LOWER CLEAR CREEK & DICKINSON BAYOU WATERSHED STUDY

Spring 2021 Virtual Public Meeting

Dickinson Bayou Watershed

March 30, 2021 – 6:00 p.m. to 8:00 p.m.
Agenda

1. Introduction
2. Project Purpose & Background
3. Technical Presentation
   a. Hydraulic Modeling
   b. Damage Assessment
   c. Individual Mitigation Concepts
   d. Combination Mitigation Solutions
4. Combination Mitigation Conclusions
5. Funding Partnership Opportunities
6. Path Forward
7. Instructions for Follow-Up Questions/Comments
Introduction

John Baumgartner
City Manager, League City
### Key Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>John Baumgartner</td>
<td>City Manager</td>
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<tr>
<td>Anthony Talluto</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Chuck Wolf</td>
<td>Project Director</td>
</tr>
<tr>
<td>Brian Gettinger</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Jim Keith</td>
<td>Technical Lead</td>
</tr>
<tr>
<td>Boris Minot</td>
<td>Modeling Lead</td>
</tr>
<tr>
<td>Rachel Massey</td>
<td>Stakeholder Lead</td>
</tr>
<tr>
<td>Greg Sevcik</td>
<td>Meeting Facilitator</td>
</tr>
<tr>
<td>Georgina Aurelio</td>
<td>Project Engineer</td>
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<tr>
<td>John Grounds</td>
<td>Technical Lead</td>
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### Coordinating Project Efforts

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>Natalie Chaney</td>
<td>Project Manager</td>
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<tr>
<td>Luis Partida</td>
<td>Technical Lead</td>
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<td>Georgina Aurelio</td>
<td>Project Engineer</td>
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<tr>
<td>John Grounds</td>
<td>Technical Lead</td>
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Other Studies and Projects in the Region

The LCCDB study is one of several ongoing, flood damage reduction studies and projects in the region. The project team is coordinating with the various entities leading these studies and projects. These ongoing studies and projects include:

- The Texas General Land Office (GLO) / Galveston County Mainland Flood Study
- The City of League City / LJA League City Master Drainage Plan
Project Background
Project Purpose

Develop a comprehensive flood mitigation plan for the Lower Clear Creek and Dickinson Bayou Watersheds, including identification of vulnerabilities in the watersheds and development and refinement of concepts to reduce flooding.
Project Area
Project Focus

• This is a riverine study of regional magnitude
• Storm analysis based on 24-hour duration, Atlas 14 intensity
• The flood risk analysis shows inundation directly caused along the creeks, but not by localized storm drain capacity constraints

• **Damages and flooding instances are higher than what is presented**

• The benefits provided by these alternatives will also be higher than what is presented
  
  • All storm drainage systems eventually outfall to the creeks, so lowering the flood elevation on the creeks will benefit local drainage system performance
• Reach 1 – DB-1 – North of FM 517
• Reach 2 – DB-2 – FM 517 to I-45
• Reach 3 – DB-3 – I-45 to Dickinson Bay at SH-146
Phase 3 Public Meeting Purpose

What is the Purpose of this Meeting?

1. Provide information developed on flood hazards and potential mitigating concepts
2. Solicit feedback on concepts including questions, concerns and issues related to flood mitigation in the region.

How to Participate in the Meeting

1. Learn About the Study
2. Talk with Study Representatives and Provide Feedback
3. Complete a Comment Form
Project Timeline

**Phase 1**
- Discovery and Baselining

**Phase 2**
- Watershed Study

**Phase 3**
- Project Identification

**ORIGINAL**

**REVISED**

Today
- February 2020
- April 2020
- December 2020
- March 2021

WE ARE HERE
Existing Flood Risk
Damage Centers - High Flooding Instances
Dickinson Bayou – Harvey Simulation
Dickinson Bayou Land Use Current
Dickinson Bayou Land Use Future

Legend
- Subbasin
- Land Use
  - Developed Storm Sewer Post 1984
  - Developed Storm Sewer Pre 1984
  - Developed Roadside Ditch
  - Open Space (Graded)
  - Undeveloped

