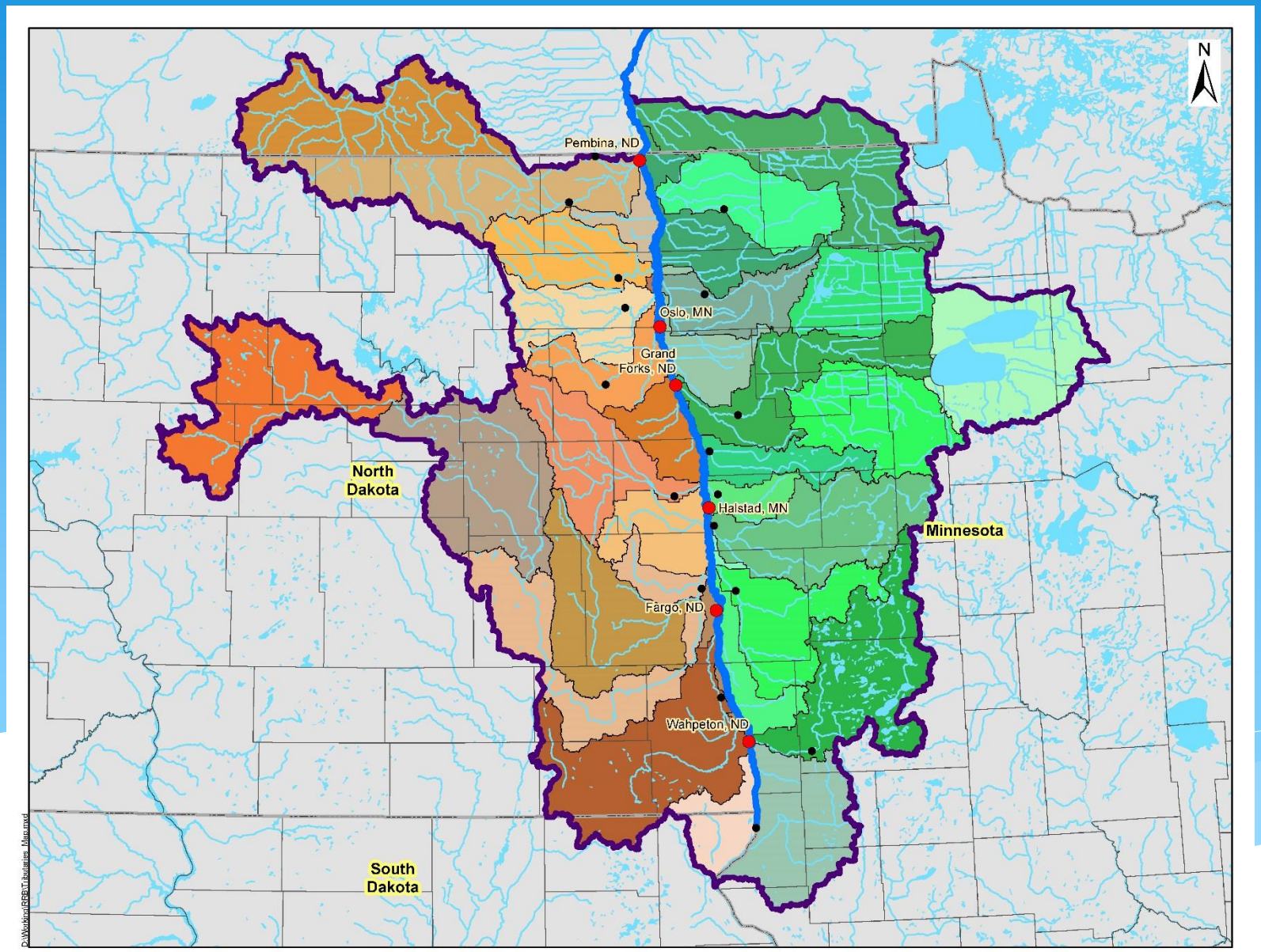
Exploring Upstream Retention and Distributed Storage

Fargo-Moorhead Area Flood Diversion Task Force Meeting
November 13, 2017

Chad Engels, PE, Moore Engineering, Inc.
Zach Herrmann, PE, Houston Engineering, Inc.
Bruce Albright, BRRWD Administrator

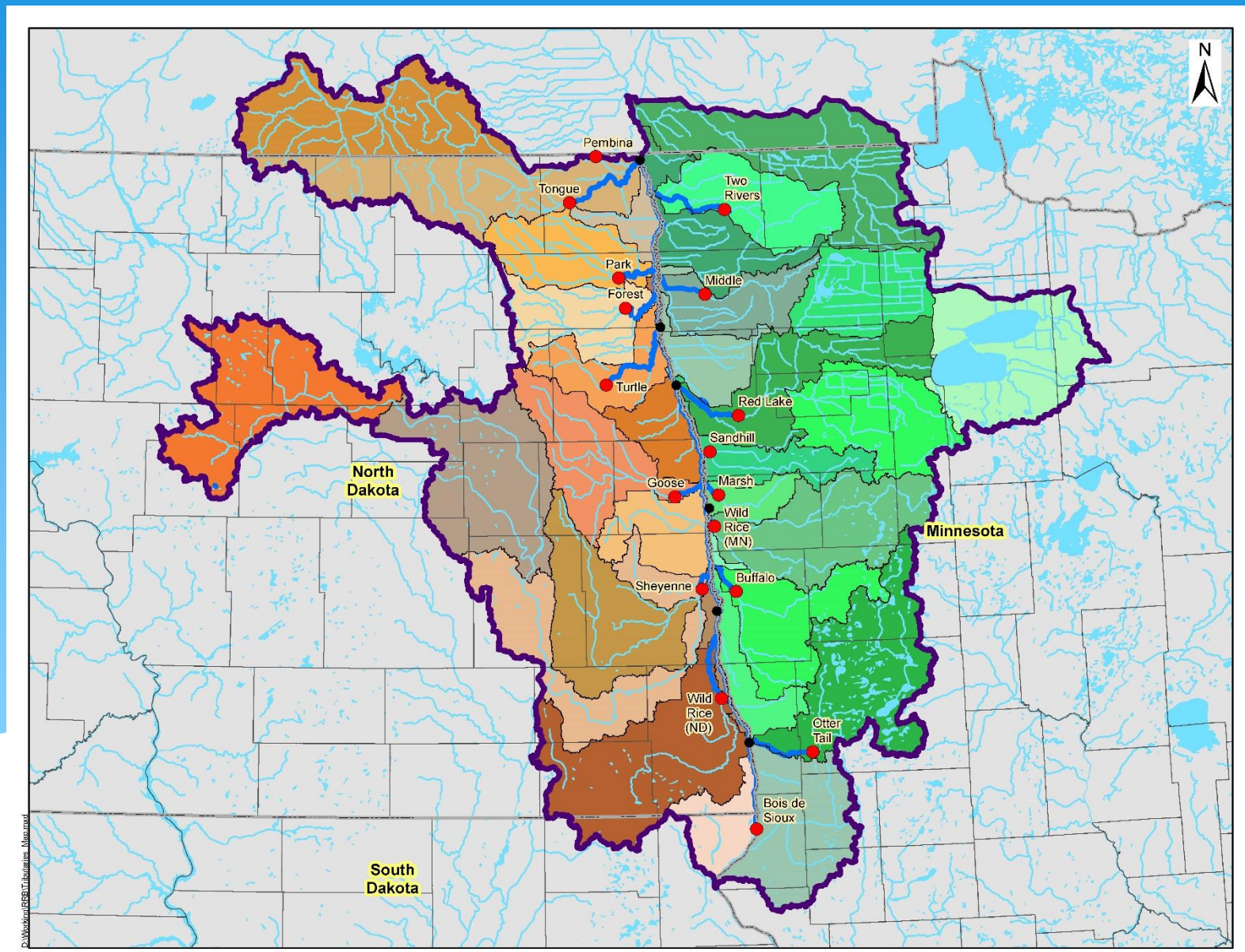
RRBC LTFS – Basinwide Flow Reduction Strategy

GOAL: 20% Red River Flow Reduction



RRBC LTFS – Basinwide Flow Reduction Strategy

GOAL: 20% Red River Flow Reduction → Requires 35% (±) Tributary Peak Flow Reduction



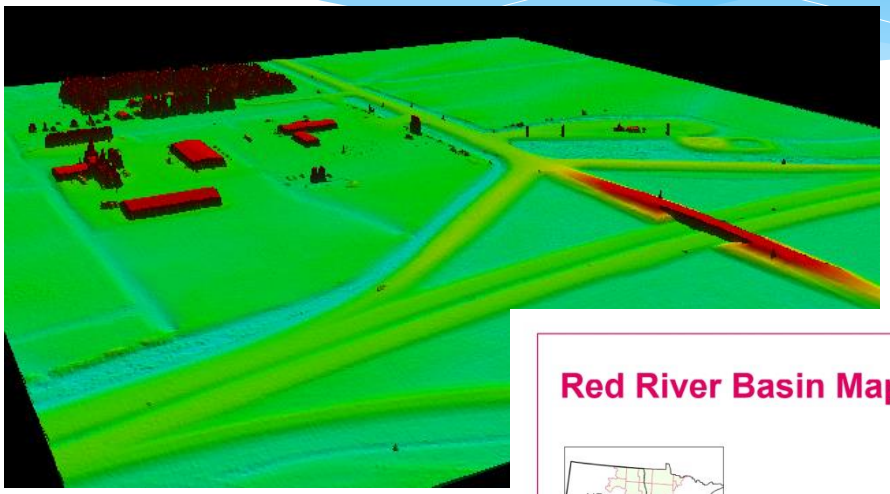
Tributary Distributed Detention Planning

- **Background Information**
  - RRBMI LiDAR ..... ***Multiple Partners, Led by IWI***
  - Phase 1 - HEC-HMS Existing Conditions ..... ***Communities of Fargo and Moorhead***
  - Site Identification Process and Level of Detail

- **Minnesota Tributary Expanded Distributed Detention Strategies**
  - *Funded By:* ***Red River Watershed Management Board (Minnesota)***
    Red River Basin Commission
    Buffalo-Red River Watershed District

- **North Dakota Tributary Comprehensive Detention Plans**
  - *Funded By:* ***Red River Joint Water Resource District (ND)***
    Local Water Resource Districts
    North Dakota State Water Commission

