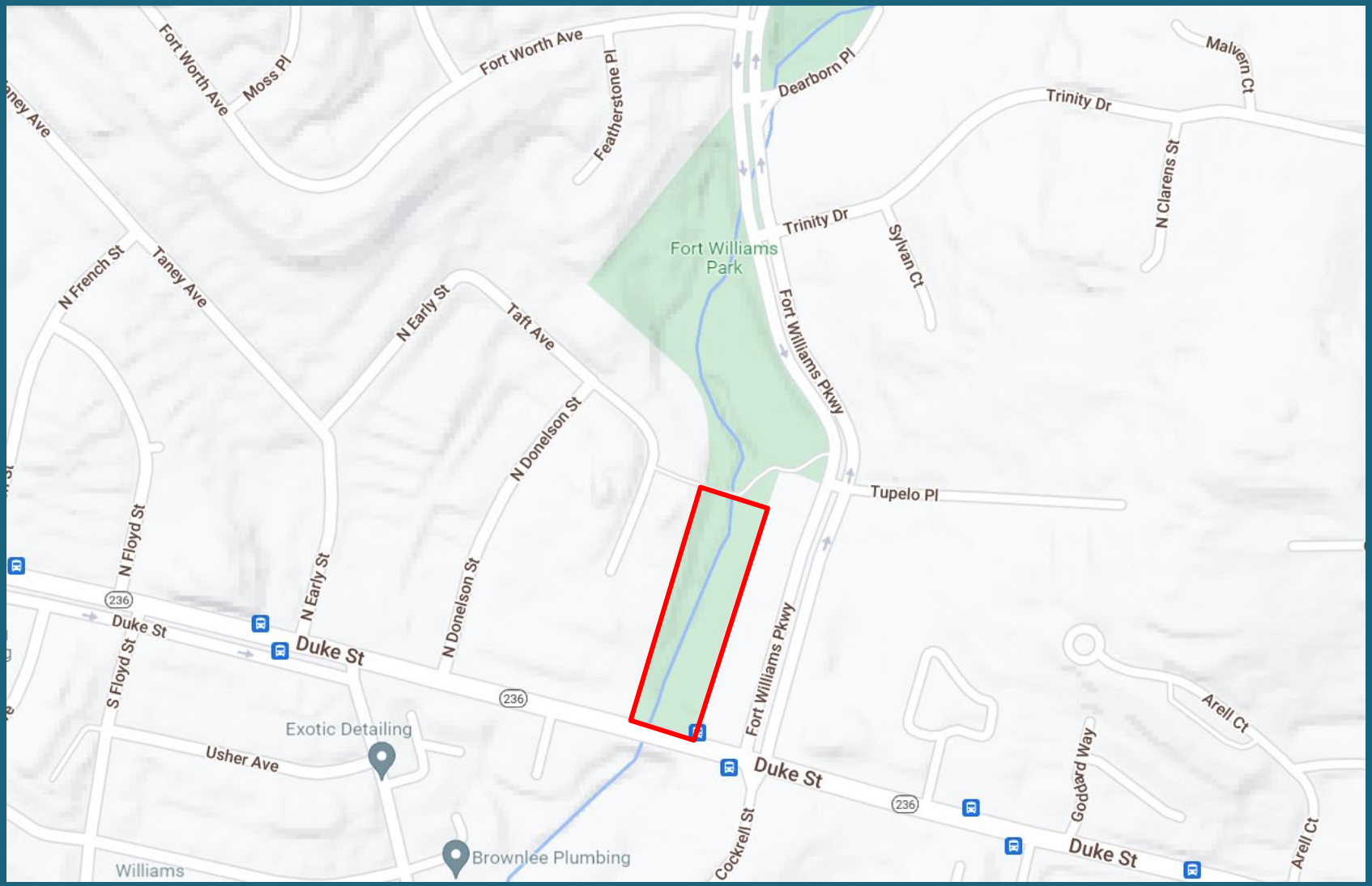
Strawberry Run Downstream Forensic Investigation

JUNE 27, 2022

Environmental Policy Commission

Presented by: Troy Biggs, PE, PH, D.WRE

Study Location



Agenda

- Overview of the problem
- Failures
- Likely contributors to failure
- Recommendations