0 1 2 Miles
### 100-Year Peak Discharges (cfs) Comparison Table

<table>
<thead>
<tr>
<th>Location</th>
<th>FEMA Effective</th>
<th></th>
<th>FNI</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watershed Outfall (SH 146)</td>
<td>22,000</td>
<td>22,495</td>
<td>23,855</td>
<td>6.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gum Bayou Confluence</td>
<td>17,100</td>
<td>20,965</td>
<td>22,409</td>
<td>6.9%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benson Bayou Confluence</td>
<td>12,000</td>
<td>15,948</td>
<td>17,202</td>
<td>7.9%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-45</td>
<td>5,920</td>
<td>11,936</td>
<td>12,629</td>
<td>5.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM 517</td>
<td>N/A</td>
<td>3,893</td>
<td>4,179</td>
<td>7.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dickinson Bayou Estimated Damages

• 500-year storm (>24 intensity than Harvey):
  • Damages = $819M
  • Structures = 14,630

• 5-year storm:
  • Damages = $54M
  • Structures = 1,325

• Area of Benefit (AOB): the zone of damages that could be mitigated
  • AOB = (500 YR Storm) – (5 Year Storm)
  • Damages = $765M
  • Structures = 13,300
Dickinson Bayou Finished Floor Elev.

“The Bowl”

Gum Bayou Tributary
The “Bowl” Topography

Gum Bayou Tributary

Legend
Topographic Surface Value
- High: 46.5231
- Low: -0.647636
Damages and flooding instances increase in the future, due to sea level rise and future development.
Transportation System Impacts

Public safety, Disruptions to Emergency Response and Mobility

Legend

100-Year USBR Hazard
- Low Danger Zone
- Judgement Zone
- High Danger Zone

Level of Service
- 5-year or less
- 10 to 50-year
- 100-year or greater
Critical Infrastructure Impacts

Water Supply, Emergency & Medical Services, Schools
Mitigation Alternatives
Evaluation Metrics - Quantitative

- **Instances of flooding**: Number of times a given structure is predicted to flood during the 50-year period
- **Structural Damages**: Monetary value resulting from the inundation of a given structure over the 50-year period
- **Capital Cost**: Cost to construct the improvement, O&M considered in non-cost factors but not quantified as part of this analysis
- **Transportation System Impacts**: Impact to culvert and bridge crossing risk. Representative of public safety hazard, mobility constraints and impacts to emergency responders.
# Evaluation Metrics - Qualitative

## Non-Cost Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Land Acquisition</th>
<th>Community Impact/Aesthetics</th>
<th>O&amp;M/Resiliency</th>
<th>Other Agency Coordination</th>
<th>Speed of Implementation</th>
<th>Total</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Acquisition</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>22.5%</td>
</tr>
<tr>
<td>Community Impact/Aesthetics</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>20.0%</td>
</tr>
<tr>
<td>O&amp;M/Resiliency</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>25.0%</td>
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<tr>
<td>Other Agency Coordination</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>10.0%</td>
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<tr>
<td>Speed of Implementation</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>9</td>
<td>22.5%</td>
</tr>
</tbody>
</table>
Dickinson Bayou Constraints

1. No crossing of I-45 with any open cut solutions

2. No channel widening on Dickinson east of Cemetery Road – aesthetics/community impact
Individual Concepts Evaluated

Detention
- Grand Parkway Basin
- McFarland Basin
- West Cemetery Road
- East Cemetery Road
- Magnolia & Benson Bayou Detention
- Golf Course (Hilton Ln) Detention

Bypass
- “Bowl” Bypass Channel
- Gum Bayou Tributary

Channel
- Clearing & De-Snagging

Non-Structural
- Property Buy Out/Elevation

Other
- “Bowl” Flood Wall

Bridges
- None

Tunnel
- None
Non-Structural – Buy Out/Elevate

• Flood mitigation can be provided by reducing the water surface or by eliminating the structures

• Purchasing structures is capital intensive and eliminates sales and ad valorem tax

• Create opportunities for amenities and open spaces
Gum Bayou Tributary Diversion

- High instances of flooding along tributary to Gum Bayou
- Locating detention very difficult due to urban nature of area
- Opportunity for possible diversion to Dickinson Bayou through buried stormwater conduit (box culvert)
- Not modeled as part of scope as not part of the main channel system but could be evaluated further in future phase
“Bowl” Flood Wall?

