APPENDIX F

Floodplain Assessment

FLOODPLAIN ASSESSMENT
SP 2506-83 (TH 52)

The proposed project involves reconstructing approximately 13 miles of pavement on southbound TH 52 Cannon Falls to Zumbrota, as well as the replacement of southbound Bridge 9414 over the North Fork Zumbro River. The replacement of the bridge will involve the full demolition of the superstructure and substructure, and replacement of the abutments piers and decking. The project also includes resurfacing of the northbound bridge adjacent to 9414.

The National Flood Insurance Program Flood Insurance Rate Maps (FIRMs) for Pine County, Minnesota, have been examined for this project. The following FIRMs contain the project area:

Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0285E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0295E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0320E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0325E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0510E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0529E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0530E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0537E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0541E, September 25, 2009
Goodhue County, Minnesota and Incorporated Areas, Map Number 27049C0545E, September 25, 2009

The project will encroach upon the Zumbro River's floodplain. The table below and attached maps describe and show the encroachment.

FLOODPLAIN ENCROACHMENT		
Floodplain	**Type of Encroachment**	**Length, ft**
Zumbro River	Transverse	40
Belle Creek	None	Not applicable
Butler Creek	None	Not applicable

See Floodplain Maps attached.

FLOODPLAIN IMPACT ANALYSIS
This project will not result in any significant floodplain impacts for the following reasons:

1. There is no significant potential for interruption of a transportation facility which is needed for emergency vehicles or provides a community's only evacuation route.

    a. The roadway grade is above the 100-year flood elevation. The 100-year flood elevation upstream (west) of the North Fork Zumbro River Bridge is 983.23. The low point elevation of the roadway located approximately 3000 feet southeast of the North Fork Zumbro River Bridge is 987.14.

    b. Traffic will be maintained during construction. The bridge improvements will be constructed separately allowing emergency vehicles to pass through the work area.

2. There is no significant impact on natural and beneficial floodplain values.

a. Impacts:

	Beneficial Impacts	Adverse Impacts
Fisheries	The proposed reduction of total spans will remove a pier from prime thalweg habitat.	Temporary impacts to the channel during construction
Wetlands	None	Minor wetland encroachment
Plants	Native seed mixtures will be used	None
Open Space/Aesthetics	Native seed mixtures will be used	None
Public Access (boat/canoe)	Not applicable	Not applicable
Channel Changes	The reduction from 2 piers to one will remove an obstruction from the channel.	None
Boat Passage	The reduction from 2 piers to one will remove an obstruction from the channel.	Not applicable
Threatened/Endangered Species	A wildlife passage bench will be incorporated into the design of the riprap being placed along the banks and under the bridge	None
Water Quality	Appropriate turf establishment and erosion control measures will be used	Minor increase in impervious surface

b. Minimization/Mitigation Measures:

The DNR's Natural Heritage Database Review was queried by the DNR to determine if any rare plant or animal species, native plant communities, or other significant natural features are known to occur within an approximate one-mile radius of the project area. There were rare features identified in the query. State-listed threatened mussel species were documented both upstream and downstream of the project. MnDOT will contract with the DNR to conduct a mussel survey for in 2020. The Corps of Engineers will review the project for federal Endangered or Threatened species as part of the permitting process.

The northern long-eared bat is federally listed as threatened and state listed as special concern found in the area and throughout Minnesota. There is evidence of bats in the northbound TH 52 bridge over the North Fork Zumbro River, so there is potential that bats are present in the southbound TH 52 bridge over the North Fork Zumbro River as well. MnDOT will inspect the bridges in 2020 and provide minimization measures as appropropriate.

Migratory birds have been noted to nest on the bridge. The project may temporarily impact these species, but no long-term adverse impacts are expected. Nets will be placed on the bridge by MnDOT prior to the start of the project to prevent migratory birds from nesting. The contractor will be responsible for preventing birds from nesting during the project.

Work in the water will take place outside the period of March 1 through June 1 to allow for undisturbed fish migration and spawning. During the restriction period, all exposed soil areas that are within 200 feet of the water's edge and drain to these waters, will have erosion prevention

stabilization activities initiated immediately after soil disturbing activity has ceased, be completed within 24 hours, and maintained for the duration.

A passage bench will be included in the North Fork Zumbro River bridge. There is crash data that suggests a higher number of deer are located in the area. Modifying this crossing to assure animal passage under the bridges would help with both ecological connectivity and road safety.

Appropriate turf establishment and erosion control measures will be used. A SWPPP will be developed in accordance with the requirements of the NPDES Construction Storm Water Permit. The SWPPP will serve as a guiding document to the contractor for minimizing the amount of erosion and sediment loss on the project. Specific erosion and sediment control measures will consist of rock construction entrances to minimize tracking of sediments off site; culvert end controls and storm drain inlet protection; perimeter control such as silt fence, sediment control logs, and riprap installed down gradient of all construction areas prior to any soil disturbance; and hydraulic soil stabilizers, mulch, temporary plastic sheeting, and natural netting erosion control blankets applied over all temporary and permanently seeded areas. Use of erosion control blankets shall be limited to these 'natural netting' types to reduce the risk of entanglement with small animals. Areas of revegetation that are not proposed for mowed turf grass will consist of native seeding.

3. There is no significant increased risk of flooding.

    a. A detailed hydraulic analysis was performed for the river crossing. The hydraulic analysis shows no stage increase from the in-place condition. A copy of the Waterway Analysis is attached.

    b. Special hydraulic features consist of random riprap places along the abutments for scour protection.

4. The project will not support and/or result in incompatible floodplain development.
   Reason(s) why project will not cause incompatible floodplain development:

    a. This project is an improvement to existing infrastructure; therefore, no new access will be provided to floodplain areas

    b. Goodhue County has zoning regulations that control floodplain development.

TRANSVERSE ENCROACHMENT

The project includes replacement of the southbound bridge over the North Fork Zumbro River. The proposed Bridge will reduce the current number of spans from 3 (68 feet each) to 2 (104 feet each). This will necessitate construction in the floodplain beneath the bridge. The overall result will be a reduction of fill in the floodplain and a reduction in flood elevations.

COORDINATION

Permits are required from the Minnesota Department of Natural Resources (MnDNR) and the United States Army Corps of Engineers for public water and wetland impacts. An NPDES General Construction Stormwater Permit will be required from the MPCA.

CONCLUDING STATEMENT

Based on the above assessment, no significant floodplain impacts are expected.

