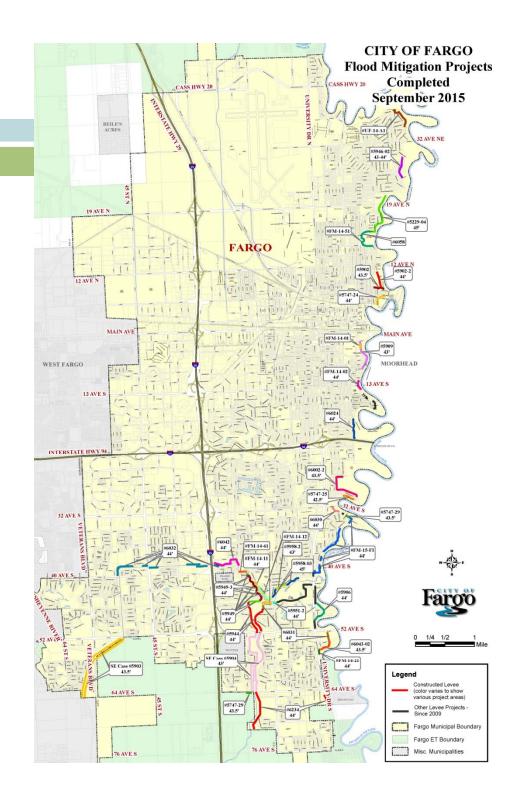


### PROJECT NO. MS-14-20

SOUTHWEST AREA STORM SEWER MASTER PLAN

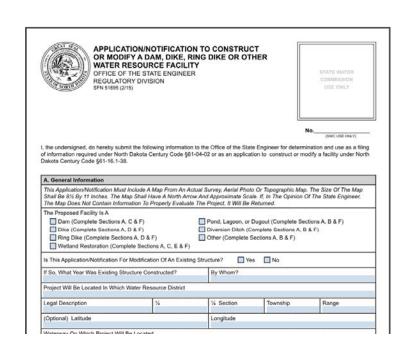
# COMPLETED PROJECTS (SINCE 2009)

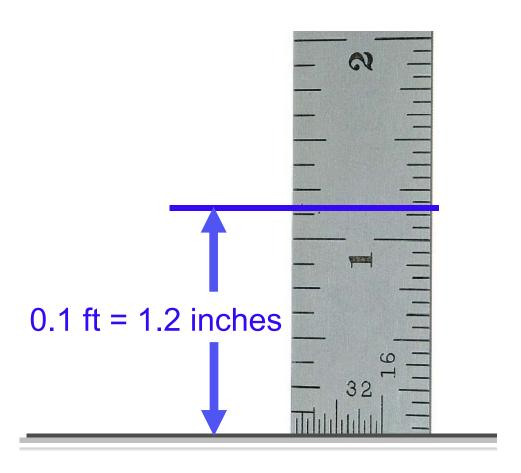
- Over 18 miles constructed
  - \*47 miles of emergency levees constructed by the City in 2009
- Project Cost ≈ \$120 million
- Reduces required sandbags by approximately 4.5 million
- 50% of the Comprehensive Plan Completed



