APPENDIX C

Support Maps

DEFINITIONS

Upstream Assessment Area (U-AA): the zone near the reservoir where there may be a direct impact. The U-AA includes the dam site, the flood pool upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of approximately 950 acres.

Downstream Assessment Area (D-AA): the zone downstream where the environment may be affected if there would be changes in the flow of the North Branch Forest River. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota

Upstream Area: the area that is not expected to be affected by the project but describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

MAPPING NOTES

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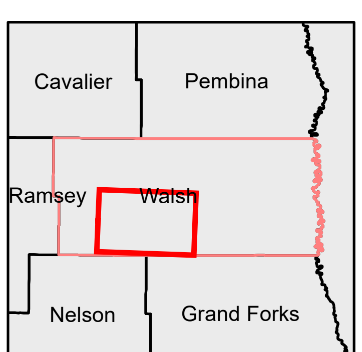
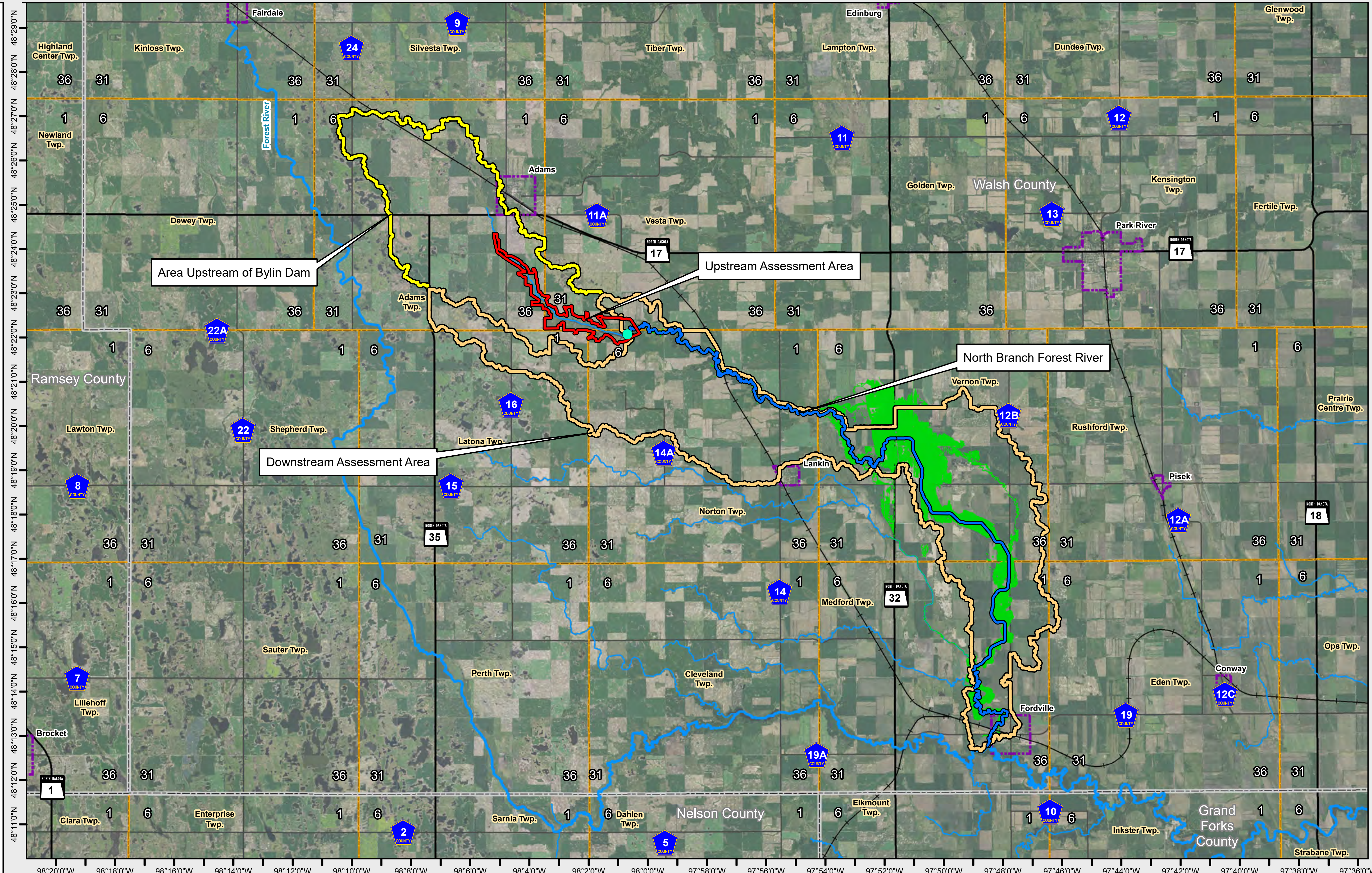
Map page size is Tabloid (11" x 17"). Accuracy of the map scales for varying paper sizes and is valid only if printed at this page size.





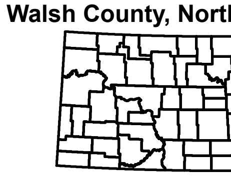
Assessment Areas

- Area Upstream of Bylin Dam (20.5 Sq. Mi.)
- Downstream Assessment Area (41.1 Sq. Mi.)
- Upstream Assessment Area (1.5 Sq. Mi.)
- Bylin Dam
- Benefited Area

N E S W

0 1.25 2.5 5 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-1
Area of Interest / Benefit Area

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/11/2022	1 of 26

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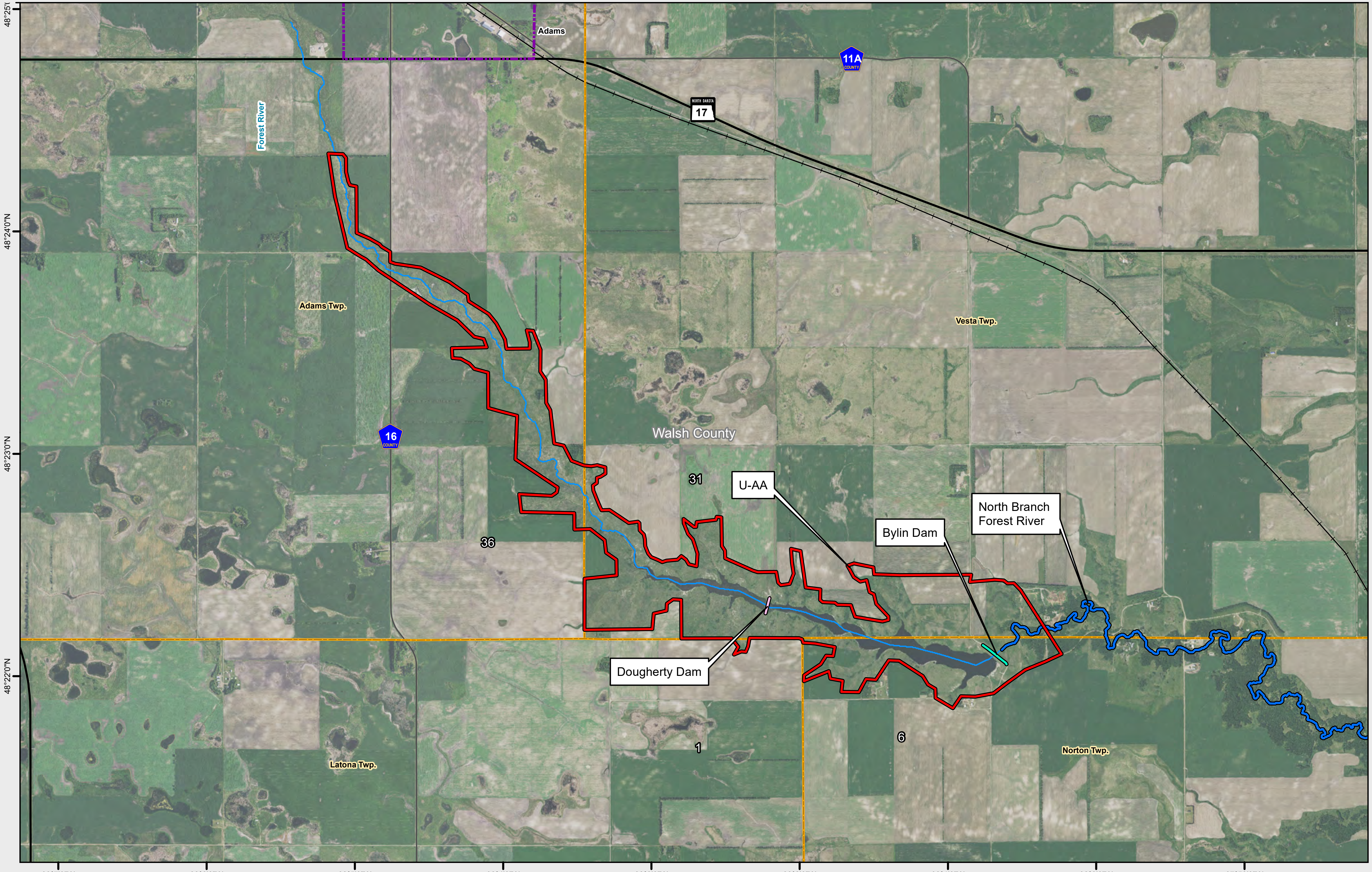
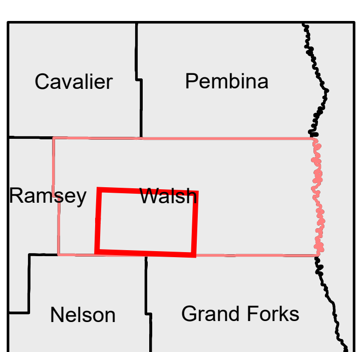


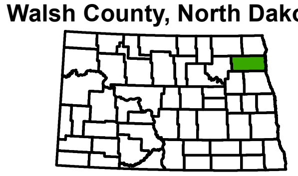


Upstream Assessment Area (1.5 Sq. Mi.)
Bylin Dam Alignment
Dougherty Dam Alignment

N
W
E
S

0 0.25 0.5 1 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-2
Upstream Assessment Area Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/11/2022	2 of 26

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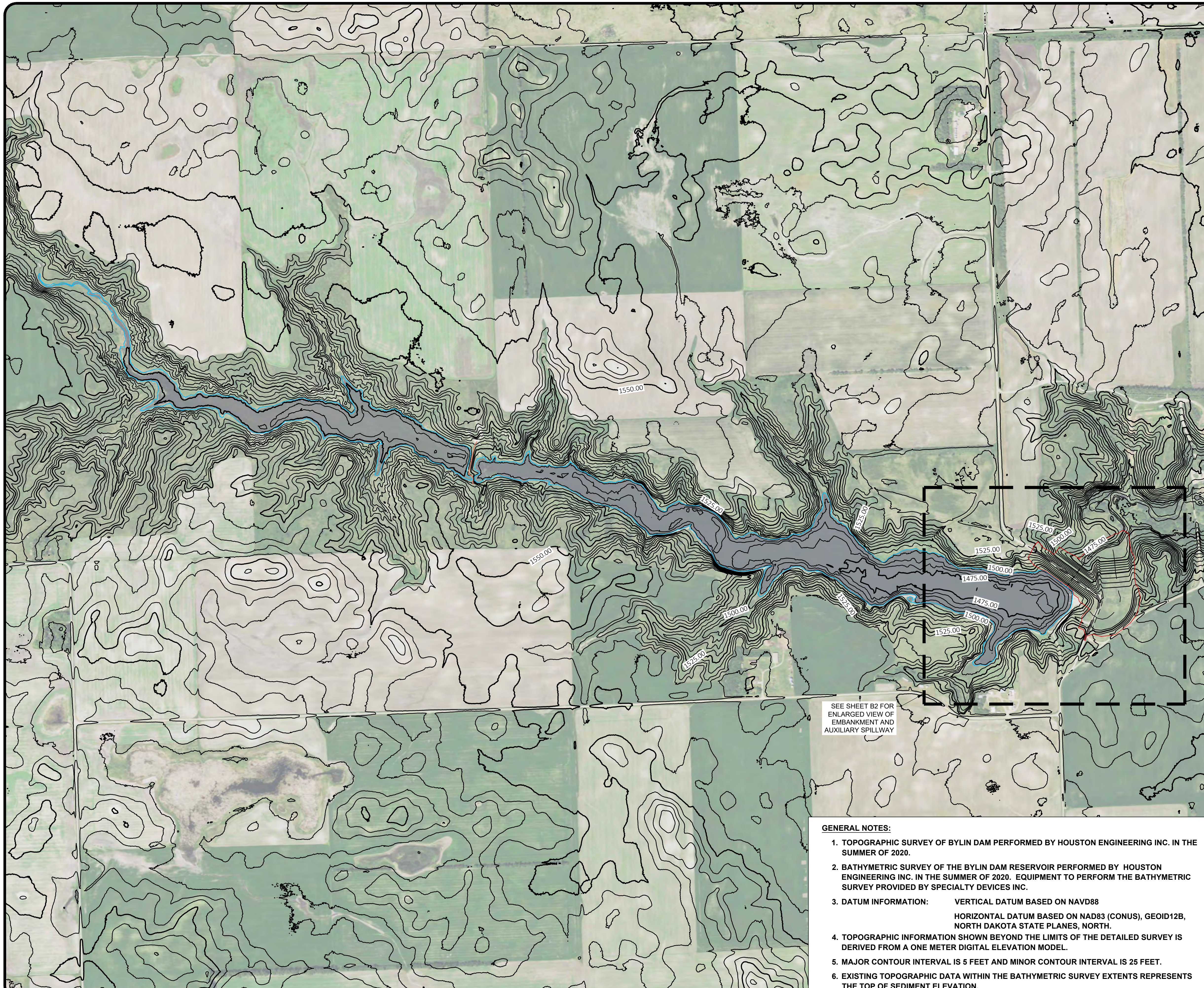

N

100 0 100 200
Scale Feet

LEGEND

MAJOR CONTOURS 1360
MINOR CONTOURS
GROUND SURVEY LIMITS
BATHYMETRIC SURVEY LIMITS

GENERAL NOTES:

1. TOPOGRAPHIC SURVEY OF BYLIN DAM PERFORMED BY HOUSTON ENGINEERING INC. IN THE SUMMER OF 2020.
2. BATHYMETRIC SURVEY OF THE BYLIN DAM RESERVOIR PERFORMED BY HOUSTON ENGINEERING INC. IN THE SUMMER OF 2020. EQUIPMENT TO PERFORM THE BATHYMETRIC SURVEY PROVIDED BY SPECIALTY DEVICES INC.
3. DATUM INFORMATION: VERTICAL DATUM BASED ON NAVD88

   HORIZONTAL DATUM BASED ON NAD83 (CONUS), GEOID12B, NORTH DAKOTA STATE PLANES, NORTH.
4. TOPOGRAPHIC INFORMATION SHOWN BEYOND THE LIMITS OF THE DETAILED SURVEY IS DERIVED FROM A ONE METER DIGITAL ELEVATION MODEL.
5. MAJOR CONTOUR INTERVAL IS 5 FEET AND MINOR CONTOUR INTERVAL IS 25 FEET.
6. EXISTING TOPOGRAPHIC DATA WITHIN THE BATHYMETRIC SURVEY EXTENTS REPRESENTS THE TOP OF SEDIMENT ELEVATION.

PRELIMINARY
NOT FOR CONSTRUCTION

No.	Revision	Date	By

APPENDIX C-3
EXISTING CONDITIONS TOPOGRAPHY

HOUSTON engineering, inc.

Drawn By	AJK,SMH
Checked By	PDL
Date	12-29-21
Scale	As Shown
Project No.	7135-0037
SHEET	C-3

\\houston\hei\JBN\7100\7135\7135_0037\CAD\Plan\Bylin Dam_Overall.dwg-Layout1-11/13/2023 11:25 AM-(zfursa)

N

100 0 100 200
Scale Feet

LEGEND

- MAJOR CONTOURS — 1360
- MINOR CONTOURS
- GROUND SURVEY LIMITS
- BATHYMETRIC SURVEY LIMITS
- SOIL BORING
- CONTROL POINT
- TOPO SURVEY POINT
- GRAVEL
- DELINEATED WETLANDS
- DRAINAGE DIRECTION

NOTE:
1. REFER TO SHEET B1 FOR GENERAL NOTES.
2. MAJOR CONTOUR INTERVAL IS 10 FEET AND MINOR CONTOUR INTERVAL IS 2 FEET
3. IMAGERY OBTAINED FROM DRONE FLIGHT IN SEPTEMBER OF 2020

PRELIMINARY
NOT FOR CONSTRUCTION

No.	Revision	Date	By

APPENDIX C-4
EXISTING CONDITIONS OVERALL SITE PLAN

HOUSTON engineering, inc.

