RUSH RIVER WATERSHED PLAN

APPENDIX A

PUBLIC PARTICIPATION, COMMENTS AND RESPONSES

Public Participation Timeline				
Date	**Action**	**Location**	**Notes**	**Public Comments**
12/10/2015	Agency Scoping Meeting	Bismarck, ND	This was a general meeting discussing the procedure and planning of PL-566 watershed planning for multiple watersheds in the Cass Joint WRD. Attended by 2 federal agencies (USCAE, NRCS), 3 state agencies (SWC, SHPO, DEQ), 1 Tribe (Spirit Lake), CJWRD and 3 engineering firms.	No comments recorded
1/6/2016	Public Scoping Meeting	Casselton, ND	12 Comments - from the meeting and the letter	12 Comments: 4 Federal including 2 from USACE, 6 State and 2 THPO (Tribe)
1/15/2016	Letter sent for additional NEPA Comments		11 Fed (including USFWS + COE), 9 State, 24 Tribes/THPO/SHPO, 7 local gov, 7 landowners. This is the initial consultation with SHPO/Tribes	
11/8/2017	Project Team Meeting - Alternatives Input		Team members include 9 local landowners/local gov and 11 invited federal, state and local agencies	
12/4/2017	Project Team Meeting - Alternatives Input	West Fargo, ND		
3/5/2018	Project Team Meeting - Alternatives Input	West Fargo, ND		
3/23/2018	Project Team Meeting - Alternatives Input	West Fargo, ND		
8/22/2018	Project Team Meeting - Alternatives Input	West Fargo, ND		
11/5/2018	NRCS Letter re: Consultation Sent to SHPO and 17 Tribes			
3/7/2019	Project Team Meeting - Alternatives Input	West Fargo, ND		
4/2/2019	2nd Public Meeting	Amenia, ND	Reviewed alternatives with local stakeholders	available upon request
10/5/2021	Draft Plan-EA, public mtg invite sent to 6 Tribes + NDSHPO		The six Tribes included two that responded to the initial consultation on 1/15/16 and 4 recommended by NRCS State CRS. No Tribes responded with comments to Draft Plan-EA.	NDSHPO responded with concurrence with "No Historic Properties Affected" from Class III survey.

10/8/2021	USFWS and USCAE - two federal cooperating agencies, were sent link to Draft Plan-EA and invitation to virtual public meeting			Patricia McQueary of USCAE responded - project may require individual 404 permit, submit 120 prior to bid opening
10/13/2021	**Draft Plan- EA invitation to attend public virtual meeting and requests for comment:** Public notices published in Cass County Reporter newspaper - 3x - Oct 13,20,&27, 2021. Invitations were sent to project team, interagency team by mail/email. Postcards were sent to landowners under and adjacent to project		Includes weblinks to virtual Teams meeting (11/2/21) at Cass Co website. And link to Draft Plan-EA on NRCS website	
11/2/2021	Virtual TEAMS Public Informational Meeting for watershed residents and watershed stakeholders	Virtual		
11/29/2021	End Tribal/SHPO Review		Approx. 45 days completed for Tribal/SHPO Review	
12/24/2021	End Public comment review		45 Days after Meeting	
1/26/2022	Public comments summarized in Plan-EA/App		Comment table and letters added to App A	A total of 18 comments were received from 6 individuals, and 3 units of government. None were considered substantive
*January 2022	Address comments, final additions, issue FONSI			

SIGN-IN SHEET CASS COUNTY WATERSHED PLANNING
AGENCY SCOPING MEETING

December 10, 2015 Bismarck, North Dakota

Name	Agency	E-mail	Phone	Mail Address
Pat McQueary	USACE	patricia.L.mcqueary@usace.army.mil	701-255-0015 701-204-3443	1512 S. 12th Bismarck, ND
Patsy Crooke	USACE	patsy.g.crooke@usace.army.mil	701-355-0015 ext 2002	" "
Mike Opat	Moore Eng.	MOpat@moore engineering inc.com	701-499-5067	925 10th Ave West Fargo, ND 58078
Pat Downs	Moore Eng	pdowns@moore engineering inc.com	701-551-1041	" "
Randy Gjestvang	ND SWC ARRA	rgjestvang@nd.gov	701-390-3578	1120-28 Ave. N Suite C Fargo, ND 58102
Chris Gross	MEI	cgross@mooreengineering inc.com	701-499-5857	925 10th Ave E West Fargo, ND 58078
CHRISTI FISHER	NRCS	christi.fisher@nd.usda.gov	701-530-2091	
John Paczkowski	OSE/SWC	jpaczkowski@nd.gov	701-328-3446	900 E Blvd Bismarck, ND 58505
Susan Quinnell	ND SHPO	Squinnell@nd.gov	701 328 3576	612 E. Blvd Ave Bismarck ND 58505
TODD HAGEL	USDA-NRCS	todd.hagel@nd.usda.gov	701-530-2004	220 E Rosser ~~ND~~ BISMARCK, ND 58501
Paul Picha	NDSHPO	ppicha@nd.gov	701 328 3574	612 E. Blvd. Ave. Bismarck ND 58501
Erich Longo	Spirit Lake THPO	thpo@gondtc.com	701-230-7077	POB 76 Fort Totten ND 58335
PETER WAX	NDDoH	pwax@nd.gov	701-328-5268	918 East Divide Ave Bismarck ND 58501
Ron Koth	Bard Co	rkoth@bakk.com	605-390-0165	122 S Berry Pine Rd Rapid City, SD 57702

Scoping Letter

January 15, 2016

Recipient
Company
Address
Address
City, State Zip

Re: Cass County Joint Water Resources District
Watershed Planning Process for Swan Creek, Rush River, and Upper Maple River Watersheds

Dear Name:

The Cass County Joint Water Resources District (District), in cooperation with the Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program (RCPP), is initiating watershed planning processes for the Swan Creek, Rush River, and Upper Maple River watersheds, as shown on the enclosed **Watershed Maps**. The watershed planning processes will rely on local input and a team of stakeholders to identify water-related concerns within each rural watershed, such as overland flooding, delayed planting, crop damages, infrastructure failures, etc. Moore Engineering Inc. and Barr Engineering Co. are assisting the District with the NRCS RCPP watershed planning processes.

The District has obtained grant funding from the NRCS RCPP to facilitate the watershed planning process for each watershed. Due to this nexus, environmental review under the National Environmental Policy Act (NEPA) of 1969, as amended, will be required to fully assess impacts associated with alternatives developed to address water-related concerns.

To ensure that all social, economic, and environmental effects are considered in the development of this project, we are soliciting your views and comments on the proposed project pursuant to Section 102 (2) (D) (IV) of NEPA. We are particularly interested in any property which your department may own or have an interest in. We would also appreciate being made aware of any proposed developments your department may be contemplating in the watershed areas. Any information that might help us in our studies would be appreciated.

Information or comments relating to environmental or other matters that you might furnish will be used in determining if these projects are a "categorical exclusion" or whether an "Environmental Assessment" or a "Draft Environmental Impact Statement" will be prepared.

It is requested that any comments or information your agency is willing to contribute for use in project development be forwarded to our office on or before **February 15, 2016**. If no reply is received by this date, it will be assumed that you have no comment on these projects.

If further information is desired regarding the proposed projects, please contact Pat Downs at 701-551-1041. Thank you for your time and cooperation.

Sincerely,

Pat Downs

Enclosures:
Watershed Maps

Address List for Scoping Letter

First Name	Company Name	Department	Address Line 1	City
Craig Odenbach	ND State Water Commission		900 East Blvd Ave, Dept 770	Bismarck, ND 58505-0850
Karl Rockeman	ND State Health Department	Environmental Health	918 East Divide Ave	Bismarck, ND 58501-1947
Susan Quinnell	ND-SHPO Ref: 16-0390	ND State Historical Society	612 E Blvd Ave	Bismarck, ND 58501
Greg Link	ND Game & Fish Department		100 N Bismarck Expressway	Bismarck, ND 58501-5095
Joyce Schmidt	ND Department of Transportation		608 E Boulevard Ave	Bismarck, ND 58505-0700
Elgin Crowsbreast	Three Affiliated Tribes, THPO		PO Box 429	Parshall ND 58770
Waste` Win Young	Standing Rock Sioux Tribe, THPO		PO Box D	Fort Yates ND 58538
Dr. Erich Longie	Spirit Lake Sioux Nation THPO		PO Box 359	Fort Totten ND 58335
Curley Youpee	Director Cultural Resource Dept. & NAGPRA Coordinator	Fort Peck Tribes	Box 836	Poplar Mt 59255
Dennis Gill	Wahpekute Band OF Dakotah		3322 Gill Rd	Waubay SD 57273
Emerson Bull Chief	THPO	Crow Nation	PO Box 159	Crow Agency MT 59022
Darrel Ziphier	Crow Creek Sioux Tribe, THPO		PO Box 50	Fort Thompson SD 57339
Perry Little	Yankton Sioux Tribe, THPO		PO Box 1153	Wagner SD 57380
Chippewa Cree Cultural Resources Preservation Dept.			PO Box 230	Box Elder MT 59521
Pete Coffey	Three Affiliated Tribes THPO Office		PO Box 429	Parshall ND 58770
Dianne Desrosiers	Tribal Historic Preservation Office	Sisseton-Wahpeton Oyate	PO Box 907	Sisseton SD 57262
Bruce Nadeau	THPO	Turtle Mountain Band of Chippewa Indians	PO Box 2022	Belcourt ND 58316
Conrad Fisher	Northern Cheyenne Nation, THPO		PO Box 251	Lame Deer MT 59043
Russell Eagle Bear	Tribal Historic Preservation Office	Rosebud Sioux Tribe	PO Box 809	Rosebud SD 57570
Michael Catches Enemy	Oglala Sioux Tribe , THPO		PO Box 1606	Pine Ridge SD 57770
Steve Vance	Cheyenne River Sioux Tribe, THPO		PO Box 590	Eagle Butte SD 57625
Rick Thomas	Santee Sioux Nation, THPO		52948 Highway 12	Niobrara NE 68760
Robert Farmer	Acting Regional Administrator	Federal Insurance & Hazard Mitigation Divison	Bldg 710, Box 25267	Denver CO 80225
Kevin Shelley	North Dakota Acting Supervisor	U.S. Fish and Wildlife Service	3425 Miriam Ave	Bismarck ND 58501-7926

Title	First Name	Last Name	Company Name	Department	Address Line 1	City	State	ZIP Code
Mr.	Bob	Christensen	Cultural Resource Specialist	Cultural Resource Section	608 E. Boulevard Ave.	Bismarck	ND	58505-0700
Mr.	Bruce	Renville			PO Box 509	Sisseton	SD	57262-0267
Mr.	Myra	Pearson			PO Box 359	Ft. Totten	ND	58335
Mr.	Mark	Fox			404 Frontage Road	New Town	ND	58763
Mr.	Richard	McCloud			PO Box 900	Belcourt	ND	58316-0900
Mr.	Dave	Archambault II			PO Box D	Fort Yates	ND	58538
Mr.	Timothy	LaPointe	Regional Director		115 4th Ave. SE, Suite 400	Aberdeen	SD	57401
Mr.	Joe	Hall	Chief, Environmental and Resource Management		PO Box 1017	Bismarck	ND	58502-1017
Mr.	Patricia	McQueary	Manager	ND Regulatory Office	1513 S. 12th St.	Bismarck	ND	58504
Mr.	Brad	Thompson	Chief, Planning Branch	Omaha District Attn: CENWO-PM-A	1616 Capital Avenue	Omaha	NE	68102-4901
Mr.	Aaron	Snyder	Chief, Project Management & Development Branch	St. Paul District	180 5th St. E., Ste 700	St. Paul	MN	55101-1678
Ms.	Mary	Podoll	State Conservationist		PO Box 1458	Bismarck	ND	58502-1458
Mr.	Kirk	Keysor		Economic Development Administration	1244 Speer Blvd., Suite 431	Denver	CO	80204
Mr.	Gerald	Paulson	Director, Transmission Lines and Substations	Western Area Power Admin.	PO Box 1173	Bismarck	ND	58502-1173
Ms.	Suzanne	Bohan	NEPA Transportation Coordinator	Region 8, EPR-N	1595 Wynkoop Street	Denver	CO	80202-1129
Mr.	Richard	Clark	Wetlands Coordinator	Region 8, EPR-EP	1595 Wynkoop Street	Denver	CO	80202-1129
Mr.	Scott	Davis			600 E. Blvd. Ave., 1st Floor, Judicial Wing, Rm 117	Bismarck	ND	58505-0300
Mr.	Cody	Schulz	Disaster Recovery Chief	Department of Homeland Security	PO Box 5511	Bismarck	ND	58506
Mr.	Larry	Kotchman	State Forester		307 1st St. E.	Bottineau	ND	58318-1100
Mr.	Steve	Dyke	Supervisor	Conservation Section	100 Bismarck Expressway	Bismarck	ND	58501-5095
Mr.	Mark	Zimmerman	Director		1600 E. Century Ave., Suite 3	Bismarck	ND	58503-0649
Mr.	Scott	Hochhalter	State Soil Specialist	NDSU Extension Service	2718 Gateway Ave., #104	Bismarck	ND	58503
Mr.	Jeff	Person	Paleontologist		600 E. Blvd. Ave.	Bismarck	ND	58505

First Name	Company Name	Department	Address Line 1	Address Line 2	City
Keith Berndt	Cass County Administrator		P.O. Box 2806		Fargo, North Dakota 58108-2806
Cass County Sheriff Paul Laney	Sheriff's Department		P.O. Box 488		Fargo, ND 58107-0488
Cass County Emergency Management			4630 15 Avenue North		Fargo, ND 58102
Jason Benson, Cass County Engineer	Cass County Highway Department		1201 Main Ave West		West Fargo, ND 58078
Mary Scherling	Chairwoman, Cass County Commission		P.O. Box 2806		Fargo, North Dakota 58108-2806
Bill Stansbery, Mayor			301 Gridley Ave		Amenia, ND 58004-4010
Lee Anderson, Mayor			PO Box 327		Casselton, ND 58012

Discussion and Disposition of Comments from Letter Received on the Draft Watershed Plan and Environmental Assessment

Not all agencies and groups requested to comment on the Draft Watershed Plan and Environmental Assessment submitted comments. The responding agencies' and groups' comments and the dispositions of each are as follows:

United States Army Corps of Engineers (USACE) Omaha District – North Dakota Regulatory Office

Comment: A section 10 permit would be required for work impacting navigable waters, this includes work over, through or under Section 10 waters. A Section 404 permit would be required for the discharge of dredge or fill material (temporarily or permanently) in waters of the United States.

Response: Comment noted. Permitting requirements have been addressed in the Draft Watershed Plan and EA.

USACE - Omaha District – Planning, Programs, and Project Management Division

Comment: The project area is land located outside of the Corps, Omaha District's civil works boundary; therefore, we cannot provide specific comments on impacts to Corps owned or operated lands or environmental-based comments on the project. Contact the St. Paul District as they have civil works jurisdiction over this area.

Response: Comment noted.

Comment: This project is located within the Corps' State of North Dakota regulatory boundary. As such, any proposed placement of dredged or fill material into waters of the United States will require Department of the Army authorization under Section 404 of the Clean Water Act. Inquiries on Section 404 permit requirements should be directed to the Omaha District Bismarck Regulatory Office.

Response: Comment noted. Permitting requirements have been addressed in the Draft Watershed Plan and EA.

North Dakota Forest Service

Comment: The project will likely impact riparian forests. Our riparian forests have been identified in North Dakota's Statewide Assessment of Forest Resources and Forest Resource Strategy as high priority forest areas. We encourage the project proponent to consider the impacts of any management decisions on riparian forests, utilize construction techniques that will avoid or minimize loss of these limited natural resources, and encourage the replacement of any trees or shrubs destroyed as a result of this project.

Response: Comment noted. Impacts to riparian forests have been addressed in the Draft Watershed Plan and EA.

North Dakota Geological Survey

Comment: No fossil sites have been identified in the Project Area. It is unlikely that paleontological sites will be encountered in the Cass, Barnes, Griggs, Steele, or Traill County tracts because those areas are covered with generally unfossiliferous glacial deposits.

Response: Comment noted.

North Dakota Parks and Recreation

Comment: The project as defined does not affect state park lands that we manage but may affect state Land and Water Conservation Fund (LWCF) project sites that we manage. A map with LWCF project locations has been attached.

Response: Potential impacts to LWCF lands are addressed in the Draft Watershed Plan and EA.

Comment: The North Dakota Natural Heritage biological conservation database has been reviewed to determine if any plant or animal species of concern or other significant ecological communities are known to occur within and approximate one-mile radius of the project area. Based on this review, there are several documented occurrences in our database within or adjacent to the project area.

Response: Potential impacts to species of concern or other significant ecological communities are addressed in the Draft Watershed Plan and EA.

North Dakota Department of Emergency Services

Comment: The North Dakota Department of Emergency Services has done numerous projects within the Rush River Watershed, including the following:

- North Dakota State Water Commission/U.S. Geological Survey Gaging Station Satellite Telemetry Installation – Rush River by Amenia (Lat 47.01531, Long -97.28401).
- Guy Wire Additions – Minnkota Power Cooperative Structure 1160 (Lat 46.95154, Long -97.28401).
- Guy Wire Additions – Minnkota Power Cooperative Structure 1294 (Lat 46.95212, Long -97.17768).

The North Dakota Department of Emergency Services requests that during the planning process of the Rush River Watershed that the CCJWRD, Moore Engineering, and Barr Engineering take into consideration the above mentioned projects when developing new strategies, goals, and projects associated with water related concerns within these watersheds.

Response: Comment noted. None of these projects have been identified as have a potential to contribute to cumulative impacts.

North Dakota Department of Transportation

Comment: The North Dakota Department of Transportation (NNDOT) has state and interstate highways that are located within the watershed areas. It is necessary to know of any changes in those watershed areas would impact our transportation system. If drainage modifications are proposed, NDDOT would like consideration given to modifications that would improve flooding as historically happens to some of the highways in the watershed areas.

Response: Potential impacts to transportation is addressed in the Draft Watershed Plan and EA.

Comment: If because of this project any work needs to be done on highway right of way, appropriate permits and risk management documents will need to be obtained from the department of Transportation District Engineer, Robert Walton.

Response: Comment noted.

North Dakota Game and Fish Department

Comment: It is important to identify and mitigate potential impacts to fish and wildlife resources associated with the watershed plan. We also believe this process must be conducted from a comprehensive perspective that includes not only future activities but past as well.

Response: Potential impacts to fish and wildlife are addressed in the Draft Watershed Plan and EA.

Comment: The construction of dams or "dry" dams within the river channel interrupts the river's continuum by impeding the physical and biological processes in the river system. The construction of a dam across rivers and streams will have more than a de minimis (i.e. inconsequential) effect on the river system and will cause identifiable individual and cumulative adverse effects on aquatic function (i.e. fish and wildlife life history requirements).

Response: Comment noted. Potential impacts to fish and wildlife are addressed in the Draft Watershed Plan and EA.

Comment: With any alternative analysis, the Department's primary concern is maintaining a relatively natural hydrography and stream connectivity in the Red River and its tributaries while still providing flood protection to the citizens. It is also important that the least damaging alternative be implemented to minimize impacts to fish and wildlife resources.

Response: Comment noted.

Natural Resources Conservation Service – North Dakota

Comment: A review of our data indicates that the Natural Resources Conservation Service-North Dakota does not own any properties in the proposed watersheds. In addition, the Natural Resources Conservation Service-North Dakota does not have any conservation easements in the Rush River Watershed.

Response: Comment noted.

Department of Energy (Western Area Power Administration)

Comment: Western Area Power Administration has three transmission lines within Cass County that may be impacted by one or more watershed areas. A primary concern is to maintain access to all of our structures in order to perform routine and/or emergency maintenance. A second concern would be the creation of any holding pond or pool whose elevation can fluctuate. Our concern in that case would be reducing vertical clearances and not meeting National Electrical Safety Code requirements.

Response: Comment noted.

Dyan R. Youpee – Fort Peck Tribal Historic Preservation Officer

Comment: I've reviewed the following projects and give the concurrence to proceed with the proposed ground disturbing/earth moving activity, they do not have adverse effects on cultural/historical properties significant to the Fort Peck Tribes. However, first and foremost, my concurrence will stay in consensus with the closest THPO's to these selected project areas. Should they NOT comment on the selected projects, then I give this concurrence to proceed for:

> Projects: PL – 566 Watershed plans under NRCS, RCPP in ND. Rush River, North Branch Park River, and Upper Maple River.

Should there be any updates to the proposed activities (other than listed on the review request), please provide an update to the T.H.P.O. with new information regarding further construction than proposed. AND should there be unanticipated inadvertent discoveries (human remains, archaeological and cultural resources uncovered), contact the Fort Peck T.H.P.O. along with your intended contacts for the projects. If there are any questions as to what these resources are, please do not hesitate to contact me. I am also willing to assist in a site visit if needed.

Response: Comment noted.

Jaime Arsenault - White Earth Reservation Tribal Historic Preservation Officer

Comment: Based upon a preliminary inquiry, there are no known cultural resources that I have on internal file for this area. This determination is based upon available information provided to this office. However, this review does not preclude the possibility of previously unknown cultural resources especially near areas of water, or elevated ground. If cultural materials are uncovered in the course of construction, all work must cease and the Tribal Historic Preservation Office must be contacted immediately at (413) 522-2345. Furthermore, I am requesting to remain in contact/consultation with you regarding all watershed projects that involve waterways that run into lakes or rivers on or near the White Earth Reservation and surrounding areas where ricing and fishing occur. Lastly, I am requesting that you reach out directly to Jim Jones at jim.jones@state.mn.us because Mr. Jones has done some recent cultural resource survey work in ND and may be able to provide valuable insight.

Response: Comment noted.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
NORTH DAKOTA REGULATORY OFFICE
1513 SOUTH 12TH STREET
BISMARCK ND 58504-6640

February 9, 2016

North Dakota Regulatory Office

Mr. Pat Downs
Moore Engineering, Inc.
925 10th Avenue East
West Fargo, North Dakota 58078

Dear Mr. Downs:

This is in response to your letter dated January 15, 2016, requesting comments on the Cass County Joint Water Resource District Watershed Planning Process for Swan Creek, Rush River, and Upper Maple River Watersheds. The United States Army Corps of Engineers is aware of the watershed planning process mentioned in your letter and will be acting as a cooperating agency.

