PROJECT NO. MS-14-20
SOUTHWEST AREA STORM SEWER MASTER PLAN
COMPLETED PROJECTS (SINCE 2009)

- Over 18 miles constructed
  - *47 miles of emergency levees constructed by the City in 2009

- Project Cost ≈ $120 million

- Reduces required sandbags by approximately 4.5 million

- 50% of the Comprehensive Plan Completed
ND LEVEE CONSTRUCTION PERMIT

- A Flowage Easement is required if a Project impounds water on land not owned by applicant.

- Impacts greater than 0.1 foot requires a property right.

0.1 ft = 1.2 inches
PERMITTING

Connecting Reaches
Removes Floodplain
Induce Impacts
Required Mitigation
OVERVIEW

- Study Area
- FEMA Floodplain
- Flood Protection to Date
- Hydraulic Modeling
- Impacts from Flood Protection
- Mitigation and Costs
STUDY AREA

- Red River
- Wild Rice River
- Drain 27
- Drain 53
- Rose Coulee
FEMA FLOODPLAIN

- Red River
- Wild Rice River
- Drain 27
- Drain 53
- Rose Coulee

- no human intervention
- no flood protection
- state of nature

Cass County FIS – Jan 2015
Clay County FIS – April 2012
TEMPORARY FLOOD PROTECTION
TEMPORARY FLOOD PROTECTION
COMPREHENSIVE FLOOD MITIGATION PLAN

MARCH 2012

Completed by Houston Engineering in cooperation with Braun Intertec

Comprehensive Review of Potential Flood Mitigation Options

CITY OF FARO

FARO
COMPREHENSIVE FLOOD MITIGATION PLAN

[Map showing flood mitigation plans in a specific area, with color-coded areas indicating different mitigation strategies.]

Areas Protected by Existing/Future Projects

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Dam</th>
<th>levee</th>
<th>Project Name</th>
<th>Beach Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Surge</td>
<td>Yes</td>
<td>X</td>
<td>[Details]</td>
<td>Yes</td>
</tr>
<tr>
<td>Flooding</td>
<td>No</td>
<td>Yes</td>
<td>[Details]</td>
<td>No</td>
</tr>
</tbody>
</table>

[Legend and scale for distance measurement.]
COMPREHENSIVE PLAN

- Conceptual Design
  - Levees
  - Floodwalls
  - Property Acquisitions
  - Geotechnical Analysis

- ~50,000 foot plan
- Modeling Approach (Steady State)
ANALYZING HYDRAULICS IMPACTS

- HEC-RAS
  - Steady State (FEMA FIS)
  - Unsteady State (FM Diversion)
FEMA FLOODPLAIN MODEL

- Simple Approach
- Steady State
- Many Unknowns
- Many Assumptions
- Does not reflect reality
- Outdated Hydrology

Cass County FIS – Jan 2015
Clay County FIS – April 2012
FEMA FLOODPLAIN MODEL

- Simple Approach
- Steady State
- Many Unknowns
- Many Assumptions
- Does not reflect reality
- Outdated Hydrology

Cass County FIS – Jan 2015
Clay County FIS – April 2012
FEMA FLOODPLAIN MODEL

- Simple Approach
- Steady State
- Many Unknowns
- Many Assumptions
- Does not reflect reality
- Outdated Hydrology
  - H&H
  - 1979
  - FM Diversion
  - FEMA Future
  - Flood Risk

Cass County FIS – Jan 2015
Clay County FIS – April 2012
FLOOD CHARACTERISTICS

- Red River
- Wild Rice River
- Drain 27
- Drain 53
- Rose Coulee
FLOOD CHARACTERISTICS

- Reverse Flow: Rose Coulee Drain 27 Drain 53
FLOOD CHARACTERISTICS

- Large Events
- Breakout Flows
  - Overland Flow
  - Wild Rice River
  - County Road 16
MODEL SIMULATION

- New Model
- FM Diversion
  - Phase 8
  - Unsteady State
    - Full Hydrograph
    - Cross Sections
    - Storage Areas
- Complex
- More Realistic
- Flow Interaction
- Wild Rice River Breakout
- Reverse Flow
STUDY AREA

Identify flood impacts from floodplain removal
FLOOD IMPACTS

Flood Impacts

1. Volume Loss
2. Conveyance Loss

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Area 4 = 100 ac-ft
Area 5 = 1,400 ac-ft
Total = 6,400 ac-ft
IMPROVEMENTS – AREA 1

Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft
IMPACTS – AREA 1

Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft

Newman Outdoor Field x 1000 ft high
**IMPACTS – AREAS 1 & 2**

**Impacts from Current Flood Protection**

Area 1 = 3,100 ac-ft  
Area 2 = 100 ac-ft  
Total = 3,200 ac-ft
Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Total = 4,200 ac-ft
IMPACTS – AREAS 1 - 3

Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Total = 4,200 ac-ft

25,500,000 cu.ft. = 585 ac-ft
Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Area 4 = 800 ac-ft
Total = 5,000 ac-ft
Impacts from Current and Future Flood Protection

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Area 4 = 800 ac-ft
Area 5 = 1,400 ac-ft
Total = 6,400 ac-ft
Impacts from Current and Future Flood Protection

Area 1 = 3,100 ac-ft
Area 2 = 100 ac-ft
Area 3 = 1,000 ac-ft
Area 4 = 800 ac-ft
Area 5 = 1,400 ac-ft
Total = 6,400 ac-ft

25,500,000 cu.ft. = 585 ac-ft
IMPACTS – ALL AREAS (1 – 5)

Newman Outdoor Field x 2100 ft high
CONVEYANCE LOSS
CONVEYANCE LOSS
CONVEYANCE LOSS

Flow over entire width of floodplain

Total = 29,000 cfs

4,500 cfs

24,500 cfs
CONVEYANCE LOSS

Levee Construction
Forces flow between the levees
Results in a stage increase

29,000 cfs
CONVEYANCE LOSS

Levee Construction
Forces flow between the levees
Results in a stage increase

24,500 cfs
FLOOD MITIGATION

30,000,000 CY Excavation
15 Miles of levee
2000 Acres of Land

Estimated Construction = $150M
Estimated Land = $30M
Estimated Total = $180M
ANALYSIS UPDATE

- Analysis to Date
- Uses latest FM Diversion model
  - Best Available
  - Model was developed for the larger scale project
  - Could be refined for this smaller scale project
- Plan to review model parameters
  - Detailed modeling to better reflect the isolated project area
  - Adjustments could result in 20-30% difference in results