Overview Of The Problem

- Prior stream assessment (2008) identified the entire segment as having degraded conditions
- Developer led downstream segment stream restoration project performed the work as part of the Taft Avenue subdivision development completed in 2010
- Focused on 600 feet of stream from the bridge to Duke Street of City property
- Recent large storm events in the last three years have impacted the project and accelerated destabilization of the stream
- Forensic investigation to diagnose the nature and causes of bed and bank instability

Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Build for Pollutant Removal Credit (revised 2/27/2020). (https://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2020/03/PROTOCOL-1-MEMO_WQGIT-Approved_revised-2.27.20_clean_w-appendices.pdf)

Overview Of The Problem

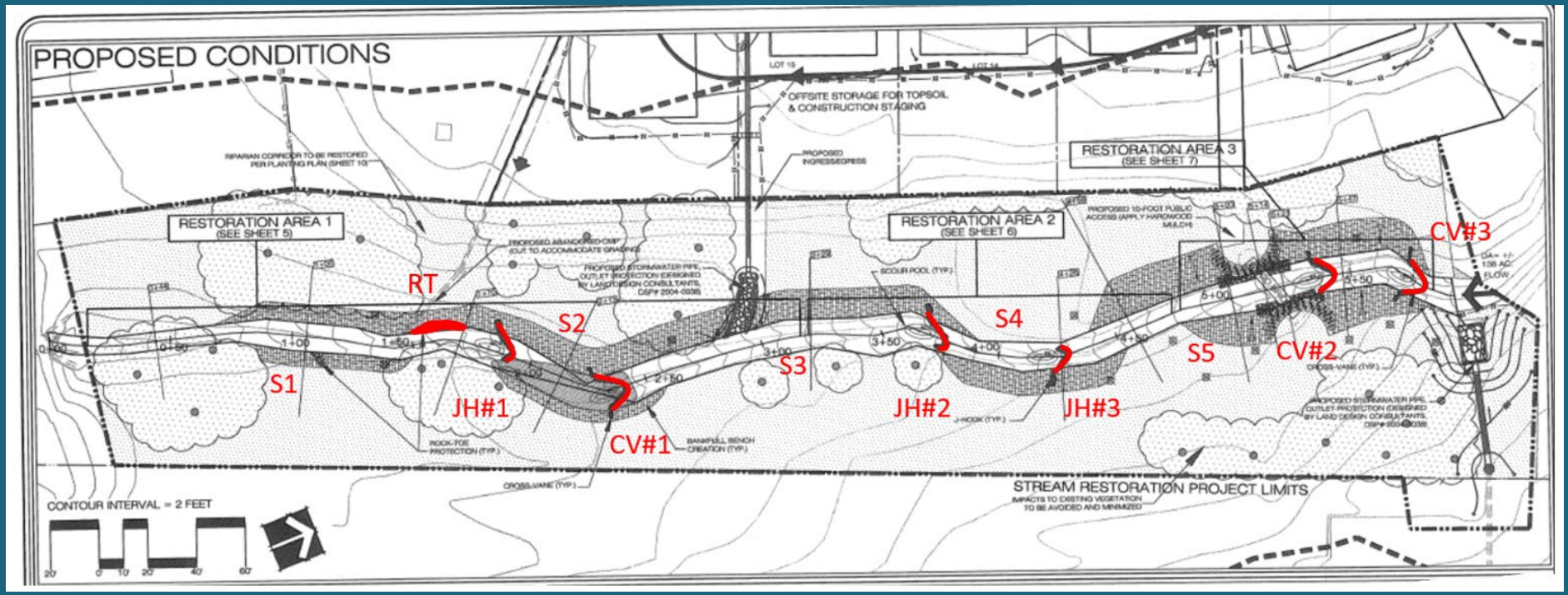
Augusta County, VA

Overview Of The Problem

11/11/21 (Looking upstream towards pedestrian bridge)

Overview of the Problem

Solutions Proposed In 2008



Structures deployed:

