit ratios
  - Will help guide decision-making for maintenance activities

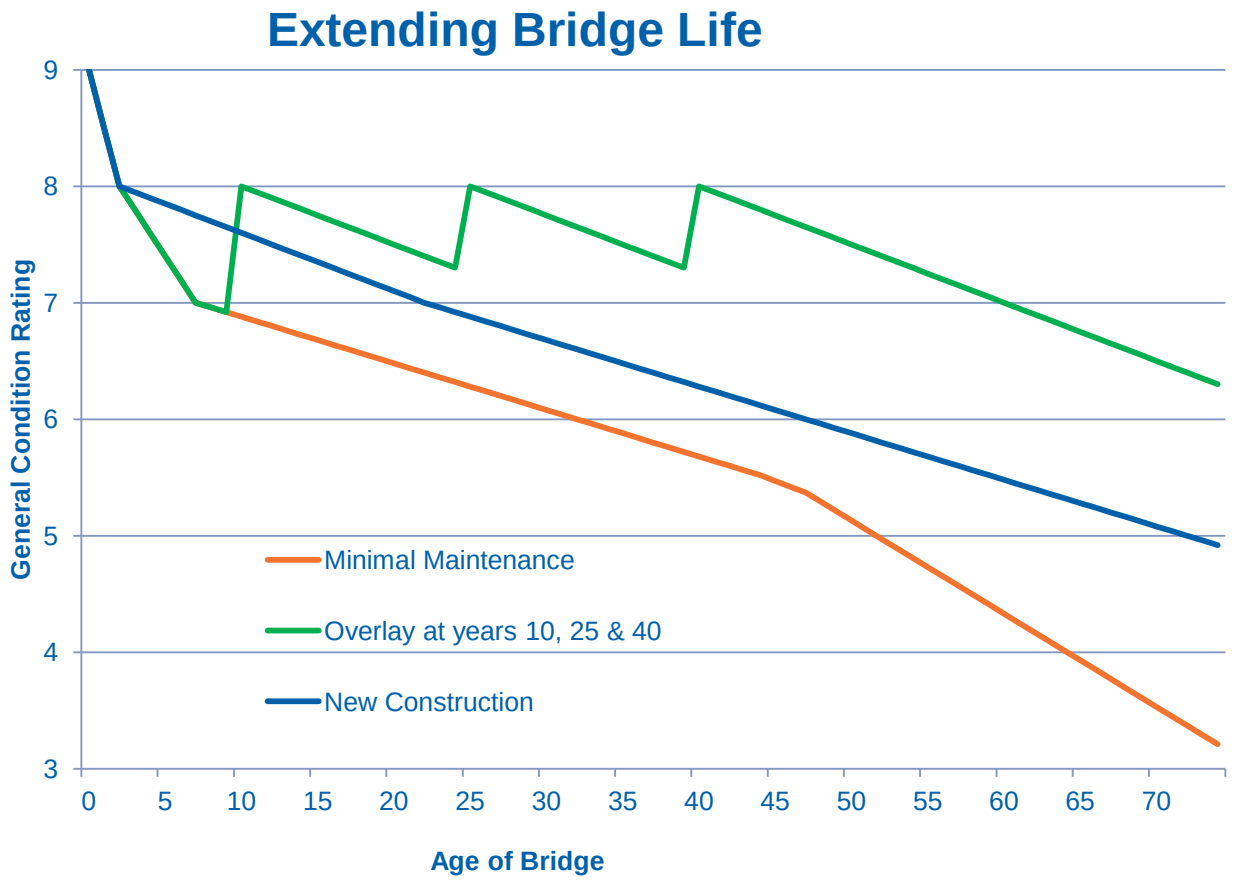
VDOT also participates in other studies such as the Long Term Bridge Performance Study being sponsored by FHWA