Drawn By	AJK,SMH
Checked By	PDL
Date	01-03-22
Scale	As Shown
Project No.	7135-0037
SHEET	C-4

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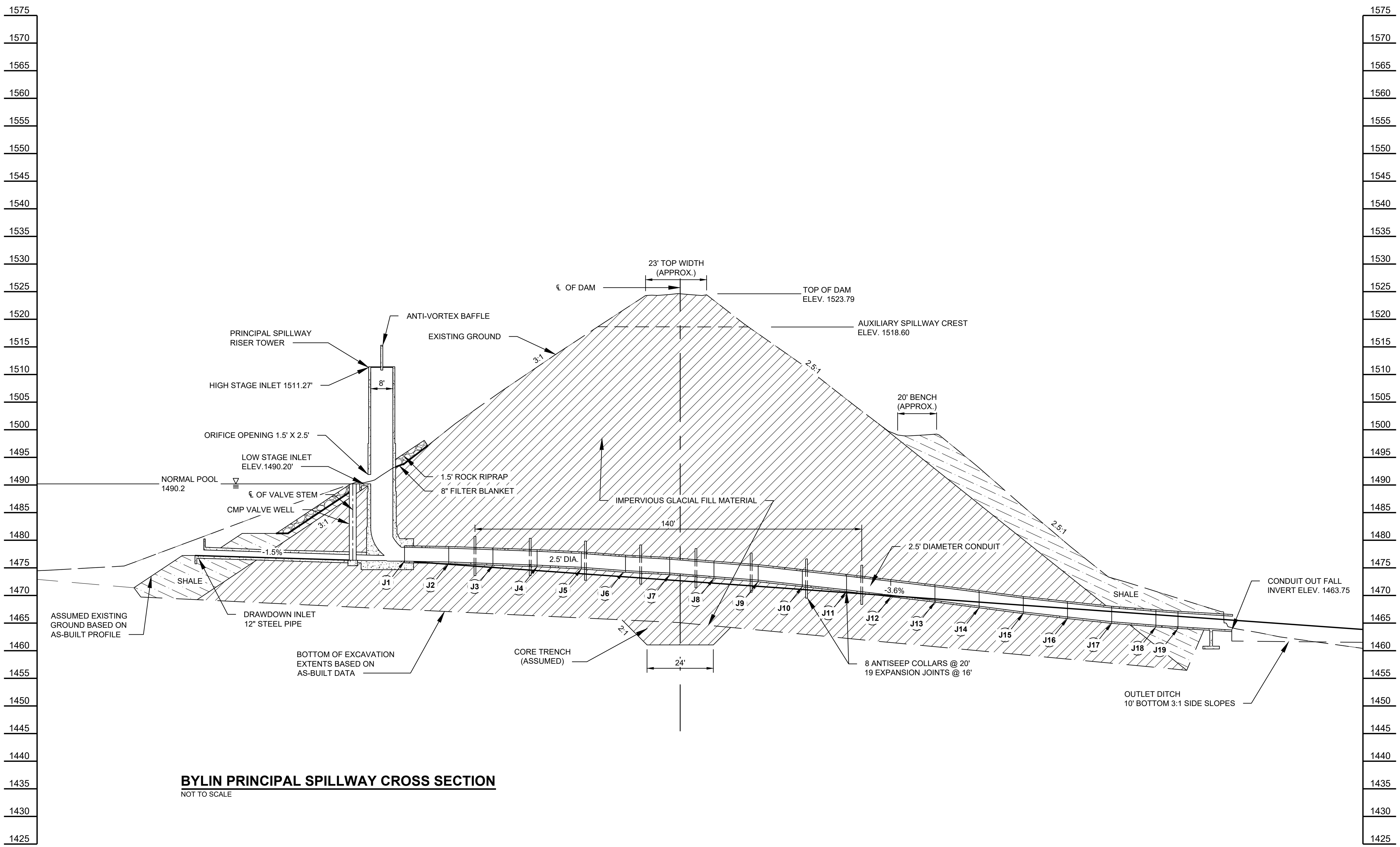

BYLIN PRINCIPAL SPILLWAY CROSS SECTION

NOT TO SCALE

LEGEND

SHALE

IMPERVIOUS GLACIAL FILL MATERIAL

CONCRETE

RIPRAP

NOTES:
1. ALL ELEVATIONS REFERENCE NAVD88 VERTICAL DATUM
2. EXISTING EMBANKMENT ELEVATIONS BASED ON AS-BUILT PLANS AND FIELD SURVEY DATA

PRELIMINARY
NOT FOR CONSTRUCTION

No.	Revision	Date	By

APPENDIX C-5
EXISTING PRINCIPAL SPILLWAY CROSS SECTION

HOUSTON engineering, inc.

Drawn By
AJK,SMH

Checked By
PDL

Date
01-03-22

Scale
As Shown

Project No.
7135-0037

SHEET
C-5

\\houston\hei\JBN\7100\7135\7135_0037\CAD\Plan\Cross Section at Spillway with 4to1.dwg-Bylin EXISTING-11/13/2023 11:11 AM-(zfursa)

Habitable Structures			
Label	Finished Floor Elevation (ft)	Maximum Depth (ft)	Maximum Velocity (ft/s)
S1	1475.187	8.566	3.236
S2	1456.163	19.412	4.316
S3	1447.876	23.762	5.329
S4	1438.282	23.896	8.042
S5	1440.189	14.891	3.387
S6	1383.104*	29.464	0.479
S7	1232.429	-	2.633
S8	1228.687	-	0.007
S9	1193.439	0.054	0.255
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S13	1178.522	0.510	0.450
S14	1175.652	0.343	1.265
S15	1172.958	-	0.335
S16	1167.996	1.181	1.627
S17	1164.042*	0.006	0.155
S18	1163.351*	-	0.457
S19	1161.253*	0.219	0.678
*Survey point inaccesible. Floor elevation estimated from available LiDAR			
- denotes WSE did not exceed floor elevation			

MODELING NOTES

The peak breach discharge was computed using USDA-NRCS TR 210-60 breach equations.

The starting water surface elevation used was the proposed top of dam elevation

The breach hydrograph was computed using breach dimensions identified from the Froehlich Equations (2008). The development time of the breach was varied within the HEC-RAS hydraulic model to attain the peak breach discharge computed based on equations in TR 210-60.

HEC-RAS 5.0.7 Unsteady Flow Module was used to route the breach hydrograph downstream.

The International Water Institute's Multi-jurisdictional Spring 2008 Red River Basin Mapping Initiative LiDAR collection and field survey data were used to create cross section geometry and to plot the inundation areas.

The dam breach inundation area represents a rapidly developing dam failure resulting from piping failure. In the event of an actual dam failure, conditions may vary resulting in variation of the breach inundation area.

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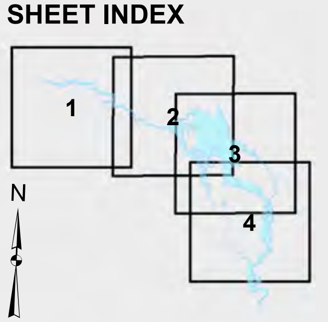
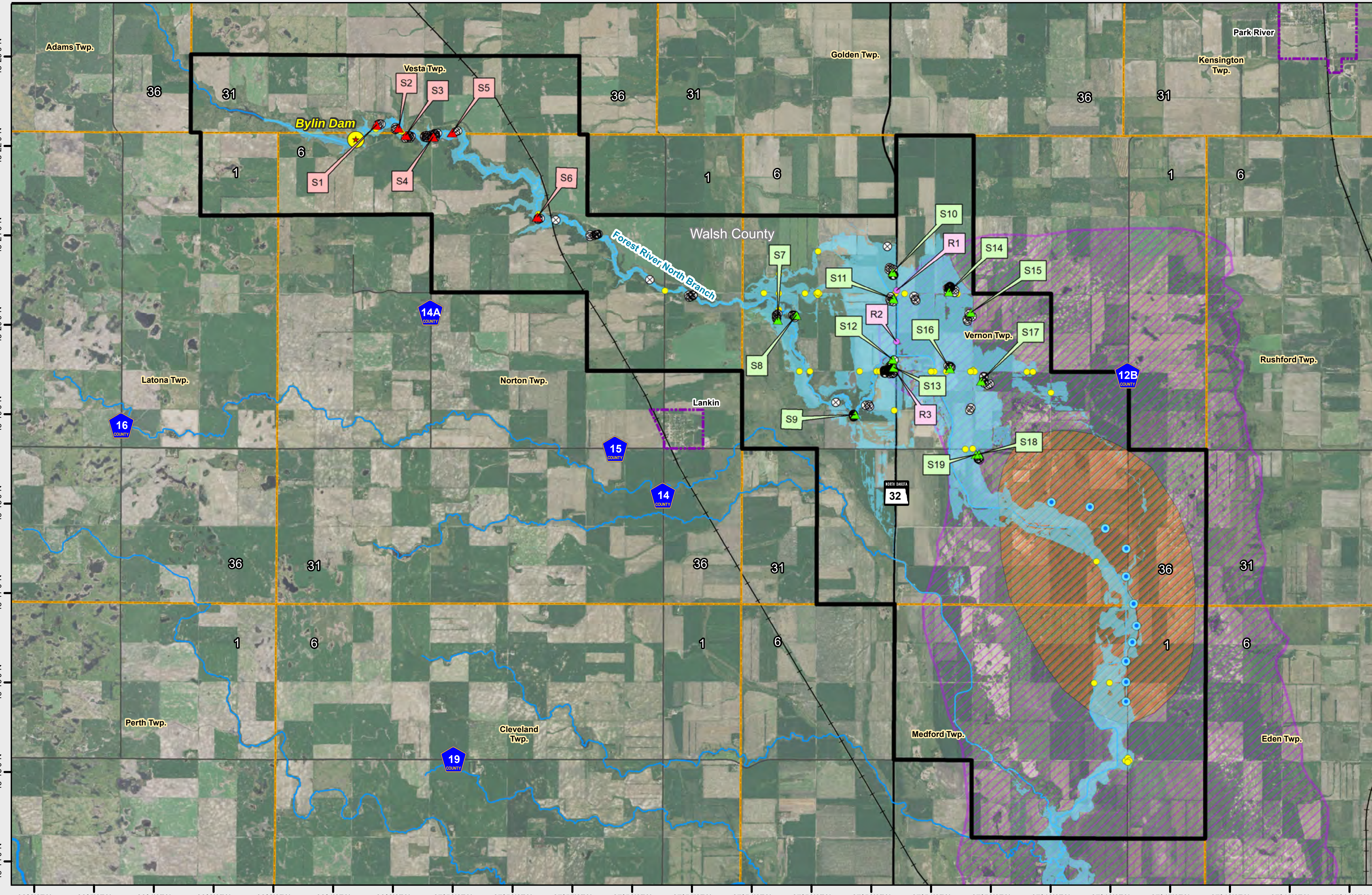
SHEET INDEX





- Bylin Dam
- Road Overtopping Locations Greater than 400 AADT
- Road Overtopping Locations
- Breach Zone
- Impacted Homestead, High Danger Potential
- Impacted Homestead, Low Danger Potential
- Impacted Non-Homestead
- Maximum Dam Breach Inundation
- Municipal Wells
- Wellhead Protection Area
- Fordville Aquifer

N S W E

0 0.75 1.5 3 Miles

Walsh County, North Dakota

Appendix C Support Maps: Figure C-6
Bylin Dam Breach Inundation - Overall

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	6 of 26

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Habitable Structures			
Label	Finished Floor Elevation (ft)	Maximum Depth (ft)	Maximum Velocity (ft/s)
S1	1475.187	8.566	3.236
S2	1456.163	19.412	4.316
S3	1447.876	23.762	5.329
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- denotes WSE did not exceed floor elevation			

MODELING NOTES

The peak breach discharge was computed using USDA-NRCS TR 210-60 breach equations.

The starting water surface elevation used was the proposed top of dam elevation

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HEC-RAS 5.0.7 Unsteady Flow Module was used to route the breach hydrograph downstream.

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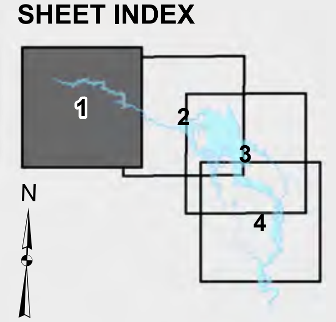
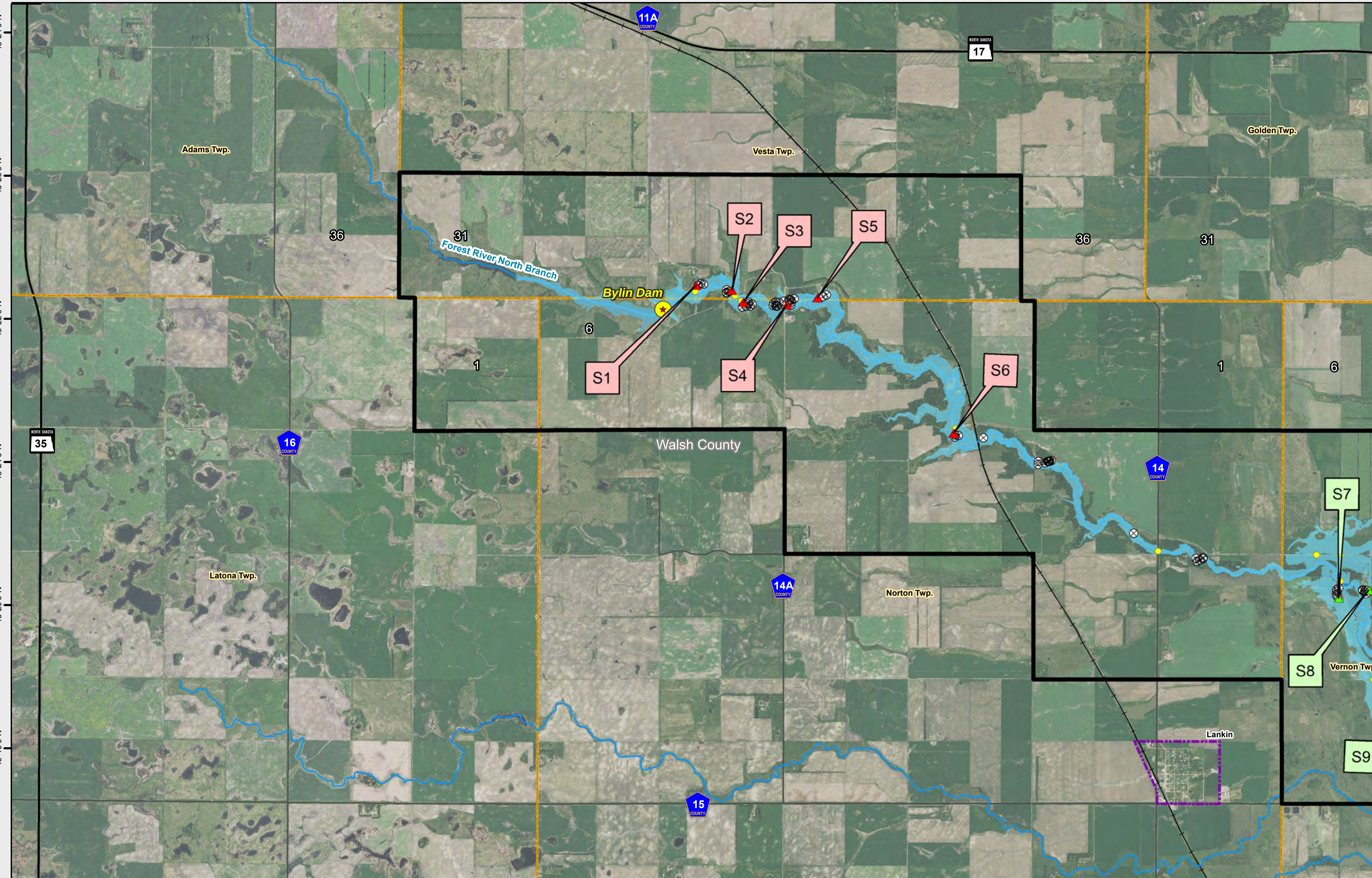




Bylin Dam

Road Overtopping Locations Greater than 400 AADT

Road Overtopping Locations

Breach Zone

Impacted Homestead, High Danger Potential

Impacted Homestead, Low Danger Potential

Impacted Non-Homestead

Maximum Dam Breach Inundation

Municipal Wells

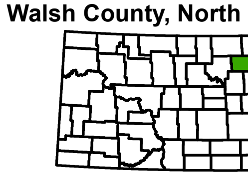
Wellhead Protection Area (WHPA)

Fordville Aquifer Footprint

N W E S

0 0.5 1 2 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-7
Bylin Dam Breach Inundation - 1

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	7 of 26

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MODELING NOTES

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The starting water surface elevation used was the proposed top of dam elevation

The breach hydrograph was computed using breach dimensions identified from the Froehlich Equations (2008). The development time of the breach was varied within the HEC-RAS hydraulic model to attain the peak breach discharge computed based on equations in TR 210-60.