ATTACHMENTS

-- FIRM Maps
-- Hydraulic Letter
-- Risk Assessment

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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National Geodetic Survey
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Silver Spring, MD 20910- 3282

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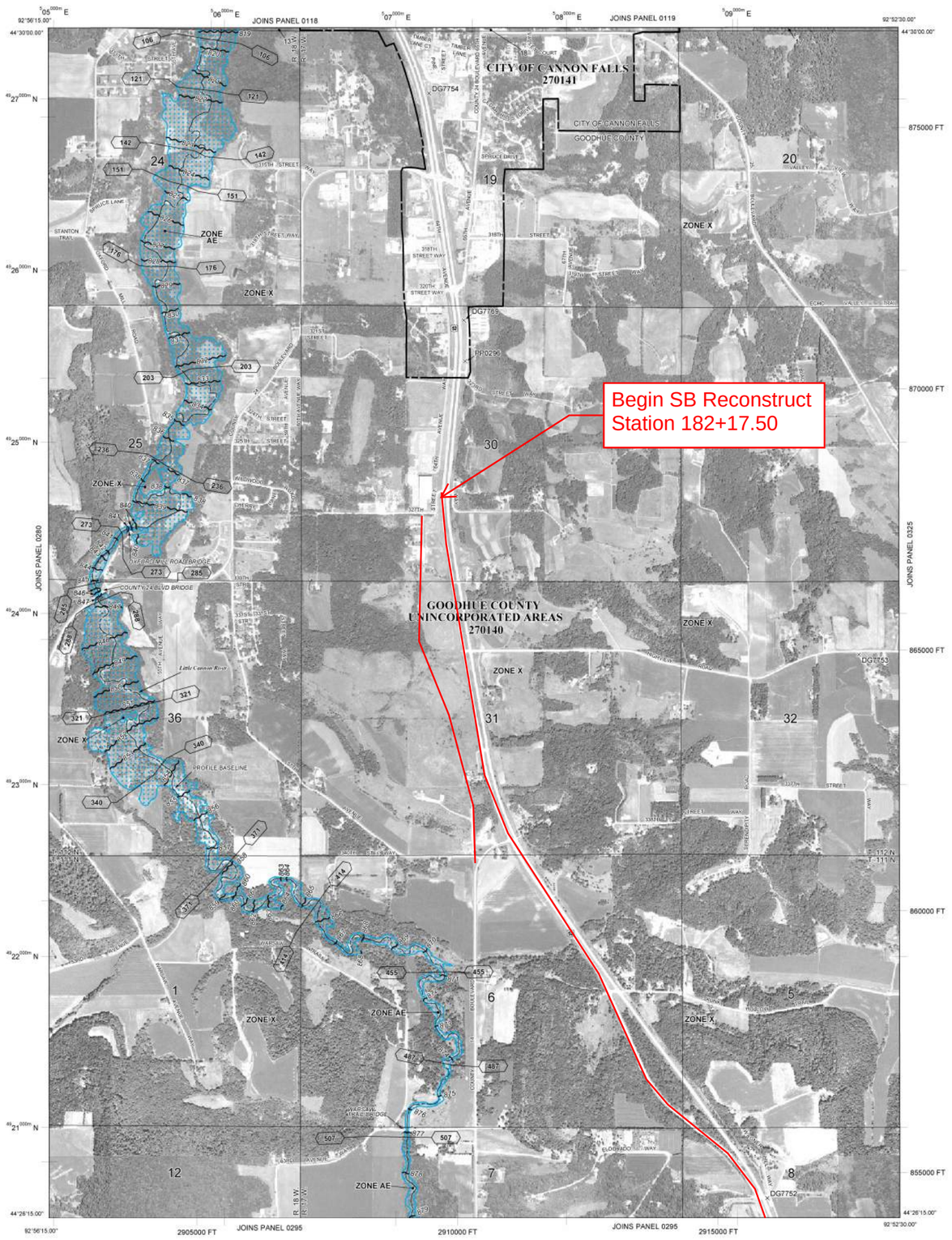

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
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- ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
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- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
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MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0285E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA
AND INCORPORATED AREAS

PANEL 285 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0285	E
CANNON FALLS, CITY OF	270141	0285	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0285E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

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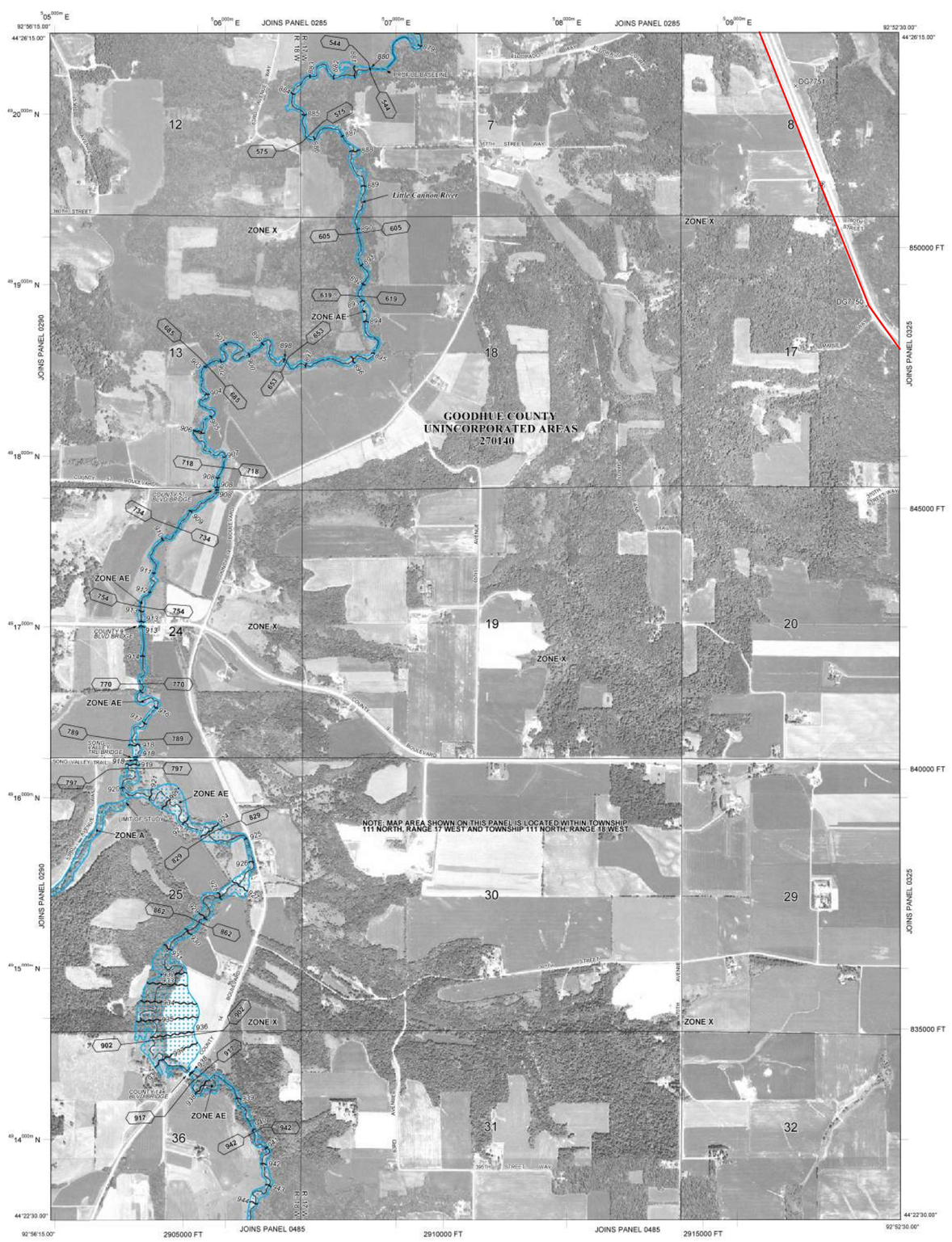