#### 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.





### **PERMITTING**

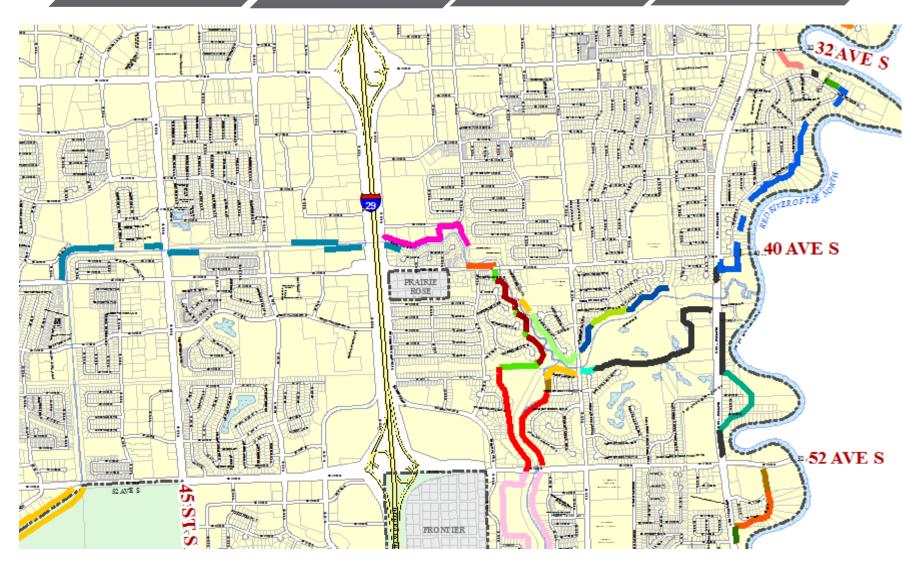


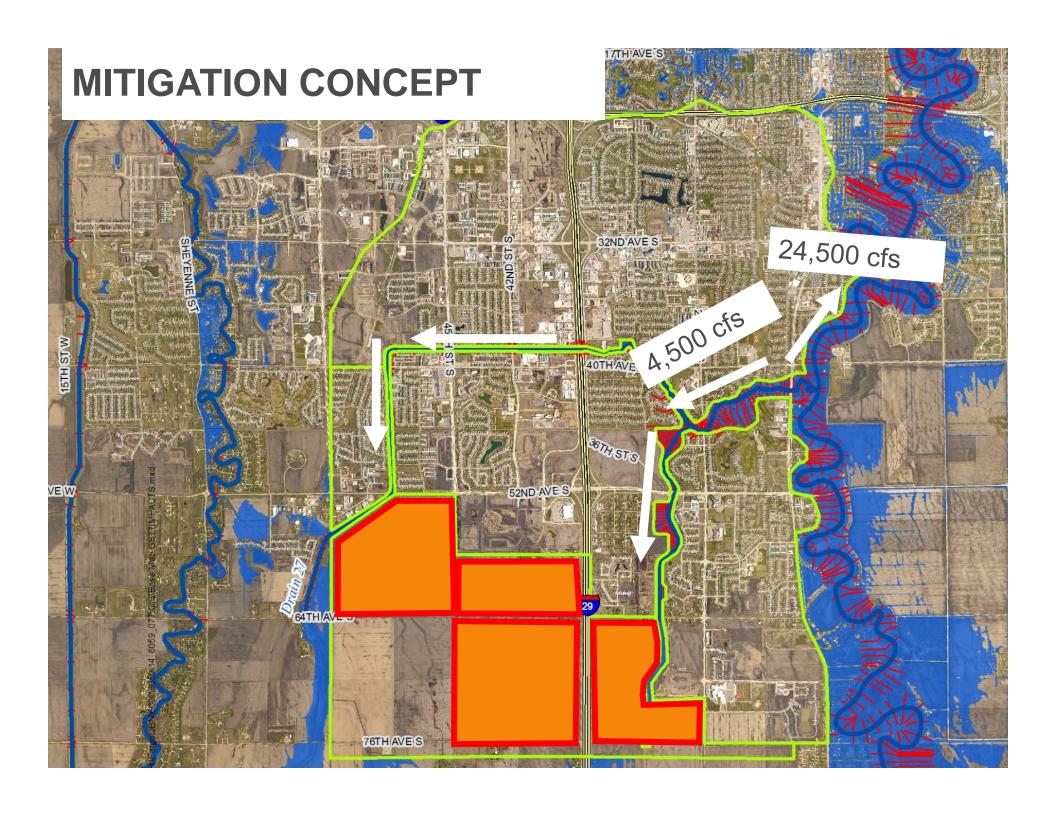
Connecting Reaches

Removes Floodplain

Induce Impacts

Required Mitigation





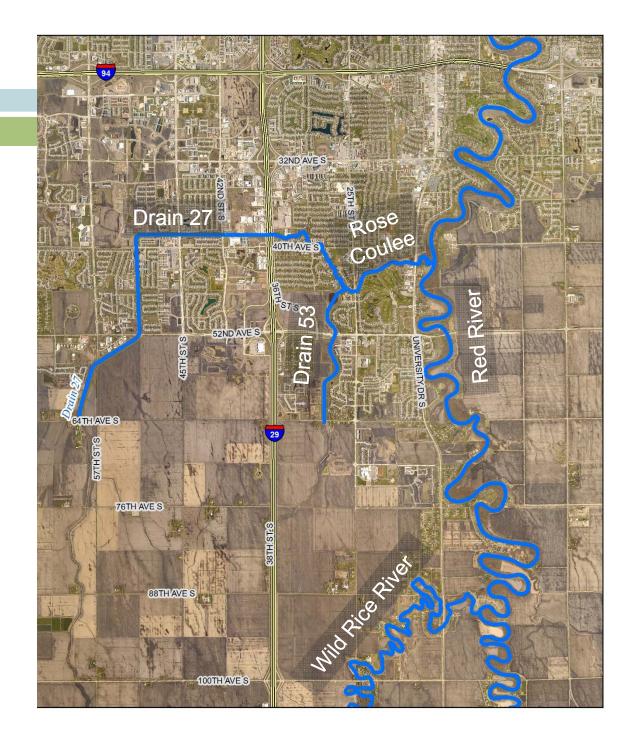
#### **OVERVIEW**



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

### **STUDY AREA**

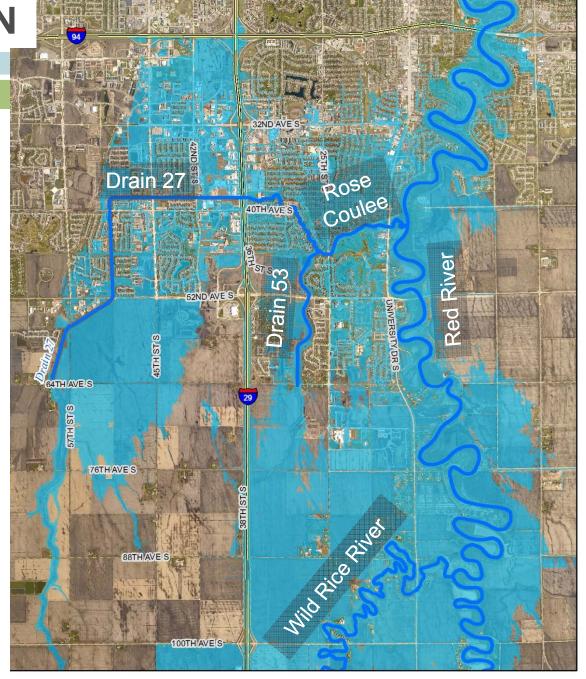
- Red River
- Wild Rice River
- Drain 27
- ■Drain 53
- Rose Coulee



**FEMA FLOODPLAIN** 

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

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







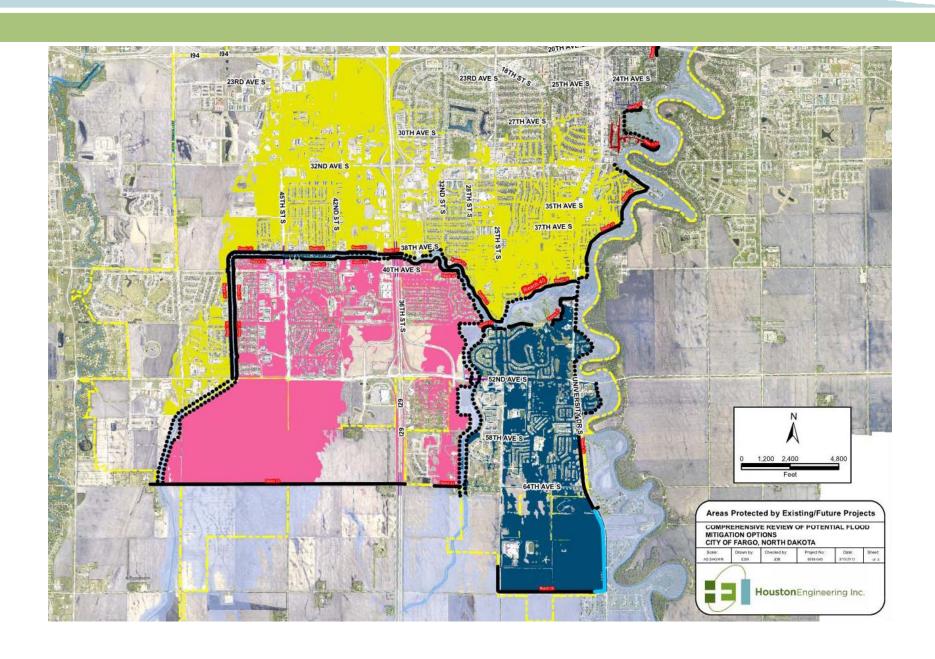
### **COMPREHENSIVE FLOOD MITIGATION PLAN**





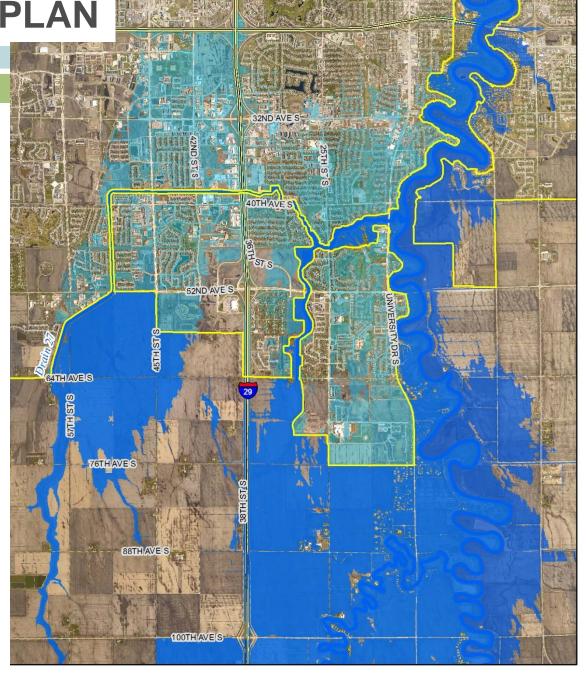
### **COMPREHENSIVE FLOOD MITIGATION PLAN**





**COMPREHENSIVE PLAN** 

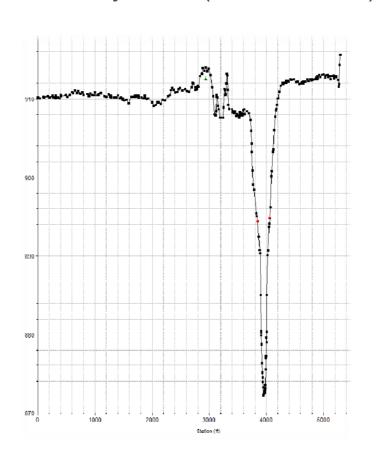
- Conceptual Design
  - Levees
  - Floodwalls
  - Property Acquisitions
- Geotechnical Analysis
- **■~**50,000 foot plan
- Modeling Approach (Steady State)

