Project Team

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Economic Context

- A solid economic plan is necessary for the successful implementation of new stormwater programs,
- Without which any new or proposed programs are likely to fail especially under the current economic conditions.
- It is important to understand the economic benefits of combining Gray and Green Infrastructure are many and include
  - Reduction of energy usage costs for heating and cooling
  - Decreased impervious cover and stormwater runoff.
  - Reduction in stress and increased resilience for municipal stormwater infrastructure (culverts, bridges, sewers)
  - Reduction of energy and infrastructure costs for stormwater and CSO management
Presentation Concept

• The environmental and water quality benefits of LID are well established,

• However, there are considerable economic, infrastructure, and adaptation planning benefits that are NOT WELL KNOWN from using LID-based strategies.
• LID may add expense on a systems basis, however cost savings are often realized on an overall project basis as the need for conventional stormwater infrastructure such as curbing, catch-basins, piping, ponds, and other controls are reduced.

• Cost savings are **not** seen when compared with **no** stormwater management.

• With new state and federal permitting requirements addressing volume and pollutant reduction, new construction and redevelopment projects requiring no stormwater controls are increasingly rare.
Residential— Boulder Hills
Commercial---Greenland Meadows
LID Retrofit--- UNH Parking Lot

COMMERCIAL AND RESIDENTIAL ECONOMIC CASE STUDIES FOR LID PRACTICES
Boulder Hills, Pelham, NH

- 2009 Installation of 900’ of first PA private residential road in Northeast
- Site is nearly Zero discharge
- LID subdivision 55+ Active Adult Community
- Large sand deposit
- Cost 25% greater per ton of asphalt however resulted in total project savings
Conventional Site Design

LID Design
• Built on 9% grade
• Avoided use of 1616’ of curbing, 785’ pipe, 8 catch-basins, 2 detention basins, 2 outlet control structures
• 1.3 acres less of land clearing
• Conventional SWM=$789,500 vs LID SWM=$740,300, $49,000 savings (6.2%)
Comparison of Unit Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Conventional</th>
<th>LID</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE PREPARATION</td>
<td>$23,200.00</td>
<td>$18,000.00</td>
<td>-$5,200.00</td>
</tr>
<tr>
<td>TEMP. EROSION CONTROL</td>
<td>$5,800.00</td>
<td>$3,800.00</td>
<td>-$2,000.00</td>
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<tr>
<td>DRAINAGE</td>
<td>$92,400.00</td>
<td>$20,100.00</td>
<td>-$72,300.00</td>
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<td>ROADWAY</td>
<td>$82,000.00</td>
<td>$128,000.00</td>
<td>$46,000.00</td>
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<tr>
<td>DRIVEWAYS</td>
<td>$19,700.00</td>
<td>$30,100.00</td>
<td>$10,400.00</td>
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<td>CURBING</td>
<td>$6,500.00</td>
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<td>-$6,500.00</td>
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<tr>
<td>PERM. EROSION CONTROL</td>
<td>$70,000.00</td>
<td>$50,600.00</td>
<td>-$19,400.00</td>
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<tr>
<td>ADDITIONAL ITEMS</td>
<td>$489,700.00</td>
<td>$489,700.00</td>
<td>$0.00</td>
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<tr>
<td>BUILDINGS</td>
<td>$3,600,000.00</td>
<td>$3,600,000.00</td>
<td>$0.00</td>
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<tr>
<td>PROJECT TOTAL</td>
<td>$4,389,300.00</td>
<td>$4,340,300.00</td>
<td>-$49,000.00</td>
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</table>

6% savings on total cost of SW infrastructure for a ~zero discharge site
Greenland Meadows Commercial, Greenland, NH

- “Gold-Star” Commercial Development
- Cost of doing business near Impaired Waters/303D
- Saved $900k in SWM on costly piping and advanced SWM proprietary
- Brownfields site, ideal location, 15yrs
- Proposed site >10,000 Average Daily Traffic count on >30 acres
Greenland Meadows
### Comparison of Unit Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Conventional Option</th>
<th>LID Option</th>
<th>Cost Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOBILIZATION / DEMOLITION</td>
<td>$555,500</td>
<td>$555,500</td>
<td>$0</td>
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<tr>
<td>SITE PREPARATION</td>
<td>$167,000</td>
<td>$167,000</td>
<td>$0</td>
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<tr>
<td>SEDIMENT / EROSION CONTROL</td>
<td>$378,000</td>
<td>$378,000</td>
<td>$0</td>
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<tr>
<td>EARTHWORK</td>
<td>$2,174,500</td>
<td>$2,103,500</td>
<td>$71,000</td>
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<td>PAVING</td>
<td>$1,843,500</td>
<td>$2,727,500</td>
<td>$884,000</td>
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<td>STORMWATER MANAGEMENT</td>
<td>$2,751,800</td>
<td>$1,008,800</td>
<td>$1,743,000</td>
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<tr>
<td>ADDITIONAL WORK-RELATED ACTIVITY (utilities, lighting, water &amp; sanitary sewer service, fencing, landscaping, etc.)</td>
<td>$2,720,000</td>
<td>$2,720,000</td>
<td>$0</td>
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<tr>
<td>PROJECT TOTAL</td>
<td>$10,590,300</td>
<td>$9,660,300</td>
<td>$930,000</td>
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</table>
LID Retrofit: UNH Parking Lot Bioretention