- Significant flooding is occurring in Dickinson “Bowl” in frequent events (5-year and 10-year storms)
- Depth of flooding in larger storm events exceeds 3 feet in many structures
- Bypass channel alone does not mitigate the risk for many of these structures
- FM 517 road elevation is >11 feet between I-45 and SH-3
- **Nearly 200 structures worth $20M have a slab elevation of EL 6 ft or less**
Dickinson Flood Wall & Stormwater Pump Station System

- FM 517 acts as flood barrier.
- Stormwater pump stations to achieve normal depth on tributaries.
- Flap Gates on tributaries leaving bowl to prevent backwater and provide ~10-year storm protection.
- >10-year storm FM517 is overtopped by Dickinson Bayou.

Benson Stormwater Pump Station
- 2500 cfs
- Backflow Prevention
- ROM Capital Cost $90M

Borden Stormwater Pump Station
- 2,600 cfs
- Backflow Prevention
- ROM Capital Cost $70M

Magnolia Stormwater Pump Station
- 2,600 cfs
- Backflow Prevention
- ROM Capital Cost $90M

FM 517 acting as flood barrier up to EL 11 ft.
# Individual Mitigation Effectiveness

<table>
<thead>
<tr>
<th>Concept</th>
<th>Flooding Instances Eliminated</th>
<th>Flooding Instances Reduced per $M</th>
<th>Flooding Instances Caused</th>
<th>Flood Damage Reduction (100 year event)</th>
<th>Flood Damage/Capital Cost</th>
<th>Flood Damage Caused (100 year event)</th>
<th>Capital Cost Estimate $M</th>
<th>Non Cost Factor Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowl Bypass Channel 11000 cfs</td>
<td>1843</td>
<td>7.37</td>
<td>60</td>
<td>126</td>
<td>0.504</td>
<td>1</td>
<td>250</td>
<td>2.6</td>
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<tr>
<td>Bowl Bypass Channel 7500 cfs</td>
<td>1265</td>
<td>6.84</td>
<td>53</td>
<td>95</td>
<td>0.514</td>
<td>1</td>
<td>185</td>
<td>2.6</td>
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<tr>
<td>Bowl Bypass Channel 8500 cfs</td>
<td>1403</td>
<td>6.68</td>
<td>55</td>
<td>104</td>
<td>0.495</td>
<td>1</td>
<td>210</td>
<td>2.6</td>
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<tr>
<td>Magnolia Bayou &amp; Benson Bayou Detention</td>
<td>30</td>
<td>3.75</td>
<td>0</td>
<td>3</td>
<td>0.375</td>
<td>0</td>
<td>8</td>
<td>3.9</td>
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<tr>
<td>McFarland Detention</td>
<td>250</td>
<td>2.50</td>
<td>0</td>
<td>18</td>
<td>0.180</td>
<td>0</td>
<td>100</td>
<td>3.9</td>
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<td>Golf Course Detention Basin (Hilton)</td>
<td>33</td>
<td>2.20</td>
<td>0</td>
<td>4</td>
<td>0.267</td>
<td>0</td>
<td>15</td>
<td>4.4</td>
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<td>West Cemetery Road Detention Basin</td>
<td>172</td>
<td>1.91</td>
<td>0</td>
<td>15</td>
<td>0.167</td>
<td>0</td>
<td>90</td>
<td>3.9</td>
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<tr>
<td>East Cemetery Road Detention Basin</td>
<td>166</td>
<td>1.28</td>
<td>0</td>
<td>16</td>
<td>0.123</td>
<td>0</td>
<td>130</td>
<td>3.2</td>
</tr>
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</table>

100-year event analysis
Individual Mitigation Conclusions

1. Individual detention improvements only provide localized benefits, have limited value over multi-day storm events, and provide little benefit in the Bowl.
2. Although the water surface is reduced by multiple feet, even with a very large diversion channel, flooding is still happening in the Bowl.
3. Large regional detention along the Bayou needs to be planned and built now before development occurs.
4. The “Bowl” is likely to need extensive elevation of structures, buy outs or a flood wall/stormwater pump station system.