- Cross-Vanes (CV)
- J-Hooks (JH)
- Rock Toe Revetment (RT)

Example: Cross-Vane Structure

Source: Wildland Hydrology

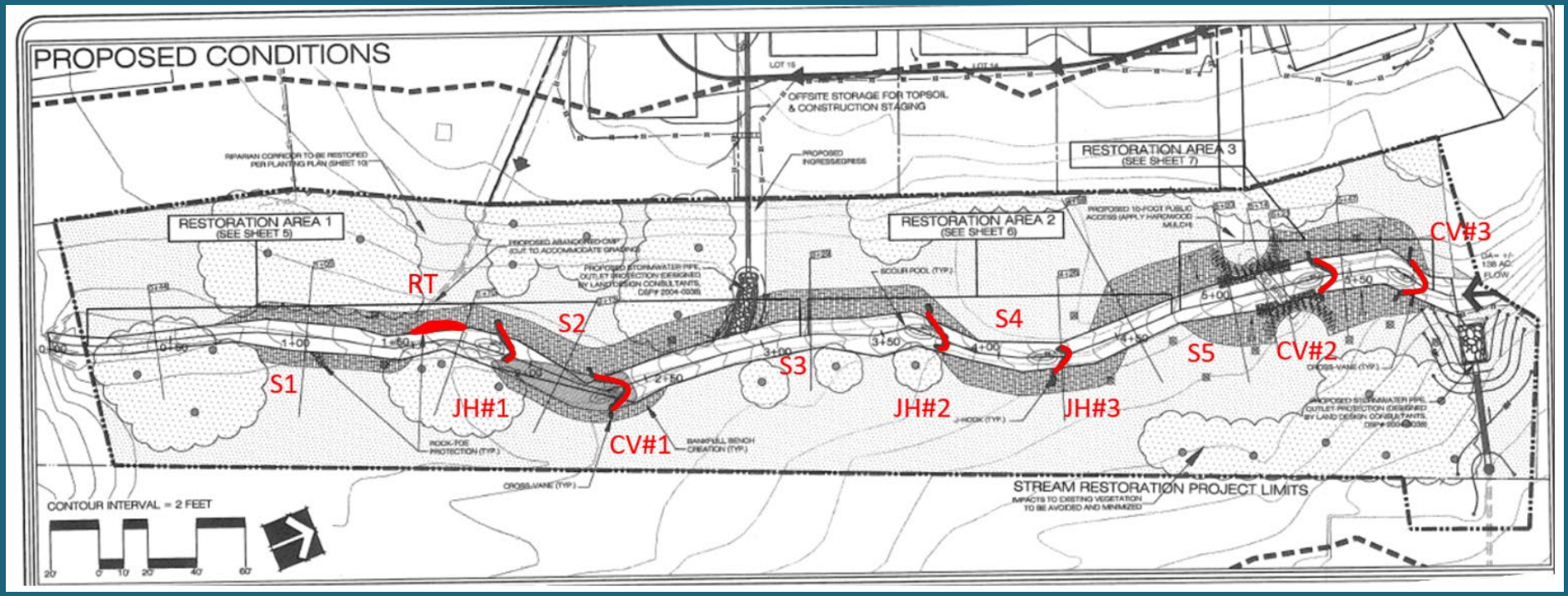
Example: J-Hook Structure

Source: Research Gate, Brady Dodd

Example: Rock Toe Revetment

Source: Wood

Solutions Proposed In 2008



Structures deployed:

- Cross-Vanes (CV)
- J-Hooks (JH)
- Rock Toe Revetment (RT)

J-Hook #3, March 2018

Follow the tree in the yellow circle

J-Hook #3, January 2021

Follow the tree in the yellow circle

J-Hook #3, November 2021

Follow the tree in the yellow circle

Scour Of J-Hook #2

November 2021; Looking Upstream

Scour Of J-Hook #2

November 2021; Looking Downstream

Failure Or Collapse Of Bank Protection Measures

November 2021; Underneath Pedestrian Bridge

Key Contributors To Stream Failure

- Hydraulics And Streambed Rock Size
- Climate Change Induced Intense Storms
- Other Potential Factors

Hydraulics And Streambed Rock Size

Hydraulics - Shear Stress

Source: emriver

Size of Streambed Rock Particles

A little more than 1 foot of water in the channel nearly mobilizes the entire bed.

