We can’t afford to keep doing this
Green infrastructure
But where do we start?
Tell us...
Ways we are helping communities

1. Economic assessment
2. Technical assistance
3. Product development
Method helps you scope out whether GI is a feasible option for your community to consider.
Economic Assessment

- Setting it up
- Estimating flood damages
- Choosing green infrastructure options
- Estimating green infrastructure costs and benefits
How we assembled our economic assessment
Committed communities
Reliable partners
Best available data *and* information
Flexibility
We laid out a path
How we estimated flood damages
Scale of our study

Site

Neighborhood

Watershed
How much rain now and in the future?
How much water could cause flooding?
Where could flooding occur?
What could flood damages cost?
How we chose green infrastructure options
Many options
Target: reduce peak discharge by

20%  10%

DULUTH  TOLEDO
How much green infrastructure storage is needed to reach this target?

<table>
<thead>
<tr>
<th>DULUTH</th>
<th>TOLEDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 acre-feet (current conditions)</td>
<td>30 acre-feet (current conditions)</td>
</tr>
<tr>
<td>86 acre-feet (future conditions)</td>
<td>32 acre-feet (future conditions)</td>
</tr>
<tr>
<td>Image 1</td>
<td>Image 2</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
</tr>
</tbody>
</table>

What and how much of each?
Worked with our communities to identify
How much are flood damages reduced?
How we estimated green infrastructure benefits and costs
Quantified benefit $ of using green infrastructure

Benefits = Damages Avoided ($)

Benefit of less homes damaged?
Benefit of this happening less?
Estimated unit cost of green infrastructure

$21/cubic foot

$2.90/cubic foot
Toledo and Duluth Uses

- Toledo
  - Secured EPA and GLAA-C funding for bioswales in Silver Creek
  - Outreach and stewardship to residents and businesses

- Duluth
  - Interested in starting a green infrastructure task force and doing more pilots
  - Helping establish criteria for site selection for GI
  - Outreach to homeowners and businesses

Example of bioswale
What Communities Should Consider

• Fill data gaps in what city’s spend on public infrastructure repair and replacement from larger storms

• Implement GI over time and look at longer lasting GI to get larger economic benefit

• Look at existing programs to implement GI like capital improvements plan

• Consider GI as a alternative to gray infrastructure or a supplement to it
Ways we are helping communities

1. Economic assessment report – completed

2. Technical assistance – in progress

3. Product development – just starting
THANK YOU!

Patekka Bannister
City of Toledo
Division of Environmental Services

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NOAA Coastal Services Center
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www.csc.noaa.gov/digitalcoast/publications/climate-change-adaptation-pilot
Extra slides if needed
Flood Impact Scenarios

1. **Current** precipitation and current land use

2. **Future** precipitation and future land use
3. **Current** precipitation and current land use with increased flood storage **using GI**

4. **Future** precipitation and future land use with increased flood storage **using GI**
Hazus Damage Estimates (Current Conditions)

**Flood Depths (1% Annual Chance)**
- Depth (ft)
  - High: 13.13
  - Low: 0.00

**Damage Summary**
- Count = 253
- Max = $52,000
- Total = $738,300

**Property Damage - Building Loss**
- $1 - $15,000
- $15,001 - $30,000
- $30,001 - $45,000
- $45,001 - $60,000
- $60,001 - $75,000
Hazus Damage Estimates (Future Conditions)

**Flood Depths (1% Annual Chance)**
- Depth (ft)
  - High: 15.99
  - Low: 0.00

**Damage Summary**
- Count = 293
- Max = $67,300
- Total = $980,800

**Property Damage - Building Loss**
- Green: $1 - $15,000
- Yellow: $15,001 - $30,000
- Orange: $30,001 - $45,000
- Red: $45,001 - $60,000
- Dark Red: $60,001 - $75,000

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, BC NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013.
Benefits
(What Toledo doesn’t have to spend on damages)

20-year period

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Benefits</th>
<th>Present Value of Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Damages</td>
<td>$38,000</td>
<td>$700,000</td>
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</tbody>
</table>

50-year period

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Benefits</th>
<th>Present Value of Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Damages</td>
<td>$43,082</td>
<td>$1.77M</td>
</tr>
</tbody>
</table>
GI Options of Interest to Toledo

- Bioretention/bioswales along unimproved roads
- Blue Roofs Permeable Pavement (Unimproved Roads)
- Permeable Pavement (Unimproved Roadways Sidewalk)
- Underground Storage
- Parcel Buy-outs (for on site detention)
Green infrastructure reduces the annual chance of a 100-year damaging peak discharge

<table>
<thead>
<tr>
<th>No Green Infrastructure Storage</th>
<th>Green Infrastructure Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current land use/current precipitation: 1%*</td>
<td>Current with green infrastructure providing flood storage: 0.50%*</td>
</tr>
<tr>
<td>Future land use/future precipitation: 1.45*</td>
<td>Future with green infrastructure providing flood storage: 0.71%</td>
</tr>
</tbody>
</table>

*Percent chance that a storm will occur in a year with peak discharge of 1,255 cfs and cause damages