U. S. Army Corps of Engineers Regulatory Offices administer Section 10 of the Rivers and Harbors Act (Section 10) and Section 404 of the Clean Water Act (Section 404). A Section 10 permit would be required for work impacting navigable waters, this includes work over, through, or under Section 10 waters. A Section 404 permit would be required for the discharge of dredge or fill material (temporarily or permanently) in waters of the United States. Waters of the United States may include, but are not limited to, rivers, streams, ditches, coulees, lakes, ponds, and their adjacent wetlands. Fill material includes, but is not limited to, rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from mines or other excavation activities and materials used to create any structure or infrastructure in waters of the United States.

If the project requires a Section 10/404 permit, a permit application and instructions for completion may be found at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/ObtainaPermit.aspx. If you do not have access to a computer, you may call this office and request a copy of the permit application and instructions be sent to you.

If we can be of further assistance or should you have any questions regarding our program, please do not hesitate to contact this office by letter or phone at (701) 255-0015.

Sincerely,

Patricia L. McQueary
Regulatory Program Manager
North Dakota

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

February 1, 2016

Planning, Programs, and Project Management Division

Mr. Pat Downs
Moore Engineering, Inc.
925 10th Avenue East
West Fargo, North Dakota 58078

Dear Mr. Downs:

The U.S. Army Corps of Engineers, Omaha District (Corps) has reviewed your letter dated January 15, 2016 (received January 20, 2016) regarding the environmental review of the Cass County Joint Water Resource District Watershed Planning Process for Swan Creek, Rush River, and the Upper Maple River Watersheds in North Dakota. The project area is land located outside of the Corps, Omaha District's civil works boundary; therefore, we cannot provide specific comments on impacts to Corps owned or operated lands or environmental-based comments on the project. For these type of comments you will need to contact our St. Paul District as they have civil works jurisdiction over this area. Please direct all future correspondence regarding this project to the following address:

U.S. Army Corps of Engineers
St. Paul District
Attention: Mr. Aaron Snyder, CEMVP-PM-B
180 Fifth Street East, Suite 700
St. Paul, Minnesota 55101

This project is located within the Corps' State of North Dakota regulatory boundary. As such, any proposed placement of dredged or fill material into waters of the United States will require Department of the Army authorization under Section 404 of the Clean Water Act. Inquiries on Section 404 permit requirements should be directed to the Omaha District Bismarck Regulatory Office. Preliminary and final project plans should be sent to the following address:

U.S. Army Corps of Engineers
Bismarck Regulatory Office
Attention: Ms. Patricia McQueary, CENWO-OD-R
1513 South 12th Street
Bismarck, North Dakota 58504

If you have any questions, please contact Ms. Amanda Ciurej of my staff at (402) 995-2897 or amanda.k.ciurej@usace.army.mil and reference PD# 6806 in the subject line.

Sincerely,

Eric A. Laux
Chief, Environmental Resources and Missouri River Recovery Program Plan Formulation Section

NORTH DAKOTA FOREST SERVICE

"Enhancing the Quality of Life Through Forestry"

February 3, 2016

Pat Downs, Project Coordinator
Moore Engineering, Inc.
925 10th Avenue East
West Fargo, ND 58078

Re: Cass County JWRD, Watershed Planning Process for Swan Creek, Rush River and Upper Maple River Watersheds

Dear Mr. Downs,

The North Dakota Forest Service has reviewed the information concerning the above-referenced project with regard to possible impacts on North Dakota's forest resources. While we own no land in or adjacent to the proposed project we note that the project will likely impact riparian forests within the watersheds.

Our riparian forests have been identified in North Dakota's Statewide Assessment of Forest Resources and Forest Resource Strategy as high priority forest areas. Riparian forests provide many environmental and social benefits. Trees and woody plants along watercourses help to control soil erosion and filter agricultural chemicals from reaching rivers. In addition, riparian forests provide recreational opportunities and provide habitat for numerous wildlife species.

We encourage the project proponent to consider the impacts of any management decisions on riparian forests, utilize construction techniques that will avoid or minimize loss of these limited natural resources, and encourage the replacement of any trees or shrubs destroyed as a result of this project. If you have any questions regarding our comments, please feel free to contact this office.

Sincerely,

Liz Smith

Liz Smith, ND Forest Service
Cc: Larry Kotchman, State Forester

Liz Smith, Forestry Incentives Specialist, NDSU-ND Forest Service
Jamestown Field Office 300 2nd Ave NE, Suite 208A Jamestown, North Dakota 58401
701-400-8330 liz.smith@ndsu.edu www.ndsu.edu/ndfs

North Dakota Geological Survey

Edward C. Murphy - State Geologist

Department of Mineral Resources

Lynn D. Helms - Director

North Dakota Industrial Commission

www.state.nd.us/ndgs

February 4, 2016

Pat Downs
Project Coordinator
Moore Engineering, Inc.
925 10th Ave. East
West Fargo, ND 58078

Pat,

I have reviewed our records to determine if any paleontological sites have been reported from the tracts listed for the:

Cass County Joint Water Resource District
Watershed Planning Process for Swan Creek, Rush River, and Upper Maple River Watersheds

No fossil sites have been identified in any of the tracts listed.

It is unlikely that paleontological sites will be encountered in the Cass, Barnes, Griggs, Steele, or Traill County tracts because those areas are covered with generally unfossiliferous glacial deposits.

Sincerely,

Jeff Person
Paleontologist
North Dakota Geological Survey

Jack Dalrymple, Governor
Mark A. Zimmerman, Director

1600 East Century Avenue, Suite 3
Bismarck, ND 58503-0649
Phone 701-328-5357
Fax 701-328-5363
E-mail parkrec@nd.gov
www.parkrec.nd.gov

February 12, 2016

Moore Engineering
Pat Downs
925 10th Ave. East
West Fargo, ND 58078

Re: Cass County Joint Water Resource District – Watershed Planning Process for Swan Creek, Rush River and Upper Maple River Watersheds

Dear Pat:

The North Dakota Parks and Recreation Department has reviewed the above referenced proposal for Cass County Joint Water Resource District – Watershed Planning Process for Swan Creek, Rush River and Upper Maple River Watersheds

Our agency scope of authority and expertise covers recreation and biological resources (in particular rare plants and ecological communities). The project as defined does not affect state park lands that we manage but may affect state Land and Water Conservation Fund (LWCF) project sites that we manage. A map with LWCF project locations has been attached. All LWCF sites received assistance from the federal LWCF program and are under protection of section 6(f) of the LWCF Act. Any property taken from within the 6f boundary of these sites must be replaced with property of equal market value. Should any public or private utilities need to be added or relocated on the LWCF recreational lands, the NDPRD must be consulted prior to any action taken. Please contact Kevin Stankiewicz (701-328-5364 or kstankiewicz@nd.gov if additional LWCF information is needed.

The North Dakota Natural Heritage biological conservation database has been reviewed to determine if any plant or animal species of concern or other significant ecological communities are known to occur within an approximate one-mile radius of the project area. Based on this review, there are several documented occurrences in our database within or adjacent to project area. Because this information is not based on a comprehensive inventory, there may be species of concern or otherwise significant ecological communities in the area that are not represented in the database. The lack of data for any project area cannot be construed to mean that no significant features are present. The absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources.

We appreciate your commitment to rare plant, animal and ecological community conservation, management and inter-agency cooperation to date. For additional information please contact me at (701-328-5370 or kgduttenhefner@nd.gov). Thank you for the opportunity to comment on this proposed project.

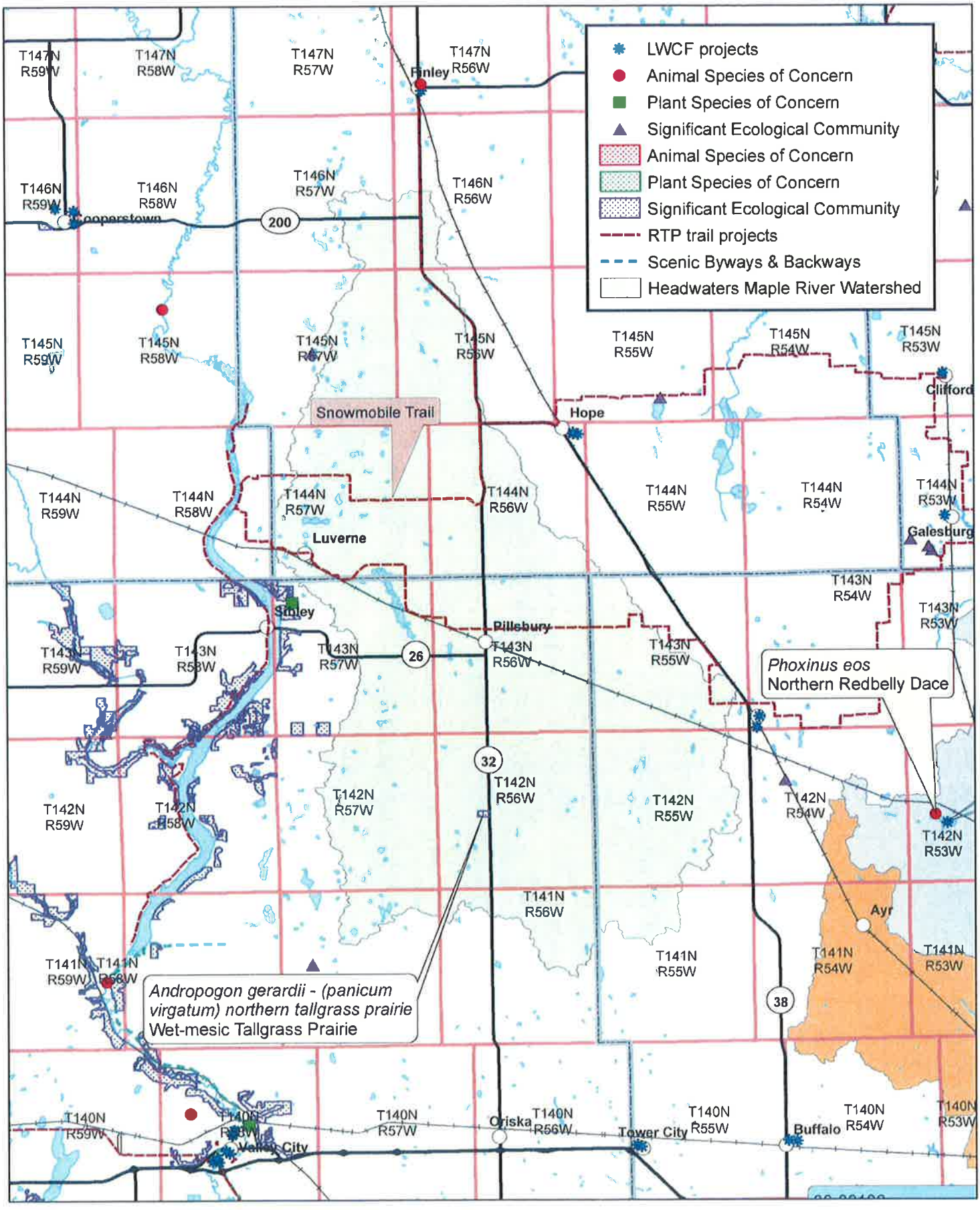
Sincerely,

Kathy Duttenhefner, Coordinator
Natural Resources Division

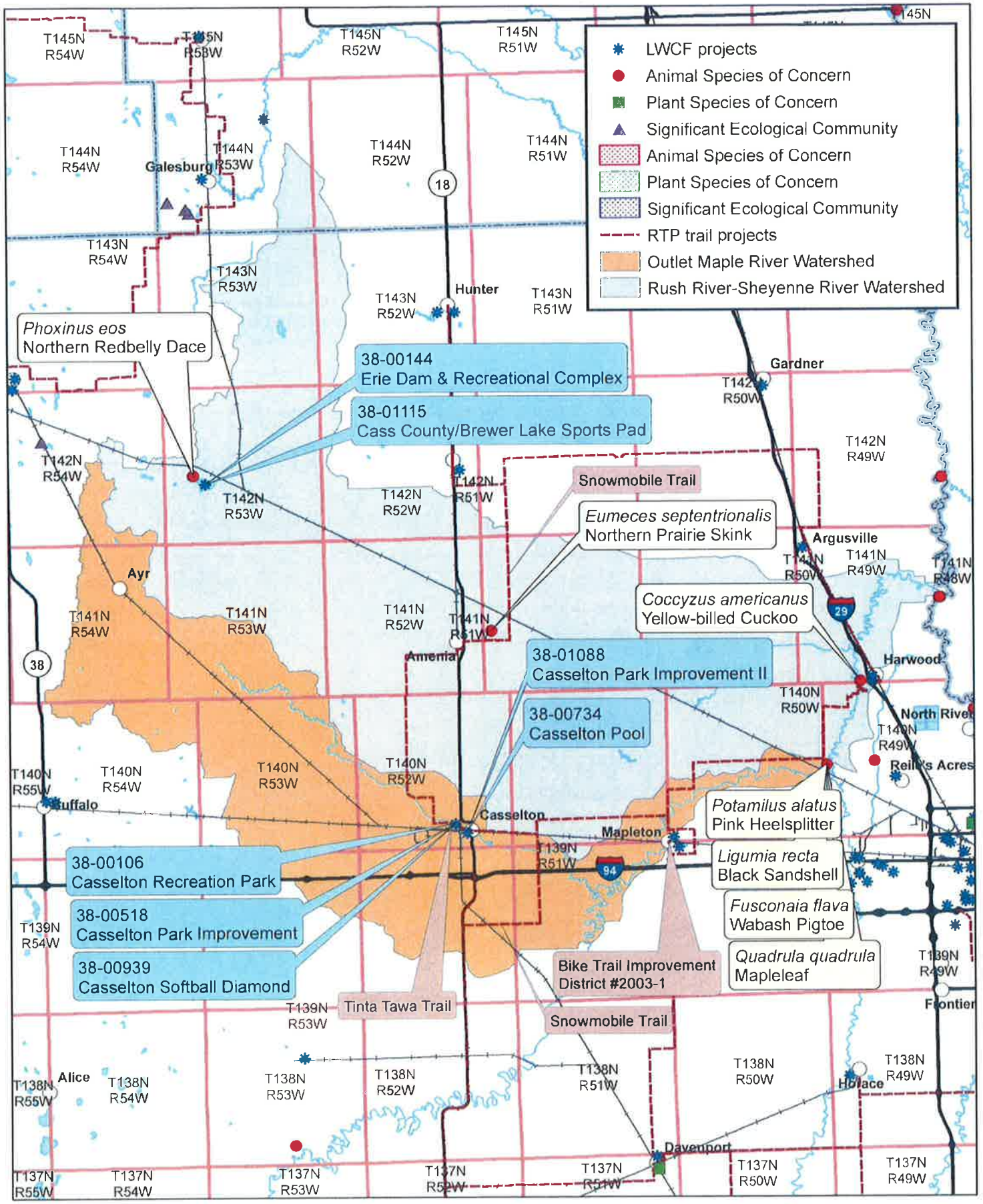
R.USNDNHI*2016-024KD2.12.2016DL2.15.2016

Play in our backyard!

North Dakota Parks and Recreation Department
North Dakota Natural Heritage Inventory



North Dakota Parks and Recreation Department
North Dakota Natural Heritage Inventory



ND Department of Emergency Services

PO Box 5511 Tel: (701) 328-8100 Email: nddes@nd.gov
Bismarck, ND 58506-5511 Fax: (701) 328-8181 Website: www.nd.gov/des

Ensuring a safe and secure homeland for all North Dakotans

February 3, 2016

Mr. Pat Downs
Project Coordinator
Moore Engineering, Inc.
925 10th Ave E
West Fargo, ND 58078

RE: Cass County Joint Water Resource District - Watershed Planning process for Swan Creek, Rush River, and Upper Maple River Watersheds

Dear Mr. Downs,

The ND Department of Emergency Services (NDDES) has received your letter requesting any views or comments our agency may have concerning the proposed Cass County Joint Water Resource District (CCJWRD) watershed planning process of the Swan Creek, Rush River, and Upper Maple River Watersheds, especially in reference to any properties we may have acquired or future developments planned within these three water sheds.

NDDES has done numerous projects within the Swan Creek, Rush River, and Upper Maple River Watersheds. The following is a full list of completed projects that have taken place in these areas, as well as addresses and/or GPS coordinates when applicable:

Swan Creek Watershed:

- Lift Station and Force Main Improvements
  - 9th Ave S Lift Station, Casselton, ND
  - Lat 46.95154, Long -97.28401
- Guy Wire Additions – Minnkota Power Cooperative Structure 1160 – Also in Rush River Watershed
  - Lat 46.95154, Long -97.28401
- Guy Wire Additions – Minnkota Power Cooperative Structure 1143
  - Lat 46.94867, Long -97.3396
- Guy Wire Additions – Minnkota Power Cooperative Structure 1102
  - Lat 46.94843, Long -97.48219

Rush River Watershed:

- ND State Water Commission/ US Geological Survey Gaging Station Satellite Telemetry Installation – Rush River by Amenia
  - Lat 47.01531, Long -97.21372
- Guy Wire Additions – Minnkota Power Cooperative Structure 1160 – Also in Swan Creek Watershed
  - Lat 46.95154, Long -97.28401
- Guy Wire Additions – Minnkota Power Cooperative Structure 1294
  - Lat 46.95212, Long -97.17768

Upper Maple River Watershed

- Acquisition/Demolition of Private Real Property
    - 1225 126th Ave SE, Hope, ND 58046 – Barnes County
    - Lat 47.23228, Long -97.83367

NDDES requests that during the planning process of the Swan Creek, Rush River, and Upper Maple River Watersheds that the CCJWRD, Moore Engineering, and Barr Engineering take into consideration the above mentioned projects when developing new strategies, goals, and projects associated with water related concerns within these water sheds.

Additionally, the Acquisition/Demolition of Private Real Property located at 1225 126th Ave SE, Hope, ND 58046 has a FEMA Hazard Mitigation Assistance (HMA) deed restriction placed on the property in order to prevent the construction or placement of any permanent structures on this land in perpetuity pursuant to 44 CFR Part 80.19. Any construction that happens on this property will need to remain compliant with 44 CFR Part 80.19 or the local applicants responsible for this lot will be considered non-compliant with federal regulations until all identified violations are remedied.

Beyond the above mentioned projects, NDDES does not have any other projects in these watersheds currently planned or in development. If you have any other questions or need additional information, please contact Justin Messner, State Mitigation Officer, at 701-328-8107.

Sincerely,

Cody Schulz
Disaster Recovery Chief

North Dakota Department of Transportation

Grant Levi, P.E.
Director

Jack Dalrymple
Governor

January 25, 2016

Pat Downs
Moore Engineering, Inc.
925 10th Avenue East
West Fargo, ND 58078

WATERSHED PLANNING PROCESS FOR SWAN CREEK, RUSH RIVER, AND UPPER MAPLE RIVER WATERSHEDS, CASS COUNTY, NORTH DAKOTA

We have reviewed your January 15, 2016, letter.

The North Dakota Department of Transportation (NDDOT) has State and Interstate Highways that are located within the watershed areas. It is necessary to know of any changes in those watershed areas that would impact our Transportation System. If drainage modifications are proposed, NDDOT would like consideration given to modifications that would improve flooding as historically happens to some of the highways in the watershed areas.

Additionally, if because of this project any work needs to be done on highway right of way, appropriate permits and risk management documents will need to be obtained from the Department of Transportation District Engineer, Robert Walton at 701-239-8903.

Robert Fode

ROBERT A. FODE, P.E., DIRECTOR – OFFICE OF PROJECT DEVELOPMENT

57/raf/js
c: Robert Walton, Fargo District Engineer

"VARIETY IN HUNTING AND FISHING"

NORTH DAKOTA GAME AND FISH DEPARTMENT

100 NORTH BISMARCK EXPRESSWAY BISMARCK, NORTH DAKOTA 58501-5095 PHONE 701-328-6300 FAX 701-328-6352

February 9, 2016

Pat Downs
Moore Engineering
925 10th Avenue East
West Fargo, ND 58078

Dear Mr. Downs:

Re: Swan Creek, Rush river and Upper Maple River Watershed Planning

The North Dakota Game and Fish Department (Department) has received notification of Cass County Joint Water Resource District's proposal to initiate watershed planning processes for Swan Creek, Rush River and Upper Maple River watersheds. The watershed planning process will rely on local input and a team of stakeholders to identify water-related concerns within each rural watershed, such as overland flooding, delayed planting, crop damages, infrastructure failure and other potential impacts.

The Department realizes the importance of protecting infrastructure and private property, but it is important for us to identify and mitigate potential impacts to fish and wildlife resources associated with watershed plans. We also believe this process must be conducted from a comprehensive perspective that includes not only future activities but past as well. Landscapes are becoming increasingly altered and fragmented over time. These changes are impacting water quality and sediment transport, changes in the timing of stream hydrology and peak flows, loss of wetlands and upstream retention to name a few. A comprehensive flood control plan should look to incorporate numerous features (i.e. wetland restoration, voluntary buyouts, setbacks, river continuity, etc.) which could protect farmland and still protect the integrity of a natural river system.

Nationally, there has been a push to remove barriers from waterways thereby reestablishing migration corridors for fish, mussels, amphibians, and other aquatic and riparian organisms. 'The River Continuum Concept' is based on the premise that a river or stream's ecosystem is constantly interacting with the river bank, its flood plain and the organic and biological components in the watershed. There is a balance that needs to be maintained between the rivers geomorphological characteristics (i.e. width, depth, velocity, sediment load) and biological factors. The construction of dams or "dry" dams within the river channel interrupts the river's continuum by impeding the physical and biological processes in the river system. The construction of a dam across rivers and streams will have more than a de minimis (i.e. inconsequential) effect on the river system and will cause identifiable individual and cumulative adverse effects on aquatic function (i.e. fish and wildlife life history requirements).

With any alternative analysis, the Department's primary concern is maintaining a relatively natural hydrograph and stream connectivity in the Red River and its tributaries while still providing flood protection to the citizens. It is also important that the least damaging alternative be implemented to minimize impacts to fish and wildlife resources. As an example, the Department encourages the project sponsors to consider projects off the mainstem of tributaries such as the North Ottawa Project in the Bois de Sioux Watershed District. This project was designed on lateral drainage ditches to provide flood control benefits as well as numerous environmental benefits. Management of the project allows portions of the area to remain in agricultural production while providing migratory bird and shorebird habitat, water quality improvements, downstream environmental flows and public recreation.

