Preliminary Draft

River Valley Flood Control Investigation

Public Information Meeting #1

Preliminary Draft

December 16, 2008

Introduction

- Presenters
- Flood of 2008
  - Background
  - Impacts and Extent
  - Causes
- Climate Trends & Future Flooding
- Progress Report on Study
- Next Steps

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What happened?

- Flooding of 4,400 acres in the River Valley
- Crops destroyed, land out of production, major losses
- Dozens of homes and businesses damaged or destroyed
- Families evacuated & displaced from homes
- Sanitary sewer system failures
- Stormwater retention ponds overtopped
- Culvert & storm sewer failures, design standards exceeded
- Roads flooded, access issues
- Health and safety problems

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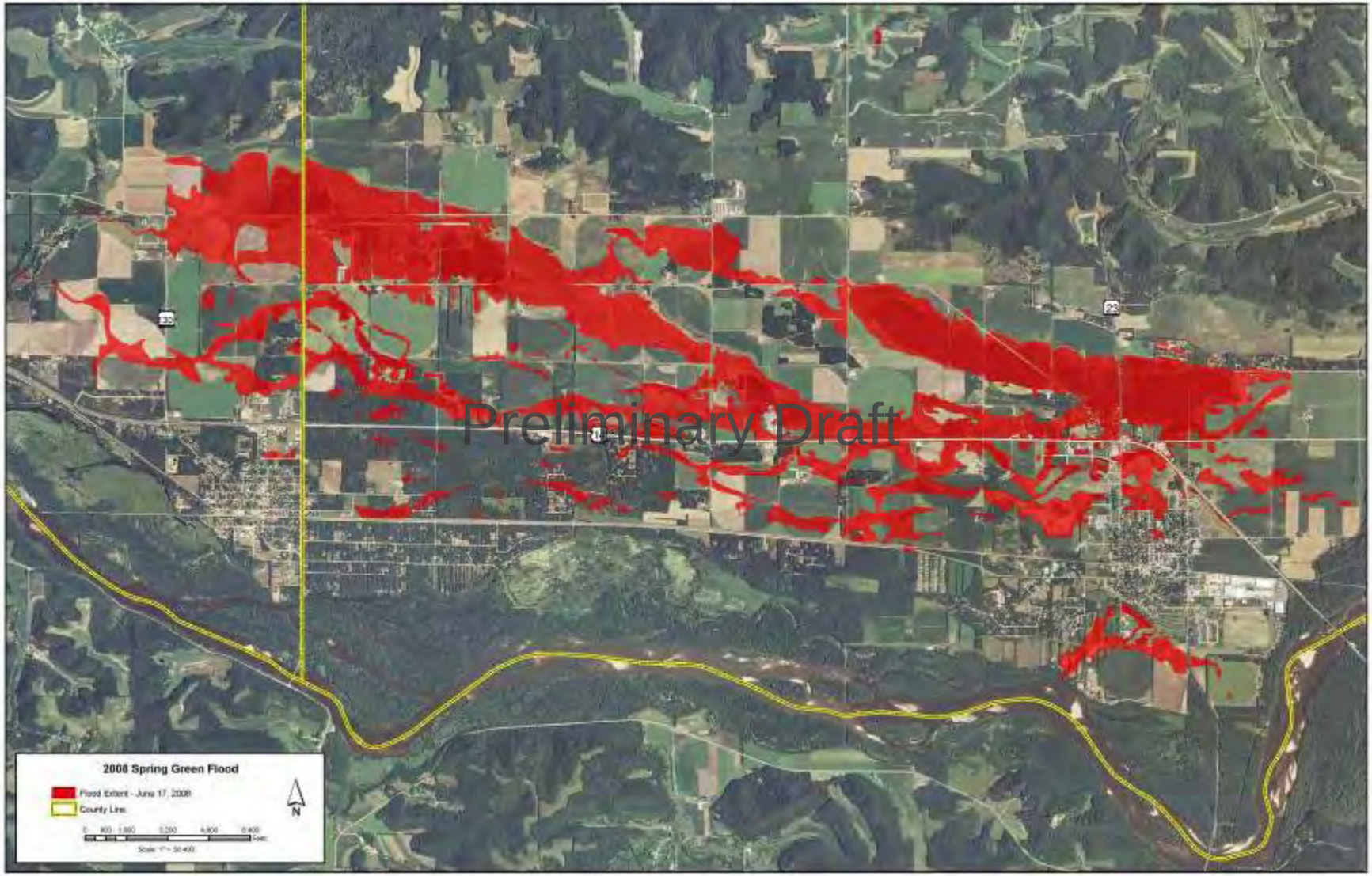
Where did it happen?



Source: F. Iausly
Map based on satellite photos of flood

Why did the flood happen?

- **Wetter than normal late summer/fall in 2007**
- **Record winter snowfall and 100” snow accumulation**
- **High water table**
- **Soil capacity for water storage fully utilized**
- **Twin storms of June 7-8 and June 12**
- **July 9-10 storm brought water levels back up**
- **Flash flooding and surface flows**
- **No outlet for flood waters**
- **Soils indicate some flooded areas were once wetlands**

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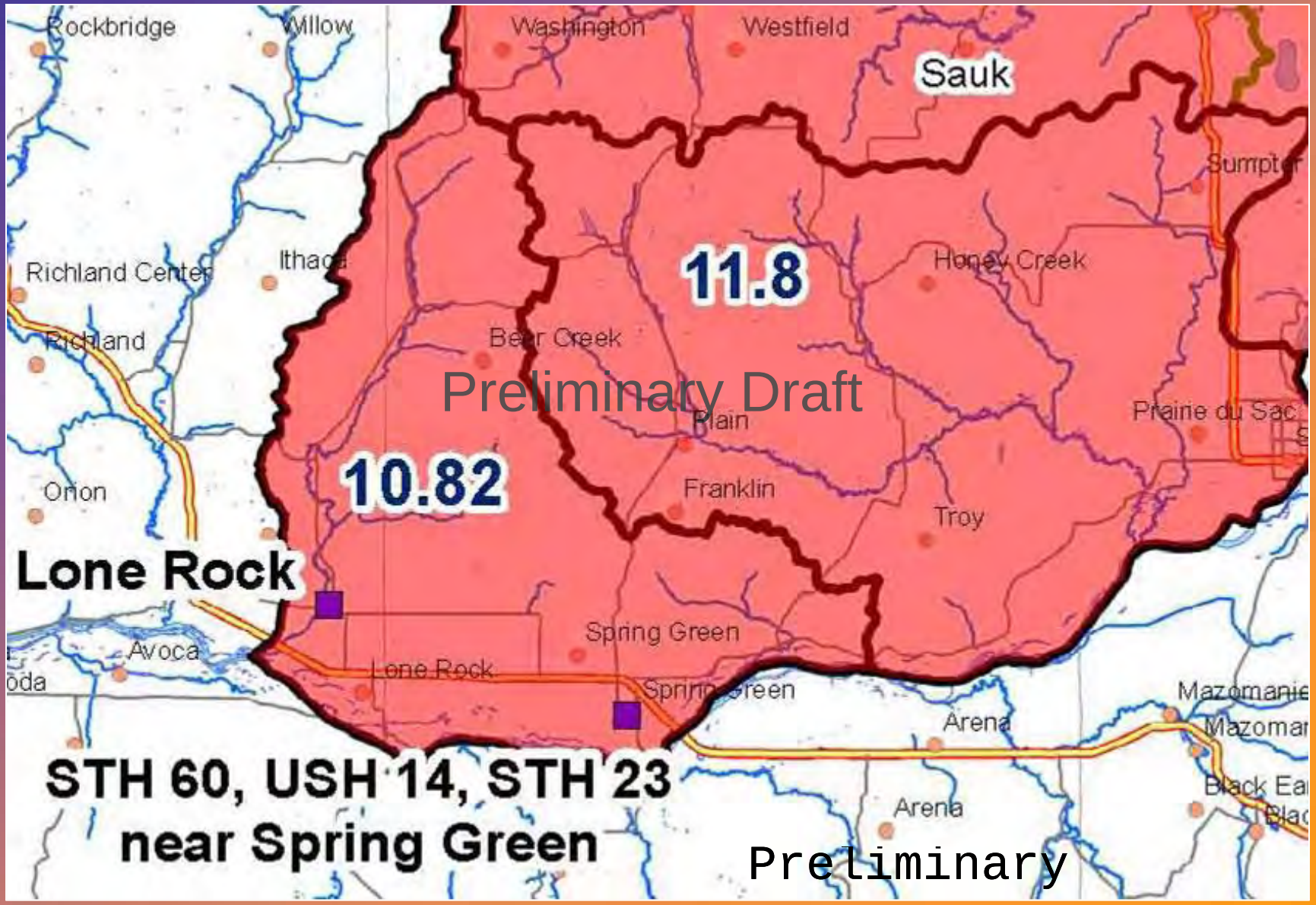
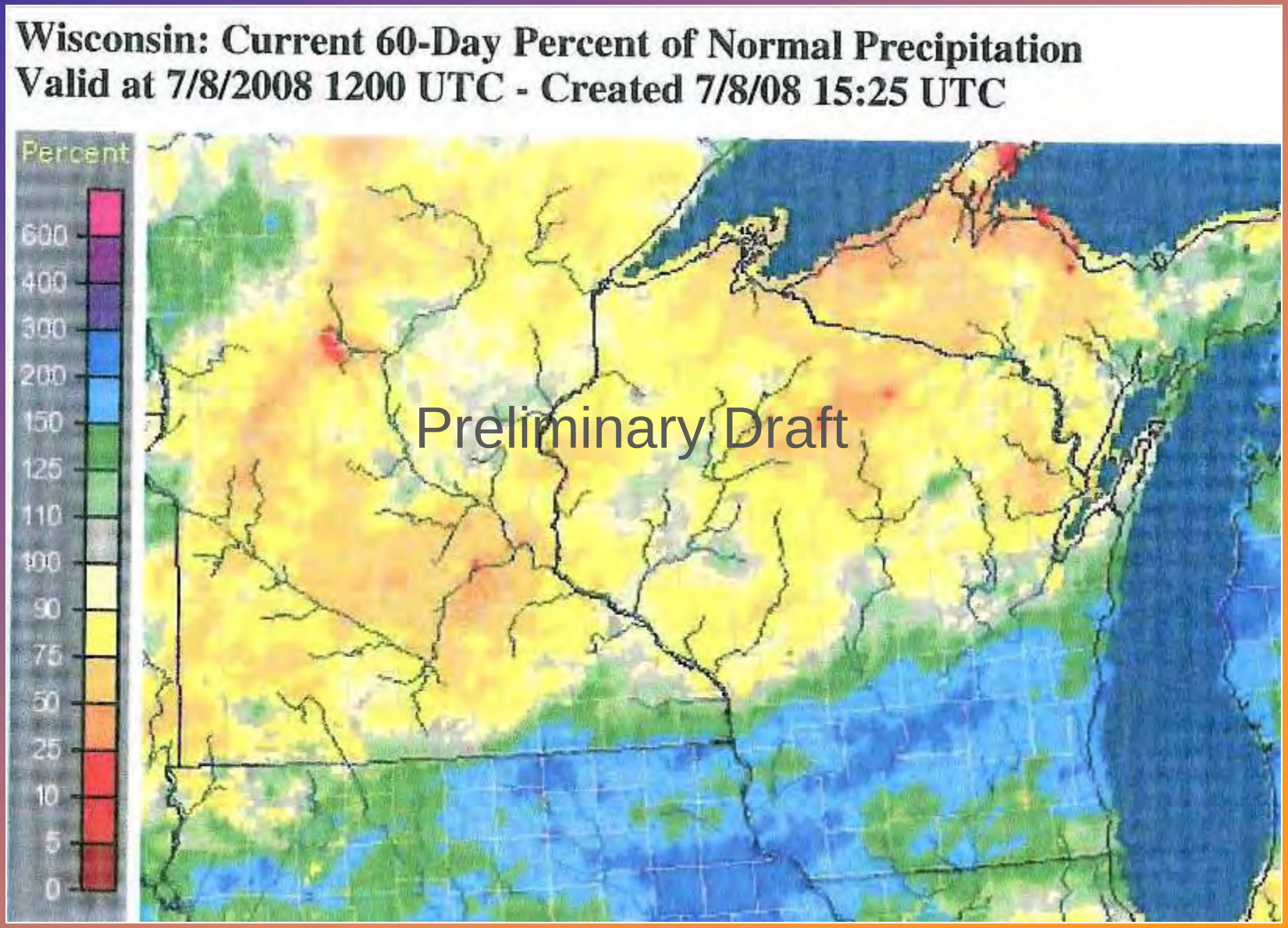
June 7-8 and June 12 Totals