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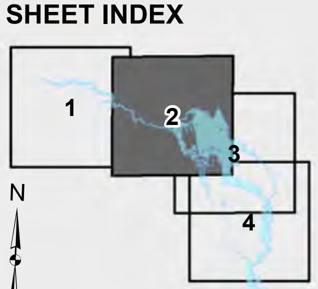
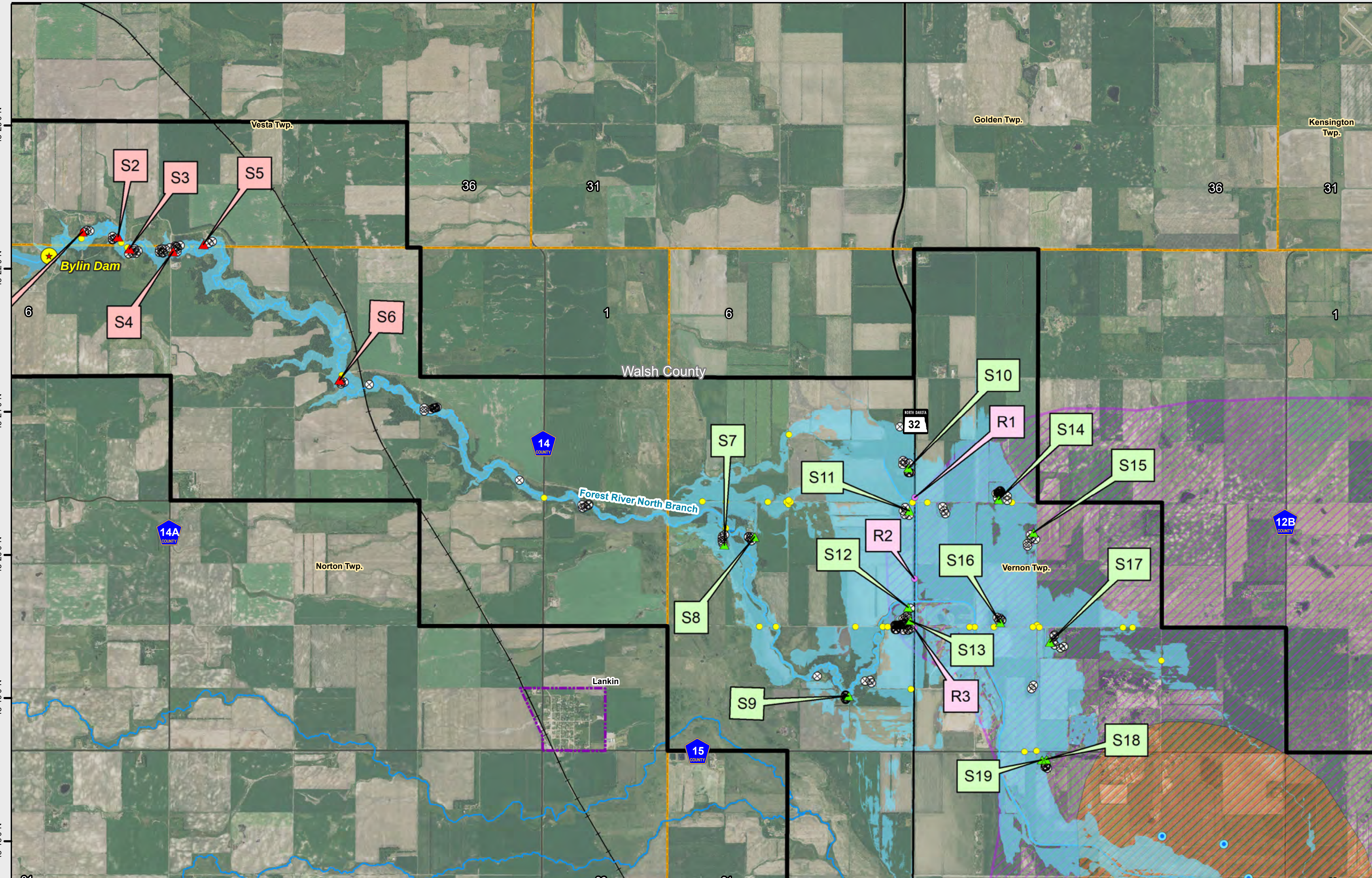
SHEET INDEX





Bylin Dam
Road Overtopping Locations Greater than 400 AADT
Road Overtopping Locations
Breach Zone
Impacted Homestead, High Danger Potential
Impacted Homestead, Low Danger Potential
Impacted Non-Homestead
Maximum Dam Breach Inundation
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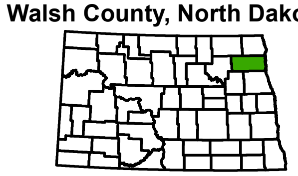
Fordville Aquifer Footprint

N
W E
S

0 0.5 1 2
Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-8
Bylin Dam Breach Inundation - 2

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	8 of 26

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Fargo, ND 58102
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*Survey point inaccesible. Floor elevation estimated from available LiDAR

- denotes WSE did not exceed floor elevation

MODELING NOTES

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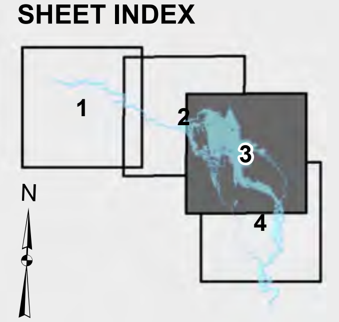
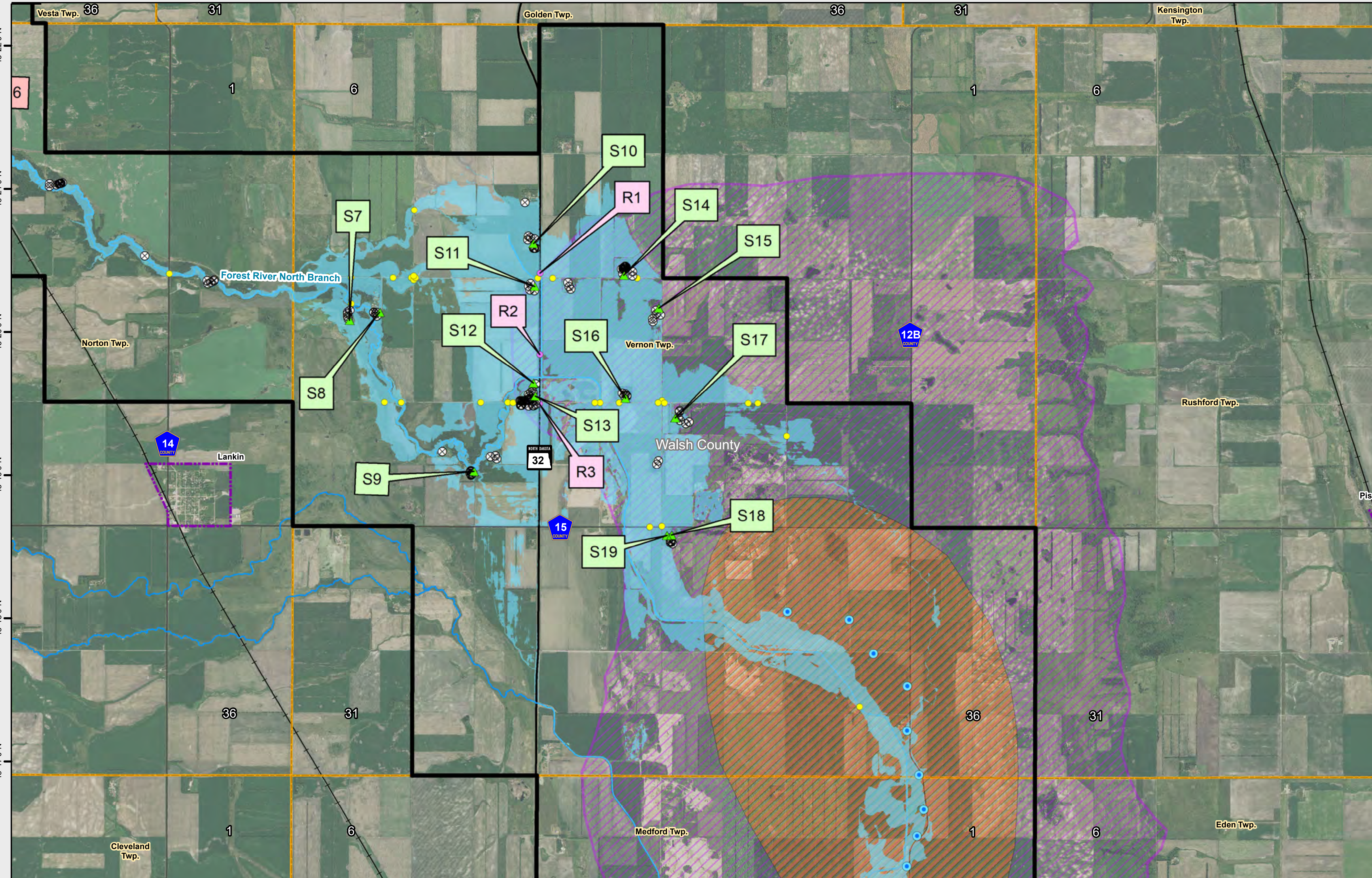
SHEET INDEX





Bylin Dam

Road Overtopping Locations Greater than 400 AADT

Road Overtopping Locations

Breach Zone

Impacted Homestead, High Danger Potential

Impacted Homestead, Low Danger Potential

Impacted Non-Homestead

Maximum Dam Breach Inundation

Municipal Wells

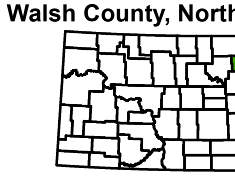
Wellhead Protection Area (WHPA)

Fordville Aquifer Footprint

N
W E
S

0 0.5 1 2 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-9
Bylin Dam Breach Inundation - 3

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	9 of 26

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701.237.5065

Habitable Structures			
Label	Finished Floor Elevation (ft)	Maximum Depth (ft)	Maximum Velocity (ft/s)
S1	1475.187	8.566	3.236
S2	1456.163	19.412	4.316
S3	1447.876	23.762	5.329
S4	1438.282	23.896	8.042
S5	1440.189	14.891	3.387
S6	1383.104*	29.464	0.479
S7	1232.429	-	2.633
S8	1228.687	-	0.007
S9	1193.439	0.054	0.255
S10	1180.41	0.546	0.679
S11	1178.629	1.072	1.826
S12	1179.035*	0.059	0.723
S13	1178.522	0.510	0.450
S14	1175.652	0.343	1.265
S15	1172.958	-	0.335
S16	1167.996	1.181	1.627
S17	1164.042*	0.006	0.155
S18	1163.351*	-	0.457
S19	1161.253*	0.219	0.678
*Survey point inaccesible. Floor elevation estimated from available LiDAR			
- denotes WSE did not exceed floor elevation			

MODELING NOTES

The peak breach discharge was computed using USDA-NRCS TR 210-60 breach equations.

The starting water surface elevation used was the proposed top of dam elevation

The breach hydrograph was computed using breach dimensions identified from the Froehlich Equations (2008). The development time of the breach was varied within the HEC-RAS hydraulic model to attain the peak breach discharge computed based on equations in TR 210-60.

HEC-RAS 5.0.7 Unsteady Flow Module was used to route the breach hydrograph downstream.

The International Water Institute's Multi-jurisdictional Spring 2008 Red River Basin Mapping Initiative LiDAR collection and field survey data were used to create cross section geometry and to plot the inundation areas.

The dam breach inundation area represents a rapidly developing dam failure resulting from piping failure. In the event of an actual dam failure, conditions may vary resulting in variation of the breach inundation area.

MAPPING NOTES

Digital orthophotography shown on this figure is from the North Dakota 2019 30cm (0.98ft) 4-band Image collection. Originally collected in Summer, 2019, through the National Agricultural Imagery Program (NAIP) with higher resolution than NAIP program specifications funded by the North Dakota Dept of Water Resources. Accessed through WMS.

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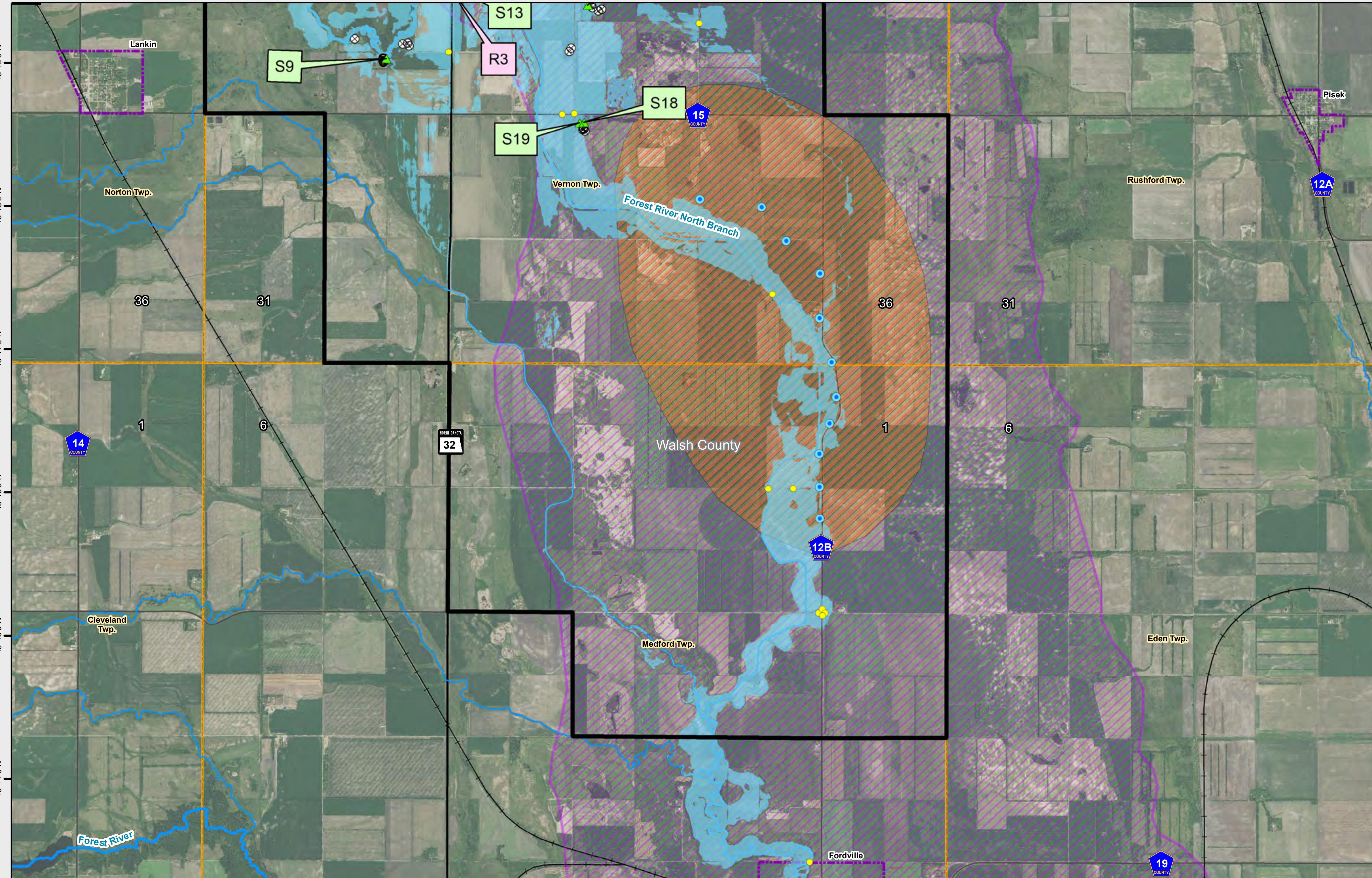
Streets, Townships, Counties, and other locational data are sourced from the North Dakota Information Technology Geographic Information Systems HUB Data portal, or locally surveyed where appropriate.

Map page size is Tabloid (11" x 17"). Accuracy of the map scales for varying paper sizes and is valid only if printed at this page size.