IWI – Red River Basin Mapping Initiative

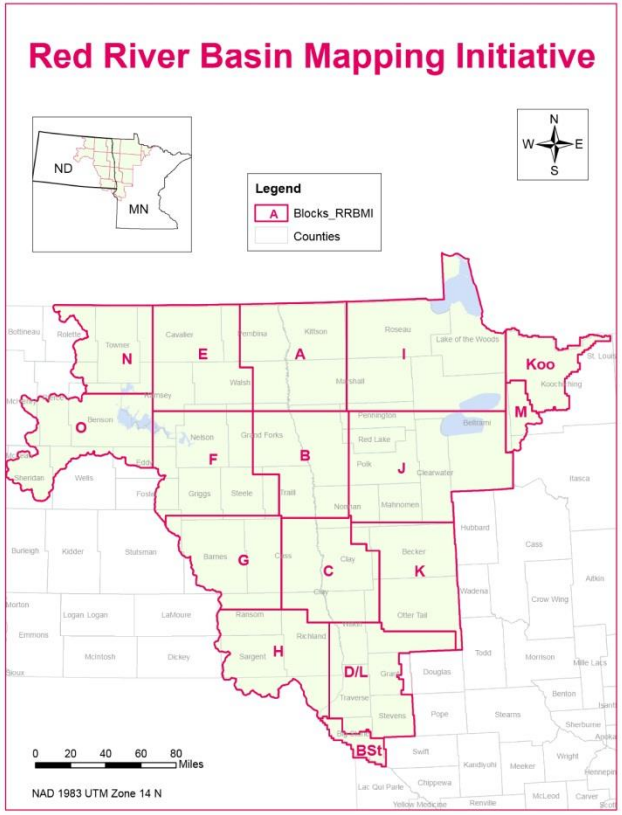


2008-2009

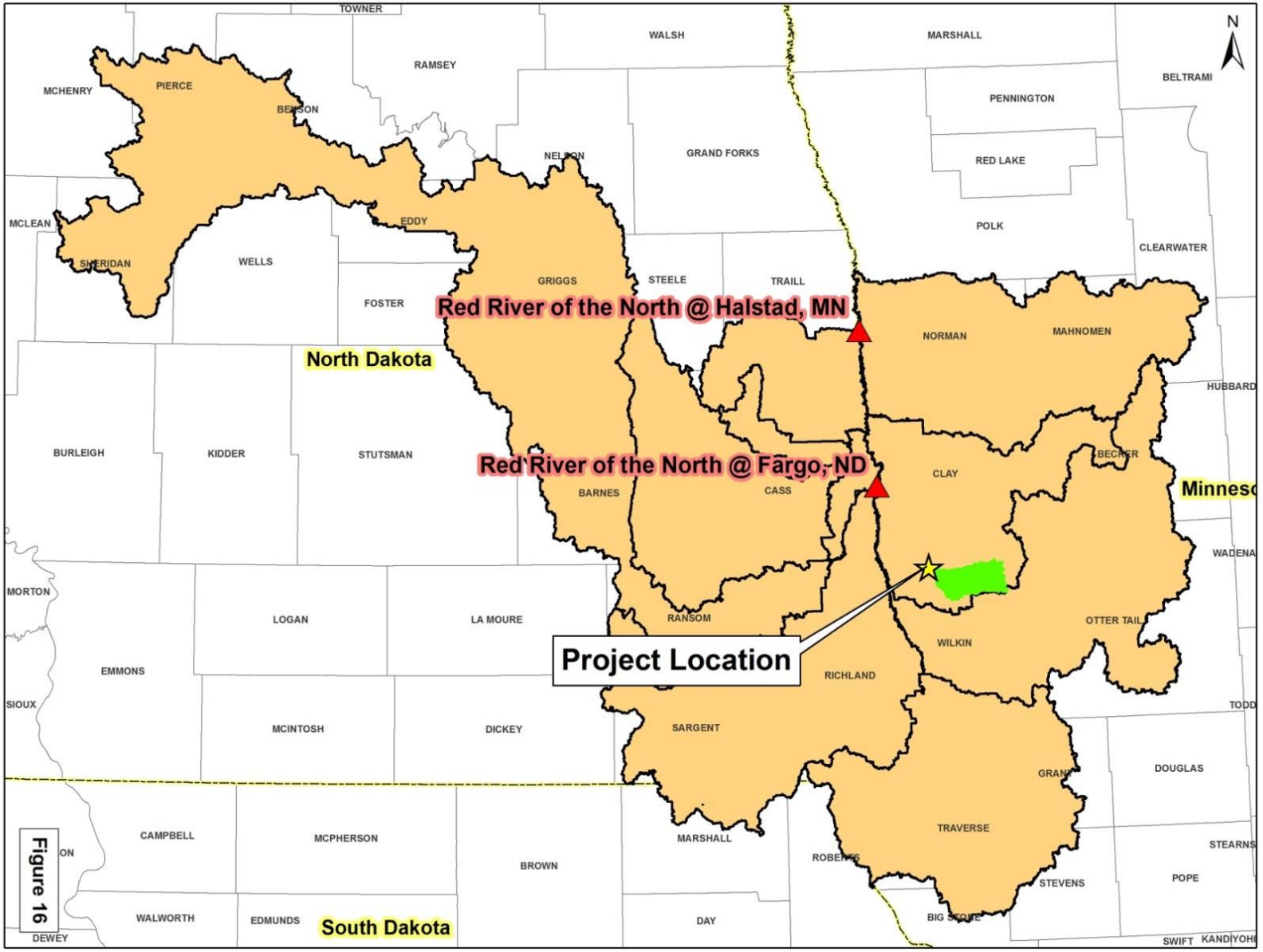
LIDAR - Light Detection and Ranging is an integration of airborne laser and global position system (GPS) technology.

The project scope included the entire U.S. portion of the RRB (including the Devils Lake Basin)

1 meter bare earth DEM



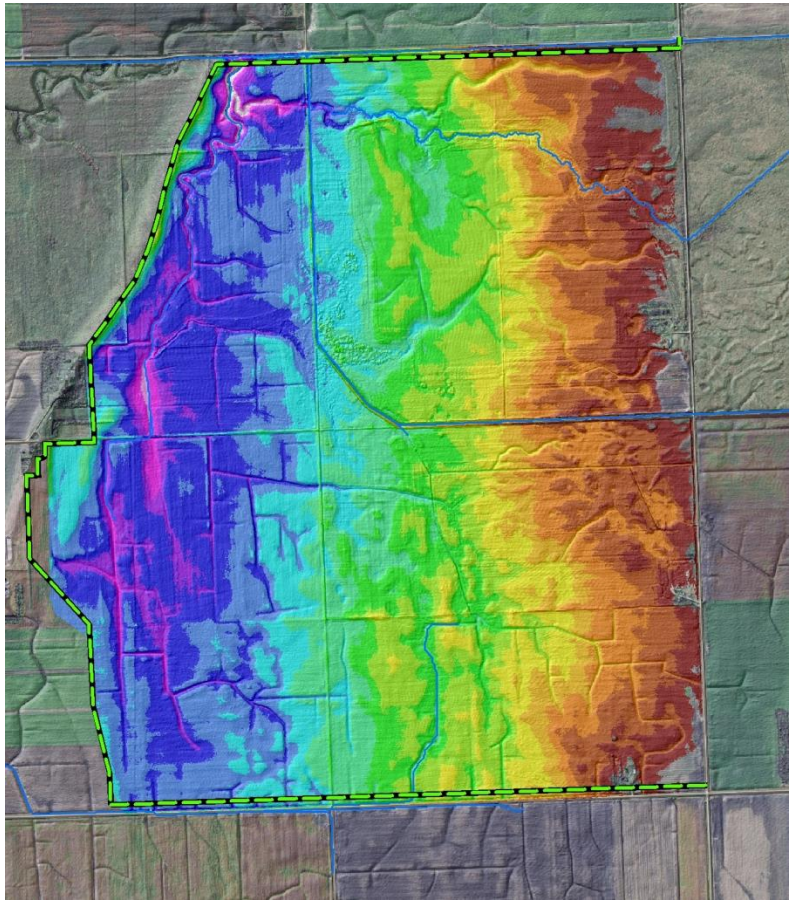
HEC-HMS Subwatershed Benefits ONLY



Site Selection Criteria and Assumptions

Methodology –

- **Site Identification Criteria**
  - Control minimum of 20 square miles
  - Avoid impacts to residential structures / infrastructure
  - Store a minimum of 3 inches of runoff
  - Avoid mainstem locations in lower 2/3 of watershed
  - Primarily select off-channel & stream locations
  - Reasonable levee heights & inundation impacts
- **Modeling Assumptions**
  - Gated with E.S. 5 feet below top of levee
  - Dry storage, no conservation pools



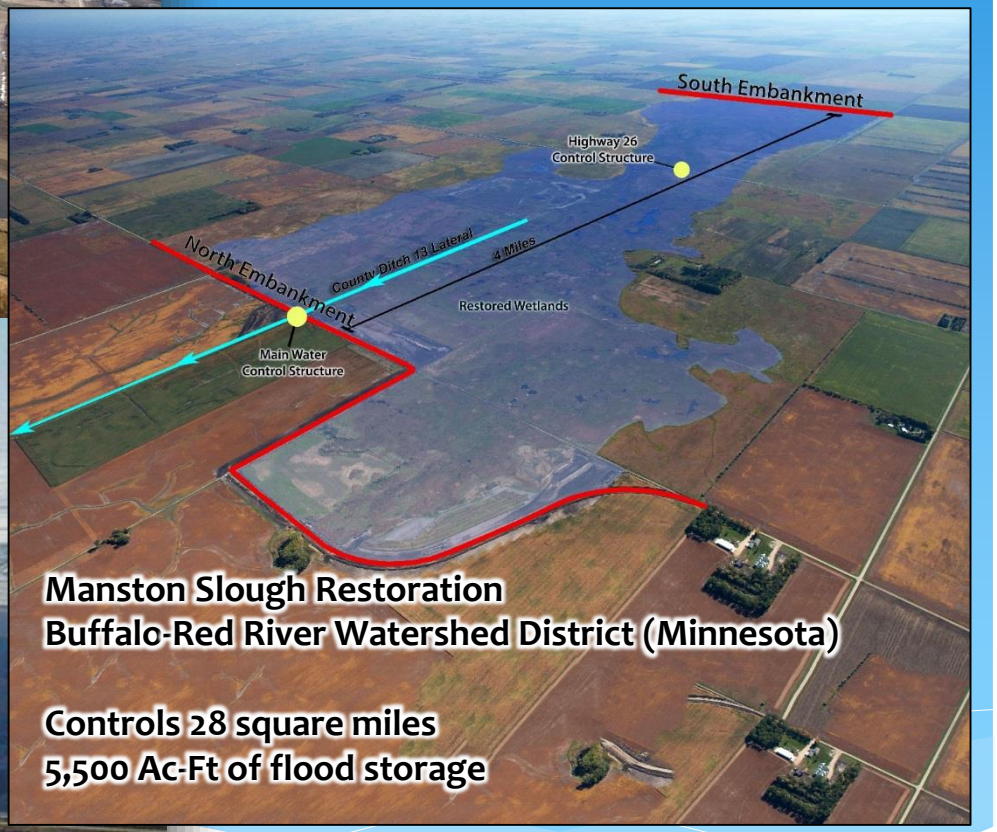
Detention Site Examples – *On-Channel, Off-Channel, Enhancement Options*

Maple River Dam
Maple River Water Resource District (North Dakota)

Controls 815 square miles
60,000(+) Ac-Ft of un-gated storage

North Ottawa Impoundment Project
Bois de Sioux Watershed District (Minnesota)

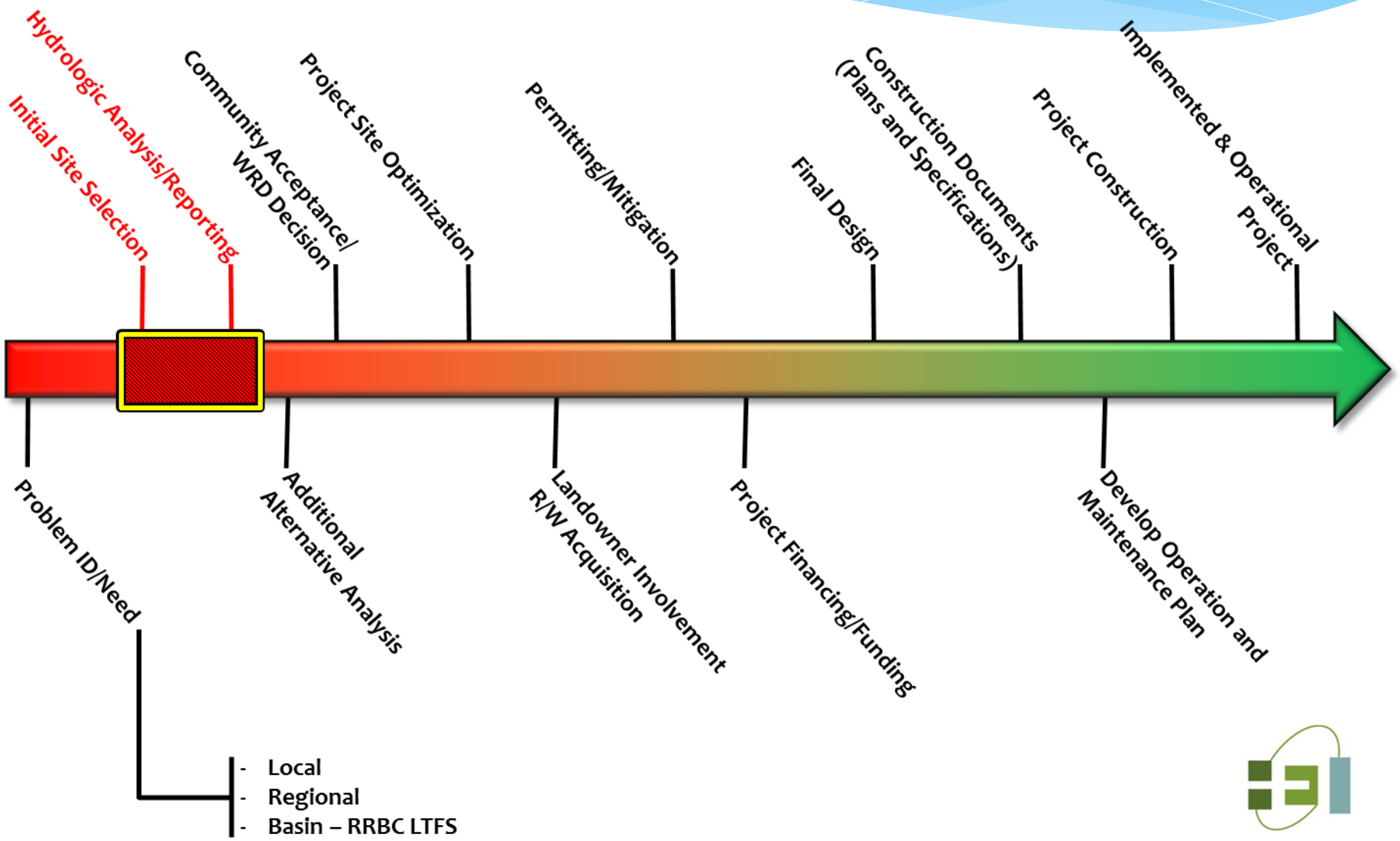
Controls 75 square miles
16,000 Ac-Ft of gated storage