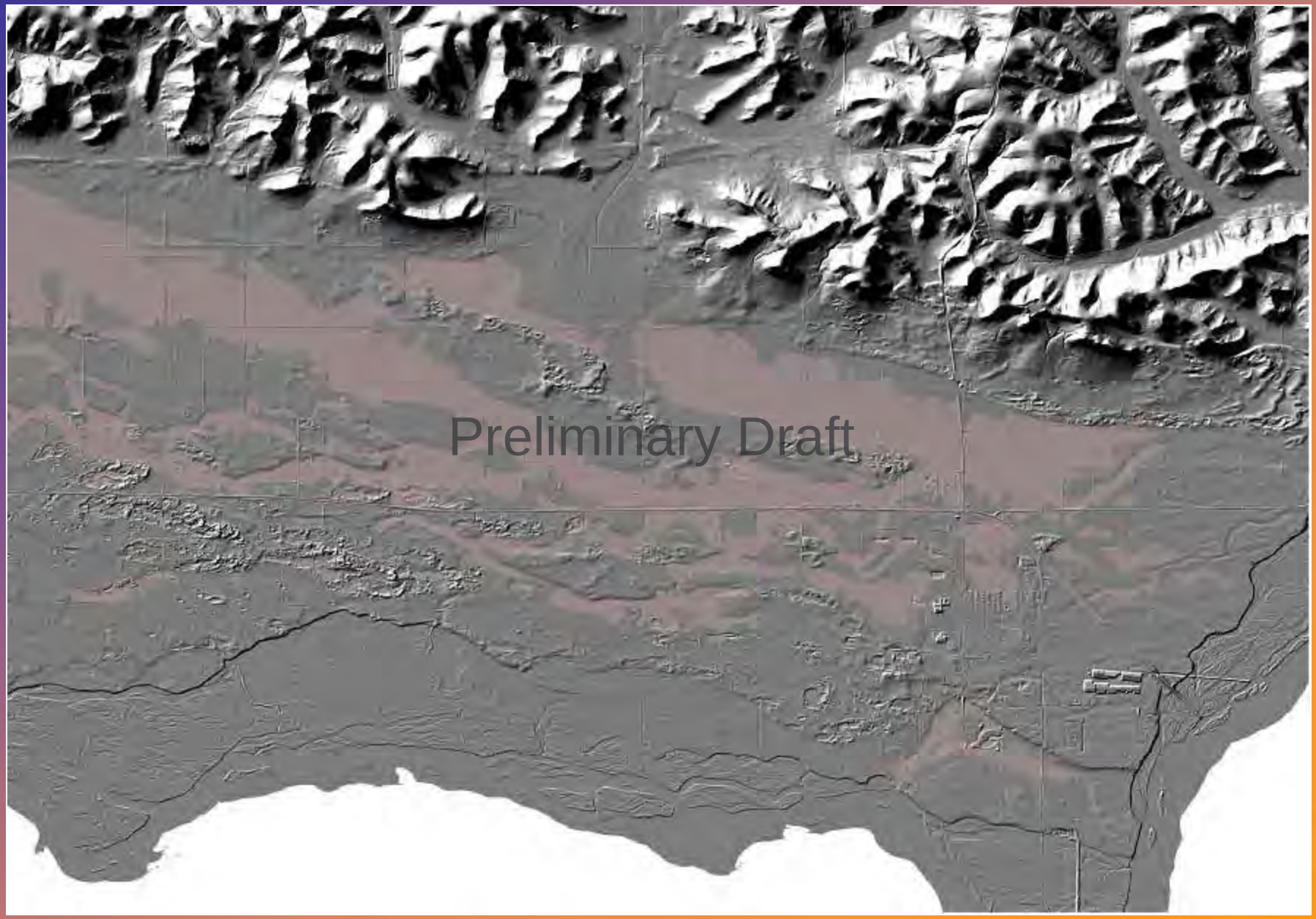


60-day precipitation 200-300% above normal



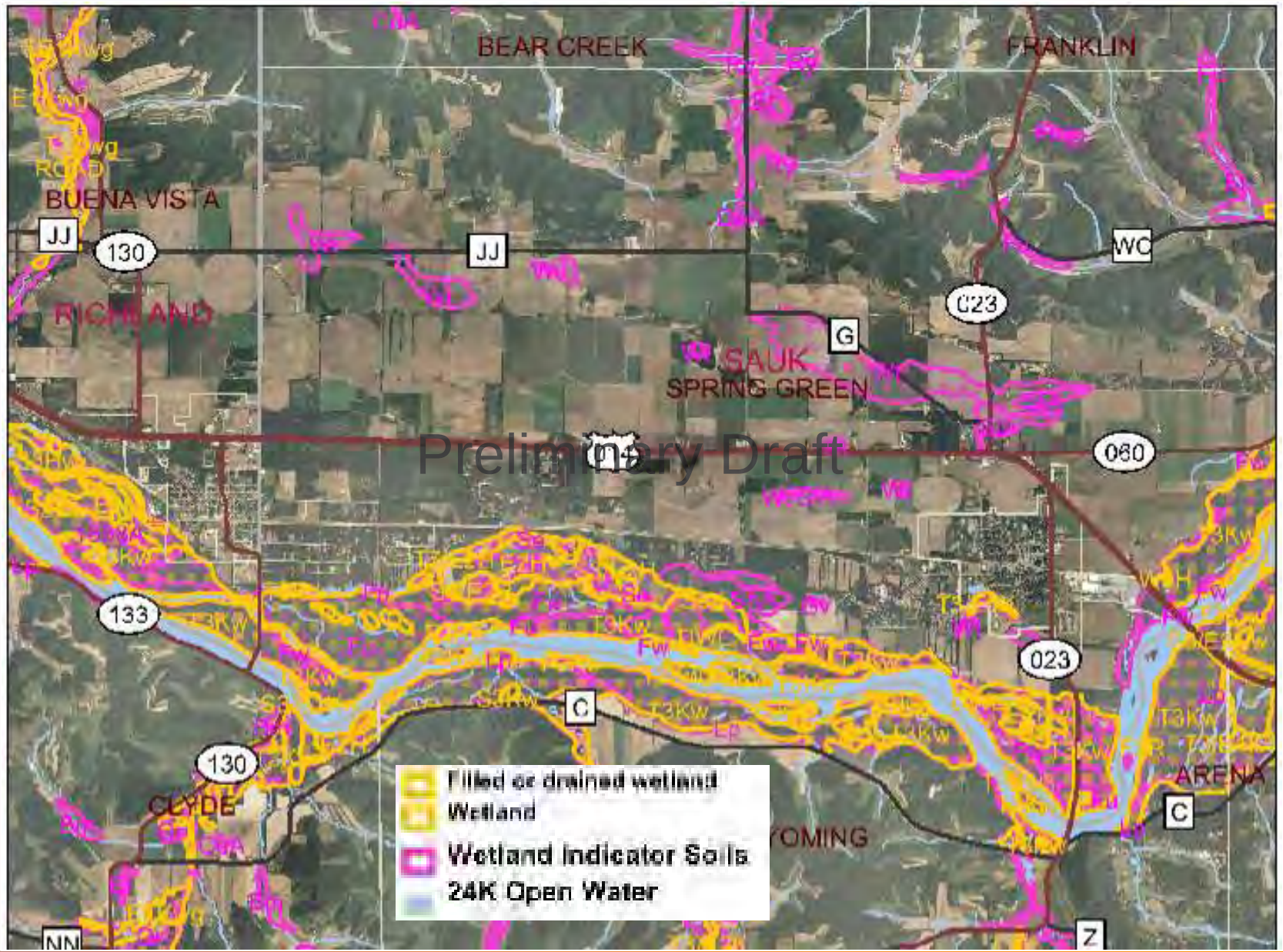
Source: NOAA

Terrain & topography



Source: Sauk Co./F. Iausly/WGS

Wetland indicator soils



Source: WDNR

Will conditions that led to flooding return?

Yes. Not a question of “if” this will happen; only “when.”

- Climatologists at UW and other places in the Midwest have been studying regional climate trends

- Seasonal precipitation trends are mixed, but the overall trend is that we are now receiving 10-15% more precipitation than 60 years ago
- Record rainfall events of just the past 10-20 years are rapidly moving up the all-time top 10 lists
- Widespread nature of recent storms is unprecedented

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Additional studies confirm the trend of a marked increase in extreme precipitation events and a decrease in lighter precipitation events.

Source: Center for Sustainability and the Global Environment (SAGE) University of Wisconsin, Madison

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Precipitation Trends

Record 24-hour Precipitation Events 1879 to Present
Madison, WI

Amount	Date
1. 5.31 inches	9/7-8/1941
2. 5.27 inches	6/7-8/2008
3. 5.20 inches	9/12-13/1915
4. 5.00 inches	8/18-19/2007
5. 4.51 inches	6/17/1996
6. 4.38 inches	5/21-22/2004
7. 4.32 inches	7/21/1881
8. 4.21 inches	7/15-16/1950
9. 4.11 inches	6/8/2008
10. 4.11 inches	5/17-18/2000

24 hr. 3-inch rains in 1990s – 2

24 hr. 3-inch rains since 2000 – 8

24 hr. 2-inch rains is 1990s – 12

24 hr. 2-inch rains since 2000 - 25

Vernon Co.
11.75 inches on 8/18/07

Locally, June 12 rain exceeded the June 7-8 storm

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Source: UW – Madison Center for Climatic Research

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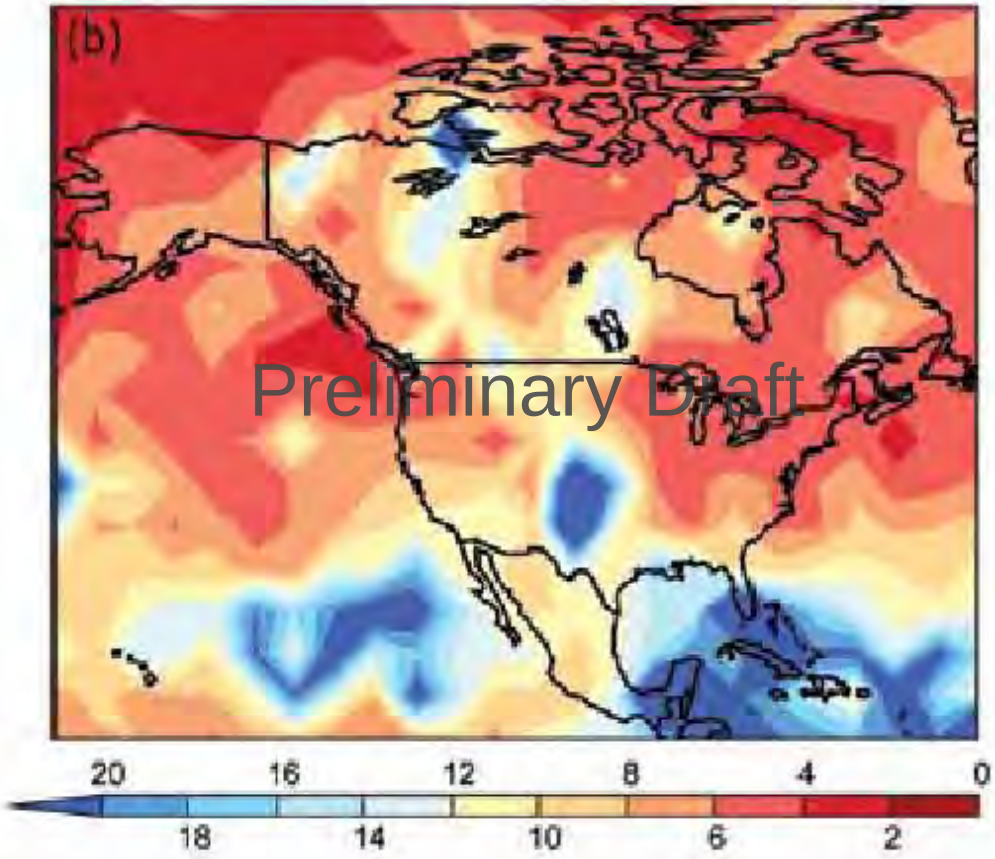
Future Return Periods of Modern 20-year Heavy Precipitation Events



Late 21st Century vs. Late 20th Century

Source: U.S. Climate Change Science Program 2008

When will conditions that led to flood return?

Elevated water table

<u>+ intense rainfall event</u>

= flood

- Predictions of return frequency have become unreliable
- Controlling the weather is beyond our ability
- All flooding can probably not be prevented
- Decreasing the extent and duration of flooding is our goal
- Study progress report: What we are learning and how we are using the knowledge to analyze potential solutions

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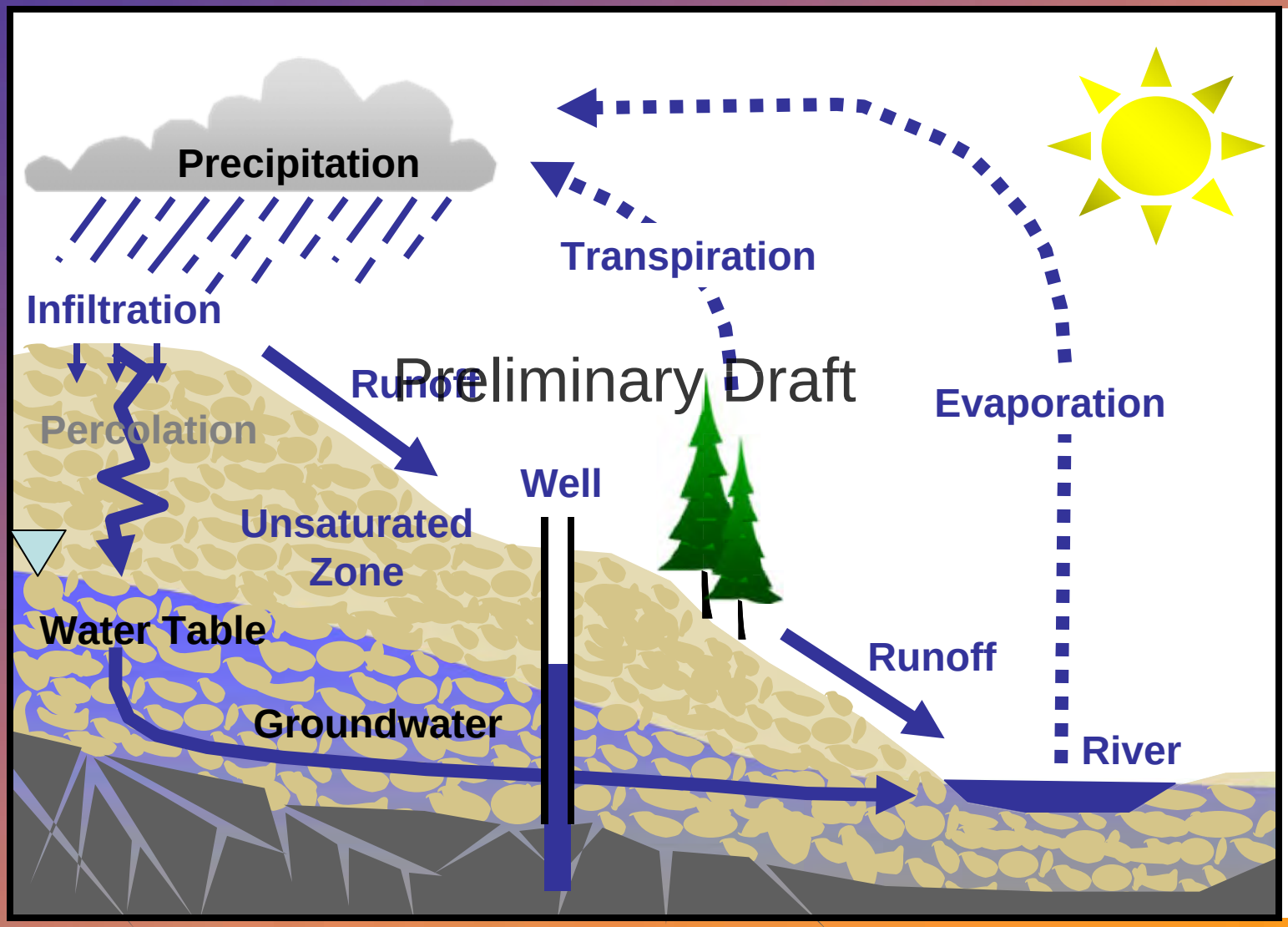
Groundwater - Surface Water Interaction

Objectives: Preliminary Draft

- **quantify the impacts of the selected surface water flooding alternative (to be determined) on the groundwater system**
- **Design and management implications**

Key Variables



Source: UW Extension

Groundwater – Surface Water Analysis

- Computer Model of Spring Green
  - WGNHS Steady State Model
  - Solves mathematical equations that describe groundwater flow
  - 3-Dimensional grid simulates flow field, wells and river
- Review of existing available data:
  - Wisconsin River, wells, and precipitation

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- Collection of water level monitoring data at 6 recently installed shallow wells
- Refine groundwater model & run additional analyses

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What Do the Model and Monitoring Data Tell Us?

- Variability in water levels and trends
- Direction and velocity of groundwater flow (Modpath-particle tracking model)
- Relationship between recharge and water level
- Influence of the Wisconsin River on water levels

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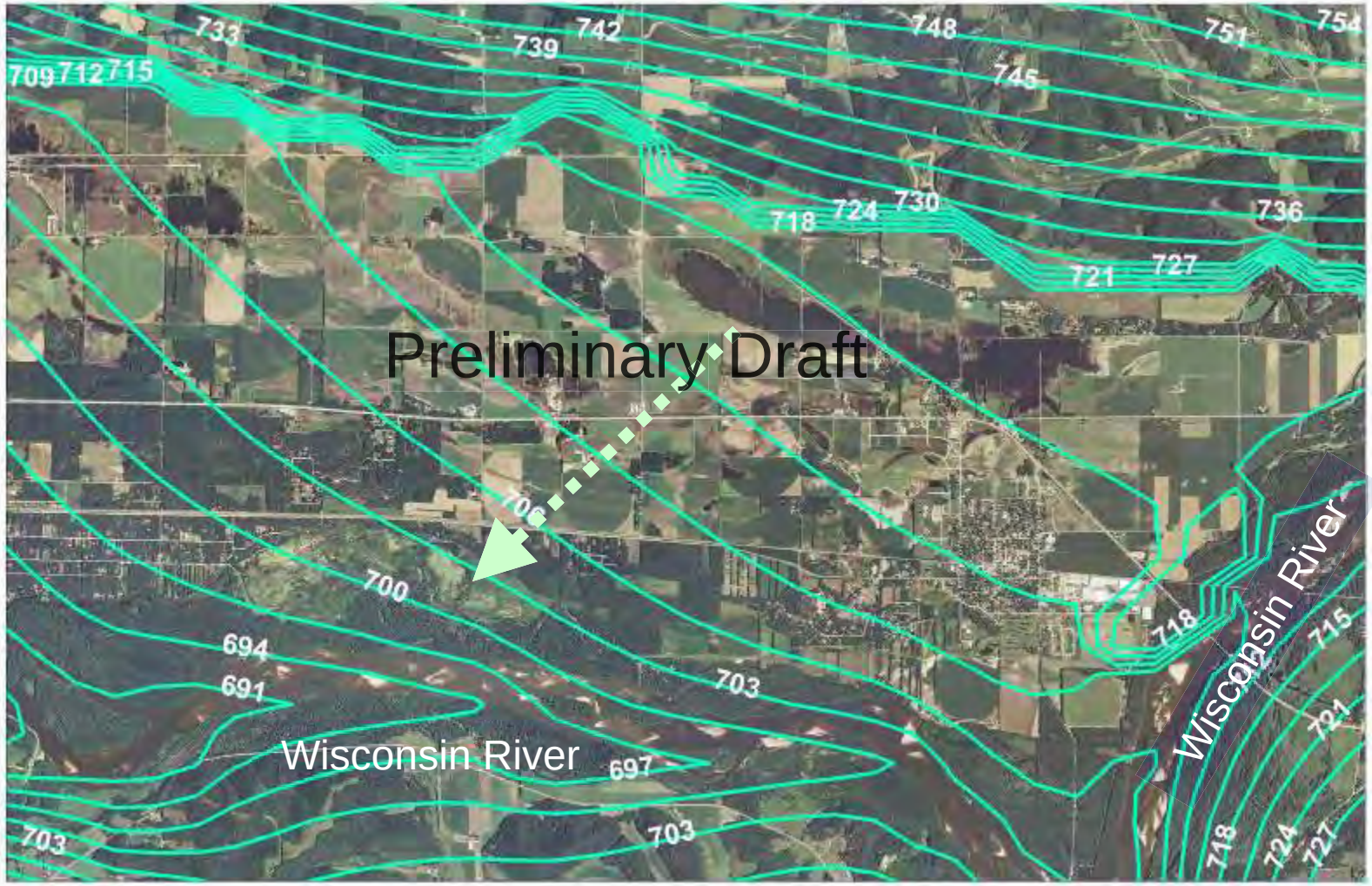
Model Water Table Map
Groundwater moves from high to low elevations



Source: WGNHS model

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How Fast Does Groundwater Move?