Depending on the type of projects proposed, the Department could request in-kind mitigation for all impacts of a project including but not limited to river channel habitat, riparian impacts, aquatic organism passage, wetland impacts and geomorphological impacts.

Sincerely,

Steve Dyke

(for) Greg Link
Chief
Conservation & Communication Division

blk

Department of Energy
Western Area Power Administration
North Dakota Maintenance Office
P.O. Box 1173
Bismarck, ND 58502-1173

6430 January 21, 2016

SENT VIA EMAIL ONLY

Moore Engineering, Inc.
ATTN: Pat Downs
925 10th Avenue East
West Fargo, ND 58078

Dear Mr. Downs:

I have reviewed your letter dated January 15, 2016 pertaining to the Cass County JWRD Watershed Planning Process for Swan Creek, Rush River and Upper Maple River Watersheds. Western has three transmission lines within Cass County that may be impacted by one or more of the watershed areas.

A primary concern for Western is to maintain access to all of our structures in order to perform routine and/or emergency maintenance. A second concern would be the creation of any holding pond or pool whose elevation can fluctuate. Our concern in that case would be reducing vertical clearances and not meeting National Electrical Safety Code requirements.

Being this project is only in the investigative stage, we will await a specific proposal(s) if it appears that they will involve our transmission line easement areas.

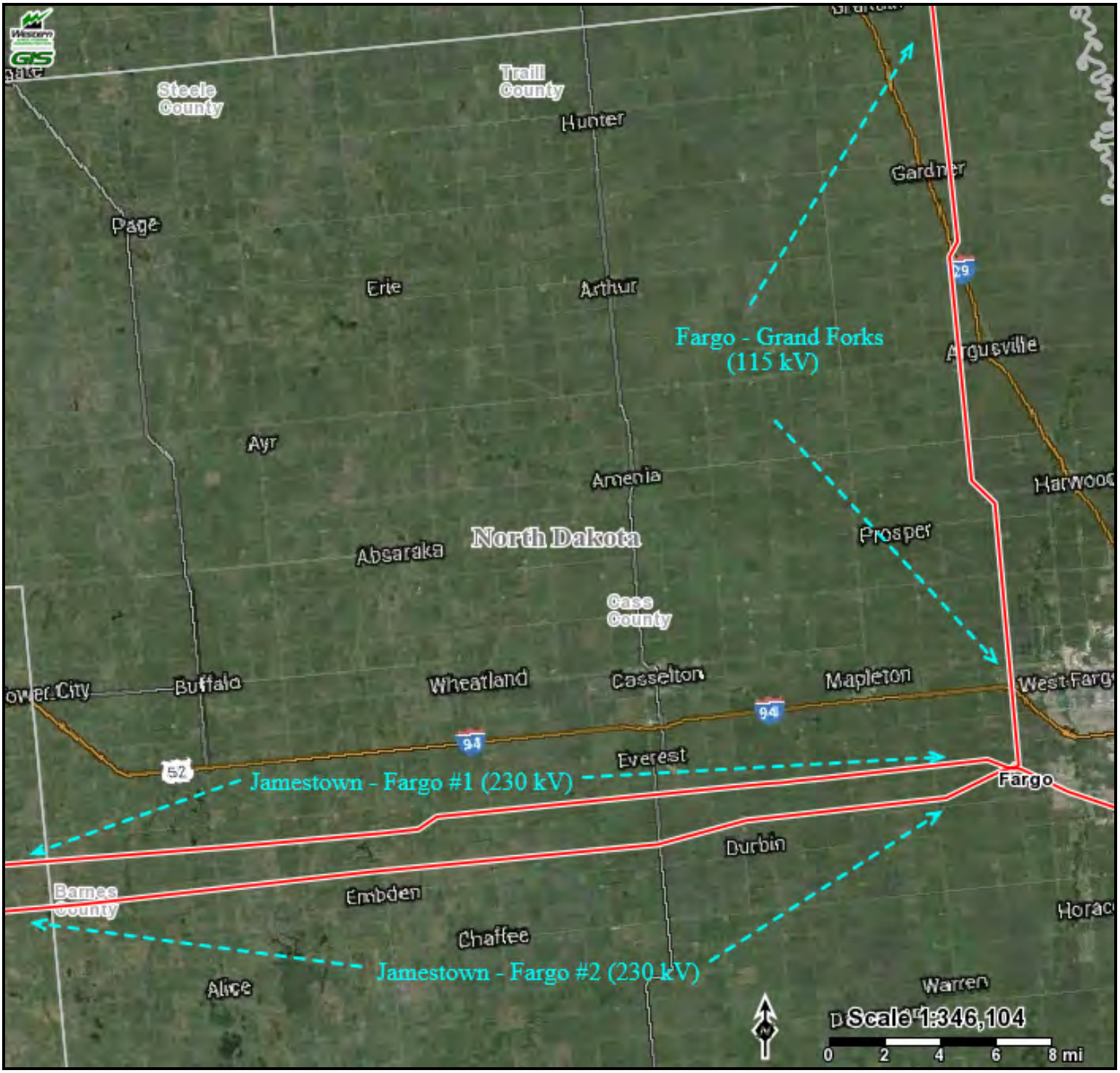
If you need additional information or have questions, please contact me at 701-221-4531 or email me at gpaulson@wapa.gov.

Sincerely,

Gerald T. Paulson, Director
Transmission Line Division

cc:
B5210.FAO, S. Scholl, West Fargo, ND
B5522.BS, A. Wood, Bismarck, ND

Western Area Power Transmission Lines in Cass County, ND



Western Area Power Administration
An agency of the U.S. Department of Energy

TRIBAL HISTORIC PRESERVATION OFFICE

Fort Peck Assiniboine & Sioux Tribes

January 2, 2019

To: Department of Agriculture
Natural Resources Conservation Services
Bismarck State Office
P.O. Box 1458, Bismarck ND 58502-1458

Fr: Dyan R. Youpee, Fort Peck Tribal Historic Preservation Officer

Cc: Mary E. Podoll, State Conservationist
Chuck Carrig, State Cultural Resources Specialist – chuch.carrig@nd.usda.gov

Chuck Carrig,

The laws and policies that protect historic and cultural resources, whether they be at the local, state or federal level, are essential and often the most effective tools to accomplishing historic preservation; yet no other approach is as controversial or misunderstood.

Information is a powerful tool. The most basic, yet critical information for successful preservation activity is the simple identification of historic and cultural resources. If we don't know what exists, how can we preserve it, let alone, use it effectively for the betterment of our communities? With every year, more properties are viewed as historic. Many are different property types and architectural styles become acknowledged as significant. T.H.P.O. survey and inventory are an ongoing and constant evolving endeavor. Once a community is aware of the historic resources it has, information on the tools, funding, methods and technologies of preservation become essential.

I've reviewed the following projects and give the concurrence to proceed with the proposed ground disturbing / earth moving activity, they do not have adverse effects on cultural / historical properties significant to the Fort Peck Tribes. ***However****, first and foremost, my concurrence will stay in consensus with the closest THPO's to these selected project areas. Should they NOT comment on the selected projects, then I give this concurrence to proceed for:*

Projects: PL – 566 Watershed plans under NRCS, RCPP in ND. Rush River, North Branch Park River, Upper Maple River

Should there be any updates to the proposed activities (other than listed on the review request), please provide an update to the T.H.P.O. with new information regarding further construction than proposed. AND should there be unanticipated inadvertent discoveries (human remains, archaeological and cultural resources uncovered), contact the Fort Peck T.H.P.O. along with your intended contacts for the projects. If there are any questions as to what these resources are, please do not hesitate to contact me. I am also willing to assist in a site visit if needed. Thank you for your cooperation and request for review. If there is anything further you need, please contact the office.

FORT PECK ASSINIBOINE & SIOUX TRIBES
CONCURRENCE
DATE: 1-2-2019
TRIBAL HISTORIC PRESERVATION OFFICER

MS. DYAN YOUPEE, T.H.P.O.
501 Medicine Bear Road
P.O. Box 1027
Poplar, MT 59255
O: 406.768.2382
E: d.youpee@fortpecktribes.net

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

April 6, 2020

USDA-NRCS
Attn: Christi Fisher, SCE
PO Box 1458
Bismarck, ND 58502-1458

The Natural Resources Conservation Service (NRCS) has reviewed your letter dated April 2, 2020, concerning the Rush River Watershed Plan.

NRCS has a major responsibility with the Farmland Protection Policy Act (FPPA) in documenting conversion of farmland (i.e., Prime, Statewide Importance and/or Local Importance) to non-agricultural use when federal funding is used. Your proposed project is within city limits where FPPA does not apply; therefore, no further action is needed.

If you have additional questions pertaining to FPPA, please contact Wade Bott, State Soil Scientist, NRCS, Bismarck, North Dakota at (701) 530-2021 or email to wade.bott@usda.gov.

WADE BOTT
Digitally signed by WADE BOTT
Date: 2020.04.06 13:47:44
-05'00'

WADE D. BOTT
State Soil Scientist

United States Department of Agriculture

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

November 5, 2018

North Dakota State Historical Society
Attn: Ms. Claudia Berg, Director
612 East Boulevard Ave.
Bismarck, North Dakota 58505

RE: Initial Consultation regarding seven PL-566 Watershed plans under the Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program (RCPP) in North Dakota

Dear Ms. Berg:

In accordance with 36 CFR 800.3, North Dakota NRCS is providing this initial consultation letter regarding seven PL-566 Watershed Planning Efforts being completed under funding through the NRCS Regional Conservation Partnership Program (RCPP) in North Dakota. The local Sponsoring Water Resource District for each plan, as well as the watershed boundary, and the specific objectives for that plan are outlined on the attached fact sheets. In general, reduction of risks or damages to public safety, natural resources, and economic damages from flooding, as well as related erosion and nutrient delivery, are the goals of the plans. Multiple structural alternatives such as on channel dams, off channel storage structures, diversion channels, levees, wetland restoration, and river channel restoration are identified and evaluated through the course of each effort. An Environmental Assessment will be prepared for each PL-566 Watershed Plan, which are expected to be completed by October 2019.

At this point, three of the seven plans are to the point of having final structural alternatives chosen for detailed study. The remainder are in the technical evaluation phase. Further feasibility analysis is currently being completed on these three alternatives, including preliminary environmental and cultural resource impact assessments. See attached conceptual alternatives maps for the Rush River (levees and channel), North Branch Park River (channels and off channel flood storage reservoirs), and Upper Maple River (on channel dams).

Due to the complexities of the seven PL-566 Watershed plans and the numerous alternatives being formulated under the NEPA process, NRCS would like to complete the Section 106 process using the Phased Identification and evaluation process as allowed under 36 CFR 800.4(b)(2) and 36 CFR 800.8.

(MORE)

Enclosed with this initial consultation letter, you will find project maps and other pertinent documents related to the proposed Areas of Potential Effect (APE).

We look forward to working with your office on these proposed RCPP Watershed plans and if you have any questions, please contact me at (701)530-2104 or by email at chuck.carrig@nd.usda.gov.

Sincerely,

CHUCK CARRIG
State Cultural Resources Specialist

Enclosures

cc:

Project Team - Rush River Watershed Planning					
Name	**Name - 2**	**Address**	**City**	**State**	**Zip**
Bill Hejl		15560 28th St SE	Amenia	ND	58004
Shaun Nelson		4400 Beach Ln S	Fargo	ND	58104
David Strand		14927 26th St SE	Amenia	ND	58004
Jake Gust		4614 81st St N	Fargo	ND	58102
Dick Sundberg		210 Park Dr	Harwood	ND	58042
Keith Peltier	ProSeed	201 Gridley Ave	Amenia	ND	58004
Levi Arneson		3321 4th Ave S - Suite E	Fargo	ND	58103
Donna Myers		1102 2nd St S - Unit 211	Casselton	ND	58012
Bill Stansberry - Mayor		n/a			
Agencies					
Jason Benson	Cass County Eng.	1201 West Main Ave	West Fargo	ND	58078
Tom Soucy	Cass County Hwy Dept	1201 West Main Ave	West Fargo	ND	58078
Keith Weston	RRRA	1220 28th Ave N - Suite C	Fargo	ND	58102
Randy Gjestjang	ND Dept of Water Resources	1220 28th Ave N - Suite C	Fargo	ND	58102
Bruce Kreft	ND - G&F Dept	100 N East Bismarck Expressway	Bismarck	ND	58501
Jeff Miller	Cass County SCD	1665 43rd St S	Fargo	ND	58103
Eric Dahl	Cass County SCD	1665 43rd St S	Fargo	ND	58103
Mike Ell	ND - State Health Dept	600 East Blvd Ave	Bismarck	ND	58505-0200
Patricia McQuery	USACE	3319 University Drive	Bismarck	ND	58504
Jerry Reinisch	USFWS	3425 Miriam Ave	Bismarck	ND	58501
Josh Munson	Cass County NRCS	1665 43rd St S	Fargo	ND	58103

Amenia (Rush River Watershed) Strategies

Meet P&N - Goals
Yes
No
?

Meet P&N - Further Consideration	
Primary Consideration	Primary
Secondary Consideration	Secondary
Not Applicable to the Plan	Not Applicable

Project Team Results: 12/18/17

Amenia - Project Team Strategy Review Flood Damage Reduction Strategies (TP#11)

Goal #3: Minimal or no impact to other properties/landowners.
NOTED HERE: No means there may be impacts to landowners; Yes means: There should be no or minimal impact to land owners
Goal #6: Impacts to Riparian and Aquatic resources:
Noted here; No means there are likley negative impacts to existing Riparian areas and Aquatic resources.
Yes means, there should be no impacts to Riparian areas and Aquatic resources (Or possible improvements)

		Outcome/Goal #1: Reduce Flood Risk	Outcome/Goal #2: Remove the need for Flood Insurance	Outcome/Goal #3: Minimal or no impact to other properties/Landowners **	Outcome/Goal #4: City remains in place	Outcome/Goal #5: Costs that are reasonable	Goal #6 : Minimal Impacts to Riparian & Aquatic Resources **	Other	Likely to create downstream impacts (Yes - No)	Locally desirable for additional evaluation (Primary, Secondary, or Not Applicable)	Additional Comments
Increase Temporary Flood Storage	Dams and Impoundments (Gated & Ungated)	Yes	?	No	Yes	?	?		No	Secondary	
	Restored or Created Wetlands (new added storage - acting as impoundments - control)	Yes	No	Yes	Yes	?	Yes		No	Secondary	Could be a final tool box strategy for the watershed as a whole - would need willing landowners for a voluntary program
	Alter ground water through drainage (tile management)	Yes	No	Yes	Yes	?	?		?	Secondary	Could be a final tool box strategy for the watershed as a whole
	Culvert sizing to meter runoff (close to the source)	Yes	?	No	Yes	Yes	?		No	Secondary	Possible upstream impacts to alter culvert crossing sizes. (smaller) Could back up water ?
	Overtopping Levees - Levee Setbacks (use floodplain storage areas) (combined)	Yes	?	No	Yes	?	Yes		Yes	Primary	
Increase Conveyance Capacity	Channelization of existing water ways and flowages - Added surface Drainage (combined)	Yes	?	No	Yes	?	?		Yes	Primary	
	Diversions	Yes	Yes	No	Yes	? - No	?		Yes	Secondary	
	Set-back Levees (restore floodway capcity - wider floodway)	Yes	?	No	Yes	?	?		Yes	Secondary	
	Increasing road crossing capacity	Yes	?	No	Yes	Yes	?		Yes	Primary	
Reduce Flood Volume	Restore or Create Wetland (infiltration - evapotransporation) (natural function)	Yes	No	Yes	Yes	?	Yes		No	Secondary	Could be a final tool box strategy for the watershed as a whole - would need willing landowners for a voluntary program
	Cropland BMPs - better infiltration-evapotransporation	Yes	No	Yes	Yes	Yes	Yes		No	Secondary	Could be a final tool box strategy for the watershed as a whole - would need willing landowners for conservation practices to be implemented
	Cropland Conversion (Back to Grass or Forest) (combined)	Yes	No	Yes	Yes	Yes	Yes		No	Secondary	Could be a final tool box strategy for the watershed as a whole - would need willing landowners for conservation practices to be implemented - The project team noted that this strategy should be combined with Cropland BMP's as many conservation practices over time can produce results like grass or forest cover. (it was noted that converting All the cropland to grass or forest is not economically practical)
	Other Beneficial Uses (irrigation - municipal/industrial - augment streamflow)	Yes	No	Yes	Yes	?	?		No	Secondary	There have
Protection/Avoidance	Urban Levees	Yes	Yes	No	Yes	?	?		?	Primary	
	Farmstead Levees	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Not Applicable	Deemed not applicable, there are no farmsteads in the priorty area for protection in the City of Amenia. Strategy is not a match to the purpose and need.
	Agricultural Levees (protecting farmland)	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Not Applicable	Deemed not applicable, generally there is not farmland targeted for protection within the City of Amenia. There may be some incidential acres protected with measures the City would pursue (But a stand alone strategy being pursued). This stategy is not a match for the purpose and need.
	Evacuation of the floodplain	Yes	Yes	No	NO	?	?		No	Secondary	Not desirable by the residents of Amenia, as noted one of the goals is for the City to remain in place. Does not meet the purpose and need. It is an actual conflict with the purpose and need.
	Flood proofing	Yes	?	Yes	Yes	?	Yes		No	Secondary	
	Flood warning system	n/a	n/a	n/a	n/a	n/a	n/a		n/a	Not Applicable	Deemed not applicable, as this strategy does not meet the purpose and need or any of the planning goals. The County does have some measures that provide some benefit to the residents of Amenia, such as a Code Red warning system and an overall County emergency action plan that includes action for flooding conditions.
	Other										Nothing identified at this time

RUSH RIVER WATERSHED NOTICE OF AVAILABILITY OF DRAFT EA AND PUBLIC MEETING

Notice of Availability of Draft Watershed Plan – Environmental Assessment and virtual public meeting November 2, 2021, for the Rush River Watershed Plan sponsored by the Cass County Joint Water Resource District.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) announces the availability of a Draft Watershed Plan – Environmental Assessment (Draft Plan-EA) for the Rush River Watershed Plan. Cass County Joint Water Resource District proposes to install 11,820 feet of levee around the city of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The project would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings. The proposed improvements would be partially funded by NRCS through the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566).

You are invited to attend a virtual public meeting to provide input on this project: Date:

November 2, 2021
Time: 1:30 pm
Link: Go to https://www.casscountynd.gov/government/water-resources- board/cass-county-joint-water-resource-district for a Teams meeting or phone link.

A recording of the meeting will be available afterward at the website listed below.

Comments on the Draft Plan-EA may be submitted during a public comment period starting **October 25, 2021, and ending on December 24, 2021.** The complete Draft Watershed Plan-EA can be accessed online at:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nd/technical/engineering/?cid=nrcseprd1829025

A copy of the Draft Plan-EA is also available at the Cass County Joint Water Resource District webpage: https://www.casscountynd.gov/government/water-resources-board/cass-county-joint-water-resource-district

Comments may be sent to Christi Fisher, ND NRCS State Conservation Engineer, christi.fisher@usda.gov, 220 E Rosser Ave, PO Box1

458, Bismarck, ND 58502-1458

USDA
Natural Resources Conservation Service

YOU'RE INVITED! PUBLIC MEETING!

Notice of Availability of Draft Watershed Plan – Environmental Assessment and Virtual Public Meeting November 2, 2021 for the Rush River Watershed Plan.

You are invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30 – 2:30 pm

Microsoft Teams Meeting Link: https://bit.ly/3aLZ51b

The Cass County Joint Water Resource District proposes to install 11,820 ft of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-event. In addition, interior stormwater features and removable road/railroad crossing barriers are incorporated.

Comments on the Draft Plan-EA may be submitted during a public comment period starting **October 25, 2021 and ending on December 24, 2021.** The complete Draft Watershed Plan-EA can be accessed online at: https://bit.ly/3mPVEMo

A printed copy of the Draft Plan-EA is also available at Cass County Joint Water Resource District, 1201 Main Ave W, West Fargo, ND 58078.

USDA
Natural Resources Conservation Service

YOU'RE INVITED! PUBLIC MEETING!

Notice of Availability of Draft Watershed Plan – Environmental Assessment and Virtual Public Meeting November 2, 2021 for the Rush River Watershed Plan.

You are invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30 – 2:30 pm

Microsoft Teams Meeting Link: https://bit.ly/3aLZ51b

The Cass County Joint Water Resource District proposes to install 11,820 ft of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-event. In addition, interior stormwater features and removable road/railroad crossing barriers are incorporated.

Comments on the Draft Plan-EA may be submitted during a public comment period starting October 25, 2021 and ending on December 24, 2021. The complete Draft Watershed Plan-EA can be accessed online at: https://bit.ly/3mPVEMo

A printed copy of the Draft Plan-EA is also available at Cass County Joint Water Resource District, 1201 Main Ave W, West Fargo, ND 58078.

USDA
Natural Resources Conservation Service

YOU'RE INVITED! PUBLIC MEETING!

Notice of Availability of Draft Watershed Plan – Environmental Assessment and Virtual Public Meeting November 2, 2021 for the Rush River Watershed Plan.

You are invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30 – 2:30 pm

Microsoft Teams Meeting Link: https://bit.ly/3aLZ51b

The Cass County Joint Water Resource District proposes to install 11,820 ft of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-event. In addition, interior stormwater features and removable road/railroad crossing barriers are incorporated.

Comments on the Draft Plan-EA may be submitted during a public comment period starting October 25, 2021 and ending on December 24, 2021. The complete Draft Watershed Plan-EA can be accessed online at: https://bit.ly/3mPVEMo

A printed copy of the Draft Plan-EA is also available at Cass County Joint Water Resource District, 1201 Main Ave W, West Fargo, ND 58078.

USDA
Natural Resources Conservation Service

YOU'RE INVITED! PUBLIC MEETING!

Notice of Availability of Draft Watershed Plan – Environmental Assessment and Virtual Public Meeting November 2, 2021 for the Rush River Watershed Plan.

You are invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30 – 2:30 pm

Microsoft Teams Meeting Link: https://bit.ly/3aLZ51b

The Cass County Joint Water Resource District proposes to install 11,820 ft of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-event. In addition, interior stormwater features and removable road/railroad crossing barriers are incorporated.