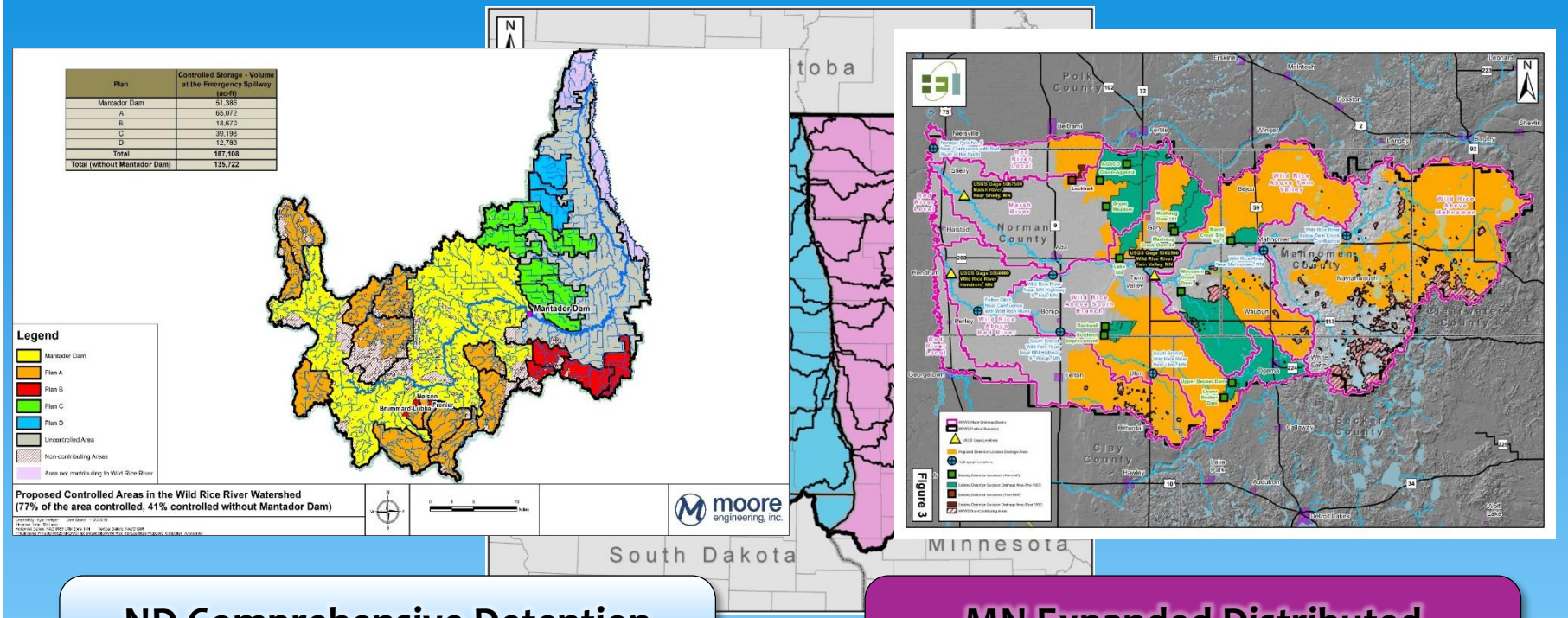
Manston Slough Restoration
Buffalo-Red River Watershed District (Minnesota)

Controls 28 square miles
5,500 Ac-Ft of flood storage

Distributed Detention Planning – *Level of Detail*



Red River Basin Tributary Detention Planning Efforts



ND Comprehensive Detention Plans

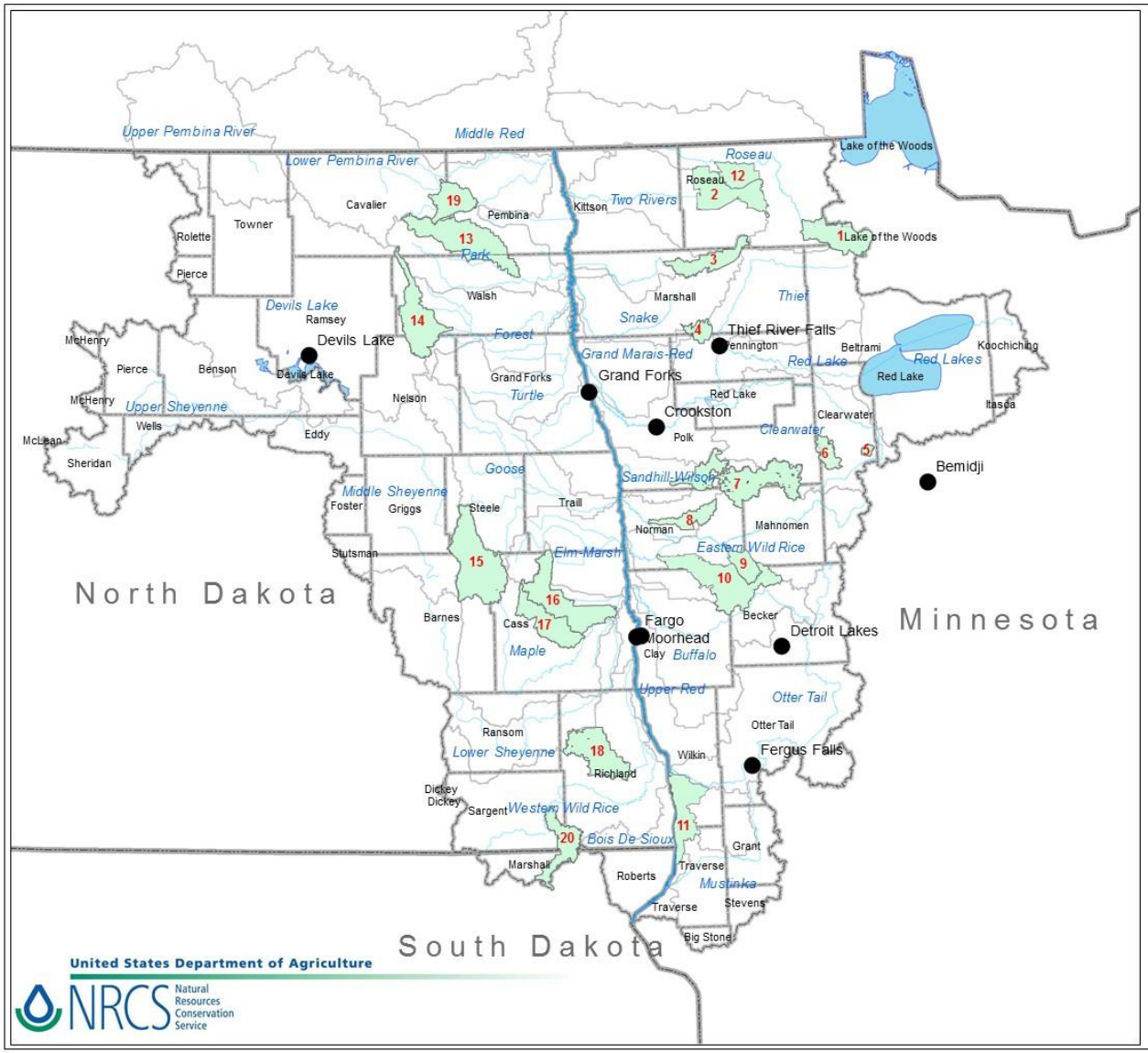
- Large Scale Sites
- Identification of all apparent sites
- WRD Involvement
- Multiple proposed conditions scenarios
- Multiple Runoff Events
- Establish benefit within Tributaries
- Establish reduction to Red River main stem
- Detailed reporting

MN Expanded Distributed Detention Strategy

- Large Scale Sites
- Identification of sites required to meet LTFS goals
- Limited WD Involvement
- One proposed condition
- Standard melt progression event only
- Establish benefit within Tributaries
- Establish reduction to Red River main stem
- Generalized reporting

Moving Forward – NRCS Regional Conservation Partnership Program

Leverage $ 12 Million in Farm Bill Funding for Watershed Planning



Red River Basin
of the North
RCPP Watershed Project Areas

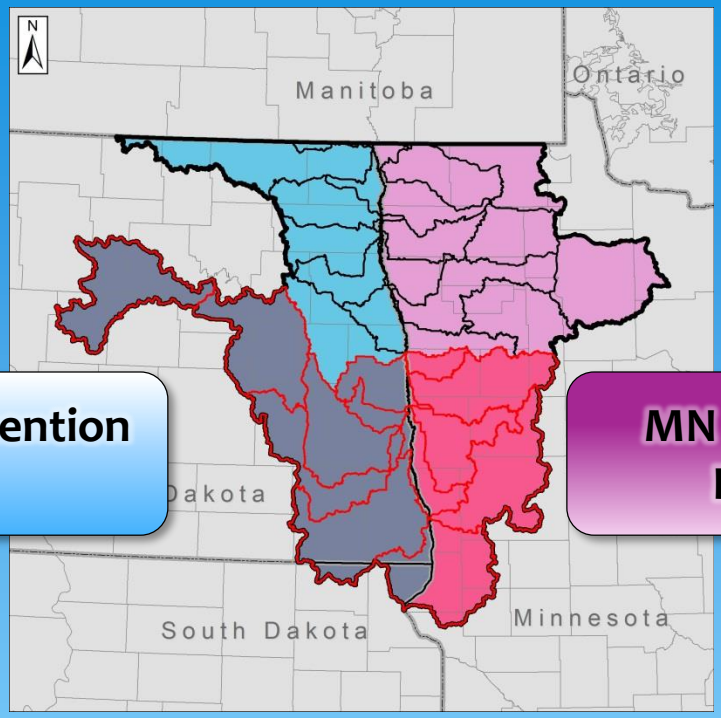
ID	Name
1	Beltrami Island State Forest
2	Klondike
3	Middle-Snake-Tamarac JD-19
4	Middle-Snake-Tamarac JD-14
5	Four Legged Lake
6	Pine Lake
7	Upper Sandhill River
8	Green Meadow
9	Moccasin Creek
10	South Branch Wild Rice River
11	Bois De Sioux Direct
12	Whitney Lake
13	North Branch Park River
14	Forest River
15	Upper Maple River
16	Rush River
17	Swan Creek
18	Antelope Creek
19	Tongue River
20	Shortfoot Creek

Legend
RCPP_Project_Watershed
City
Counties

1 in = 30 miles

0 15 30 60 90 120
Miles

Halstad Upstream Retention Study



ND Comprehensive Detention Plans

MN Expanded Distributed Detention Strategy

Halstad Upstream Retention Study

Halstad Upstream Retention Study Background

- Completed by the Red River Basin Commission
- Funded by the Fargo-Moorhead Diversion Authority

SCOPE OF STUDY

- To provide information to advance the Red River Basin Commission's Long Term Flood Solutions Report

- To provide assistance to the Fargo-Moorhead Diversion Authority on how to prioritize/allocate the approved $25 Million in Detention Funding

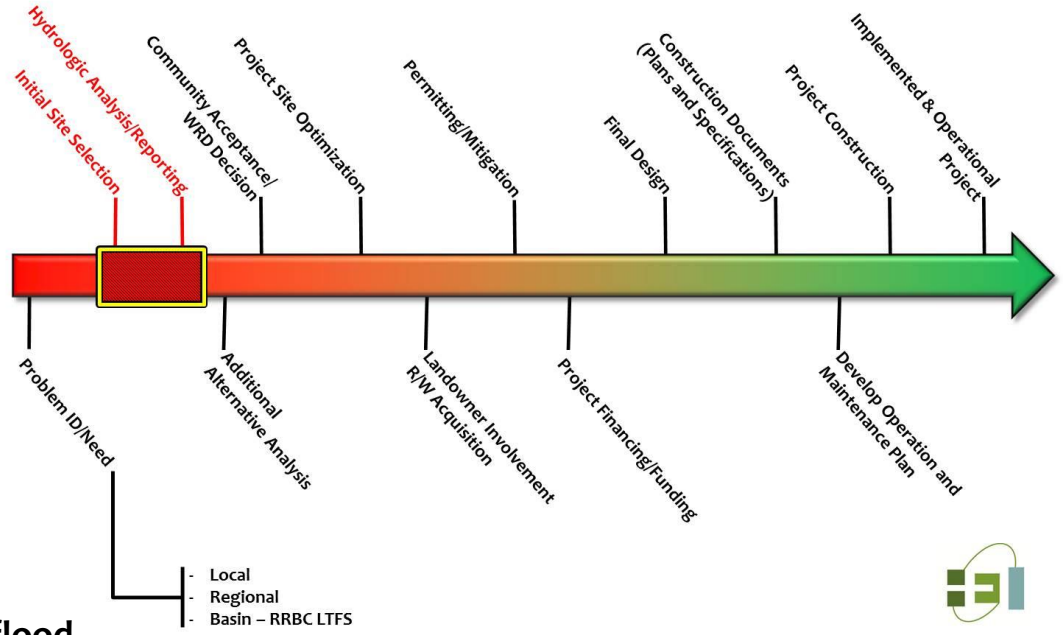
- **NOT to determine how upstream detention would alter current Fargo-Moorhead Metro Diversion Design**

Halstad Upstream Retention Study Assumptions

- **Sites Identified for Local Benefits First**
  - *Sites Identified by **Local Watershed Districts & Water Resource Districts***
  - *Local Benefits First*
  - *Sites Initially Empty (No Normal Pool)*
  - *Drawdown of Gated Storage Not Considered*

- **All Detention Sites Built**
  - *Full Implementation Required to Generate Reported Benefits*
  - *Assumes full implementation*