The biggest particle found was 110 mm. The 1-yr discharge moves approximately 200 mm particle.

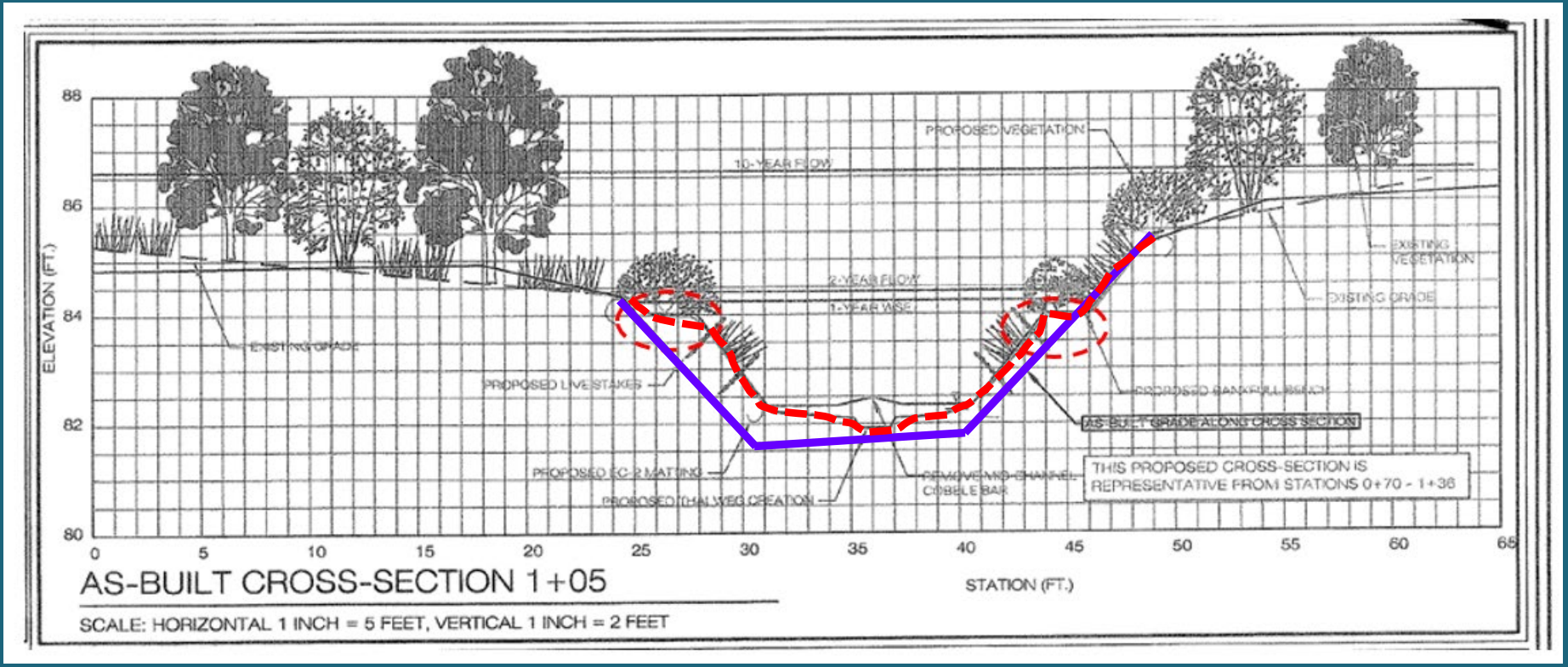
Climate Change Induced Intense Storms

Climate Change: More Frequent, More Intense Storms

- One month post-construction in 2010, a 5-10-Yr storm event occurred
- Flash floods occurred:
  - July 21, 2018
  - July 8, 2019
  - July 23, 2020
  - September 10, 2020
  - August 15, 2021

Other Potential Factors

Construction As-built



- Constructed channel elevations not matching the design profile (structure elevations too high)
- Constructed cross sections not matching the design sections (no bankfull bench)