DISCLAIMER

This map has been compiled using the best information available and is believed to be accurate; however, its preparation required many assumptions. Actual conditions during a failure may vary from those assumed, so the accuracy cannot be guaranteed. The limits of flooding shown and the temporal data should only be used as a guideline for emergency planning and response actions. Actual areas inundated will depend on specific flooding and failure conditions and may differ from the areas shown on the maps

SHEET INDEX



Bylin Dam

Road Overtopping Locations Greater than 400 AADT

Road Overtopping Locations

Breach Zone

Impacted Homestead, High Danger Potential

Impacted Homestead, Low Danger Potential

Impacted Non-Homestead

Maximum Dam Breach Inundation

Municipal Wells

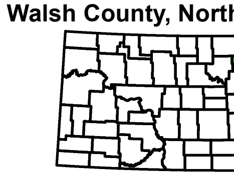
Wellhead Protection Area (WHPA)

Fordville Aquifer Footprint

N
W E
S

0 0.5 1 2 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-10
Bylin Dam Breach Inundation - 4

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	10 of 26

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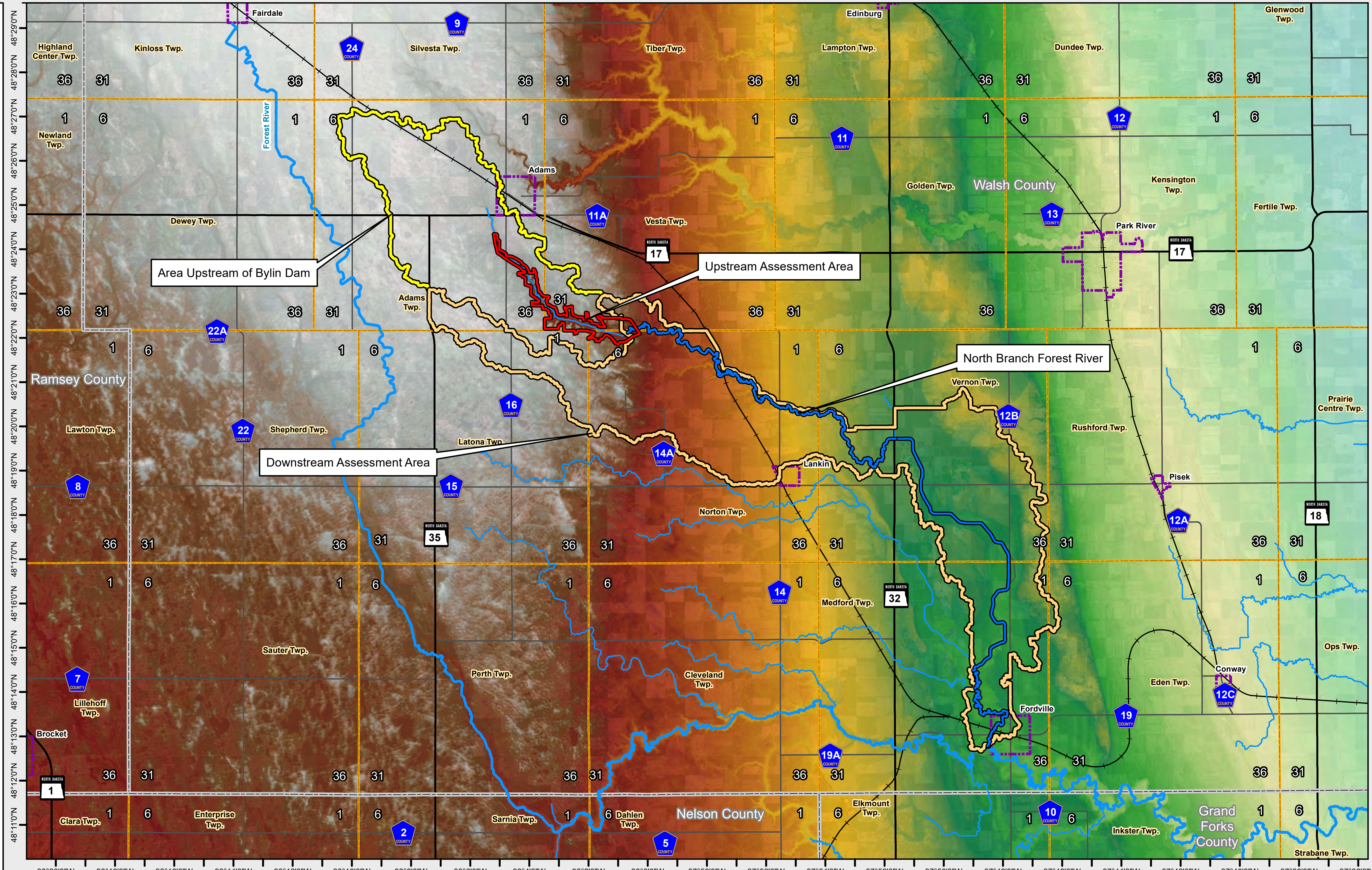

DEFINITIONS

Upstream Assessment Area (U-AA): the zone near the reservoir where there may be a direct impact. The U-AA includes the dam site, the flood pool upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of approximately 950 acres.

Downstream Assessment Area (D-AA): the zone downstream where the environment may be affected if there would be changes in the flow of the North Branch Forest River. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota

Upstream Area: the area that is not expected to be affected by the project but describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

MAPPING NOTES

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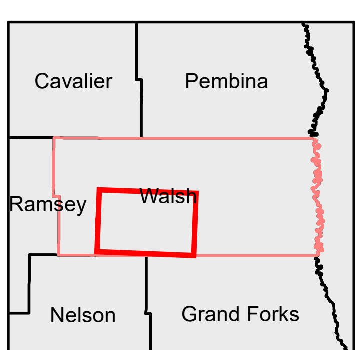


Assessment Areas

- Area Upstream of Bylin Dam (20.5 Sq. Mi.)
- Downstream Assessment Area (41.1 Sq. Mi.)
- Upstream Assessment Area (1.5 Sq. Mi.)

Elevation

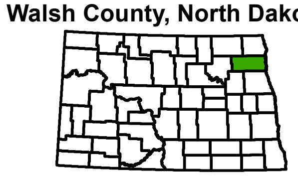
Value

High : 1645.68 Low : 861.592

N W E S

0 1.25 2.5 5 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-11 LiDAR Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/11/2022	11 of 26

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Landcover	Total Area (ac.)[1]	Percentage
Open Water	283	0.7%
Developed, Open Space	1,197	3.0%
Developed, Low Intensity	314	0.8%
Developed, Medium Intensity	75	0.2%
Developed, High Intensity	11	0.0%
Barren Land	158	0.4%
Deciduous Forest	709	1.7%
Evergreen Forest	50	0.1%
Mixed Forest	30	0.1%
Shrub/Scrub	26	0.1%
Herbaceous	1,252	3.1%
Hay/Pasture	5,516	13.6%
Cultivated Crops	29,120	71.8%
Woody Wetlands	29	0.1%
Emergent Herbaceous Wetlands	1,768	4.4%

[1]Total Area is the I-APE and Area upstream of Bylin Dam combined

DEFINITIONS

Upstream Assessment Area (U-AA): the zone near the reservoir where there may be a direct impact. The U-AA includes the dam site, the flood pool upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of approximately 950 acres.

Downstream Assessment Area (D-AA): the zone downstream where the environment may be affected if there would be changes in the flow of the North Branch Forest River. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota

Upstream Area: the area that is not expected to be affected by the project but describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

MAPPING NOTES

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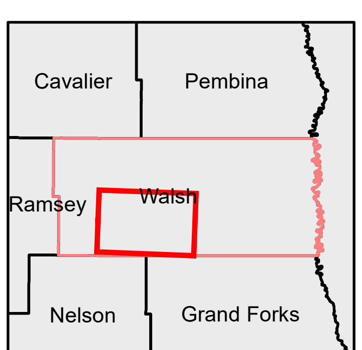
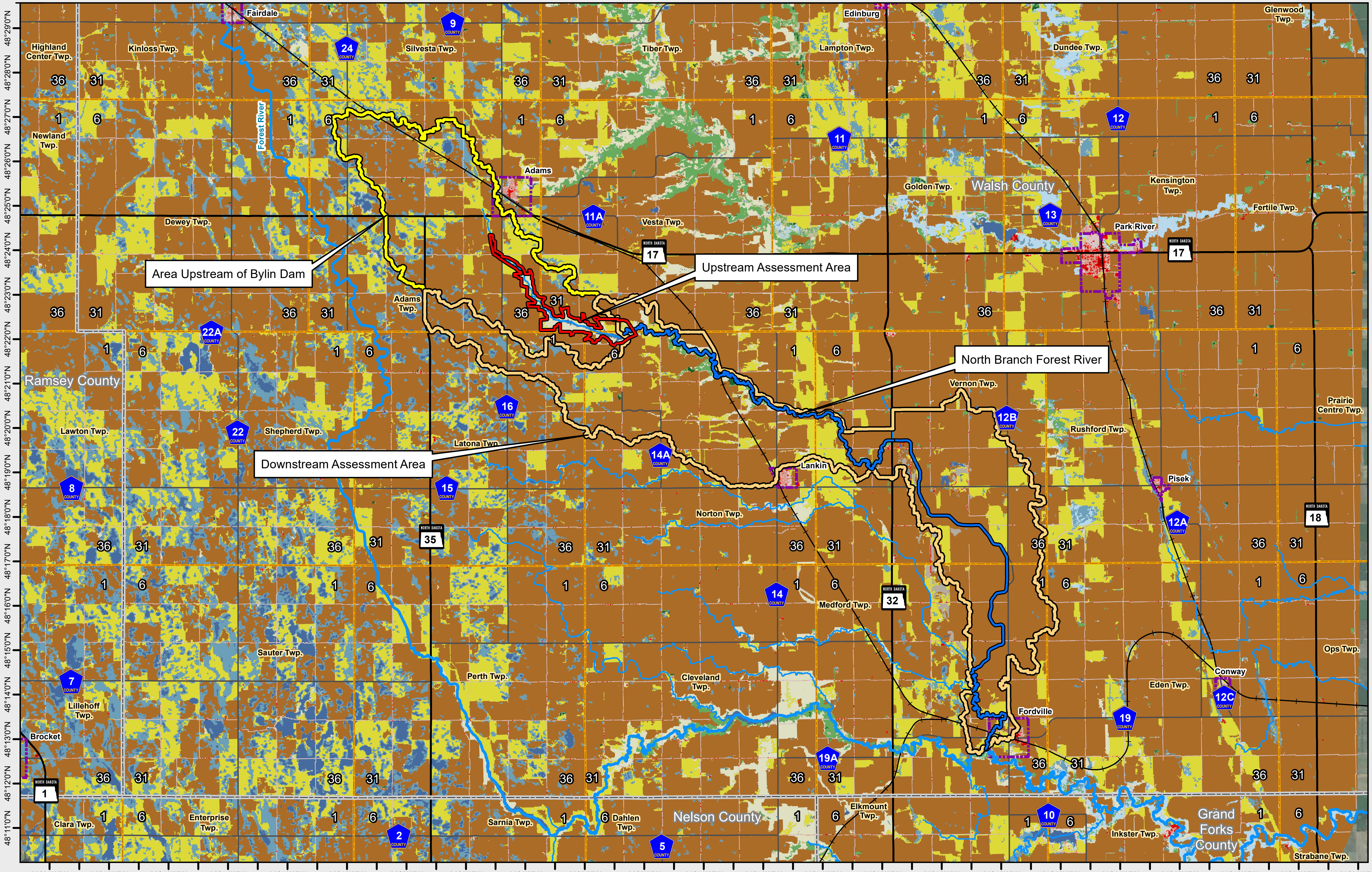




Assessment Areas

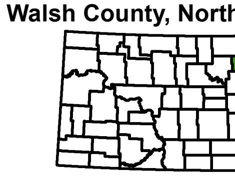
- Area Upstream of Bylin Dam (20.5 Sq. Mi.)
- Downstream Assessment Area (41.1 Sq. Mi.)
- Upstream Assessment Area (1.5 Sq. Mi.)

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Herbaceous
- Hay/Pasture
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

N W E S

0 1.25 2.5 5 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-12
Land Use Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/11/2022	12 of 26

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Farmland Class	Total Area (ac.)[1]	Percentage
All Areas are Prime Farmland	25,720	63.5%
Farmland of Statewide Importance	3,158	7.8%
Not Prime Farmland	11,190	27.6%
Prime Farmland if Drained	446	1.1%

[1]Total Area is the I-APE and Area upstream of Bylin Dam combined

DEFINITIONS

Upstream Assessment Area (U-AA): the zone near the reservoir where there may be a direct impact. The U-AA includes the dam site, the flood pool upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of approximately 950 acres.

Downstream Assessment Area (D-AA): the zone downstream where the environment may be affected if there would be changes in the flow of the North Branch Forest River. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota

Upstream Area: the area that is not expected to be affected by the project but describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

MAPPING NOTES

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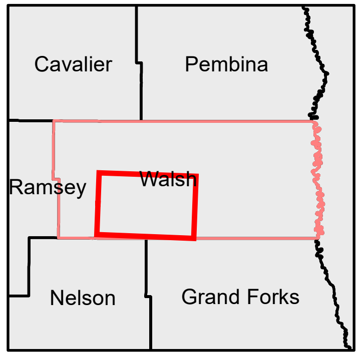
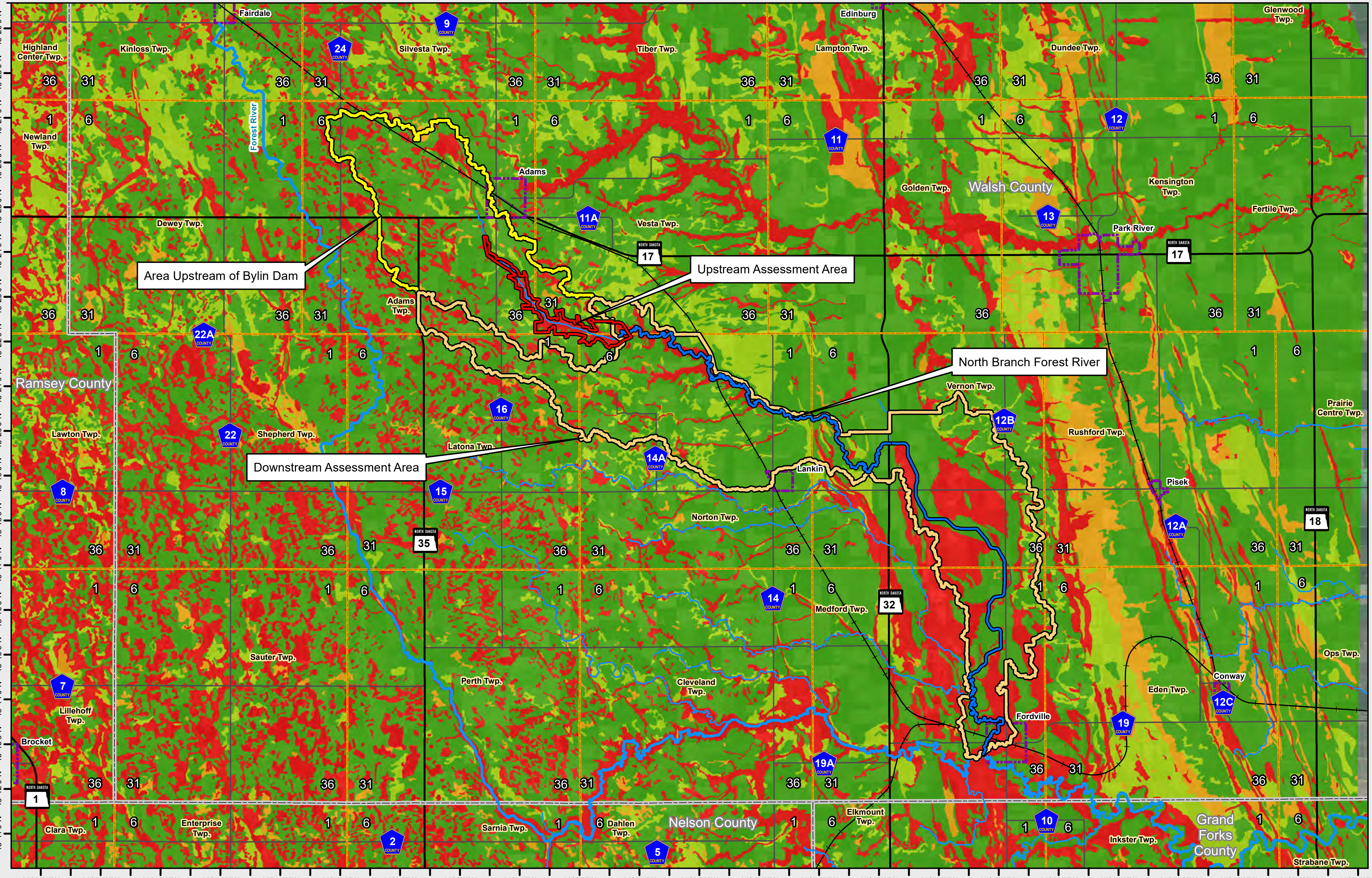




Assessment Areas

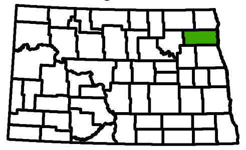
- Area Upstream of Bylin Dam (20.5 Sq. Mi.)
- Downstream Assessment Area (41.1 Sq. Mi.)
- Upstream Assessment Area (1.5 Sq. Mi.)