Average General Condition Ratings of Virginia's Structures

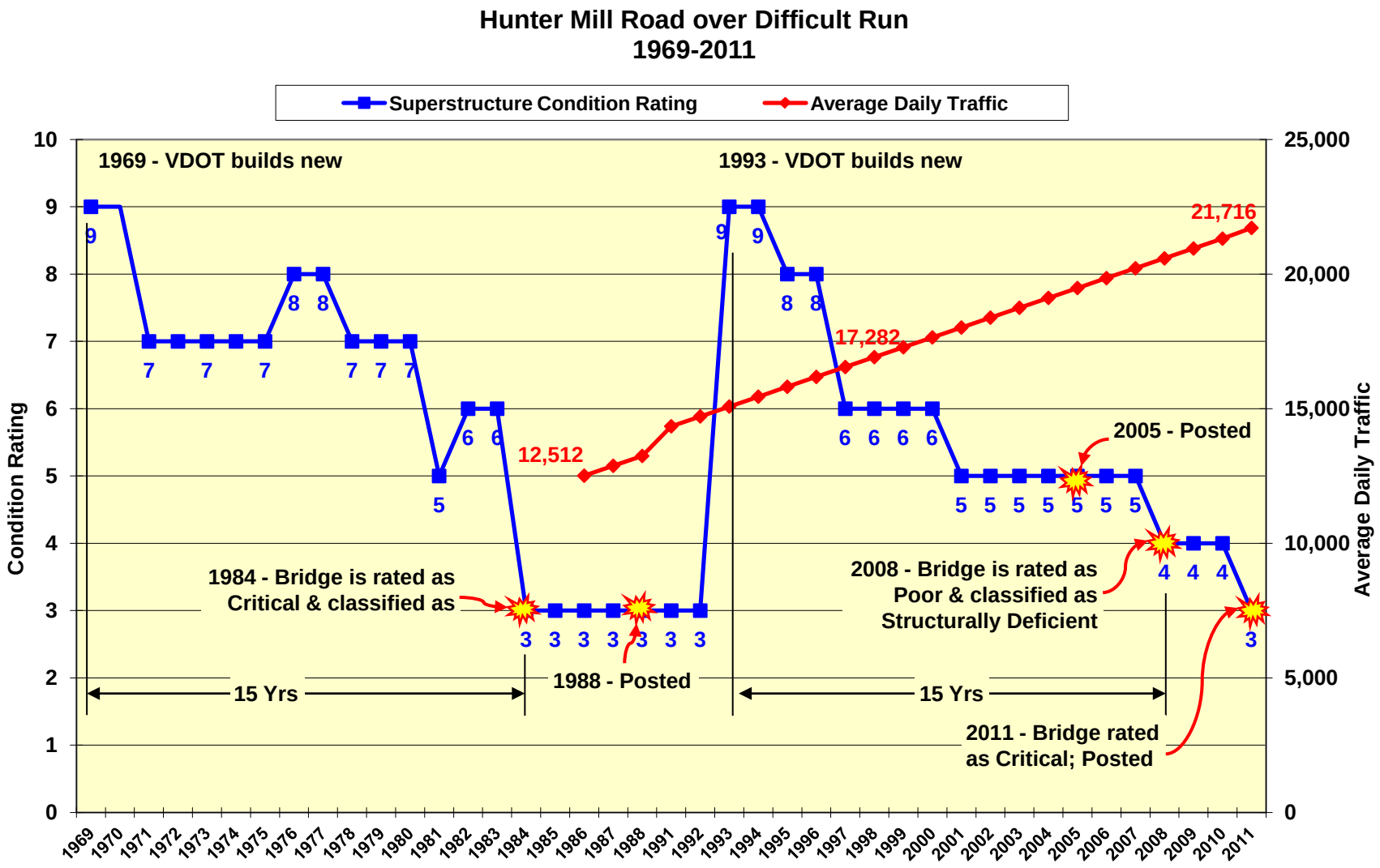


Using Data to Make Better Decisions

