The New Normal – Planning for Sediment Project Water Management Considering Climate Change

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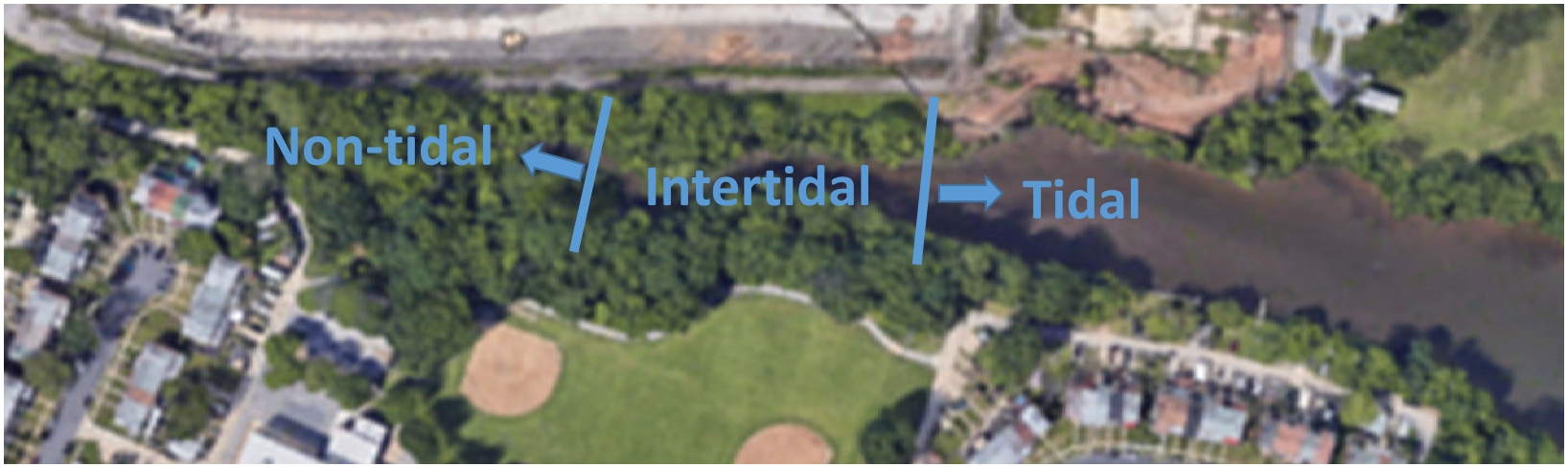
CDM Smith

Remedial Action Objectives

- Tidally influenced creek and estuary contaminated with PCBs, PAHs, metals
  - Situated between residential and industrial areas
- Reduce risks from stream sediment



Remedy Action

- Remedy selected with community input
- Remove 14,000 cubic yards of contaminated sediment via “excavation in the dry”
  - Bypass pump-around system and series of cofferdams to create dry working conditions
  - Water treatment system required to treat contact water
- Followed by 1.2-acre floodplain reconstruction and 2.5-acre wetland restoration

Design Analysis

- Design based on state regulatory requirements
  - Required sufficient capacity to convey 2-year flows (24-hour precipitation event)
- CDM Smith served role of owner's representative during design and construction
  - Coordinated "Failure Modes and Effects Analysis" during 60% design
  - Among 96 potential risks, two identified related to:
    - **uncommon weather conditions** or **large storm event**
    - **failure of cofferdam, or bypass pump-around system**
  - Potential effects identified:
    - Flooding, inundation of work area; more contact water to collect, store and treat; possible recontamination
  - Recommended actions:
    - Develop a contingency plan for handling storm bigger than design
    - Incorporate safety factor into the design

Bypass Pump Around System

- State regulations required sufficient capacity to convey 2-year (24-hour precipitation event) flows
  - Equates to 3.3 inches precipitation, or 20 cubic feet per second [cfs]
- Pumping equipment **over-designed** to handle 10-year storm
  - Added redundant pumping system to accommodate total of 5.1 inches precipitation, or 30 cfs

Dam System

- Dams used in conjunction with bypass pump-around system to create dry working conditions
- Dam heights designed for **2-year flow event**
  - Included 1-foot freeboard

Dam System


Station 26+50
Bladder Dam
Station 19+00
Sand Bag Dam
Outfall 4
Outfall
2
Outfall
3
Station 10+00
Sand Bag Dam
Station 8+00
Sand Bag Dam