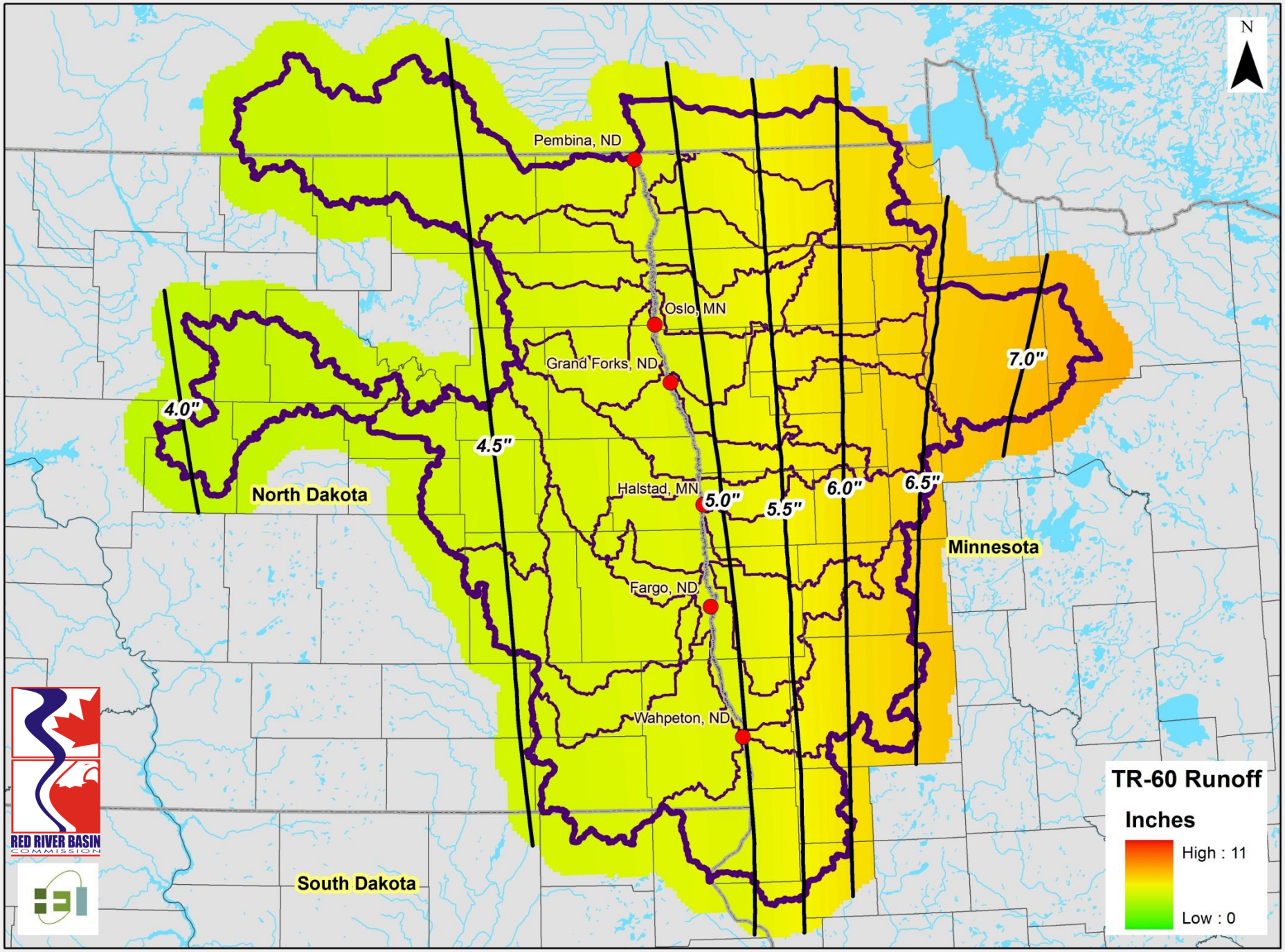
- **Conceptual Impoundment Locations**
  - *No Landowner Involvement*
  - *Ability to Implement*
  - *No Cost Evaluations*
  - *Limited Site Data*



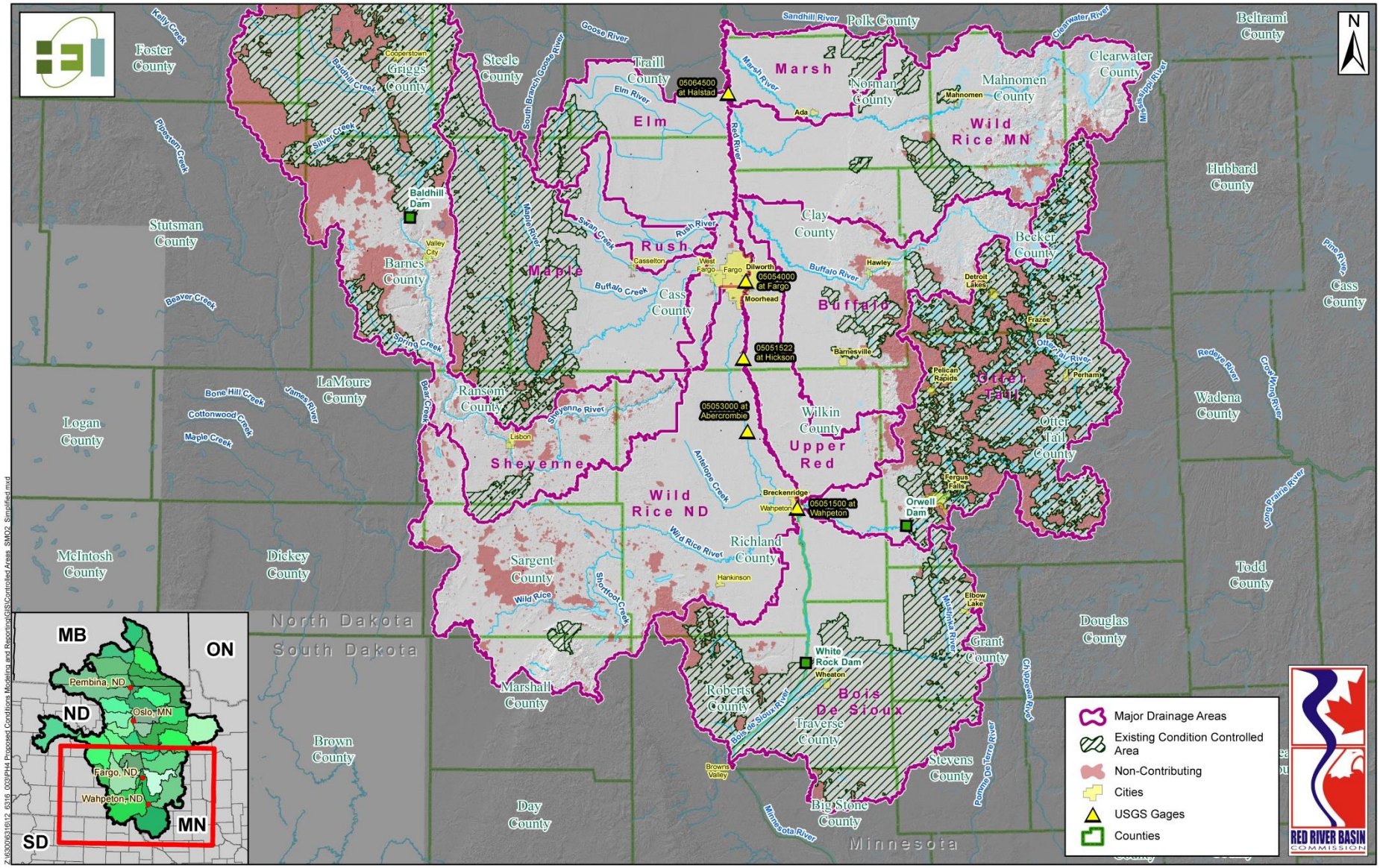
- **Modeling based on approximate 100-year flood**
  - *Based on Uniform/Standardized Runoff Assumption*
  - *Non-uniform runoff expected during actual events*
  - *Drawdown of Gated Storage Not Considered*
  - *Wet Period Hydrology*

- **Modeling completed based on the existing Red River condition**
  - *Potential changes to FM Diversion Project not evaluated*

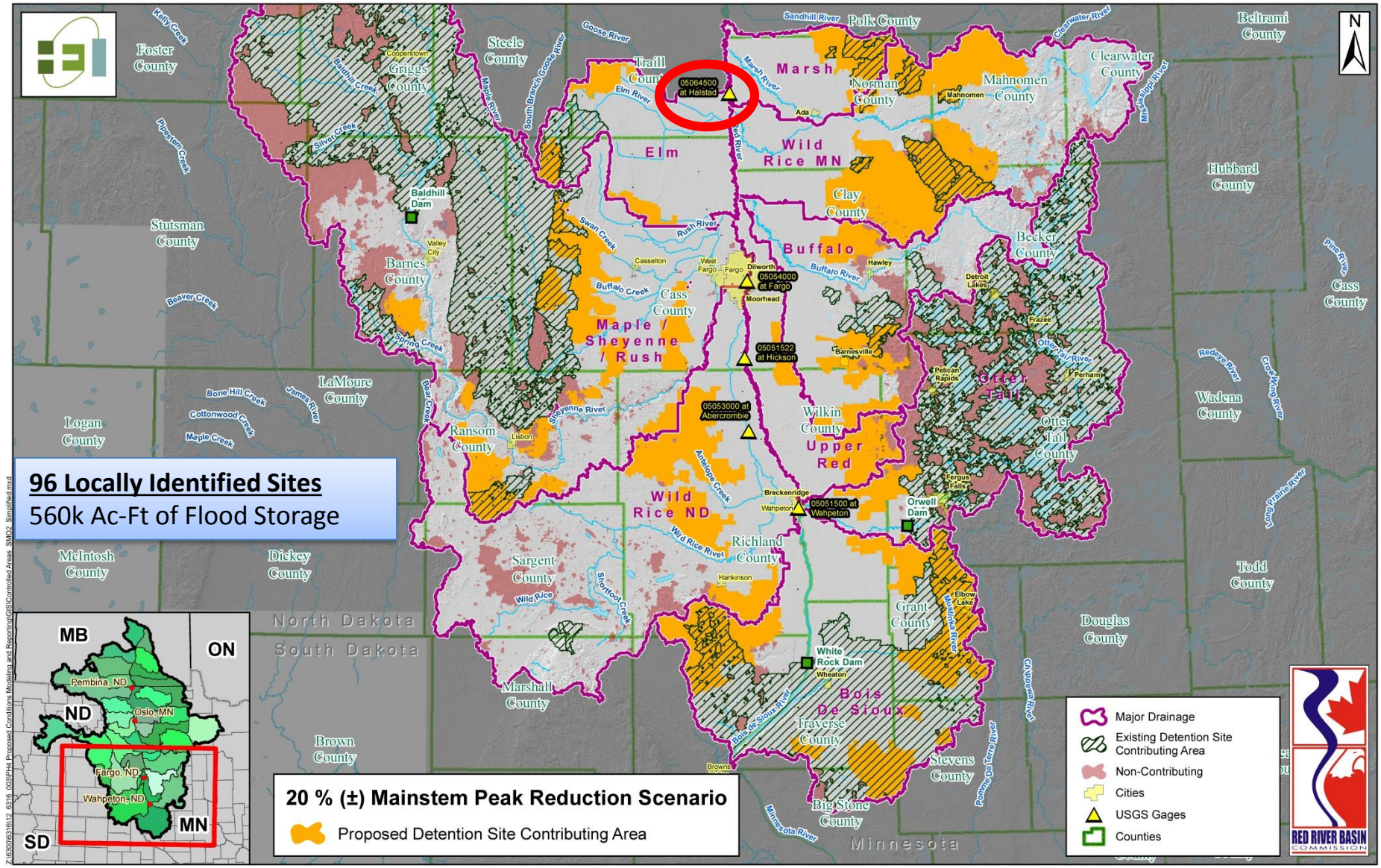
RED RIVER BASIN COMMISSION


N
Pembina, ND
Oslo, MN
Grand Forks, ND
Halstad, MN
Fargo, ND
Wahpeton, ND
4.0"
4.5"
5.0"
5.5"
6.0"
6.5"
7.0"
North Dakota
South Dakota
Minnesota
RED RIVER BASIN
COMMISSION
TR-60 Runoff
Inches
High : 11
Low : 0

