Creating Value ...

... Delivering Solutions

Chesapeake Bay Protection & Restoration

Improvements and Lessons Learned At Craney Island & Southgate Annex, Norfolk, Virginia

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**Title:** Chesapeake Bay Protection & Restoration: Improvements and Lessons Learned At Craney Island & Southgate Annex, Norfolk, Virginia

**Authors:** Naval Facilities Engineering Command Mid Atlantic, Water Compliance Section, Norfolk, VA, 23511

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Presentation Overview

- Study Drivers
  - Chesapeake Bay Watershed and TMDL
  - Presidential Executive Order 13508
- Methodology
- Results
- Highlights of Craney Island and Southgate Annex Case Study
Bay Impairment

- Low Dissolved Oxygen
- Poor Water Clarity
- Too Much Bad Algae

Chesapeake Bay and Tidal Tributary Nutrient and/or Sediment Impaired Waterbodies

Note: Representation of 303(d) listed waters for nutrient and/or sediment water quality impairments for illustrative purposes only. For exact 303(d) listings, contact EPA (http://www.epa.gov/owow/tmdl/).
1999 Lawsuit

- EPA commits to bring the Bay and tidal tributaries into compliance with water quality criteria by 2010 or develop a TMDL
  - December 29, 2010 TMDL

TMDL or Total Maximum Daily Load is a “pollution diet” that identifies the maximum amount of a pollutant a water body can receive and still meet water quality standards
- Characterization and estimation of point and nonpoint source loads
- Estimation of watershed-scale load reductions
- Signed – December 29, 2010
Watershed Implementation Plans (WIPs)

- How the states and DC plan to meet the maximum load restrictions imposed by the TMDL with reasonable assurance

**State-Basin Allocation**

- Source Sector-Local Jurisdiction Allocation
  - Wastewater
  - Urban Runoff/MS4
  - Agriculture
  - Forest
  - Septic Systems

**Phase 1 WIP - 2010**

**Phase 2 WIP - 2011**

**Phase 3 WIP - 2017**
State Basin Allocation: Example=Virginia

Table ES-1. Chesapeake Bay TMDL watershed nitrogen, phosphorus and sediment final allocations by jurisdiction and by major river basin.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Basin</th>
<th>Nitrogen allocations (million lbs/year)</th>
<th>Phosphorus allocations (million lbs/year)</th>
<th>Sediment allocations (million lbs/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia</td>
<td>Eastern Shore</td>
<td>1.31</td>
<td>0.14</td>
<td>11.31</td>
</tr>
<tr>
<td></td>
<td>Potomac</td>
<td>17.77</td>
<td>1.41</td>
<td>829.53</td>
</tr>
<tr>
<td></td>
<td>Rappahannock</td>
<td>5.84</td>
<td>0.90</td>
<td>700.04</td>
</tr>
<tr>
<td></td>
<td>York</td>
<td>5.41</td>
<td>0.54</td>
<td>117.80</td>
</tr>
<tr>
<td></td>
<td>James</td>
<td>23.09</td>
<td>2.37</td>
<td>920.23</td>
</tr>
<tr>
<td></td>
<td>VA Total</td>
<td>53.42</td>
<td>5.36</td>
<td>2,578.90</td>
</tr>
</tbody>
</table>
Nitrogen Loading by Source Sector

- **Agriculture-Manure** (17%)
- **Agricultural Atmospheric Deposition** (6%)
- **Atmospheric Deposition-Mobility, Utilities and Industries** (19%)
- **Atmospheric Deposition-Natural** (1%)
- **Developed Lands-Chemical Fertilizer** (10%)
- **Municipal and Industrial Wastewater** (19%)
- **Atmospheric Deposition to Tidal Waters** (7%)
- **Septic Systems** (4%)
- **Agriculture-Chemical Fertilizer** (15%)
- **Natural Atmospheric Deposition to Tidal Waters** (7%)

Note: Does not include loads from the ocean or tidal shoreline erosion. Wastewater loads are based on measured discharges; other loads are based on an average-hydrology year using the Chesapeake Bay Program Watershed Model Phase 4.3 (Chesapeake Bay Program Office, 2009). Values do not add up to 100% due to rounding.
Phosphorus Loading by Source Sector

- Agriculture-Manure (26%)
- Natural Sources (3%)
- Municipal and Industrial Wastewater (21%)
- Urban/Suburban Runoff and In-stream Sediment (31%)
- Agriculture-Chemical Fertilizer (19%)

Note: Does not include loads from the ocean or tidal shoreline erosion. Wastewater loads are based on measured discharges; other loads are based on an average-hydrology year using the Chesapeake Bay Program Watershed Model Phase 4.3 (Chesapeake Bay Program Office, 2009).