Water Treatment System

- Frac tank, sand filter unit, bag filters and 5000-lbs of activated carbon filters
- Design capacity 300 gallons per minute
  - <1 cfs

Project Challenges – Storm Events; Dam Overtopping and Failure

Storm Events Encountered

- July 28 and 29, 2017
  - 5.7 inches of rain overnight
  - Storm approached and possibly exceeded 24-hour, 25-year flow event
  - Dam at station 10+00 overtopped and dam at station 19+00 breached
- August 18, 2017
  - 1.5 inches of rain in 1-hour
  - Storm exceeded 60-minute, 2-year flow event
  - Dam at station 10+00 overtopped
- August 21, 2017
  - 1.75 inches of rain in 2-hours
  - Storm exceeded 2-hour, 2-year flow event
  - Dam at station 10+00 overtopped

- Design (with safety factor)
  - 10-year flow event (24-hours)
  - equivalent to 5.1 inches of precipitation in 24-hours
    - ~0.2 inches/hr

Dam Overtopping and Breeches


Sandbag dam at Station 10+00 on 07-12-17


Sandbag dam at Station 10+00 overtopped on 07-29-17

Sandbag dam at Station 19+00 on 07-14-17


Sandbag dam at Station 19+00 breached on 07-29-17

Consequences

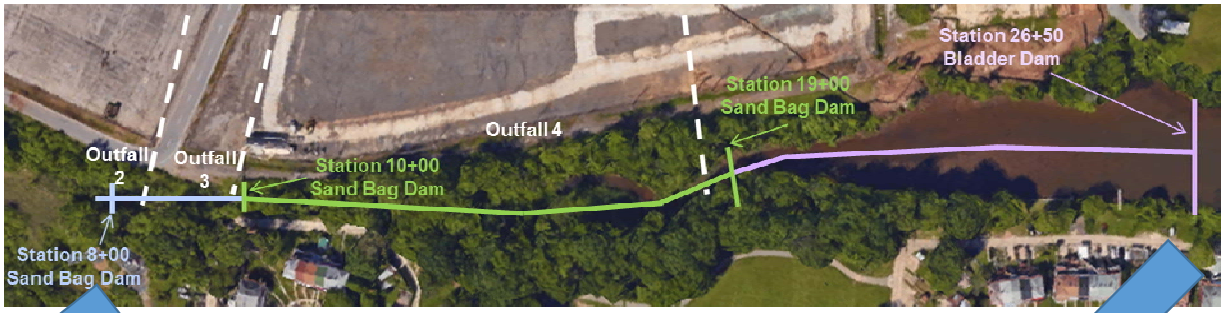
- Released untreated contact water downstream of the work area
- Schedule delayed due to inundation of the work areas
- Overwhelmed the water treatment system due to the need to treat significantly more contact water than planned

Dewatered creek early July 2017

Dewatered creek inundated with water on 7/29/2017

Corrective Action

- Constructed additional dams and impoundments
- Reinforced by installing sheet plates
- Optimized the water treatment system



Project Challenges – Bladder Dam Failure

Bladder Dam Failure

- Bladder dam installed August 25, 2017
- Bladder dam breached on November 10, 2017 by creek water channeling under the dam from the downstream side, flooding the upstream segment

Consequences/ Corrective Action

Consequences

- Schedule delays due to inundation of the work areas
- Operation of the water treatment system problematic due to need to treat significantly more contact water than planned
- Release of untreated contact water downstream of the work area

Corrective Action

- Multiple repair attempts
- Repair completed by placing an impermeable liner and 800 tons of sand upstream and downstream of the dam
- Large volume of contact water in excavation area treated prior to completing excavation activities

Project Completion

- Corrective actions sufficient for completion of excavation and restoration efforts
- Following excavation, creek reconstructed and restored
- Restoration included:
  - Floodplain reconstruction
  - Wetland restoration
  - Slope stabilization
  - Restoration of submerged vegetation

Lessons Learned

- Failure modes should be considered during design process and during construction preparation
- Design based on regulatory requirements, even with 50% safety factor, proved insufficient for storm events that occurred during construction
  - As part of the design process, future projects should consider increased frequency and increased intensity of storms that may be a result of climate change
- Contingency plans for failure modes should be developed **prior** to construction
- Unintended consequences of design changes **must** be fully considered