Presentation to:
Conference Ecological and Ecosystem Restoration

Restoring Fish Passage on Whitemarsh Run

July 30, 2014
Outline

• Background on Mitigation Project

• Design History
  – Assessment
  – Concepts & Agency Feedback

• Final Design
  – Design Constraints
  – Overview
Mitigation History

- I-95 Express Toll Lanes\textsuperscript{SM}
- 8-mile segment of I-95 = Section 100
  - 12,199 linear feet of streams impacted
  - 2.89 acres of wetlands impacted
  - Mitigation achieved at King Avenue Mitigation Site and Whitemarsh Run Mitigation Site
Mitigation History

• Whitemarsh Run
  – Coastal plain sand and gravel-bedded stream located in Baltimore County, Maryland
  – Geomorphic assessment included:
    • Stream gage installations
    • Discharge and bedload measurements during storm events
    • Sediment transport modeling
    • Baseflow analysis
Mitigation History

• Whitemarsh Run Mitigation Site
  – 183.6 acres containing streams, forest, and wetlands
  – Proposed mitigation
    • Vernal pool creation
    • Invasive species management
    • Floodplain, upland, and wetland preservation
    • Streambank stabilization
    • Fish passage restoration
Whitemarsh Run Mitigation Site

- Urbanized 13.5-mi² watershed
- History of gravel mining
- Upstream restoration projects have had varying success
- Straughan measured large bedload supply to downstream reaches
Whitemarsh Run Mitigation Site

• Initial mitigation goals
  – Replace the functions and values of the wetlands and streams unavoidably impacted by the Section 100 project
  – Preserve, enhance, and create wetlands and forest
  – Restore Whitemarsh Run to a geomorphically stable dimension, pattern, and profile that transports the sediment and water of the watershed without further aggradation or degradation
Whitemarsh Run Design Process

- Initial concept design
  - Natural channel design
  - Use reference reach to design stable Bc channel
  - Reconnect floodplain
  - Remove riprap and concrete
  - Provide grade control
  - Create emergent and oxbow wetlands
  - Control Phragmites
Whitemarsh Run Design Process

• Limitations of initial concept design
  – Client and review agencies were wary of traditional stream restoration design due to restoration history in Whitemarsh Run watershed
  – Viewed as cost-prohibitive
  – Wells indicated that existing groundwater elevation was too low at proposed wetland creation site
  – No mitigation credit to be provided for oxbow wetlands
  – Ground penetrating radar and soil analysis indicated 10 to 20 feet of waste concrete and diesel fuel contamination southeast of US 40 crossing
Other concept stream designs

- Shallow braided stream through wetlands
  - Suspended sediment and nitrogen removal
  - Fish passage may be limited
  - Gravel aggregation expected
  - Historical images and topo maps suggest stream is naturally single-threaded
Whitemarsh Run Design Process

- Other concept stream designs
  - Valley plugs to form distributary channels
    - Estimated ability to store 37K tons of sediment over a 7-year period
    - Similar concept recommended by peer reviewer
  - Fish passage may be concern
  - Future stability uncertain
Whitemarsh Run Design Process

- Other concept stream designs
  - In-situ enhancement
    - Limited bank grading
    - Fish ladder required
    - No sediment storage
    - Improvements at BGE right-of-ways not possible
Whitemarsh Run Design Process

• Other concept stream designs
  – Bypass channel
    • Bypass solely for fish passage at baseflow
    • Primary channel below structural spillway for bedload transport and high discharge conveyance
    • Bypass channel may aggrade and require maintenance
• Revised Goals
  – Primary Objectives
    • Carry out wetland creation, enhancement, preservation, and restoration activities at selected locations
    • Manage Phragmites and Bittersweet
    • Protect existing infrastructure
    • Stabilize stream banks at selected locations
    • Improve fish passage for selected anadromous species at the Route 40 culvert
      – MDE and NOAA/NMFS recommended a rock riffle grade control structure
Whitemarsh Run Riffle Grade Control

- Riffle grade controls installed successfully at other Maryland coastal plain streams
- 5-foot vertical barrier at Whitemarsh Run
- Alewife is the weakest target anadromous fish
  - Baseflow must be at least 9 inches deep and less than 3 ft/s to provide passage
Whitemarsh Run Riffle Grade Control

• Design constraints:
  – Minimum Spring baseflow depth = 9 in
  – Maximum Spring baseflow velocity = 3 ft/s
  – Structural stability during the 10- and 100-year discharges
  – Competence and capacity to transport existing bedloads
  – Maintenance of the existing floodplain elevation along U.S. 40
  – Strict grading limitations due to measured diesel fuel soil contamination and utility right-of-ways
Whitemarsh Run Riffle Grade Control

- Iterative design
  - Stone size and gradation determine roughness at baseflow
    - Which determines baseflow depth and velocity
  - Slope and cross-sectional parameters drive:
    - Baseflow depth and velocity and
    - Required stone sizes for structural stability at 10- and 100-year storms, which must be available stone sizes
  - Bedload competence and capacity determined with models including iSURF
  - Final depths, velocities, and floodplain elevations modeled with HEC-RAS
Riffle Grade Control

- Plunge pool downstream of U.S. 40 and downstream of RGC
- Loosely follows the existing stream alignment to maximize length (1,407 ft)
- Slope = 0.0092 (0.92 %), 3X existing stream slope
- Contains refugia boulders to provide fish resting areas
Whitemarsh Run Mitigation Site

• Mitigation proposed at Mitigation Site
  – Plunge pools and riffle grade control structure
  – Streambank stabilization (338 ft, reducing erosion by an estimated 362 ton/yr)
  – Wetland enhancement (3.2 ac) and preservation (43 ac)
  – Vernal pool construction (3.3 ac)
  – Invasive species eradication (14.6 ac)
  – Reforestation (1.3 ac)
  – Native plantings

• Total estimated construction cost = $4.86M

• Construction underway!