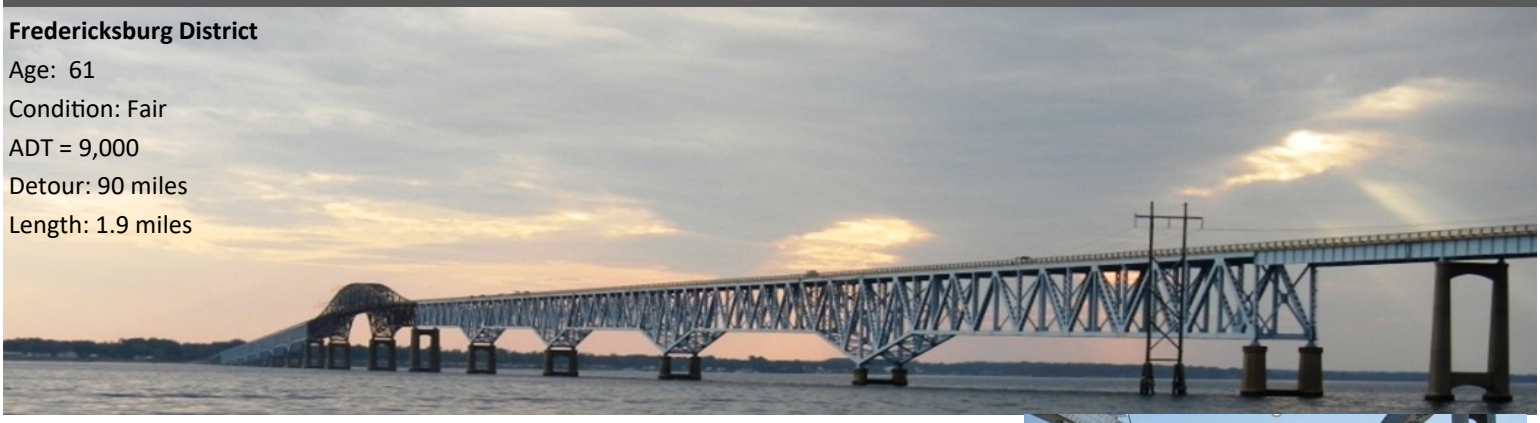
Norris Bridge: Route 3 over Rappahannock River (#16)



Fredericksburg District
Age: 61
Condition: Fair
ADT = 9,000
Detour: 90 miles
Length: 1.9 miles

Norris Bridge: General Information

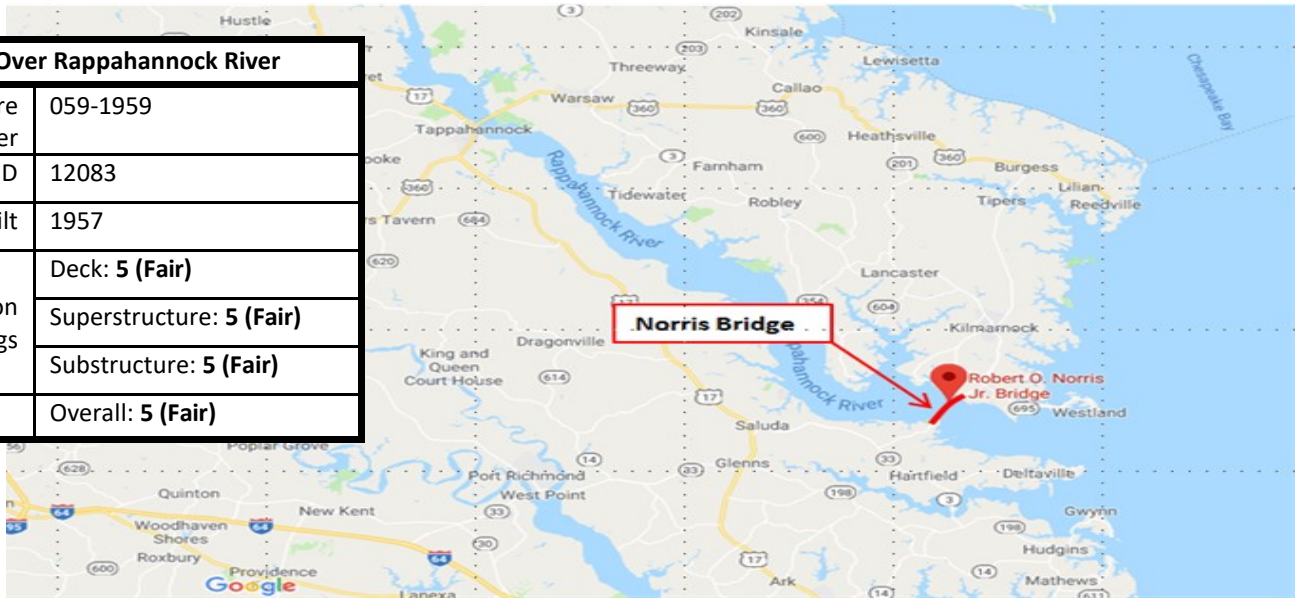
The Robert O. Norris Bridge (Norris Bridge) carries Route 3 over the mouth of the Rappahannock River. The bridge is fracture critical, which means that failure of a primary structural member could lead to a collapse of the structure. The structure also includes a large number of "pin and hanger" assemblies. These assemblies provide no redundancy (alternate paths for loads) in the event of failure. Structural repairs to steel beams and other support members are required for the safe operation and functionality of the bridge.