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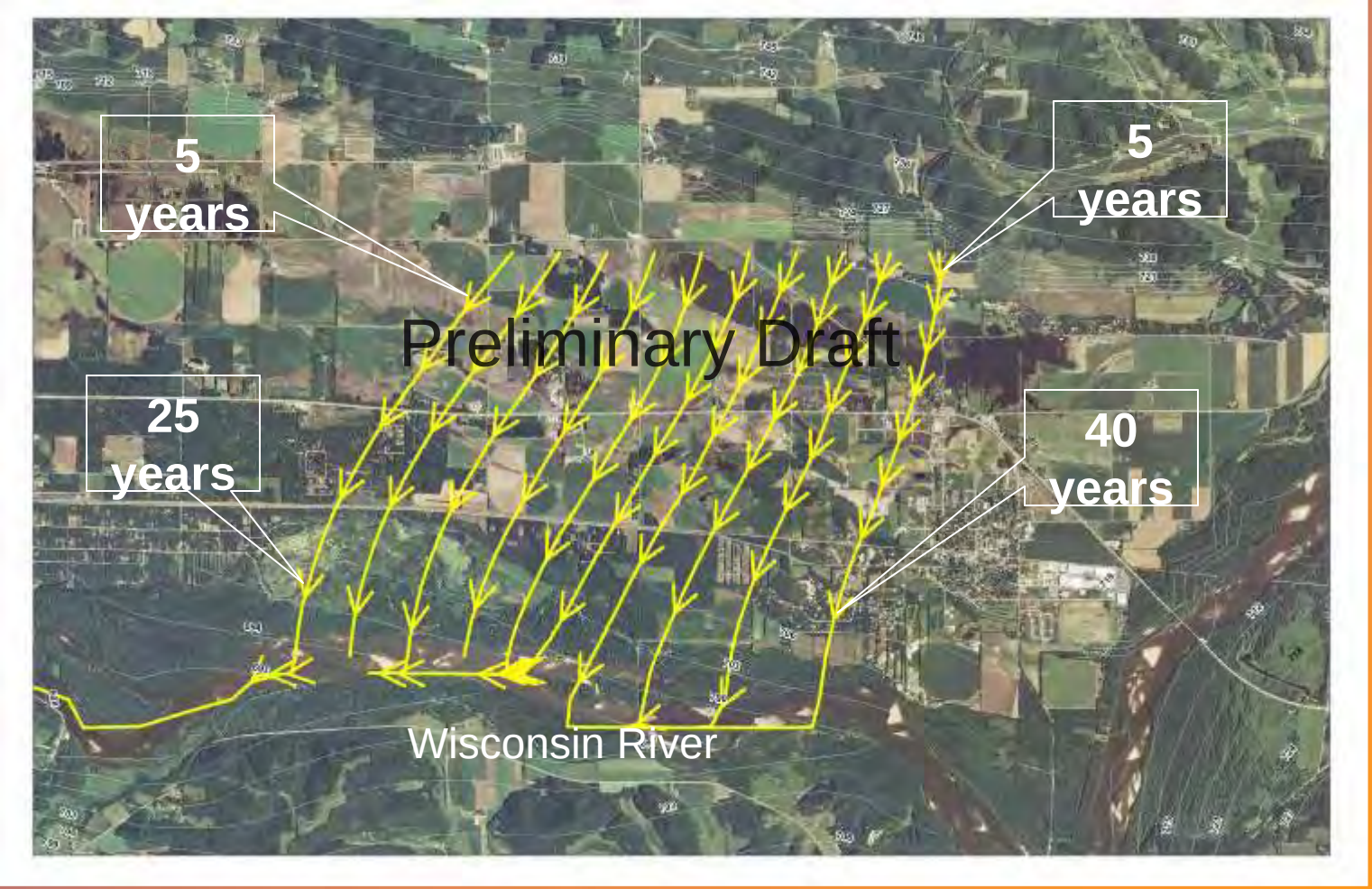
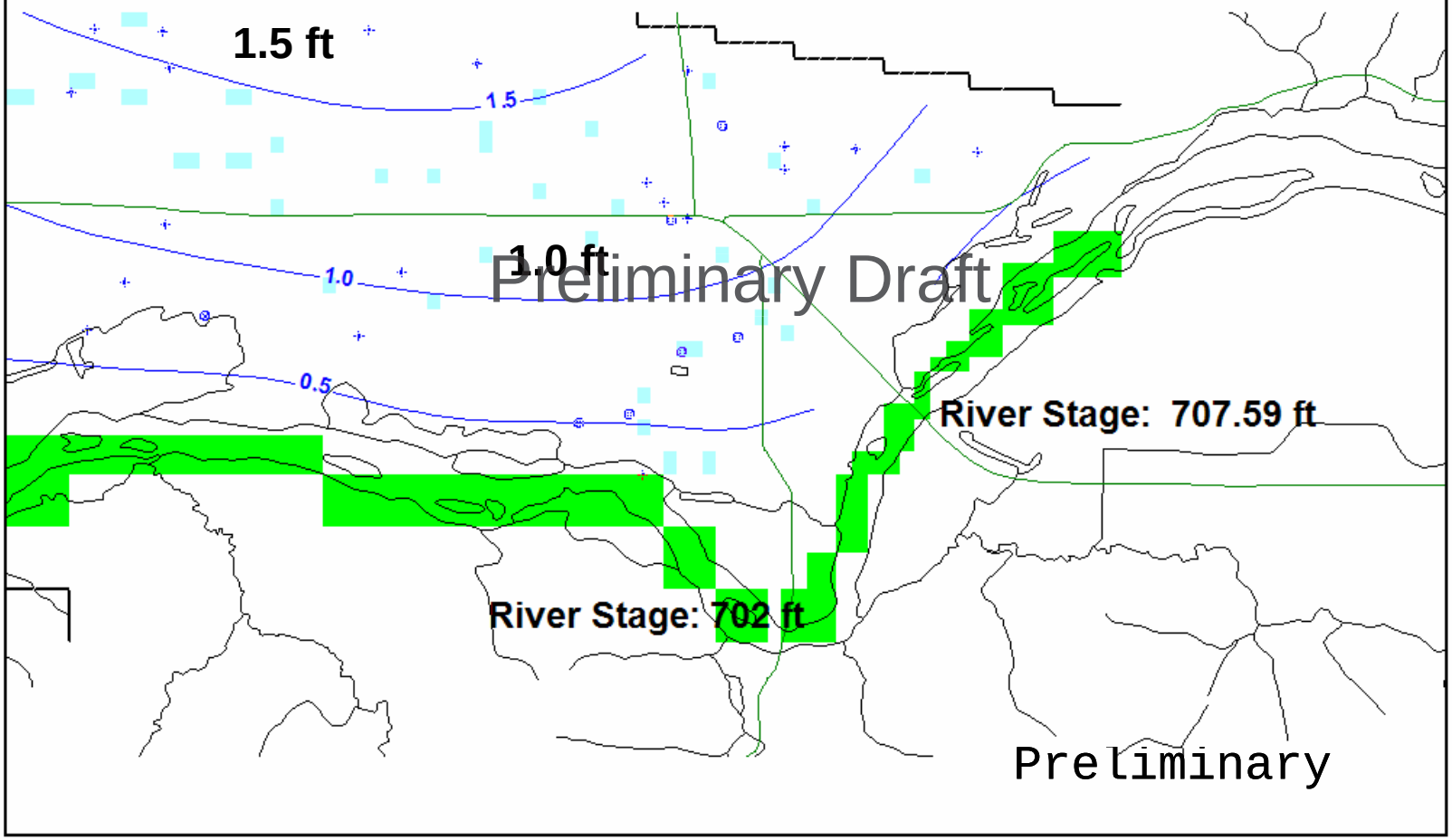


Average linear velocity is approximately 0.5 – 2 ft. per day

Source: WGNHS model

Modeled Increase/Decrease in Water Table (ft) when Average Recharge is Increased/Reduced by 1 inch



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Shallow Monitoring Well Locations

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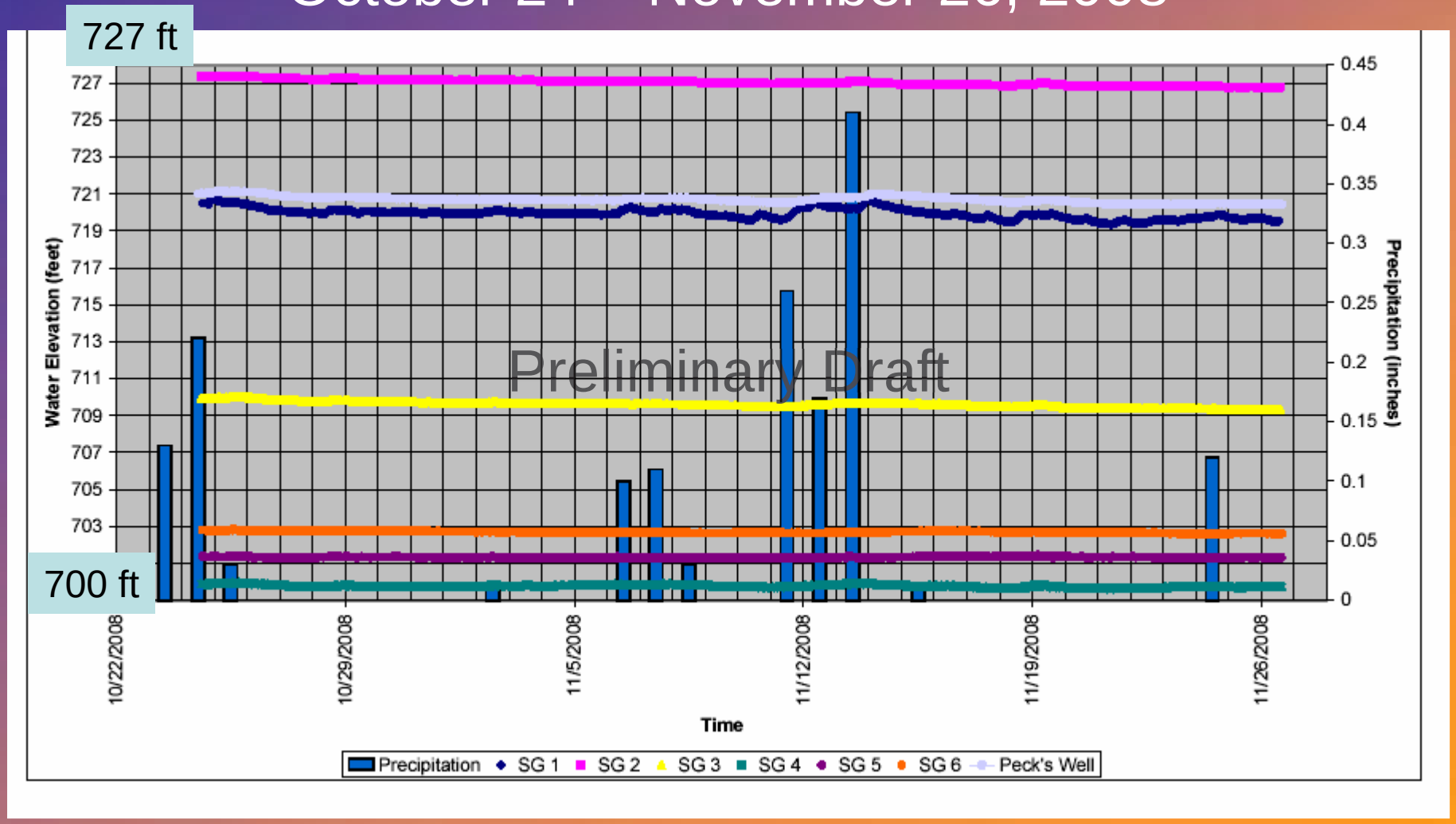
Water Levels and Daily Precipitation
October 24 – November 26, 2008



Velocity = 297 ft/day * 27 ft/14,000 ft * 1/0.25 = 2.29 ft/day

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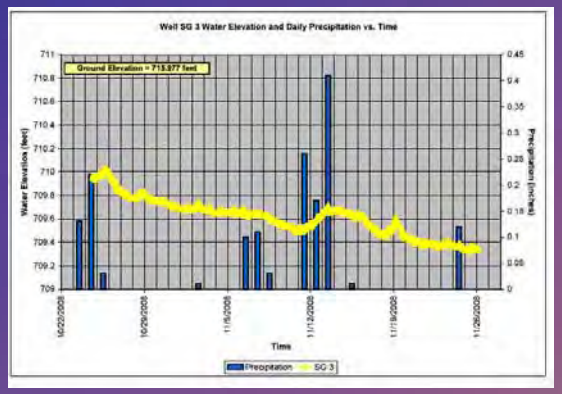
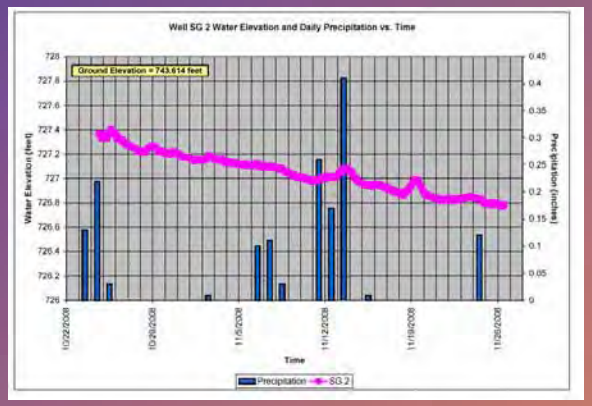
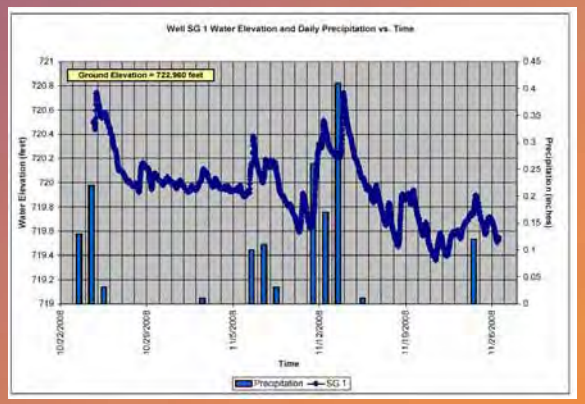
SG 3 – Airport



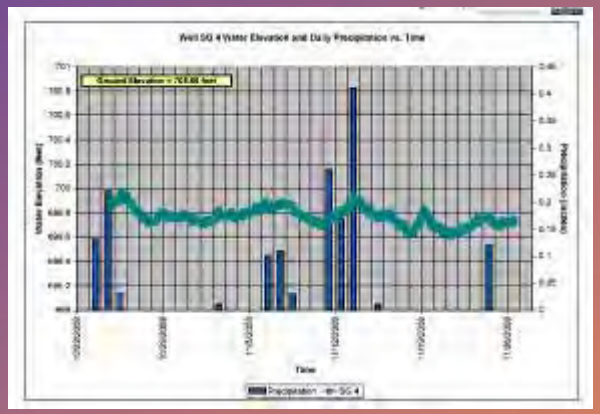
SG 2 – Base of Big Hollow



SG 1 – High water table



SG 4



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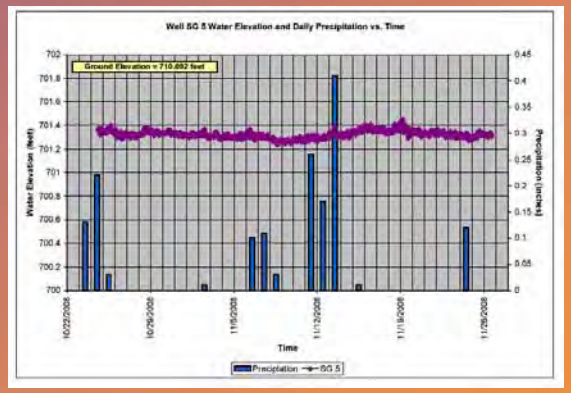
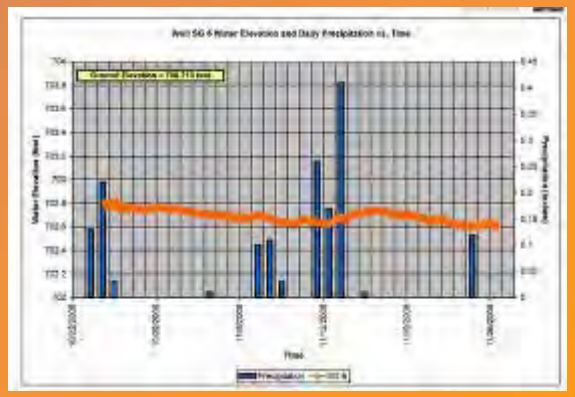
SG 5



SG 6



Closest to the river

Summary and Next Steps

- Average water levels (October 24 – November 26) range from approximately 727 ft to 700 ft across the valley.
- Average linear velocities range from inches to a few feet.
- Increasing/decreasing recharge of one inch may raise/lower the water table about 0.5 - 1.5 feet
- Water table fluctuations are dependent on precipitation, depth to water, distance from the river and other factors
- Continue to collect water level monitoring data to refine the model
- Evaluate the changes in the groundwater system based on the selected alternative to be determined

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What can be done???