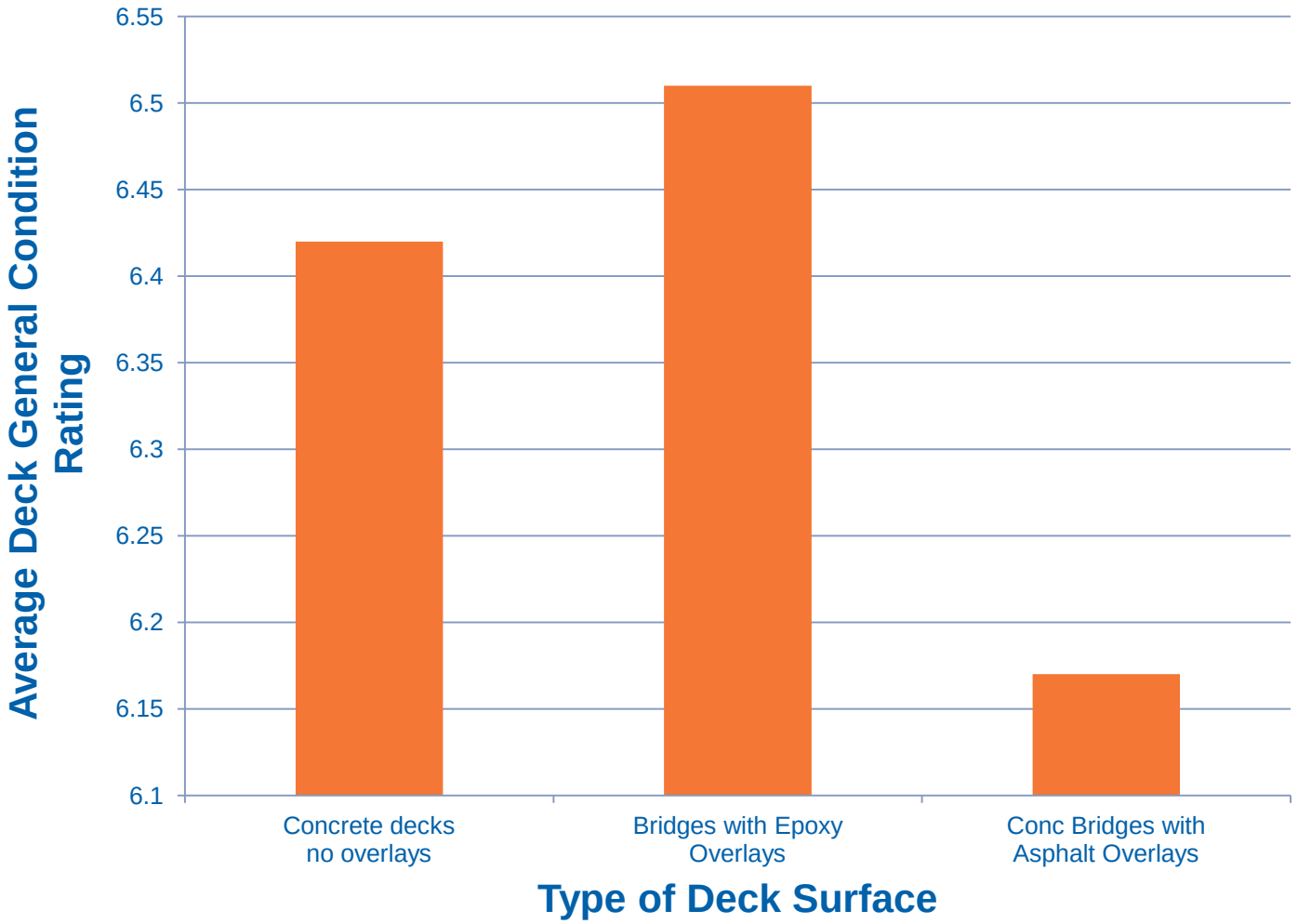
Theoretical Deterioration



Evaluating Interventions

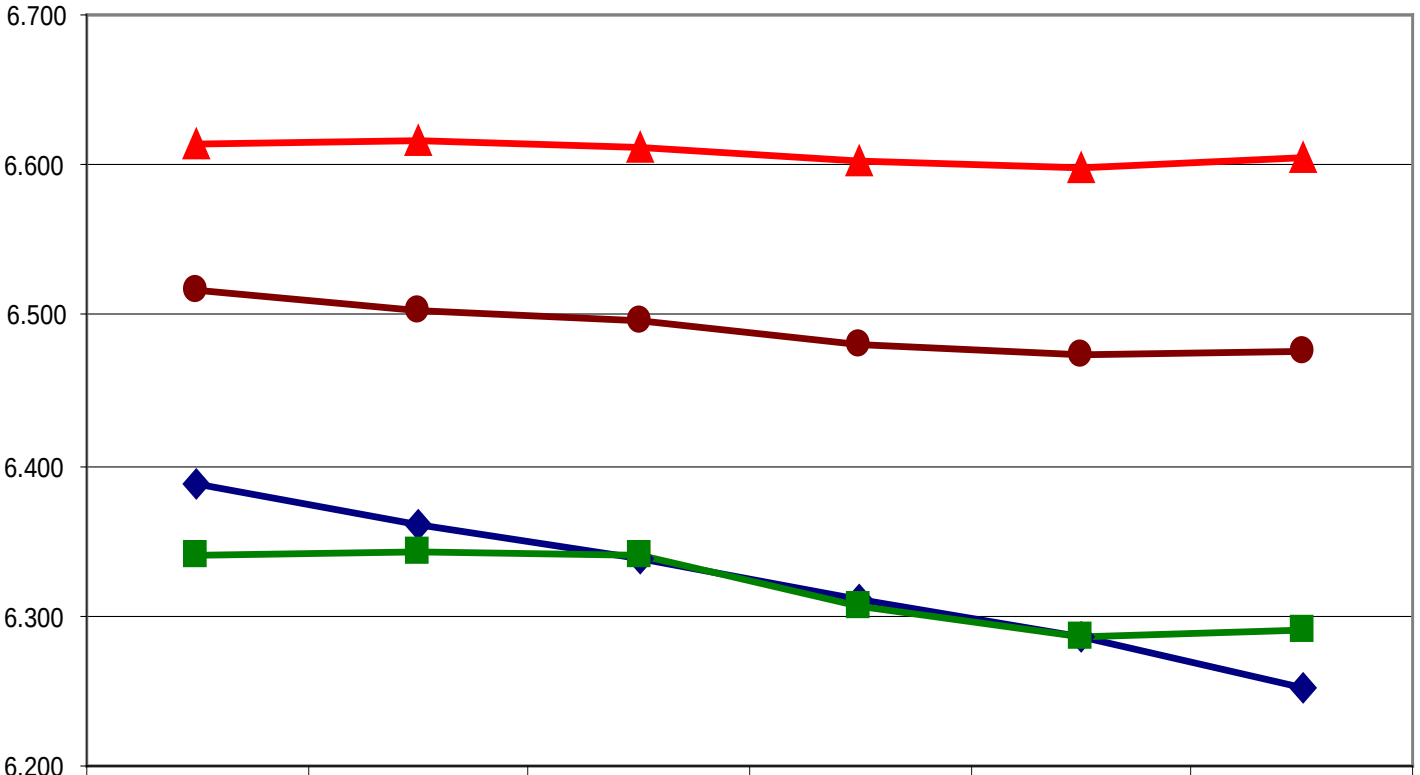


Evaluating Interventions – Epoxy Overlays



Effect of Overlays on Deck General Condition Rating

6 year GCR Trends (2006 through 2011)