Overarching Conclusions

1. Combination solutions necessary to maximize benefits.
2. Full benefit of mitigation needs to take local drainage network benefits into account.
## Combination Mitigation Measures

<table>
<thead>
<tr>
<th>Detention</th>
<th>Detention + Diversion Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. McFarland Rd Detention</td>
<td>Detention plus:</td>
</tr>
<tr>
<td>2. Cemetery Rd West Detention</td>
<td>1. “Bowl” 11,000 cfs Diversion Channel</td>
</tr>
<tr>
<td>3. Golf Course (Hilton Ln) Detention</td>
<td></td>
</tr>
<tr>
<td>4. Magnolia &amp; Borden Detention</td>
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<tr>
<td>5. Voluntary Buyouts</td>
<td></td>
</tr>
</tbody>
</table>
Detention

1. McFarland Rd Detention
2. Cemetery Rd West Detention
3. Golf Course (Hilton Ln) Detention
4. Magnolia & Borden Detention
5. Voluntary Buyouts

Estimated Capital Cost $220M
Total Detention = >5,200 ac-ft
Detention Sequencing

All projects are self mitigating and can be completed independently without dependencies:

1. McFarland Rd Detention
2. Cemetery Rd West Detention
3. Golf Course (Hilton Ln) Detention
4. Magnolia & Borden Detention
5. Voluntary Buyouts
Detention Quantitative Metrics

Cost to Construct: $220M

100-YR Reduction:
- Instances: 497
- $ Damage: $36M
- WSEL Reduction at I-45: 0.37 ft

50 Year Design Period Reductions:
- Instances: 2,488
- $ Damage: $41M

Flood Mitigation Efficiency (50 Year Period)
- 11.3 instances of flooding reduced per $M
- $90,000 per instance of flooding reduced
Storage Concept Take-Aways

1. Lack of structures west of Cemetery Road limits quantifiable benefits of upstream storage
2. Open land is available now and set asides should be made for regional detention
3. Storage alone has minimal benefit in “Bowl”
4. Significant residual risk exists even with the improvement
Detention + Channel

1. McFarland Rd Detention
2. Cemetery Rd West Detention
3. Golf Course (Hilton Ln) Detention
4. Magnolia & Borden Detention
5. Voluntary Buyouts
6. “Bowl” 11,000 cfs Diversion Channel

Estimated Capital Cost $500M
EXHIBIT 10: Channelization / Diversion Alternative
Detention + Diversion Channel Sequencing

All projects are self mitigating and can be completed independently without dependencies:

1. McFarland Rd Detention
2. Cemetery Rd West Detention
3. Golf Course (Hilton Ln) Detention
4. Magnolia & Borden Detention
5. Voluntary Buyouts
6. “Bowl” 11,000 cfs Diversion Channel - may require mitigation as part of improvement
**Diversion Channel Quantitative Metrics**

**Cost to Construct:** $500M

**100-YR Reduction:**
- Instances: 2,285
- $ Damage: $146M
- WSEL Reduction at I-45: 2.29 ft

**50 Year Design Period Reductions:**
- Instances: 15,075
- $ Damage: $245M

**Flood Mitigation Efficiency (50 Year Period)**

- 30.2 instances of flooding reduced per $M
- $30,000 per instance of flooding reduced
Diversion Channel Downstream Impacts

- Additional concept development needed to mitigate downstream impacts or identify properties for buy out
- 60 to 70 structures valued at <$3M
Diversion Channel Concept Take-Aways

1. Very large number of structures removed from flooding risk
2. Downstream impacts will need to be mitigated for solution to be actionable
3. Even with major WSEL reduction (>2 feet) in the “Bowl” many structures are still flooding.
   a. Over 1,800 in a 10-year event
4. $30,000 per instance efficiency is the best analyzed in LCCDB study
Combination Mitigation
Bowl WSEL Profile