Developing a Strategy

- Break down the valley into basins based on topography
- Monitor groundwater at strategic locations
- Quantify volume and flow rates of water during extreme precipitation events
- Compare and contrast storm effects with various groundwater elevations
- Develop a strategy or alternative strategies for each basin
- Apply the knowledge from the studies toward possible solutions
- Test the proposed solutions with computer modeling, field verification and consultation with area landowners & residents

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Surface Water Drainage

- Surface water drainage problem coupled with high groundwater table
- Currently under these conditions:
  - No easy drainage to Wisconsin River
  - No way for water to infiltrate into groundwater
- Objectives:

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  - Quantify volume and flow rates of water during extreme precipitation events
  - Develop surface water drainage alternatives to provide relief to flooded areas

Rainfall

- Rainfall
  - 7-8 June – 6 inches
    - Lone Rock Airport Hourly Data
  - June 12 – 5 inches
    - La Crosse NOAA NEXRAD Radar
    - Intersection of Mercer Road and Big Hollow Road
  - 100 year Precipitation
    - 6.1 inches

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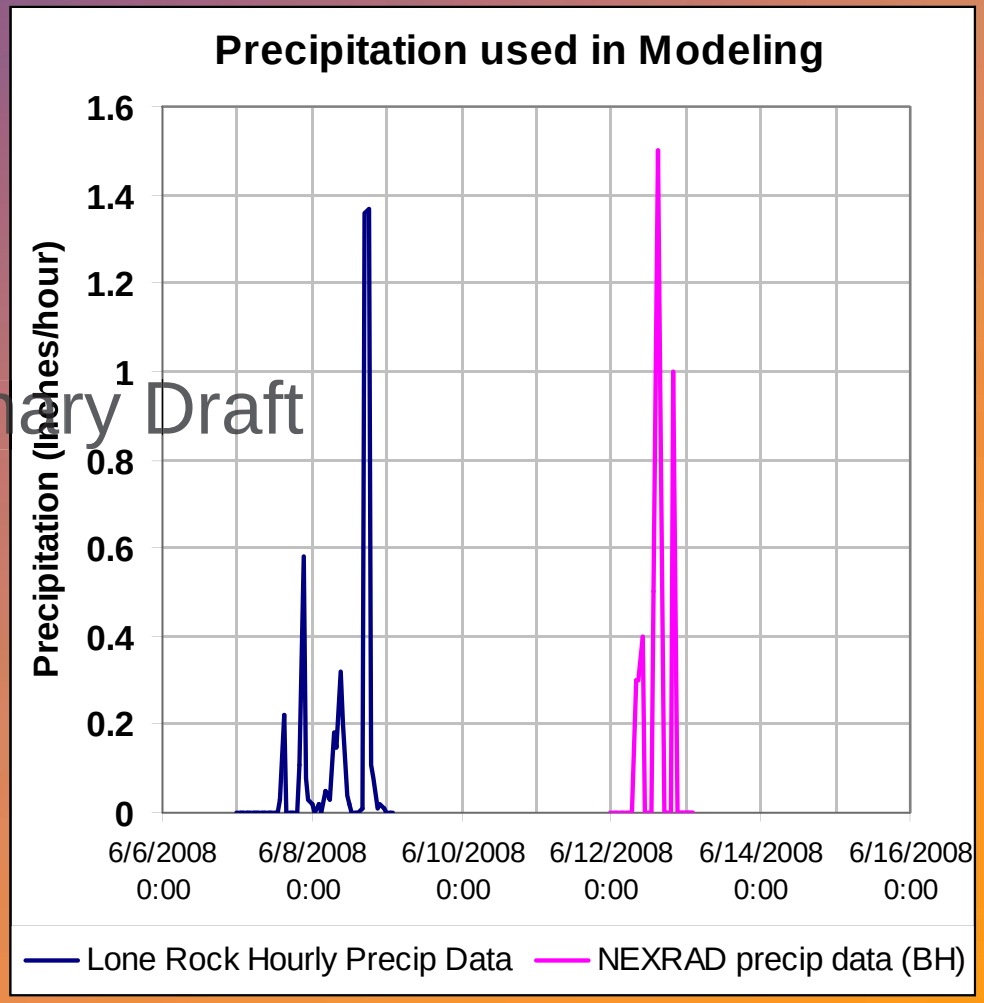

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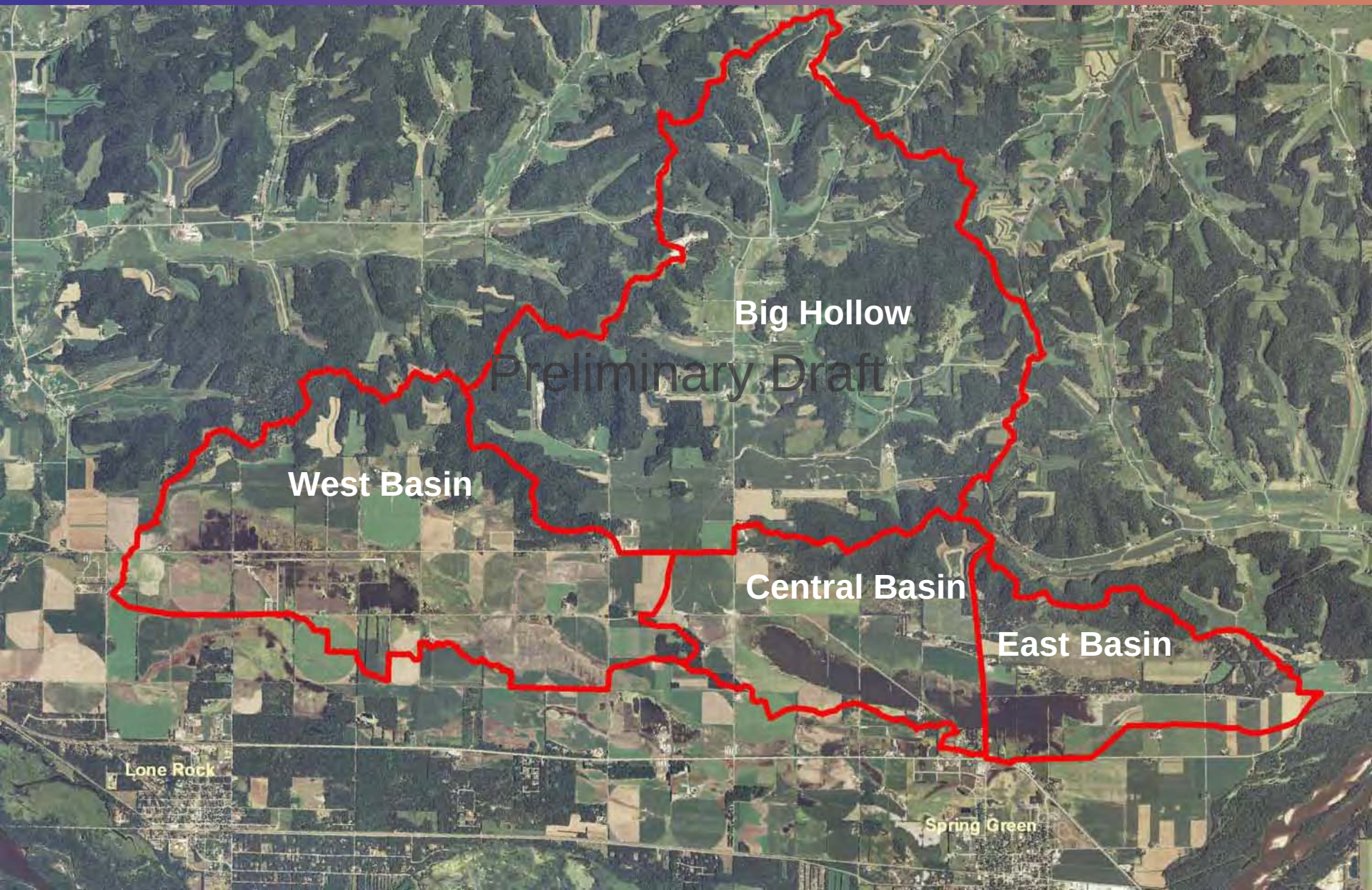
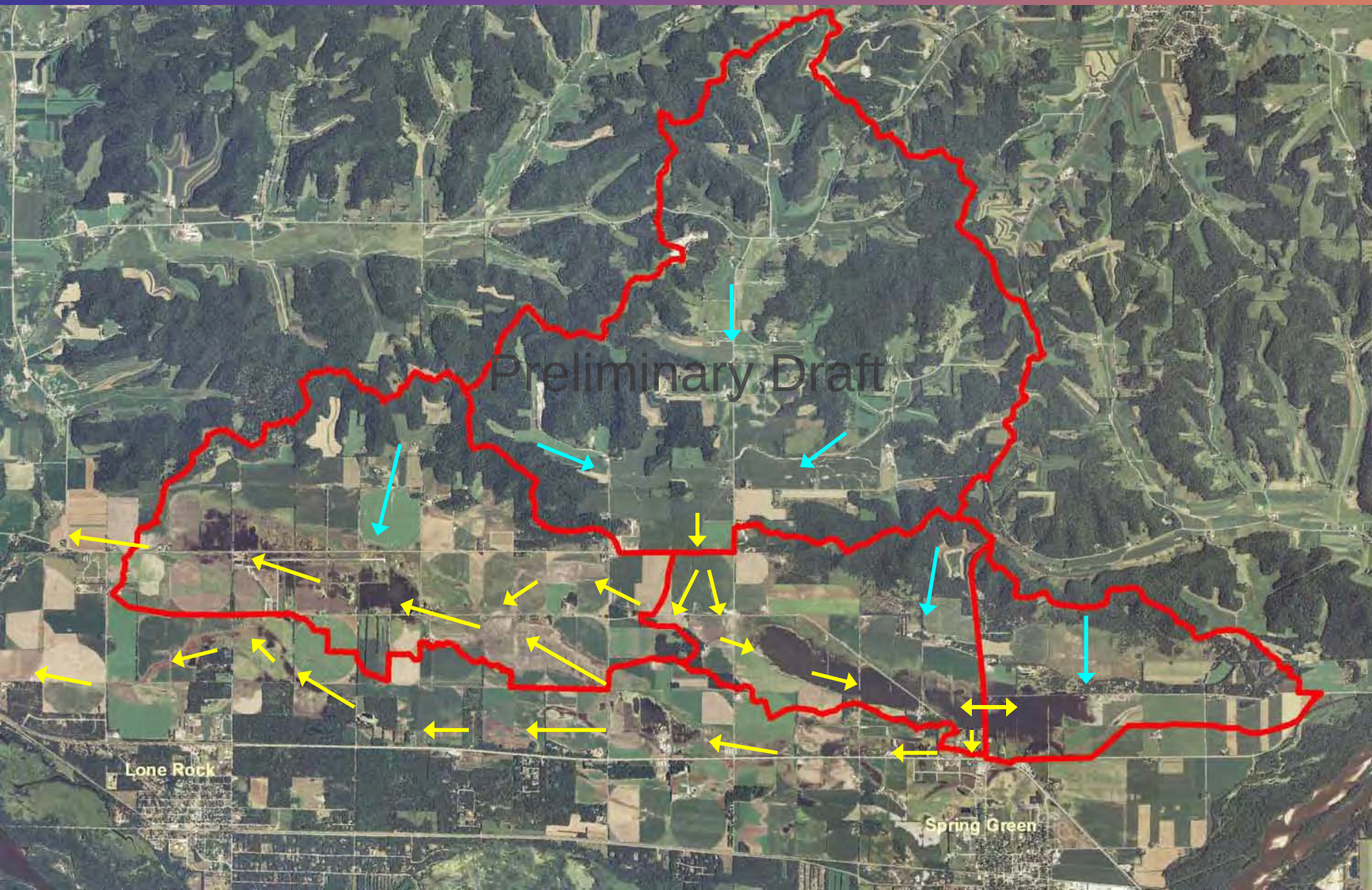
Subwatershed Delineation Preliminary

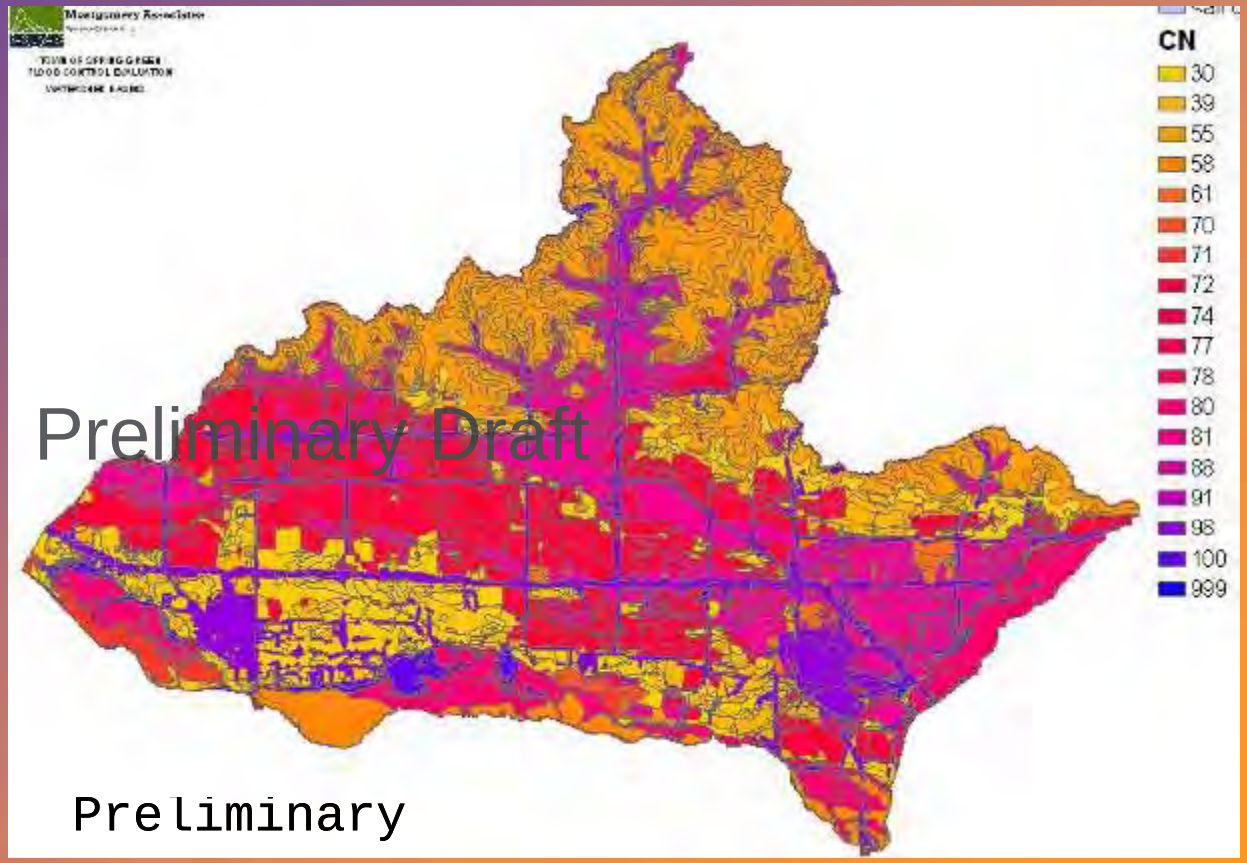


Current Runoff Pattern Preliminary



Runoff Volumes

- Runoff Volumes
  - SCS Curve Number Methodology
    - Soils runoff potential
    - Land use runoff potential
  - Antecedent moisture conditions accounted for