EO 13508 Draft Strategy for Protection and Restoring the Chesapeake Bay
Sediment Loading by Source Sector

- Agriculture (60%)
- Natural Sources (21%)
- Urban/Suburban Runoff and In-stream Sediment (19%)

Note: Does not include loads from the ocean or tidal shoreline erosion. Loads are based on an average-hydrology year using the Chesapeake Bay Program Watershed Model Phase 4.3 (Chesapeake Bay Program Office, 2009).
### Table 8-3. Percent reductions in edge-of-stream loads to achieve urban stormwater WLAs

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Per-acre edge-of-stream % changes in urban stormwater load from a 2009 baseline*</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nitrogen</td>
<td>Phosphorus</td>
<td>Sediment</td>
<td></td>
</tr>
<tr>
<td>District of Columbia</td>
<td>6.6%</td>
<td>29.6%</td>
<td>29.6%</td>
<td></td>
</tr>
<tr>
<td>Delaware</td>
<td>14.3%</td>
<td>18.3%</td>
<td>23.7%</td>
<td></td>
</tr>
<tr>
<td>Maryland**</td>
<td>16.9%</td>
<td>35.7%</td>
<td>37.5%</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>11.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>28.9%</td>
<td>17.7%</td>
<td>7.0%</td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>16.4%</td>
<td>20.8%</td>
<td>32.5%</td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

* Edge-of-stream reductions assumed within the urban stormwater WLAs result from differences in BMP implementation rates between 2009 and the final WIP submission.

** Maryland’s assumed reductions are calculated as the difference between 2009 edge-of-stream loads and Maryland’s final edge-of-stream target loads for urban stormwater WLAs. Maryland derived its final loads using the method outlined in Appendix A of Maryland’s WIP.
Executive Order 13508 - “Chesapeake Bay Protection and Restoration”

- Federal Government is one of the largest land owners
- Signed by President Barack Obama on May 12, 2009
Executive Order 13508 - “Chesapeake Bay Protection and Restoration

- Department of Defense (DoD) is lead on stormwater management practices for Federal facilities (EPA was lead on stormwater guidance documents)

- Dept of Navy (DON) is lead agency for DoD’s Chesapeake Bay Restoration effort

Photo Credit: NASA
Assess properties to determine feasibility of urban retrofit practices

Align cost-effective urban stormwater retrofits and erosion repairs with TMDL goals

Assess and implement non-structural BMPs to control runoff from developed areas

Consider full spectrum of nutrient and sediment sources to assess ideal reduction methods
Craney Island & Southgate Annex

Purpose: *Provide implementation “road map” that identifies Stormwater Management (SM), Erosion Control (EC) and Infrastructure (INF) opportunities and ranks SM’s and EC’s*

*Southgate Annex* on the South Branch of the Elizabeth River, Portsmouth, VA

*Craney Island* near the mouth of the Elizabeth and James Rivers
1. **Pre-Assessment Planning, Site Assessment Strategy**

- **Existing Data Sources Evaluated**
  - CAD, GIS, Aerials

- **Assessment Form Developed**
  - Based on Prioritization Criteria/Detail Required for Concept Design
  - Database Framework Known
Craney Island & Southgate Annex

1. Pre-Assessment Planning, Site Assessment Strategy

- Opportunity Scoring
  - Scoring System for Stormwater Management
    - Category 1: Environmental Improvement Factors
    - Category 2: Benefits
    - Category 3: Constraints
    - Category 4: Relative BMP Cost Factors
  - Scoring System for Erosion Control
    - Location, Extent, Impact, Access, Design
  - No Scoring for Infrastructure
Case Study: Craney Island & Southgate Annex