- Not prime farmland
- Prime farmland if drained
- Farmland of statewide importance
- All areas are prime farmland

N W E S

0 1.25 2.5 5 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-13
Farmland Classification Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/11/2022	13 of 26

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DEFINITIONS

Upstream Assessment Area (U-AA): the zone near the reservoir where there may be a direct impact. The U-AA includes the dam site, the flood pool upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of approximately 950 acres.

Downstream Assessment Area (D-AA): the zone downstream where the environment may be affected if there would be changes in the flow of the North Branch Forest River. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota

Upstream Area: the area that is not expected to be affected by the project but describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

MAPPING NOTES

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FEMA Flood Hazard Information sourced from FEMA Map Service Center (MSC). Panels within study area include: 38035C0050E (Eff. 12/17/2010); 38099C0908D, 38099C0650D, 38099C0910D, 38099C0625D, 38099C0925D, 38099C0315D, 38099C0300D, 38099C0620D, 38099C0350D, 38099C0610D, 38099C0906D, 38099C0325D, and 38099C0600D (Eff. 11/2/2012)

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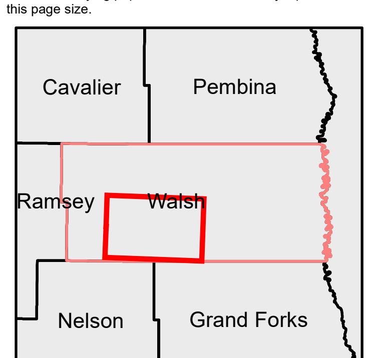
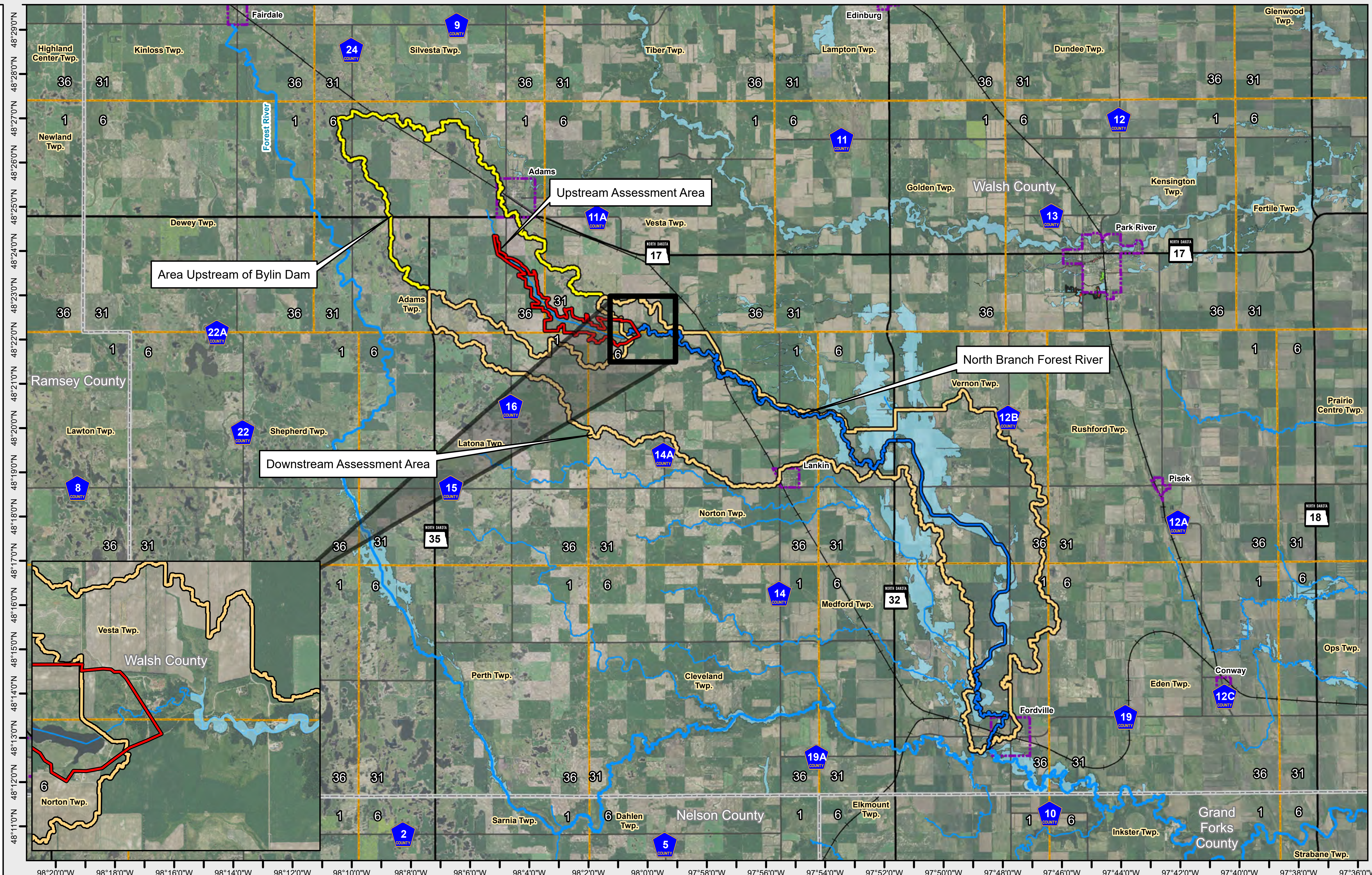




Assessment Areas

- Area Upstream of Bylin Dam (20.5 Sq. Mi.)
- Downstream Assessment Area (41.1 Sq. Mi.)
- Upstream Assessment Area (1.5 Sq. Mi.)

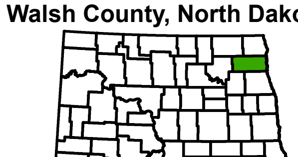
Effective Flood Zone

- A
- AE
- Floodway
- 0.2 Pct Chance Annual Flood Hazard
- Zone X

N W E S

0 1.25 2.5 5 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-14
Upstream Assessment Areas Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/12/2022	14 of 26

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Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

Synthetic rainfall events were developed based on rainfall depths obtained from NOAA Atlas 14.

Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

Hydrologic parameters such as time of concentration and Clark's storage coefficient were develeoped from calibration of the hydraulic model based on historic rainfall events.

Other information on the development of the hydraulic model is available in Appendix D-1.

IWI Spring 2008 LiDAR collect in conjuction with field survey data was used to create cross section geometry and to plot the inundation areas.

MAPPING NOTES

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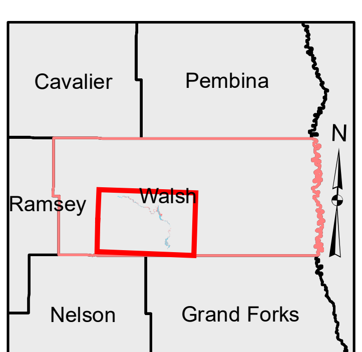
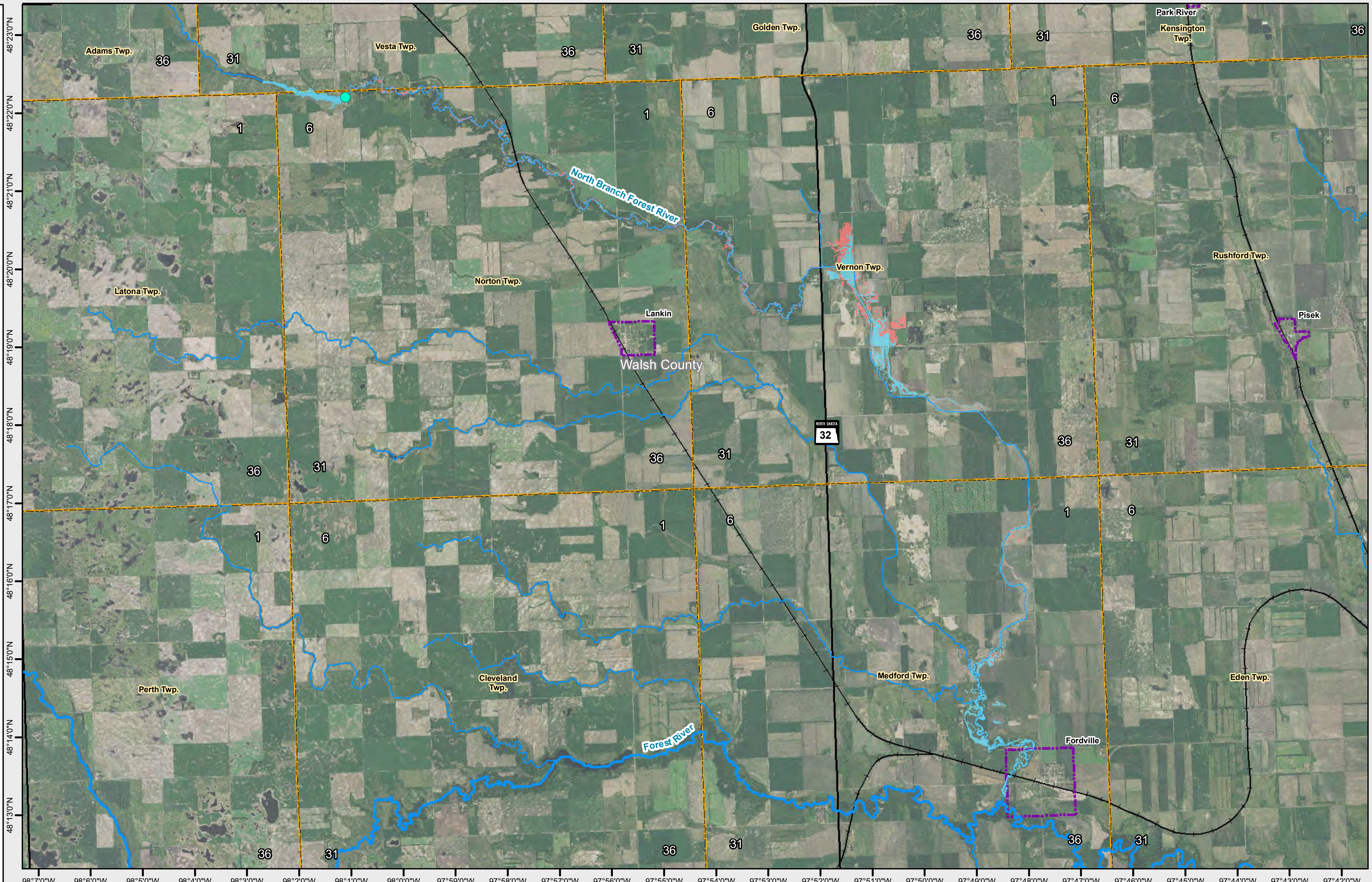


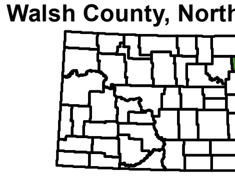


- Removed From Inundation With Project (0)
- Structure Inundated With Project (0)
- Bylin Dam
- Inundation Boundary (Without Dam)
- Inundation Boundary (With Project)

N W E S

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-15
2-Year Unundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	15 of 26

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Fargo, ND 58102
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Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

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Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

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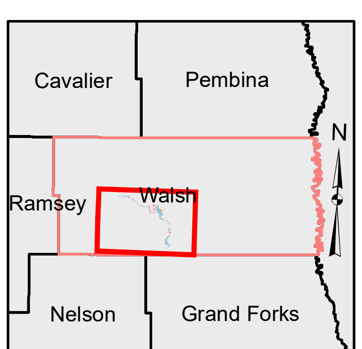

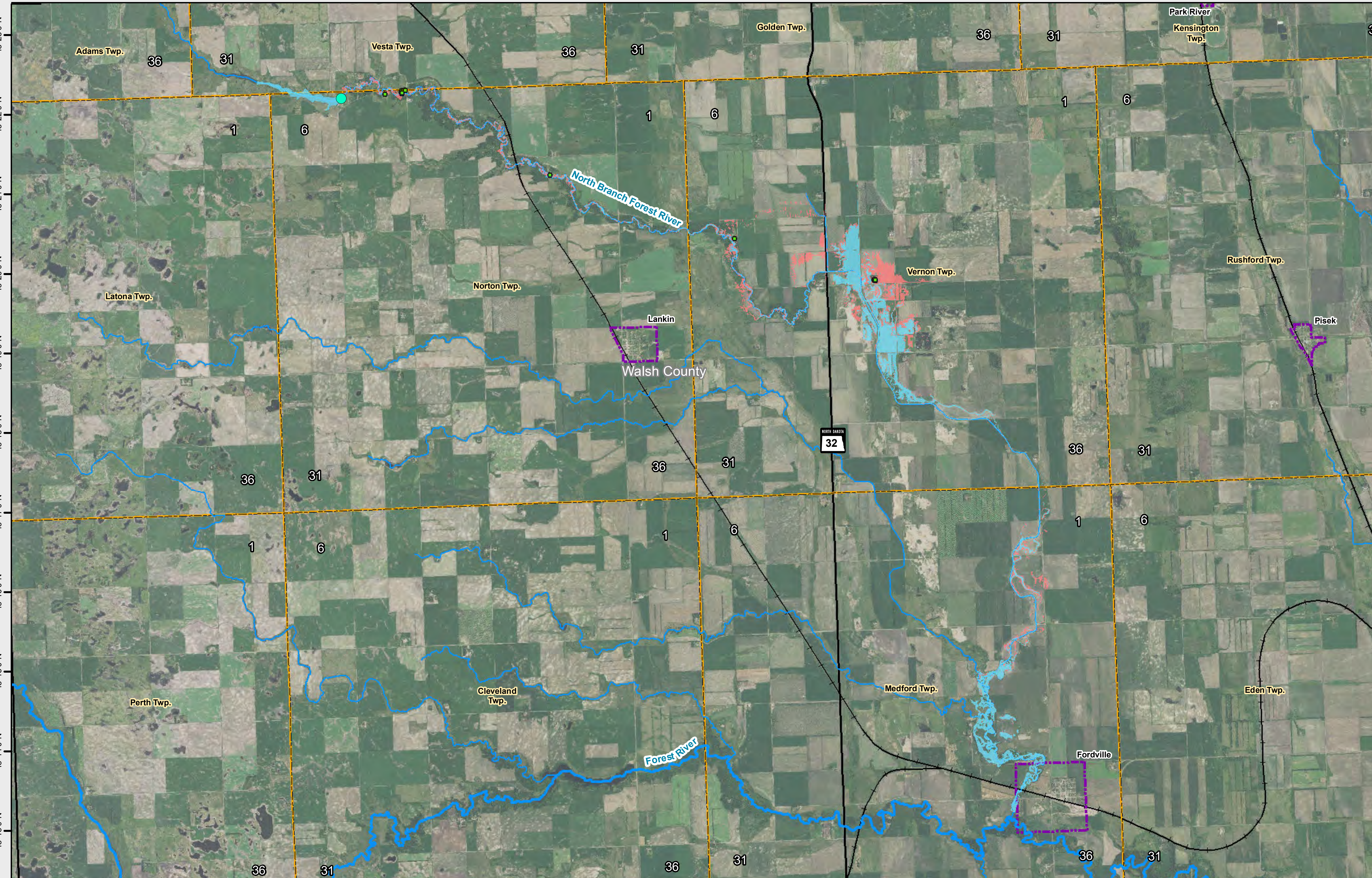

Removed From Inundation With Project (12)

Structure Inundated With Project (0)

Bylin Dam

Inundation Boundary (Without Dam)

Inundation Boundary (With Project)

N W E S

0 0.75 1.5 3 Miles

Walsh County, North Dakota

Appendix C Support Maps: Figure C-16
5-Year Inundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	16 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

Synthetic rainfall events were developed based on rainfall depths obtained from NOAA Atlas 14.

Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

Hydrologic parameters such as time of concentration and Clark's storage coefficient were develeoped from calibration of the hydraulic model based on historic rainfall events.

Other information on the development of the hydraulic model is available in Appendix D-1.

IWI Spring 2008 LiDAR collect in conjuction with field survey data was used to create cross section geometry and to plot the inundation areas.

