Recommended Solutions for Cuyahoga South Stormwater Master Plan

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Key Topics

• Regional Stormwater Management Program
• Stormwater Master Planning Approach/Objectives
• CRS Master Plan Findings and Recommendations
• Case Studies:
  – #1: Solutions to restore stream/floodplain function
  – #2: Integrated subwatershed solutions
• Key Conclusions and Lessons Learned
At a glance:

- Political subdivision of the State of Ohio
- Created by Court Order in 1972
- Regional agency separate and distinct from municipalities and counties
At a glance

- Own, operate 3 wastewater treatment plants
- 1 million customers
- 330 miles of sewers
- Water quality monitoring
- Lake Erie beach monitoring, maintenance
- 420+ miles regional stormwater system
Regional Stormwater Management Program

- Impervious Surface Fee
- Service Area: 355 sq. mi.
- Contributing Watershed Area: 1,524 sq. mi.
- Regional Stormwater System (RSS) in Service Area: 445+ mi.
  - 300 acre drainage
  - Intercommunity Drainage
Pepper Pike, Ohio
Pepper Luce Creek
August, 2017

Impervious Surfaces = Stormwater Runoff
Stormwater Runoff = Flooding and Erosion

Shaker Boulevard
Pepper Luce Creek Culvert Replacement at Shaker Boulevard

Existing Culvert

Remove House and Daylight Stream

Shaker Boulevard
Infrastructure Issues
Blocked basin outlet
35 Cubic Yards of Debris Removal
Mill Creek, Cleveland/Warrensville Heights

Pre-Maintenance
Infrastructure Issues
Blocked basin outlet
35 Cubic Yards of Debris Removal
Mill Creek, Cleveland/Warrensville Heights

Post-Maintenance
Streambank erosion on Doan Brook threatens Cleveland Museum of Art
Moved stream and widened the floodplain
May 2019
Regional Stormwater Management Program

Inspect & Maintain

SW Master Plans

Construct Projects

Encourage Good Practices
Program Goals

- **Leverage** the watershed-based approach to deliver equitable services to customers, partners, member communities, and NEORSD staff.

- **Perform** modeling and master planning to:
  - Identify problems and recommend and prioritize projects for the Stormwater Construction Plan,
  - Direct operations and maintenance projects along the RSS, and
  - Support projects within the local stormwater system.

- **Identify** and communicate policy needs and encourage watershed stewardship in all member communities.
**Program Goals**

- **Complete** water resource projects involving stormwater maintenance, construction, and acquisition to:
  - Arrest stormwater-induced erosion through stabilization of stream and river banks
  - Mitigate flood risk
  - Accomplish physical, chemical, and biological water quality protection and enhancement
  - Monitor and maintain stormwater conveyance through debris removal and stormwater asset management
Stormwater Master Plans

- Cuyahoga River South: $5.2M
- Cuyahoga River North: Complete SWMP In 2019
- Cuyahoga River South: SWMP Complete
- Chagrin River & Lake Erie Tribs: Complete SWMP In 2021
- Rocky River: Complete SWMP In 2020
- Chagrin River and Lake Erie Direct: $10.0M

Rocky River: Complete SWMP In 2020

Cuyahoga River North: Complete SWMP In 2019

Chagrin River & Lake Erie Tribs: Complete SWMP In 2021
# Stormwater Master Planning Approach

<table>
<thead>
<tr>
<th>Operational Performance Evaluation</th>
<th>• Identify areas of erosion and flooding through modeling, field assessments, and monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternatives Development &amp; Evaluation</td>
<td>• Comprehensive set of solutions, incorporating stream health, function, habitat, and water quality improvements</td>
</tr>
<tr>
<td>Development of Master Plans</td>
<td>• Recommended policies, construction projects, maintenance activities, and areas for preservation</td>
</tr>
</tbody>
</table>
Cuyahoga River South SWMP Overview

- Total Study Area – 288 sq. mi.
  - 89 sq. mi. in Service Area
  - 9 Subwatersheds
  - 24 Member Communities
  - Includes Cuy. Mainstem Alternatives Development
- August 2016 – March 2019
- Over $200M in recommendations
Findings and Recommendations

- Identified **87 locations** where flooding, erosion, and/or structural condition do not meet the District’s Acceptable Level of Risk (ALR)

- Locations in private and public land
  - Project responsibility not specifically identified
Findings and Recommendations