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NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0295E

FIRM
FLOOD INSURANCE RATE MAP

GOODHUE COUNTY, MINNESOTA
AND INCORPORATED AREAS

PANEL 295 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0295	E

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MAP NUMBER
27049C0295E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

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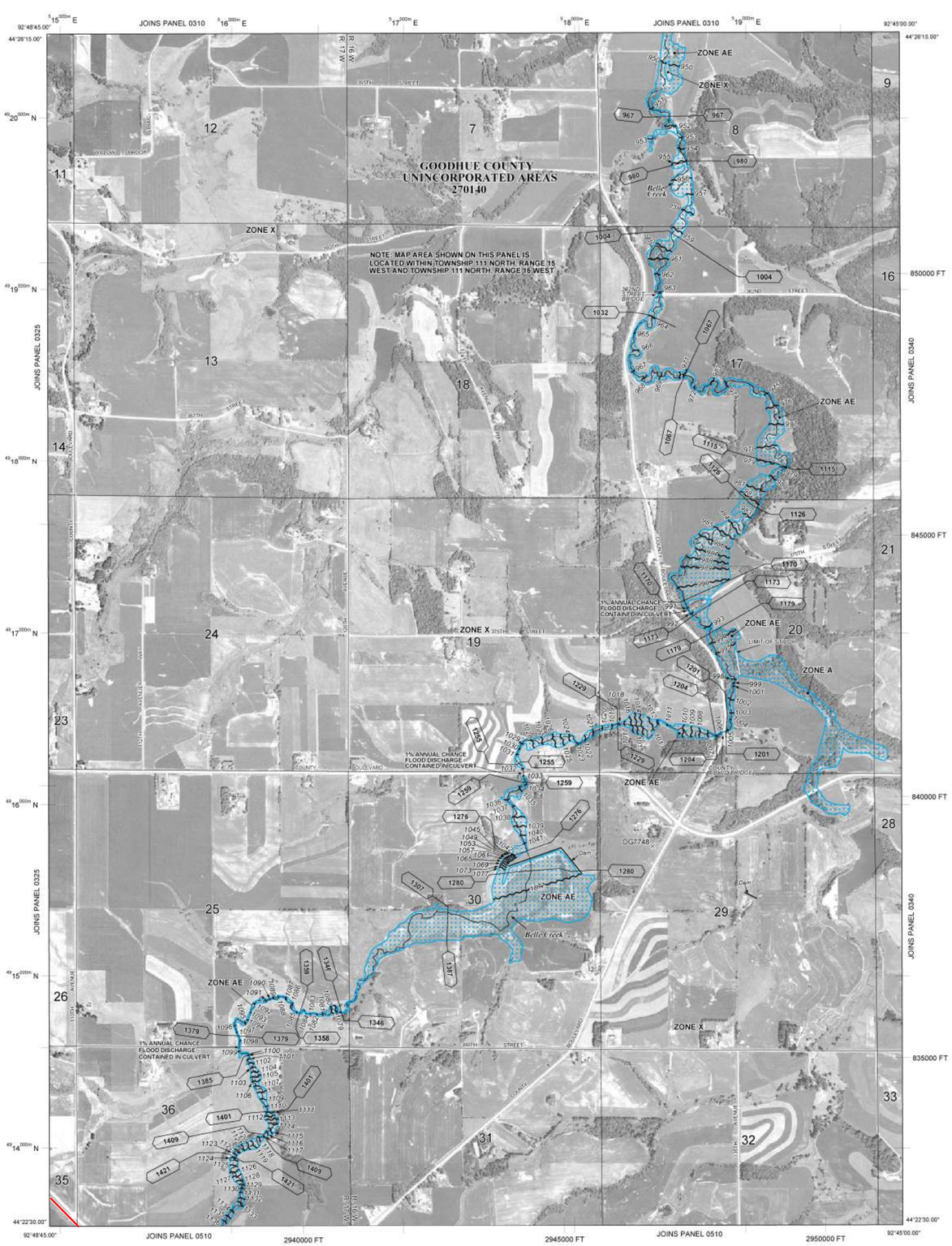

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A — No Base Flood Elevations determined.
- ZONE AE — Base Flood Elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 15
- 6000000 FT — 5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

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MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0320E

FIRM
FLOOD INSURANCE RATE MAP

GOODHUE COUNTY, MINNESOTA AND INCORPORATED AREAS

PANEL 320 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0320	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0320E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

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Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

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NOAA, N/NGS12
National Geodetic Survey
SSMC- 3, #9202
1315 East- West Highway
Silver Spring, MD 20910- 3282