WSEL Reduction at I-45
Detention: 0.37 ft
Channel: 2.29 ft

Bypass Channel Intake
Combination Mitigation Conclusions

1. The Bowl remains a significant risk area even with an 11,000 cubic feet per second diversion and a nearly 3 ft water surface elevation reduction.
   - Over 1,000 structures at risk from a 5-year storm
   - Structural mitigation unlikely to be cost effective beyond what has been analyzed
   - Elevation and buy outs likely necessary

2. Benefits indicated do not fully account for local drainage benefits

3. 50-year project window focuses benefits on high recurrence events and minimizes mitigation benefits for large events

4. Significant residual risk exists east of I-45 due to low lying structures, rising sea levels and storm surge
5. The diversion channel is the most cost-effective mitigation solution.
   a. Storage alone does not maximize the mitigation benefits and provides no benefit once full in a multi-day event.

6. Conveyance improvements are not duration dependent.
   a. Harvey was >100-year storm intensity and lasted for more than 24 hours.

7. Improvements are focused on major storm events not 2-year or 5-year events.
   • Smaller local infrastructure improvements or buy-outs/elevations could address these.
Financial Partnerships

- Multiple potential funding opportunities available
- Due to funding or eligibility limitations, it will be necessary to pursue multiple funding partners
- Due to the overall cost of the projects required, USACE is the most likely federal partner for most of the necessary mitigation funding.
- Where possible, separate out discreet project components to analyze those projects further against the criteria of the various funding programs outlined above.
- Local matches are required for most Federal partnerships
- Possible LMI/SVI opportunity in “Bowl” and along Gum Bayou
Potential Financial Partners

- TXGLO
- US Army Corps of Engineers®
- FEMA
- Texas Water Development Board
- USDA (Natural Resources Conservation Service)
- United States Department of Agriculture
Financial Partnership Opportunities

External partnerships bring additional complexity to flood-reduction projects as part of the substantial financial aide provided.

Each partner will have distinct eligibility and accountability criteria by which they are legally obligated to, often including benefit-cost-ratio.

Many of these requirements include:

- Additional Protections for Cultural Resources and the Environment
- Restrictions on what actions are reimbursable
- Additional reporting requirements on how money is spent
- Transparency and fairness in how contracts are advertised and awarded
- Special contract provisions regarding how work will be recorded and conducted
Local Funding Opportunity

LOWER CLEAR CREEK & DICKINSON BAYOU WATERSHED STUDY
Purpose: Support capital improvements and operations and maintenance to the main channel of Dickinson Bayou to mitigate flooding impacts. Local sponsor for federal and state funding partners

Partner with other agencies including:
- Galveston County Drainage District No. 1
- Galveston County Drainage District No. 2
- Municipalities along the Creek: Dickinson, League City, Texas City, Santa Fe, Alvin and others

Generate revenue through ad valorem tax on property in watershed
- Based on current appraisal district values: $7.4 billion of property in watershed

Watershed appraisal values expected to increase significantly in next 20 years due to growth in western part of watershed. Opportunity for increased project funding
Example: Gulf Coast Protection District

• Proposed in current legislative session to be local sponsor for Texas Coastal Surge Protection System

• District would encompass the coastal counties:
  • Brazoria
  • Chambers
  • Galveston
  • Harris
  • Jefferson
  • Orange

• Leaders would be appointed by the governor.

• Needed to fund non-federal partner share ($8.8B) and $131M of annual maintenance
Next Steps

1. Finalize combination alternatives based on feedback received from public meeting

2. Finalize study with written documentation including recommended path forward on alternatives

3. Identify needs in next Study Phases to assess benefits to local drainage systems to increase project benefit metrics
Final Thoughts

1. Solutions exist to mitigate risk in major events, but they are expensive and will require significant local investment.

2. Local drainage system benefits may increase total project benefits and open door to additional funding opportunities.

3. Regardless of the improvements, significant residual risk will remain. Elevating structures and buy outs will need to be considered.
Instructions for Follow-Up Questions & Comments
Instructions for Follow-Up Questions/Comments

- Email the team: LCCDB@leaguecity.com
- Fill out the online form on the study website www.leaguecity.com/LCCDB