Creating Value...

... Delivering Solutions

Innovations in Stormwater Master Planning for the Town of Cary, NC

Scott W. Brookhart, P.E., CFM
“At the Town of Cary, we focus every day on enriching the lives of our citizens by creating an exceptional environment and providing exemplary services that enable our community to thrive and prosper.”

- #1 in Quality of Life among Major Markets
  Portfolio.com/bizjournals, May 2010
- #1 Top Business Climate (North Carolina)
  Site Selection, November 2008
- #1 among America’s Most Wired Cities
  Forbes.com, March 2010
- #8 Best Place to Live
  RelocateAmerica.com, April 2010
5 PRIMARY WATERSHEDS

POPULATION
148,000

GROWTH
4%-5% Annually
Stormwater Master Plan (SWMP) Objectives

- **Summarize** the Town’s existing stormwater management program
- **Investigate** key components of stormwater as it relates to the Town
- **Identify** future stormwater management opportunities
- **Establish** and **define** tools that advance the stormwater program
- **Provide** a foundation for the future
Components of Stormwater Master Plan

- Introduction & Background
- Define Existing Stormwater Program
- Water Quantity
- Water Quality
- Findings & Opportunities
- Economic Analysis & Funding
- Toolbox
THREE NON-FEMA STREAMS ASSESSED
Coles Branch, Swift Creek Trib, and Walnut Creek
LIDAR Acquisition/FFE Determination

MOBILE LiDAR/PHOTOS ACQUIRED ON 700 STRUCTURES IN TOWN CENTER AREA AROUND FLOODPLAINS
Cary Risk Assessment – Flood Prone Structures

- Townwide – 743 buildings touching or within 500-year boundary
- 178 buildings identified within the Town Center study area
- Information collected from GIS on structures
  - Tax parcel data
  - Ground LiDAR used to determine LAG and HAG, FFE from Mobile LiDAR, Photo
  - Land classification, building value
### Cary Risk Assessment – Floodprone Structures

#### Location in Floodplain

<table>
<thead>
<tr>
<th>Location in Floodplain</th>
<th>No. of Primary Buildings</th>
<th>Approx. Building Value ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Mapped Floodway</td>
<td>46</td>
<td>$41</td>
</tr>
<tr>
<td>Surrounded by Mapped Floodplain</td>
<td>224</td>
<td>$73</td>
</tr>
<tr>
<td>Touches a Mapped Floodplain</td>
<td>473</td>
<td>$252</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>743</strong></td>
<td><strong>$366</strong></td>
</tr>
</tbody>
</table>

#### Floodplain Designation

<table>
<thead>
<tr>
<th>Floodplain Designation</th>
<th>No. of Primary Buildings</th>
<th>Approx. Building Value ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-yr Floodplain (Existing Conditions)</td>
<td>462</td>
<td>$173</td>
</tr>
<tr>
<td>100-yr Floodplain (Future Conditions)</td>
<td>86</td>
<td>$60</td>
</tr>
<tr>
<td>500-yr Floodplain</td>
<td>195</td>
<td>$132</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>743</strong></td>
<td><strong>$366</strong></td>
</tr>
</tbody>
</table>

#### Land Classification

<table>
<thead>
<tr>
<th>Land Classification</th>
<th>No. of Primary Buildings</th>
<th>Percent of Total (by No. of Buildings)</th>
<th>Approx. Building Value ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Residential</td>
<td>602</td>
<td>81%</td>
<td>$153</td>
</tr>
<tr>
<td>Commercial</td>
<td>29</td>
<td>4%</td>
<td>$91</td>
</tr>
<tr>
<td>Golf Course</td>
<td>15</td>
<td>2%</td>
<td>$87</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>2%</td>
<td>$18</td>
</tr>
<tr>
<td>Apartment/Condo/Townhouse</td>
<td>15</td>
<td>2%</td>
<td>$7</td>
</tr>
<tr>
<td>Manufactured Home Park</td>
<td>65</td>
<td>9%</td>
<td>$10</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>743</strong></td>
<td><strong>100%</strong></td>
<td><strong>$366</strong></td>
</tr>
<tr>
<td>Label</td>
<td>Condition</td>
<td>Metric</td>
<td>Weight</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Finished Floor (FF) Flooding - Moderate</td>
<td>Flood elevation above FF</td>
<td>35%</td>
</tr>
<tr>
<td>B</td>
<td>Finished Floor (FF) Flooding - Major</td>
<td>Additional weight for FF flooding &gt; 2'</td>
<td>25%</td>
</tr>
<tr>
<td>C</td>
<td>Flooding Surrounds Building</td>
<td>Building is surrounded by flood waters</td>
<td>25%</td>
</tr>
<tr>
<td>D</td>
<td>Flooding at Building - Moderate</td>
<td>Flood elevation above lowest adjacent grade (LAG)</td>
<td>5%</td>
</tr>
<tr>
<td>E</td>
<td>Flooding at Building - Major</td>
<td>Additional weight of LAG flooding =&gt; 3'</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Totals / Maximum Scores</strong></td>
<td></td>
<td></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
## Assessment – Flood Risk Adjustment Factors