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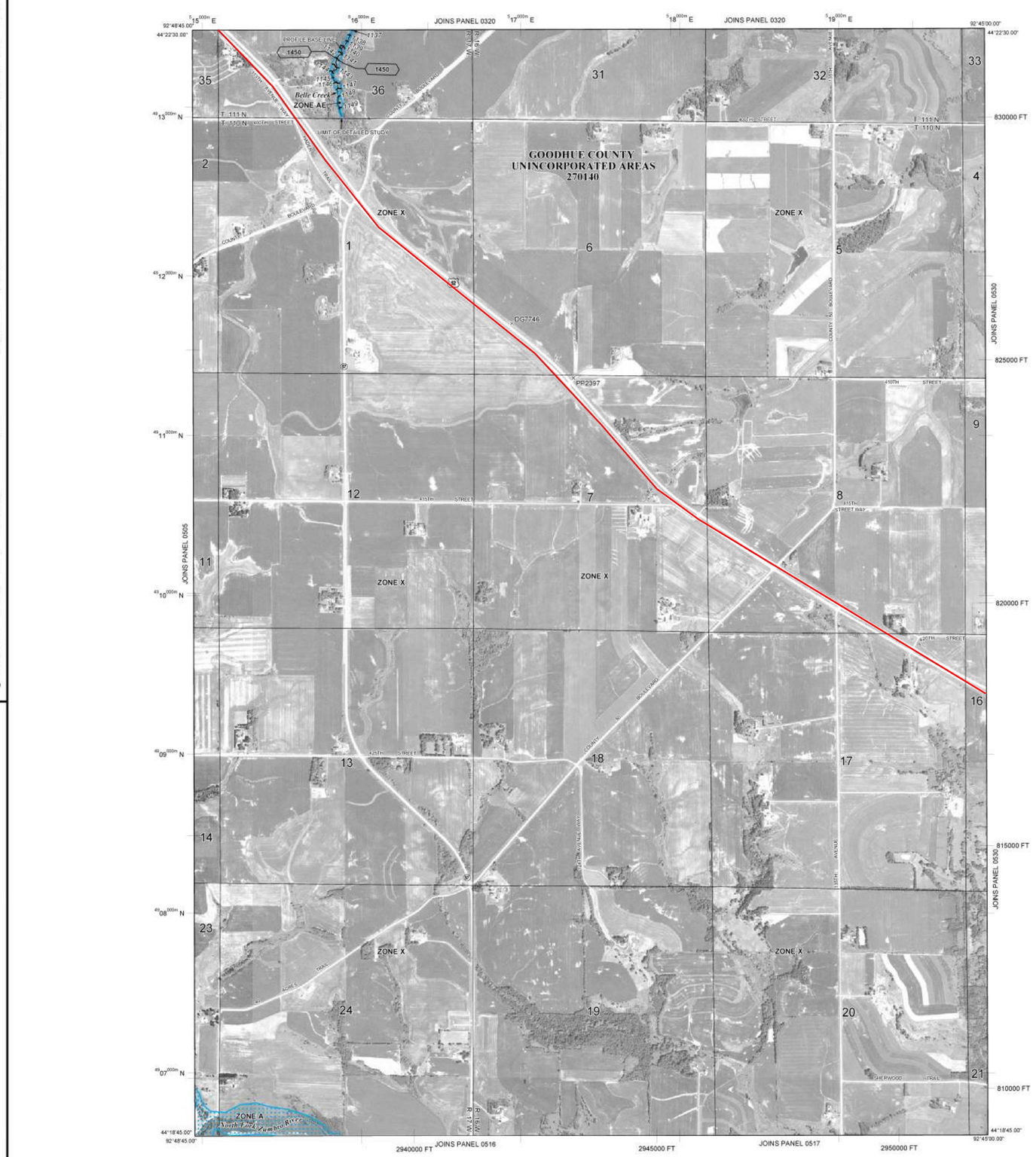

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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ZONE A	No Base Flood Elevations determined.
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FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
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6000000 FT	5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
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M1.5	River Mile

MAP REPOSITORIES
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EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0510E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA
AND INCORPORATED AREAS

PANEL 510 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0510	E

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MAP NUMBER
27049C0510E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

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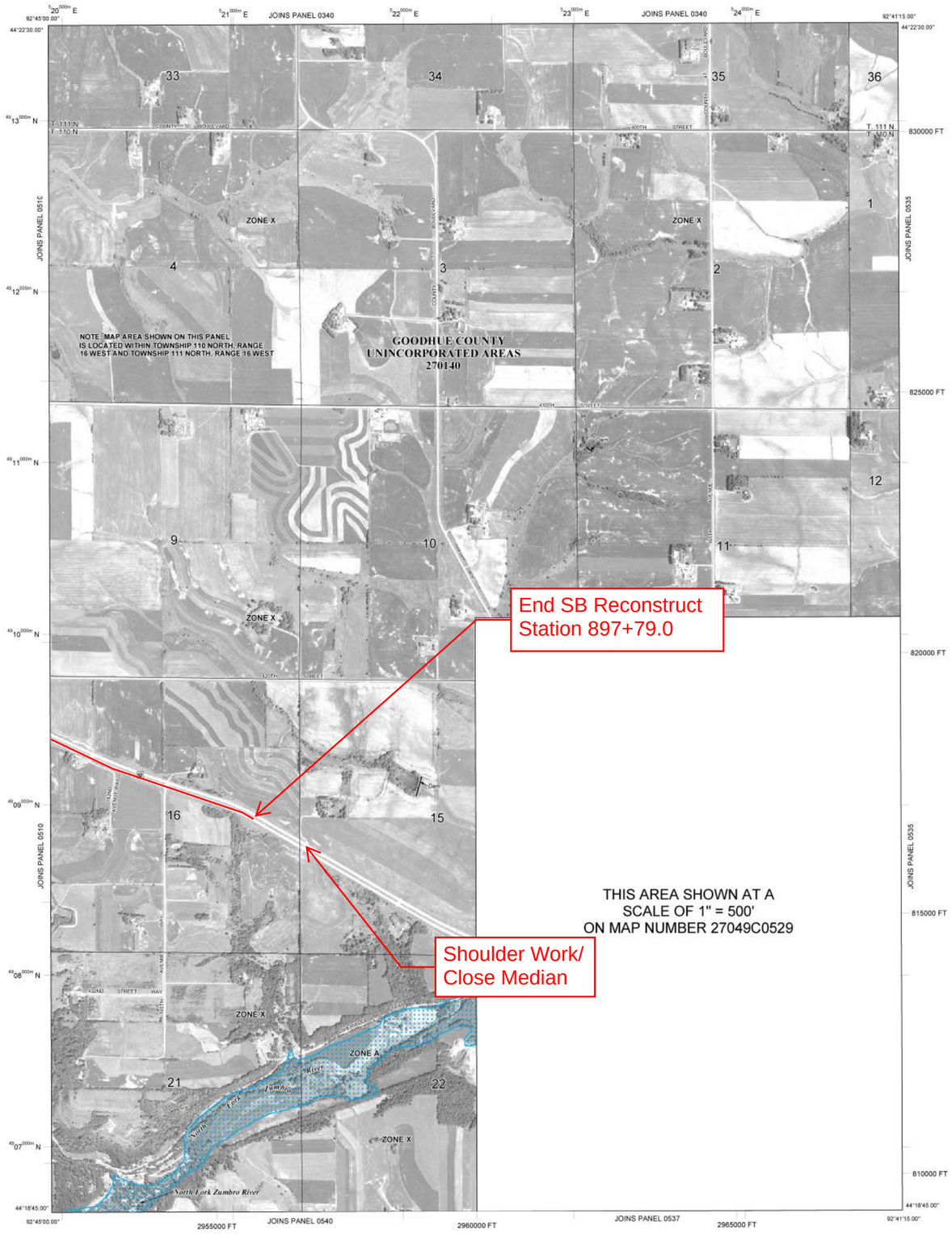

