Project Location
Project Background

- Severe bank erosion threatening infrastructure at the City’s WWTP
  - 12-inch force main
  - Sampling station

- River periodically experiences flash flooding
  - Top of bank events (~20 ft depth)
  - Quick rise and fall
Existing Conditions
Existing Conditions
Existing Conditions
Project Background

• Segment of Harpeth River listed as impaired for sedimentation/siltation

• Project Constraints
  • Canoers use
  • WWTP Operations/Sampling
  • FEMA established Floodplain and Floodway
  • Bats
  • Permit under General ARAP

• Public Involvement
  • Harpeth Conservancy
Project Objectives

• Proactively Relocate Force Main
• Stabilize Left Descending Bank
• Conceptual Design Evaluated
  • Natural Stream Design Principles
  • Bioengineering
  • Traditional stabilization techniques
    • Sloping bank back and covering with riprap

• Hydraulic Analysis
  • Equal Conveyance
Permits

• TDEC General ARAP – Bank Stabilization
• TDEC Construction General Permit
• USACE Nationwide Permit #13 – Bank Stabilization Activities
Design

- ~550 feet of Longitudinal Stone Toe Protection
- Floodplain Bench
- Locked Logs
- Live Branch Cuttings
- Live Stakes
- Native Riparian Seeding
Design
Longitudinal Stone Toe Protection

SECTION A-A

STONE TOE BUILT INTO RECONSTRUCTED BANK

LONGITUDINAL STONE TOE

NOT TO SCALE

LONGITUDINAL STONE TOE NOTES

1. LONGITUDINAL STONE TOE IS A LOWER BANK PROTECTION MEASURE THAT IS LOCATED AT THE TOP OF THE RECONSTRUCTED BANK OR CONSTRUCTED AND NATURAL RECONSTRUCTION OF THE TOE AND ENCLOSURE THE GROWTH OF ERODING MATERIAL AS THE BANK SLOPE FAILS.

2. LONGITUDINAL STONE TOE IS ACCEPTABLE FOR USE IN SINGLE AULT CHANNELS WHERE THE LOWER BANK IS FAILING BUT THE UPPER BANKS ARE NOT FAILING.

3. USE OF THIS IN-STREAM MEASURE SHALL NOT DEFEAT THE HORIZONTAL CAPACITY OF THE CHANNEL.

4. LONGITUDINAL STONE TOE SHOULD NOT BE USED IN BEDROCK CHANNELS.

5. LONGITUDINAL STONE TOE CAN BE USED IN COMBINATION WITH OTHER HYDRAULIC CONTROL STRUCTURES (E.G., DAMS, RAPIDS, ETC.), AND ANY OTHER BANK STABILIZATION MEASURES.

6. MINIMUM SLOPE OF 1:6 SHOULD BE MAINTAINED FOR CONSTRUCTING LONGITUDINAL STONE TOE SHOULD BE SELECTED BASED ON CRITERIA IN SECTION 11.14 OF THE DESIGN MANUAL.

7. WHEN THE STONE TOE IS BUILT WITHIN A RECONSTRUCTED BANK (E.G., LOWER BANK) IT SHALL BE PLACED BEHIND THE ROCK TO PREVENT SOLIDIFICATION THROUGH THE STRUCTURE.

8. THE TOP ELEVATION OF THE STRUCTURE SHALL BE NO LOWER THAN THE CHANNEL FLOW ELEVATION OF THE STREAM.

9. ACCESS TO THE STREAMBED AREA SHALL BE PROVIDED FOR RIGHT-OF-WAY, MONITORING, AND MAINTENANCE.

10. PAVING FOR LONGITUDINAL STONE TOE SHALL INFLICT ALL MATERIALS AND LABOR NECESSARY FOR THE CONSTRUCTION OF THE TOE PROTECTION SYSTEM.

11. TREES PLANTED WITHIN TWO TIMES THAT ARE SELECTED FOR PLANTING MAY BE INCORPORATED ALONG THE LONGITUDINAL STONE TOE PROTECTION AS DIRECTED BY THE ENGINEER. THE TREES SHALL BE ERECTED BY THE ENGINEER AND MAINTAINED FOR USE PRIOR TO THE COMMISSIONING OF CONSTRUCTION. TREES SHOULD BE INSTALLED PER THE LOOKED LOG DETAIL.
Stabilize the toe of the bank by “self-launching” stone into scour holes that develop during higher flow events.

Arrest future bank sloughing that may occur in the lower and mid bank areas.

General ARAP limits to 1/5 bank height.
NOTES ON LOCKED LOGS:

1. TREES WITHIN THE WORK LIMITS THAT ARE SELECTED FOR REMOVAL MAY BE INCORPORATED ALONG THE LONGITUDINAL STONE TOE PROTECTION AS DIRECTED BY THE ENGINEER. THE TREES SHALL BE IDENTIFIED BY THE ENGINEER AND MARKED FOR USE PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.


3. TREES WILL BE PLACED AS DIRECTED BY THE ENGINEER. THE TREES SHALL BE PLACED ON THE STREAM BOTTOM ORIENTED DOWNSTREAM AT AN APPROXIMATE 25 DEGREE ANGLE, THEN ANCHORED IN PLACE WITH THE LONGITUDINAL STONE TOE PROTECTION. APPROXIMATELY 8 TO 10 FEET OF THE TRUNK BASE SHALL BE COVERED WITH ROCK.

LOCKED LOG DETAIL

NOT TO SCALE
Locked Logs

- Protects the bank by increasing the roughness and decrease the velocity along the toe of the bank
- Used select trees removed during construction
- Mimicked existing trees that had fallen in river
- General ARAP limits to 5 instream structures
Locked Logs
Vegetation

• Live Branch Cuttings
• Live Stakes
• Native Riparian Seed Mix
  • Straw
  • Coir Matting
• Milkweed included at City’s request to attract Monarch Butterflies
Live Stakes
Live Stakes
During Construction - Bankfull
During Construction – After Bankfull
Final Construction – December 2017
Post Construction – June 2018
Post Construction – March 2018
Post Construction – October 2018
Harpeth River - Franklin, TN

Daily Photograph
April - October, 2018
Harpeth River – Franklin, TN

April 22-24 Rain Event