Comments on the Draft Plan-EA may be submitted during a public comment period starting October 25, 2021 and ending on December 24, 2021. The complete Draft Watershed Plan-EA can be accessed online at: https://bit.ly/3mPVEMo

A printed copy of the Draft Plan-EA is also available at Cass County Joint Water Resource District, 1201 Main Ave W, West Fargo, ND 58078.

Rush River Watershed - Notice of Availability of Draft EA and Public Meeting

Notice of Availability of Draft Watershed Plan – Environmental Assessment and Virtual Public Meeting November 2, 2021 for the Rush River Watershed Plan sponsored by the Cass County Joint Water Resource District.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) announces the availability of a Draft Watershed Plan – Environmental Assessment (Draft Plan-EA) for the Rush River Watershed Plan. Cass County Joint WRD proposes to install 11,820 feet of levee around the city of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The project would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings. The proposed improvements would be partially funded by NRCS through the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566).

You are invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30 – 2:30 pm
Link:

A recording of the meeting will be available afterward at the website listed below.
Comments on the Draft Plan-EA may be submitted during a public comment period starting **October 25, 2021 and ending on December 24, 2021**. The complete Draft Watershed Plan-EA can be accessed online at:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nd/technical/engineering/?cid=nrcseprd1829025

A printed copy of the Draft Plan-EA is also available at Cass County Joint Water Resource District, 1201 Main Ave W, West Fargo, ND 58078

Comments may be sent to Christi Fisher, ND NRCS State Conservation Engineer, christi.fisher@usda.gov, 220 E Rosser Ave, PO Box 1458, Bismarck, ND, 58502-1458,

Landowners Invited to Attend Virtual Meeting and Comment on Draft Plan EA					
Name	**Name - 2**	**Address**	**City**	**State**	**Zip**
Bill Hejl		15560 28th St SE	Amenia	ND	58004
Shaun Nelson-Amenia SN Property LLC		4400 Beach Ln S	Fargo	ND	58104
Lindstrom Family Farm		15292 28th St SE	Amenia	ND	58004
Malinda Lindstrom		502 Fairway Dr	Casselton	ND	58012
City of Amenia		122 Chaffee Ave	Amenia	ND	58004
Northwest Capital Management & Trust	David Camrud-Trust Officer	PO Box 340	Moorhead	MN	56561
Mark Chaffee		2350 DeMores Dr S	Fargo	ND	58103
Jonathon & Alisha Prien		107 Reed St E	Amenia	ND	58004

Tribe and SHPO List - Received copies of Draft Plan - EA, Invited to virtual meeting and to comment						
Name	**Title**	**Tribe/Organization**	**Address**	**City**	**State**	**Zip**
Bill Peterson	State Historic Preservation Officer	State Historical Society of North Dakota	612 East Boulevard Ave	Bismarck	ND	58505
Dr. Erich Longie	Tribal Historic Preservation Officer	Spirit Lake Tribe of Fort Totten	PO Box 76	Fort Totten	ND	58335
Douglas Yankton, Sr.	Chairman	Spirit Lake Tribe of Fort Totten	PO Box 359	Fort Totten	ND	58335
Jeffrey Desjarlais	Tribal Historic Preservation Officer	Turtle Mountain Band of Chippewa Indians	PO Box 900	Belcourt	ND	58316
Jaime Azure	Chairman	Turtle Mountain Band of Chippewa Indians	PO Box 900	Belcourt	ND	58316
Kade Ferris, THPO	Tribal Historic Preservation Officer	Red Lake Band of Chippewa Indians	PO Box 274	Red Lake	MN	56671
Darrell G. Seki, Sr.	Chairman	Red Lake Band of Chippewa Indians	PO Box 550	Red Lake	MN	56671
Dianne Desrosiers	Tribal Historic Preservation Officer	Sisseton-Wahpeton Oyate of the Lake Traverse Reservation	PO Box 907	Sisseton	SD	57262
Delbert Hopkins, Jr.	Chairman	Sisseton-Wahpeton Oyate of the Lake Traverse Reservation	PO Box 509	Agency Village	SD	57262
Michael Fairbanks	Chairman	MN Chippewa Tribe - White Earth Band	PO Box 418	White Earth	MN	56591
Jaime Arsenault	Tribal Historic Preservation Officer	MN Chippewa Tribe - White Earth Band	PO Box 418	White Earth	MN	56592
Dyan R. Youpee	Tribal Historic Preservation Officer	Fort Peck Assiniboine and Sioux Tribes	PO Box 1027	Poplar	MT	59255
Floyd Azure	Chairman	Fort Peck Assiniboine and Sioux Tribes	PO Box 1027	Poplar	MT	59255

USDA
United States Department of Agriculture

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

October 5, 2021

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Honorable Floyd Azure
Fort Peck Assiniboine and Sioux Tribes
PO Box 1027
Poplar, MT 59255

RE: Consultation Packet for Rush River Watershed Plan and Environmental Assessment

Dear Chairman Azure:

In November of 2018, in accordance with 36 CFR 800.3(b)(3), the Natural Resources Conservation Service (NRCS), initiated the Section 106 consultation process with the Fort Peck Assiniboine and Sioux Tribes, requesting your participation in the planning and environmental assessment of the Rush River Watershed Plan.

Since that time, we have completed the final draft plan and final draft environmental assessment (EA). These documents were prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). We are once again seeking your comments and input on these final draft documents.

Planning efforts have resulted in a preferred alternative (Alternative 1) and boundary area (area of potential effect (APE)), located in Sections 23-26, Township 141, Range 52 in Cass County, North Dakota. NRCS recognizes that the Fort Peck Assiniboine and Sioux Tribes may have ancestral ties to this project. This consultation is in accordance with federal law (54USC§3061) regulation (36CFR§800), and NRCS policy (Title 401 Part 601).

The need for watershed planning is due to historical floods occurring in the City of Amenia, North Dakota. The preferred alternative proposes to construct approximately 11,820 feet of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The preferred alternative would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings.

Cultural Resources Investigation:
In March of 2016, SWCA Environmental Consultants (SWCA) completed a Class I cultural resource inventory of a study area. SWCA reviewed files maintained at the State Historical Society of North Dakota (SHSND) and the General Land Office survey records for buildings, structures, and other features of potential significance. The age of the SWCA report necessitated a review its findings.

Research conducted on April 7, 2020 by the NRCS State Cultural Resource Specialist (SRCS) confirmed the SWCA report for the preferred alternative.

A Class III cultural resource investigation was completed by the NRCS and is been included in Appendix D of the Environmental Assessment (enclosed). Both the SWCA report and SCRS review showed that, within one mile of the APE, two previous cultural resource inventories were conducted (1995-2017) in support of highway and county road safety studies, and electric transmission lines.

The Class III Survey resulted in the following conclusions and recommendations by the NRCS SRCS:
Six known sites/site leads have been either destroyed by fire, redevelopment, infrastructure construction or are so generalized they do not meet NRHP listing criteria. The undertaking will have no direct effect on a seventh site (32CS5120), however there may be minimal visual effects. The undertaking proposes a 5-7-foot-high, grass covered, levee to the north of the site that may be obscured in the Summer and Fall due to tree leaf-out and crop growth. Based on this, NRCS is consulting with the NDSHPO and requesting them to make a *determination of "**no effect on historic properties***" (NRHP). Please note, that should the project require additional borrow material from an offsite unevaluated location, the borrow site will be subjected to investigation and consultation prior to being utilized.

The Fort Peck Assiniboine and Sioux Tribes is welcome to provide additional information and comments on the enclosed Rush River Watershed Plan and Environmental Assessment. **Comments are respectfully requested within 30 days of your receipt of this letter and packet.** You are also welcomed to attend a virtual meeting on the project on November 2, 2021, please contact Rita Sveen, rita.sveen@usda.gov to obtain a link for this meeting.

If you have any questions or comments, please contact the Cultural Resources Specialist, Christopher A. Plount at Christopher.Plount@usda.gov (701) 530-2104. Thank you for your timely response and assistance with this project.

Sincerely,

MARY E. PODOLL
State Conservationist

Enclosures:
Rush River Watershed Plan
Rush River Environmental Assessment

cc: Dyan Youpee, Tribal Historic Preservation Officer
Cass County Water Resource District
Moore Engineering

United States Department of Agriculture

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

October 5, 2021

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Bill Peterson, Director and SHPO
State Historical Society of North Dakota
612 E. Boulevard Ave
Bismarck, ND 58505

RE: Consultation Packet for Rush River Watershed Plan and Environmental Assessment

Dear Mr. Peterson:

In November of 2018, in accordance with 36 CFR 800.3(b)(3), the Natural Resources Conservation Service (NRCS), initiated the Section 106 consultation process with the Historical Society of North Dakota, as well as 17 tribal officials, requesting your participation in the planning and environmental assessment of the Rush River Watershed Plan.

Since that time, we have completed the final draft plan and final draft environmental assessment (EA). These documents were prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). We are once again seeking your comments and input on these final draft documents. Specifically, we are requesting a written determination of "***no effect on historic properties***" on a registered historic site.

Planning efforts have resulted in a preferred alternative (Alternative 1) and boundary area (area of potential effect (APE)), located in Sections 23-26, Township 141, Range 52 in Cass County, North Dakota.

The need for watershed planning is due to historical floods occurring in the City of Amenia, North Dakota. The preferred alternative proposes to construct approximately 11,820 feet of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The preferred alternative would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings.

Cultural Resources Investigation:
In March of 2016, SWCA Environmental Consultants (SWCA) completed a Class I cultural resource inventory of a study area. SWCA reviewed files maintained at the State Historical Society of North Dakota (SHSND) and the General Land Office survey records for buildings, structures, and other features of potential significance. The age of the SWCA report necessitated a review its findings.

Research conducted on April 7, 2020 by the NRCS State Cultural Resource Specialist (SRCS) confirmed the SWCA report for the preferred alternative.

A Class III cultural resource investigation was completed by the NRCS and is been included in Appendix D of the Environmental Assessment (enclosed). Both the SWCA report and SCRS review showed that, within one mile of the APE, two previous cultural resource inventories were conducted (1995-2017) in support of highway and county road safety studies, and electric transmission lines.

The Class III Survey resulted in the following conclusions and recommendations by the NRCS SRCS:
Six known sites/site leads have been either destroyed by fire, redevelopment, infrastructure construction or are so generalized they do not meet National Register of Historic Places (NRHP) listing criteria. The undertaking will have no *direct* effect on a seventh site (32CS5120), however there may be minimal visual effects. The undertaking proposes a 5-7-foot-high, grass covered, levee to the north of the site that may obscure site 32CS5120 in the Summer and Fall due to tree leaf-out and crop growth. Based on this, NRCS is requesting the NDSHPO to make a determination of *"**no effect on historic properties***" (NRHP). Please note, that should the project require additional borrow material from an offsite unevaluated location, the borrow site will be subjected to investigation and consultation prior to being utilized.

If you need further information or clarification on the Class III, or if you believe there *will* be an effect on the historic property, please contact the Cultural Resource Specialist, Christopher A. Plount at Christopher.plount@usda.gov 701-530-2104. You are also welcomed to attend a virtual meeting on the project on November 2, 2021, please contact Rita Sveen, rita.sveen@usda.gov to obtain a link for this meeting.

We respectfully request your written determination and any comments on the enclosed Rush River Watershed Plan and Environmental Assessment by November 29, 2021.

Thank you for your timely response and assistance with this project.

Sincerely,

MARY E. PODOLL
State Conservationist

Enclosures:
Rush River Watershed Plan
Rush River Environmental Assessment

cc: Cass County Water Resource District
Moore Engineering

United States Department of Agriculture

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

October 8, 2021

U.S. Army Corp of Engineers – Regulatory Division
Attn: Ms. Patricia McQueary
3319 University Drive
Bismarck, ND 58504

RE: Notice of Availability of the Draft Rush River Watershed Plan – Environmental Assessment – Request for Interagency Comments and Invitation to a Virtual Public Meeting on November 2, 2021.

Dear Ms. McQueary:

The USDA Natural Resources Conservation Service (NRCS), with assistance from the local sponsoring agency, the Cass County Joint Water Resource District, has completed a draft watershed plan – environmental assessment (EA) for a proposed flood protection project in the Rush River Watershed, Cass County North Dakota. The Rush River Watershed is located within the Red River Basin. The project is a federally assisted action prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). Thank you for your participation with the planning team over the last several years, evaluating the multiple other alternatives considered in this watershed.

The Cass County Joint WRD proposes to install 11,820 feet of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The project would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings.

We are requesting that you complete a final review this project in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). **We request that comments be received by this office on or before December 24, 2021.** If your comments are not received by this date, we will assume you do not wish to comment.

The complete Draft Watershed Plan-EA can be accessed online at:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nd/technical/engineering/?cid=nrcseprd1829025

You are also invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30-2:30 pm
Microsoft Teams Meeting Link has been forwarded to you via email

Please send comments to Christi Fisher, State Conservation Engineer, christi.fisher@usda.gov, 220 E Rosser Ave, PO Box 1458, Bismarck, ND, 58502-1458, or by phone at (701) 530-2091.

Thank you for your timely response and cooperation with this project.

Sincerely,

MARY E. PODOLL
State Conservationist

cc: Cass County Joint Water Resource District
Moore Engineering

United States Department of Agriculture

Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

October 8, 2021

Drew Becker
US Fish and Wildlife Service
3425 Miriam Avenue
Bismarck, ND 58501

RE: Notice of Availability of the Draft Rush River Watershed Plan – Environmental Assessment – Request for Interagency Comments and Invitation to a Virtual Public Meeting on November 2, 2021.

Dear Mr. Becker:

The USDA Natural Resources Conservation Service (NRCS), with assistance from the local sponsoring agency, the Cass County Joint Water Resource District, has completed a draft watershed plan – environmental assessment (EA) for a proposed flood protection project in the Rush River Watershed, Cass County North Dakota. The Rush River Watershed is located within the Red River Basin. The project is a federally assisted action prepared under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566). Thank you for your participation with the planning team over the last several years, evaluating the multiple other alternatives considered in this watershed.

The Cass County Joint WRD proposes to install 11,820 feet of levee around the City of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A 10-foot-wide channel would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows. A stormwater pond would be developed to capture floodwaters and runoff of approximately 180 surface acres within the levee system. The project would also include constructing removable features to act as temporary levees over three road crossings and two railroad crossings.

We are requesting that you complete a final review this project in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). **We request that comments be received by this office on or before December 24, 2021.** If your comments are not received by this date, we will assume you do not wish to comment.

The complete Draft Watershed Plan-EA can be accessed online at:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nd/technical/engineering/?cid=nrcseprd1829025

You are also invited to attend a virtual public meeting to provide input on this project:

Date: November 2, 2021
Time: 1:30-2:30 pm
Microsoft Teams Meeting Link has been forwarded to you via email

Please send comments to Christi Fisher, State Conservation Engineer, christi.fisher@usda.gov, 220 E Rosser Ave, PO Box 1458, Bismarck, ND, 58502-1458, or by phone at (701) 530-2091.

Thank you for your timely response and cooperation with this project.

Sincerely,

MARY E. PODOLL
State Conservationist

cc: Cass County Joint Water Resource District
Moore Engineering

October 13, 2021

Ms. Mary Podoll
NCRS
Bismarck Sate Office
PO Box 1458
Bismarck, ND 58502-1458

ND SHPO Ref.: 22-5030 Consultation Packet for Rush River Watershed Plan and Environmental Assessment in portions of [T141N R52W Sections 23-26], Cass County, North Dakota

Dear Ms. Podoll,

We reviewed ND SHPO Ref.: 22-5030 Consultation Packet for Rush River Watershed Plan and Environmental Assessment in portions of [T141N R52W Sections 23-26], Cass County, North Dakota and we concur with a determination of "No Historic Properties Affected" for this project provided it takes place in the location and in the manner described in the documentation and provided all borrow comes from an approved source.

Thank you for the opportunity to review this project. Please include the ND SHPO Reference number listed above in further correspondence for this specific project. If you have any questions please contact Lisa Steckler, Historic Preservation Specialist at (701) 328-3577 or lsteckler@nd.gov

Sincerely,

for William D. Peterson, PhD
State Historic Preservation Officer
(North Dakota)

22-5030

Comments/Responses/Letters on Rush River Draft Plan/EA and November 2, 2021, Public Meeting

Commenter	Comment	Response	Relevant Section in EA	Comment Substantive Y/N
Unknown	What is the difference between the 100 year and 500-year flood elevations	It is about 1' or less difference based on the information we know. The water continues to spread out across the area and the elevation does not change much.	6.2.5 and 6.2.6 Floodplain/Floodwater Damage	N
Brandon Lindstrom	Question about the affected wetlands on the west side of town. How are those wetlands determined? It is seasonably wet and there is a plugged drain in the trees to the east of this area and it has never been listed as a wetland on any of our FSA maps and Farm program information	Wetlands were delineated as required for the plan by the National Environmental Policy Act (NEPA), based on USCOE procedures which consider soils, vegetation, and hydrology. This NEPA determination will not be used for USDA Food Security Act wetland compliance. Your FSA maps may differ because the delineation processes and labeling are different between USDA and USCOE.	4.2.13 Wetlands	N
Bill Hejl	Do you have a record of all participants logged on to the meeting?	Yes	7 Public Participation	N
Brandon Lindstrom	What did the wetland impacts change in the planning? Based on the wetland assessment, did that affect your decision-making process?	NEPA requires wetland acres/values impacted by the project be mitigated. Avoiding impacts to wetlands where possible was considered in the process.	4.2.13 Wetlands	N
Bill Hejl	Be sure to follow the property boundaries for the levee along the RR tracks on the south and north to the Elevator property and then east along the trees towards the highway and then north again.	Minor route changes may be considered during the final design within the corridor already assessed for environmental impacts and cultural resources.	5 Alternatives and 6.1 Human factors	N
Ardele Meyers	Are the internal ditches and drains in and around the City plan to be cleaned out? As part of the project?	Yes, drainage needs to properly flow to the new stormwater pond.	8.7 Operation and Maintenance	N

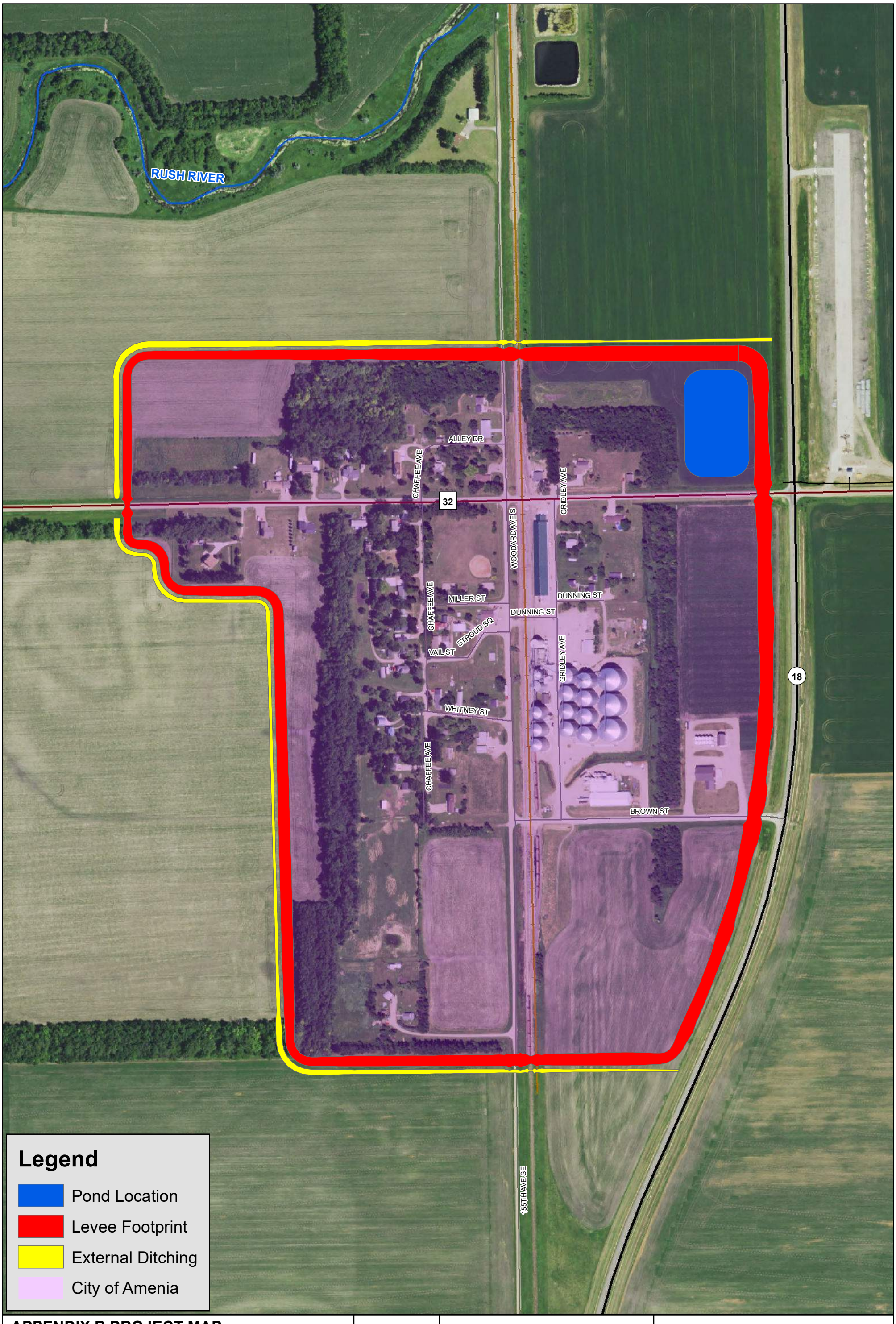
Bill Hejl	Would there be a flood control district formed to maintain everything?	Cass Joint Water Resource District is the PL-566 sponsor, and they will sign the 50-year O&M agreement with NRCS for the project. CassJWRD may make arrangements on their own behalf for an additional district outside of this agreement if desired.	8.7 Operation and Maintenance	N
Bill Hejl	Would there be an entity created to maintain it?	Cass Joint Water Resource District is the PL-566 sponsor, and they will sign the 50-year O&M agreement with NRCS for the project. CassJWRD may decide on their own behalf to form entities for project operation and maintenance.	8.7 Operation and Maintenance	N
Ardele Meyers	Who would be that someone?	Cass Joint Water Resource District is the PL-566 sponsor, and they will sign the 50-year O&M agreement. CassJWRD may decide on their own behalf to form entities for project operation and maintenance.	8.7 Operation and Maintenance	N
Keith Weston	What is the life expectancy for this project?	For this Plan - it is 50 years.	8.7 Operation and Maintenance	N
Tony Roth	I know you do not have the final dollar amounts currently, but what have you seen for the cost of that is normally fronted by the City? A combination of the City, Water Resource Board, and State? Like the percentage of maintenance to maintain over the lifetime? Do you know year by year that is a standard cost? such as 1% of the total cost on average or something like that? I know you do not have exact figures but? There must be something from previous projects that can give an idea on this sort of project and who would brunt that cost?	The ongoing maintenance will be addressed as the project moves forward and discussed with all the potential funding partners. As listed in Section 5.5 of the plan, the estimate of average annual Operation and Maintenance costs over the 50-year anticipated lifespan is $12,000 a year. At this point the project is still in the development stage, but the details for a maintenance agreement would be worked out as final engineering design work proceeds, prior to any construction taking place.	8.6 Installation and Financing and 8.7 O&M	N