Runoff Volumes

Runoff Volumes (Acre-Feet)			
	June 7-8	June 12	100 year Storm
Big Hollow	1,013	1,740	1,442
Central Basin	560	546	725
East Basin	360	350	479
West Basin	1,182	1,153	1,516
Total Volume	**3,116**	**3,790**	**4,162**

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1 Acre Foot = One acre covered to a depth of one foot

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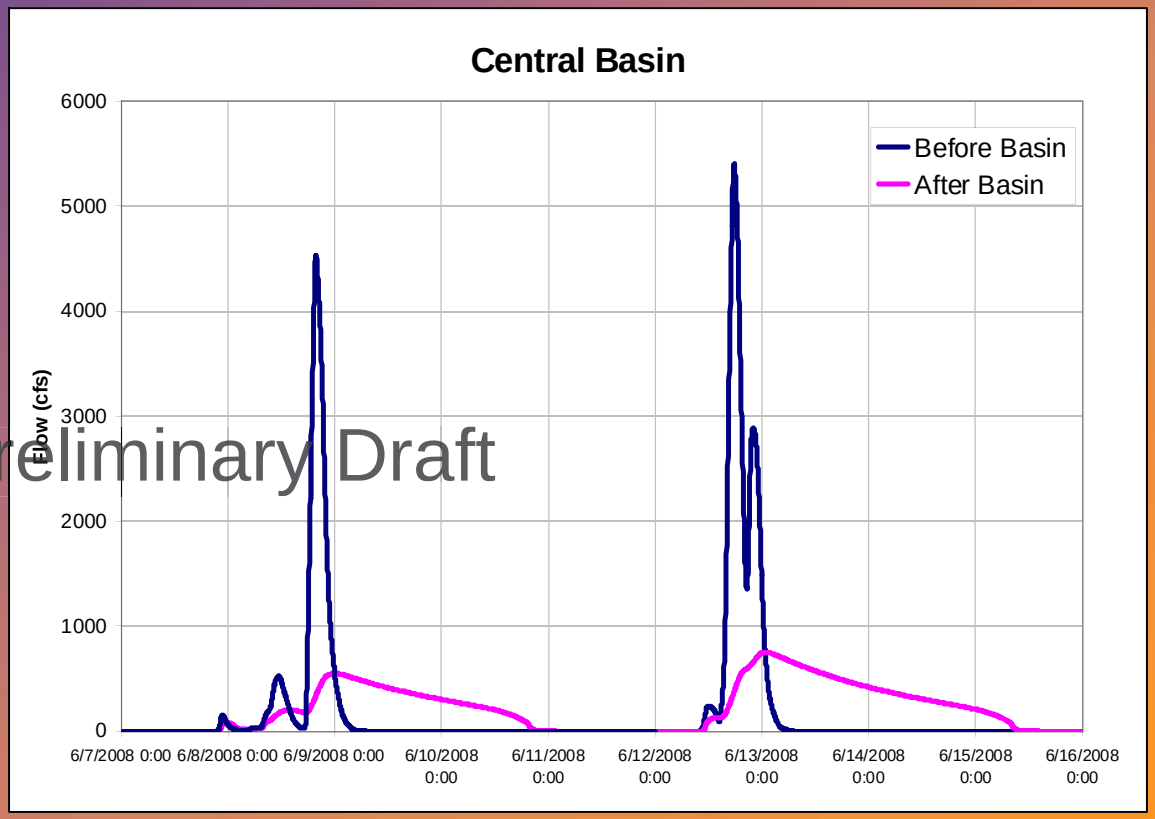
Peak Runoff

- Peak Runoff
  - SCS curve number and NEH-4 Methodology
  - XP-SWMM Hydrologic and hydraulic modeling software
- Basin area very effective for peak control
- Used for design of drainage alternatives



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Design Objectives

- Provide long-term protection of life & property
- Minimize negative impacts on farms, homes & businesses
- Minimize negative impacts on natural resources
- Avoid overhead and underground utility corridors
- Locate storage areas and outlets for surface flooding
- Size and locate drainage conduits (swales, pipes, etc.)
- Size structures to efficiently conduct water under roads/RR
- Avoid negative impacts on air traffic safety
- Work with government agencies for required permits

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Flood Control Alternatives

- Purpose: Provide conveyance of surface water runoff to the Wisconsin River
- Big Hollow volumes major contributor

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- 1. Storage areas in Big Hollow
- 2. Channel Big Hollow peak runoff to River
- 3. Area west of Pearl Rd Temporarily Flooded (central basin) surface drainage channels from central basin and east basin to River

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Flood Storage in Big Hollow

- Big Hollow Runoff Volumes
  - June 7-8 = 1013 acre-feet
  - June 12 = 1740 acre-feet
  - 100 year storm = 1442 acre-feet

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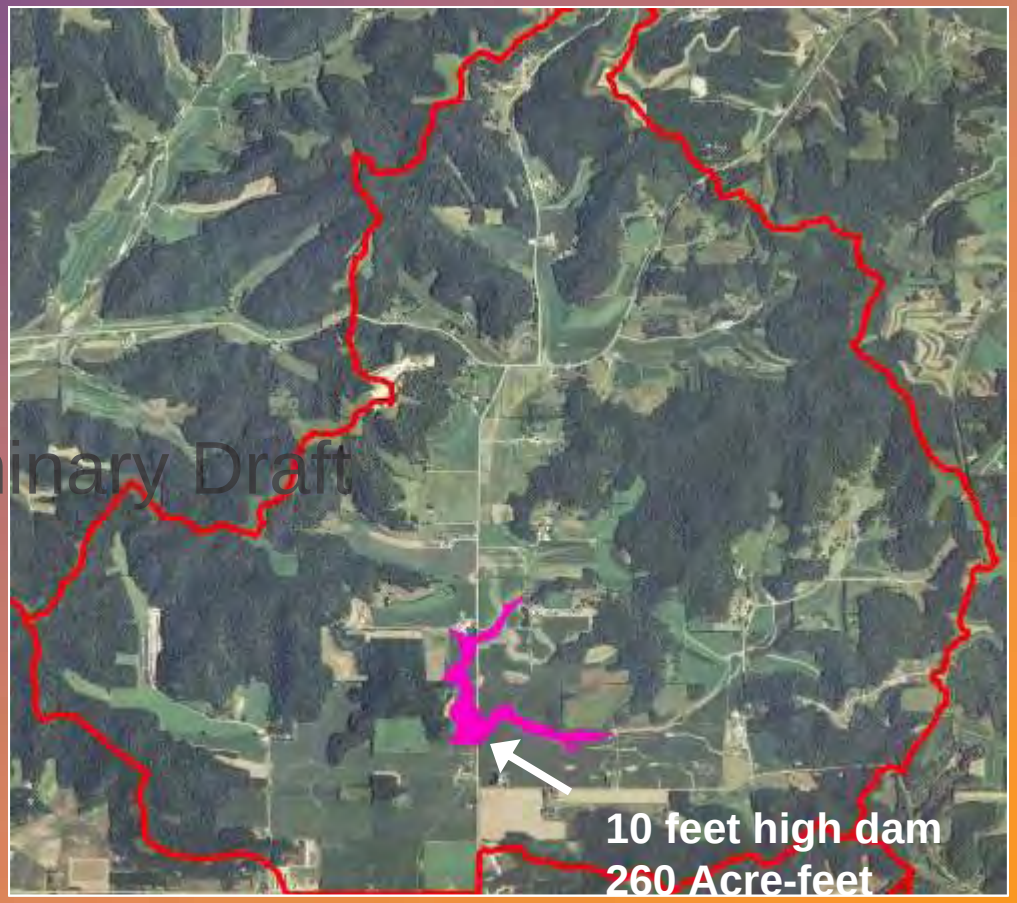
- Multiple dams necessary
- Storage insufficient
- Water still has to go somewhere



Likely impractical

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Direct Discharge Alternative

- Big Hollow flood water channeled south to Wisconsin River
- Big Hollow Peak Flow (Cubic feet per second):

	June 7-8	June 12	100 year Storm
Big Hollow	3,342 cfs	4,372 cfs	3,738 cfs

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- Potential Channel Geometry:
  - Channel bottom width = >100 feet wide
  - Channel bottom depth = >7 feet deep
  - Channel velocities = ~ 6 feet per second

Major impacts on farm operations due to size of channel

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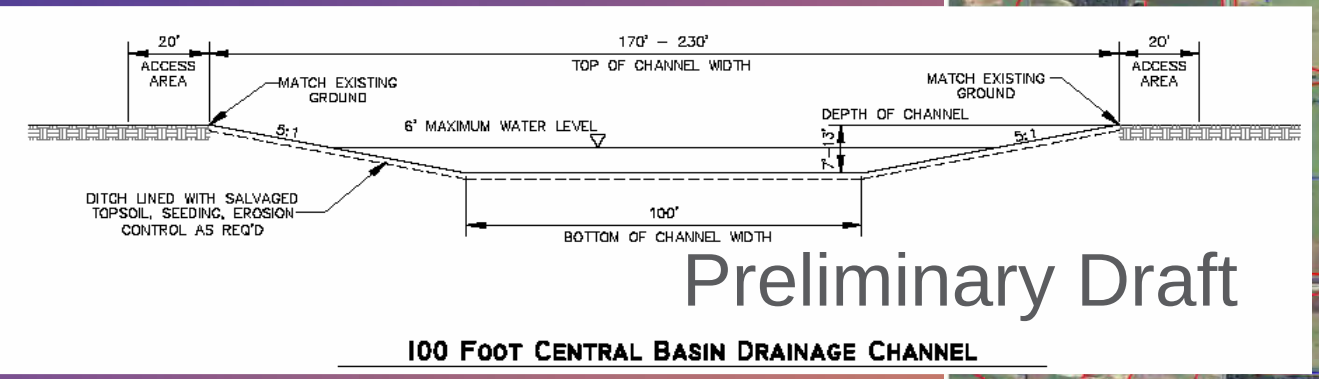
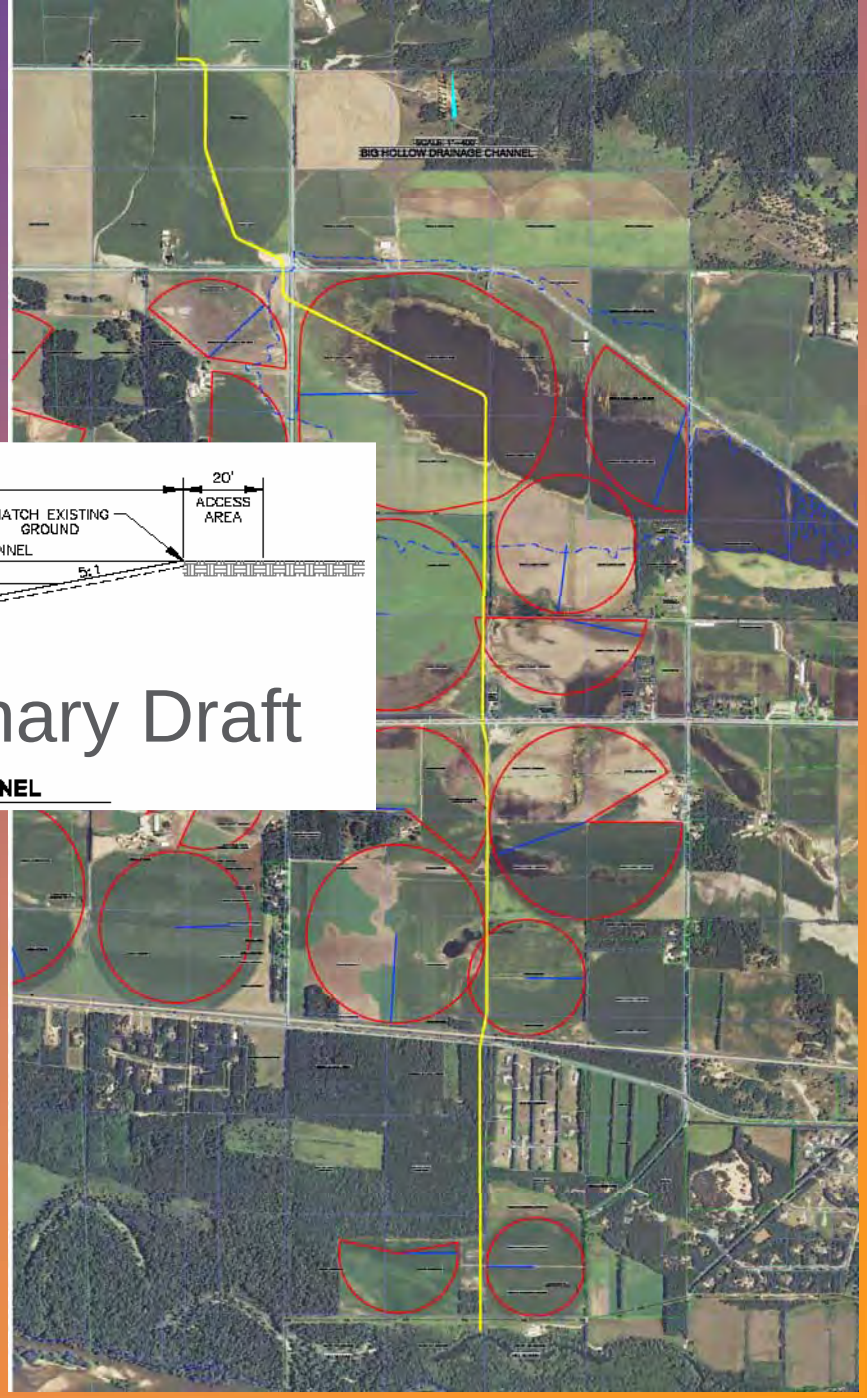
Central Basin Channel from CTH JJ (preliminary)





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Temporary Storage/Dual Outlets

Design Considerations

- Three variables
  1. Channel Geometry (channel width, depth and plan orientation)
  2. Area Flooded (depth of water ponded)
  3. Drawdown Time (Duration of flooding)

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- Each are interdependent and have costs and benefits to be balanced