Existing Contributing Area Controlled



HUR Proposed Condition



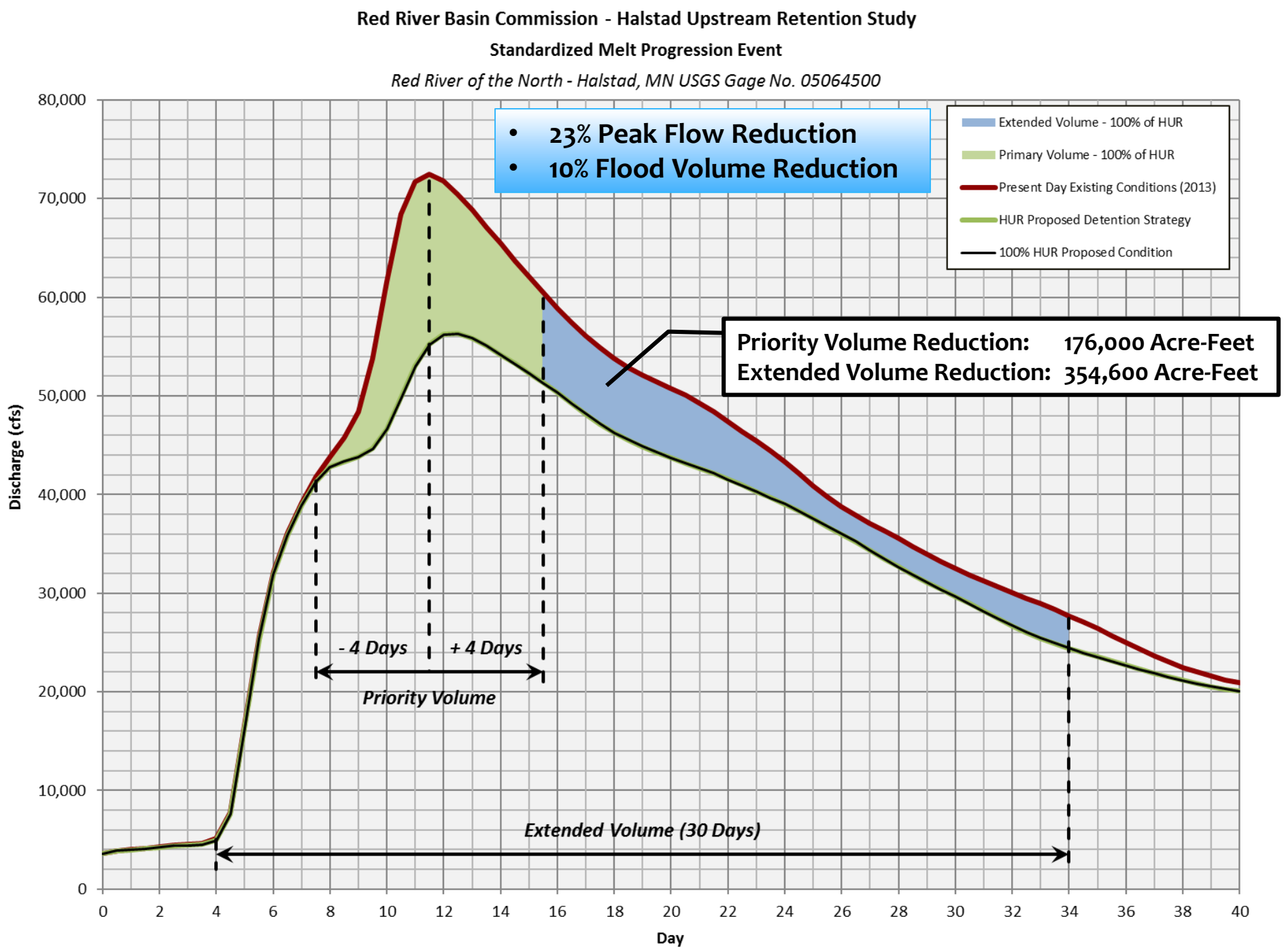
To Attain the RRBC LTFS Basinwide Flow Reduction Strategy

Halstad Upstream Retention Strategy

Study Scenario Resulting in a 20% Peak Flow Reduction
96 Locally Identified Sites Upstream of Halstad, MN

Watershed	Contributing Area *Square Miles*	Contributing Area of Proposed Sites *Square Miles*	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Gated Storage* *Acre-Feet*	Utilized Ungated Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*
Bois De Sioux	1,850	589	22	106,200	88,100	18,100	20,130
Otter Tail	1,380	44	1	6,400	2,500	3,900	1,530
Upper Red River	486	159	4	37,800	29,300	8,500	9,340
Wild Rice (ND)	2,022	345	13	75,600	64,700	10,900	17,870
Maple/Rush/Sheyenne	5,397	506	26	120,500	98,800	21,700	20,050
Buffalo	995	198	6	37,000	25,400	11,600	11,140
Elm (Red River Ungaged)	478 (255)	109	3	23,900	18,900	5,000	4,780
Wild Rice (MN)	1,616	589	17	123,700	101,000	22,700	18,340
Marsh	398	115	4	28,200	26,800	1,400	4,590
Totals	***14,622***	***2,654***	***96***	**559,300**	***455,500***	***103,800***	***107,770***

**Presented storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*


Red River Basin Commission - Halstad Upstream Retention Study
Standardized Melt Progression Event
Red River of the North - Halstad, MN USGS Gage No. 05064500
• 23% Peak Flow Reduction
• 10% Flood Volume Reduction
Extended Volume - 100% of HUR
Primary Volume - 100% of HUR
Present Day Existing Conditions (2013)
HUR Proposed Detention Strategy
100% HUR Proposed Condition
Priority Volume Reduction: 176,000 Acre-Feet
Extended Volume Reduction: 354,600 Acre-Feet
- 4 Days
+ 4 Days
Priority Volume
Extended Volume (30 Days)
Discharge (cfs)
Day
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0
2
4
6
8
10
12
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22
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26
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32
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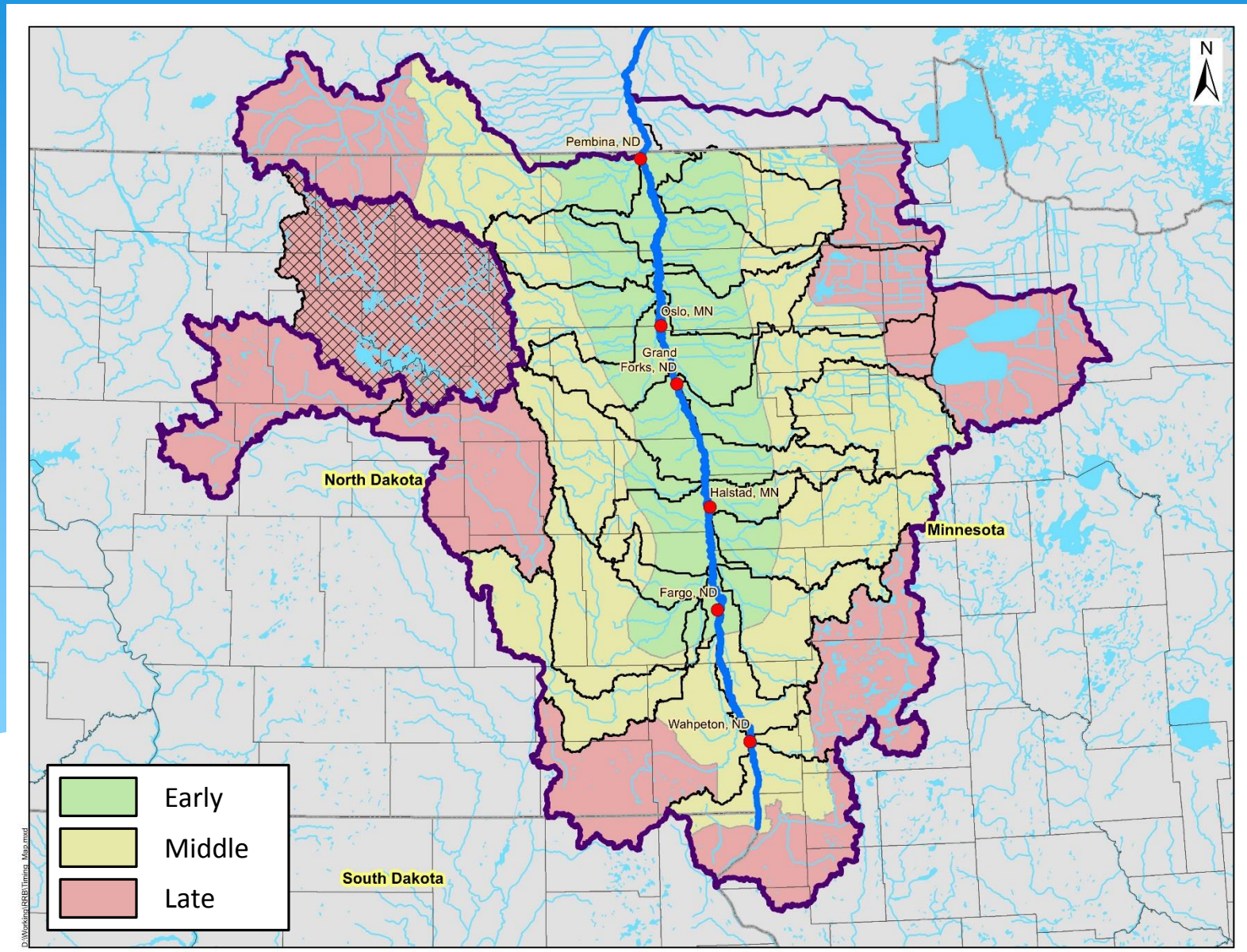
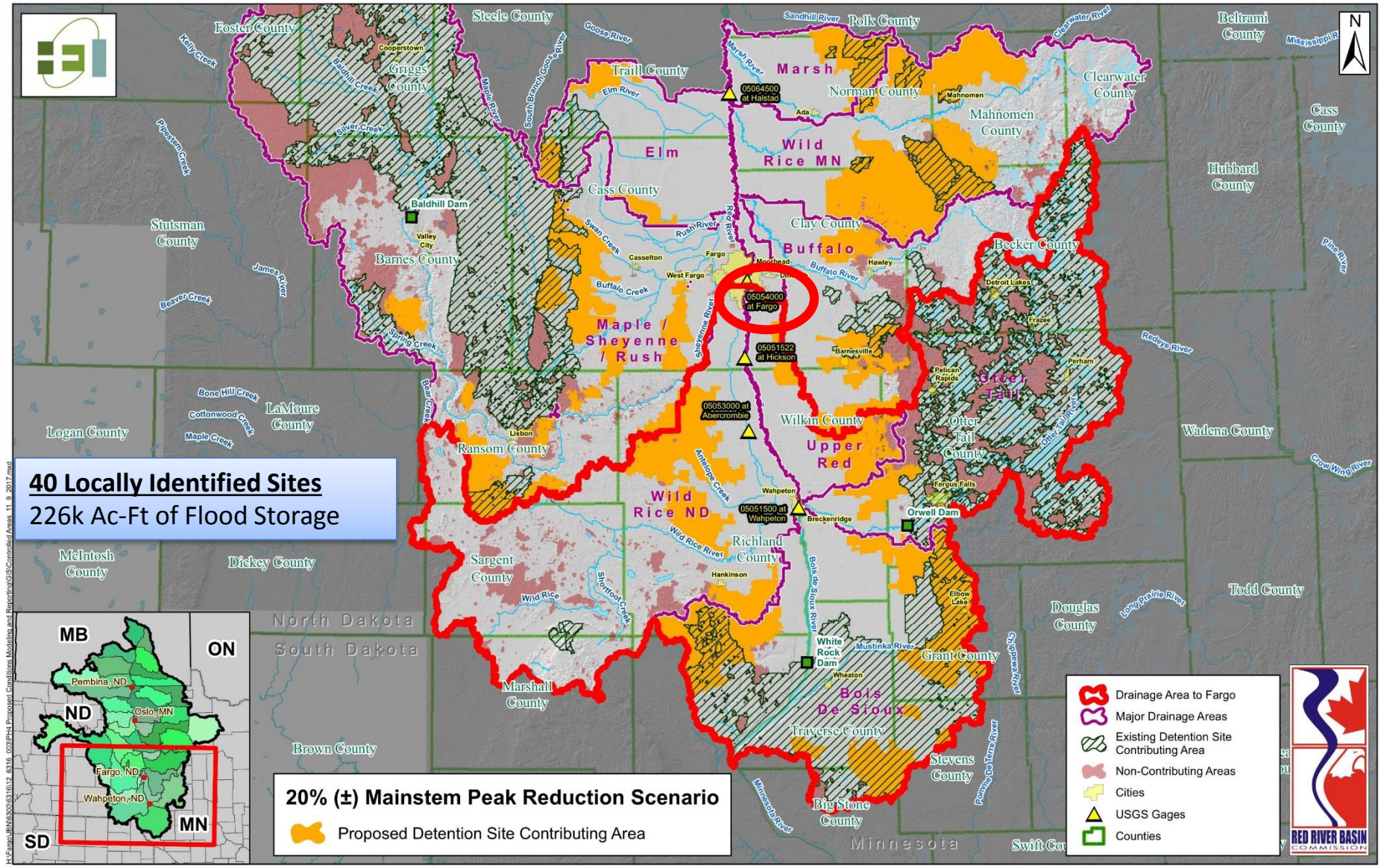
36
38
40