Legend

Design

As-built

Upstream Bedload Supply

Aggradation

November 2021; S2 Area

Lack Of Rock Toe Protection

November 2021; S2 Area

Downed Trees / Channel Blockages

November 2021; S2 Area

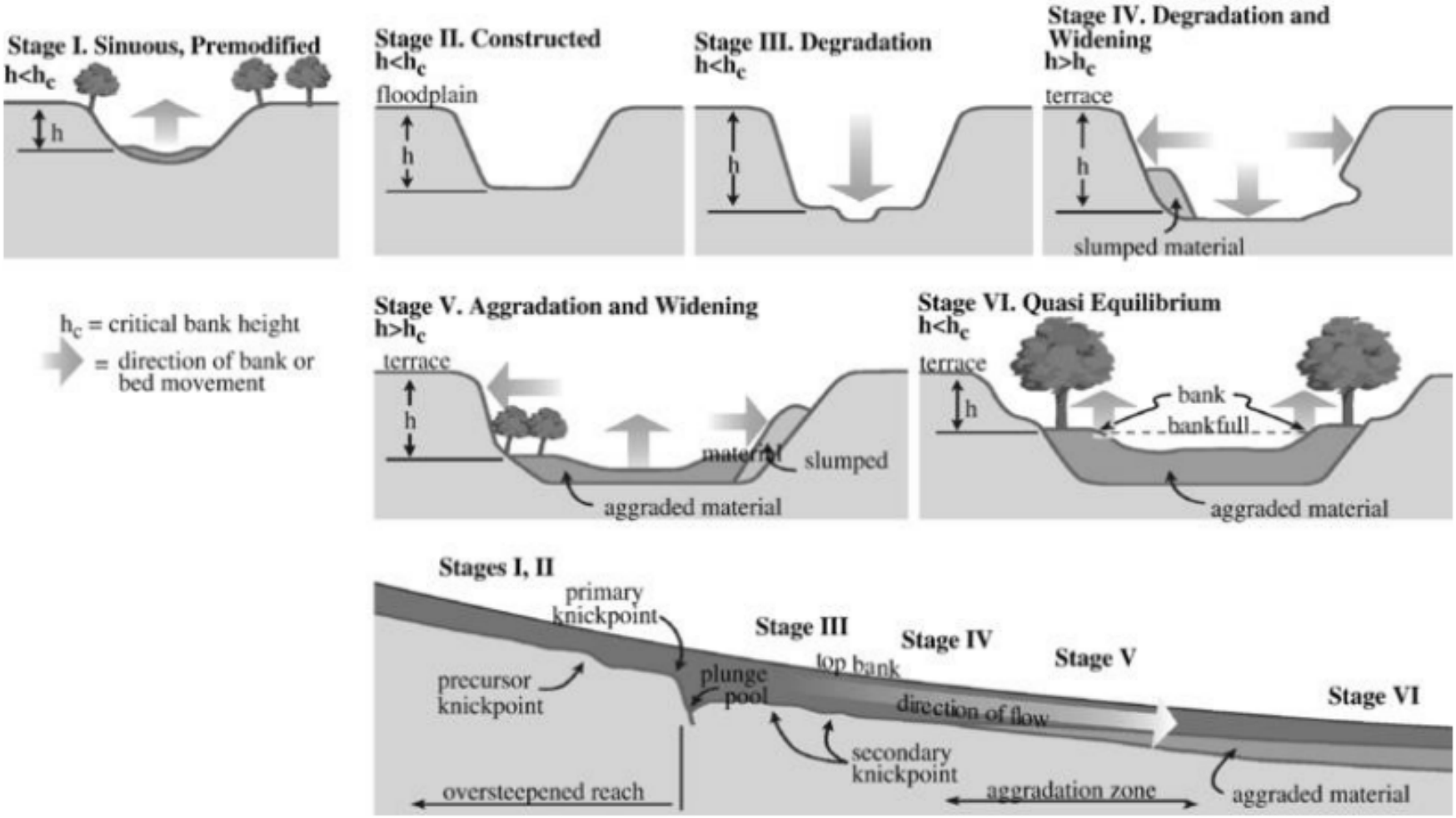
Findings And Recommendations

- Findings:
  - >50% Of Stream Project Failed
    - Lose Credit And Abandon The Project, Or
    - Reconstruct A New Stable Channel
- Recommendations:
  - Short-term
  - Long-term

