WHERE DID THE CREEK GO?
USING 2D ANALYSIS TO EXAMINE A ZONE ‘A’ WHERE THERE IS NO STREAM

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TFMA Rockwall, Texas
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PURPOSE

To better understand:
when to develop a 2D model,
the benefits of 2D modeling for overland flow,
and how detailed analysis can help make informed decisions about infrastructure improvements
AGENDA

BACKGROUND – How did we get here?
DEVELOPMENT – Show me the models!
IMPACTS – How can we use this?
NEXT – Where do we go from here?
PROJECT LOCATION

CITY CENTER, HURST, TX
AGENDA

BACKGROUND – How did we get here?

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Background

Storm Drain System
Zone ‘A’ Delineation

Hurst, Texas

- 170 acre drainage basin
- 17,000 LF storm drain (36” RCP to 8’x7’ RCB)
- Tributary to Lorean Branch
- SH 183 – Major Road
- Fully Developed Area
  - Hurst City Center
  - Tarrant Community College
  - Commercial
Background

Storm Drain System
Zone ‘A’ Delineation

Hurst, Texas

- Original USGS Quad Map shows a stream
- NFIP 1968
- Area begins to develop in 1960’s and 1970’s
- First Hurst FHBM 1984
- Zone ‘A’ Identified for a stream that was gone
- Continued redevelopment
AGENDA

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Development

The Situation

First step is admitting you have a problem

- Increase in runoff is proportional to increase in development
- Undersized and aging storm drain system
- Flooding of streets and neighborhoods in unmapped areas – overland flow
- Flood damage to private and public properties
- Need to address flooding problems

Money can be thrown at it... an inlet here, a pipe there... but the best plan is to know why it is happening and what needs to be done to fix it.
• Flow runs in multiple directions
• Overland flow patterns are challenging
• Backflow and surcharge
• Detention systems and volumes
• Parallel systems and bifurcations
• Calculation assumptions

Traditional drainage calculations require the engineer to make assumptions about these issues...these may be over-simplified, very conservative, or just plain wrong.
• Hydrology – Uses full hydrograph instead of just peak discharges.
• Hydraulics – Realistic interaction between storm drain/channel and overland areas
  • Complex overland flow directions
  • Break over from one stream/system to another
  • Storage in low-lying areas and impoundments
  • Split flow situations and relief channels
  • Surcharge from conduit to overland system
• Holistic Approach - Look at the system as a whole and optimize the solutions to reduce project costs

Benefits of dynamic analysis
Development

Picking the right approach

Hydrology and hydraulics models are tools

- When is dynamic modeling appropriate?
- Hydraulic models are tools
  - Situation
  - Intent of model
  - Level of detail
  - Level of accuracy

Each tool has its appropriate use. Several tools can achieve the same results. However, what are you really looking for? Can you use what you get?
What do you need to get started?

- As-built or design plans
- Survey*
- GIS data
  - Storm drain lines
  - Storm drain assets
  - Terrain
  - Planimetrics*
  - Landuse
  - Rainfall data
  - Aerials
Let’s talk about 2D modeling

- Link-Node 1D system
- 2D surface
  - Triangle or square mesh
  - Takes on “shape” of terrain
  - Depth, direction, and velocity
  - Uses Manning’s n-values
Development

1D and 2D Analysis

Dynamic 1D/2D modeling is an iterative process

- Improve Node/Link Connectivity (Plans and Survey)
- Adjust Node/Link Elevations (Lower 1D System)
- Generate 2D Mesh from LiDAR and Survey
- Breaklines (Curb, ROW)
- Voids (Structures)
- Set Proper 2D Boundaries
- Improve 1D/2D Interaction
- Monitor Volume Balance
- Computational Stability
Development