<table>
<thead>
<tr>
<th>Label</th>
<th>Condition</th>
<th>Description</th>
<th>Adjustment to Raw Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Critical Facility or High-Occupancy Facility</td>
<td>Flooding of hospitals, treatment plants, multifamily residences that would increase importance or impact more people</td>
<td>20%</td>
</tr>
<tr>
<td>F2</td>
<td>Located in Floodway</td>
<td>Building located in floodway</td>
<td>10%</td>
</tr>
<tr>
<td>F3</td>
<td>Has Previous Documented Flooding</td>
<td>Building/Property is Repetitive Loss structure or has had previous flooding complaint</td>
<td>3%</td>
</tr>
<tr>
<td>F4</td>
<td>Significant Property Improvements Flooding</td>
<td>Property with significant exterior property improvements that would be damaged by floodwaters</td>
<td>2%</td>
</tr>
</tbody>
</table>
A single-family residential house with typical property improvements meets the following characteristics:

- Experiences moderate finished floor starting in the 25-yr storm event, but never more than 2 feet in any of the larger defined storm events (i.e. 50- and 100-yr events)
- Completely surrounded by the mapped 100-yr floodplain
- Experiences moderate flooding at the lowest portion of the building starting at the 10-yr storm event, and starts to experience major (i.e. => 3’) flooding at the building in the 100-yr event
- Not a critical facility
- Not located in a mapped floodway
- Has drainage requests associated with flooding
RESULTS

Cary Flood Risk Assessment

Flood Risk Score of >100 indicates a significant Risk

<table>
<thead>
<tr>
<th>Risk Score</th>
<th>No. of Primary Buildings</th>
<th>Percent of Total (by No. of Buildings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 500</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>201 - 500</td>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>101 - 200</td>
<td>6</td>
<td>3%</td>
</tr>
<tr>
<td>81 - 100</td>
<td>9</td>
<td>5%</td>
</tr>
<tr>
<td>51 - 80</td>
<td>33</td>
<td>19%</td>
</tr>
<tr>
<td>11 - 50</td>
<td>42</td>
<td>24%</td>
</tr>
<tr>
<td>1 - 10</td>
<td>19</td>
<td>11%</td>
</tr>
<tr>
<td>0</td>
<td>64</td>
<td>36%</td>
</tr>
</tbody>
</table>

LEGEND

- Building Risk Score:
  - 0
  - 1 - 10
  - 11 - 50
  - 51 - 80
  - 81 - 100
  - 101 - 200
  - 201 - 500
  - > 500

- Drainage Complaints:
  - Other
  - Drainage
  - Erosion
  - Flooding

- 100-yr Flood Depth:
  - < 0.5'
  - 0.5' - 1'
  - 1' - 3'
  - 3' - 6'
  - > 6'
Figure 3.15 TCAP Flood Risk - Swift Creek

LEGEND

Building Risk Score
- 0
- 1 - 10
- 11 - 50
- 51 - 80
- 81 - 100
- 101 - 200
- 201 - 600
- > 600

Drainage Complaints
- Other
- flooding
- erosion
- drainage
- Repetitive Loss Structures

100-yr Flood Depth
- < 0.5
- 0.5 - 1'
- 1' - 3'
- 3' - 6'
- > 6'