- **Baseline solutions** to maintain/restore existing system function:
  - **Policies** to maintain RSS function (e.g., “no-net-loss” of floodplain storage / riparian function, local stormwater system controls)
  - **Repairs** to RSS assets ($7.5M) to restore erosive streambanks, deteriorating structures, etc.
Findings and Recommendations

- **System enhancements** to increase RSS function ($196.3M)
  - Floodplain / stream restoration
  - Conveyance improvements while mitigating downstream impacts
  - New/enhanced detention basins
  - Property acquisition / flood mitigation
Case Study #1: Echo Lane, Broadview Heights

- **Flooding:**

<table>
<thead>
<tr>
<th>Issue</th>
<th>10-Year</th>
<th>25-Year</th>
<th>50-Year</th>
<th>100-Year</th>
</tr>
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<tbody>
<tr>
<td>Residential Flooding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Foundation</td>
<td>4</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>-- First Floor</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Roadway Flooding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Inundated</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>-- Impassible</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

- **Erosion:** No infrastructure threatened
- **Structural:** One culverted stream has a visible void
- **Water Quality:** Straight, channelized stream with little habitat, separated from floodplain, riparian areas; culverted stream barrier to fish passage.
Case Study #1: Echo Lane, Broadview Heights

Baseline Solutions

- No-net-loss of 16 ac-ft of floodplain storage
- Preserve/restore 8 acres of vegetated riparian area
- Increased inspection/maintenance to address debris blockages
Case Study #1: Echo Lane, Broadview Heights

Alternative 1: Detention and Stream Restoration

- **A101**: Enlarge and deepen the basin from 1 to 2 acres (from 5 to 11 acre-feet of storage).
- **A102**: Create 1,200 linear feet of channel restoration with connected floodplain.
- **A103**: Demolish existing culverted stream; create 630 linear feet of channel restoration with connected floodplain.

Estimated Project Cost: $11,696,000
Case Study #1: Echo Lane, Broadview Heights

Alternative 2: Detention and Conveyance

- **A201**: Enlarge and deepen the basin from 1 to 2 acres (from 5 to 11 acre-feet of storage).
- **A202**: Replace/enlarge culverted stream
- **Estimated Project Cost**: $3,496,000
Case Study #1: Echo Lane, Broadview Heights

Project Scorecard

- Both alternatives mitigate flooding.
- Alternative 1 improves geomorphic function/ecologic health. Alternative 2 does not.
- Stream restoration under Alternative 1 is less maintenance-intensive.
- Alternative 1 is over 3 times more expensive, with significant implementation issues. Alternative 1 is the preferred alternative.
Case Study #2: Downtown Hudson

- **Flooding**: see table
- **Erosion**: Threatens one non-residential building, three parking lots, and two utilities
- **Structural**: Two crossings and two basins exhibit structural deterioration.
- **Water Quality**: Channel entrenched, straight, with limited riparian area, habitat, and floodplain.

<table>
<thead>
<tr>
<th>Asset</th>
<th>Non-Res Buildings</th>
<th>Roadways</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Year</td>
<td>25-Year</td>
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<tr>
<td>Non-Res Buildings</td>
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<td></td>
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<tr>
<td>-- Foundation</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>-- First Floor</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Roadways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Inundated</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>-- Impassible</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case Study #2: Downtown Hudson

Baseline Conditions

• No-net-loss of 85 ac-ft of floodplain storage
• Preserve/restore 17 acres of vegetated riparian area
• Increased inspection/maintenance to address debris blockages
• Repair RSS assets:
  – BL02: Remove and replace CMP culvert structure, and replace headwall
  – BL03: Patch the inside of the barrel top slab and repoint deficient masonry joints
  – Cost: $293,000
Case Study #2: Downtown Hudson

Alternative 1: Expand detention, stabilize streambank

- **A101**: Increase detention by 9.5 ac-ft, with operational controls to lower pool.
- **A102**: Redirect flow to existing wetland for detention, water quality.
- **A103**: New 5 ac-ft detention facility.
- **A104**: Toe boulder stabilization
- **A105**: Stacked rock wall stabilization

Estimated Project Cost: $2,056,000
Case Study #2: Downtown Hudson

Alternative 2: Two-stage channel with rock walls, microhabitat

- **A201**: Acquire four flood-prone properties.
- **A202 and A203**: Stacked rock wall stabilization with inset compound channel and microhabitat
- **A204**: Monitor structural condition
- **Estimated Project Cost**: $6,286,000
Case Study #2: Downtown Hudson

**Project Scorecard**

- Both alternatives mitigate flooding, partially mitigate erosion.
- Alternative 2 marginally improves ecologic health. Alternative 1 does not.
- Both alternatives require moderate maintenance/renewal.
- Alternative 1 is over 2 times more expensive, with significant implementation issues.