2D Analysis
Development

2D Analysis Results

100yr or 1% chance...
<table>
<thead>
<tr>
<th>Hot Spot</th>
<th>Flood Depth (ft)</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Campus Dr and Harwood Rd (public)</td>
<td>1.7</td>
<td>48-in storm drain has insufficient capacity. Inlets are surcharging.</td>
</tr>
<tr>
<td>2. Hurst Conference Center (public)</td>
<td>0.3</td>
<td>8’x4’ storm drain at Thousand Oaks Dr has insufficient capacity. Contributes to inlets are surcharging at Conference Center.</td>
</tr>
<tr>
<td>3. Campus Dr and Thousand Oaks Dr (public)</td>
<td>1.0</td>
<td>8’x4’ storm drain at Thousand Oaks Dr has insufficient capacity. Inlets are surcharging.</td>
</tr>
<tr>
<td>4. Syms Center (private)</td>
<td>4.1</td>
<td>48-in storm drain has insufficient capacity. Inlets are surcharging.</td>
</tr>
<tr>
<td>5. Access Road along HWY 183/121 (public)</td>
<td>2.1</td>
<td>2-7’x3’ storm drain have insufficient capacity. Inlets are surcharging.</td>
</tr>
<tr>
<td>6. Precinct Line and HWY 183/121 (public)</td>
<td>0.7</td>
<td>2-7’x3’ storm drain have insufficient capacity. Inlets are surcharging.</td>
</tr>
</tbody>
</table>
Development

2D Analysis Results

Identified Hot Spots
## Development

**2D Analysis Results**

### Checked Approx. FFE

<table>
<thead>
<tr>
<th>Location</th>
<th>Approx FFE (ft msl)</th>
<th>HGL (ft msl)</th>
<th>WSEL (ft msl)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. EECU Building 1600 Campus Dr</td>
<td>587.5</td>
<td>586.7</td>
<td>587.0</td>
<td>HGL taken at inlet in SW corner of parking lot. WSEL taken at NW corner of building.</td>
</tr>
<tr>
<td>b. Liberty Bank Drive Thru Campus Dr and Thousand Oaks Dr</td>
<td>585.5</td>
<td>586.2</td>
<td>585.2</td>
<td>HGL taken at manhole along Campus Dr. WSEL taken just NW of building.</td>
</tr>
<tr>
<td>c. Syms Center 840 Airport Freeway</td>
<td>586.5</td>
<td>584.6</td>
<td>584.8</td>
<td>HGL taken at manhole. WSEL taken NW corner of building. Flood waters appear to contact the building perimeter.</td>
</tr>
<tr>
<td>d. Abuelo’s Restaurant 824 Airport Freeway</td>
<td>581.5</td>
<td>578.1</td>
<td>578.1</td>
<td>HGL and WSEL taken at inlet located at SW corner of parking lot.</td>
</tr>
</tbody>
</table>
Impacts

Improvement Alternatives

Can we fix it?

“Bottleneck”
Existing 2-7’x5’ RCB
into 2-7’x3’ RCB
Impacts

Improvement Alternatives

Alternative 1 - $2,120,000
Impacts

Improvement Alternatives

Alternative 3 - $2,330,000
Impacts

Improvement Alternatives

Alternative 3 - $2,330,000
Impacts

Improve Alternatives

Highway Improvements

Visuals - Maps

North Tarrant Express Project Map

CONSTRUCTION ACTIVITIES - APRIL 2012
Impacts

Improvement Alternatives

Highway Improvements

North Tarrant Express Hwy Improvements
Impacts

Improvement Alternatives

Alternative 3 revisited

Potential savings $400k
AGENDA

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**Impacts**

**Improved Drainage Information**

Leverage Better Information

**Hurst, Texas**

- Establish more realistic drainage patterns
- Determine root causes of flooding
  - System capacity
  - Backwater effects
  - Significant street flow/ponding
Impacts

Establish Realistic Drainage Patterns

Leverage Better Information

Hurst, Texas

- Look at improvements on a system-wide basis
  - Downstream impact
- Leverage information to engage partners
  - Development
  - TCC Improvements
  - NTE Culverts
- Saved valuable $$ by having timely and accurate information
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Next

Use the 2D modeling to benefit the City
Work to remove the Zone ‘A’

- Improved development regulation
- Construct improvements per plan
- Use modeling as basis for SWU fees
- Remove Zone ‘A’?
  - Regulate based on improved data
  - Zone AE is not appropriate
  - Work with FEMA to remove Zone ‘A’

Understanding the role of the floodplain administrator and using the latest and greatest data can lead to significant savings. Communication between City Engineer and Floodplain Administrator is KEY!
1D/2D dynamic analysis can help FLOODPLAIN ADMINISTRATORS make informed decisions about development which can lead to the design of a better and more cost-effective engineering solutions.
QUESTIONS

Turn around! Don’t drown!