Storage Timing – Red River Mainstem



HUR Proposed Condition



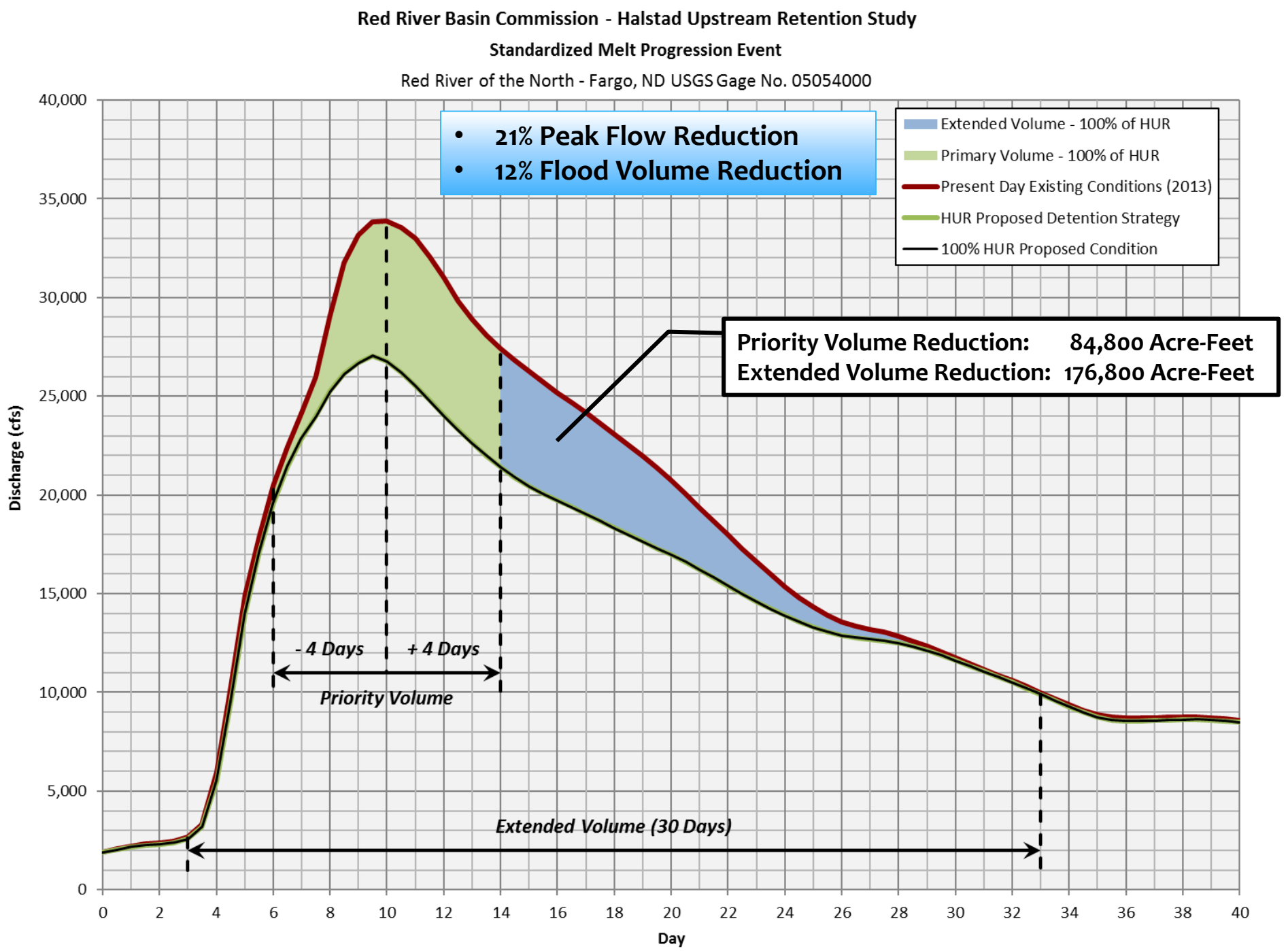
To Attain the RRBC LTFS Basinwide Flow Reduction Strategy

Halstad Upstream Retention Strategy

Study Scenario Resulting in a 20% Peak Flow Reduction
40 Locally Identified Sites Upstream of Fargo, ND

Watershed	Contributing Area *Square Miles*	Contributing Area of Proposed Sites *Square Miles*	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Gated Storage* *Acre-Feet*	Utilized Ungated Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*
Bois De Sioux	1,850	589	22	106,200	88,100	18,100	20,130
Otter Tail	1,380	44	1	6,400	2,500	3,900	1,530
Upper Red River	486	159	4	37,800	29,300	8,500	9,340
Wild Rice (ND)	2,022	345	13	75,600	64,700	10,900	17,870
Totals	***5,738***	***1,137***	***40***	***226,000***	***184,600***	***41,400***	***48,870***

**Presented storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*


Red River Basin Commission - Halstad Upstream Retention Study
Standardized Melt Progression Event
Red River of the North - Fargo, ND USGS Gage No. 05054000
• 21% Peak Flow Reduction
• 12% Flood Volume Reduction
Extended Volume - 100% of HUR
Primary Volume - 100% of HUR
Present Day Existing Conditions (2013)
HUR Proposed Detention Strategy
100% HUR Proposed Condition
Priority Volume Reduction: 84,800 Acre-Feet
Extended Volume Reduction: 176,800 Acre-Feet
- 4 Days
+ 4 Days
Priority Volume
Extended Volume (30 Days)
Discharge (cfs)
Day
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
0
2
4
6
8
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34
36
38
40

Halstad Upstream Retention Strategy

Study Scenario Resulting in a 20% Peak Flow Reduction
40 Locally Identified Sites Upstream of Fargo, ND

County	State	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*	Event Peak Inundation Area *Square Miles*
Big Stone County	MN	3	4,710	1,310	2.0
Clay County	MN	1	4,970	2,530	4.0
Grant County	MN	2	7,290	1,320	2.1
Ottertail County	MN	1	2,770	390	0.6
Stevens County	MN	2	4,530	3,120	4.9
Traverse County	MN	7	45,950	5,870	9.2
Wilkin County	MN	7	48,360	10,030	15.7
MN Subtotal		***23***	***118,580***	***24,570***	***38.4***
Cass County	ND	0	0	0	0.0
Ransom County	ND	0	0	0	0.0
Richland County	ND	15	93,560	22,430	35.0
Sargent County	ND	0	0	0	0.0
Roberts County	SD	2	13,860	1,870	2.9
Totals		***40***	***226,000***	***48,870***	***76.4***

**Storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*

Halstad Upstream Retention Study Summary

- **Red River mainstem 20% peak flow reduction is attainable for the analyzed event**
  - Differing events will result in varying levels of flow reduction benefit
  - Estimated Stage Reduction of 1.0' at Halstad, MN (1.3' at Fargo, ND)

- **96 Locally Identified Sites were used to for the proposed HUR Scenario**
  - Stores a portion of runoff from 2,650 square miles
  - 560,000 Acre-Feet of Storage (455,000 Acre-Feet Gated)
  - 107,800 Acres Inundated within Storage Sites (170± Sections)
  - Conceptual Locations

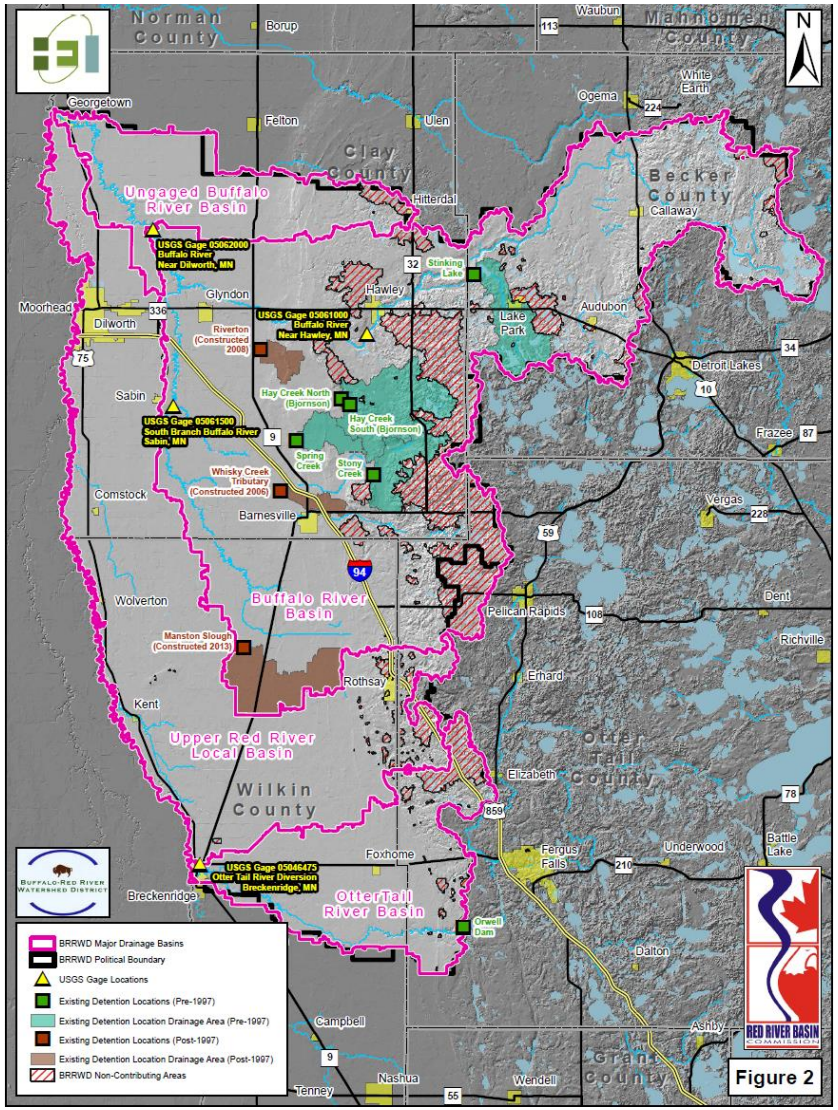
- **Standardized Melt Progression Event represents one scenario to produce a 100-year flood at Fargo, ND**
  - Based on wet period hydrology
  - Varying events may also result in a 100-year flood at Fargo, ND
  - Uniform runoff assumption for project comparison

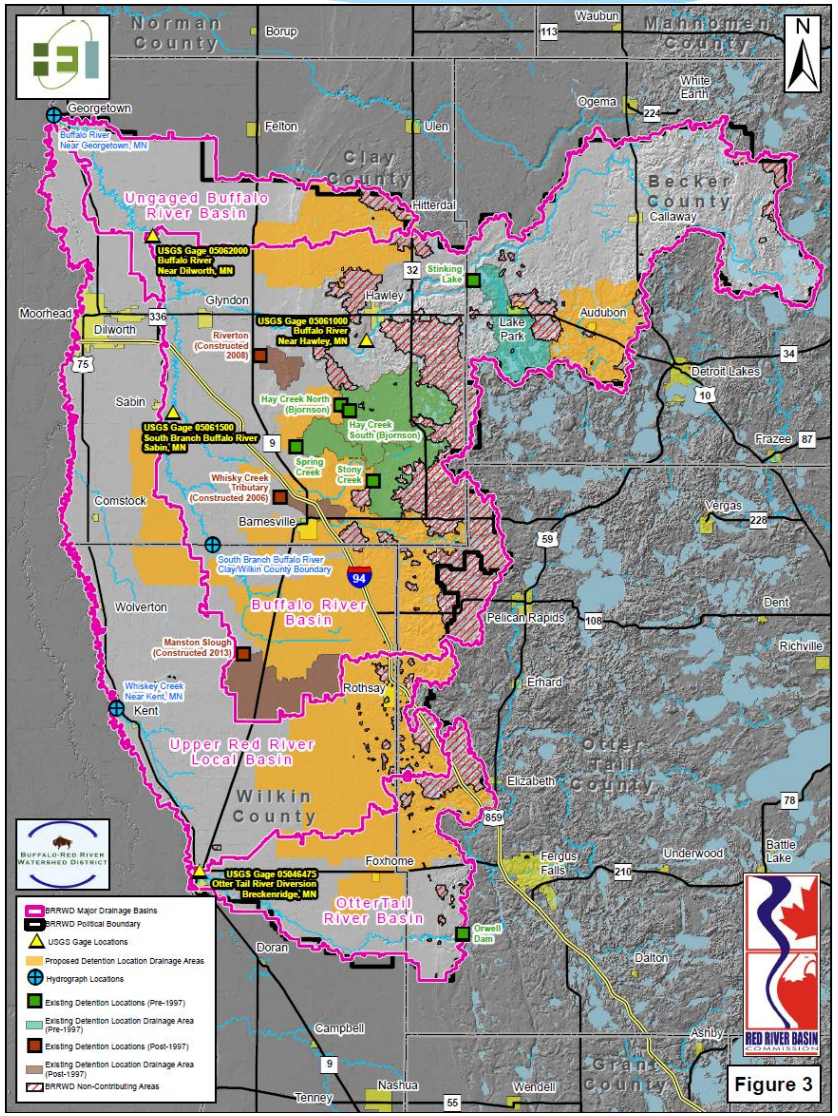
- **Provides tools necessary to evaluate specific projects for regional performance**

- **The HUR Study does NOT evaluate retention as an alternative to the current F-M Metro Flood Control Project**