MAPPING NOTES

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Streets, Townships, Counties, and other locational data are sourced from the North Dakota Information Technology Geographic Information Systems HUB Data portal, or locally surveyed where appropriate.

Map page size is Tabloid (11" x 17"). Accuracy of the map scales for varying paper sizes and is valid only if printed at this page size.

DISCLAIMER

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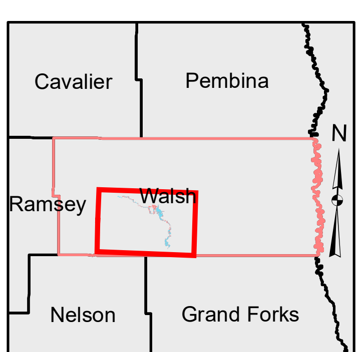
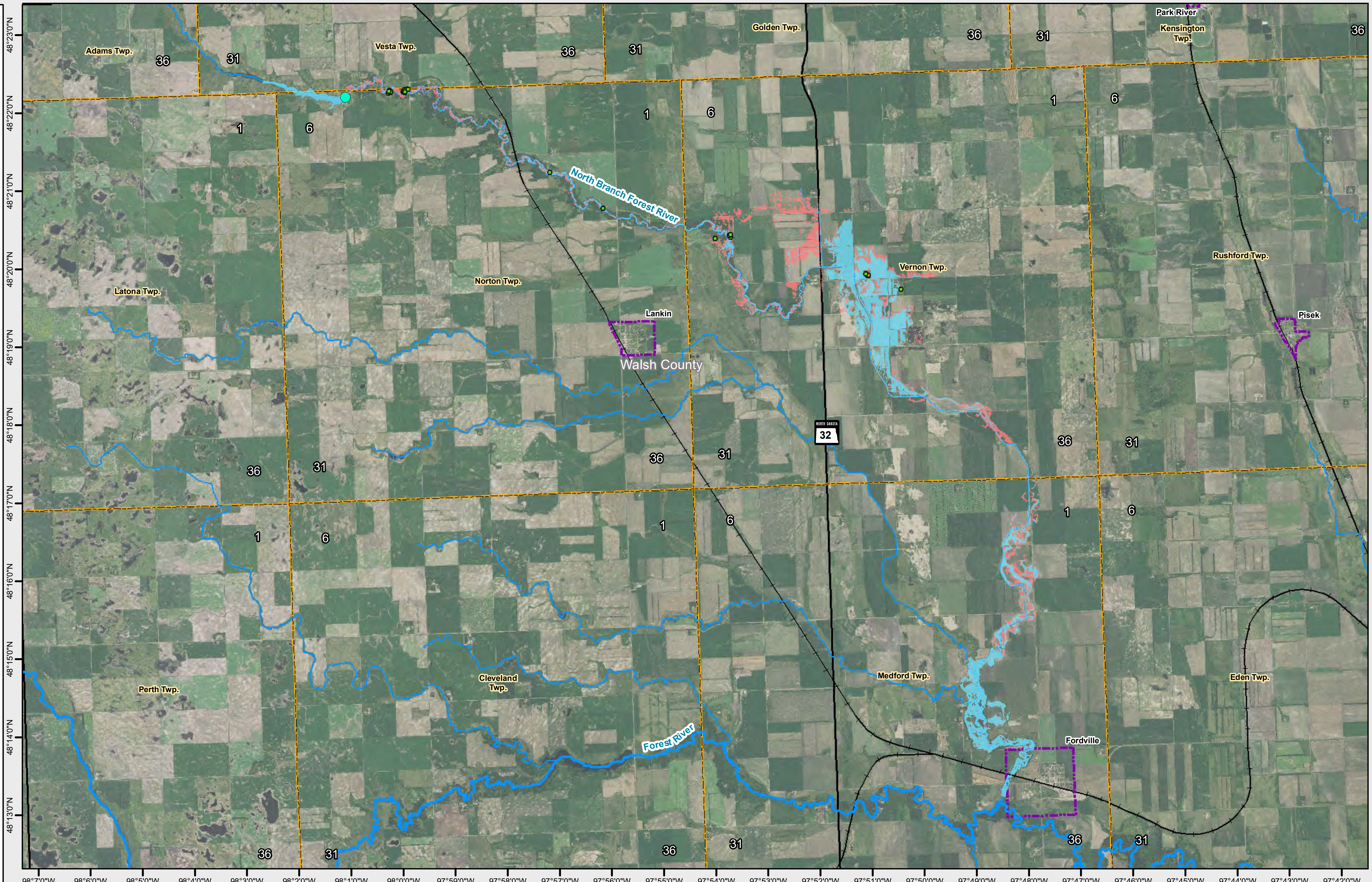




Removed From Inundation With Project (21)

Structure Inundated With Project (3)

Bylin Dam

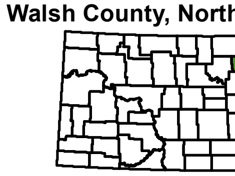
Inundation Boundary (Without Dam)

Inundation Boundary (With Project)

N
W E
S

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-17
Upstream Assessment Area Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	17 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

Synthetic rainfall events were developed based on rainfall depths obtained from NOAA Atlas 14.

Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

Hydrologic parameters such as time of concentration and Clark's storage coefficient were develeoped from calibration of the hydraulic model based on historic rainfall events.

Other information on the development of the hydraulic model is available in Appendix D-1.

IWI Spring 2008 LiDAR collect in conjuction with field survey data was used to create cross section geometry and to plot the inundation areas.

MAPPING NOTES

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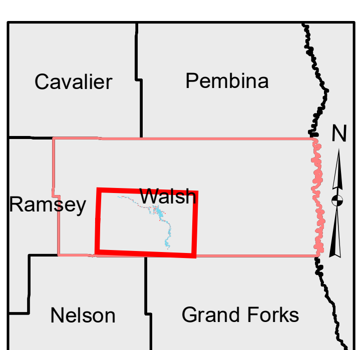
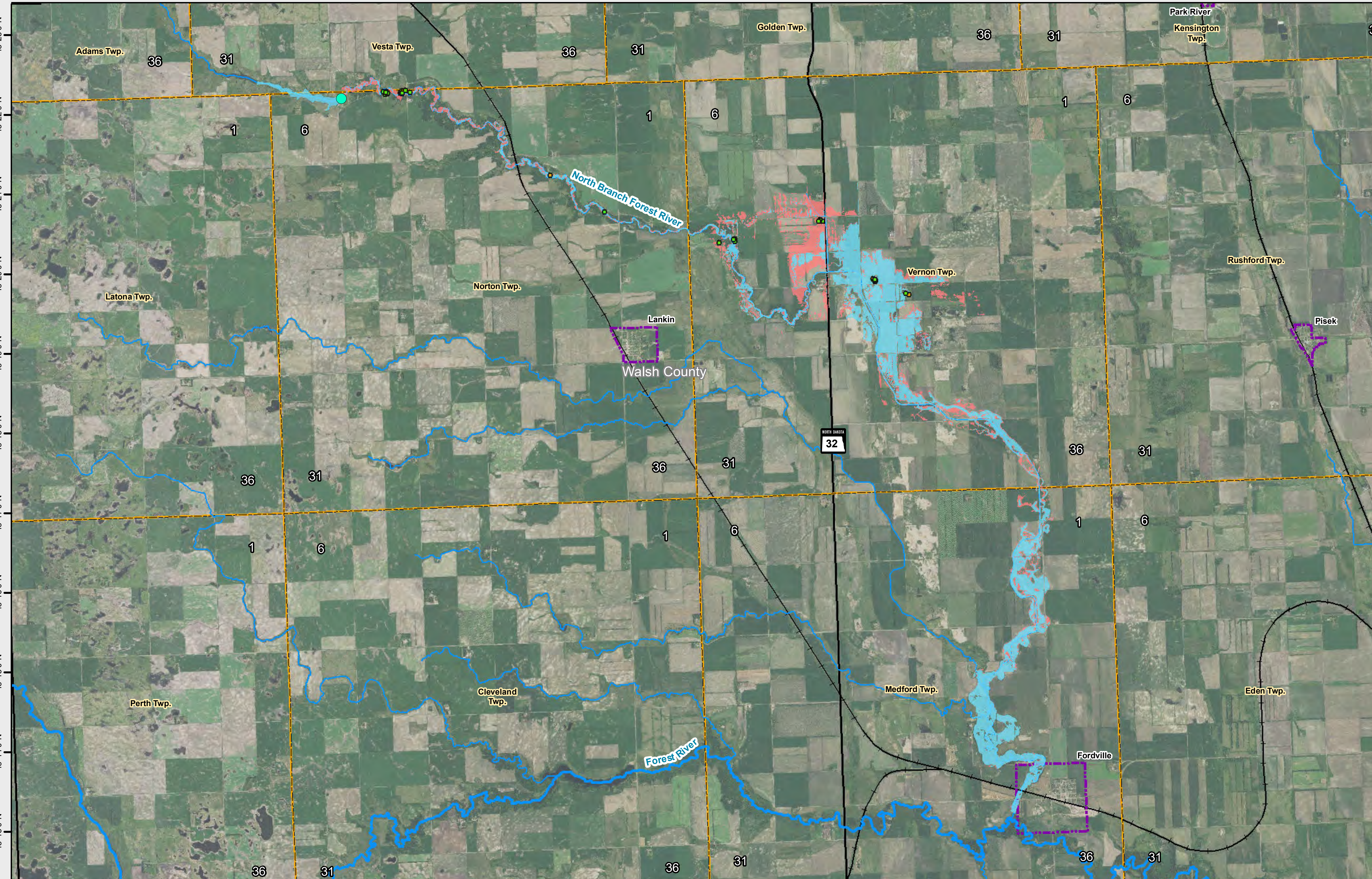


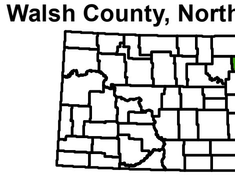


Removed From Inundation With Project (24)
Structure Inundated With Project (8)
Bylin Dam
Inundation Boundary (Without Dam)
Inundation Boundary (With Project)

N
W E
S

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-18
25-Year Inundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	18 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

H:\BN\7100\7135\7135_0037\GIS\Bylin NRCS2_figures_11_3.mxd

Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

Synthetic rainfall events were developed based on rainfall depths obtained from NOAA Atlas 14.

Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

Hydrologic parameters such as time of concentration and Clark's storage coefficient were develeoped from calibration of the hydraulic model based on historic rainfall events.

Other information on the development of the hydraulic model is available in Appendix D-1.

IWI Spring 2008 LiDAR collect in conjuction with field survey data was used to create cross section geometry and to plot the inundation areas.

MAPPING NOTES

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Streets, Townships, Counties, and other locational data are sourced from the North Dakota Information Technology Geographic Information Systems HUB Data portal, or locally surveyed where appropriate.

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DISCLAIMER

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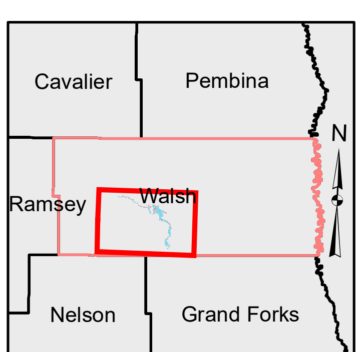

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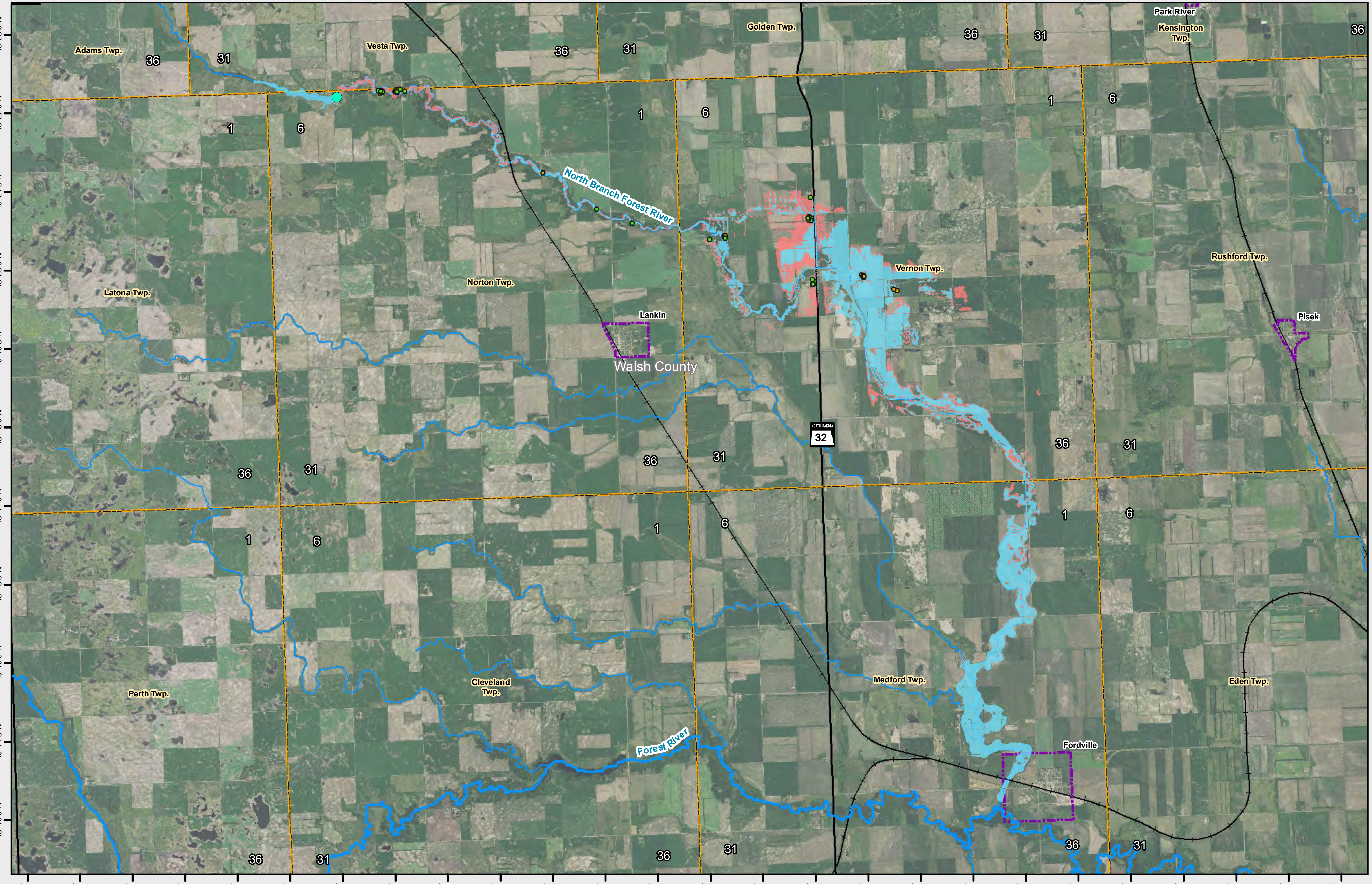


Removed From Inundation With Project (30)

Structure Inundated With Project (12)

Bylin Dam

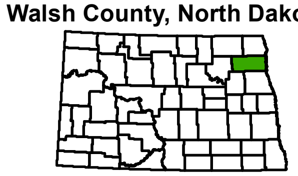
Inundation Boundary (Without Dam)

Inundation Boundary (With Project)

N W E S

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-19
50-Year Inundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	19 of 26

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1401 21st Avenue North
Fargo, ND 58102
701.237.5065

Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

Synthetic rainfall events were developed based on rainfall depths obtained from NOAA Atlas 14.

Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

Hydrologic parameters such as time of concentration and Clark's storage coefficient were develeoped from calibration of the hydraulic model based on historic rainfall events.

Other information on the development of the hydraulic model is available in Appendix D-1.

IWI Spring 2008 LiDAR collect in conjuction with field survey data was used to create cross section geometry and to plot the inundation areas.