Inventory and Condition Information

A brief summary with condition and inventory information is provided below:

- The bridge is 61 years old and has exceeded its 50 year anticipated service life
- The bridge has been in "Fair" condition for 21 years. Prior to that it had been in "Poor" (structurally deficient) condition due the deck condition. The deck repairs removed the structurally deficient status.
- The bridge is fracture critical, so failure of a primary structural member could lead to a collapse of the structure
- The saltwater environment is highly aggressive, so the bridge deteriorates rapidly
- At 1.9 miles, the bridge is extremely long and expensive to maintain and inspect
- The bridge has a 90 mile detour, which makes it critical for local residents
- The bridge lacks a fender system to protect its piers from vessel impact
- The bridge is narrow. Due to the 23' curb-to-curb width, traffic is impacted during any lane closure for maintenance or inspection or whenever a vehicle becomes disabled.

Rt. 3 Over Rappahannock River	
Structure Number	059-1959
Federal ID	12083
Year Built	1957
Condition Ratings	Deck: **5 (Fair)**
	Superstructure: **5 (Fair)**
	Substructure: **5 (Fair)**
	Overall: **5 (Fair)**



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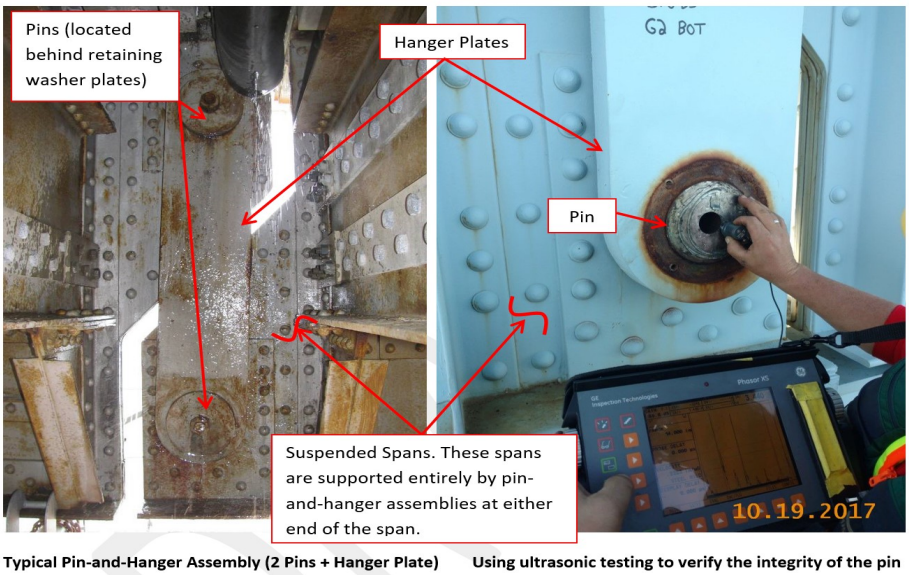
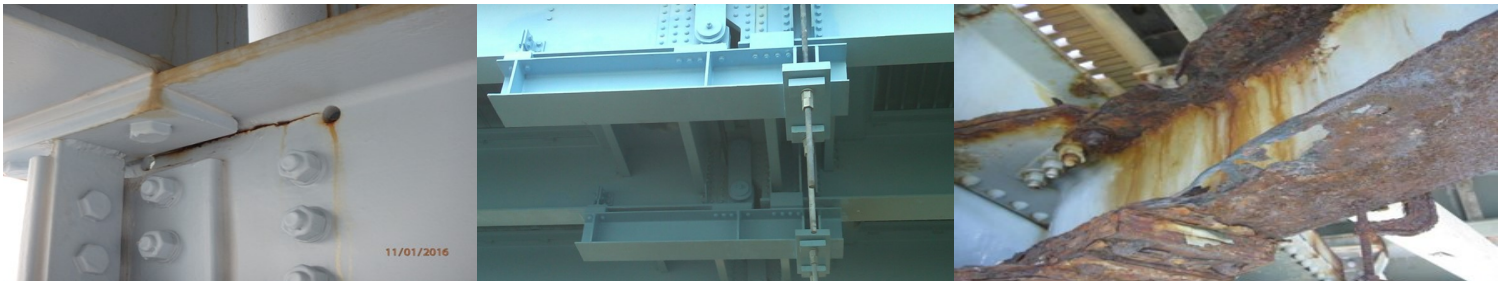
Large Complex Structures - Major Projects in 30-Year Plan				
Project Number	**Project Description**	**Start Year in 30-Year Plan**	**Cost (2018 Dollars)**	**Reason for Importance/Potential Consequences of Inaction**
1	Superstructure Rehabilitation	2	$26M	• The bridge is fracture critical, making repair and maintenance of the structure essential for safety
2	Replacement	18	$322M	• At 80, the bridge will have exceeded its service life
Norris Bridge 30-Year Plan Total in 2018 Dollars			**$348M**	