1. Pre-Assessment Planning, Site Assessment Strategy

Field Preparation

- Print off large maps
- Pocket Rod
- 100’ Tape
- Tape
- Hand Level
- Field metal box
- Field book
- Driver’s Lic
- Passport (or Birth Cert.)
- I-9 Form
- Soil auger
- 2nd camera w/ both cards and charger
- Camera chord
- Lighter power converter
- Geolink
- Thumb drive with important files
- Baker hat
- Itinerary
- Computer

Identify Opportunities to Strengthen Storm Water Management to Comply with EO 13508 – Chesapeake Bay Protection and Restoration at Craney Island, Southgate Annex

N62470-10-D-3000; DO WE19

Michael Baker Jr., Inc.
Maps for Field Work Week of November 1, 2010

Contacts:
Abbi Dorn, PE  770-861-8539
Jake McClean, PE  828-545-3865

Baker
2. Field Assessment

### Site Information

**GENERAL SITE INFORMATION**
- Date: 
- Time: 
- Initials: 
- Location: 
- Restricted area? 
- Path (intersection) 
- Photo IDs: 
- Photo taken: 

**Observed Land Uses (can include)**
- Residential 
- Commercial 
- Green 
- Forest 

**Observed Utilities**
- Fiber Cable 
- Buried Electric 
- Overhead Electric 

**Observed Problems (General Site)**
- Drainage
- Erosion
- Obstructions (subsurface)
- Overgrown vegetation
- Structure damage (fence, tire)

**Drainage Notes:**
- 

**WQ Notes:**
- 

**Infrastructure Notes:**
- 

**Oppportunity Overview (for any SM)**
- Stormwater Management
- BMP Status
- BMP BMP
- BMP BMP
- BMP BMP
- BMP BMP

**Opportunity Information**

**SITE SPECIFIC RECOMMENDATIONS**
- Site ID: 
- Sheet #: 

**Stormwater Management (SM) Opportunities**
- Stormwater Management (SM) Opportunities
- Stormwater Management (SM) Opportunities
- Stormwater Management (SM) Opportunities
- Stormwater Management (SM) Opportunities
- Stormwater Management (SM) Opportunities

**Scoring/Ranking (SM)**

**Ranking (EC)**

*No Ranking for Infrastructure (INF)*
Case Study: Craney Island & Southgate Annex

2. Field Assessment, Site Specific Information

- Date, Site ID, Time, Location...
- Observed Land Uses
- Observed Utilities
- Observed Problems

“Site”

“Opportunity” (multiple within a site)
## Opportunity Overview

<table>
<thead>
<tr>
<th>Stormwater Management (SM) Opportunities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed BMPs:</td>
</tr>
<tr>
<td>Rooftop/Imp. Area Disconnect</td>
</tr>
<tr>
<td>Infiltration</td>
</tr>
<tr>
<td>Dry Extended Detention</td>
</tr>
<tr>
<td>Flow to open space/filter strip</td>
</tr>
<tr>
<td>Bioretention</td>
</tr>
<tr>
<td>Regional pond</td>
</tr>
<tr>
<td>Grass Channels</td>
</tr>
<tr>
<td>Dry swale</td>
</tr>
<tr>
<td>Level spreader</td>
</tr>
<tr>
<td>Soils compost amendments</td>
</tr>
<tr>
<td>Wet swale</td>
</tr>
<tr>
<td>Underground detention</td>
</tr>
<tr>
<td>Vegetated Roofs</td>
</tr>
<tr>
<td>Filtering practice</td>
</tr>
<tr>
<td>Oil/grit separator</td>
</tr>
<tr>
<td>Rainwater harvesting</td>
</tr>
<tr>
<td>Constructed wetlands</td>
</tr>
<tr>
<td>Tree box filter</td>
</tr>
<tr>
<td>Permeable pavement</td>
</tr>
<tr>
<td>Wet ponds</td>
</tr>
<tr>
<td>Other: ________________</td>
</tr>
<tr>
<td>Existing BMPs: Yes/No</td>
</tr>
<tr>
<td>Maintenance Required: Yes/No</td>
</tr>
</tbody>
</table>
## Erosion Control (EC) Opportunities:

<table>
<thead>
<tr>
<th>Landscape Position:</th>
<th>Uplands</th>
<th>Other: ________________</th>
</tr>
</thead>
</table>

### Stream Specific Questions:

<table>
<thead>
<tr>
<th>Perennial</th>
<th>Ephemeral</th>
<th>Intermittent</th>
</tr>
</thead>
</table>

