Leveraging Advances in 2D Modeling to Efficiently Assess Impacts of Green Infrastructure

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2014 Pilot Study to answer:

- What are existing conditions flood damages
- What are future conditions flood damages
- What are existing and future flood damages with runoff reductions from Green infrastructure
- Can GI significantly decrease flood inundation and reduce flood damages
- What are quantifiable benefits of flood reduction with GI
- What are co-benefits of GI
Pilot Study Approach
Pilot Study H&H Steps

- EPA CREAT tool to assess climate change impacts on rainfall
- Hydrology - USGS regression equations
- Hydraulics - HEC-RAS
  - Obtain terrain data
  - Develop model schematic in ArcGIS & GeoRAS (streamlines, x-sections)
  - Import model geometry from ArcGIS
  - Refine geometry in HEC-RAS
  - Perform steady state modeling
  - Develop inundation polygons and depth grids
- Future conditions hydrology assumes reduction in peak Q from GI (not explicit modeling of GI)
Pilot Study Results

Scenarios Assessed

– Current precipitation - current land use
– Future precipitation - future land use
– Current with storage
– Future with storage
Silver Creek Results

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
Chester Creek Results

**Flood Depths (1% Annual Chance)**

- **High:** 41.10
- **Low:** 0.00

**Damage Summary**
- **Count:** 22
- **Max:** $95,100
- **Total:** $419,900

**Property Damage - Building Loss**
- $1 - 25,000
- $25,001 - 50,000
- $50,001 - 75,000
- $75,001 - 100,000
- $100,001 - $125,000

*Sources: ESRI, DLNR, NAVTEQ, USGS, Intermap, IPCC, NRCAN, ESRI Japan, METI, ESRI China (Hong Kong), ESRI (Thailand), TomTom, 2013*
A 2\textsuperscript{nd} Pilot Study
Pilot 2 - Objectives

Look at alternatives to increase efficiency of modeling process
Pilot 2 - Scope

- Evaluate application of 2D modeling approach to previous pilot study areas
- Assess existing and future (with and w/out GI) scenarios
- Prepare summary findings and recommendations
Pilot 2 Approach - Simplify the Modeling Effort

• Leverage 2D direct rainfall modeling approach
• Eliminate separate H&H modeling steps
• Reduce data input requirements
• Develop suitable results for comparative purposes
• Utilized TUFLOW GPU

  • Note RAS 5.0 is now an option with addition of DRM
2D Direct Rainfall Modeling (rain on grid)
Direct rainfall for hydrology
The Power of 2D Direct Rainfall Modeling
Chester Creek Topography
Silver Creek Topography
# 1D vs 2D Modeling Steps

<table>
<thead>
<tr>
<th>Data Requirements</th>
<th>1D H&amp;H Approach</th>
<th>2D Direct Rainfall Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrain</td>
<td>Hydro-enforced DEM</td>
<td>Hydro-enforced DEM</td>
</tr>
<tr>
<td>Hydrology</td>
<td>Land use, Soils, Rainfall, Sub-catchment delineations, Peak flow values</td>
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<tr>
<td>Hydraulics</td>
<td>Streamlines, Cross sections, Boundary conditions, Peak discharges &amp; locations</td>
<td>Boundary conditions, Control file (time steps, simulation length)</td>
</tr>
<tr>
<td>Outputs</td>
<td>Inundation extents, Depth, Velocity (with post processing)</td>
<td>Inundation extents (entire catchment), Depth, Velocity, Flow direction/ vectors</td>
</tr>
</tbody>
</table>
Silver Creek – TUFLOW vs HEC-RAS results
Chester Creek – TUFLOW vs HEC-RAS results
Findings & Next Steps

• This approach is a cost effective “before and after” assessment tool
• Requires more enhancement for use in developing regulatory data sets
• Next step is to compute damage calculations for the entire catchment (not just limited HEC-RAS studied reaches)
• Look at viability of other 2D platforms (RAS 5.0)
Takeaways from 2\textsuperscript{nd} Pilot

– Significant decrease in model set up
– Tremendous increase in extent of hydraulic modeling
– Simplified approach has value as a comparative tool
– Results are less predictable in urban areas – attenuation and storage
– Topo quality had large impact on model
– Gage information can add significant value
Questions?

Joe Chapman

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Take Away or Pull Quote Statement
Bullet Text Layout

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Presentation Divider Title
Presentation Divider Sub-Title
Paragraph Text Layout

– Use the Title and Paragraphs slide master when inserting paragraphs of text. The first text level is AECOM Sans 24pt without bullets or a hanging indent. Second level text and higher include bullets like other slide masters.

– Level one text has 18pt of spacing between returns to keep paragraphs of text clearly spaced and easy to read. If space allows, consider shrinking the width of the text box to 3-columns wide using the built in guides for reference. Paragraphs of text are easier to read in narrower columns.
Text and Photo Layout

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Photo and 2-columns Text Layout

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Two Photos and Two Text Layout

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- Level 1 text 20pt AECOM Sans
  - Level 2 bullet 18pt AECOM Sans
- Level 1 text 20pt AECOM Sans
Case Study
Subtitle or Summary of Case Study. Image on left, text on right.

First Level Text for Paragraph Heading
Use the Increase list level button in the Paragraph palette of the Home tab for level two text. Level Two is for paragraphs of text and is set with space after each paragraph.

Paragraph Heading: 16pt of space is added after each paragraph. If you want to have a bold heading on the same line as your regular paragraph, be sure to use Level Two text so spacing is maintained. If you reset the slide, manually applied bold text will disappear, so where possible use the example above: one line title, Level One text, followed by Level Two.

– Level Three text is bulleted
– Space has been added between bullets
– Use the Increase List Level button to access this text level
  • Level Four text is bulleted and indented
  • Use the [tab] key or Increase List Level to access this text level
  • Add an extra return or space before the next paragraph

16pt of space after paragraph was manually added to the last Level Four bullet above.
Level One Text Heading

Level Two Text Subhead or Attribution. Insert picture below.
Thank you for participating!

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