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FLOODWAY AREAS IN ZONE AE

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MAP REPOSITORIES
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EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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500 0 1000 2000 FEET
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NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0530E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA AND INCORPORATED AREAS

PANEL 530 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0530	E

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MAP NUMBER
27049C0530E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

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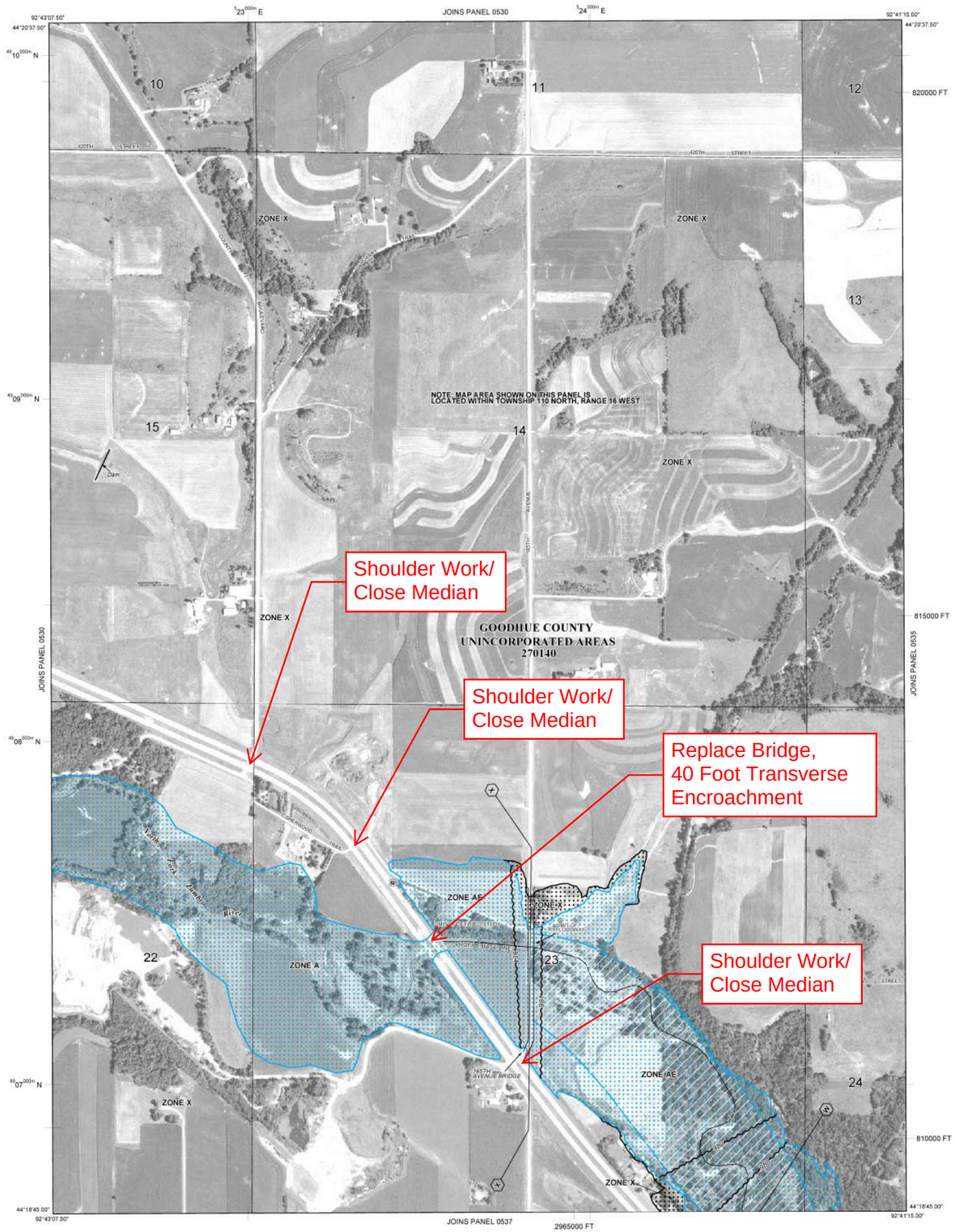

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275 000m N	1000-meter Universal Transverse Mercator grid ticks, zone 15
6000000 FT	5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1- 800- 638- 6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0529E

FIRM

FLOOD INSURANCE RATE MAP

GOODHUE COUNTY, MINNESOTA AND INCORPORATED AREAS

PANEL 529 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0529	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0529E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC- 3, #9202
1315 East- West Highway
Silver Spring, MD 20910- 3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on the FIRM was provided by the Goodhue County GIS Department. This information was derived from digital orthophotos meeting National Mapping Accuracy Standards from photography dated October 2003.

This map reflects more detailed and up- to- date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de- annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1- 800- 358- 9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1- 800- 358- 9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1- 877- 336- 2627) or visit the FEMA website at http://www.fema.gov/.

Numbered cross sections shown on this panel were created in association with a Limited Detailed Study and contain no floodway computations.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 15
6000000 FT	5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1- 800- 638- 6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0537E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA AND INCORPORATED AREAS

PANEL 537 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0537	E
ZUMBROTA, CITY OF	270148	0537	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0537E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

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SSMC- 3, #9202
1315 East- West Highway
Silver Spring, MD 20910- 3282