Bill Hejl	The question is who provides the funding to the maintenance cost? That is something that is decided between the City and the Water Resource District - Later?	Cass Joint Water Resource District is the PL-566 sponsor, and they will sign the 50-year O&M agreement. The main costs will be the maintenance of the interior ditching, and the pump in the stormwater pond. There will be pump testing and maintenance over the next 50 years. Any partnerships who may pay for future maintenance will need to be formed separately from the PL-566 project. There will also be costs to address any mowing, temporary closures, and other maintenance as part of the project. For the plan it was estimated at $12,000 per year for O&M costs for the 50 life of the project.	8.7 Operation and Maintenance	N
Brandon Lindstrom	Do you have a slide that shows the affected farmland acres? Does that included the retention pond, and everything correct?	It is noted that about 7 acres of prime farmland will be affected by the project. The width of the levee and the stormwater pond are the areas that will affect (remove) farmland acres.	6.1.4 Agriculture and Prime Farmland	N
Brandon Lindstrom	We would prefer the levee to be as close to the trees in the NW corner of the project to lessen farmland acres affected.	Minor route changes may be considered during the final design within the corridor already assessed for environmental impacts and cultural resources.	5 Alternatives and 6.1 Human factors	N
Brandon Lindstrom	Is there going to be any sort of special assessments or is that yet to be determined?	There will be a local share for the project, and it is yet to be determined and finding all the available funding secured, the water resource district and city will go through an assessment voting process and follow the state statues for the benefiting parties and the impacted parties in terms of actual construction costs and footprint and the parties will have the opportunity to vote in favor or against the project.	8.6 Installation and Financing and 8.7 O&M	N

Merle Myers (email)	Are you making the least amount of square corners in, or are you figuring in large rounded or 45 deg. Corners that are easier to put in and maintain?	With the 4:1 proposed sideslopes, 90-degree corners end up rather rounded, and are typically straightforward to construct and maintain. That said, minor alignment modifications may be considered during the final design phase, within the corridor already assessed for environmental impacts and cultural resources.	5 Alternatives and 6.1 Human factors	N
Cooperating Agency Responses/Tribes	**Letters and Draft EA/Plan were mailed between 10/5/2021 and 10/8/2021**			
William Peterson (NDSHPO)	Letter dated 10/13/21, Concurs with NRCS finding of "No Historic Properties Affected" (Consult packet 22-5030)	NA	6.1.5 Cultural Resources	N
USFWS	No Response			N
USCOE	The proposed project may require an individual permit. We will determine when an application is submitted. If an individual permit is required, the application should be submitted at least 120 days prior to bid opening for the proposal.	Noted, permit applications to the USCOE will be submitted at least 120 days prior to bid opening.		N
Tribes				
Fort Peck	No Response			N
Turtle Mountain	No Response			N
Lake Traverse	No Response			N
Red Lk Band of Chippewa	No Response			N
Spirit Lake	No Response			N
White Earth Band	No Response			N

RUSH RIVER WATERSHED
PLAN APPENDIX B
PROJECT MAP

Appendix B



APPENDIX B PROJECT MAP
RUSH RIVER WATERSHED RCPP
CASS COUNTY, NORTH DAKOTA

Created By: BPK Date Created: 06/15/2020 Date Saved: 06/15/20 Date Plotted: 08/04/17 Date Exported: 06/15/20
Plotted By: benjamin.kugler Parcel Date: N/A Aerial Image: 2017 County NAIP SIDS Elevation Data: Lidar
Horizontal Datum: NAD 1983 UTM Zone 14N Vertical Datum: NAVD1988
T:\Projects\18700\18747\102-IdentifyProblemsGoals\AmeniaAlternatives\LeveeAlt1Project.mxd

N W E S

0 200 400 800 Feet

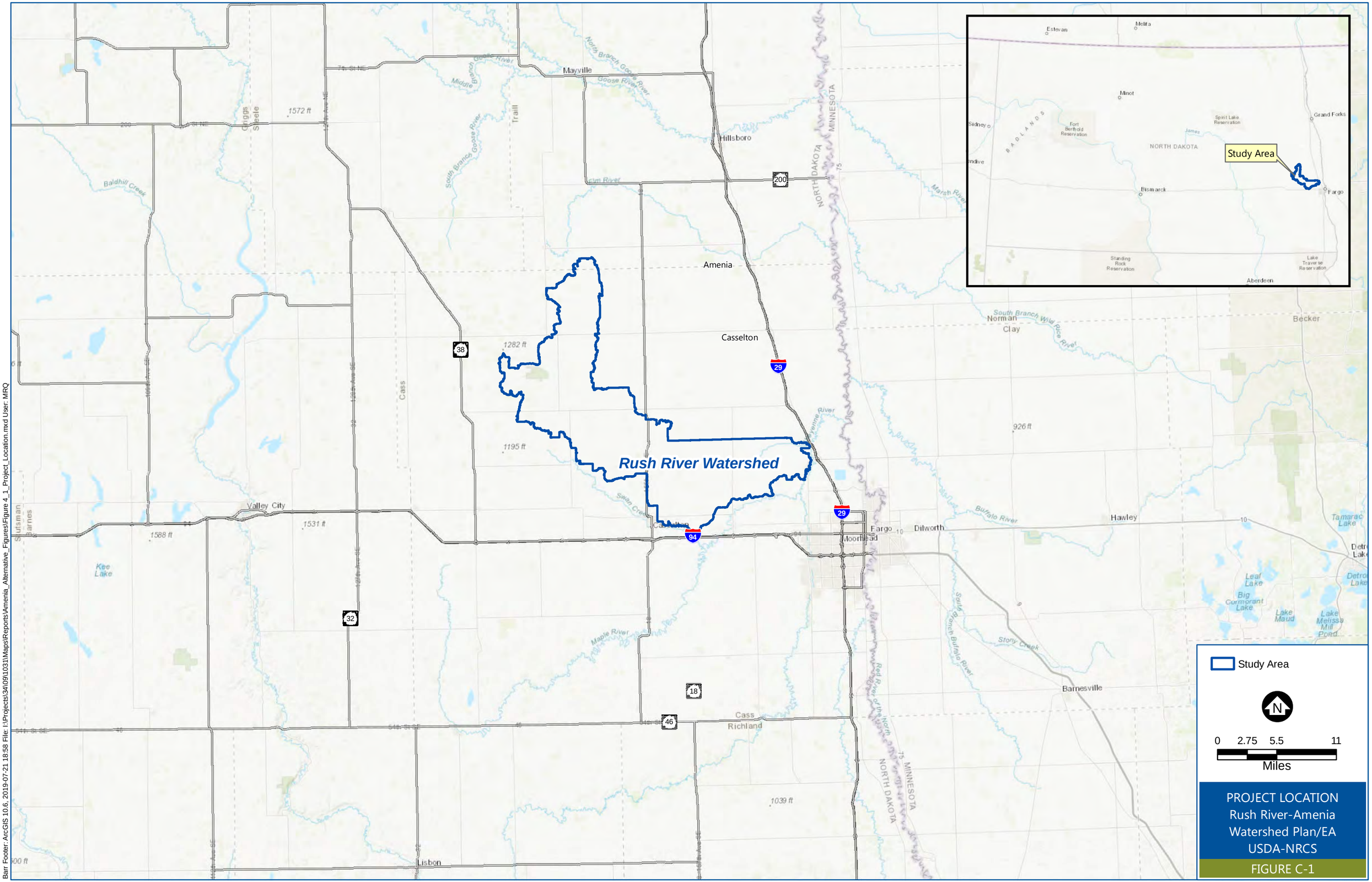
1 in = 400 feet

moore engineering, inc.

RUSH RIVER WATERSHED

PLAN APPENDIX C

SUPPORT MAPS



Barr Footer: ArcGIS 10.6, 2019-07-21 18:58 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 4_1_Project_Location.mxd User: MRQ

Steele County
Broadlawn Township
Traill County
Galesburg Township
Greenfield Township
Bohnsack Township
Kelso Township
Elm River Township
Elm River
Page Township
Dows Township
Hunter Township
Bell Township
Kinyon Township
Noble Township
County Ditch No. 44
Lake Township
Rich Township
Erie Township
Arthur Township
Gunkel Township
Gardner Township
Wiser Township
29
18
Cass County
38
Cornell Township
Ayr Township
Empire Township
Amenia Township
Rush River Township
Berlin Township
Harwood Township
Amenia
Rush River
Rush River
Tower Township
Buffalo Township
Wheatland Township
Casselton Township
Harmony Township
Raymond Township
Casselton
Swan Creek
94

County Boundary
Study Area
Railroad
Major Roadways
Stream
Bridges
Airports
LUST Sites
UST Sites
Civil Township
Land Classification
Wetland
Shrub/Scrub
Open Water
Herbaceuous
Hay/Pasture
Developed
Forest
Cultivated Crops
Barren Land

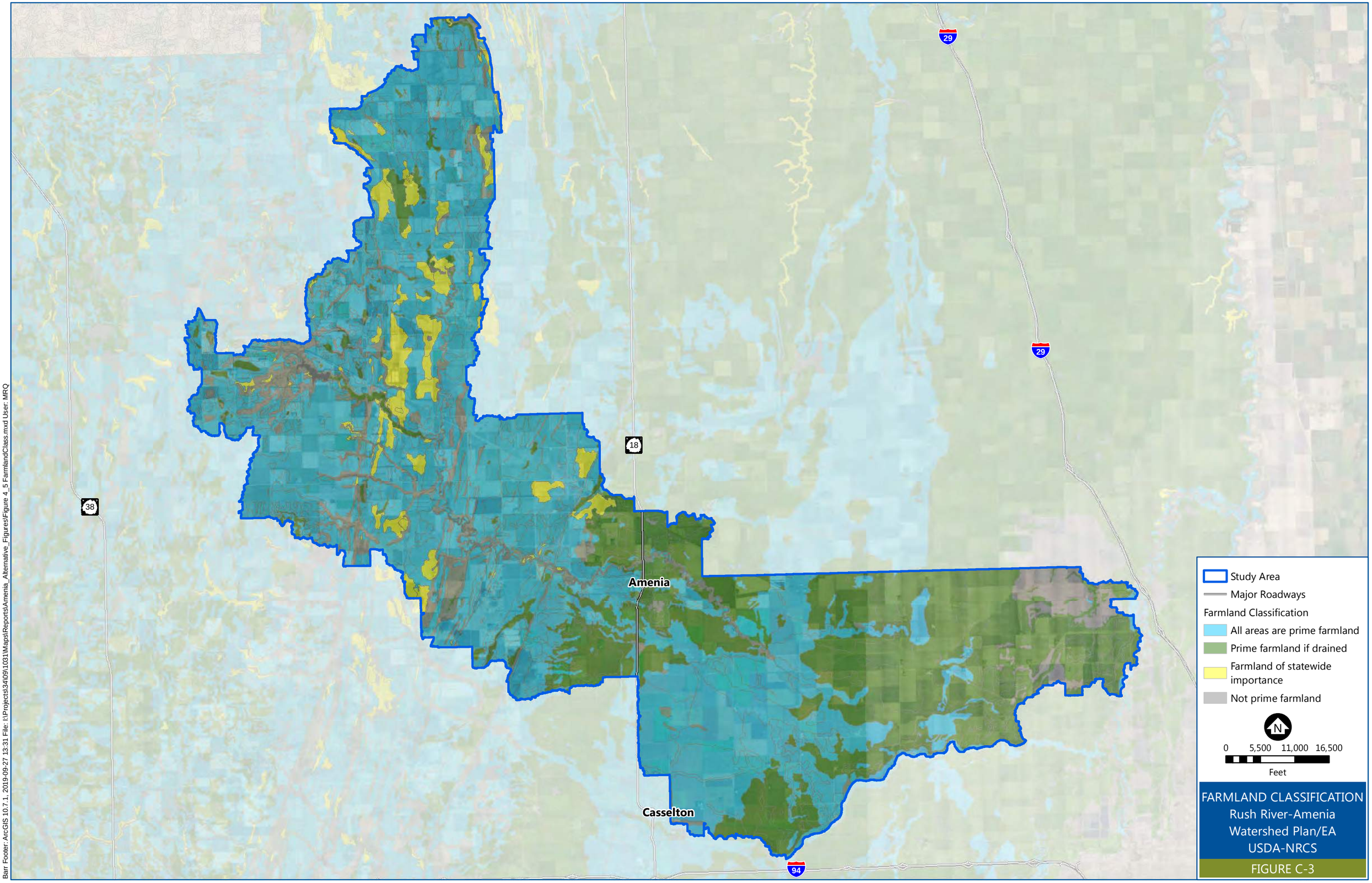
N

0 5,500 11,000 16,500
Feet

LAND USE AND INFRASTRUCTURE
Rush River-Amenia Watershed Plan/EA
USDA-NRCS

FIGURE C-2

Barr Footer: ArcGIS 10.6, 2019-07-21 19:12 File: I:\Projects\34\091031\Maps\Reports\Amenia_Alternative_Figures\Figure 4_2_LandUse.mxd User: MRQ



Barr Footer: ArcGIS 10.7.1, 2019-09-27 13:31 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 4_5 FarmlandClass.mxd User: MRQ

Erie Dam/ Brewer Lake

Brewer Lake Campground and the Erie Dam State Recreation Area

29

29

18

38

Amenia

Magnolia WMA

Casselton

94

Study Area

Wildlife Management Area

Snowmobile Trail

Major Roadways

N

0 5,500 11,000 16,500

Feet

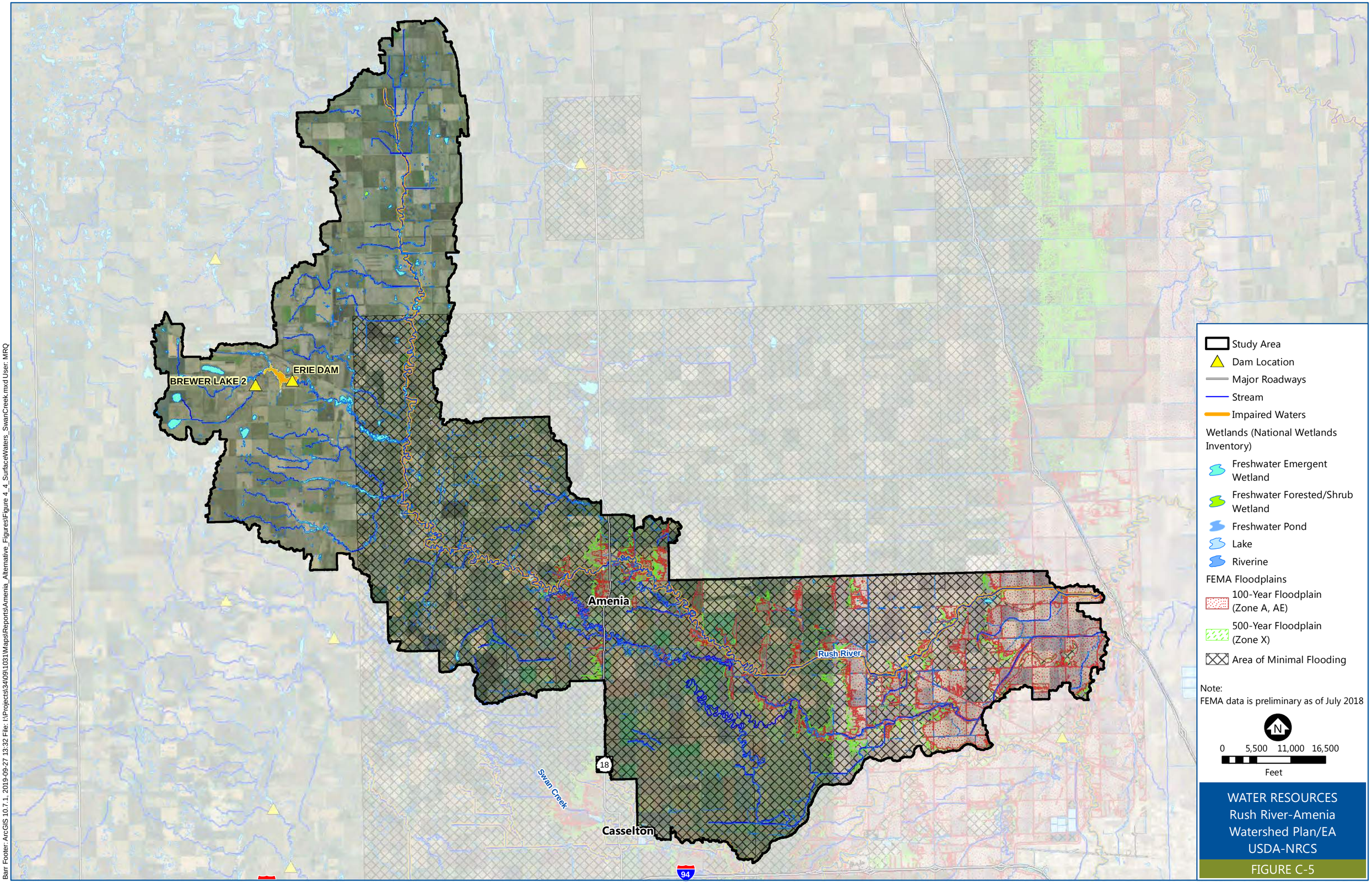
RECREATION AND WILDLIFE RESOURCES

Rush River-Amenia Watershed Plan/EA

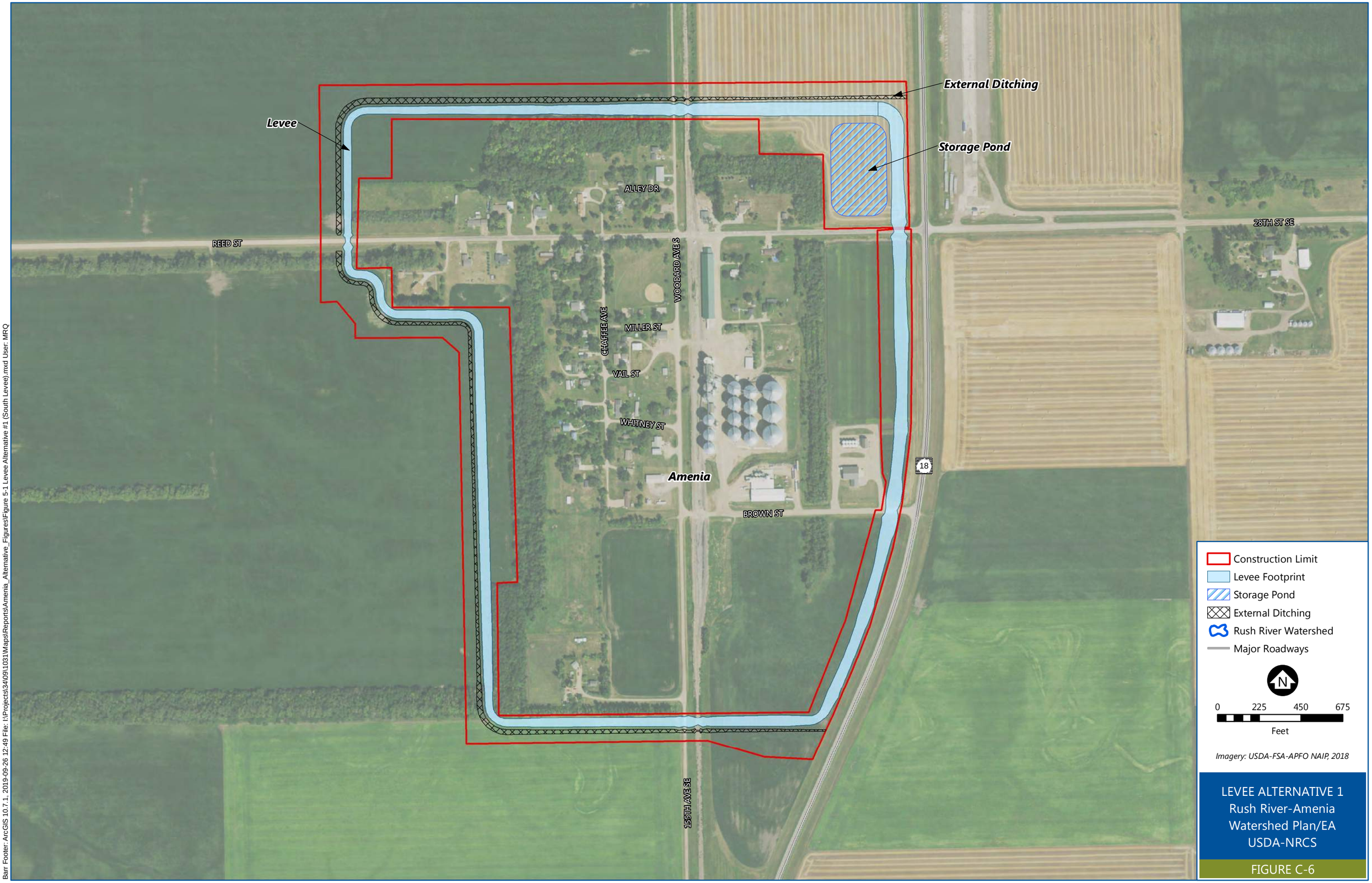
USDA-NRCS

FIGURE C-4

Barr Footer: ArcGIS 10.7.1, 2019-09-27 13:29 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 4_3_FishWildlife.mxd User: MRQ