MAPPING NOTES

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DISCLAIMER

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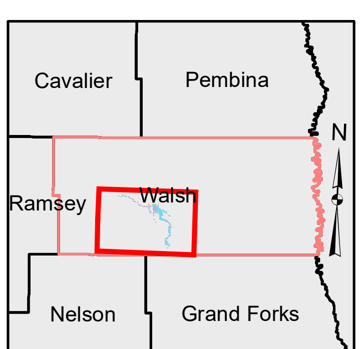
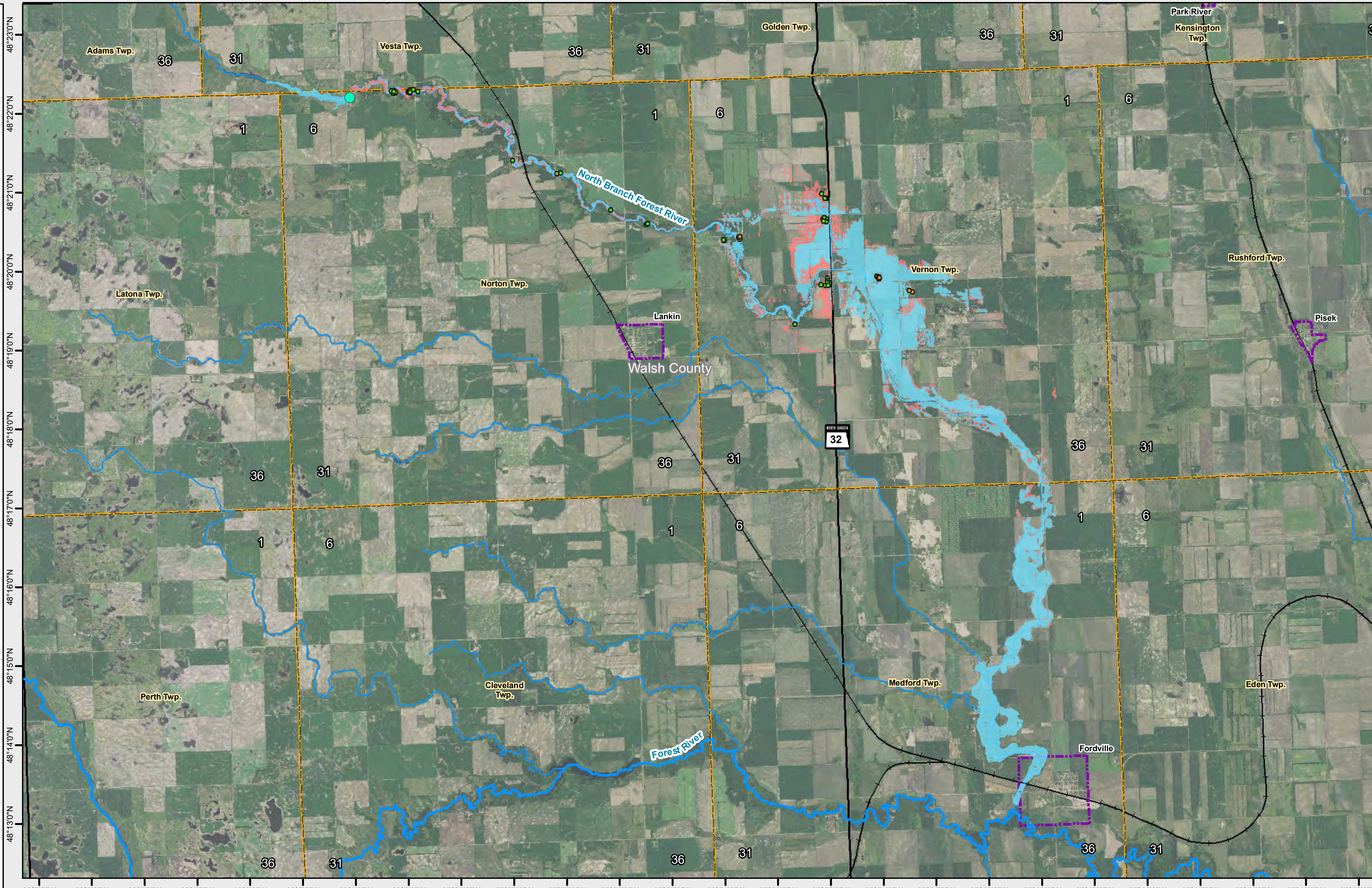


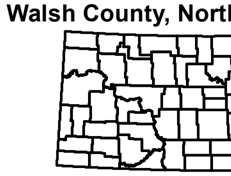


- Removed From Inundation With Project (39)
- Structure Inundated With Project (15)
- Bylin Dam
- Inundation Boundary (Without Dam)
- Inundation Boundary (With Project)

N W E S

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-20
100-Year Inundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	11/9/2021	20 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

Recurrence Interval	Total Inundation without Dam (Acres)	Total Inundation with Proposed Alternative (Acres)	Percent Reduction
2-Year	734.74	531.15	27.71%
5-Year	1377.32	943.54	31.49%
10-Year	2058.64	1390.76	32.44%
25-Year	2855.52	2026.58	29.03%
50-Year	3331.74	2506.87	24.76%
100-Year	3728.68	2970.53	20.33%
500-Year	4746.95	3785.92	20.25%

MODELING NOTES

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Hydraulic routing of the simulated synthetic rainfall events was completed using a HEC-RAS version 5.0.7 hydraulic model.

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MAPPING NOTES

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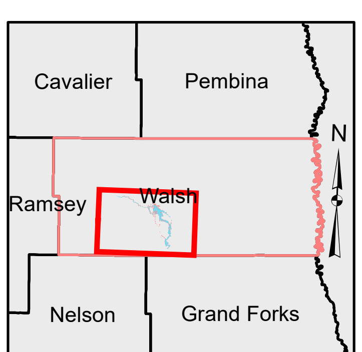
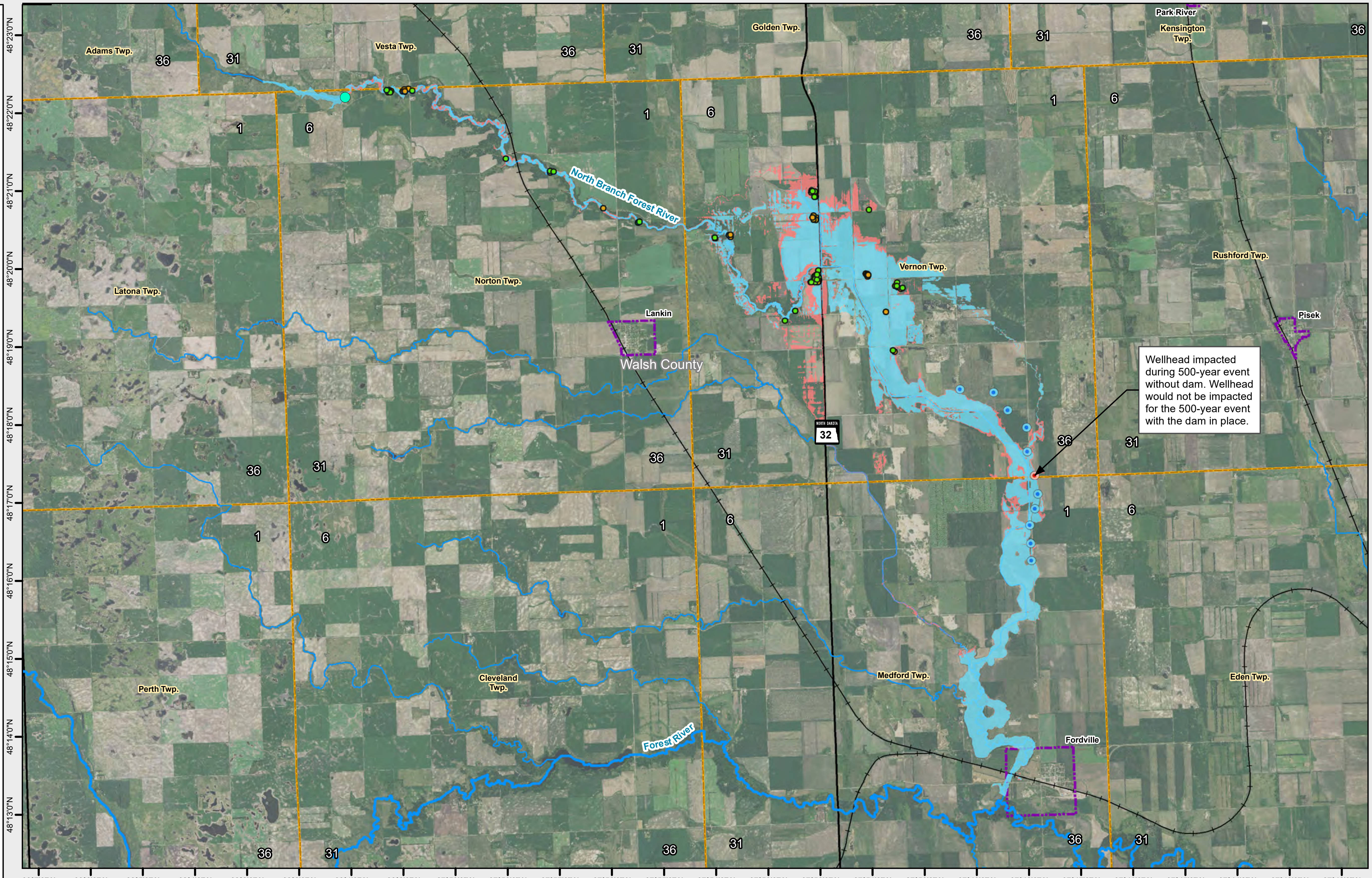


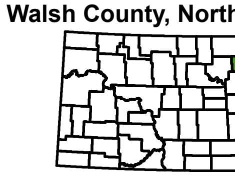


Removed From Inundation With Project (42)
Structure Inundated With Project (41)
Bylin Dam
Inundation Boundary (Without Dam)
Inundation Boundary (With Project)
Municipal Wells (Not Impacted)

N S W E

0 0.75 1.5 3 Miles

Walsh County, North Dakota



Appendix C Support Maps: Figure C-21
500-Year Inundation

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	4/5/2022	21 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

N

100 0 100 200

Scale Feet

LEGEND

DELINEATED WETLANDS

ACB

12" DUAL WALL HDPE

NOTES:
1. 2020 NAIP AERIAL IMAGERY
2. ALL ELEVATIONS REFERENCE NAVD 1988 VERTICAL DATUM
3. TOPOGRAPHIC SURVEY DATA COLLECTED IN JULY 2020
4. ARTICULATED CONCRETE BLOCK (ACB) DESIGN BASED ON REQUIREMENTS IN CHAPTER 54, PART 628, NATIONAL ENGINEERING HANDBOOK

No.	Revision	Date	By

APPENDIX C-22

PREFERRED ALTERNATIVE OVERALL SITE PLAN

HOUSTON engineering, inc.

Drawn By: RCG, ZCF

Checked By: PDL

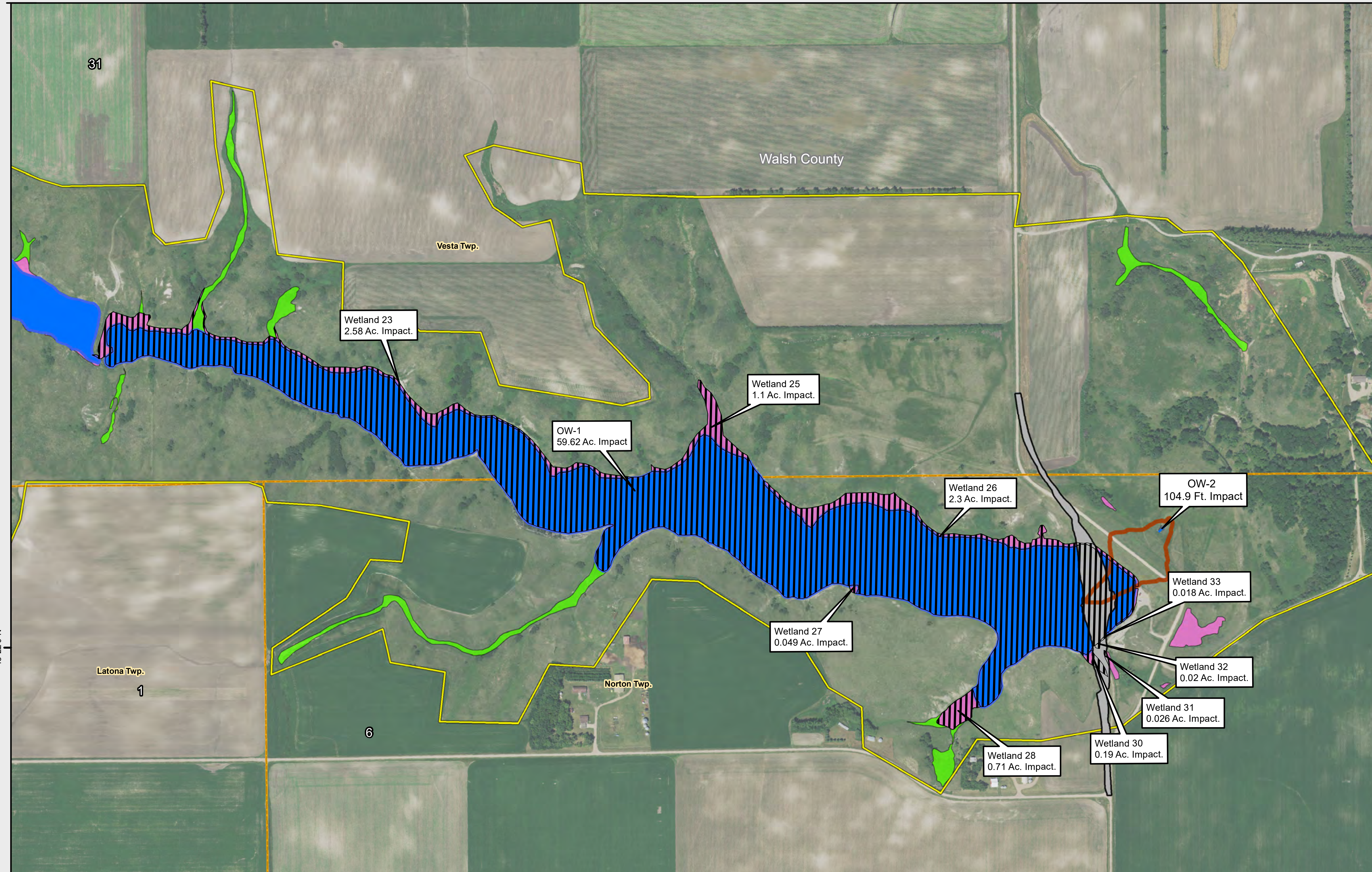
Date: 12-30-21

Scale: As Shown

Project No.: 7135-0037

SHEET C-22

\\houston\hei\BM\7100\7135\7135_0037\CAD\Plan\Bylin Dam Topo_Proposed_Working.dwg-SITE PLAN (2)-11/13/2023 1:21 PM-(zfursa)



MAPPING NOTES

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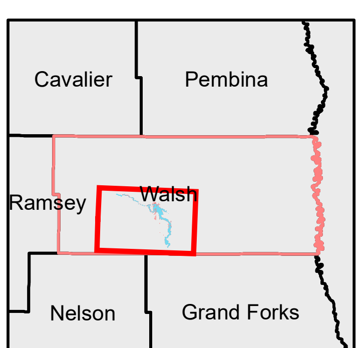


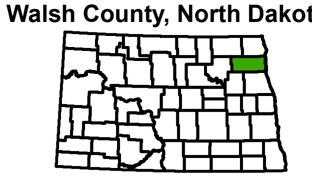
Legend

- Survey Area
- Natural Wetland
- Artificial Wetland
- Other Waters/Reservoir
- Other Waters/Flow
- Permanent Impacts from Drawdown
- Proposed Embankment Cut
- Proposed Road Extents

N
W E
S

0 300 600 1,200 Feet

Walsh County, North Dakota



C-23 Alternative 1 - FWOFI - Aquatic Resource Impacts Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	JHL	DJ	7135-0037	5/9/2022	23 of 26