Reasons Not To Abandon Project

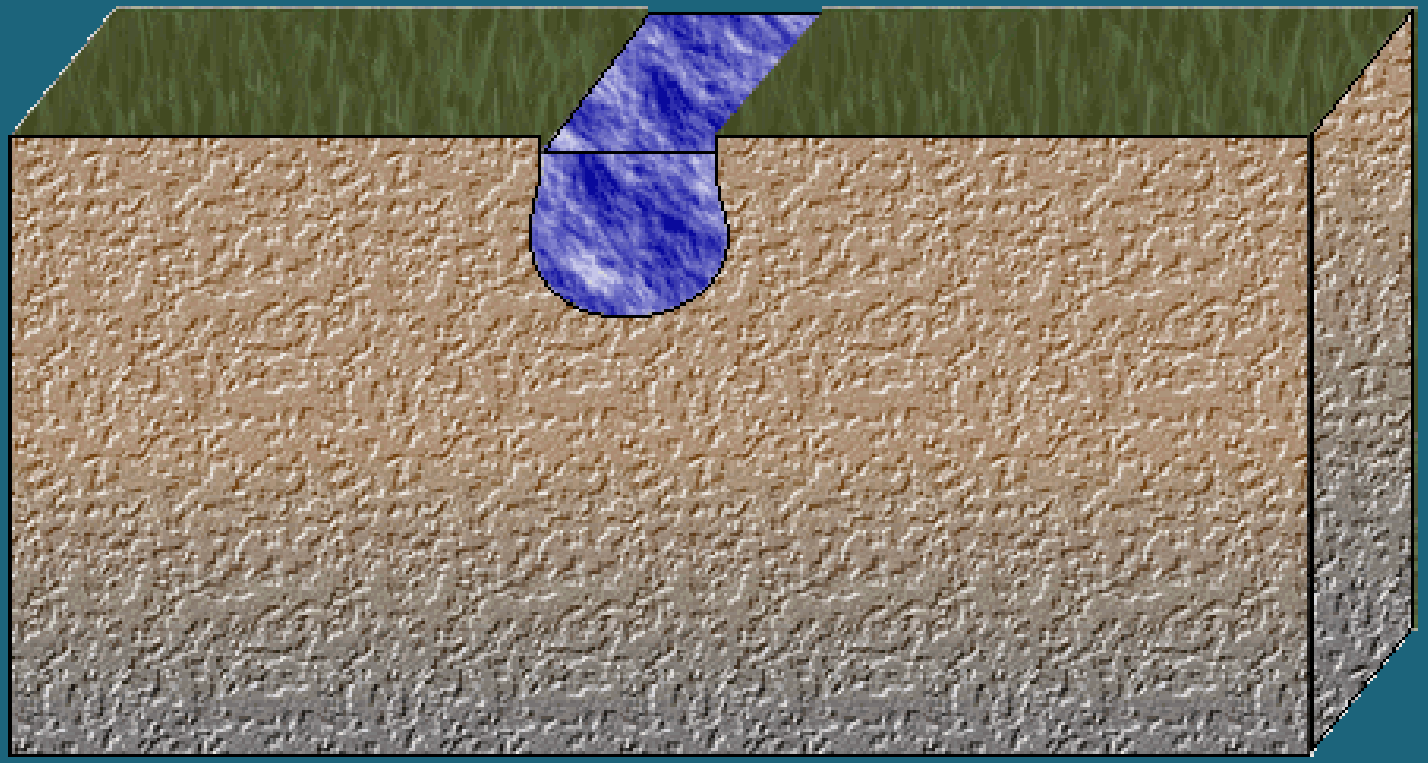
- Risks to infrastructure (pedestrian bridge, storm sewer)
- Public safety concerns (at crossing and along corridor)
- Continued erosion and trend towards lateral instability creating future risk to private property
- Continued erosion and tree loss
- Loss of conveyance capacity
- Increasing/on-going channel maintenance requirements
- Downstream conveyance impacts for the piped portions of the stream
- Sedimentation impacts to the Lake Cook Forebay that may impact the water quality function of the forebay and require frequent, costly maintenance to ensure proper functioning