Barr Footer: ArcGIS 10.7.1, 2019-09-27 13:32 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 4_4_SurfaceWaters_SwanCreek.mxd User: MRQ



Amenia

18

Levee Alternative 1 - Construction Limits

Rush River Watershed

100-year Peak Flood Inundations

Area of Existing Flooding

Area of Existing Flooding Removed

Area of Additional Flooding under Levee Alternative 1 Conditions

N

0 1,000 2,000 3,000

Feet

Imagery: USDA-FSA-APFO NAIP, 2018

100-YEAR PEAK FLOOD INUNDATION AREAS
LEVEE ALTERNATIVE 1
Rush River-Amenia Watershed Plan/EA
USDA-NRCS

FIGURE C-7

Barr Footer: ArcGIS 10.7.1, 2019-09-26 12:52 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 5-2 Levee Alt #1 100-Year Peak Flood Inundation Areas.mxd User: MRQ

Rush River

Levee

Storage Pond

18

28TH ST SE

154TH AVE SE

WOODARD AVE S

ALLEY DR

REED ST

MILLER ST

VAIL ST

Amenia

WHITNEY ST

CHAFFEE AVE

BROWN ST

Construction Limit
Levee Footprint
Storage Pond
Stream
Rush River Watershed
Major Roadways

N

0 225 450 675
Feet

Imagery: USDA-FSA-APFO NAIP, 2018

LEVEE ALTERNATIVE 2
Rush River-Amenia
Watershed Plan/EA
USDA-NRCS

FIGURE C-8

Barr Footer: ArcGIS 10.6, 2019-02-26 11:02 File: I:\Projects\34\09\1031\Maps\Reports\Amenia_Alternative_Figures\Figure 5-3 Levee Alternative #2 (North Levee).mxd User: MRQ

Amenia

18

Levee Alternative 2 - Construction Limits

Rush River Watershed

100-year Peak Flood Inundations

Area of Existing Flooding

Area of Existing Flooding Removed

Area of Additional Flooding under Levee Alternative 2 Conditions

N

0 1,000 2,000 3,000

Feet

Imagery: USDA-FSA-APFO NAIP, 2018

100-YEAR PEAK FLOOD INUNDATION AREAS
LEVEE ALTERNATIVE 2
Rush River-Amenia Watershed Plan/EA
USDA-NRCS

FIGURE C-9

Barr Footer: ArcGIS 10.7.1, 2019-09-26 12:55 File: I:\Projects\34\09\.1031\Maps\Reports\Amenia_Alternative_Figures\Figure 5-4 Levee Alt #2 100-Year Peak Flood Inundation Areas.mxd User: MRQ

RUSH RIVER WATERSHED PLAN

APPENDIX D

Appendix	Sub Report Title	Pages	PDF pages
D-1	Investigation and Analysis Report	D1-D63	66-128
D-2	Preliminary Geotechnical Engineering Report	D64-D106	129-171
D-3	Economic Report	D107-D130	172-195
D-4	Wetland Delineation Report	D131-D151	196-216
D-5	Class III Cultural Resources Report	D152-D1211	217-276
D-6	CPA-52	D212-D219	277-284

INVESTIGATION AND ANALYSES REPORT RUSH RIVER WATERSHED RCPP AMENIA FOCUS

Prepared for

Rush River Watershed and Cass County Joint Water Resource District

September 2019
Revised: March 2020

Prepared by
Brett Bailly, PE
Josh Hassell, PE
Yaping Chi, PE
Ben Kugler, EI

Appendix D-1

Table of Contents

List of Tables

List of Figures

List of Appendices

1. Background

1.1 Authority

The Cass County Joint Water Resource District (District) was established to address the common issues related to the four water resource districts in Cass County, which include the Maple River Water Resource District, the Southeast Cass Water Resource District, the North Cass Water Resource District and the Rush River Water Resource District.

The District is the sponsoring local organization (SLO) and entered into a cooperative agreement with the Natural Resources Conservation Service (NRCS) to engage in watershed planning in the Rush River watershed, a subwatershed of the Sheyenne River and the Red River of the North. The cooperative agreement is funded under the Regional Conservation Partnership Program (RCPP) as authorized in the 2014 Farm Bill that allowed the PL-566 framework for planning in watersheds.

The District utilized guidance included in the Watershed Protection and Flood Prevention Act of 1954 (PL-566) to help facilitate the watershed planning.

1.2 Location

The city of Amenia is located in Cass County, North Dakota. The Rush River flows from west to east approximately 0.5 miles north of Amenia, and the Lower Rush River flows from west to east approximately 0.75 miles south of Amenia. The watershed is drained by the Rush River, which discharges into the Sheyenne River upstream of its confluence with the Red River of the North.

1.3 Flood History

Amenia has had historic flood events and annual risks with overbank flooding from the Rush River, ice jams, and overland flooding. Additionally, preliminary FEMA flood insurance rate maps (FIRM maps) indicate that much of the city will be included in the 100-year and 500-year floodplain. Therefore, homeowners and businesses with federally-backed mortgages would be required to purchase flood insurance on their properties if the preliminary FIRM maps are adopted, which is anticipated to happen in 2020. With the rising costs associated with flood insurance, this is a considerable permanent expense for property owners unless certified flood protection is implemented. Preliminary FEMA FIRM maps have been included in Appendix A.

1.4 Proposed Project Alternatives

There are two levee alternatives described below and shown in Figure 1-1 and Figure 1-2.

Levee Alternative #1 (Preferred Alternative) proposes to construct approximately 11,820 feet of levee around the north, west, and south sides of the city of Amenia to provide flood protection from the Rush River, Lower Rush River and overland flooding to residents during a 100-year event. A 10-foot-wide channel approximately 2 feet in depth would be constructed approximately 15 feet from the toe of the levee as an additional measure of protection from flood flows and to convey summer rainfalls around the city. An internal stormwater pond would be developed for Levee Alternative #1 to capture floodwaters and runoff of approximately 180 surface acres within the levee system. Levee Alternative #1 would include constructing removable features to act as temporary levees over the ease and west crossings of county Hwy 32, north and south crossings of 155th Ave SE/Woodard Ave S, east crossing of Brown St, and the north and south railroad crossing.

Levee Alternative #2 would construct approximately 10,100 feet of levee on the south side of the Rush River, approximately 0.13 miles north of the city of Amenia to provide flood protection from the Rush River to Amenia residents for a 100-year event. A stormwater pond would be developed for Levee Alternative #2 to capture floodwaters and runoff from approximately 860 surface acres in the immediate vicinity of the levee precluded from draining directly to the river by levee construction.

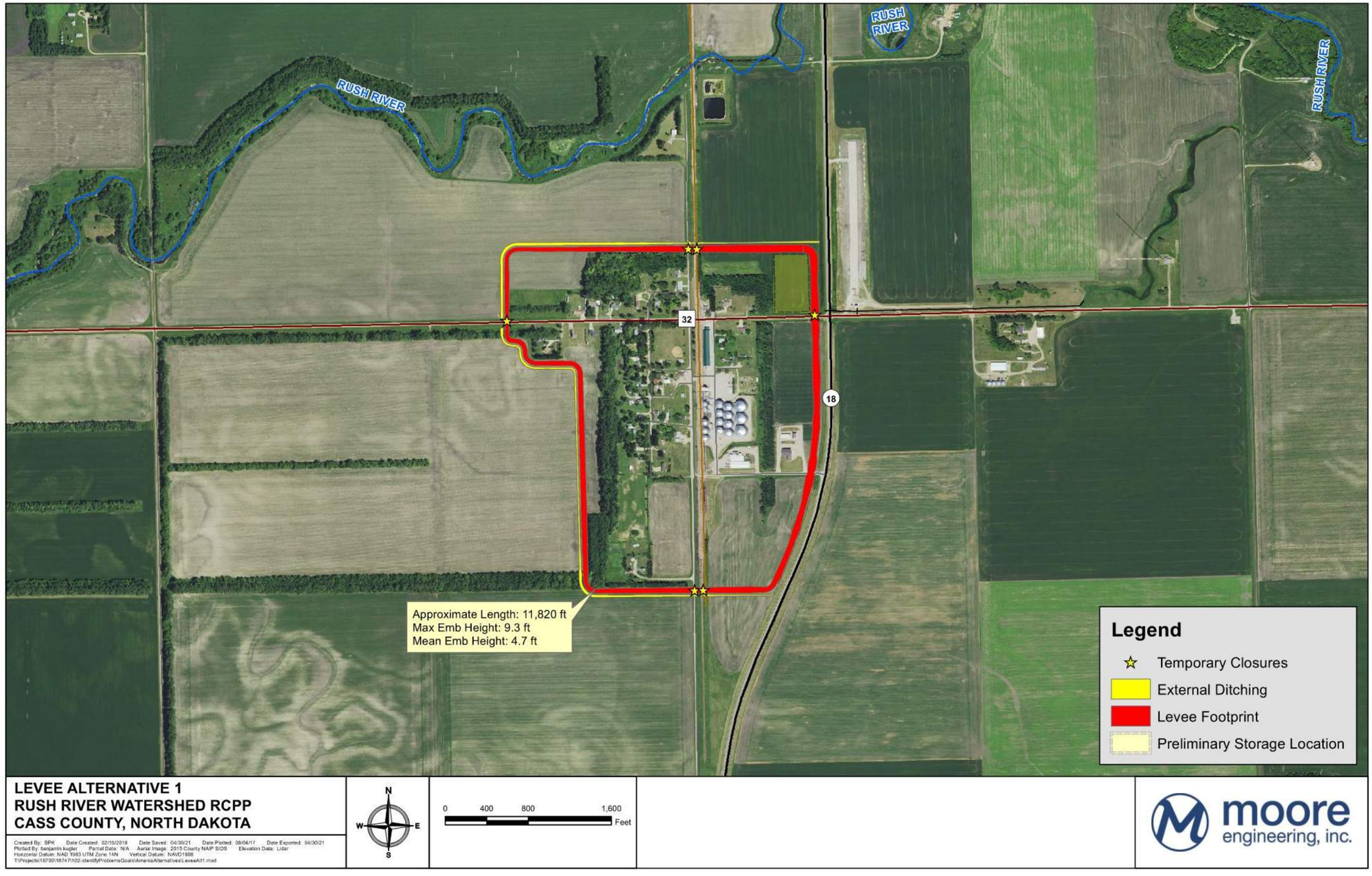


Figure 1-1 – Proposed Levee Alternative 1 for the City of Amenia, ND

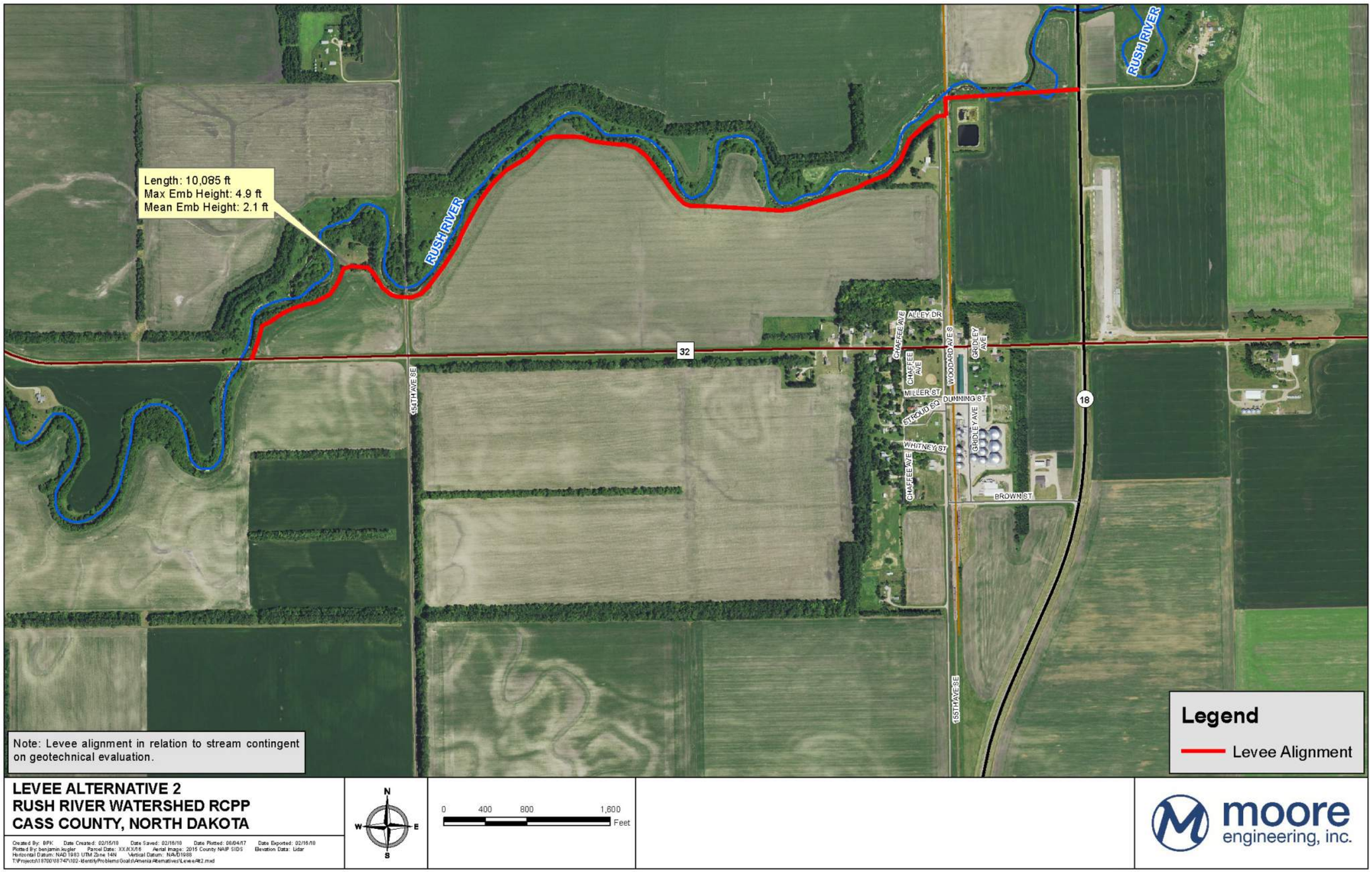


Figure 1-2 – Proposed Levee Alternative 2 for the City of Amenia, ND

2. Hydrology & Hydraulics

2.1 Alternative Hydraulic River Modeling

Inflow hydrology was originally developed during the FM Diversion Project's Final Feasibility Report and Environmental Impact Statement (FEIS) [1]. The hydrology focused on a shorter period of record developed by an Expert Opinion Elicitation (EOE) panel. This produced peak flow and balanced hydrographs that vary over time and is known as the Wet Cycle Hydrology. However, it does not include floods after 2009.

U.S. Geological Survey (USGS) gage 05060500 is located on the Rush River at Amenia and has a contributing drainage of 116 square miles. As part of the FEIS described above an analytical flow frequency study was carried out at Amenia using the USGS annual instantaneous peak flow records for a period of record of 1947 to 2009. The FEIS states, "Weighted skew, using a generalized skew coefficient from the USGS Generalized Skew study, was used to carry out the analysis." The peak flow for a 1% Annual Chance event was calculated to be 4,215 cfs. The 2006 event was used as the pattern hydrograph for developing the balanced hydrographs. The Tributary Peak Existing 100-year Phase 8.1 model uses this hydrograph at the upstream end of the Rush River. Breakout flow from the Rush River to the Lower Rush River is modeled with a lateral structure.

One change was made to the model hydrology for this study. The Phase 8.1 model has a constant 10 cfs inflow at the most upstream cross section of the Lower Rush River for model stability. This additional flow is not necessarily representative of the hydrology of the area. In order to minimize the impact of this stability baseflow, it was lowered to the lowest rate that would still allow stable model results. It was found that the model was stable with just 1 cfs for this baseflow.

2.1.1 Alternative 1 – HEC-RAS Modifications

Storage areas RUSHA64, RUSHA66, RUSHSA67, and RUSHA68 were modified to reflect the area protected by the Alternative. The storage areas had their areas reduced, and storage curves modified to reflect this change, as it was assumed the Alternative would no longer allow the protected area to be utilized as storage. It should be noted that the connections (culverts) between RUSHSA67 & RUSHSA68 in addition to those between RUSHSA64 & RUSHSA65 were maintained in the modelling. These connections (culverts) are required to pass the local drainage and breakout flows from the Rush River during times of flooding. During normal summer/fall rainfall events, the drainage from the city is assumed to be gravity drainage along the existing drainage paths. However, during a flooding scenario,

the city will need to cut off those drainage paths to prevent water from backing up into town. The existing and proposed drainage paths in town have been included in Figure 2-2.

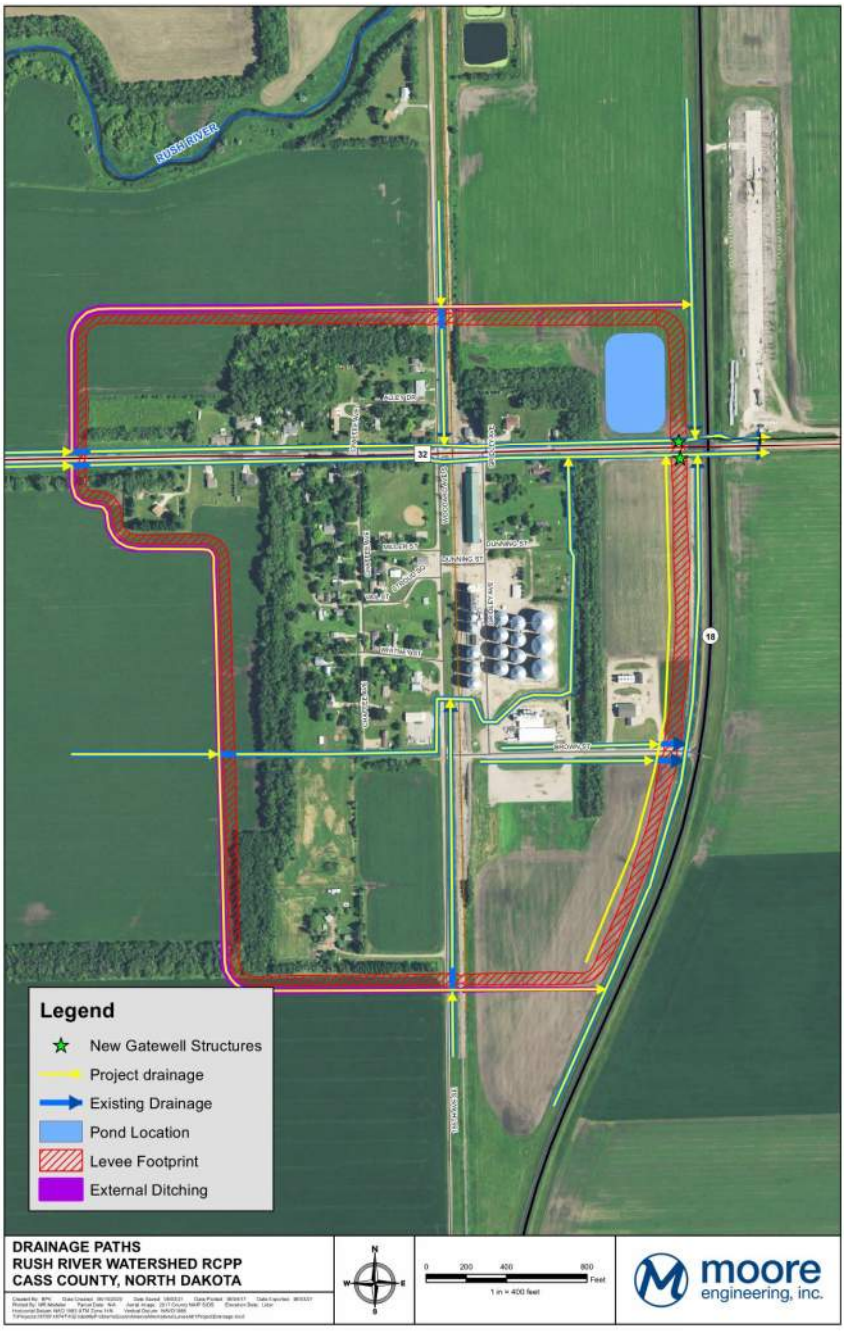


Figure 2-1 - Existing Drainage Paths

Thus, gravity flow from the protected area will not be allowed to discharge as the flow is limited to the capacity of the culverts downstream which are backing up water. Increasing culverts/bridge was an alternative considered; however, the watershed team ruled that alternative out due to increasing flows

downstream. Thus, a pump station will be required to discharge rainfall events during a flooding scenarios. The model geometry layout is shown in Figure 2-2.