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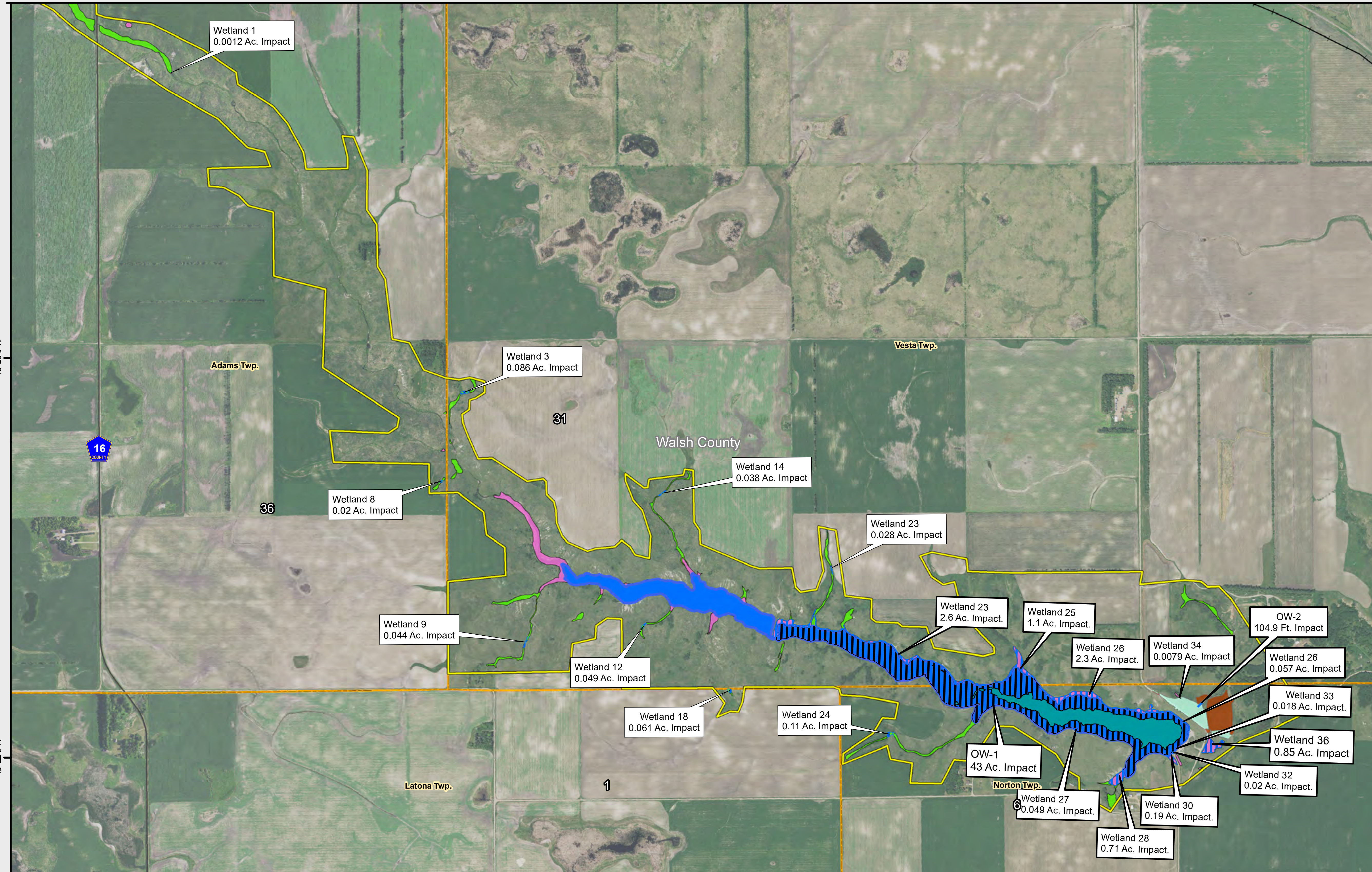
1401 21st Avenue North
Fargo, ND 58102
701.237.5065



MAPPING NOTES

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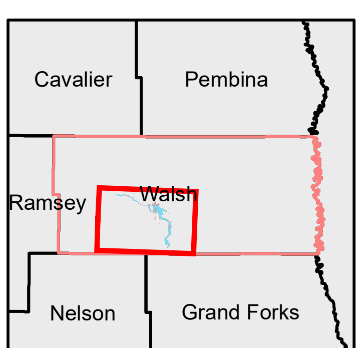


\\houston\hei\JBN\7100\7135\7135 0037\GIS\Appendix C Impacts.mxd

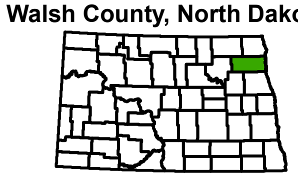
Legend

- Survey Area
- Natural Wetland
- Artificial Wetland
- Other Waters/Reservoir
- Other Waters/Flow
- Drawdown Extent
- Temporary Impacts
- Permanent Impacts
- Excavation
  - Cut
  - Fill

N
W E
S

0 750 1,500 3,000 Feet

Walsh County, North Dakota



C-24 Alternative 2 - Structural Alternative - Aquatic Resource Impacts Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	JHL	DJ	7135-0037	5/9/2022	24 of 26

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1401 21st Avenue North
Fargo, ND 58102
701.237.5065

MAPPING NOTES

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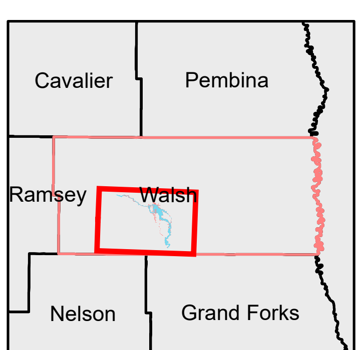
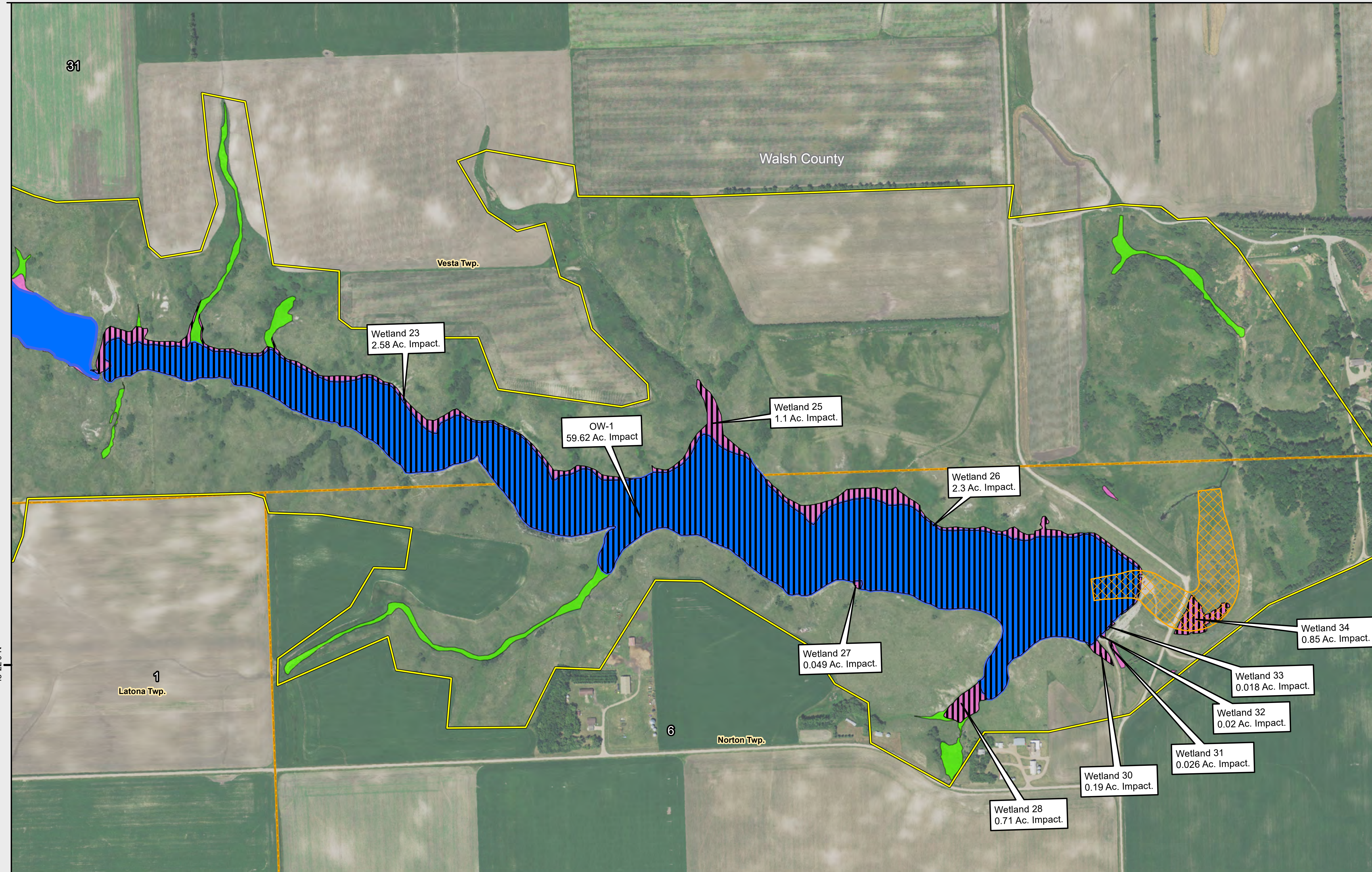
Map page size is Tabloid (11" x 17"). Accuracy of the map scales for varying paper sizes and is valid only if printed at this page size.





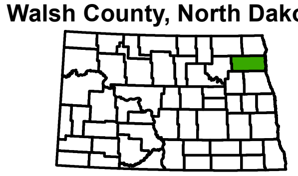
Legend

- Survey Area
- Natural Wetland
- Artificial Wetland
- Other Waters/Reservoir
- Other Waters/Flow
- Permanent Impacts from Drawdown
- Breach Footprint

N
W E
S

0 300 600 1,200 Feet

Walsh County, North Dakota



C-25 Alternative 3 - No Action - Breach Scenario

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	TSW	DJ	7135-0037	11/6/2023	25 of 26

HOUSTON engineering, inc.
1401 21st Avenue North
Fargo, ND 58102
701.237.5065

Parcel ID	Owner	Inundated Acres	
		Existing	Proposed
27000006694000	Jeff Flaten Life Est.	22.1	24.8
27000006693000	Walsh County Water Res. Dist.	44.2	46.5
27000006695000	Jeff Flaten Life Est.	21.8	24.9
27000006696000	John R Karas Life Est.	4.8	7.8
27000006691000	John R Karas Life Est.	5.0	8.0
27000006692000	Kevin J & Kent E Drevecky	3.6	6.3
27000006701000	Walsh County Water Res. Dist.	54.6	60.8
27000006699000	Garrett Skorheim	0.6	1.4
27000006700000	Keith J Bylin	2.8	4.1
26000006360020	Don A Bylin	0.6	1.1
26000006356030	Earl D Samuelson Etal	0.0	<0.1
26000006362000	Keith J Bylin	22.7	26.2
31000007443000	Joann Bylin	0.6	1.8
31000007444000	Tara Shirek	0.1	3.3
31000007445000	Charlotte Johnson Family	0.0	<0.1
31000007446000	Skorheim Land LLLP	12.8	18.9
26000006360000	Lowell D Bylin	0.7	1.7
26000006357000	Walsh County Water Res. Dist.	9.5	11.3
26000006361000	Walsh County Water Res. Dist.	60.1	62.5
26000006360010	Don A Bylin	1.1	1.9
31000007493000	Jeff Flaten Life Est.	17.7	22.2
30000007139000	Justin W Sobak	0.0	0.1
		285.4	335.5

MAPPING NOTES

Digital orthophotography shown on this figure is from the North Dakota 2019 30cm (0.98ft) 4-band Image collection Originally collected in Summer, 2019, through the National Agricultural Imagery Program (NAIP) with higher resolution than NAIP program specifications funded by the North Dakota Dept of Water Resources. Accessed through WMS.

The coordinate system used in the preparation of this map is North Dakota Walsh County State Plane 1983 Ground Coordinates, Lambert Conformal Conic Projection. Horizontal Datum is NAD 83, GRS80 Spheroid. Elevations on this map are referenced to the North American Vertical Datum of 1988.

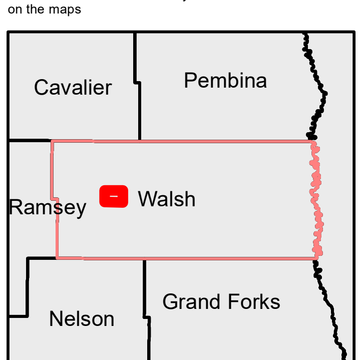
Walsh County Parcel Data obtained from Walsh County GIS, January 2022. Parcel data accessible at "https://wc-hs.maps.arcgis.com/apps/webappviewer/index.html?id=cffdb5034b314a0a9e7fdc67242ee6e7"

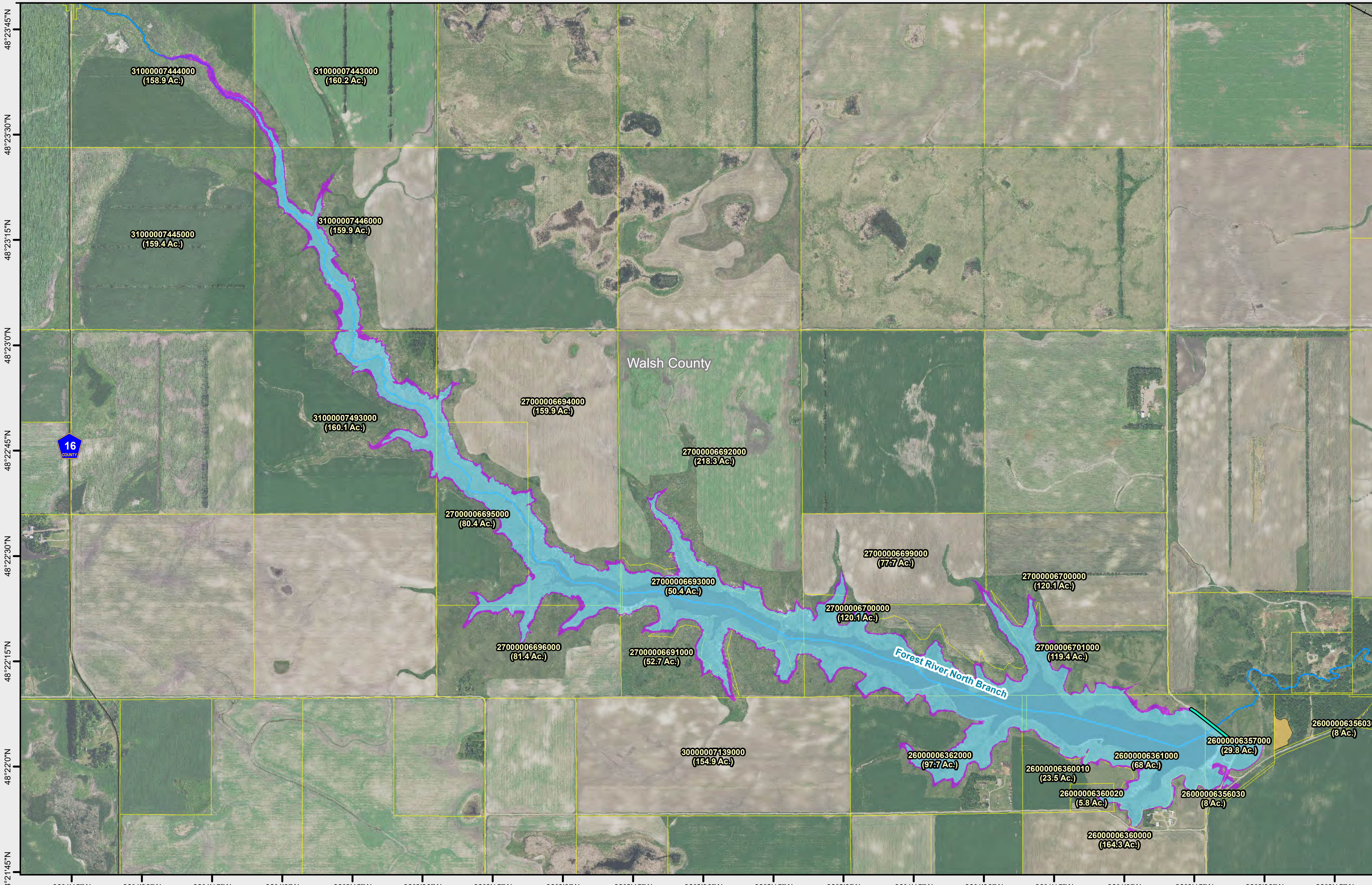
Streets, Townships, Counties, and other locational data are sourced from the North Dakota Information Technology Geographic Information Systems HUB Data portal, or locally surveyed where appropriate.

Map page size is Tabloid (11" x 17"). Accuracy of the map scales for varying paper sizes and is valid only if printed at this page size.

DISCLAIMER

This map has been compiled using the best information available and is believed to be accurate; however, its preparation required many assumptions. Actual conditions during a failure may vary from those assumed, so the accuracy cannot be guaranteed. The limits of flooding shown and the temporal data should only be used as a guidleine for emergency planning and response actions. Actual areas inundated will depend on specific flooding and failure conditions and may differ from the areas shown on the maps





Bylin Dam

Walsh County Parcel Data (Total Parcel Acres.)

Bylin Dam Spillway Pools

Existing Top of Dam

Proposed Top of Dam

Potential Spoil Placement and Temporary Easement Location

N W E S

0 0.125 0.25 0.5 Miles

Walsh County, North Dakota

Appendix C Support Maps: Figure C-26
Land Rights Map

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	NRI	PDL	7135-0037	2/22/2022	26 of 26

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