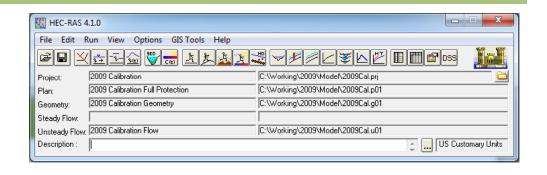


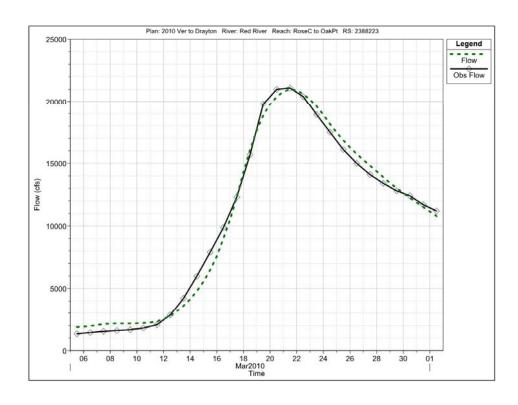
### **ANALYZING HYDRAULICS IMPACTS**



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

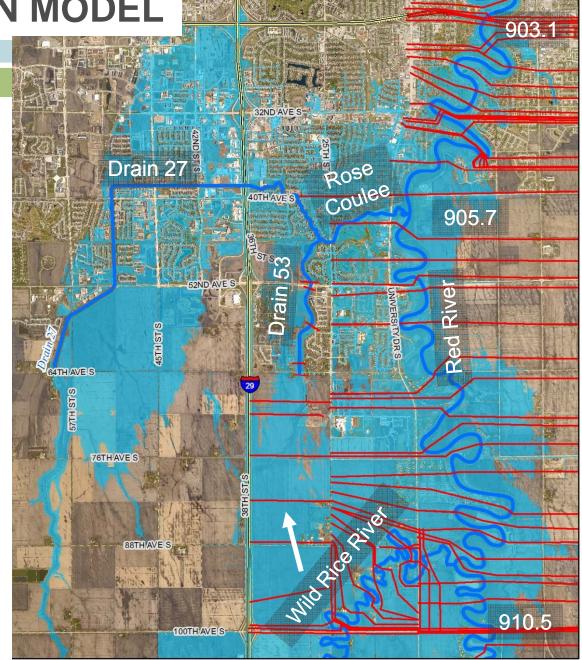






FEMA FLOODPLAIN MODEL

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



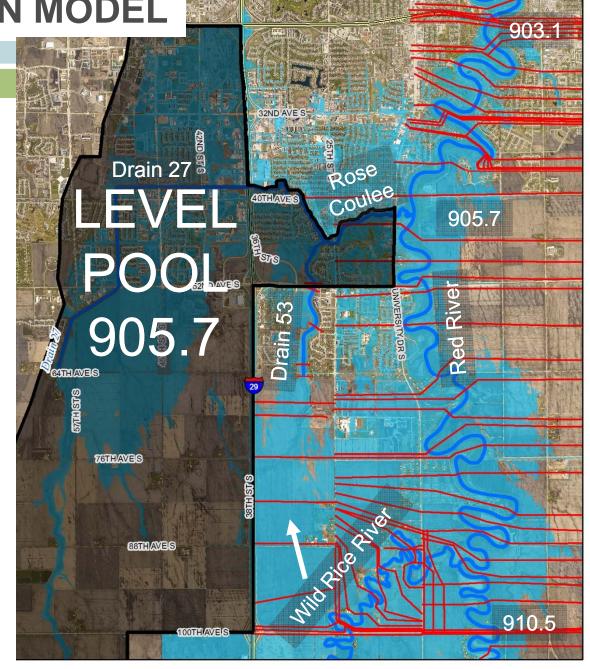
FEMA FLOODPLAIN MODEL

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

Drain 27 Rose Conlee 905.7 100TH/AVEIS

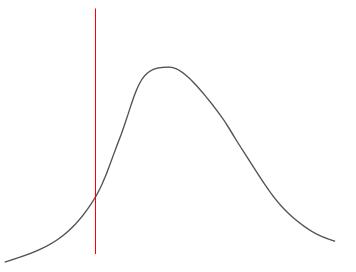
FEMA FLOODPLAIN MODEL

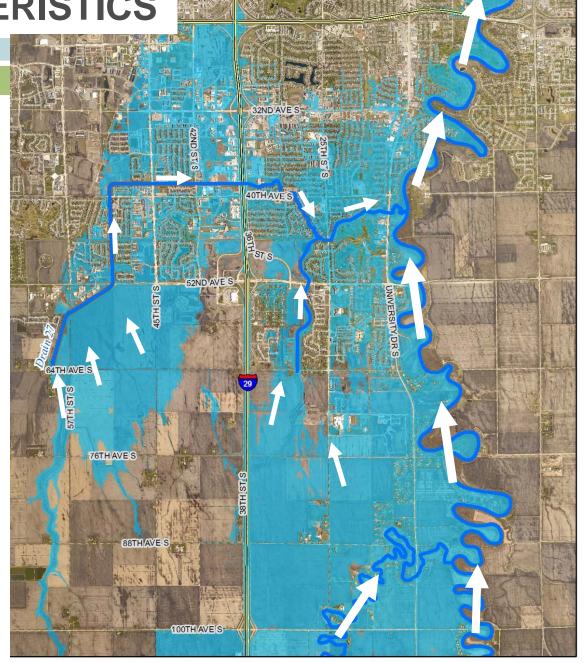
- Simple Approach
- Steady State
- Many Unknowns
- Many Assumptions
- Does not reflect reality
- Outdated Hydrology
  - ■H&H
  - **1979**
  - FM Diversion
  - FEMA Future
  - Flood Risk



FLOOD CHARACTERISTICS

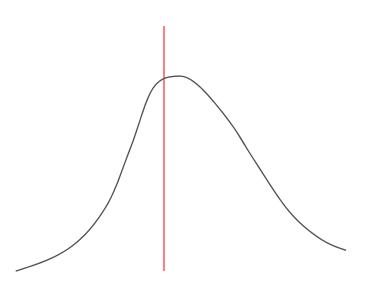
- Red River
- Wild Rice River
- Drain 27
- ■Drain 53
- Rose Coulee

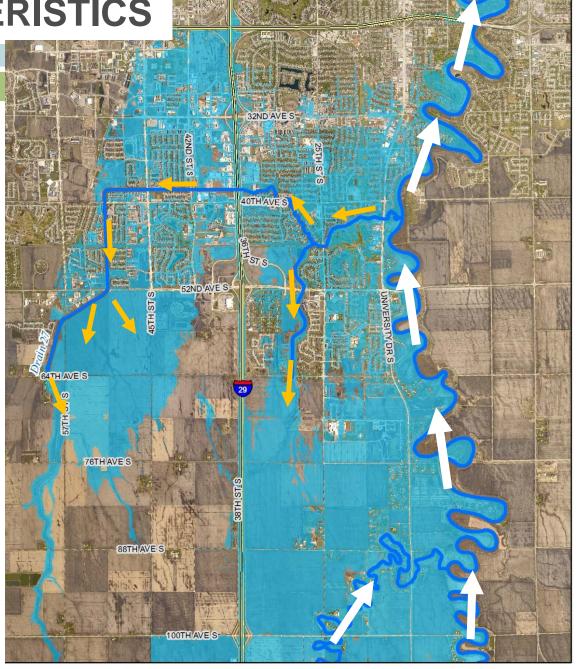




### FLOOD CHARACTERISTICS

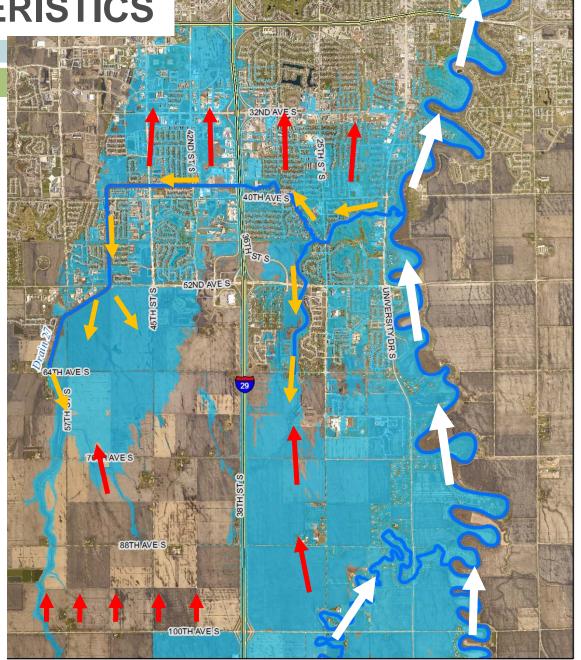
Reverse Flow: Rose Coulee Drain 27Drain 53