Project #1 – Superstructure Rehabilitation - Start Year 2 in 30-Year Plan

Structure and substructure rehabilitation are included in this project. Structure rehabilitation will be required for both the structural steel and concrete support elements. VDOT has been repairing the most critical portions of the structural steel framing members on a nearly continuous basis for the past several years. These repairs have included replacement of pins (pins are an integral part of a pin-and-hanger system - see explanatory photos), painting, and the installation of auxiliary support systems for critical pin-and-hanger assemblies. The auxiliary support systems provide redundancy for pin-and-hanger assemblies (in the event of pin or hanger failure, the auxiliary support systems will assume the load).



Typical Pin-and-Hanger Assembly (2 Pins + Hanger Plate) **Using ultrasonic testing to verify the integrity of the pin**



Cracked and Deteriorated Structural Steel. Despite nearly continuous repairs, an aggressive environment affects the steel

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Project # 1 cont. – Superstructure Rehabilitation - Start Year 2 in 30-Year Plan

The substructure (concrete piles and piers) is subjected to saltwater, which permeates the concrete and attacks the reinforcing steel, causing corrosion and deterioration. The damaged concrete in the piers will be removed and replaced where necessary. Piles requiring repair will be addressed with pile jackets.

Pile jackets are a protective and restorative treatment that improves the condition of the pile while slowing the rate of the deterioration. Jackets are placed over the piles in a region known as the "splash zone". This zone begins just below the waterline and extends several feet above the portion of the pile that is routinely exposed to water. The jackets are filled with concrete, adding strength and protecting the pile from further infiltration of water. The jackets also include systems that protect the native pile by slowing the corrosion rate of its reinforcing steel. Pile jackets have a limited service life but can be effective preservation treatments for bridges with permeable concrete substructures. The photographs below show pile jackets during and after installation.

While it would be ideal to be able to ignore the structure repairs in anticipation of the replacement project, this is not a viable alternative. The repairs are necessary, and, considering the bridge's fracture-critical status, essential, so continued maintenance repairs and preservation are warranted.

Project # 2 – Replacement - Start Year 18 in 30-Year Plan

By the 18th year of the program, the bridge will be 80 years old, 30 years beyond its original service life. The annual cost of maintaining the structure will have reached the point where replacement is the most cost-effective action from a life-cycle cost perspective.

The restricted width of the bridge creates significant disruptions to motorists and trucks whenever the bridge is being inspected or repaired. The replacement bridge can have wider lanes and shoulders and will be better able to handle traffic during maintenance and inspection activities. The replacement bridge will not be fracture critical, but due to the size of the structure the bridge will remain part of VITAL Infrastructure even after replacement.