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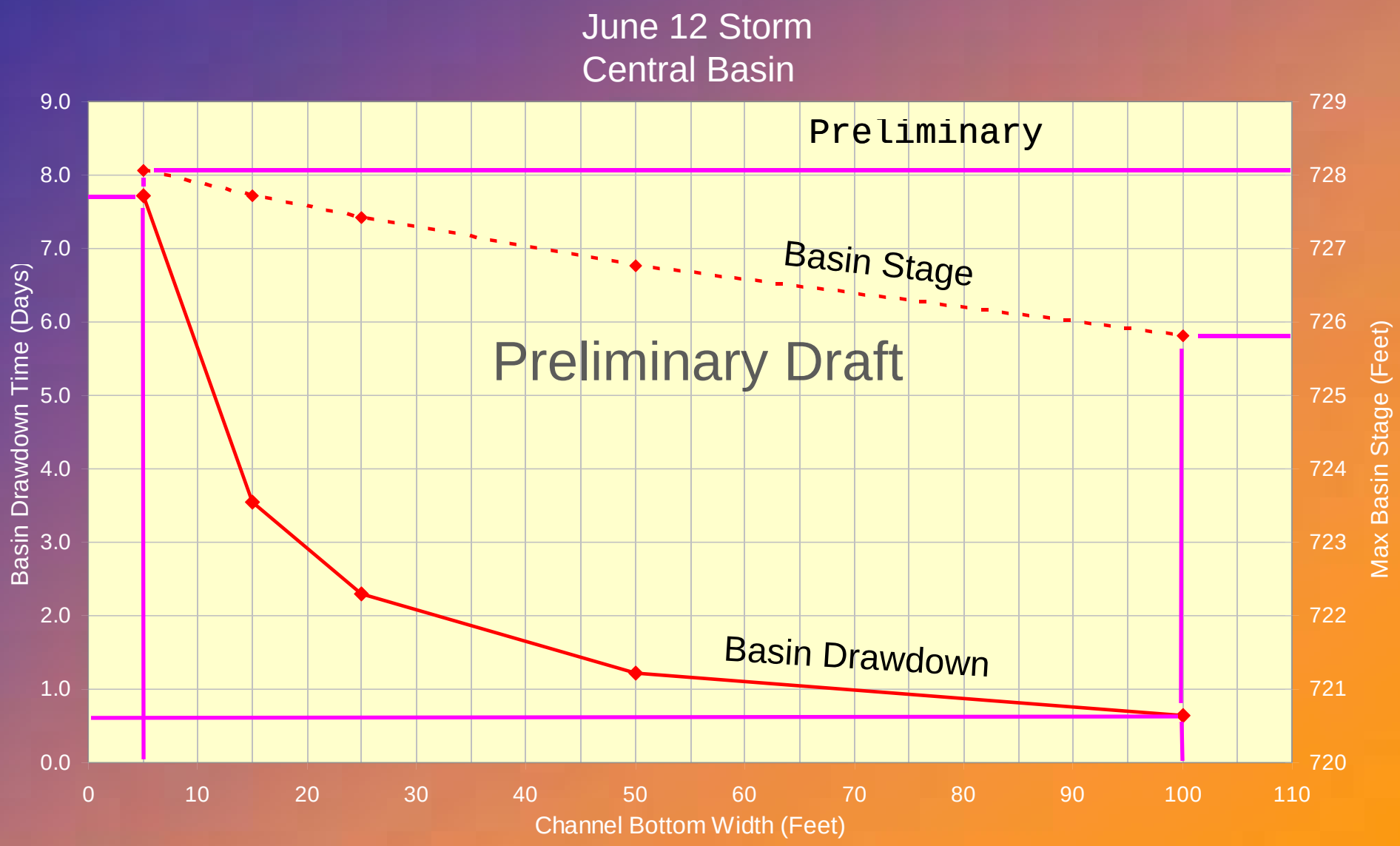
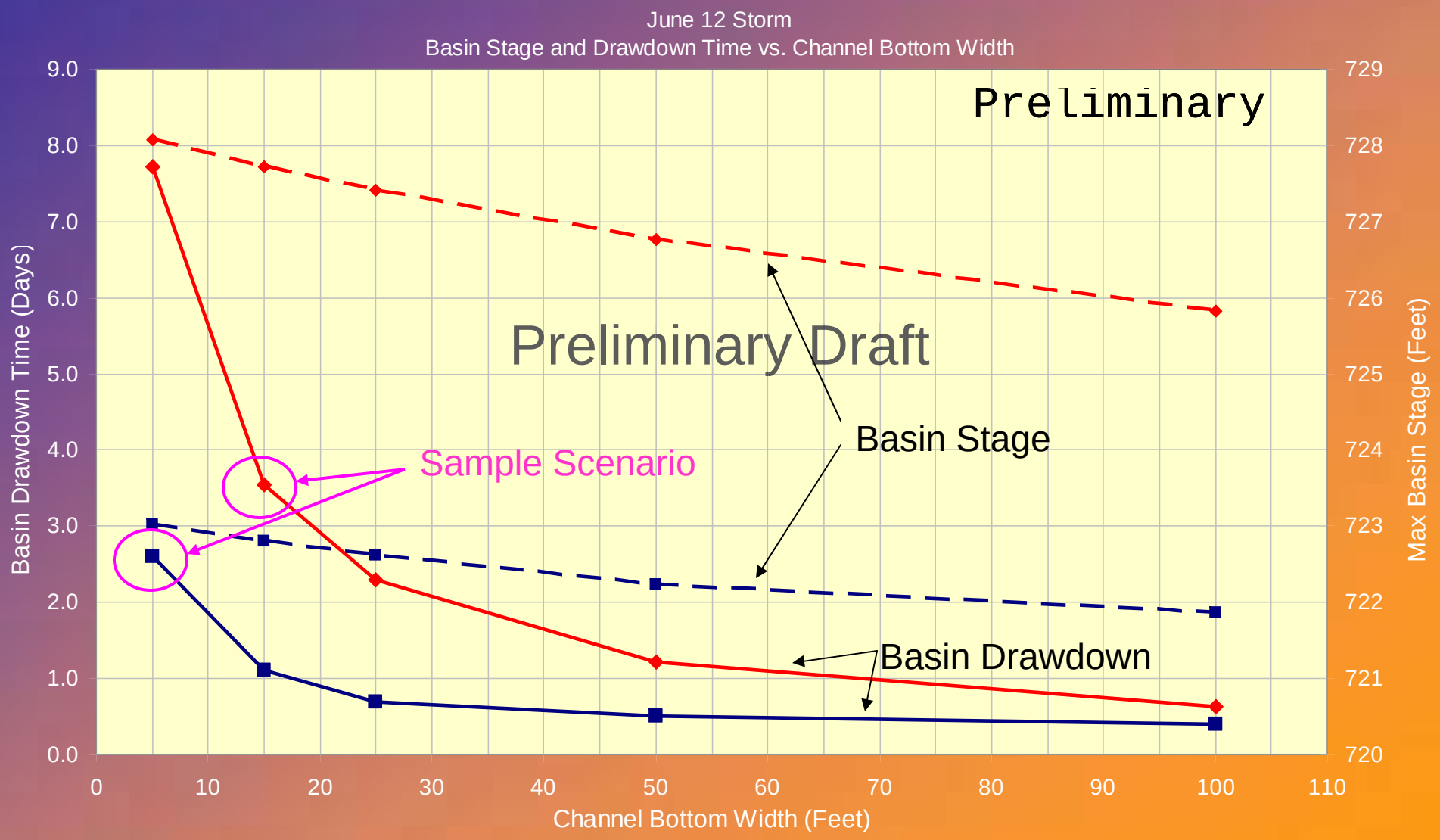
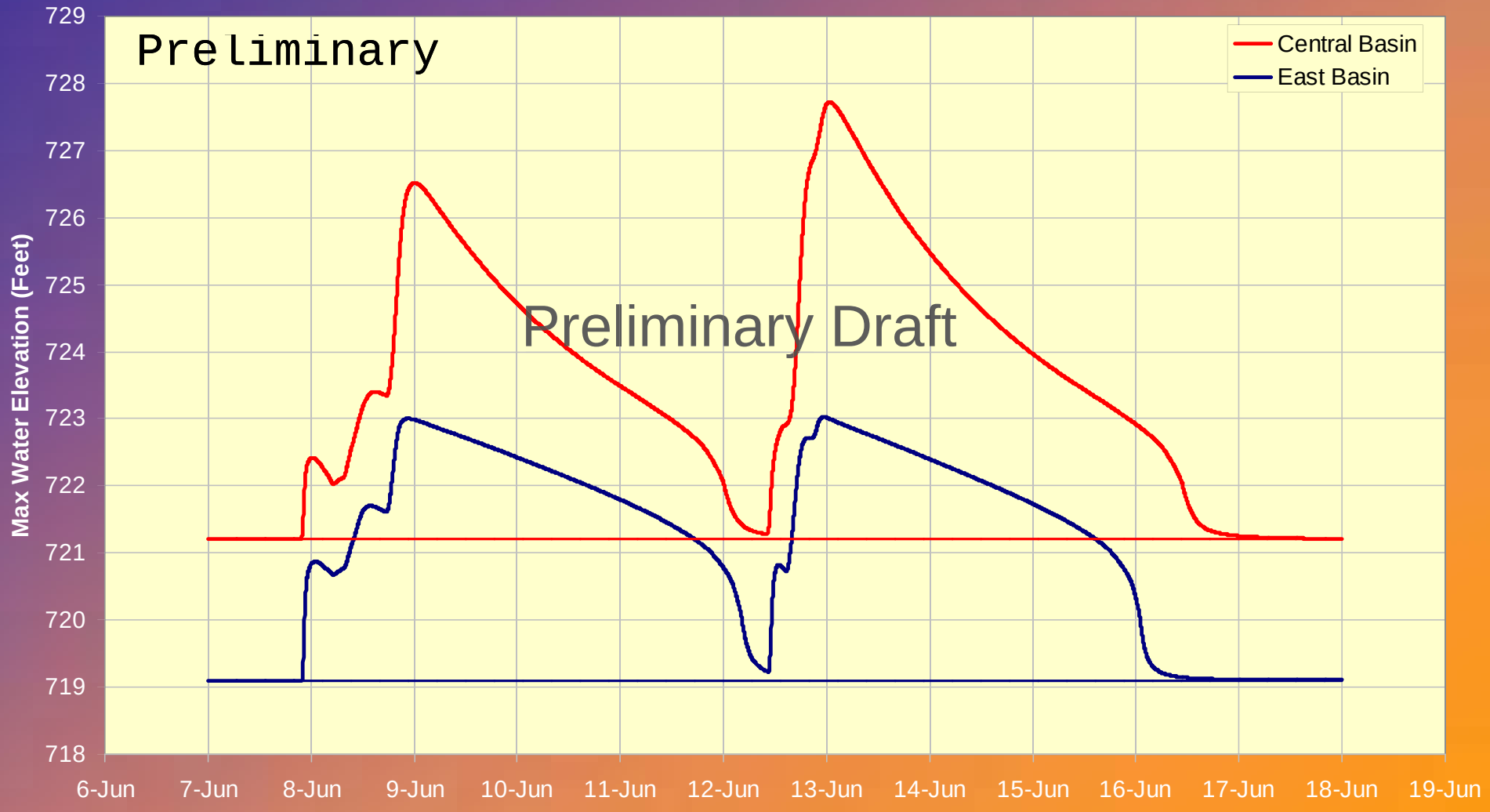
Drawdown and Stage vs. Channel Geometry



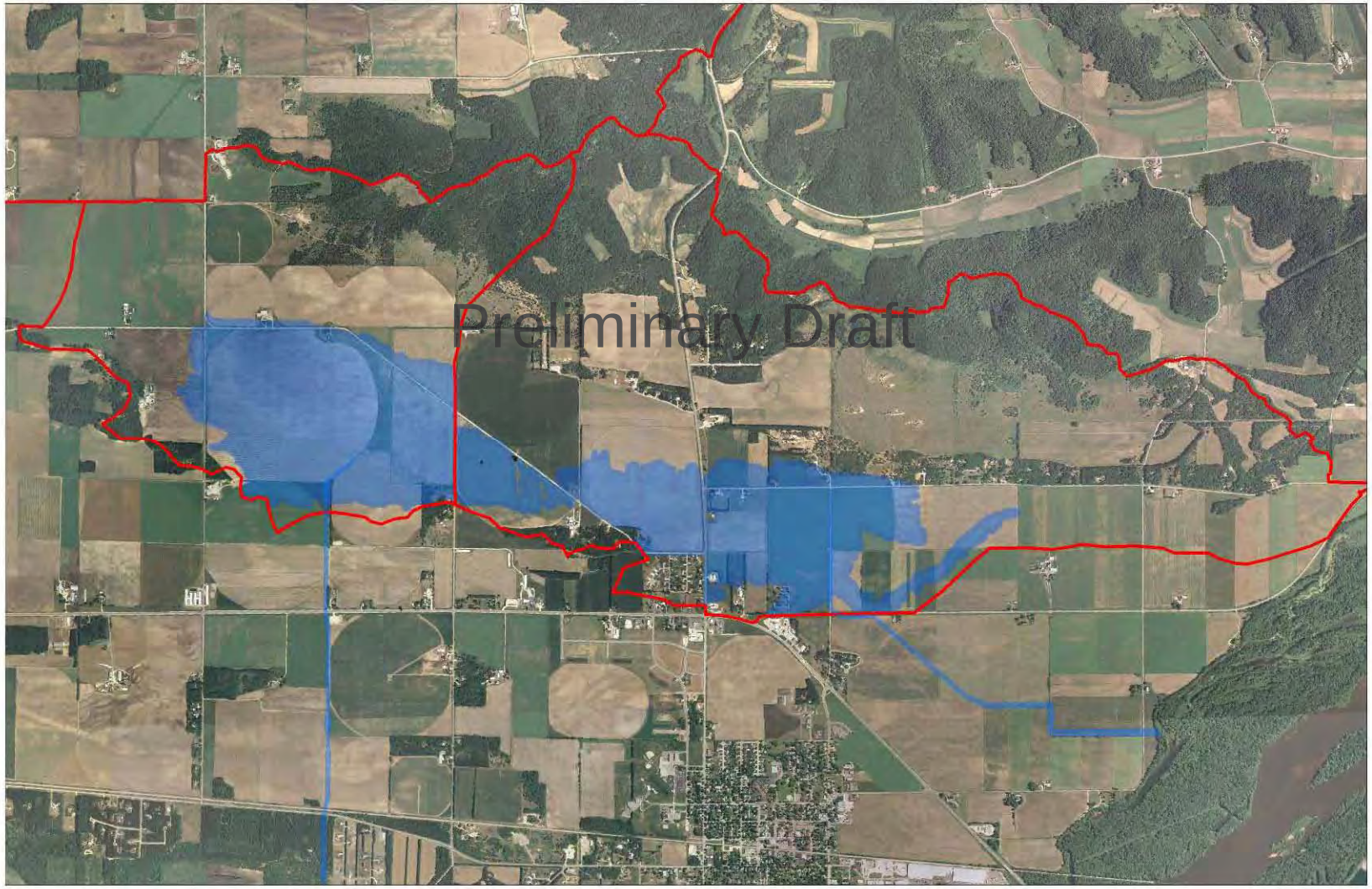
Drawdown and Stage vs. Channel Geometry



Sample Scenario - Basin Stages



Sample Scenario - Flooded Area
June 13 Preliminary



Sample Scenario - Flooded Area
June 15

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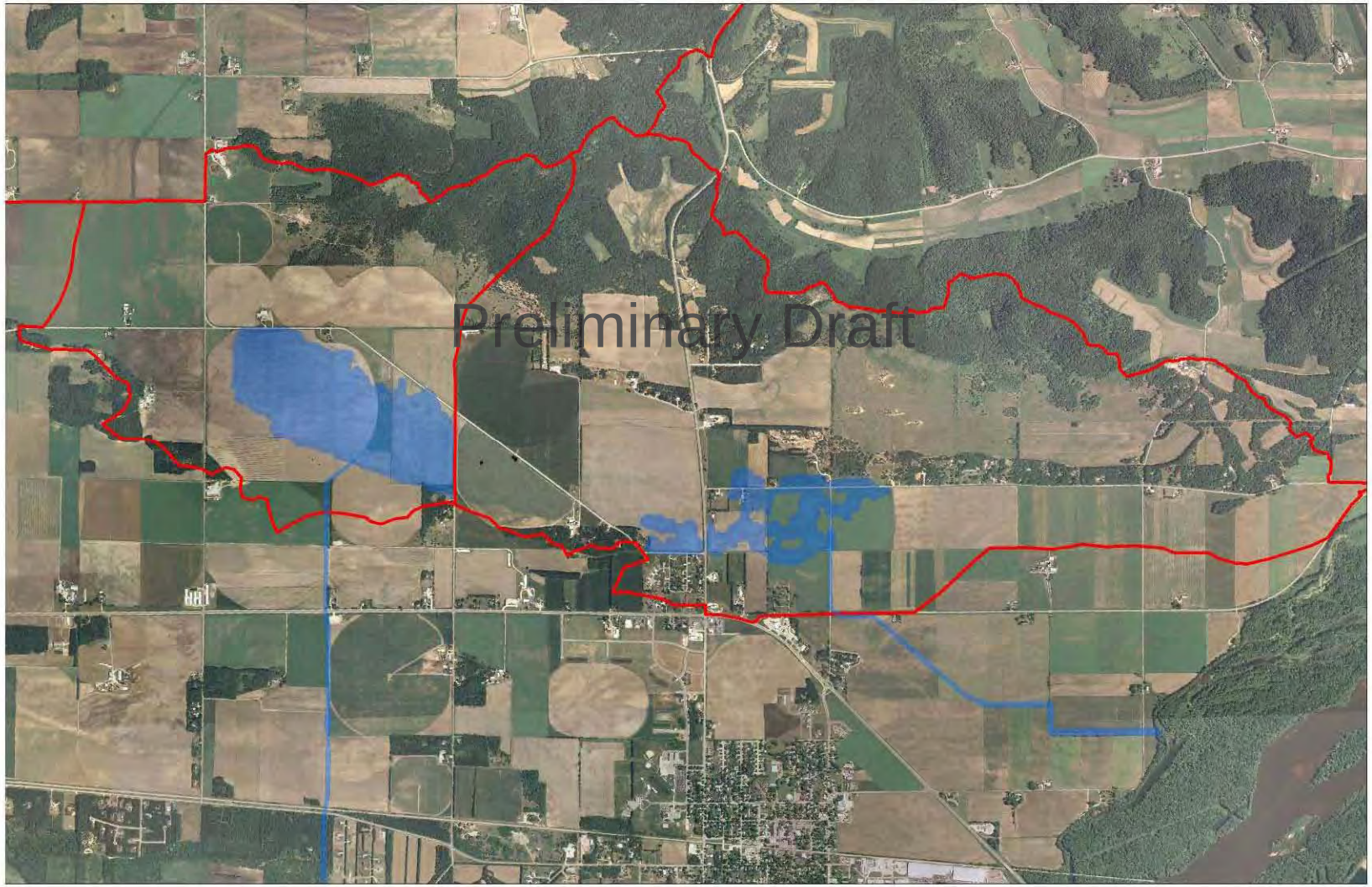