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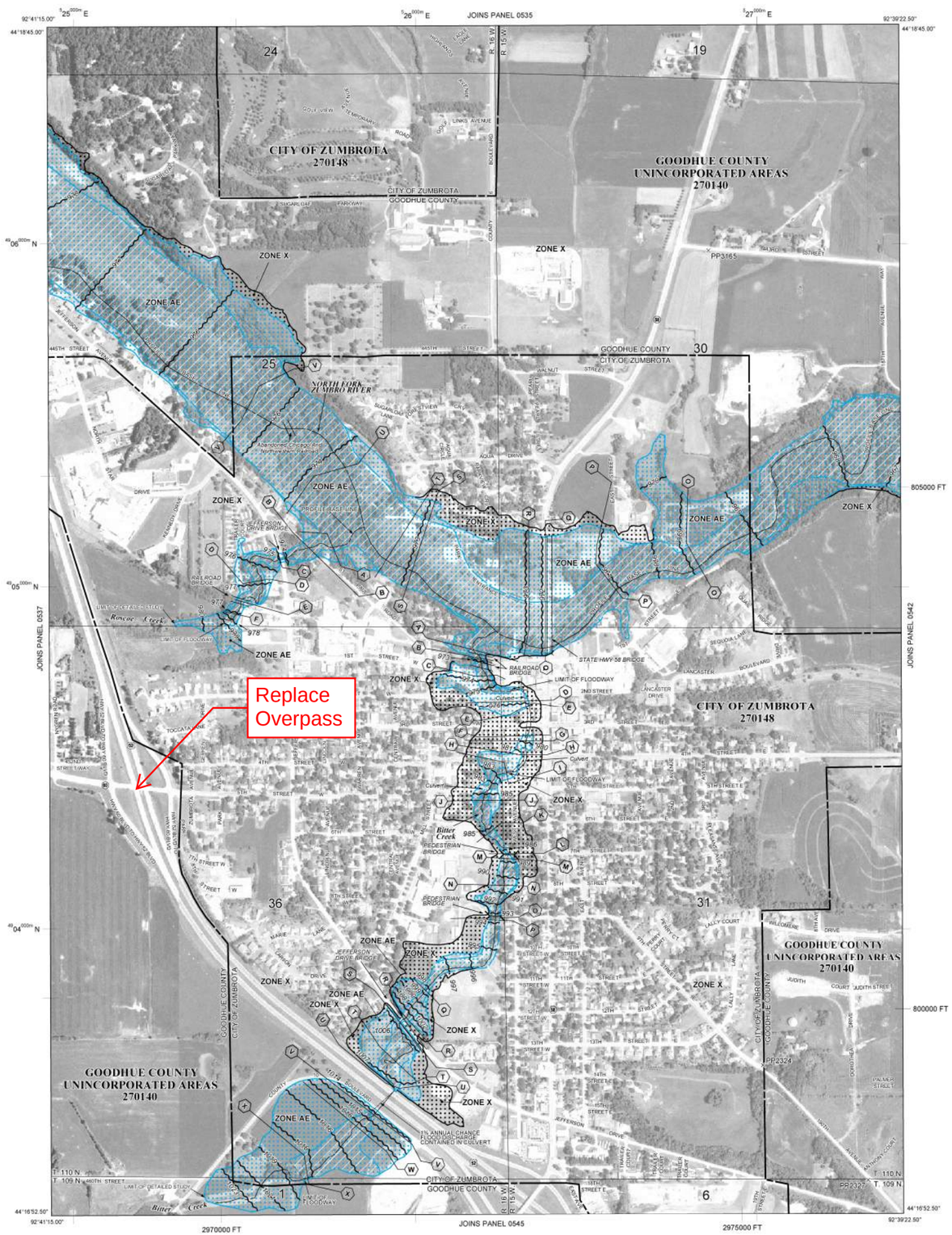

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
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ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
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* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

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6000000 FT	5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0541E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA AND INCORPORATED AREAS

PANEL 541 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0541	E
ZUMBROTA, CITY OF	270148	0541	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0541E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

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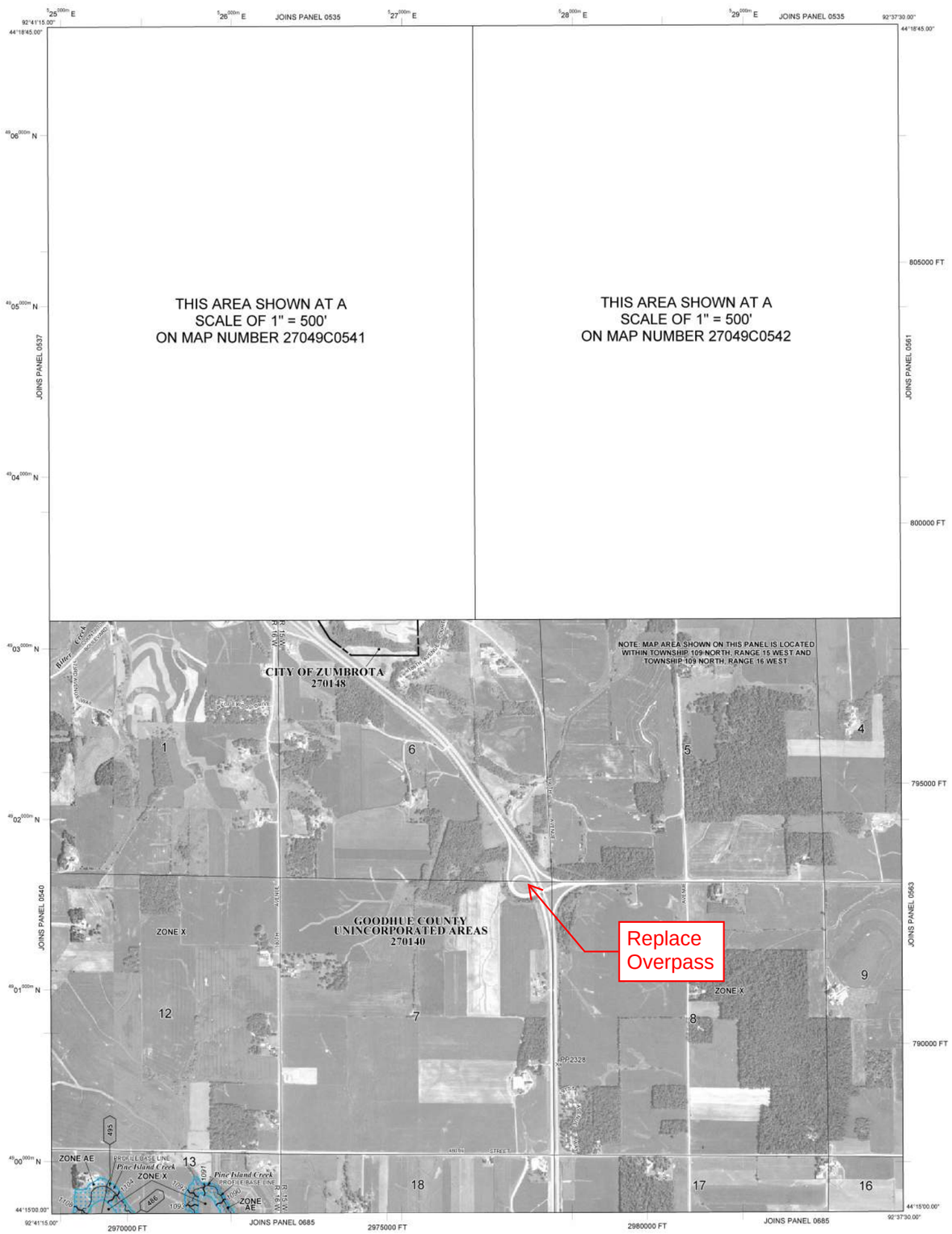