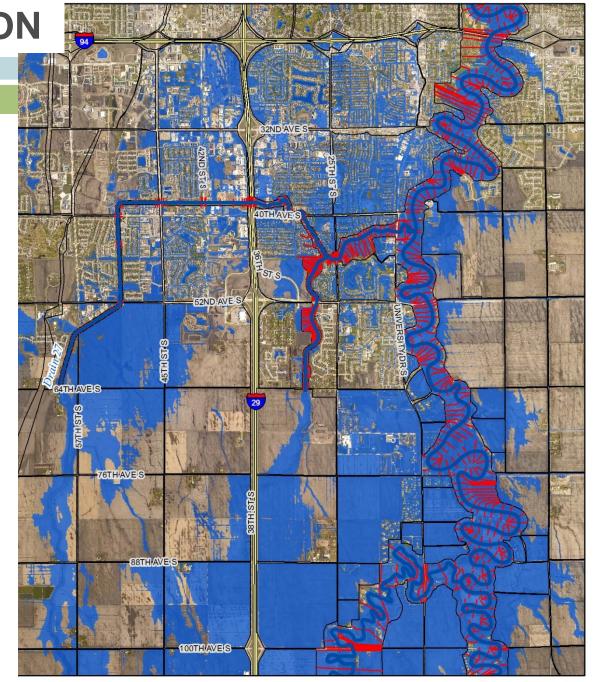
**FLOOD CHARACTERISTICS** 

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



**MODEL SIMULATION** 

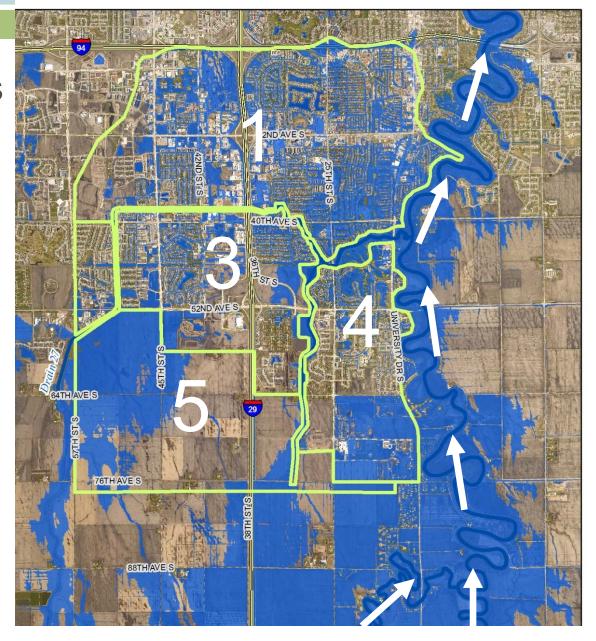
- New Model
- FM Diversion
  - Phase 8
  - Unsteady State
    - •Full Hydrograph
    - Cross Sections
    - Storage Areas
- Complex
- More Realistic
- Flow Interaction
- Wild Rice River Breakout
- Reverse Flow



### **STUDY AREA**



Identify flood impacts from floodplain removal



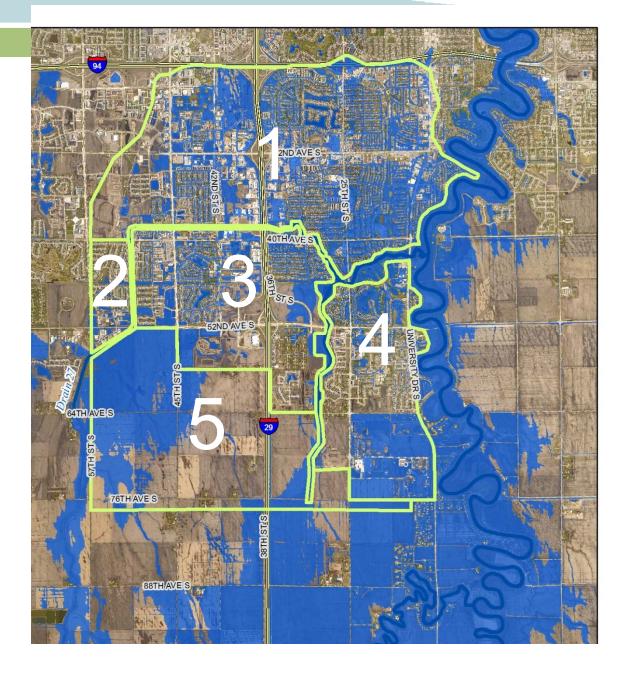
### **FLOOD IMPACTS**



### Flood Impacts

- 1. Volume Loss
- 2. Conveyance Loss

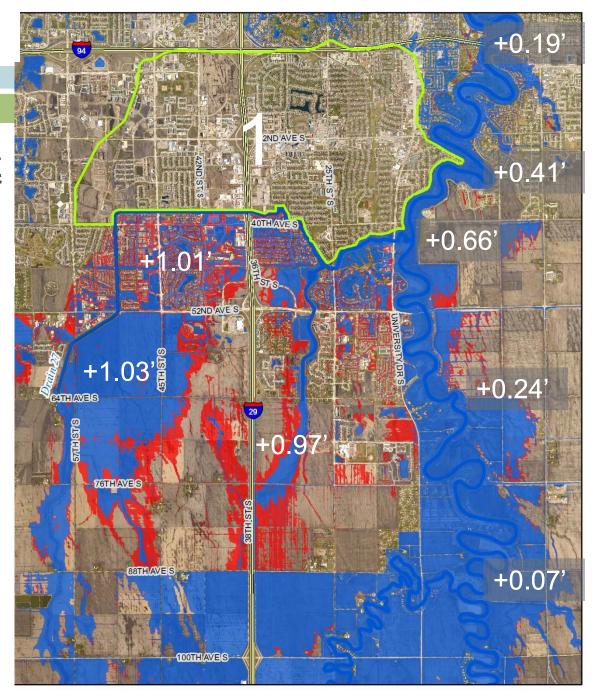
Area 1 = 3,100 ac-ft Area 2 = 100 ac-ft Area 3 = 1,000 ac-ft Area 4 = 100 ac-ft Area 5 = 1,400 ac-ft Total = 6,400 ac-ft