Local Implementation in the Buffalo-Red River Watershed District

RRBC LTFS in the BRRWD





Local Implementation in the Buffalo-Red River Watershed District

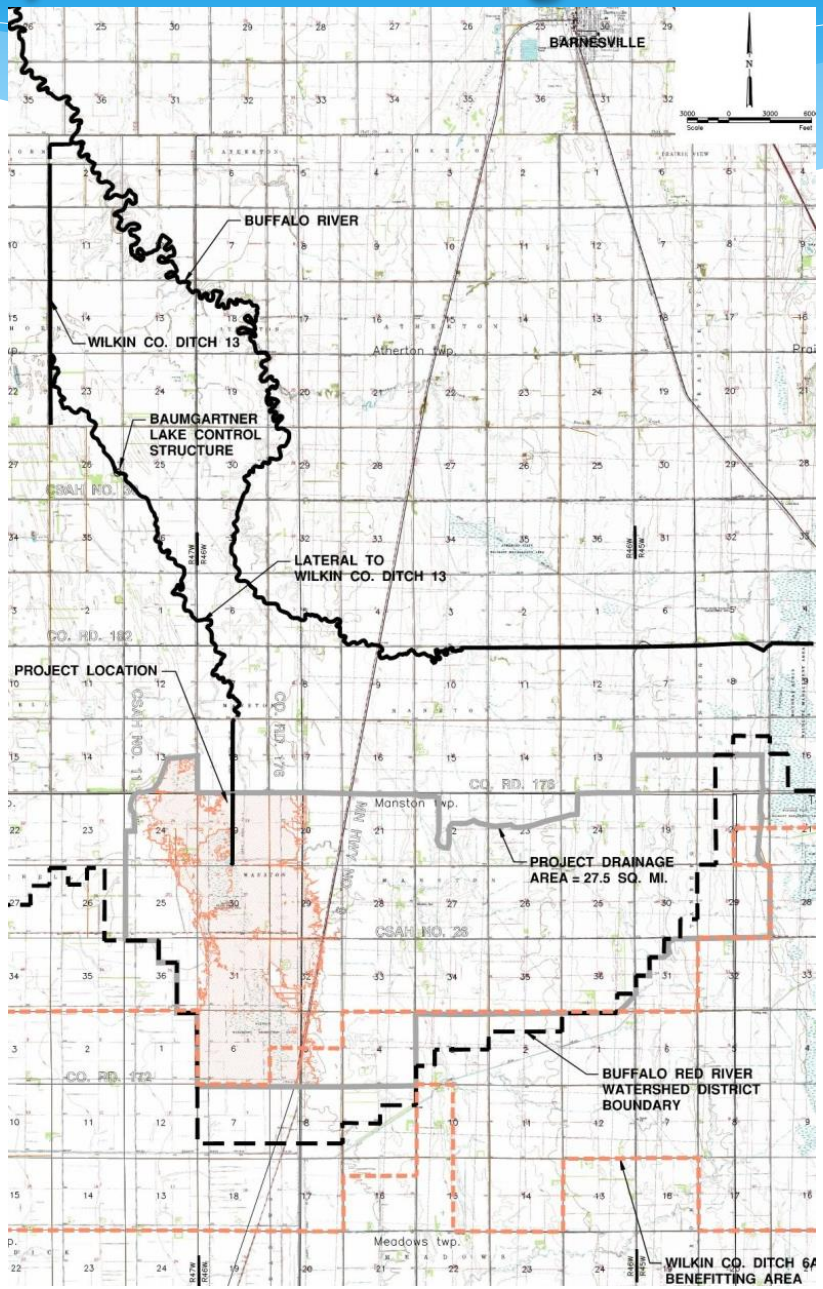
Project Development Considerations

- **Identified Need**
  - Local Concerns → Primary
  - Basinwide/Mainstem Concerns → Secondary
- **Technical Considerations**
  - Reasonable dike heights
  - Efficient Storage (volume vs drainage area)
  - Geotechnical Considerations
  - Meaningful Storage (Storage at peak damages)
- **Public Support**
  - Receptive landowners at alternative locations
  - Local demand to solve flooding issues
- **Environmental Considerations**
  - Multipurpose Potential (Natural Resource Enhancement)
  - Environmental concerns within the project area

BRRWD Example Project: Manston Slough

Project Area

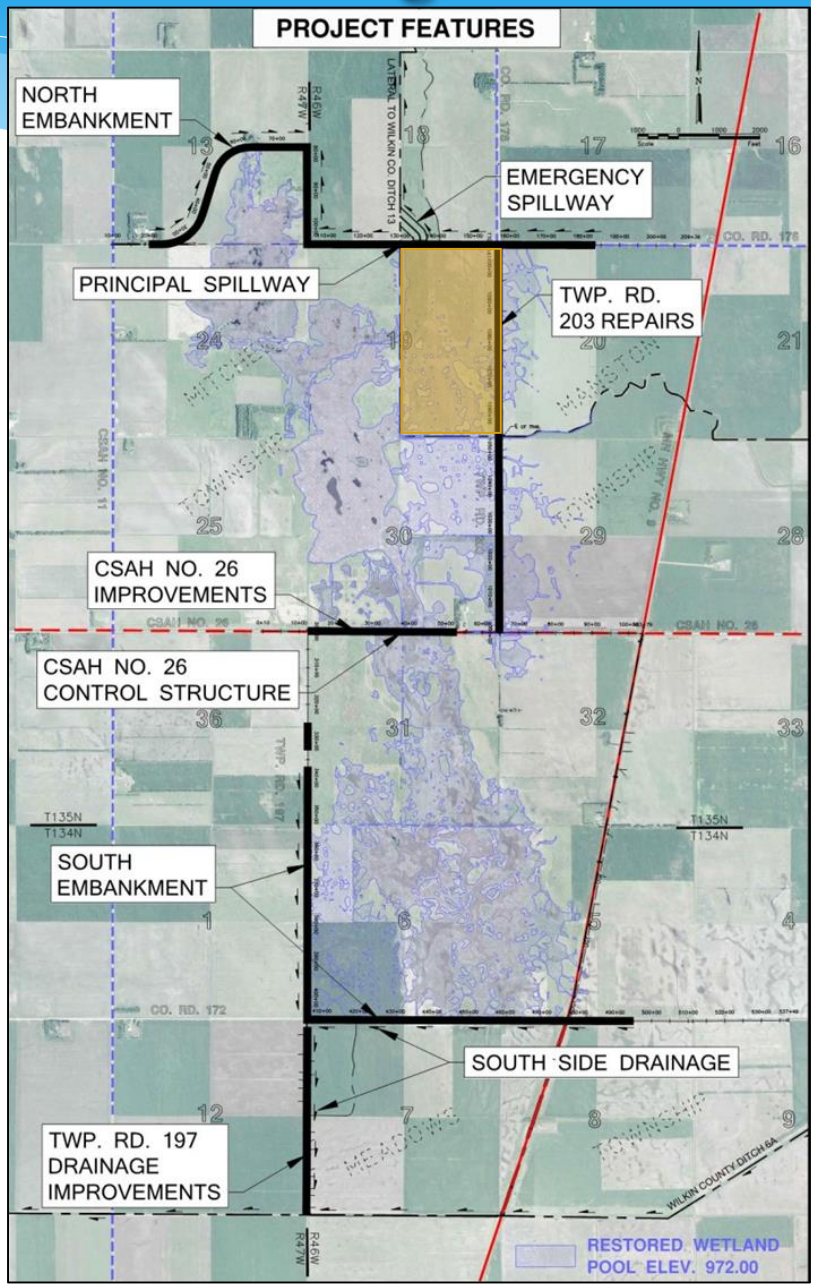
- **Lateral to Wilkin County Ditch No. 13**
  - Legal Ditch System in Wilkin County, MN
- **South of Barnesville, MN in Mitchell, Manston, and Meadows Townships**
- **27.5 square mile drainage area**
- **Manston Slough is a recharge point for the Buffalo Aquifer**
  - Source of drinking water for Moorhead, MN



BRRWD Example Project: Manston Slough

Project Background

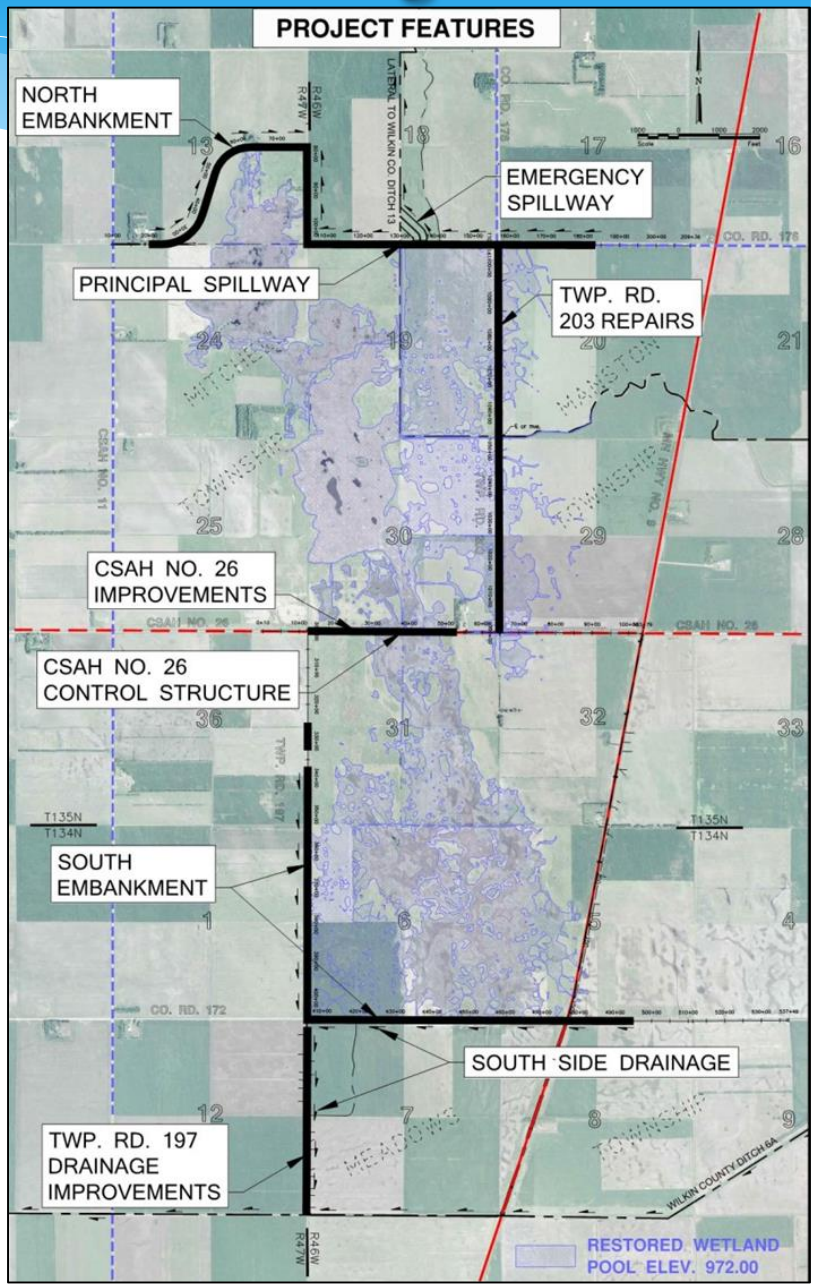
- Original Project Proposed by DNR and Ducks Unlimited involved diking the E ½ of Section 19, Manston Twp.
- Proposed Wetland Restoration to Elevation 972 is shown in blue
- BRRWD Identified an opportunity for a larger collaborative effort between agencies for a multipurpose project



BRRWD Example Project: Manston Slough

Project Features

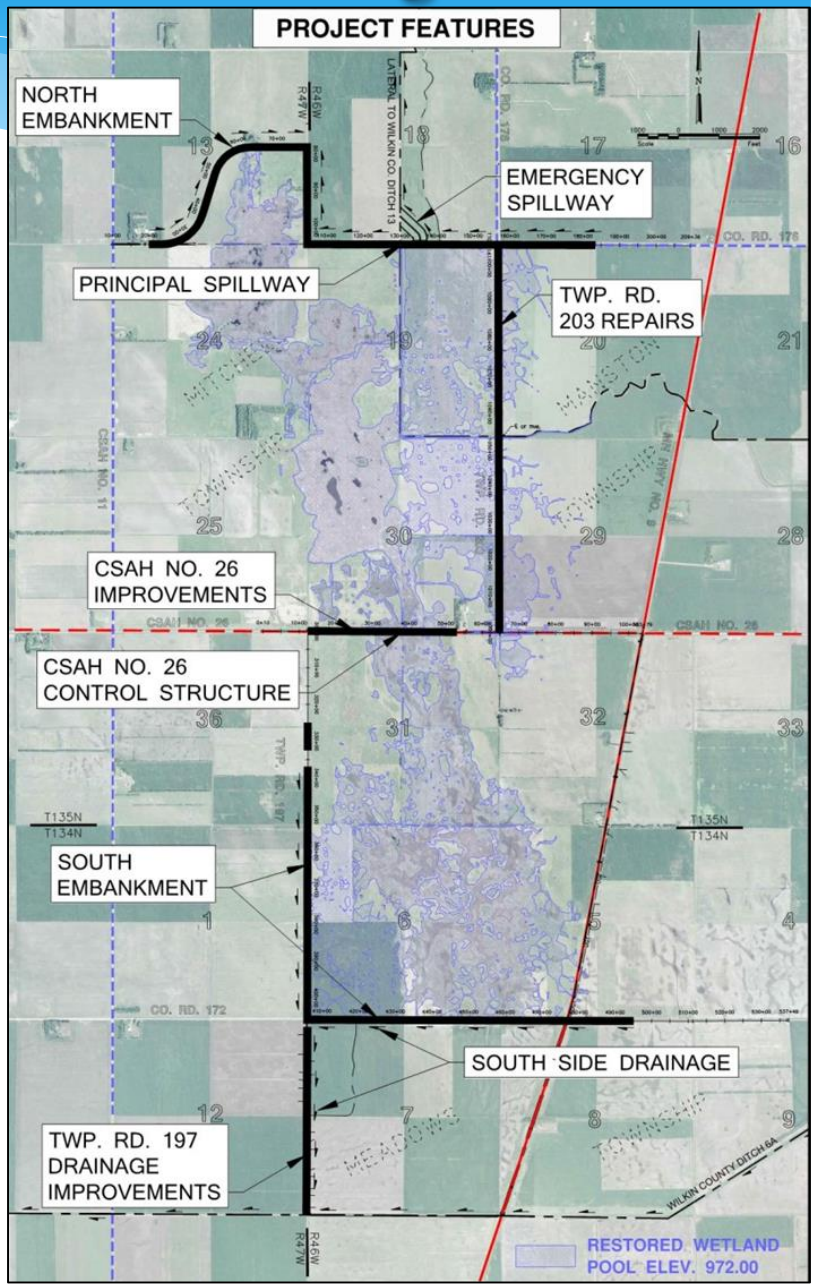
- **North Embankment**
  - Includes Principal and Emergency Spillways
  - Highest Embankment is 10 feet at the Spillway
- **South Embankment**
  - Drainage Improvements on south side
- **County Highway 26 Control Structure**
  - Allows for different pool levels north vs south
- **County Highway 26 Improvements**
  - Flatten slopes in the pool area
- **Township Road 203 Repairs**
  - Minimum elevation of 974
  - Additional Culverts
- **Fish Barrier on Baumgartner Lake**