Map Date: September 2012

SWIFT CREEK TRIBUTARY 7
Figure 3.16 TCAP Flood Risk - Walnut Creek
Cary Risk Assessment - Advantages

- Cost effective
- Covers areas outside FEMA SFHAs
- Refined analysis over the “in or out”
- Provides a basic ranking tool that can be repeated easily
- Flexible, and other pieces can be added to risk factors
- Stays simple and allows for individual property assessment
- Sets the stage for outreach and mitigation
Actions Recommended to Town Council

- Use Risk Assessment results to help target outreach and education efforts
  - Target high-risk and moderate-risk properties
    - Using SWMP data and future FEMA/NCFMP flood risk data
  - Educate property owners on risk and NFIP
  - Provide literature and other education information (FEMA and Town-generated)
Establish a “Quick Buy” Program

- Program to purchase houses, post disaster, at damaged price - Voluntary program for citizens
- Property owners would receive insurance payment for the difference between the damaged and undamaged value
- Modeled after the City of Charlotte program
- Removes high-risk properties from future damage
- Estimated potential impact
  - Based on TCAP – 6% of homes are high risk
  - Extrapolated Property Values at risk – $10.8 million
Stormwater Management Toolbox

- **Why a Toolbox?**
  - Complex regulatory environment (multiple watersheds)
  - Aid Town and community in decision making
  - Assists staff in educating community
### BMP Toolbox

#### Stormwater Wetland

**DESCRIPTION**

Stormwater Wetlands are engineered and constructed wetlands that have similar functions and processes of natural wetlands for treating stormwater. Stormwater Wetlands use physical, chemical, and biological processes to provide pollutant and nutrient removal to stormwater runoff.

**TYPICAL USERS**

- **Pollutant removal**
  - Total Suspended Solids: 85%
  - Metals (Cadmium, Copper, Zinc): Medium
  - Pathogens (Coliform, Streptococci): Medium
  - Oil, Grease, and Hydrocarbons: Medium

**STORMWATER BENEFITS**

- Peak Runoff Attenuation: Yes
- Runoff Volume Reduction: Yes
- Rainwater Harvesting: No
- Infiltration: No

**NEUSE NUTRIENT PERCENT REMOVAL**

- Total Nitrogen (TN): 40%
- Total Phosphorus (TP): 35%

**SECONDARY BENEFITS**

- Aesthetic Potential: High
- Dual Use: Low
- Natural Habitat Function: High
- Natural Appearance: High
- Groundwater Recharge: Medium
- Temperature Reduction: Medium

**JORDAN LAKE NUTRIENT EFFLUENT CONC.**

- Volume Reduction Percent: 120%
- TN Effluent Concentration (mg/L): 1.08
- TP Effluent Concentration (mg/L): 0.12

**WATERSHED IMPLEMENTATION BENEFITS**

<table>
<thead>
<tr>
<th>Neuse River Basin</th>
<th>Implementation Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutant Removal</td>
<td>Nutrient Removal</td>
</tr>
<tr>
<td>High</td>
<td>Water Quantity Reduction</td>
</tr>
<tr>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Swift Creek Watershed (Neuse Sub-watershed)</th>
<th>Implementation Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutant Removal</td>
<td>Nutrient Removal</td>
</tr>
<tr>
<td>High</td>
<td>Water Quantity Reduction</td>
</tr>
<tr>
<td>High</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Jordan Lake Watershed</th>
<th>Implementation Considerations</th>
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</thead>
<tbody>
<tr>
<td>Pollutant Removal</td>
<td>Nutrient Removal</td>
</tr>
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<td>High</td>
<td>Water Quantity Reduction</td>
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<tr>
<td>High</td>
<td></td>
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</table>

**IMPLEMENTATION CONSIDERATIONS**

- Land Required: High
- Size of Treatable Drainage Area: Large
- Maintenance Burden: Medium
- Constructability Issues: Medium
- Public Safety Concerns: Medium
- Groundwater Proximity Required: High
- Groundwater Avoidance Required: Low
- Retrofit Opportunity: Low
- Residential/Subdivision Use: High
- Urban/High Density Development: Low
Questions & Answers