### **IMPACTS - AREA 1**

## Impacts from Current Flood Protection

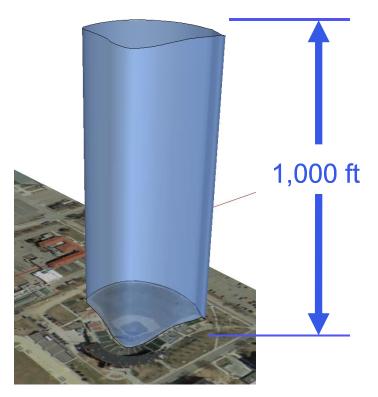
Area 1 = 3,100 ac-ft



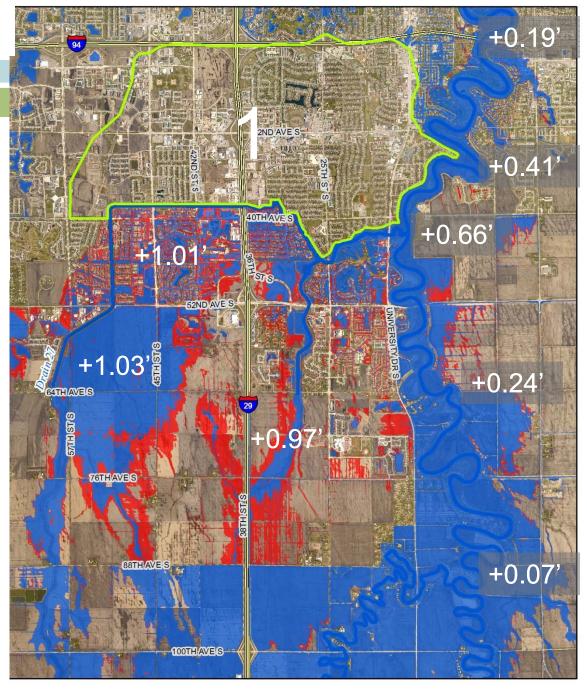
### **IMPACTS - AREA 1**

### Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft



Newman Outdoor Field x 1000 ft high



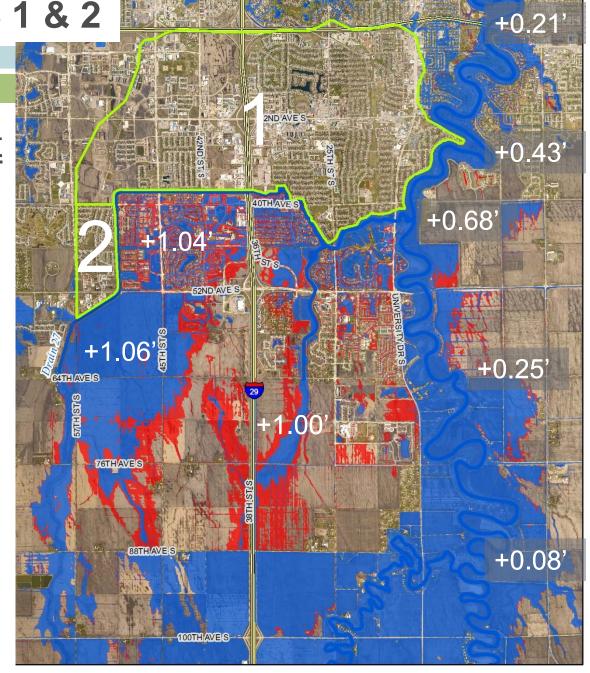
IMPACTS - AREAS 1 & 2

### Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft

Area 2 = 100 ac-ft

Total = 3,200 ac-ft



IMPACTS – AREAS 1 - 3

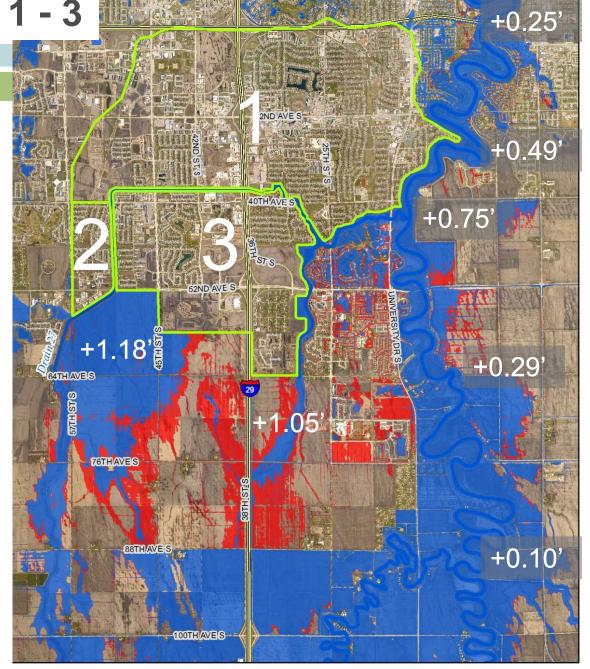
### Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft

Area 2 = 100 ac-ft

Area 3 = 1,000 ac-ft

Total = 4,200 ac-ft



IMPACTS – AREAS 1 - 3

### Impacts from Current Flood Protection

Area 1 = 3,100 ac-ft

Area 2 = 100 ac-ft

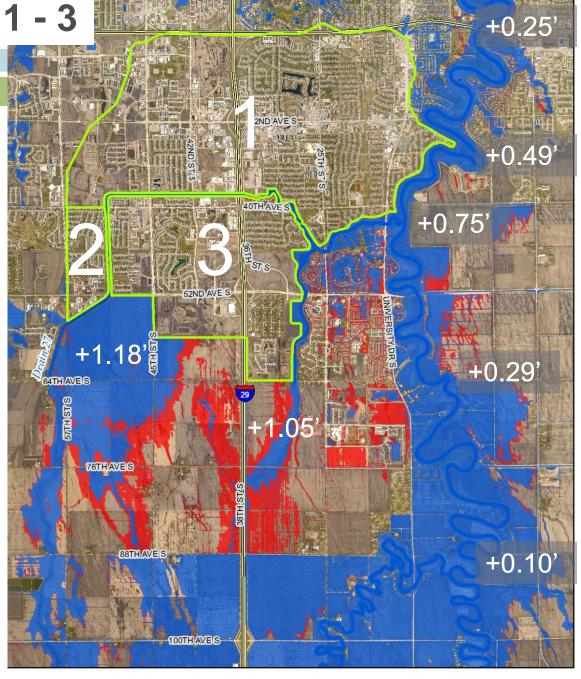
Area 3 = 1,000 ac-ft

Total = 4,200 ac-ft



Photo by championshipsubdivision.com

25,500,000 cu.ft. = 585 ac-ft



**IMPACTS - AREAS 1 - 4** 

### Impacts from Current Flood Protection

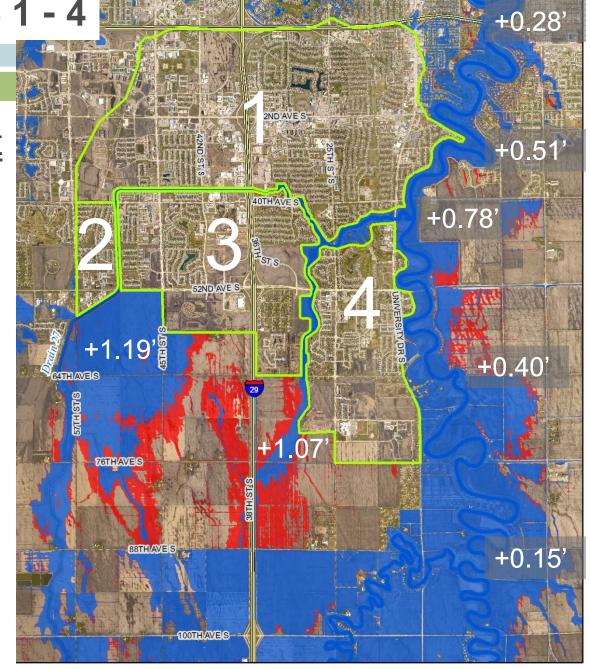
Area 1 = 3,100 ac-ft

Area 2 = 100 ac-ft

Area 3 = 1,000 ac-ft

Area 4 = 800 ac-ft

Total = 5,000 ac-ft



IMPACTS - ALL AREAS (1 - 5)