Channel Evolution Model



Source: Simon and Rinaldi, 2006

Channel Evolution Model

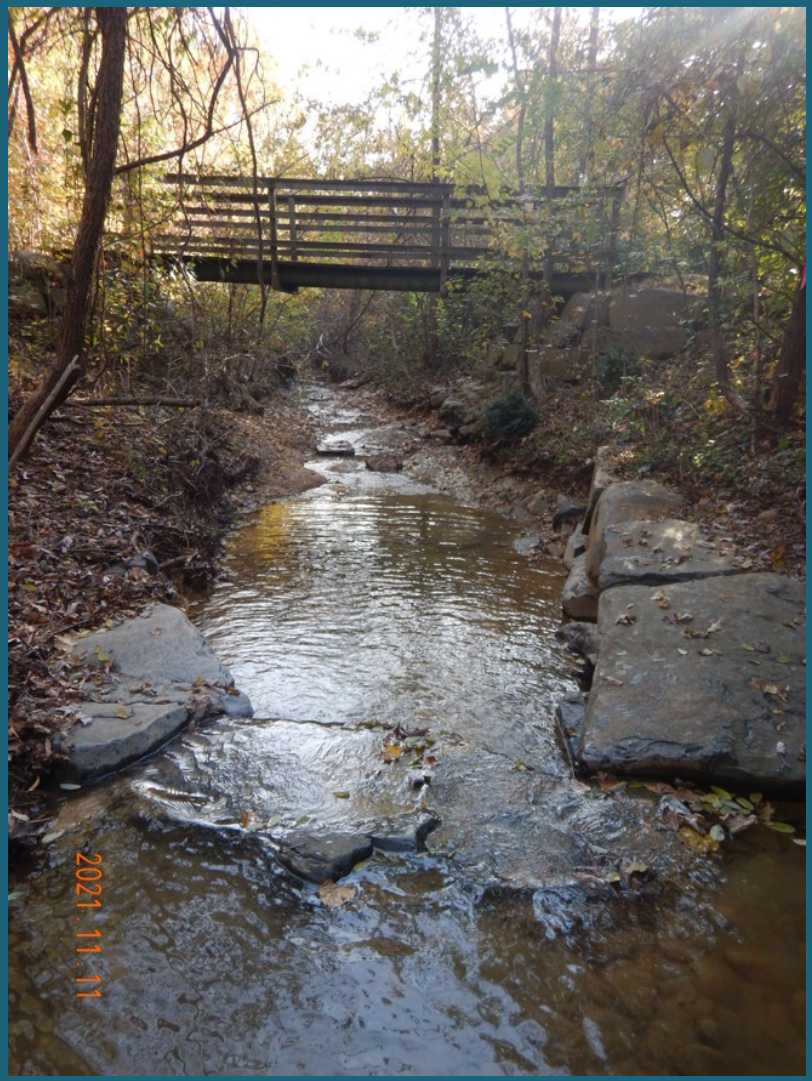


Source: T. Endreny at SUNY ESF

Short Term Recommendation: Protect The Pedestrian Bridge

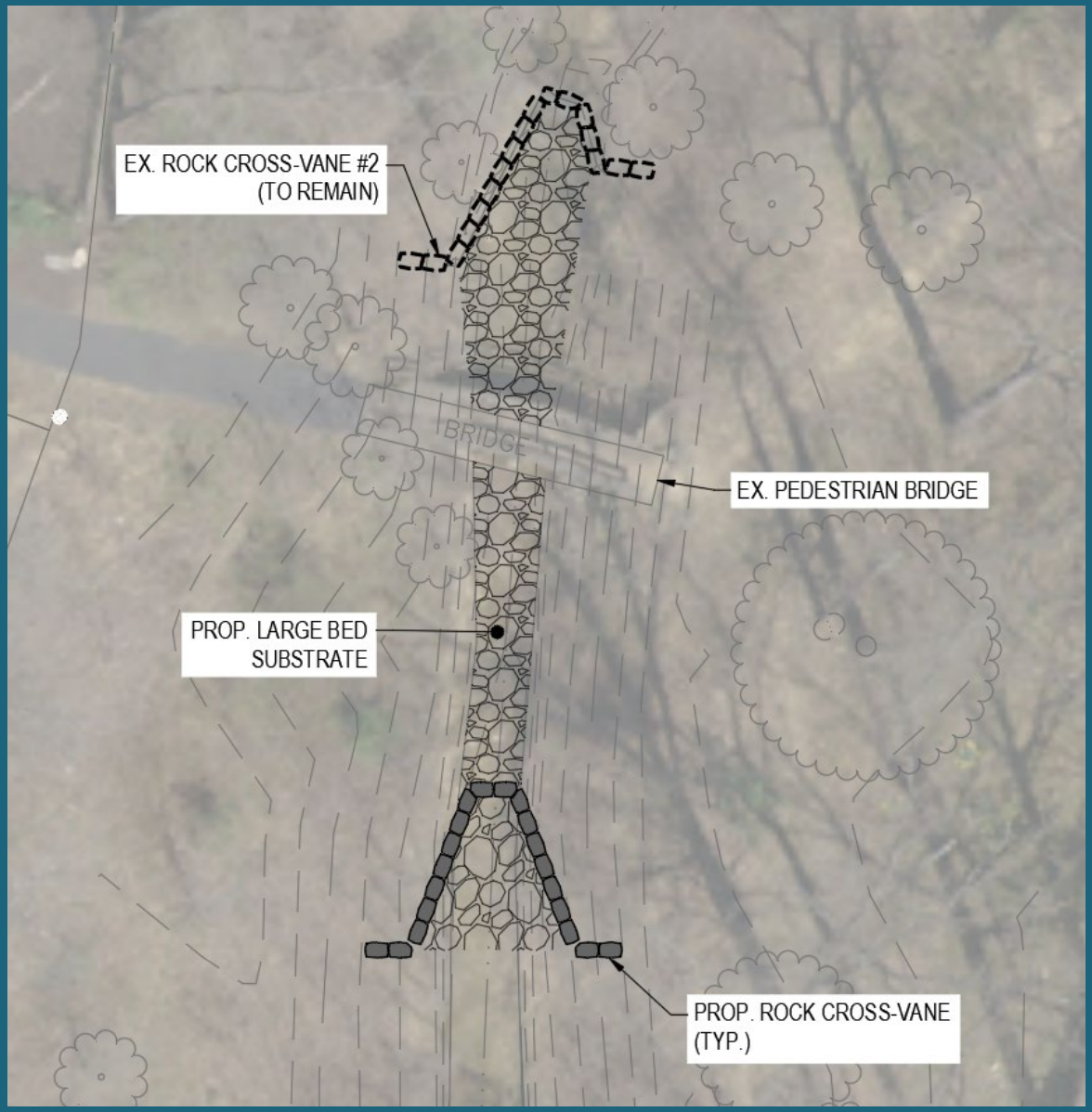
Protect Pedestrian Bridge

November 2021; Underneath Bridge



November 2021; Cross-Vane #2

Protect The Pedestrian Bridge



Long Term Recommendation: Design and Build a Stable Channel

Example: Stable Channel

Factors:

- Key-in logs back into the bank
- Import resistant materials
- Channel boundary materials stay in-place
- Structures help redirect flows and dissipate energy
- Direct flows toward center of channel and away from banks

Conclusion And Recommendations

Short Term:

- Protect The Pedestrian Bridge

Long Term:

- Design and Build a Stable Channel

Contact Information

Troy Biggs, PE, PH, D.WRE
Senior Principal Water Resources Engineer
Wood Environment & Infrastructure Solutions, Inc.
troy.biggs@woodplc.com

Murphy Ng, PE
Associate Project Manager
Department of Project Implementation
City of Alexandria, VA
Murphy.Ng@alexandriava.gov