Sample Scenario - Flooded Area
June 17

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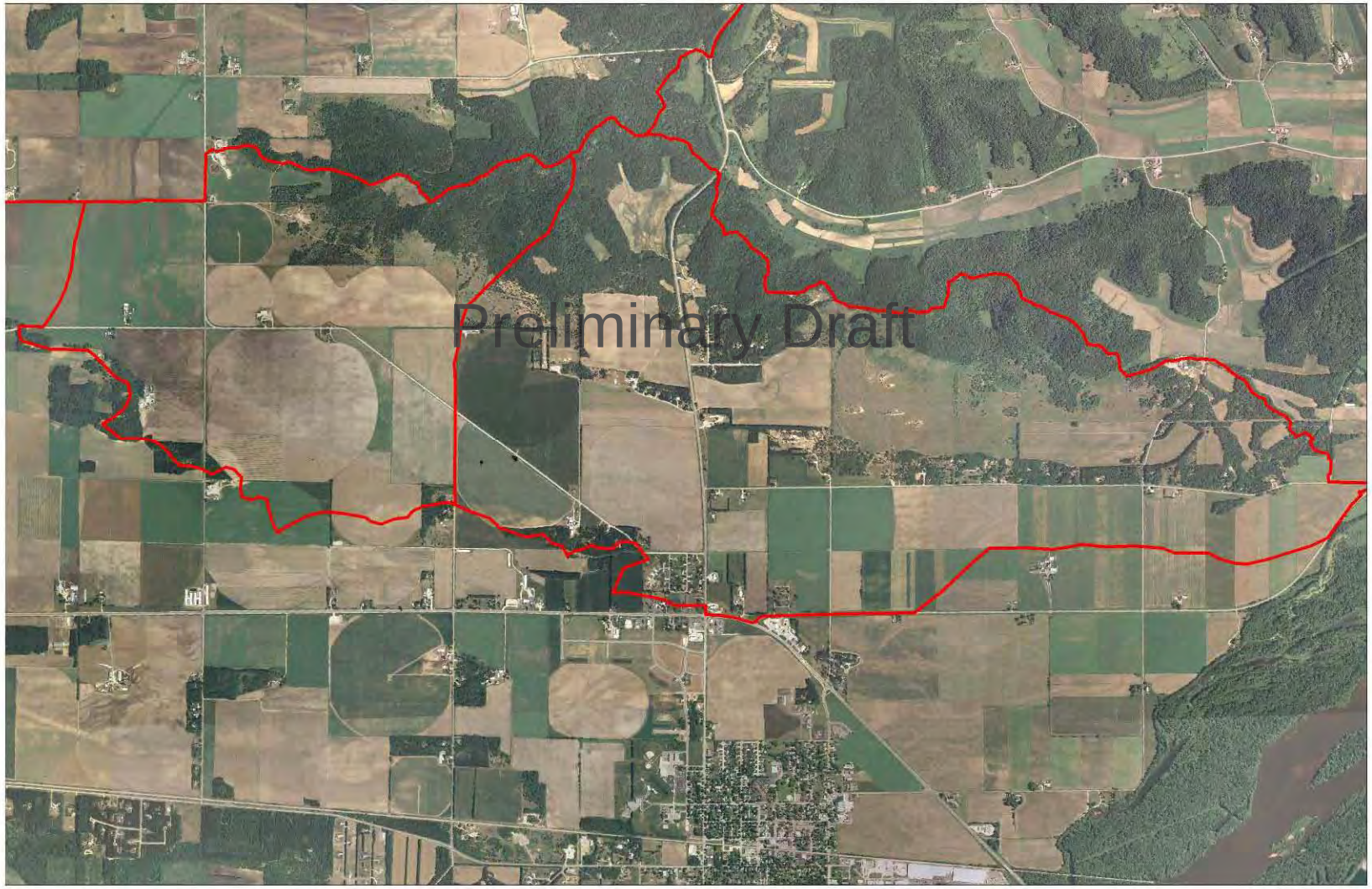

Minimize negative impacts on farm operations

- Open discussions with land owners
- Create outlets for flood waters to minimize length of time fields are under water
- Where possible route drains to avoid major compromise of center pivot irrigation systems and farm operations
- Adjust drain design to allow pivots to move through
- Model groundwater impacts of drains on wells

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Minimize negative impacts on homes & businesses

- Route drains away from residential and commercial development
- Create outlets for flood waters
- Model groundwater impacts of drains on wells
- Buyout of flood-prone properties
- Zoning restrictions

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Permits, Coordination & Design Standards

- Department of Natural Resources
- Lower Wisconsin State Riverway Board
- Department of Transportation – USH 14
- Department of Transportation – Railroad
- Wisconsin & Southern Railroad
- DATCP & NRCS
- Town of Spring Green – Kennedy Road
- Above Ground and Underground Utilities

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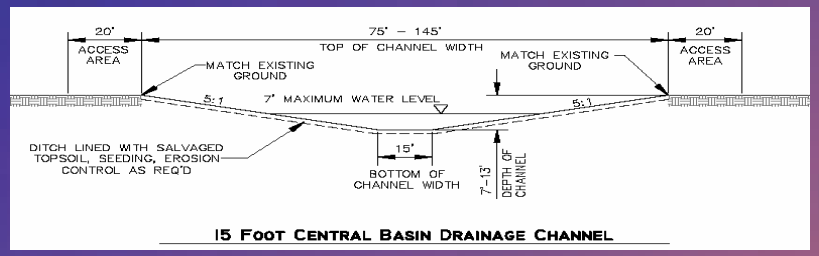
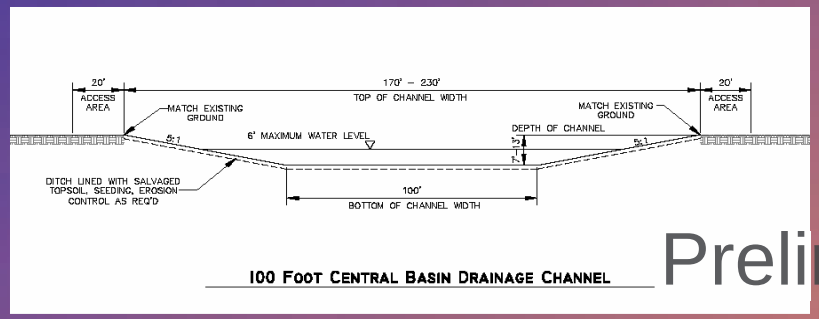
Central Basin Channel-temporary flooding



15 FOOT CENTRAL BASIN DRAINAGE CHANNEL



100 FOOT CENTRAL BASIN DRAINAGE CHANNEL

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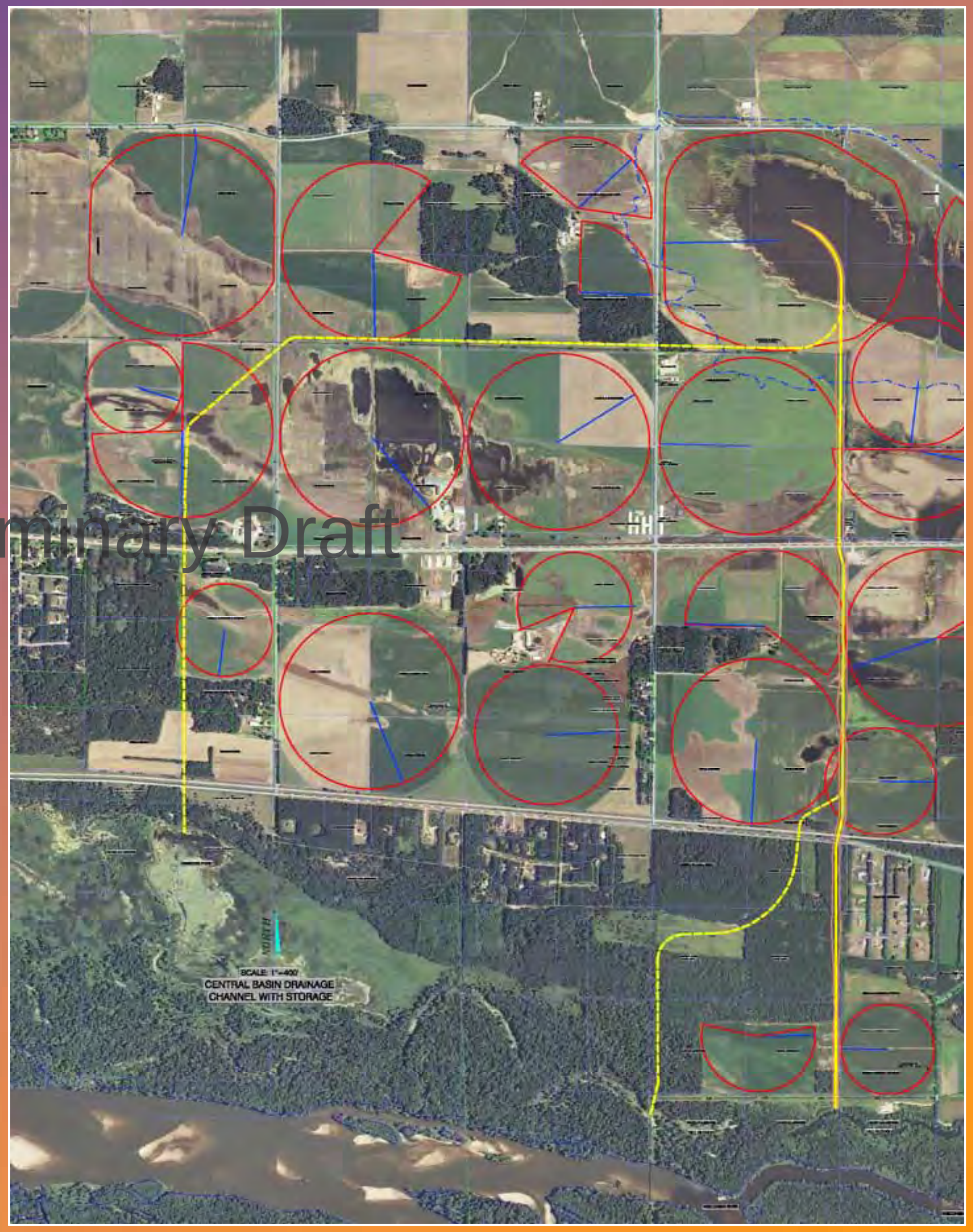

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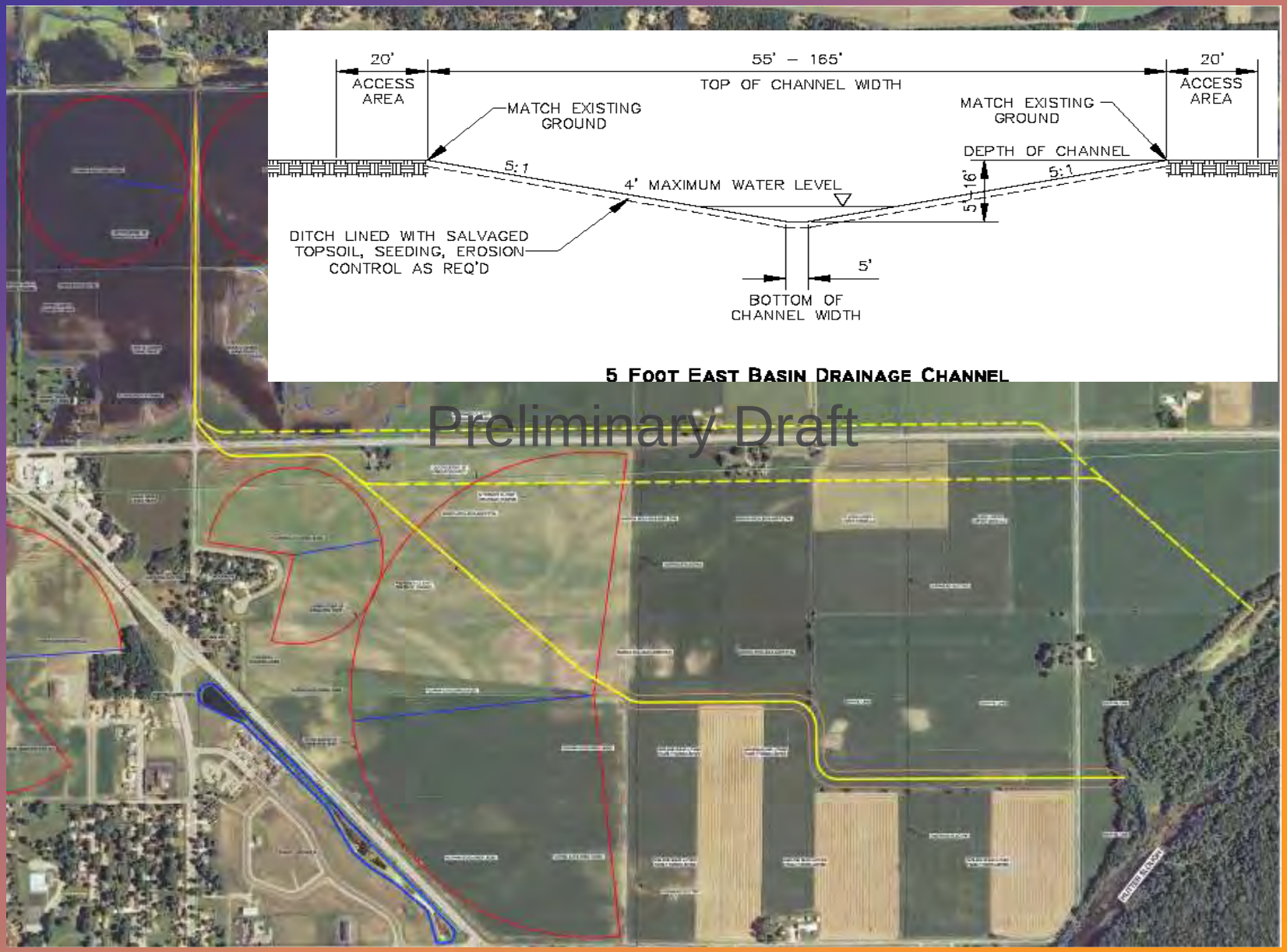
East Basin Channel Preliminary