Alternative 1 is the preferred alternative.

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### Estimated Alternative Costs

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Costs (BL + Alt)</td>
<td>$2,349,000</td>
<td>$6,579,000</td>
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</table>

### Business Case Evaluation of Alternatives

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ECONOMICS</strong></td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
<tr>
<td>Life Cycle Costs</td>
<td>2</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>Reason: Cost within less than half</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flood Damage Mitigation</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason: Achieves 100 Year ALR and reduces flood BRE &gt; 500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion/Structural Damage Mitigation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reason: ALR achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>5.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Weighted Subtotal</strong></td>
<td>41.67</td>
<td>8.33</td>
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<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
<tr>
<td>Vertical Stability</td>
<td>-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reason: Poor connectivity, Not in equilibrium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral Stability</td>
<td>-2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reason: Frequent erosive velocities, No sinuosity</td>
<td></td>
<td></td>
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<tr>
<td>Runoff Volume and Pollutant Loading</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Reason: No change in runoff volumes, loads.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fish Community</td>
<td>-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reason: Significant barriers to fish passage/community</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat Preservation/Restoration</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reason: Fair QHEI score</td>
<td></td>
<td>Overall good habitat and QHEI score.</td>
<td></td>
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<tr>
<td>Preserve/Restore Natural Land</td>
<td>-1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Reason: Maintains existing very narrow riparian area.</td>
<td></td>
<td>Two-stage channel provides narrow riparian area.</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>-5.00</td>
<td>4.00</td>
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<tr>
<td><strong>Weighted Subtotal</strong></td>
<td>-20.83</td>
<td>16.67</td>
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<tr>
<td><strong>O&amp;M</strong></td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
<tr>
<td>Frequency</td>
<td>0</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Reason: Routine maintenance, renewal</td>
<td></td>
<td>Rock Walls require frequent renewal</td>
<td></td>
</tr>
<tr>
<td>Simplicity</td>
<td>0</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Reason: Routine maintenance, renewal</td>
<td></td>
<td>Rock Walls difficult to renew</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>0.00</td>
<td>-2.00</td>
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<tr>
<td><strong>Weighted Subtotal</strong></td>
<td>0.00</td>
<td>-25.00</td>
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<tr>
<td><strong>IMPLEMENTATION</strong></td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
<tr>
<td>Property Acquisition</td>
<td>1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Reason: Located on a few contiguous parcels.</td>
<td></td>
<td>Multiple properties, critical acquisitions</td>
<td></td>
</tr>
<tr>
<td>Construction Impacts</td>
<td>-2</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>Reason: Multi-Season Construction</td>
<td></td>
<td>Multi-Season Construction</td>
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</tr>
<tr>
<td>Ease of Construction</td>
<td>0</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Reason: Minimal disturbance to wetlands/streams.</td>
<td></td>
<td>Moderate disturbance to wetlands/streams.</td>
<td></td>
</tr>
<tr>
<td>Regulatory</td>
<td>0</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>Reason: Routine regulatory requirements</td>
<td></td>
<td>Significant regulatory requirements</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>-1.00</td>
<td>-6.00</td>
<td></td>
</tr>
<tr>
<td><strong>Weighted Subtotal</strong></td>
<td>-6.25</td>
<td>-37.50</td>
<td></td>
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<tr>
<td><strong>TOTAL SCORE</strong></td>
<td>14.59</td>
<td>-37.50</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Comments**

Alternative 1 has the higher score and is the recommended alternative.
Key Conclusions and Lessons Learned

• A regional, watershed-based approach is fundamental to defining feasible, cost-effective, multi-objective controls
• Outreach to communities is critical
• Successful projects:
  – Obtain all three goals of flood reduction, erosion impacts, and water quality benefits
  – Use property acquisition to remove risk to buildings, transportation, and/or utilities
  – Solve intercommunity issues
Questions?

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Echo Lane Project Area, Broadview Heights