Impacts from Current and

**Future Flood Protection** 

Area 1 = 3,100 ac-ft

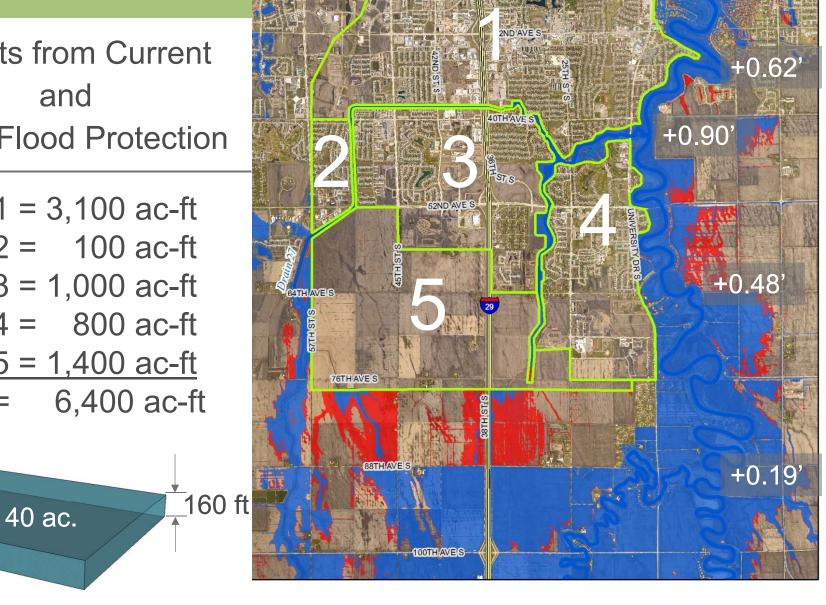
Area 2 = 100 ac-ft

Area 3 = 1,000 ac-ft

Area 4 = 800 ac-ft

Area 5 = 1,400 ac-ft

Total = 6,400 ac-ft



IMPACTS - ALL AREAS (1 - 5)