### Qualitative Reach Wide Erosion Status:

<table>
<thead>
<tr>
<th>Severe &gt; 50%</th>
<th>Moderate</th>
<th>Minimal or None (&lt;10%)</th>
</tr>
</thead>
</table>

**Problem Description:** ______________________________________________________

**Prescribed Solution:** ______________________________________________________

## Infrastructure (INF) Opportunities:

### Type:

- Repair/Replacement
- Maintenance/Enhancement

### Opportunity Type:

- Reconstruct feature
- Gutter repair
- Preventative maintenance
- Unpaved road
- Sediment removal
- Debris removal
- Utility protection
- Structure repair
- Demo

**Problem Description:** ______________________________________________________
Case Study: Craney Island & Southgate Annex

2. Field Assessment Ranking Categories

- **Environmental Improvement Factors**
  - Impervious Area
  - Land Use
  - (33%)

- **Benefits**
  - Water Quantity
  - Water Quality
  - Env. Benefits
  - (33%)

- **Constraints**
  - Space
  - Access
  - Utilities
  - Engineering
  - Construction
  - Maintenance
  - (33%)

- **Relative BMP Cost Factors**
## Case Study: Craney Island & Southgate Annex

<table>
<thead>
<tr>
<th>Category</th>
<th>Scoring Elements</th>
<th>Maximum Element Score</th>
<th>Maximum Category Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Improvement Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contributing Impervious Drainage Area</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Stormwater Benefits from Existing Landscape</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Land Use</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Receiving Water Sensitivity</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Nitrogen, Phosphorous, and Solids Removal</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Runoff Reduction</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Environmental Benefits</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tree and Vegetation Loss Minimization</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Constraints</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Construction Access</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Utility Conflicts</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Engineering Design Issues</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Relative BMP Cost Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Construction Cost</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Maintenance Burden/Cost</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total Maximum Possible Score:</strong></td>
<td>150</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fatal Flaws** - Considerations that may preclude certain opportunities from being viable, as described at the beginning of Appendix A

F
3. Data Development

- Wrestling with the data...
3. Data Development

- Pinning down the data...
Case Study: Craney Island & Southgate Annex

4. Report Production (Primary Deliverable!)

Opportunity: 04-SM-1
Location: Engineering Building (Building 288) southwest of intersection of Waterfront Rd and North Butler Rd, the parking lot immediately south of the building, and both parking lots west of the building
Description: Upgrade the existing culverts to provide stormwater benefits of a vegetated channel, wetland area also possible
Cost Estimate: $10,500
Rank: 79

Opportunity: 04-SM-2
Location: Engineering Building (Building 288) southwest of intersection of Waterfront Rd and North Butler Rd, the parking lot immediately south of the building, and both parking lots west of the building
Description: Downspout disconnection to free box filter or rain garden, sediment also possible
Cost Estimate: $9,000
Rank: 40

Opportunity: 04-SM-3
Location: Engineering Building (Building 288) southwest of intersection of Waterfront Rd and North Butler Rd, the parking lot immediately south of the building, and both parking lots west of the building
Description: Install of water separator to treat pollutants from circular traffic
Cost Estimate: $75,000
Rank: 62

Opportunity: 04-SM-4
Location: Engineering Building (Building 288) southwest of intersection of Waterfront Rd and North Butler Rd, the parking lot immediately south of the building, and both parking lots west of the building
Description: Remove parking and install permeable pavements. While possible, this is probably not a feasible solution given the relatively good condition of the existing surface
Cost Estimate: $154,300
Rank: 34
## Case Study: Craney Island & Southgate Annex