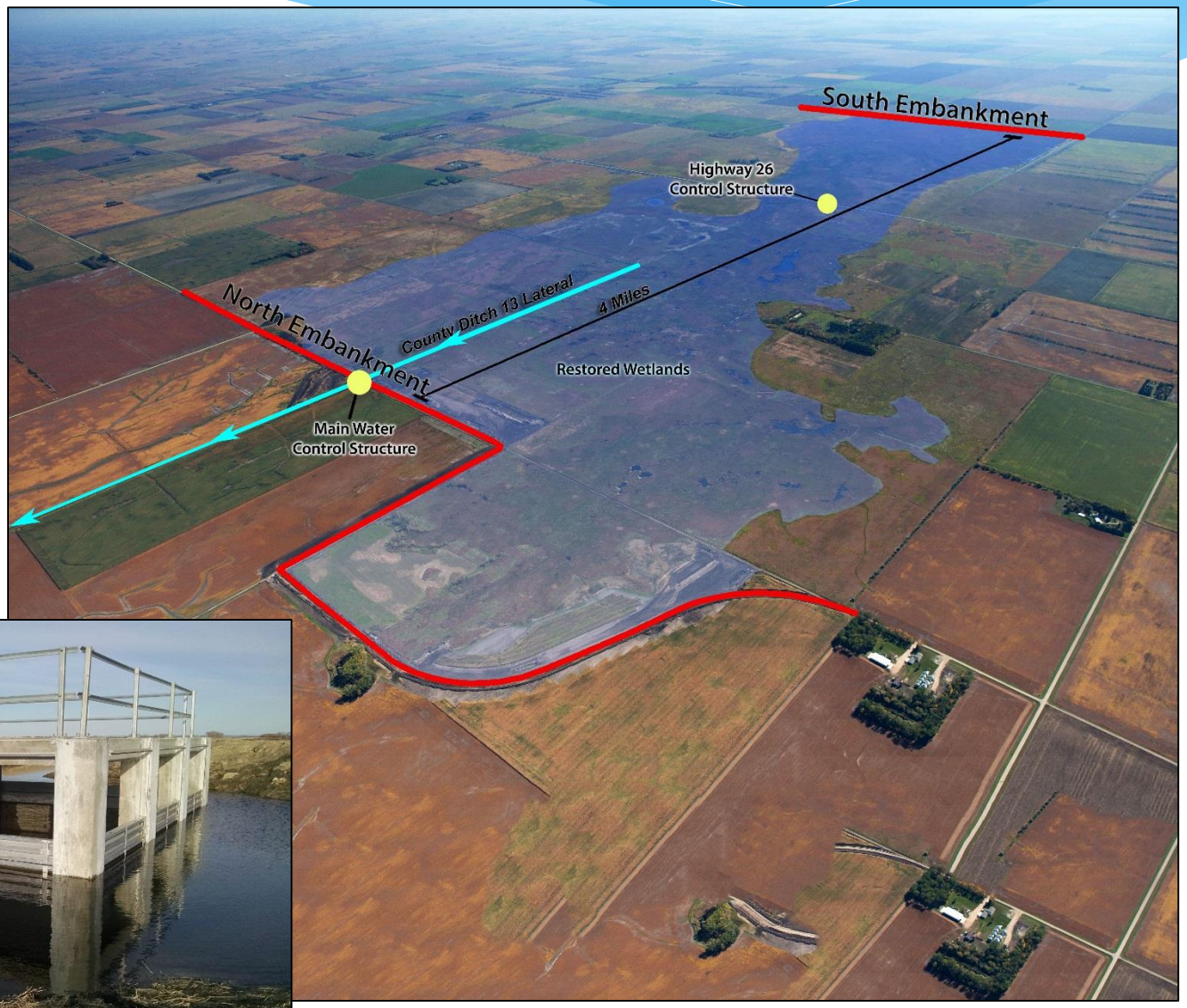
BRRWD Example Project: Manston Slough

Project Benefits

- **Flood Damage Reduction**
  - 3.7” Runoff Flood Storage (5,500 Acre-Feet)
  - Flood Pool set to elevation 974
  - Reduce flood flow by 50-80%
  - Work towards LTFS recommendations
  - Reduce flows on South Branch Buffalo River
- **Natural Resource Enhancement**
  - Normal Pool/Wetland set to elevation 972
  - Restore historic migratory bird stopover
    - Designed to mimic 1951 wetland levels
  - Outlet structure designed for enhanced wetland management during non-flood times
  - Water quality improvements
  - Reduce sediment loading to the Buffalo River
  - Enhance groundwater recharge
  - 6,000 acres open to the public (State/Federal)



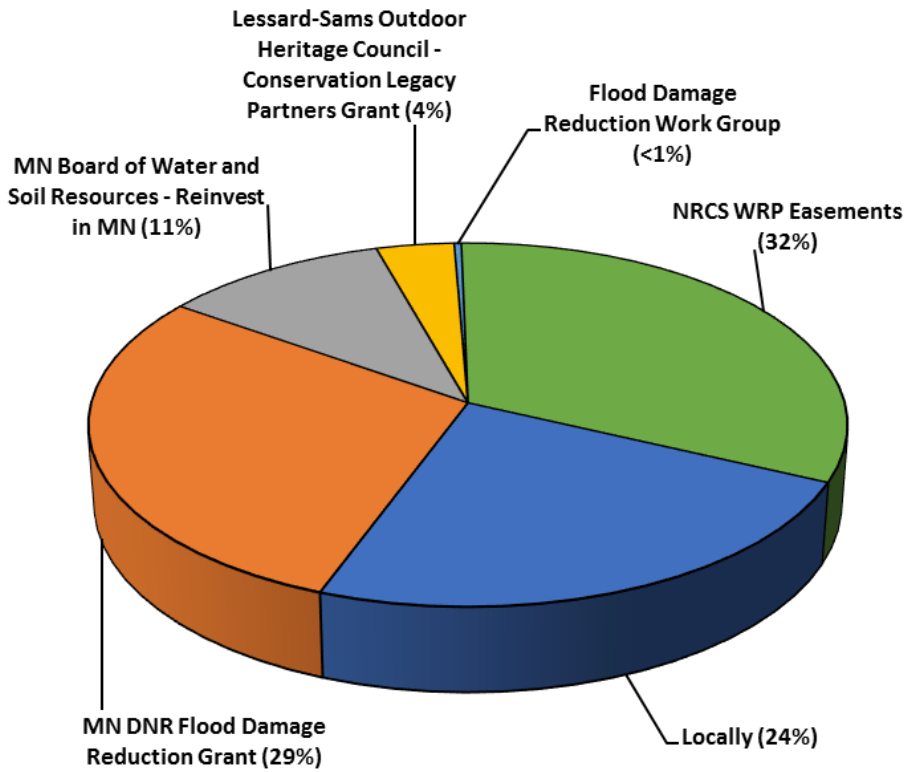
BRRWD Example Project: Manston Slough



BRRWD Example Project: Manston Slough

Project Financing

- **Total Costs: $ 9.3 Million**
  - Construction: $ 2.7 Million
  - Easements: $ 5.3 Million
  - Administration: $ 1.3 Million
- **Funding Partners:**
  - BRRWD (M.S.A. 103D.905, Subd. 3) / Project Assessments per Benefited Party (103D.725) (24%)
  - State of Minnesota DNR Flood Damage Reduction Grant (29%)
  - State of Minnesota Board of Water and Soil Resources – Reinvest in MN (11%)
  - Lessard-Sams Outdoor Heritage Council – Conservation Legacy Partners Grant (4%)
  - Flood Damage Reduction Work Group (<1%)
  - Donated USFWS & MN DNR Land Rights
  - NRCS WRP Easement Funding (32%)



BRRWD Example Project: Manston Slough

Project Timeline

- March 2002: Ducks Unlimited initiates design on a wetland project in the E1/2 of Section 19 Manston Twp.
- April 2002: BRRWD tour Manston Slough area
- April 2002: Watershed decision to pursue Larger Manston Slough Project
- May 2002: LIDAR Survey acquisition
- November 2002: LIDAR Survey results
- 2003: BRRWD Project Team Considers Project Preliminary Design
- Fall 2003: Project added to Governor's Clean Water Initiative Project List
- January 2004: Landowner meeting scheduled to discuss potential Project.
- 2004-2005: Preliminary Project Design
- 2005 Geotechnical evaluation completed
- December 2005 Preliminary Resolution Hearing
- 2007: Engineer's Report
- 2007-2009: Develop MOU and O&M with partner agencies
- 2007-2015: Landowner Easement Acquisition
- 2009-2013: MN EAW and other Permitting
- 2003-2013: Funding Search
- May 2012/April 2013: Final Hearing
- Construction 2013/2015 (Native seeding in 2015)
- 2015 and beyond: Continued Operation & Maintenance

BRRWD Example Project: Manston Slough

Why do projects take so long to develop???

- **The Issues**
  - Landowner support/buy-in
  - Problem Identification
  - Develop range of alternatives
  - Design/study funding
  - Permitting – local, state, federal
  - Cultural resources/special interests
  - Search for project funding
  - Secure land rights/easements
  - Construction
  - Monitoring/evaluation

Additional Discussion

Halstad Upstream Retention Strategy

Study Scenario Resulting in a 20% Peak Flow Reduction
40 Locally Identified Sites Upstream of Fargo, ND

County	State	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Gated Storage* *Acre-Feet*	Utilized Ungated Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*	Event Peak Inundation Area *Square Miles*
Big Stone County	MN	3	4,710	3,170	1,540	1,310	2.0
Clay County	MN	1	4,970	230	4,740	2,530	4.0
Grant County	MN	2	7,290	5,280	2,010	1,320	2.1
Ottertail County	MN	1	2,770	2,390	380	390	0.6
Stevens County	MN	2	4,530	3,320	1,210	3,120	4.9
Traverse County	MN	7	45,950	39,840	6,110	5,870	9.2
Wilkin County	MN	7	48,360	39,330	9,030	10,030	15.7
MN Subtotal		***23***	***118,580***	***93,560***	***25,020***	***24,570***	***38.4***
Cass County	ND	0	0	0	0	0	0.0
Ransom County	ND	0	0	0	0	0	0.0
Richland County	ND	15	93,560	80,930	12,630	22,430	35.0
Sargent County	ND	0	0	0	0	0	0.0
Roberts County	SD	2	13,860	10,110	3,750	1,870	2.9
Totals		***40***	***226,000***	***184,600***	***41,400***	***48,870***	***76.4***

**Storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*

Halstad Upstream Retention Strategy

One Scenario Resulting in a 20% Peak Flow Reduction
40 Locally Identified Sites Upstream of Fargo, ND

County	State	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Gated Storage* *Acre-Feet*	Utilized Ungated Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*
Big Stone County	MN	3	4,710	3,170	1,540	1,310
Clay County	MN	1	4,970	230	4,740	2,530
Grant County	MN	2	7,290	5,280	2,010	1,320
Ottertail County	MN	1	2,770	2,390	380	390
Stevens County	MN	2	4,530	3,320	1,210	3,120
Traverse County	MN	7	45,950	39,840	6,110	5,870
Wilkin County	MN	7	48,360	39,330	9,030	10,030
Cass County	ND	0	0	0	0	0
Ransom County	ND	0	0	0	0	0
Richland County	ND	15	93,560	80,930	12,630	22,430
Sargent County	ND	0	0	0	0	0
Roberts County	SD	2	13,860	10,110	3,750	1,870
Totals		***40***	***226,000***	***184,600***	***41,400***	***48,870***

**Presented storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*

Halstad Upstream Retention Strategy

One Scenario Resulting in a 20% Peak Flow Reduction
40 Locally Identified Sites Upstream of Fargo, ND

County	State	Pre-1997 Sites	Post 1997 Sites	Number of Sites Included	Total Utilized Storage* *Acre-Feet*	Gated Storage* *Acre-Feet*	Utilized Ungated Storage* *Acre-Feet*	Event Peak Inundation Area *Acres*
Big Stone County	MN	0	0	3	4,710	3,170	1,540	1,310
Clay County	MN	0	0	1	4,970	230	4,740	2,530
Grant County	MN	0	1	2	7,290	5,280	2,010	1,320
Ottertail County	MN	0	0	1	2,770	2,390	380	390
Stevens County	MN	0	0	2	4,530	3,320	1,210	3,120
Traverse County	MN	1	0	7	45,950	39,840	6,110	5,870
Wilkin County	MN	0	0	7	48,360	39,330	9,030	10,030
Cass County	ND	0	0	0	0	0	0	0
Ransom County	ND	0	0	0	0	0	0	0
Richland County	ND	0	0	15	93,560	80,930	12,630	22,430
Sargent County	ND	3	0	0	0	0	0	0
Roberts County	SD	0	0	2	13,860	10,110	3,750	1,870
Totals		***4***	***1***	***40***	***226,000***	***184,600***	***41,400***	***48,870***

**Presented storage volumes correlate to runoff volume detained during the analyzed 4-day Initial Melt Progression Event.*