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

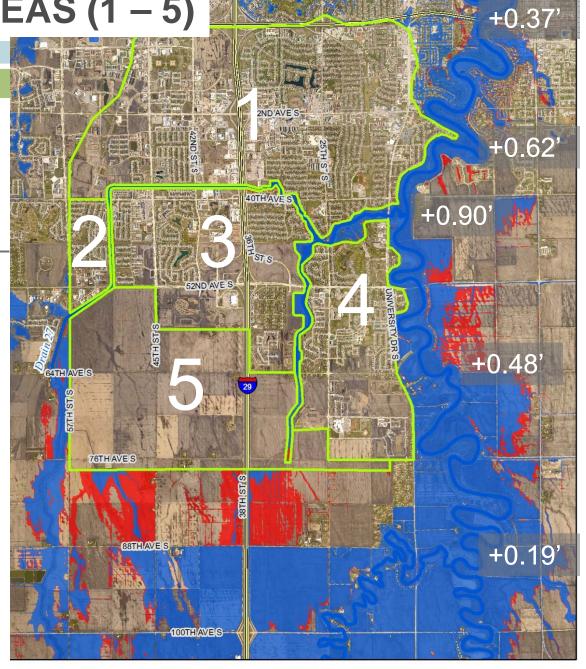
Total = 6,400 ac-ft



x 11

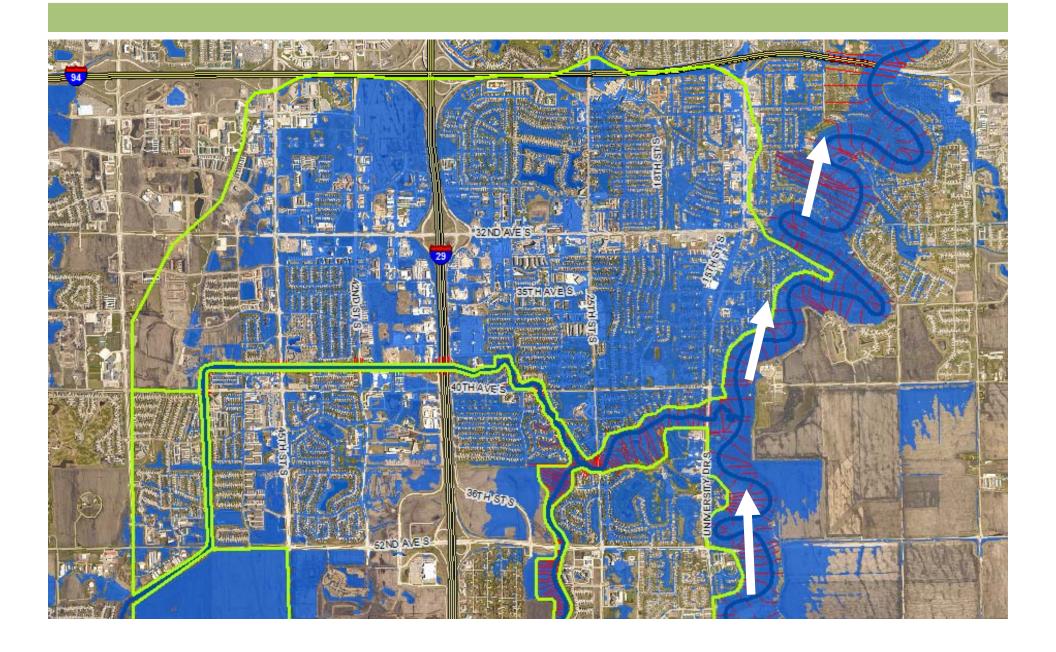
Photo by championshipsubdivision.com

25,500,000 cu.ft. = 585 ac-ft

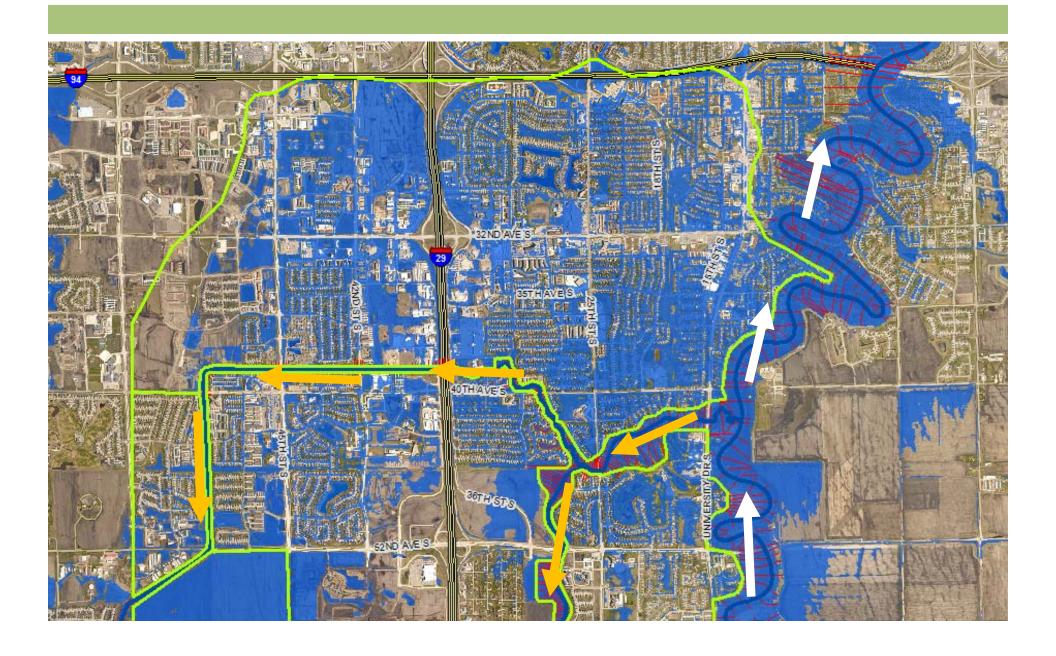


## IMPACTS - ALL AREAS (1 - 5) 2,100 ft +0.48' +0.19' Newman Outdoor Field x 2100 ft high

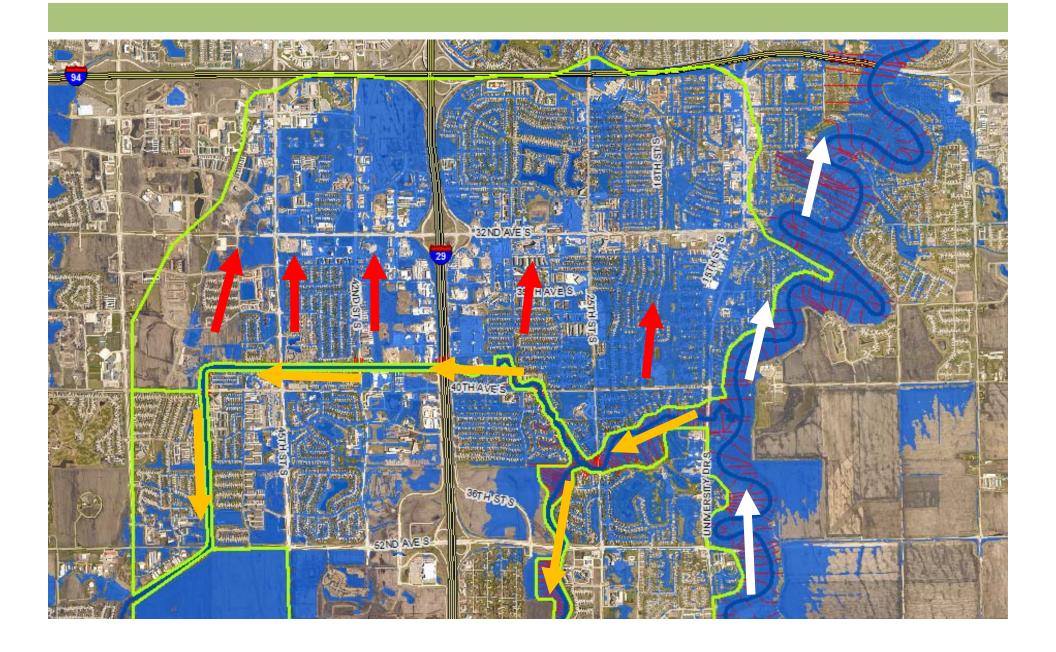












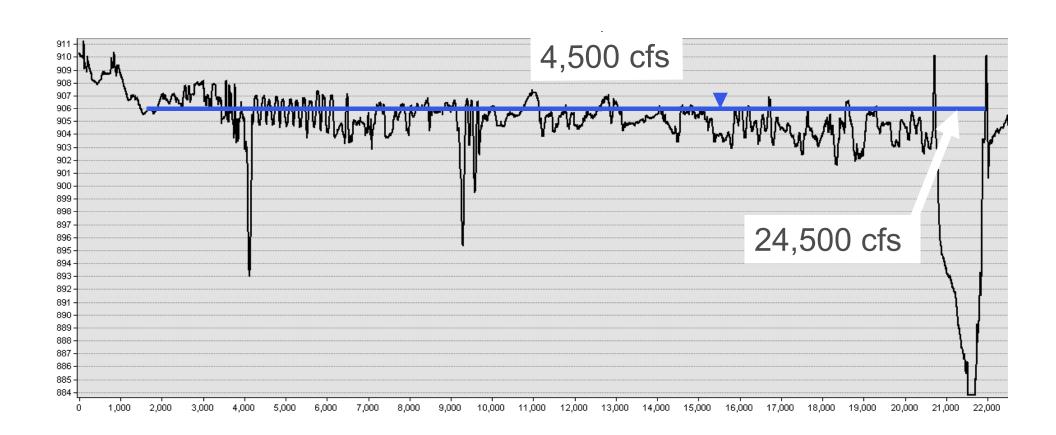






### Flow over entire width of floodplain

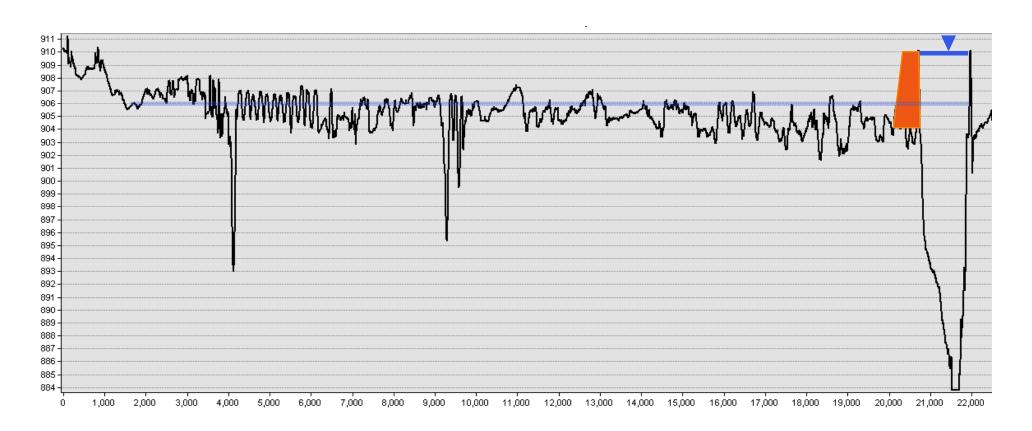
Total = 29,000 cfs





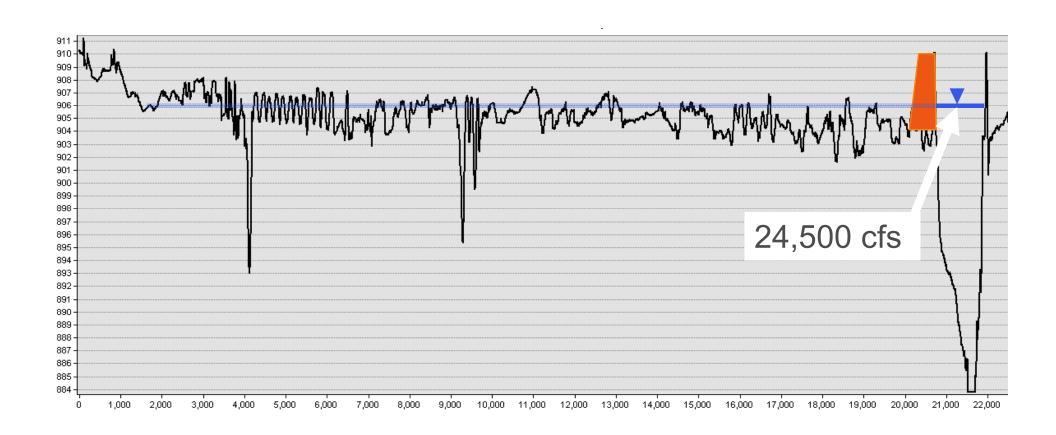
Levee Construction
Forces flow between the levees
Results in a stage increase