4. Report Production (Primary Deliverable!)

### Southgate Annex Top 20 of 28 By Rank

<table>
<thead>
<tr>
<th>ProjectID</th>
<th>Improvement</th>
<th>Cat1</th>
<th>Cat2</th>
<th>Cat3</th>
<th>Cat4</th>
<th>Fatal Flaw</th>
<th>Score</th>
<th>Rank</th>
<th>Rank</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-SM-1</td>
<td>Impervious cover conversion</td>
<td>32</td>
<td>50</td>
<td>12</td>
<td>14</td>
<td>108</td>
<td>1</td>
<td>1</td>
<td>1/28</td>
<td>$81,300</td>
</tr>
<tr>
<td>03-SM-1</td>
<td>Impervious cover conversion</td>
<td>22</td>
<td>50</td>
<td>20</td>
<td>14</td>
<td>106</td>
<td>2</td>
<td>2</td>
<td>2/28</td>
<td>$36,000</td>
</tr>
<tr>
<td>08-SM-1</td>
<td>Impervious cover conversion</td>
<td>22</td>
<td>50</td>
<td>20</td>
<td>14</td>
<td>106</td>
<td>2</td>
<td>2</td>
<td>2/28</td>
<td>$57,000</td>
</tr>
<tr>
<td>08-SM-2</td>
<td>Impervious cover conversion</td>
<td>22</td>
<td>50</td>
<td>20</td>
<td>14</td>
<td>106</td>
<td>2</td>
<td>2</td>
<td>2/28</td>
<td>$84,000</td>
</tr>
<tr>
<td>08-SM-5</td>
<td>Forest buffer establishment</td>
<td>32</td>
<td>30</td>
<td>23</td>
<td>20</td>
<td>105</td>
<td>5</td>
<td>5</td>
<td>5/28</td>
<td>$23,400</td>
</tr>
<tr>
<td>08-SM-4</td>
<td>Forest buffer establishment</td>
<td>27</td>
<td>30</td>
<td>23</td>
<td>20</td>
<td>Y</td>
<td>100</td>
<td>6</td>
<td>6/28</td>
<td>$27,000</td>
</tr>
<tr>
<td>08-SM-3</td>
<td>Forest buffer establishment</td>
<td>32</td>
<td>30</td>
<td>15</td>
<td>20</td>
<td>97</td>
<td>7</td>
<td>7</td>
<td>7/28</td>
<td>$36,800</td>
</tr>
<tr>
<td>06-SM-1</td>
<td>Infiltration (micro scale)</td>
<td>15</td>
<td>48</td>
<td>24</td>
<td>8</td>
<td>95</td>
<td>8</td>
<td>8</td>
<td>8/28</td>
<td>$43,500</td>
</tr>
<tr>
<td>04-SM-1</td>
<td>Dry swale (or bioretention if enough head)</td>
<td>35</td>
<td>33</td>
<td>14</td>
<td>11</td>
<td>93</td>
<td>9</td>
<td>9</td>
<td>9/28</td>
<td>$90,800</td>
</tr>
<tr>
<td>01-SM-2</td>
<td>Flow to open space/filter strip</td>
<td>32</td>
<td>30</td>
<td>12</td>
<td>14</td>
<td>Y</td>
<td>88</td>
<td>10</td>
<td>10/28</td>
<td>$78,000</td>
</tr>
<tr>
<td>05-SM-3</td>
<td>Wet swale</td>
<td>32</td>
<td>20</td>
<td>22</td>
<td>11</td>
<td>85</td>
<td>11</td>
<td>11</td>
<td>11/28</td>
<td>$75,300</td>
</tr>
<tr>
<td>07-SM-4</td>
<td>Soil ammendment and revegetated</td>
<td>22</td>
<td>20</td>
<td>25</td>
<td>17</td>
<td>84</td>
<td>12</td>
<td>12</td>
<td>12/28</td>
<td>$10,200</td>
</tr>
<tr>
<td>02-SM-2</td>
<td>Constructed wetland</td>
<td>37</td>
<td>20</td>
<td>12</td>
<td>14</td>
<td>83</td>
<td>13</td>
<td>13</td>
<td>13/28</td>
<td>$35,700</td>
</tr>
<tr>
<td>06-SM-2</td>
<td>Forest buffer establishment</td>
<td>15</td>
<td>28</td>
<td>20</td>
<td>20</td>
<td>Y</td>
<td>83</td>
<td>13</td>
<td>13/28</td>
<td>$23,400</td>
</tr>
<tr>
<td>01-SM-3</td>
<td>Wet swale</td>
<td>32</td>
<td>20</td>
<td>17</td>
<td>11</td>
<td>80</td>
<td>15</td>
<td>15</td>
<td>15/28</td>
<td>$70,500</td>
</tr>
<tr>
<td>02-SM-1</td>
<td>Wet swale</td>
<td>37</td>
<td>20</td>
<td>10</td>
<td>11</td>
<td>78</td>
<td>16</td>
<td>16</td>
<td>16/28</td>
<td>$96,200</td>
</tr>
<tr>
<td>03-SM-2</td>
<td>Wet swale</td>
<td>27</td>
<td>20</td>
<td>19</td>
<td>11</td>
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<td>30</td>
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<td>14</td>
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## Case Study: Craney Island & Southgate Annex