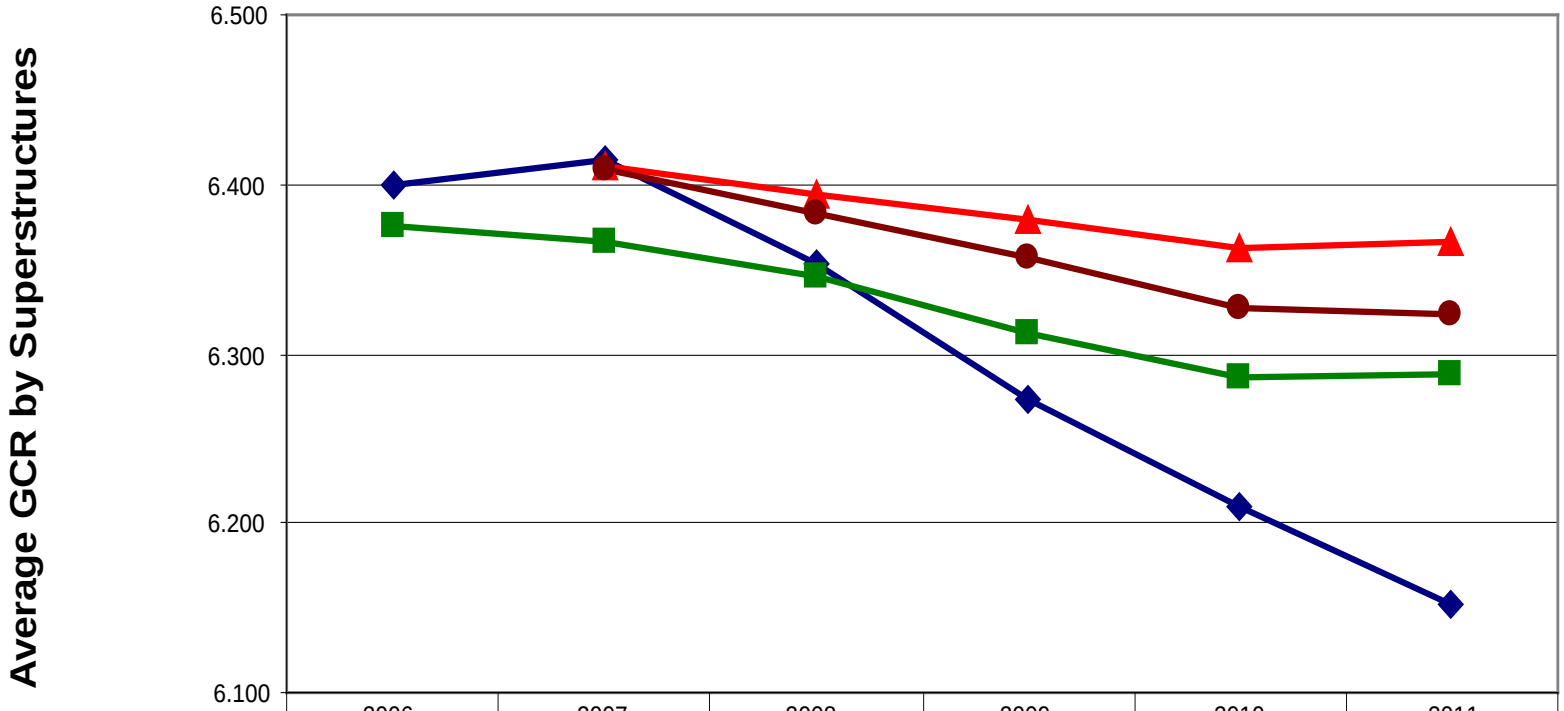


Average GCR of Bridge Decks

	2006	2007	2008	2009	2010	2011
Interstate	6.387	6.361	6.338	6.310	6.285	6.253
Primary	6.339	6.342	6.340	6.307	6.286	6.291
Secondary	6.614	6.617	6.613	6.603	6.598	6.606
Average	6.516	6.504	6.497	6.481	6.474	6.477