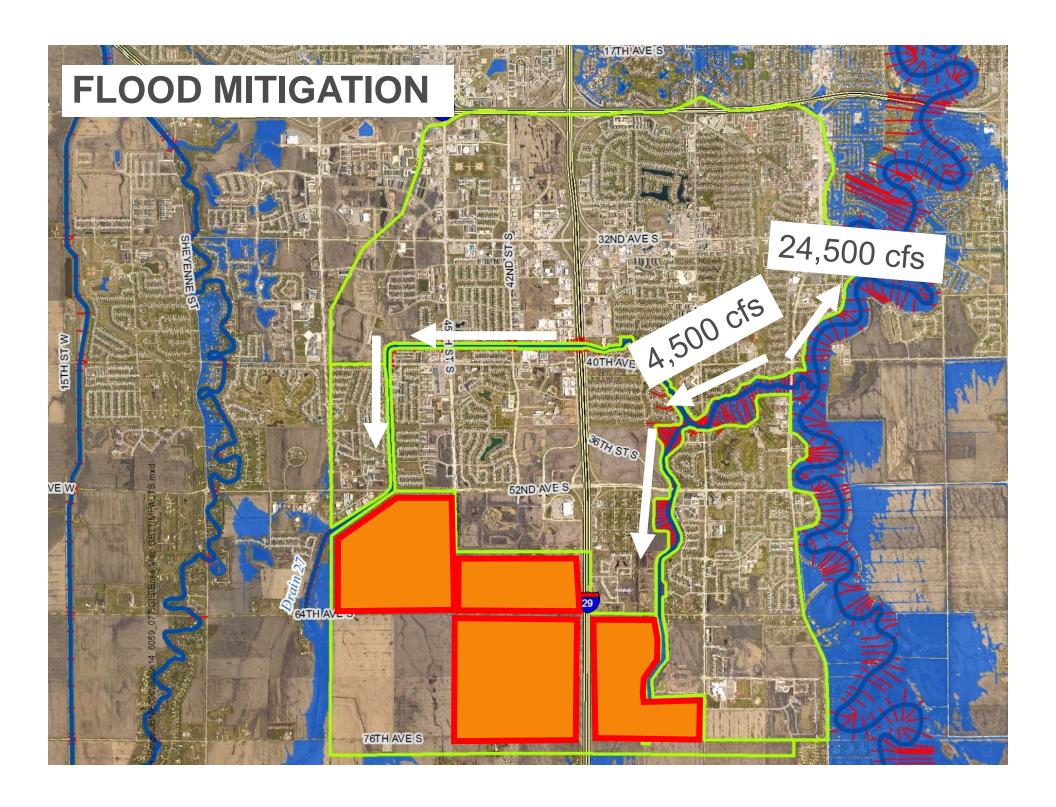
29,000 cfs

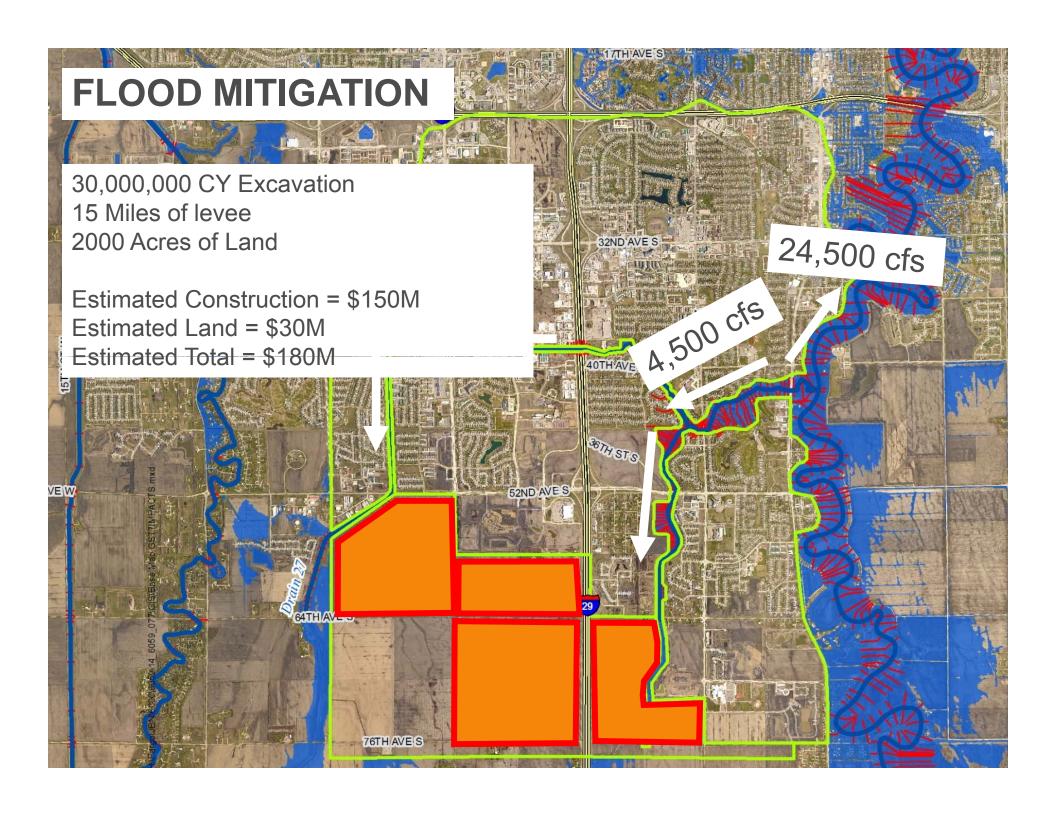




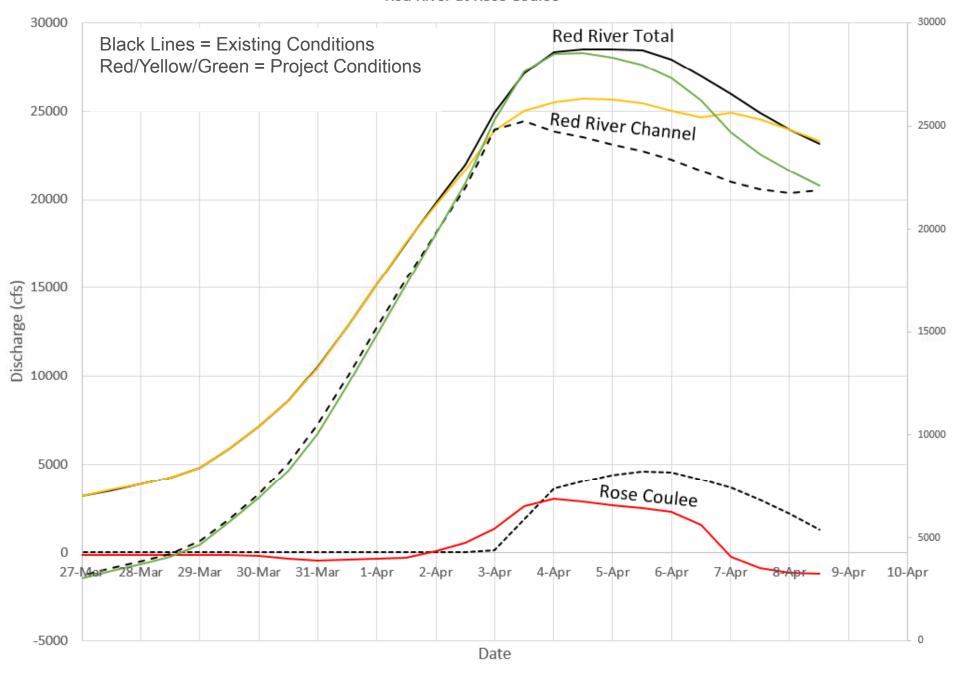
Levee Construction
Forces flow between the levees
Results in a stage increase







#### Red River at Rose Coulee



#### **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