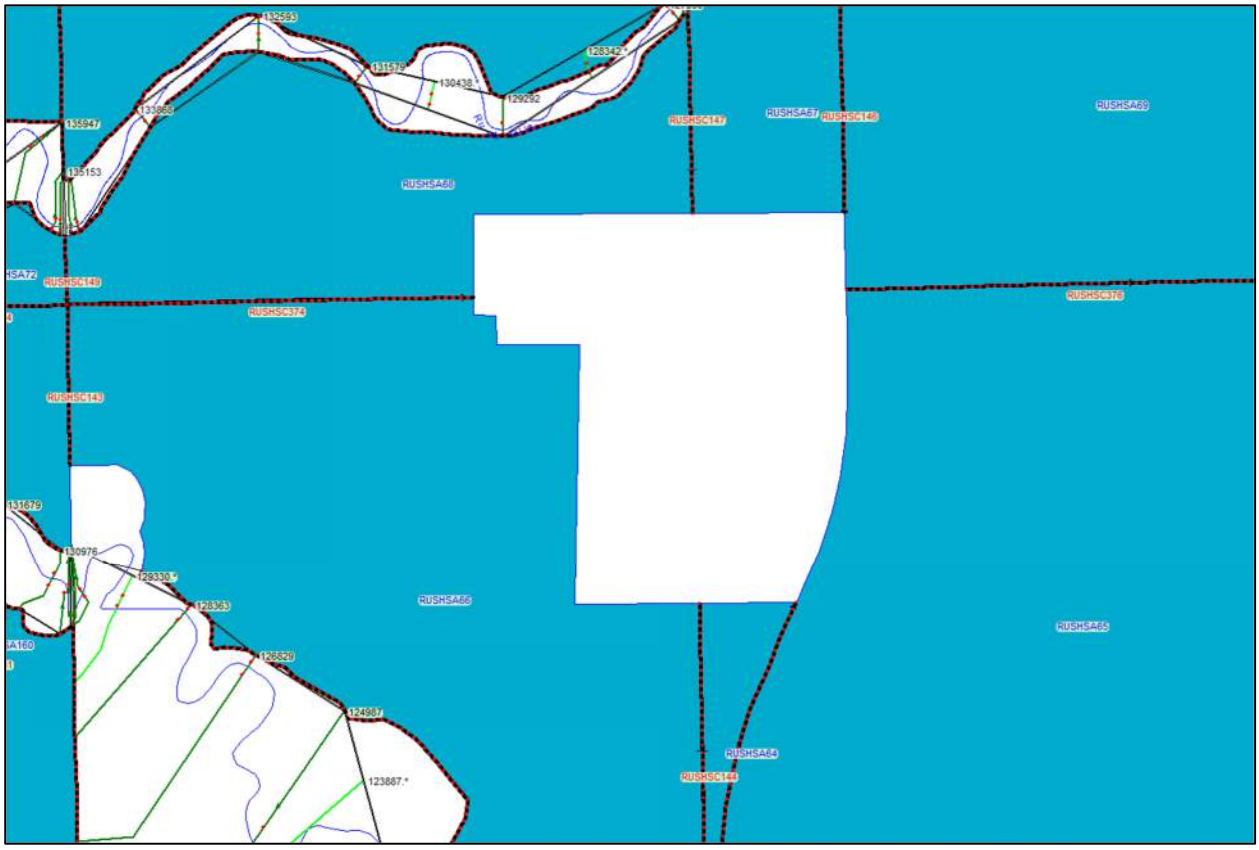


Figure 2-2 - HEC-RAS Geometry Layout - Alternative 1

2.1.2 Alternative 2 – HEC-RAS Modifications

Lateral Structures on the Rush River reach Amenia to Sheyenne at stations 138236.8, 135004.8, and 127152.8 were modified to simulate a levee by raising the embankment elevation to a level where the 1% annual chance event modeled flows would no longer break out. Figure 2.3 shows the HEC-RAS model configuration.

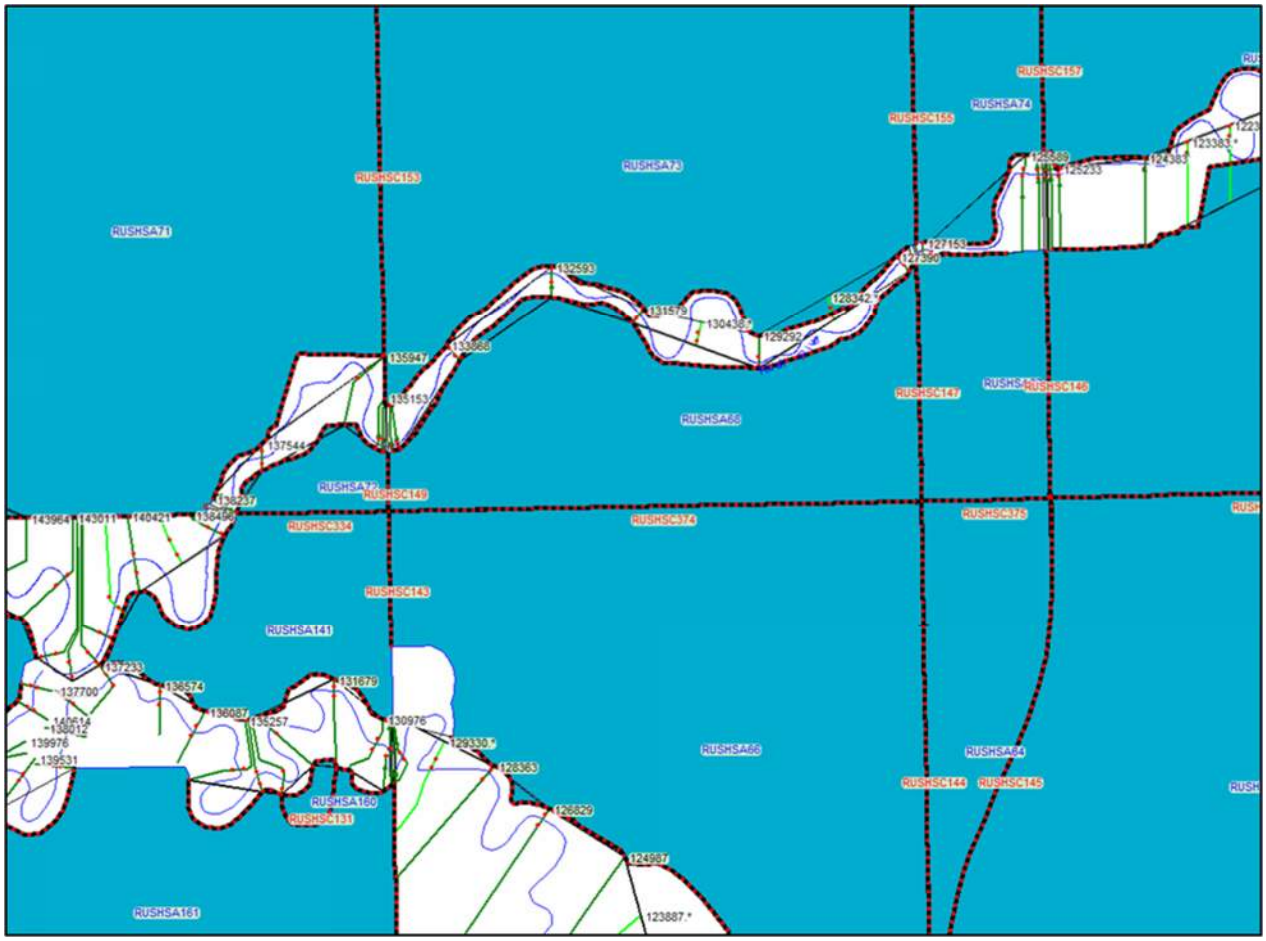


Figure 2-3 - HEC-RAS Geometry Layout - Alternative 2

3. Design Considerations

3.1 Datum

Coordinate System and Projection: North American Datum 1983 (NAD83), Universal Transverse Mercator Coordinate System, Zone 14N

Vertical Datum: North American Vertical Datum of 1988 (NAVD 88-Geoid 09)

3.2 Levee Design

Detailed drawings showing the proposed project alternatives are shown in Appendix B and Appendix C.

3.2.1 Geotechnical

Barr Engineering Company was retained by Moore to complete a preliminary geotechnical investigation and evaluation of levee alternatives 1 and 2. Their report titled," Preliminary Geotechnical Engineering Report Rush River Watershed - Amenia Levee Alternative Sites Alt1 and Alt2 Cass County, North Dakota" contains their analyses. [3] The analysis results show long-term settlement estimated at 5 to 7 inches. After taking into account immediate elastic settlement, the actual settlement will likely be 7 to 9 inches.

A levee cross section with 4H:1V side slopes and a 10 foot top was analyzed for seepage and slope stability for Alternative 1 and determined to be generally suitable. Further lab testing to confirm the drained shear strength of the embankment and foundation soil will confirm the results. Alternative 2 utilized a 4H:1V on the north side and a 5H:1V on the south side to address low factor of safety. Alternative 2 also has a top width of 10 feet.

The geotechnical report recommended that slope protection such as vegetation, riprap, or turf reinforcement be used for the constructed levee embankment, particularly for any slope exposed to moving water during flood events. Barr recommended the latter two on the upstream slope due to the rural location and limited inspection anticipated for the project once constructed. However, both levees will be within half a mile of the city of Amenia and are expected to be inspected annually as well as during flood events. After construction, the city will be eligible to apply for the USACE Non-Federal Levee Program, which will require annual inspections and provide additional federal support. Therefore, vegetation is recommended for slope protection.

3.2.2 Levee Certification

In order for FEMA to accredit a levee as providing a 1% annual chance level of protection, the levee systems must meet, and continue to meet, the National Flood Insurance Program (NFIP) requirements described in Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10). This requires that levees have at least 3 feet of freeboard above the 1% annual chance event, or Base Flood Elevation (BFE) and be 3.5 feet above the BFE at the upstream end. Levees must also be 4 feet above the BFE within 100 feet of structures such as bridges.

Alternative 1 levee was set to an elevation of 959.0. This elevation is 4 feet above the elevation identified for the flood elevation from modeling and mapping using LiDAR. Only 3 feet is required to meet FEMA requirements. However, an additional foot was added to account for settlement and spreading of topsoil. In addition to the levee, the project would include constructing removable features during a flood to act as temporary levees over three road crossings and one railroad crossing. For paved road crossings, the

asphalt pavement would be cut out during levee construction and roadbed prepared such that a concrete sleeper slab could be placed. The concrete sleeper slab would replace the asphalt as a traversable surface but would act as support for the temporary placement of clay fill at the road crossings to bring the levee up to the design elevation during flood scenarios, while removing pervious material from the levee alignment. Once the flood recedes, the temporary clay fill would be removed and the road would be passable with no additional work. For gravel roads, the gravel overlying the roadbed would be removed and the roadbed would be reconstructed in a similar fashion to the levee as to make it congruent in material and compaction. Upon completion of the roadbed, the gravel would be reestablished for normal use. Under a flood scenario, the gravel would be removed and a clay fill temporarily added to bring the levee up to the design elevation. Once the flood recedes, the temporary clay fill would be removed and the gravel layer would be reestablished. The railroad would receive similar treatment to the gravel roadway, differing only in the need for the railroad company to remove the tracks and ballasts during a flood before clay fill is brought in.

A road raise is avoided because of the amount of pavement needed to be removed to allow for a vertical curve for the roadway design speed limit could result in hundreds of feet of pavement needing to be removed and replaced. The sleeper slab minimizes costs while allowing a suitable base for a temporary levee that limits seepage during a flood.

Alternative 2 levee was set to an elevation of 969.0 on the upstream side and 959.0 on the downstream and graded along the profile between those two points. The elevations were set to 4 feet above the flood elevations determined. The additional foot was added to account for settlement and spreading of topsoil. In addition to the levee, the project would include constructing removable features during a flood to act as temporary levees over one road crossings and one railroad crossing. The road crossing would be at an existing gravel road. The gravel overlying the roadbed would be removed and the roadbed would be reconstructed in a similar fashion to the levee as to make it congruent in material and compaction. Upon completion of the roadbed, the gravel would be reestablished for normal use. Under a flood scenario, the gravel would be removed and a clay fill temporarily added to bring the levee up to the design elevation. Once the flood recedes, the temporary clay fill would be removed and the gravel layer would be reestablished. The railroad would receive similar treatment to the gravel roadway, differing only in the need for the railroad company to remove the tracks and ballast during a flood before clay fill is brought in.

A road raise to 154th Avenue SE is avoided because of an existing bridge over the river. In order to minimize the length of the levee, the crossing would occur near the river. A road raise would require the road to be raised approximately four feet above the existing roadway. In order to not replace the bridge and to avoid steep roadway slopes, a temporary levee crossing would be utilized.

3.2.3 Pond Design

A.1 Interior Drainage Analysis

The City of Amenia currently has no requirements for sizing storm water runoff systems. This analysis was based on knowledge of other municipalities in the region along with some basic assumptions that will be further evaluated during final design. The original sizing of the pump was determined by calculating the existing runoff from the protected area. This analysis was based on runoff generated by the area assuming residential development with group C soils and impervious surfaces of 20% and 12% for Alternatives 1 and 2, respectively. This results in an NRCS Curve Number (CN) of 79 and 77,

respectively. As a preliminary starting point, the 10-year rainfall was analyzed to size the pumps. Municipalities vary in that some require post project conditions cannot exceed the existing conditions 2-year and others the 5-year. The 10-year peak runoff is conservative in that the pumps may be larger and can potentially be downsized in the future based on input from the City. That scenario may require a larger pond; however, additional material is necessary to construct the levee. The existing conditions peak discharge was approximately 35 cfs which was generated using AutoCAD Storm and Sanitary Analysis (SSA). It was assumed that a peak pumping capacity for the system was 28 cfs. By not exceeding 28 cfs, the proposed project would not have an adverse impact to people downstream above what would happen if this project were not constructed. The required stormwater pond capacity was determined by creating enough storage to not exceed a peak discharge of 28 cubic feet per second (cfs) while minimizing the chances of internal flooding during the 100-Year recurrence rain event during a Rush River spring flood.

By having the Alternative 1 ring levee and Alternative 2 river levee options use the same pump sizes, then the cost comparison between levee options would assume both levee options would have the same lift station costs. Then the difference in costs would be mainly due to earthwork. Figure 3-1 and Figure 3-2 show drainage maps used in the modeling of Alternatives 1 and 2, respectively, with the boundary of the model's subcatchments shown. The maps show the boundary of a possible ring levee and the boundary of the area protected by a levee along the Rush River.

Figure 3-1 - Alternative 1 Drainage Map

Figure 3-2 - Alternative 2 Drainage Map

A.2 Hydrology

The procedures outlined in EM 1110-2-1413 were used to analyze historic river stage and rainfall records to determine coincident rainfall amounts during blocked gravity outlet conditions [2].

Historic rainfall data was obtained from the NOAA's National Climatic Data Center for the rainfall gage at Hector International Airport, where daily rainfall data has been recorded since 1891. This is the closest rainfall gage for this project. This rainfall data was correlated with stream gaging records from the USGS Gage 05060500, Rush River at Amenia, ND. Stream gage data for this location is available from August 1946 until the present. This produces 73 years of combined streamflow and rainfall records from 1946 through 2018. The top 10 largest historic flood events were chosen from the daily USGS data. These top 10 flood events occurred from March 17th to April 19th, with an average date of April 7th. The peak daily rainfall data were analyzed using a 6-week window centered on April 7th.

The approximate 1% coincident rainfall amount is determined by creating a rainfall – frequency plot based on Weibull plotting positions of the historic coincident events in the data set as follows:

P = m/(N+1)
P = plotting position
m = ranking of individual events in the data set, 1 being the highest N = number of events in the dataset

Confirmed records for rainfall and river stage were both available for the period from 1946-2018, or 73 years. Therefore, the 1% coincident rainfall amount was extrapolated based on the available data on the Weibull's plot. Figure 3.4 shows the 1% coincident rainfall amount of 2.8 inches estimated from the Weibull plot.

This is the expected 100-Year rainfall recurrence event that would occur during spring flooding from a snow melt. The modeled utilized a rainfall distribution developed using NOAA Atlas 14 [5] per Part 650 Chapter 4 of the National Engineering Handbook. [6] For the synthetic storm distribution, the NRCS has four rainfall distribution patterns, Type I, Type IA, Type II, and Type III, which are specific to different regions of the continental United States. At the project location, the Type II distribution has typically been deemed appropriate. However, with Atlas 14 data available, a nested rainfall distribution can be developed directly from the point rainfall information. The advantage of using a nested distribution is that each interval shown in Figure 3-3 is placed symmetrically around the center of the distribution. This way, each time duration is modeled in a single model run and the critical duration for pond design is included, eliminating the need to model different durations for each recurrence interval.

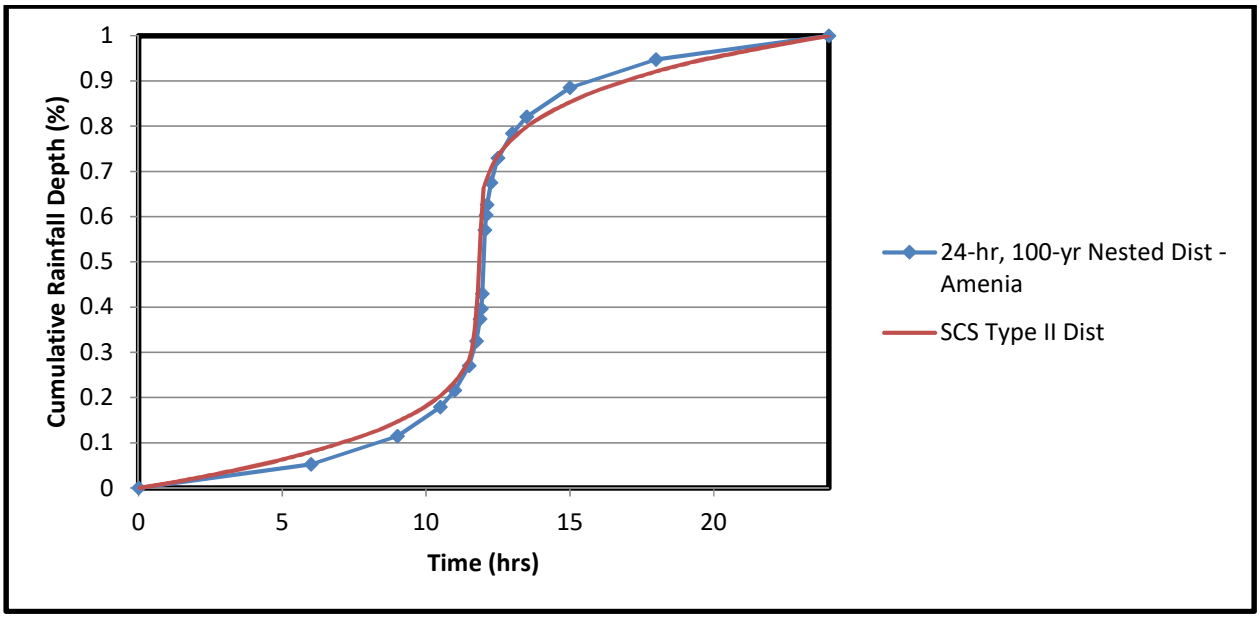


Figure 3-3 24-Hour Nested Distribution vs. SCS Type II Distribution

A.3 Pond Modeling

Modeling was completed utilizing Autodesk Storm and Sanitary Analysis 2019 (SSA) software. SSA allows the use of a hydrodynamic link routing method. The hydrology runoff method used SCS TR-55. The model scenario discussed in this report assumes a free discharge at the outlet of the system. The model does not consider tailwater effects at the outfall due to the discharge forcemain having to be at or above the levee freeboard, per U.S. Army Corps of Engineers (USACE) requirements. The forcemain piping would be constructed in the levee freeboard, which represents lifting the discharge above the water surface elevation of river flooding, which would result in the tailwater condition having no impact.

The coincident rainfall event occurs in March-April. During this time period, the frost is typically coming out of the ground. We evaluated a number of alternatives to represent the changes in soil conditions at this

time period. One alternative that was considered was to utilize soils group C with an antecedent moisture condition III. However, that produced a curve number that was in the low 90s which was considered high. Another alternative was to increase the impervious percentage, but the percentage was defined based on existing conditions. Ultimately, it was a curve number of 84 and 82 that was utilized which is reflective of soils group D, due to the fact it would allow for more runoff, but it would not act as relatively impervious. The proposed peak discharge for post project conditions was based on runoff generated by the area assuming residential development with curve numbers of 84 and 82 and impervious surfaces of 20% and 12% for Alternatives 1 and 2, respectively. The total runoff generated by the area in question was modeled with all runoff reaching a storm lift station with two pumps. The project watershed was modeled as a single subcatchment. The Time of Concentration (Tc) was calculated by inputs to SSA. The Tc is expected to be 240 minutes for Alternative 1 and 324 minutes for Alternative 2. The high Tc for Alternative 1 is due to very flat ground for initial sheet flow along with the length of street ditches and their flat slopes.

The ponds are presently modeled as a wet pond. The bottom of pond was assumed to be at an elevation of 934 with a normal water level elevation of 942. This elevation was assumed based on the assumption that the normal ground water level is within the top 10 feet of the soils as discussed in Section 3.2 of the Preliminary Geotechnical Engineering Report. This is to use the ponds as a "wet well", to minimize pump cycles, extending the expected service life of the pumps. A wet pond also minimizes the fouling of the pumps from sediment or floating debris. The pond volume used in the stormwater model assumed the ponds had a uniform side slope of 5H:1V, from pond bottom to top. During final design, the pond could have a different slope below normal water and above normal water level. The normal water level may change based on further evaluation during final design. The actual pond would likely have a bench at the normal water level.

A.4 Results

The duplex storm lift station was modeled with the pumps using the pump curves of Prime Pump model 16A at 880 RPM with a 10 degree impeller. Figure 3-5 and Figure 3-6 show the bounce of the pond for the 100-year storm event for Alternative 1 and 2, respectively. The pumps will take longer to drain the total volume of Alternative 2 due to the larger tributary area draining to the pond.

The Alternative 1 pond size of 300x500x16ft would result in less material being excavated than would be required to construct the ring levee, and thus would require import material. The offsite location and haul distance are not presently known for the borrow site, which could raise the cost of the levee. In order to minimize the amount of import material needed, the pond could be oversized from what is presently modeled. A larger pond could result in being able to reduce the size of the pumps, since more stormwater storage would be available. This could lower the cost of the lift station.

The Alternative 2 pond size of 650x1,500x16ft would produce more material than needed to construct the river levee, requiring that excess material be hauled away. This would also raise the cost of the levee since the borrow site location and haul distance are not presently known. In order to minimize the amount of export material, the pond could be reduced in size, but then the lift station would need to have a larger capacity than the ring levee option. Either Alternative 2 pond option would then have a higher construction cost than Alternative 1.

The storm pumps combined peak discharge rates for each alternative are shown in Table 3.1. Both proposed project discharge rates are less than the calculated existing discharge rate of 28 cubic feet per

second. The expected pond bounce is also shown in the table and are less than 5 five feet, the maximum amount of bounce desired.

