Humble Road Place and Parkland Estates Subdivision Drainage Improvements
A Harris County Engineering Project
Overview of the Drainage Impact Analysis
By Pacheco Koch and Gauge Engineers
Prepared for
TFMA, March 10, 2022

Project Location

Current Floodplain (Pre-Atlas 14)
Topography and Existing Runoff Characteristics

- Flat topography
- Raised roads with bar ditches
- Structure floors below road
- Shallow ditches and small culverts
- Bisected by Railroad, drainage divide
- Used 2D model to determine drainage divides

Historical Flooding

- P133 overflow to P100 (Greens) during Hurricane Harvey
- Localized flooding from events prior to Hurricane Harvey

Existing Drainage Infrastructure

- Limited as built plans
- Storm in Old Humble Road ranging from 24" to 60" RCP
- Cross culverts ranging from 18" to 36" RCP
- Project area characterized by streets higher than lots, shallow ditches and small drive and cross culverts compromised with sediment

Proposed HDR diversion alignment does not affect existing drainage conditions
Existing Utilities and Railroad

- 6 large petrochem lines—tunnel under 42-inch water line along railroad—cross twice with adjustments
- Several crossings of small service lines for gas, telecom, water & sewer
- Railroad—tunnel under two locations

<table>
<thead>
<tr>
<th>Utility Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>SUNOCO 14&quot;, located at Caven south of Laramie</td>
</tr>
<tr>
<td>Gas</td>
<td>SUNOCO 12&quot;, located at Caven south of Laramie</td>
</tr>
<tr>
<td>Gas</td>
<td>MAGELLAN 20&quot;, located east of Dorylee and Smith intersection</td>
</tr>
<tr>
<td>Gas</td>
<td>MAGELLAN 16&quot;, located east of Dorylee and Smith intersection</td>
</tr>
<tr>
<td>Gas</td>
<td>CHEVRON 8&quot;, located east of Dorylee and Smith intersection</td>
</tr>
<tr>
<td>Gas</td>
<td>WESTERN 4&quot;, located east of Dorylee and Smith intersection</td>
</tr>
<tr>
<td>Water</td>
<td>CITY OF HOUSTON 42&quot;, located at RR and Laramie</td>
</tr>
<tr>
<td>Water</td>
<td>CITY OF HOUSTON 42&quot;, located at RR and Dorylee</td>
</tr>
</tbody>
</table>

Problem Statement

- History of known flooding in the area
- Flooding from local drainage
- Flooding from Greens Bayou (P100-00-00) and Tributary P133-00-00
- Overflow from P133 west of Railroad
- Nearly 400 structures flooded during Hurricane Harvey (2017)

Project Goals and Objectives

Project Goal:
Evaluate and recommend a capital project that provides demonstrable flood reduction benefits to the community

Project Objectives:
1. Collect data necessary to perform a detailed analysis
2. Identify and analyze existing flooding sources and extents
3. Perform detailed evaluation of flood reduction options
4. Recommend preferred option
5. Demonstrate No Adverse Impact
Project Challenges

- **Project Schedule**: Compressed schedule meant adjustments to the methodology.
- **Detention Location**: Predetermined detention location.
- **Physical Impediments**: Railroad and major gas line crossings created pinch points.
- **Flat Terrain**: Low pipe & detention elevations and significant TW influence and backflow.
- **Smith Road Diversion**: Large diameter diversion project crossing the proposed improvements.
- **Impact Analysis**: Demonstrating NAI with differing model types and capabilities.

Project Approach

**Used Infraworks ICM** - Given its capabilities with complex 2D overland and 1D subsurface conduit modeling.

**Existing Conditions Modeling**
- Developed 3D model using LiDAR, Plans, Field Data
- Limited existing storm sewer
- Real-world hydrology using Atlas 14 rainfall
- Considered multiplicity sewer crossings
- Developed boundary conditions using effective hydraulics and Atlas 14 hydrology

**Proposed Conditions Modeling**
- Evaluated three (3) preliminary alternatives
  - Alternative 1: improvements to existing roadside ditch and culverts
  - Alternatives 2 & 3: Significant storm sewer improvements with detention
- Added natural and detention improvements to existing conditions ICM model
- Provided more detailed modeling for preferred alternative

Existing Conditions Drainage

- Significant localized flooding due to elevated roads and low-lying structures
- Limited capacity in ditches and restricted crossings
- Flooding from Greens Bayou (P100-00-00) and Tributary P133-03-00 for 10% and 1% AEP
- Overflow from P133 toward Greens Bayou west of railroad
Preliminary Alternatives

- **Alternative 1** - Improved roadside ditch and culverts
- **Alternative 2** - Storm Sewer improvements with trunk alignment on Smith Rd.
- **Alternative 3** - Storm Sewer improvements with trunk alignment on Caven St.

Preliminary Results

- **Alternative 1** - Limited flood reduction
  - Small channel capacity increase
  - Limited depth at the railroad for improved culverts
- **Alternative 2** - Significant flood reduction
  - Much more expensive
  - In conflict with the Smith Rd. diversion
- **Alternative 3** - Significant flood reduction
  - ~5-7% less expensive than Alternative 2
  - Minimize conflict with the Smith Rd. diversion

Overcoming Challenges

**Aggressive Schedule**
- Used ICM Rain-on-Mesh capabilities
- Apply excess rainfall
- Avoid multiple hydrology efforts
- Developed stage hydrographs using effective models
- Effective RAS model with River 14 flows
- Avoid having to build channel models
- Minimized terrain modification
  - Used equivalent pipes for ditches
  - Proposed detention cut out for mesh

**Complex Drainage Issues**
- Predetermined Detention Location
  - Located east of Smith Rd.
  - Rerouting of drainage from P100 to P133
- Physical Impediments (RR and pipelines)
  - Pipe/detention below flood elevations
  - Conflict with the Smith Rd. Diversion

Overcoming Challenges

**Complex ICM Modeling**
- Lower profile boxes under RR and pipelines
- Bypass line flows into 9’x5’ RCB
- Direct high flows to detention basin via weir
- Incorporate diversion into specialty junction
- Add 3 flap gates to prevent backflow
- Optimize detention to mitigate impacts
Overcoming Challenges

Impact Analysis Challenges
- ICM and Greens Bayou model inconsistent
- Atlas 14 vs. pre-Atlas rainfall
- Flows from several outlet locations

Evaluating Impacts
- Combined overland flow from 2D mesh and pipe discharges
- Compared hydrographs for individual receiving channels and combined
- Evaluated increases into receiving channels
- Considered peak flood elevations vs. local system drainage elevations
- Developed 2D depth comparison grids

Questions