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US 14 route with storage

Sample Scenario - Flooded Area
June 13

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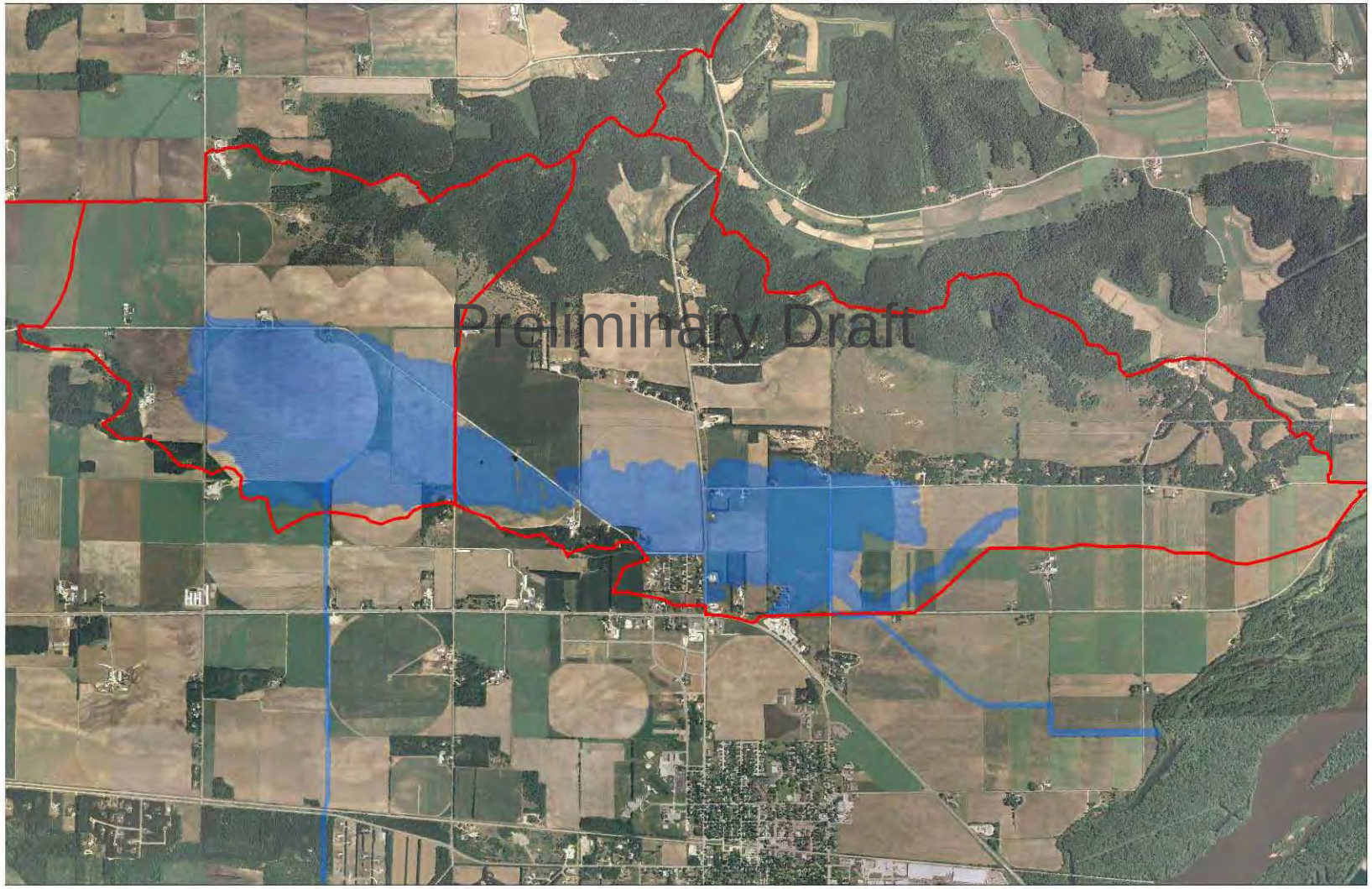
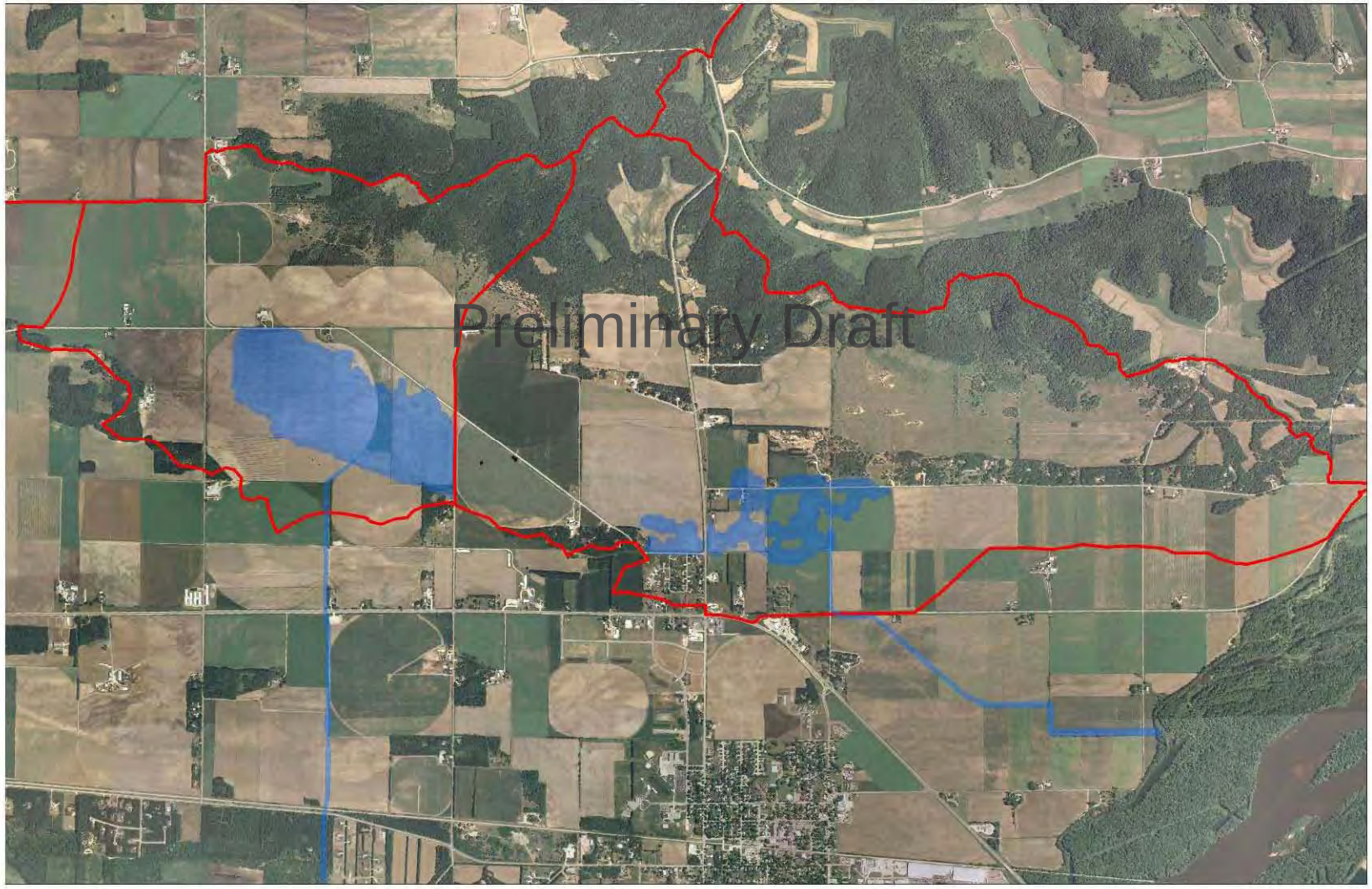
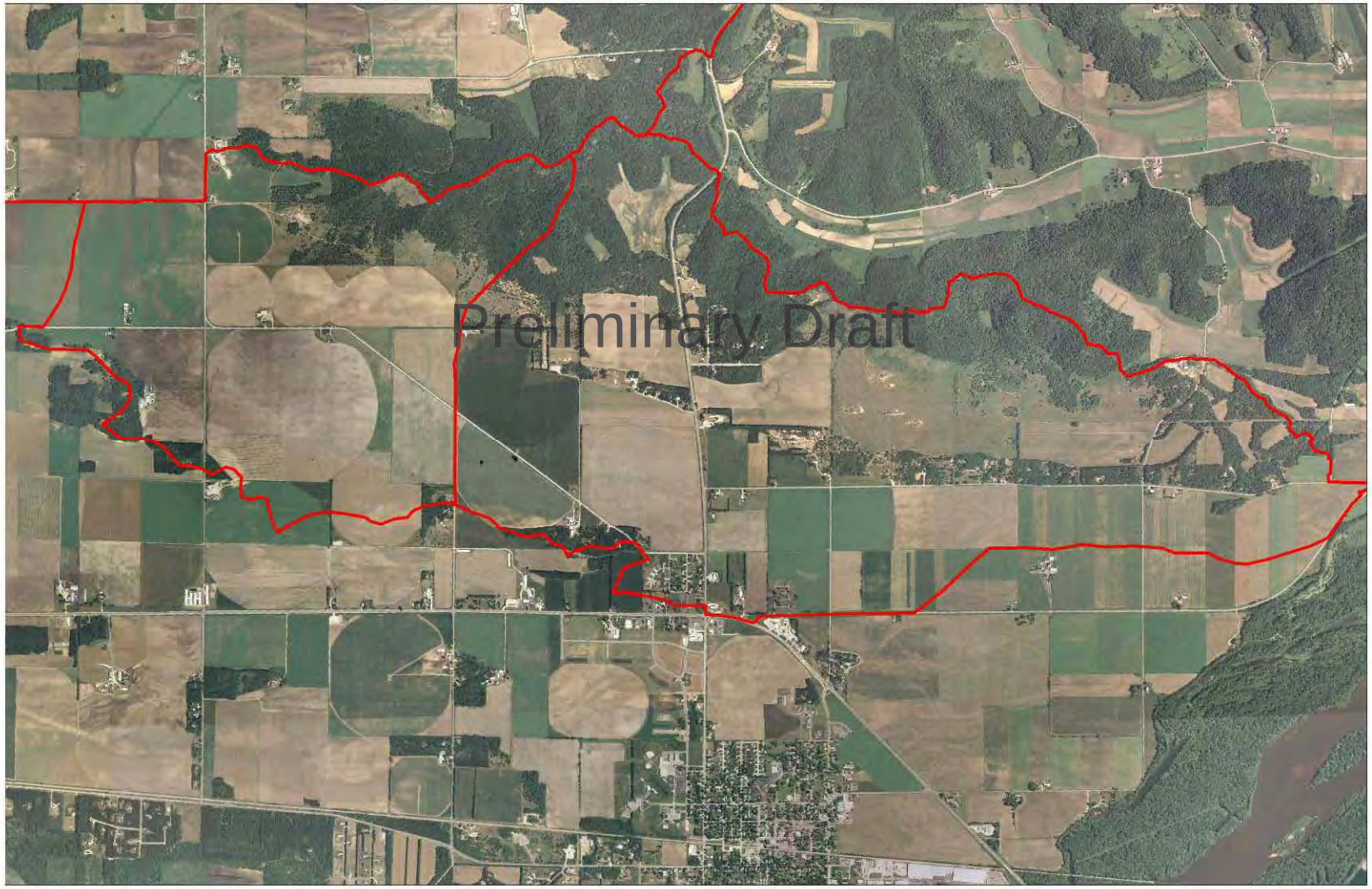


Sample Scenario - Flooded Area
June 15

Preliminary



Sample Scenario - Flooded Area
June 17 Preliminary



Surface Water Summary

- Big Hollow runoff is a major contributor to the flooding and should be high priority in the solution
- The River Valley basin areas are very effective in reducing the flood discharge down and allow for reasonable engineered solutions
- The cost and benefits of 1) area impacted 2) time of drawdown and 3) channel design need to be weighed in any proposed engineered solutions
- An engineered solution for this flooding problem is possible

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Shifflet Road Stormwater Issues

- **Over 200 acres of Village and Township property drain through pipes or over land to the farm fields between Shifflet and Carpenter Roads**
- **Flooding and crop damage persistent at this location**
- **2008 Flood waters were pumped to this location increasing the impacts**
- **No existing viable outlet to river**

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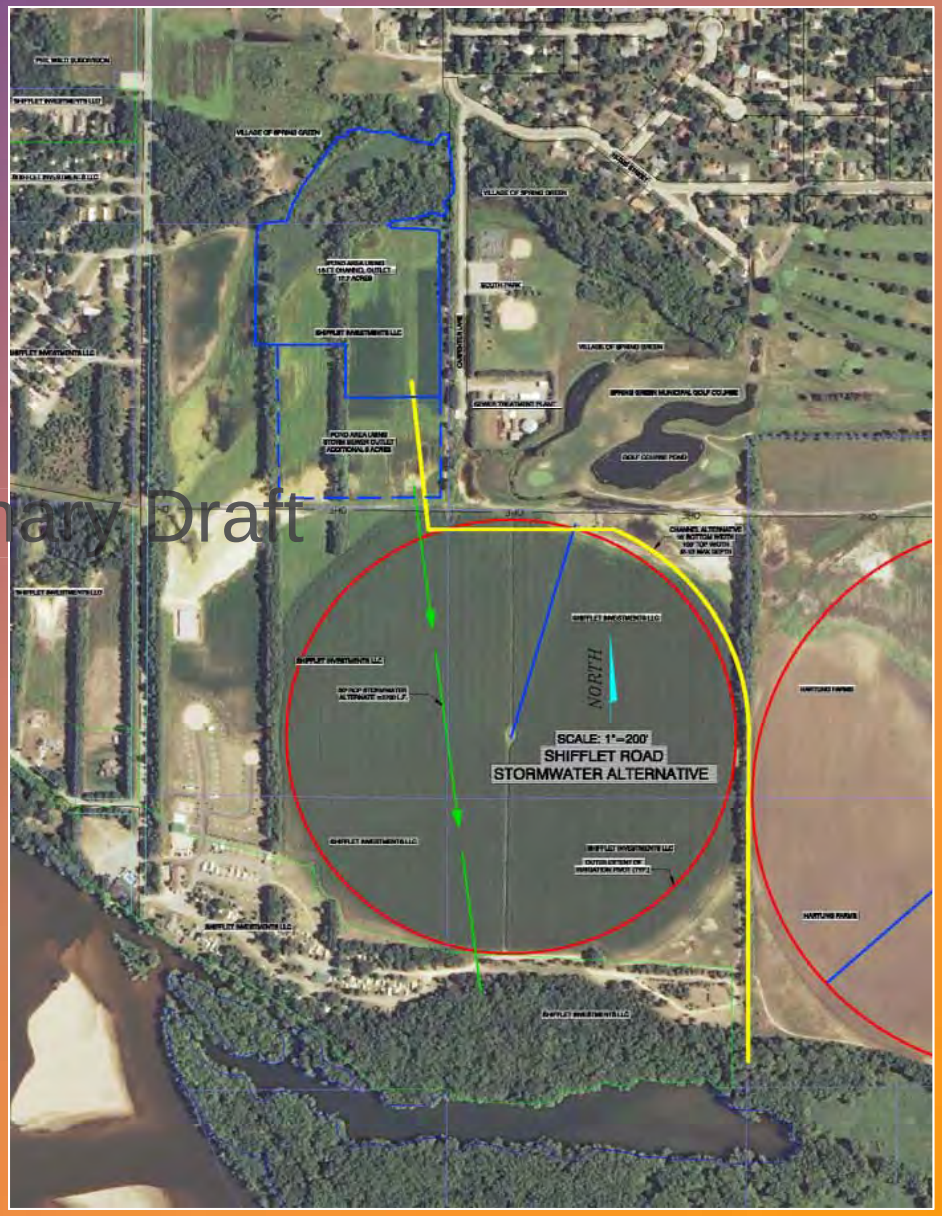
Shifflet Road Stormwater

- Study the feasibility of placing a stormwater pond southwest of the village
- Preliminary design to handle 100-year event
- Drainage channel and piping outlets being explored
- Preliminary alternatives require channel with a 15-foot bottom and 135-foot wide impact or a 36-inch storm sewer pipe

Preliminary



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Other Challenges

- Secure cooperation of affected property owners
- Meet all regulatory & statutory requirements
- Cost versus benefit must be acceptable
- Control costs of project construction
- Long-term maintenance
- Funding Source Development

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Funding Source Development

- Grant Programs at State & Federal Levels
- Legislation at State & Federal Levels
- Local Government
- Landowners
- Drainage District(s)
- Stormwater Utility

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Next Steps

- Continue discussions with landowners
- Fine tune drainage routes and cross sections
- Extend efforts to other flooded areas if needed
- Feasibility analysis
- Estimate Construction Costs
- Maintenance and Operational Costs
- Cost/benefit analysis
- Recommendations

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Questions & Comments

Thank you for your attendance and attention.

We need your input.

Please come up and talk with us to give us your questions and comments.

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If you prefer to put your comments in writing, please use one of the comment sheets on the back table and mail it to us or bring it to our office or the Town office.