Deck General Condition Rating

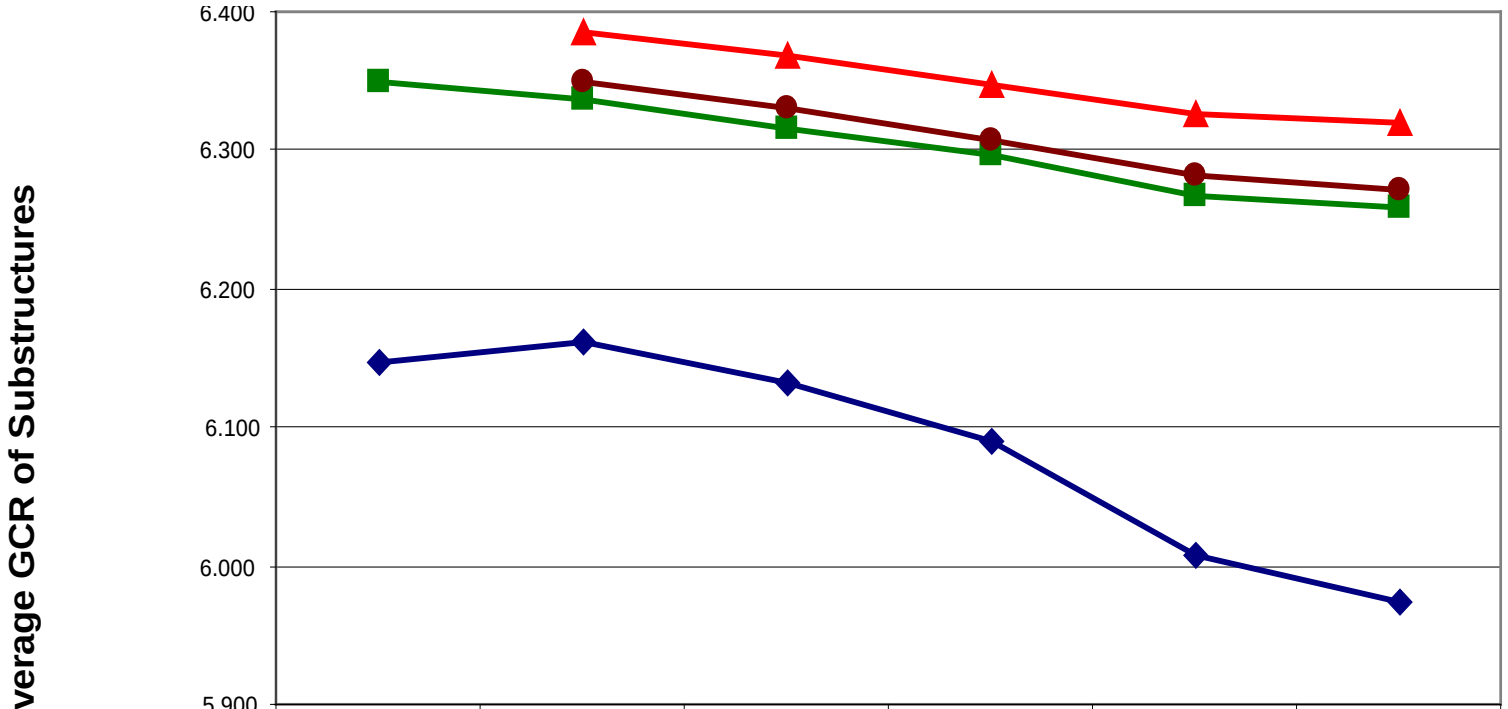
6 year GCR Trends (2006 through 2011)



	2006	2007	2008	2009	2010	2011
Interstate	6.400	6.415	6.352	6.273	6.210	6.152
Primary	6.375	6.367	6.346	6.313	6.287	6.288
Secondary		6.411	6.394	6.379	6.362	6.366
Average		6.408	6.383	6.357	6.328	6.324

Superstructure General Condition Rating

6 year GCR Trends (2006 through 2011)