LEGEND

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FLOODWAY AREAS IN ZONE AE

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OTHER FLOOD AREAS

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	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 15
6000000 FT	5000-foot grid ticks: Minnesota State Plane coordinate system, south zone (FIPSZONE 2203), Lambert Conformal Conic
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1- 800- 638- 6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0545E

FIRM
FLOOD INSURANCE RATE MAP
GOODHUE COUNTY, MINNESOTA
AND INCORPORATED AREAS

PANEL 545 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GOODHUE COUNTY	270140	0545	E
ZUMBROTA, CITY OF	270148	0545	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
27049C0545E
EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

TKDA
444 Cedar Street, Suite 1500
Saint Paul, MN 55101
651.292.4400
tkda.com

S.P. 2506-83 Southbound TH 52 Reconstruction
Bridge No. 9414 Replacement

To:	Jai Kalsy, MnDOT Kris Langlie, MnDOT Solomon Woldeamlak, MnDOT	**Reference:**	TH 52 Project SB Station 990+50 Bridge over the North Fork Zumbro River
Copies To:	Matthew Wassman Mark Daubenberger	**Project No.:**	16421.010
From:	Christopher Helland	**Routing:**	
Date:	August 13, 2020		

This memorandum summarizes the hydraulic analysis of the proposed replacement of the southbound Trunk Highway 52 bridge over the North Fork Zumbro River in Zumbrota, MN. The existing bridge (Bridge No. 9414) is a three-span prestressed concrete beam structure located in Section 23 Township 110N Range 16W. The bridge is located approximately 1,300 feet northwest of the intersection of TH 52 and 165th Avenue and approximately three river miles upstream of the town of Zumbrota. Although the bridge is located in FEMA Zone A (unstudied), the adjacent upstream and downstream areas are located in FEMA Zone AE. The DNR provided a model containing the Zone A reach that included Bridge No. 9414. This HEC-RAS 5.0.6 model was considered the *effective model*. A *corrected effective/existing conditions* model was created to update the low chord of the existing bridge from 986.00 to 983.90 as shown on the 1961 existing bridge plans (adjusted from NGVD29 to NAVD88). The existing corrected low chord elevation does not meet DNR navigational clearance.

The proposed bridge geometry was incorporated into the *corrected effective model* to create the *proposed conditions* model. The proposed two span bridge geometry reduces the number of piers and extends the total bridge length four feet to the north to allow for a DNR requested habitat bench. The proposed bridge does not meet DNR navigational clearance requirements but does increase navigational clearance compared to existing conditions and raises the low chord elevation (984.26). The removal of a pier will improve navigability and fish passage at the main stem channel, and the overall increase in flow area results in no adverse increase in flood elevations.

Provided Design Flows	
Design Storm Event	North Fork Zumbro River Flow (cfs)
10-year	5540
25-year	7420
50-year	8860
100-year	10400
100-year+	13312
500-year	14300

	Hydraulic Data TH 52 over the North Fork Zumbro River		
	Vertical Datum	NAVD 88	
*	Stream Name	Zumbro River	
	Drainage area	142.6	mi^2
	Flood of record	Unknown	ft^3/s
	Maximum observed high-water elevation	Unknown	ft
*	**Design and basic flood (100-year frequency)**	10,400	ft^3/s
(1)	Road sag point elevation	979.55	ft
(2)	Stage	982.69	ft
	Total Stage increase	0.54	ft
* (3)	Headwater elevation	983.23	ft
(3)	Headwater elevation of in-place condition	983.23	ft
	Stage increase of in-place condition	0.54	ft
(4)	Minimum waterway opening	1849	ft^2
(5)	Low member at or above elevation	984.26	ft
(6)	Mean velocity	5.62	ft/s
*	**Greatest Flood (500-year frequency)**	14,300	ft^3/s
(2)	Stage	984.63	ft
	Total Stage increase	0.63	ft
* (3)	Headwater elevation	985.26	ft
(3)	Headwater elevation of in-place condition	985.24	ft
	Stage increase of in-place condition	0.61	ft
(6)	Mean velocity	5.35	ft/s
	Approximate Flowline Elevation	971.06	ft
	Skew	none	
	Riprap Size	Class IV	

*Items to be shown on grading plan
(1) Approximate low point highway centerline 1 mile southeast.
(2) Elevation downstream at HEC-RAS cross section 30437.6
(3) Elevation upstream at HEC-RAS cross section 30501.55U
(4) Cross sectional area of HEC-RAS cross section 30501.55U
(5) Proposed bridge low member elevation (upstream) at HEC-RAS cross section 30501.55U
(6) Proposed velocity at HEC-RAS cross section 30501.55U

RISK ASSESSMENT FOR ENCROACHMENT DESIGN

Date: 8/13/2020

District: 6 **County:** Goodhue **Vicinity of:** Zumbrota

DATA REQUIREMENTS

1. **Location of Crossing:** TH 52 **C.S.** 990+70 **M.P.** 80.850

   Sec. 23 **T** 110 N **R** 16 W

2. **Name of Stream:** North Fork Zumbro River **Bridge No. Old:** 9414 **New:** N/A

3. **Current ADT:** 20,550 (2018) **Projected ADT:** 26,500 (2041)

4. **Practicable detour available** ☑ Yes ☐ No

If no is checked, please explain: Not applicable

If there is no practicable detour available, then the use of the road must be analyzed. Considerations such as emergency vehicle access, emergency supply and evacuation route, and the need for school bus, milk and mail routes should be studied. Factors to consider for this analysis include design frequency, depth, duration, and frequency of inundation if appropriate, and available funding.

5. **Hydraulic Data: (Fill in as appropriate)**

Elevation Datum: NAVD 88

Q_2 =		cfs	HW_2 Elevation		ft
Q_5 =		cfs	HW_5 Elevation		ft
Q_{10} =	5,540	cfs	HW_{10} Elevation	980.58	ft
Q_{25} =	7,420	cfs	HW_{25} Elevation	981.72	ft
Q_{50} =	8,860	cfs	HW_{50} Elevation	982.40	ft
Q_{100} =	10,400	cfs	HW_{100} Elevation	983.23	ft
Q_{500} =	14,300	cfs	HW_{500} Elevation	985.26	ft

Approximate Flowline Elevation: 971.06 Ft

Design Frequency Event: ☑ 100-yr ☐ 50-yr ☐ 25-yr ☐ 10-yr

Reasons for selecting Design Frequency: MnDOT Drainage Manual states design frequency for bridges shall be the 100-year when the overtopping flood is above the 100 year state. The crossing is also a MnDNR Public Water which requires 3 feet for freeboard over the 50-year storm.