- Simple, used existing infrastructure and median
- $14,000/acre retrofit for everything
- Labor and install was $8500/ac
- Materials and plantings $5500/ac
- Model partnership
Narragansett Bay Commission
Portland, Oregon
Kansas City, Missouri
Chicago, Illinois

LID PRACTICES FOR CSO MANAGEMENT
Narragansett Bay Commission: a Baseline Gray infrastructure approach to CSO management

- NBC RI has completed construction of six miles of underground storage tunnels at a projected cost of $467 million (1992 dollars).
- Tunnels store the sewage overflows during intense rain events for later treatment.
- Tremendous long-term costs for store, pump, treat.
- Does not address increased storm size.
Portland, Oregon

For the City of Portland, utilizing green streets is the preferred strategy for helping relieve sewer overflow conditions because it is the most cost-effective and eliminates the need for expensive below-ground repairs, which often involve replacing infrastructure.
A National Leader

GOALS OF WWF Control Program

• Capturing and detaining stormwater runoff as close to the source as possible;
• Reducing the volume of stormwater entering the combined sewer system;
• Filtering stormwater to remove pollutants before the runoff enters groundwater, streams, or wetlands;
• Using and promoting methods that provide multiple environmental benefits; and
• Using techniques that are less costly than traditional piped solutions.
Tabor to the River: Brooklyn Creek Project

• Program sought to rectify CSO, street and basement flooding

• The original cost estimate using gray infrastructure was $144 million (2009 dollars).

• Gray-Green design including a total of $11 million allocated for green solutions, the cost estimate for this integrated approach was $81 million, a savings of $63 million for the city
<table>
<thead>
<tr>
<th>Project/Program</th>
<th>Effective Imp. Acres Controlled</th>
<th>Est. 3-year Volume Removed (MG)</th>
<th>Capital Cost</th>
<th>Marginal Cost ($/Gallon)</th>
<th>Cumulative Volume Removed (MG)</th>
<th>Cumulative Capital Cost</th>
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<tbody>
<tr>
<td>Extended Downspout Disconnection Program (can include LID)</td>
<td>284</td>
<td>7.45</td>
<td>$6,633,000</td>
<td>$0.89</td>
<td>7.45</td>
<td>$6,633,000</td>
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<td>School Disconnection*</td>
<td>68</td>
<td>1.77</td>
<td>$1,954,000</td>
<td>$1.10</td>
<td>9.22</td>
<td>$8,587,000</td>
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<td>Church Disconnection*</td>
<td>32</td>
<td>0.96</td>
<td>$2,031,000</td>
<td>$2.12</td>
<td>10.18</td>
<td>$10,618,000</td>
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<tr>
<td>Beech-Essex Sewer Separation</td>
<td>37</td>
<td>1.40</td>
<td>$3,889,000</td>
<td>$2.78</td>
<td>11.58</td>
<td>$14,507,000</td>
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<td>ES Curb Extensions (LID)</td>
<td>349</td>
<td>4.29</td>
<td>$12,323,000</td>
<td>$2.87</td>
<td>15.87</td>
<td>$26,830,000</td>
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<td>Tanner Phase 3 Sewer Separation</td>
<td>85</td>
<td>3.10</td>
<td>$10,767,616</td>
<td>$3.47</td>
<td>18.97</td>
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<td>ES Roof &amp; Parking IC (LID)</td>
<td>475</td>
<td>17.64</td>
<td>$72,047,000</td>
<td>$4.08</td>
<td>36.61</td>
<td>$109,645,000</td>
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<td>NWN Pre-design – Tanner North Sewer Separation</td>
<td>14</td>
<td>0.22</td>
<td>$1,127,000</td>
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<td>36.83</td>
<td>$110,772,000</td>
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<td>Carolina Stream &amp; Storm Separation</td>
<td>93</td>
<td>1.02</td>
<td>$5,319,000</td>
<td>$5.21</td>
<td>37.85</td>
<td>$116,091,000</td>
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<td>NWN Pre-design – Tanner South Sewer Separation</td>
<td>13</td>
<td>0.26</td>
<td>$1,602,000</td>
<td>$6.16</td>
<td>38.11</td>
<td>$117,693,000</td>
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<td>NWN Pre-design – Tanner Central Sewer Separation</td>
<td>2</td>
<td>0.04</td>
<td>$269,000</td>
<td>$7.60</td>
<td>38.14</td>
<td>$117,962,000</td>
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<td>NWN Pre-design – Nicolai/Outfall Sewer Separation</td>
<td>34</td>
<td>0.54</td>
<td>$6,321,000</td>
<td>$11.76</td>
<td>38.68</td>
<td>$124,283,000</td>
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<td>NWN Pre-design – Nicolai/Outfall 13 Sewer Separation</td>
<td>52</td>
<td>0.68</td>
<td>$8,217,000</td>
<td>$12.04</td>
<td>39.36</td>
<td>$132,500,000</td>
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<tr>
<td>Green Roof Legacy Project (LID)</td>
<td>20</td>
<td>1.04</td>
<td>$14,179,000</td>
<td>$13.65</td>
<td>40.40</td>
<td>$146,679,000</td>
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<td>NWN Pre-design – Nicolai/Outfall 15 Sewer Separation</td>
<td>24</td>
<td>0.36</td>
<td>$6,546,000</td>
<td>$17.98</td>
<td>40.77</td>
<td>$153,225,000</td>
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<tr>
<td>Holladay Sewer Separation</td>
<td>125</td>
<td>0.69</td>
<td>$14,360,000</td>
<td>$20.94</td>
<td>41.45</td>
<td>$167,585,000</td>
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<td>NWN Pre-design – Balch Neighborhood Sewer Separation</td>
<td>8</td>
<td>0.14</td>
<td>$7,664,000</td>
<td>$55.06</td>
<td>41.59</td>
<td>$175,249,000</td>
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<td>NWN Pre-design – Balch/Forest Park Storm Separation</td>
<td>5</td>
<td>0.13</td>
<td>$12,026,000</td>
<td>$93.82</td>
<td>41.72</td>
<td>$187,275,000</td>
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</tbody>
</table>
LID Avoidance Costs