### 4. Report Production (Primary Deliverable!)

#### Craney Island Top 30 of 85 by Rank

<table>
<thead>
<tr>
<th>Project ID</th>
<th>Improvement</th>
<th>Cat1</th>
<th>Cat2</th>
<th>Cat3</th>
<th>Cat4</th>
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<td>20</td>
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<td>$8,000</td>
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<td>28</td>
<td>17</td>
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<td>81</td>
<td>22 / 85</td>
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<td>28</td>
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<td>14</td>
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<td>81</td>
<td>22 / 85</td>
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<td>27-SM-2</td>
<td>Flow to open space/filter strip</td>
<td>22</td>
<td>28</td>
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<td>81</td>
<td>22 / 85</td>
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<tr>
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<td>28</td>
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<td>20</td>
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<td>17</td>
<td>14</td>
<td></td>
<td>79</td>
<td>27 / 85</td>
<td>$29,400</td>
</tr>
</tbody>
</table>
4. Concept Plans

- **Potential Inlet #2** - Condition is good.
- **Potential Inlet** - Impervious cover conversion.
- **Remove** - Concrete, loosen in situ soils to depth of X", and amend top 12" with 6" of compost.
- **Potential to use** - Rubble generated from removal to supplement existing riprap erosion control on river front.

**Notes:**
- Topography and base mapping depicted is a combination of CADD and GIS information provided by Naval Facilities for this project. Aerial photography has been manipulated to fit to base mapping and is not georeferenced or to scale.

**Potential Inlet:**
- **191**
- **192**
- **Waterfront Drive**
- **SM-2** 1600 SQ FT
- **SM-3**
- **SM-4** 4200 SQ FT

**Inlet Aerial:**
- From external source to depict new building at site.

**Filter Strip:**
- Amend adjacent soils and vegetation (or at least veg mgmt) between impervious concrete pad and inlet (assume 30' width x 60' length; actual amended area depends on inlet used).
<table>
<thead>
<tr>
<th>Rank</th>
<th>Proj. ID</th>
<th>Improvement</th>
<th>Cost</th>
</tr>
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<tbody>
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<td>Impervious Cover Conversion</td>
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</table>
Southgate Annex Select Results-Top 5 Opportunities

Site 1: 01-SM-1 Impervious Cover Conversion
## Craney Island - Top 5 Opportunities

<table>
<thead>
<tr>
<th>Rank</th>
<th>Proj. ID</th>
<th>Improvement</th>
<th>Cost</th>
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<tbody>
<tr>
<td>1 / 85</td>
<td>28-SM-1</td>
<td>Forest Buffer Establishment</td>
<td>$8,200</td>
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<td>3 / 85</td>
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<td>3 / 85</td>
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<tr>
<td>5 / 85</td>
<td>09-SM-3</td>
<td>Impervious Cover Conversion</td>
<td>$17,500</td>
</tr>
</tbody>
</table>
Craney Island Select Results - Top 5 Opportunities

Site 9

09-SM-3 | Impervious Cover Conversion
Project Highlights

- Enhancements to the existing prioritization
  - Favor sustainable approaches such as LID
  - Incorporate water quantity reduction as a ranking element
  - Include consideration of habitat for aquatic and terrestrial resources
  - Incorporate the “cost” component of cost-effectiveness into the ranking
  - Development of “fatal flaw” concept to flag opportunities that should not be pursued
Project Highlights

- Development and Automation of high quality opportunity information sheets
  - Prioritization metrics
  - Photographs
  - and maps!
Project Highlights – Field Data Collection Automation

- **GEOLINK: Baker’s GPS/GIS Data Collection System**
  - Take georeferenced photos
  - Sketch shape files
  - Input all “form” data – gets formatted
  - Directly into a database structure!!
  - Eliminates lengthy post processing
  - Eliminates errors
  - Still need paper forms!
Presenters

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