6. **Magnitude and Frequency of the smaller of "Overtopping" or "500 yr." (Greatest) flood:** 10,400+ cfs, 100-year+

7. **Low member elevation:** 984.26

8. **Minimum roadway overflow elevation if appropriate:** 983.25 (165th Ave South, 2,200 feet south)

9. **Elevation of high risk property, i.e. residences:** 985.50, residence 1,700 feet south

   Other buildings NA

10. Horizontal location of overflow: low point TH 52 SB Sta. 1038+50

☐ At Structure (See 12) ☑ Not At Structure:

11. Type of proposed structure(s):

☑ Bridge (See 12) ☐ Culvert(s)

12 If the proposed structure is a bridge with the sag point located on the bridge and there is ice and debris potential, strong consideration should be given to using Q_{50} as design discharge with 3' of clearance between the 50 year tailwater stage and low member.

	LTEC Design
1. BACKWATER DAMAGE - Major flood damage in this context refers to shopping centers, hospitals, chemical plants, power plants, housing developments, etc.	
1a. Is the overtopping flood greater than the 100 yr. flood? ☑ Yes (Go to 1b) ☐ No (Go to 1e)	
1b. Is the overtopping flood greater than the "greatest" flood (500 yr. Frequency)? ☐ Yes (Go to 1d) ☑ No (Go to 1c)	
1c. Is there major flood damage potential for the overtopping flood? ☑ No (Go to 1e)	☐ Yes (Go to 1e)
1d. Is there major flood damage potential for the greatest flood (500 year frequency)? ☑ No (Go to 1e)	☐ Yes (Go to 1e)
1e. Will there be flood damage potential to residence(s) or other buildings during a 100 yr. flood? ☐ Yes (Go to 1f) ☑ No (Go to 2)	
1f. Could this flood damage occur even if the roadway crossing wasn't there? ☐ Yes (Go to 1g) ☐ No (Go to 1h)	
1g. Could this flood damage be significantly increased by the backwater caused by the proposed crossing? ☐ Yes (Go to 1h) ☐ No (Go to 2)	
1h. Could the stream crossing be designed in such a manner so as to minimize this potential flood damage? ☐ Yes (Go to 1i) ☐ No (Go to 2)	
1i. Does the value of the building(s) and/or its contents have sufficient value to justify further evaluation of risk and potential flood damage? ☐ No (Go to 2)	☐ Yes (Go to 2)
2. TRAFFIC RELATED LOSSES	
2a. Is the overtopping flood greater than the "greatest" flood (500 yr. frequency)? ☐ Yes (Go to 3) ☑ No (Go to 2b)	
2b. Does the ADT exceed 50 vehicles per day? ☑ Yes (Go to 2c) ☐ No (Go to 3)	

2c. Would the (duration of road closure in days) multiplied by the (length of detour minus the length of normal route in miles) exceed 20?

☐ Yes (Go to 2d) ☑ No (Go to 3)

2d. Does the annual risk cost for traffic related costs exceed 10% of the annual capital costs?

☑ No (Go to 3) (See figures A and B – Appendix A(2) - for Assistance) ☐ Yes (Go to 3)

3. ROADWAY AND/OR STRUCTURE REPAIR COSTS

3a. Is the overtopping flood less than a 100 year frequency flood?

☐ Yes (Go to 3b) ☑ No (Go to 3i)

3b. Compare the Tailwater (TW) elevation with the roadway sag point elevation for the overtopping flood. Check the appropriate category.

☐ When TW is above the sag point (Go to 4)

☐ TW is between 0 and 0.5' below sag point (Go to 3c)

☐ TW is between 0.5' and 1.0' below sag point (Go to 3d)

☐ When TW is 1.0' and 2.0' below sag point (Go to 3e)

☐ When TW is more than 2.0' below sag point (Go to 3g)

3c. Does the embankment have a good erosion resistant vegetative cover?

☐ Yes (Go to 3i) ☐ No (Go to 3d)

3d. Is the shoulder constructed from erosion resistant material such as paved, coarse gravel, or clay type soil?

☐ Yes (Go to 3i) ☐ No (Go to 3e)

3e. Will the duration of overtopping for the 25-year flood exceed 1 hour?

☐ Yes (Go to 3f) ☐ No (Go to 3i)

3f. Is the embankment constructed from erosion resistant material such as a clay type soil?

☐ Yes (Go to 3i) ☐ No (Go to 3g)

3g. Is the overtopping flood less than a 25-year frequency flood?

☐ Yes (Go to 3h) ☐ No (Go to 3i)

3h. Will the cost of protecting the roadway and/or embankment from severe damage caused by overtopping exceed the cost of providing additional culvert or bridge capacity?

☐ No (Go to 3i); ☐ Yes (Go to 3i)

3i. Is there damage potential to the structure caused by scour, ice, debris or other means during the lesser of the overtopping flood or the 100 year flood?

☐ Yes (Go to 3j) ☑ No (Go to 4)

3j. Will the cost of protecting the structure from damage exceed the cost of providing additional culvert or bridge water capacity?

☑ No (Go to 4); protecting abutments from scour by riprap. ☐ Yes (Go to 4)

4. Will the capital cost of the structure exceed $1,000,000?

	☐ No (Go to 5);	☑ Yes (Go to 5)
5.	In your opinion, are there any other factors that you feel should require further study through a risk analysis?	
	☑ No (Go to 6);	☐ Yes (Indicate)

6. If there are no ✓'s in the LTEC Design column on the right, proceed with the design, selecting the lowest acceptable grade line and the smallest waterway opening consistent with the constraints imposed on the project. The risk assessment has demonstrated that potential flood damage costs, traffic related costs, roadway and/or structure repair costs are minor and therefore disregarded for this project.

One or more ✓'s in the LTEC Design column indicates further analysis in the category checked may be required utilizing the LTEC design process or justification (below) why it is not required.

JUSTIFICATION: The bridge provides 2.5 feet of freeboard over the 100 year flood at the deck, this is in an area where TH 52 is at a running grade. "Overtopping" occurs ½ mile to the SE, not at the bridge and would still likely occur if the bridge were not there. The proposed replacement will reduce piers in the thalweg, improve aquatic passage, and will not cause an increase in flood elevations.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota:

Signature: 

Christopher M. Helland

License Number: **55693** Date: **August 13, 2020**