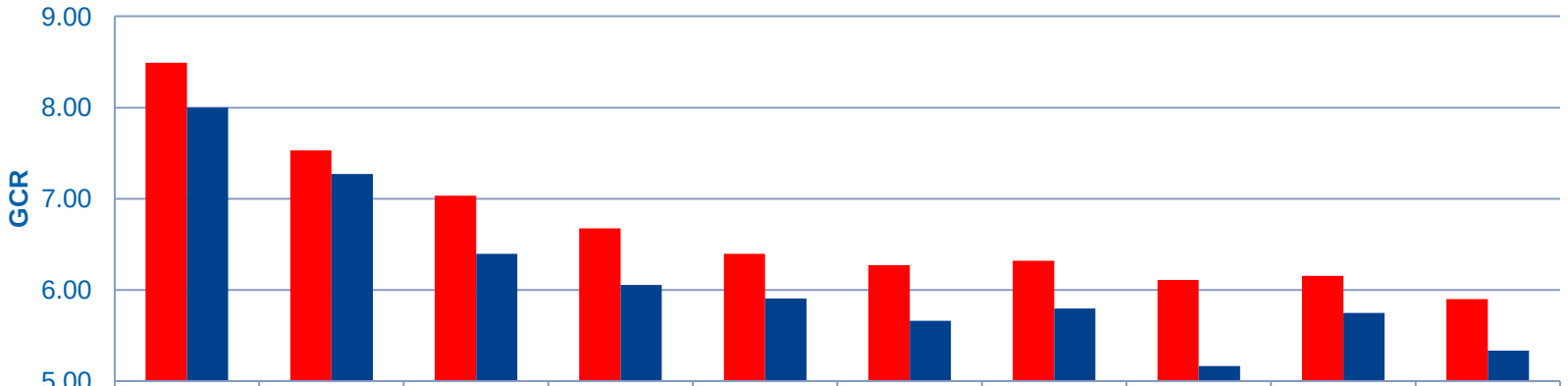


	2006	2007	2008	2009	2010	2011
Interstate	6.147	6.162	6.132	6.091	6.008	5.974
Primary	6.349	6.338	6.317	6.296	6.268	6.258
Secondary		6.386	6.369	6.347	6.326	6.319
Average		6.350	6.330	6.307	6.283	6.271

Superstructure General Condition Rating

Evaluating the Performance of Culverts

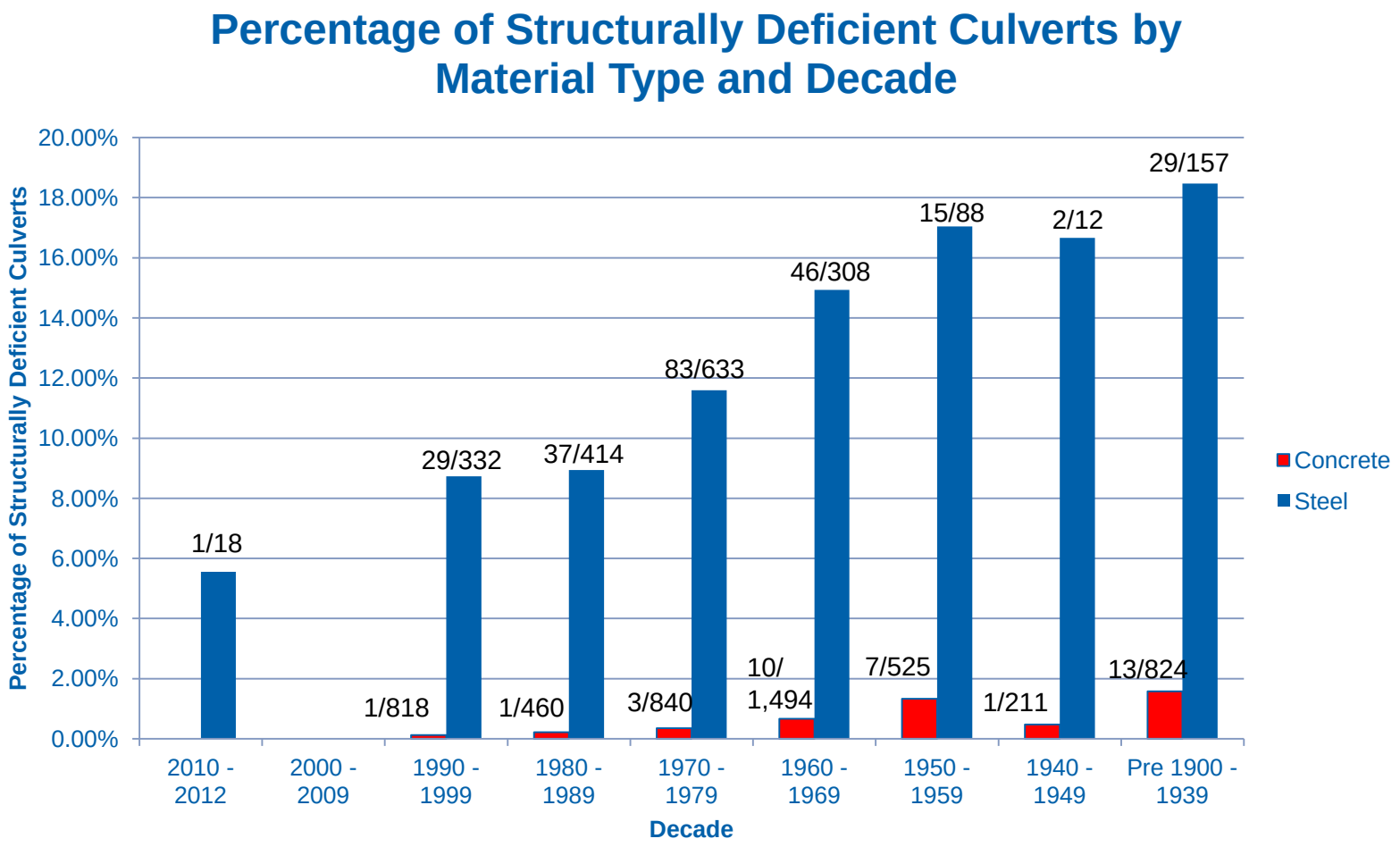
Average Culvert GCR by Decade and Material