1. **Annual O&M costs avoidance** to pump and convey stormwater through the existing combined sewer system.
   - The city measures this by applying a rate of $0.0001 per gallon treated and $0.0001 per gallon pumped.

2. **Capital improvement cost avoidance**
   - $4 per gallon is the cost-effectiveness point for projects/programs that remove stormwater volume from the CSO system.
Kansas City, Missouri: Gray & Green Infrastructure

- National Demonstration Project EPA
- KC needs to meet EPA CSO requirements.
- Grey infrastructure (separate, store, and treat) cost ~$6 billion.
- Using 100 acre subwatershed as test site.
- $54 million grey infrastructure at $18/gal
- $35 million of green and gray combination.
- Will reduce overflows to 6X per year and eliminate need for storage
- Will provide distributed storage of 3.5 million gallons
Green solutions considered included:
• catch basin retrofits,
• curb extension swales
• pervious pavement
• street trees,
• green roofs
• stormwater planters.

The city estimated that it should be possible to completely replace two CSO storage tanks with distributed green solutions without increasing costs or reducing CSO control performance.
## Unit Costs for GI

<table>
<thead>
<tr>
<th>GREEN SOLUTION</th>
<th>UNIT COST ($/GAL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catch Basin Retrofits in Road and Street ROW</td>
<td>$2.28-$7.13 (avg $5.00)</td>
</tr>
<tr>
<td>Porous Pavement</td>
<td>$4.62</td>
</tr>
<tr>
<td>Street Trees (Residential)</td>
<td>$10.80</td>
</tr>
<tr>
<td>Street Trees (Commercial)</td>
<td>$23.36</td>
</tr>
<tr>
<td>Curb Extension Swales</td>
<td>$10.86</td>
</tr>
<tr>
<td>Replacement of Sidewalks in ROW with porous pavement</td>
<td>$11.62</td>
</tr>
<tr>
<td>Conversion of Roof Areas to Green Roofs</td>
<td>$22.68</td>
</tr>
<tr>
<td>Stormwater Planters</td>
<td>$26.83</td>
</tr>
</tbody>
</table>

Presentation at the Midwest AWMA Annual Technical Conference (January 2009) by Terry Leeds, Overflow Control Program Manager, Kansas City Water Services Department.
Conclusions

• Substantial economic benefits exist in the use of LID practices
• A range of well documented examples nationwide exist—the process of standardization is underway
• Benefits include real project cost savings
• Benefits extend to municipal, private, and commercial
• Benefits also include increased community resiliency to flooding
About Forging the Link

• FTL is both a training and a resource

• Audience is Municipal Decision Makers, Designers, and Planners

• Products are:
  2. Brief presentation
  3. Training materials
Acknowledgments

National Estuarine Research Reserve Coastal Training Program Coordinators

• Heather Elmer of the old Woman Creek NERR,
• Christine Feurt of the Wells NERR,
• Steve Miller of the great Bay NERR,
• Tonna-Marie Surgeon-Rogers of the Waquoit Bay NERR,
• David Dickson, National NEMO Coordinator;
• LaMarr Clannon, Maine NEMO Coordinator; and Julie Westerlund of Northland NEMO.

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• Bill Owen, P.E., Engineering Services with the City of Portland Bureau of Environmental Services;
• Peter Mulvaney, Sustainable Infrastructure Administrator for the City of Chicago Department of Water Management.

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For More Information

• If you would like to provide review—please contact us

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Questions?