	2010 - 2012	2000 - 2009	1990 - 1999	1980 - 1989	1970 - 1979	1960 - 1969	1950 - 1959	1940 - 1949	1930 - 1939	Pre 1900 - 1929
Concrete	8.49	7.53	7.03	6.68	6.40	6.27	6.32	6.11	6.15	5.90
Steel	8.00	7.27	6.39	6.06	5.91	5.66	5.80	5.17	5.75	5.33

Culverts have outperformed bridges and concrete culverts have outperformed steel culverts

Evaluating the Performance of Culverts



Culverts have outperformed bridges and concrete culverts have outperformed steel culverts

Importance of Quality Control

Governmental procurement rules require many steps before any work can be done in the field

Inspection

Inventory
- Work needs
- Structure Condition

Bridge Management
- Work Prioritization
- Project Scoping

Project Development
- Design
- Permitting
- Right of Way
- Advertisement & Award

Construction
- Preconstruction Conf.
- Mobilization
- Traffic Control
- Joint Preparation

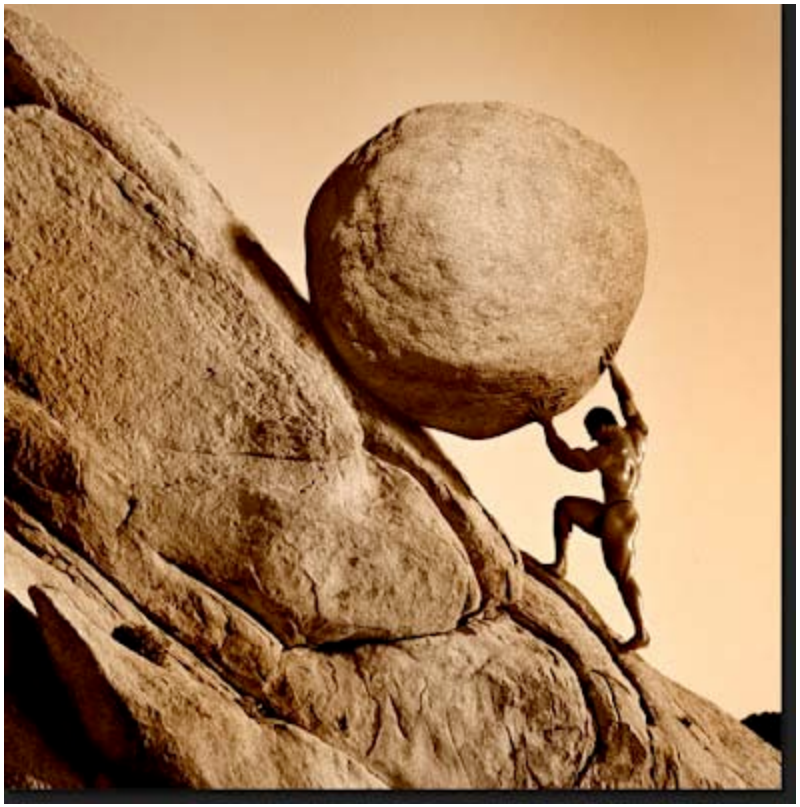
Installation

Importance of Quality Control

Installation

All previous efforts are wasted if the final step isn’t properly performed

Importance of Quality Control



Importance of Quality Control

Summary

- Replace joints in a timely manner
- Spend resources wisely
  - Emphasize preventive maintenance
  - Make data-driven decisions when selecting interventions
  - Constantly evaluate new materials and methods
  - Balance spending
- Perform high quality work