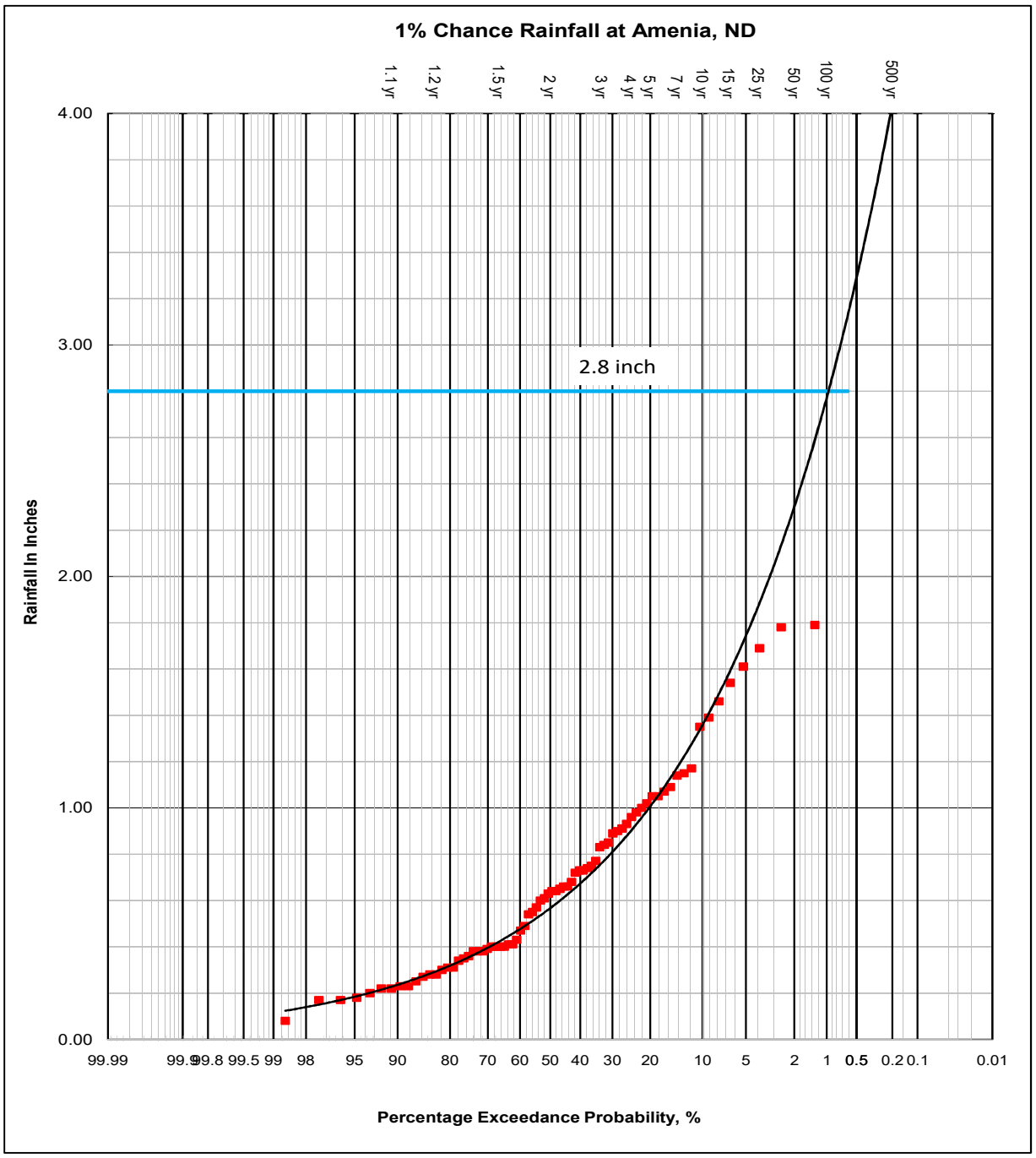


Figure 3-4 - 1% Coincident Rainfall Estimation

Table 3.1 also shows the subcatchment area, expected total runoff, total runoff volume, and the time needed to pump the runoff volume. Both alternatives show continuity with the model since the total volume pumped equals the total runoff volume.

Table 3.1 - Comparison of Alternatives 1 and 2 Pump and Pond Data

	Alternative 1	**Alternative 2**
Pump Combined Peak Discharge (cfs)	24.45	24.55
Pond Bounce (ft)	3.21	3.27
Subcatchment area (ac)	183	860
100-year Storm Total Runoff (in)	1.35	1.22
Total Runoff Volume (ft^3)	896,800	3,809,000
Runoff Volume Pump Time (hrs)	12	43

The pond storage curves and pump curves for Alternatives 1 and 2 are shown in Figure 3-7 through Figure 3-10.

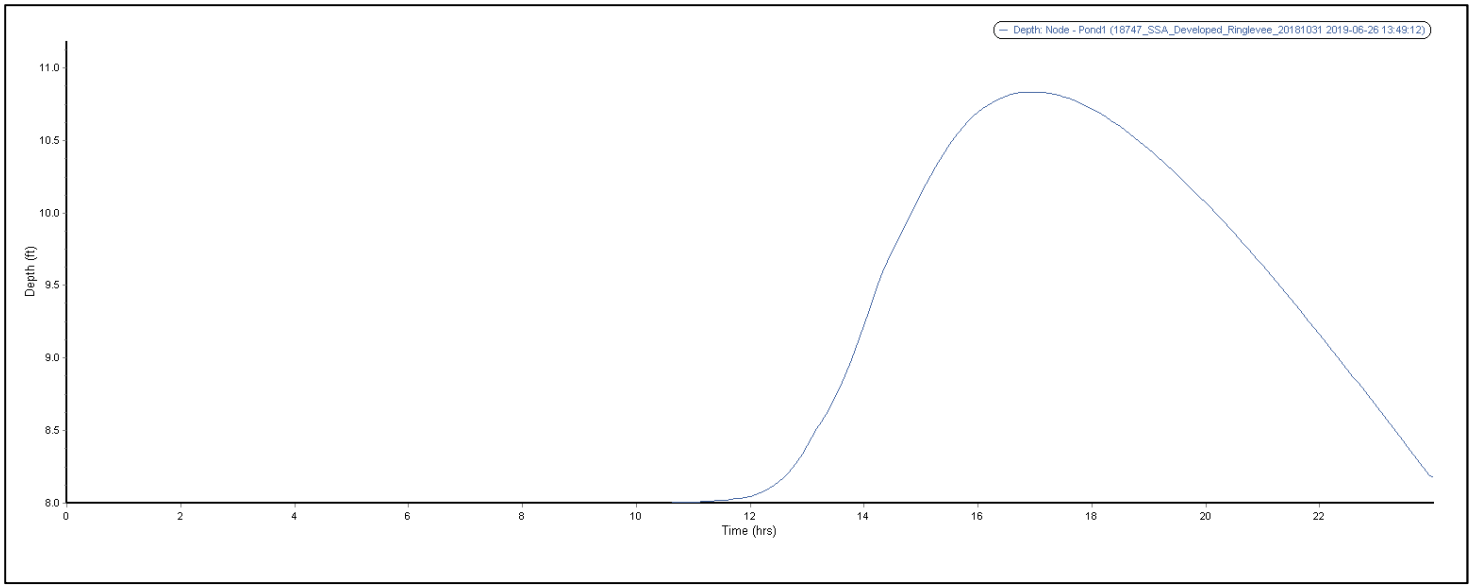


Figure 3-5 - 100-year Pond Bounce Hydrograph - Alternative 1

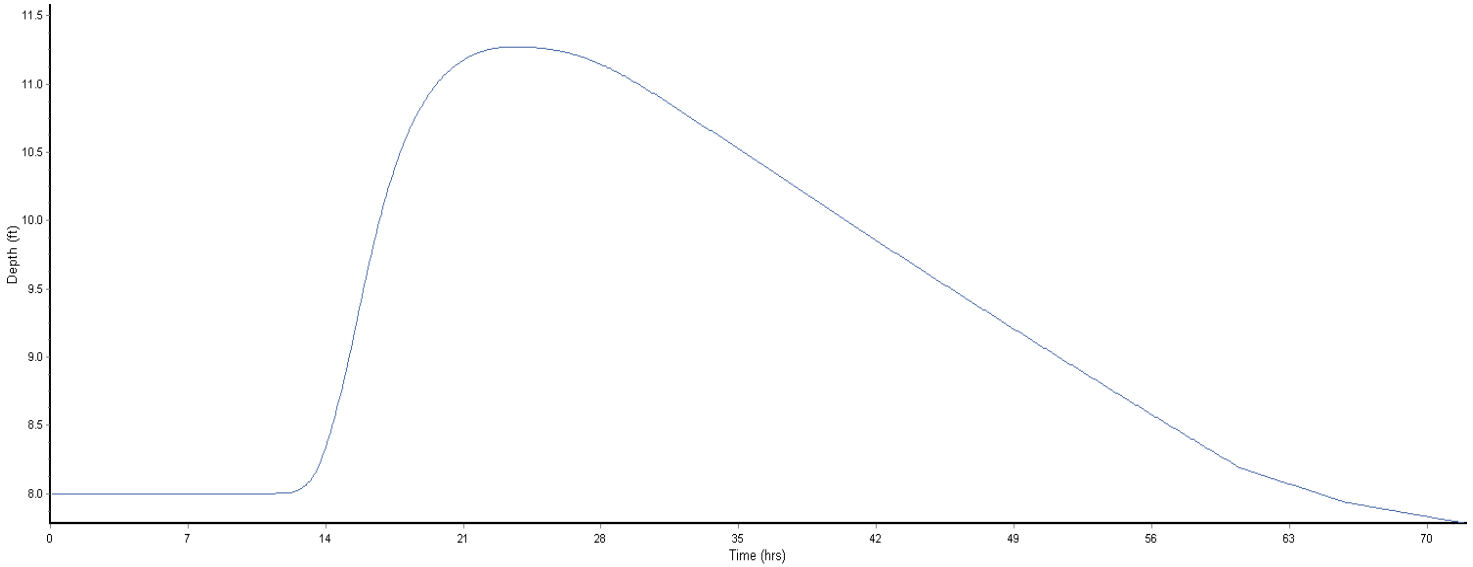


Figure 3-6 - 100-year Pond Bounce Hydrograph - Alternative 2

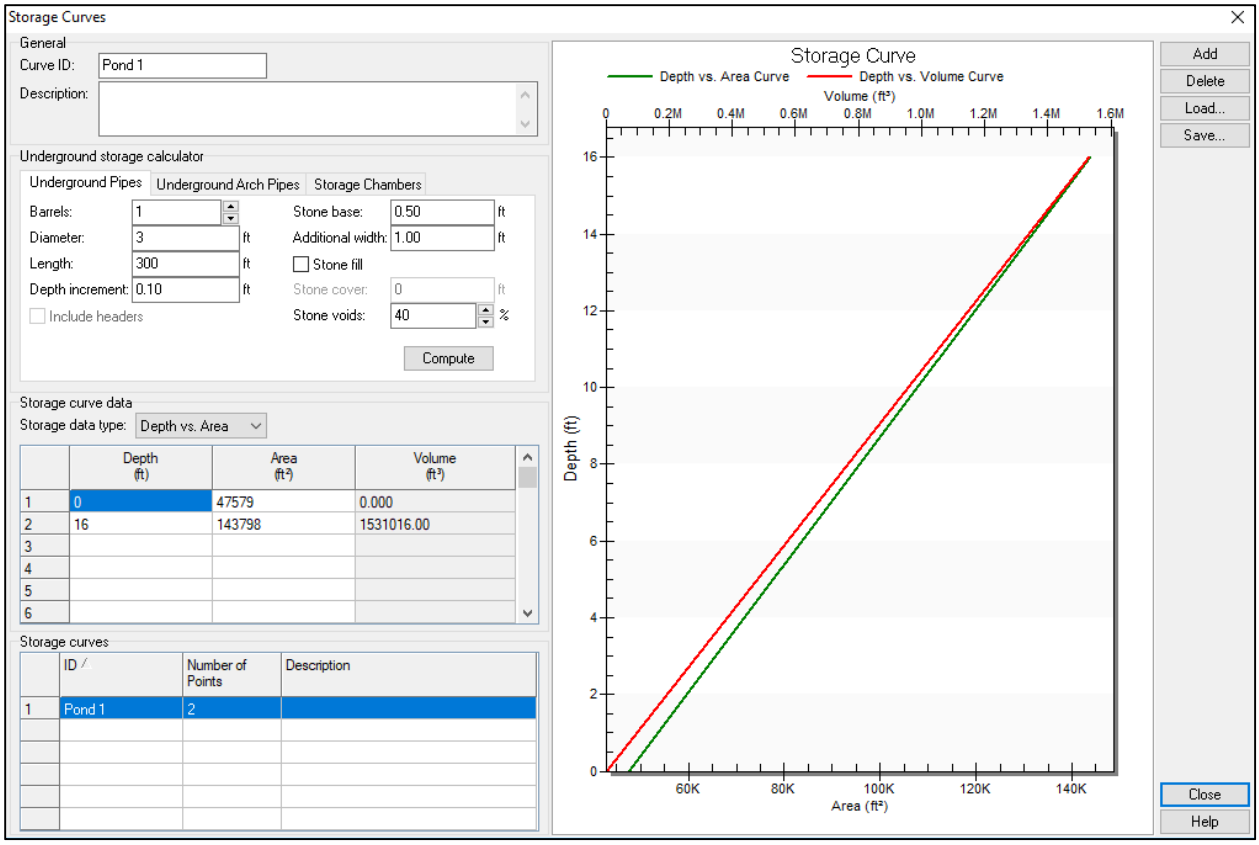


Figure 3-7 - Pond Storage Curve - Alternative 1

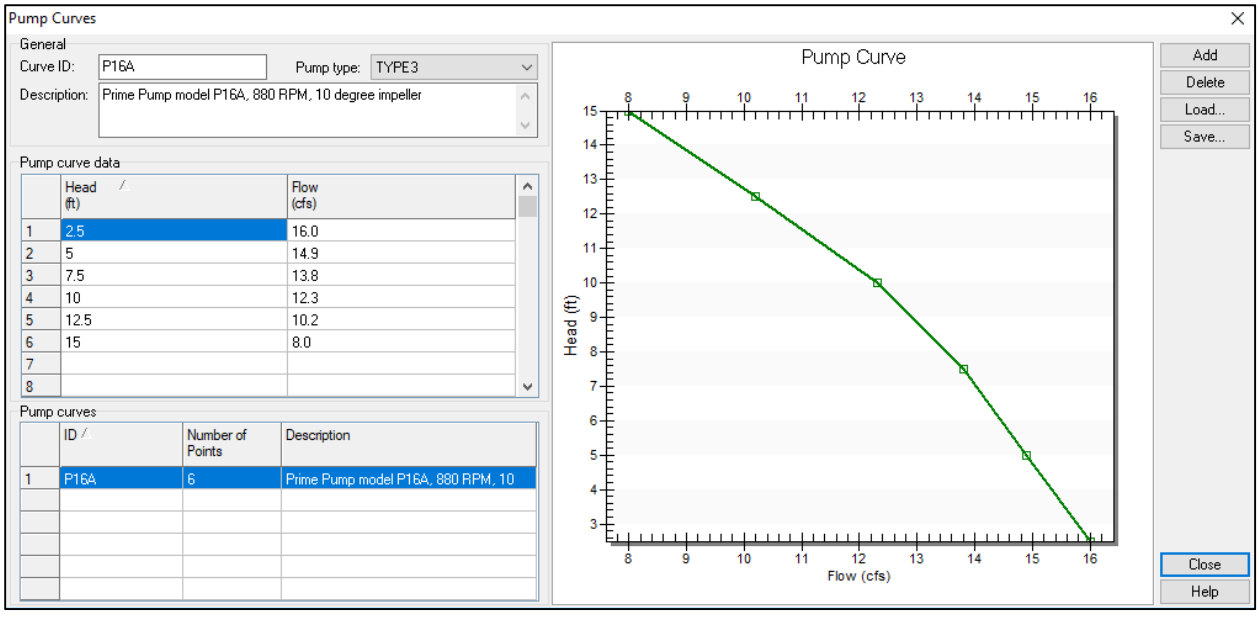


Figure 3-8 - Pump Curve - Alternative 1

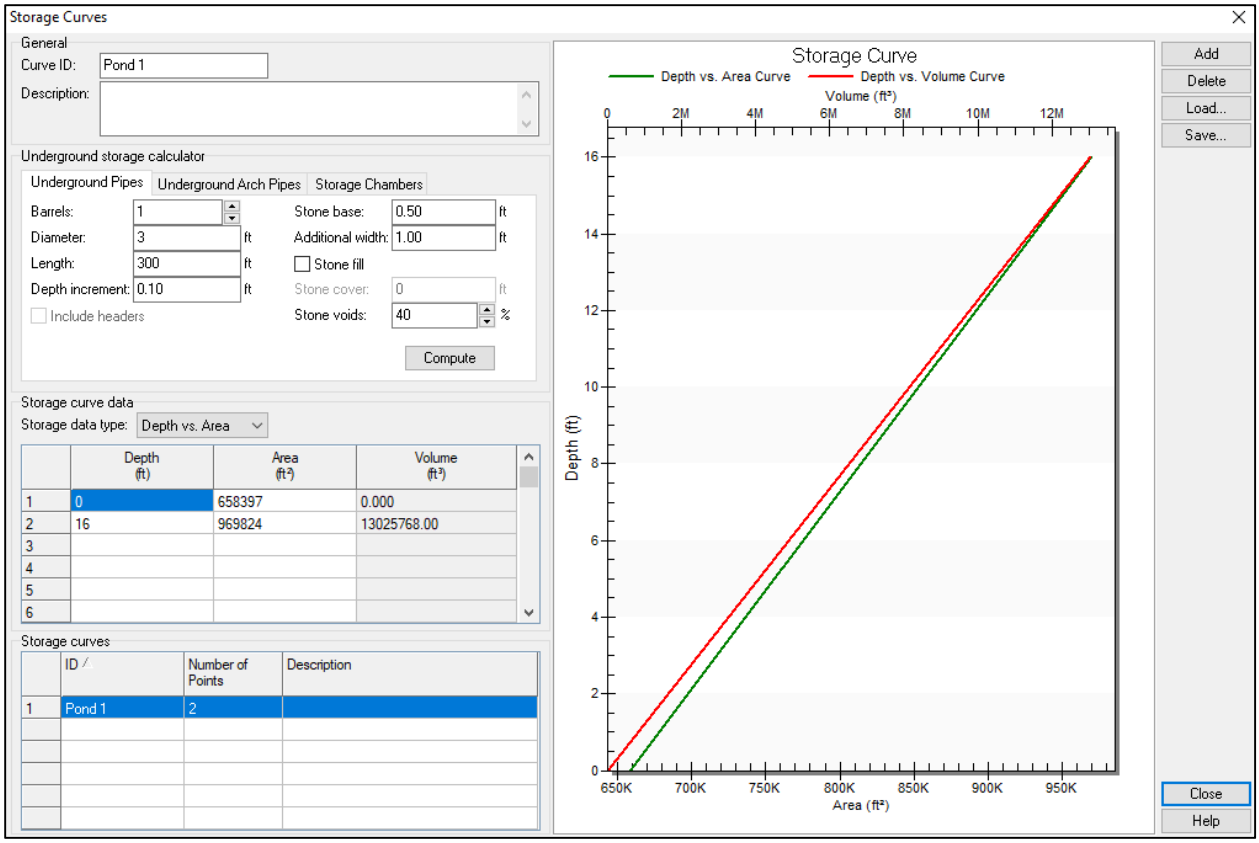


Figure 3-9- Pond Storage Curve - Alternative 2

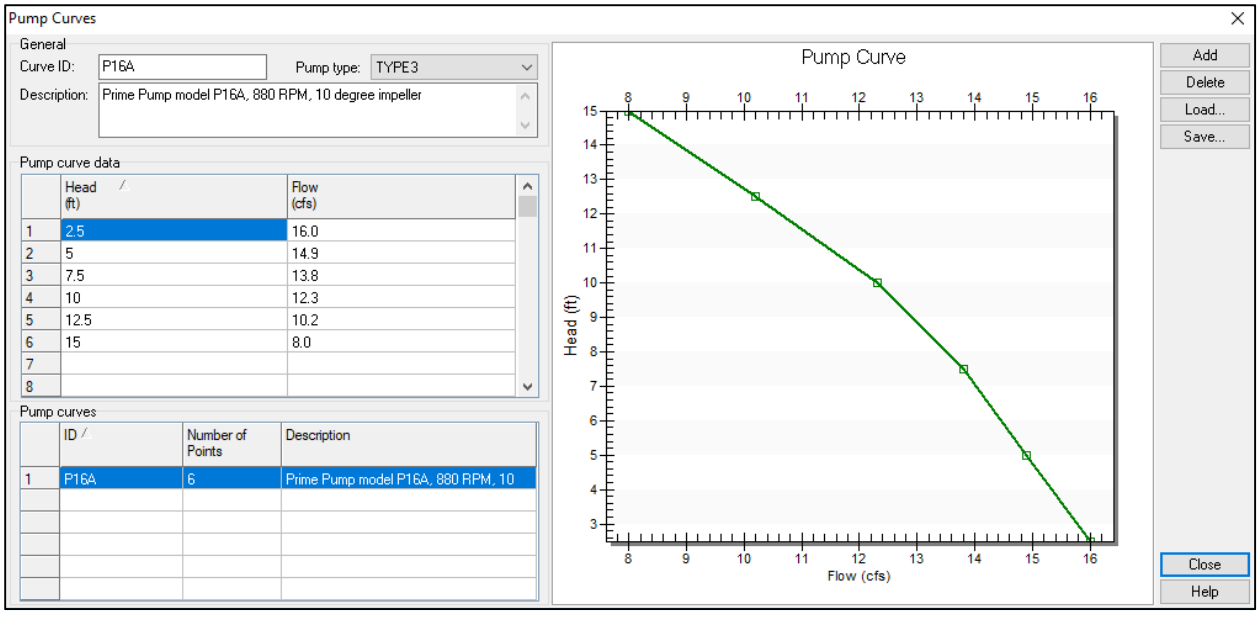


Figure 3-10 - Pump Curve - Alternative 2

3.3 Hazard Classification

It is assumed for this design that the levee alternatives would be classified as Significant Hazard Potential projects based on the definitions presented in section 520.21 E of the NRCS Title 210 National Engineering Manual [3] that defines Significant Hazard Potential as "where failure may damage isolated homes, main highways, or minor railroads, or interrupt service of relatively important public utilities."

A failure of the embankment of either alternative during the 1% annual chance event would not result in the high velocity and volume of discharge present in a typical dam breach scenario due to the relatively small volumes of water and shallow depths of pooling on the exterior of the levee for Alternative 1, and the remoteness of the levee embankment of Alternative 2. The volume of water that reaches the city of Amenia during the 1% annual chance event would not be significantly altered from existing conditions. Inundation from a breach would result in similar inundation as shown on the FIRM maps. Figure 3-11

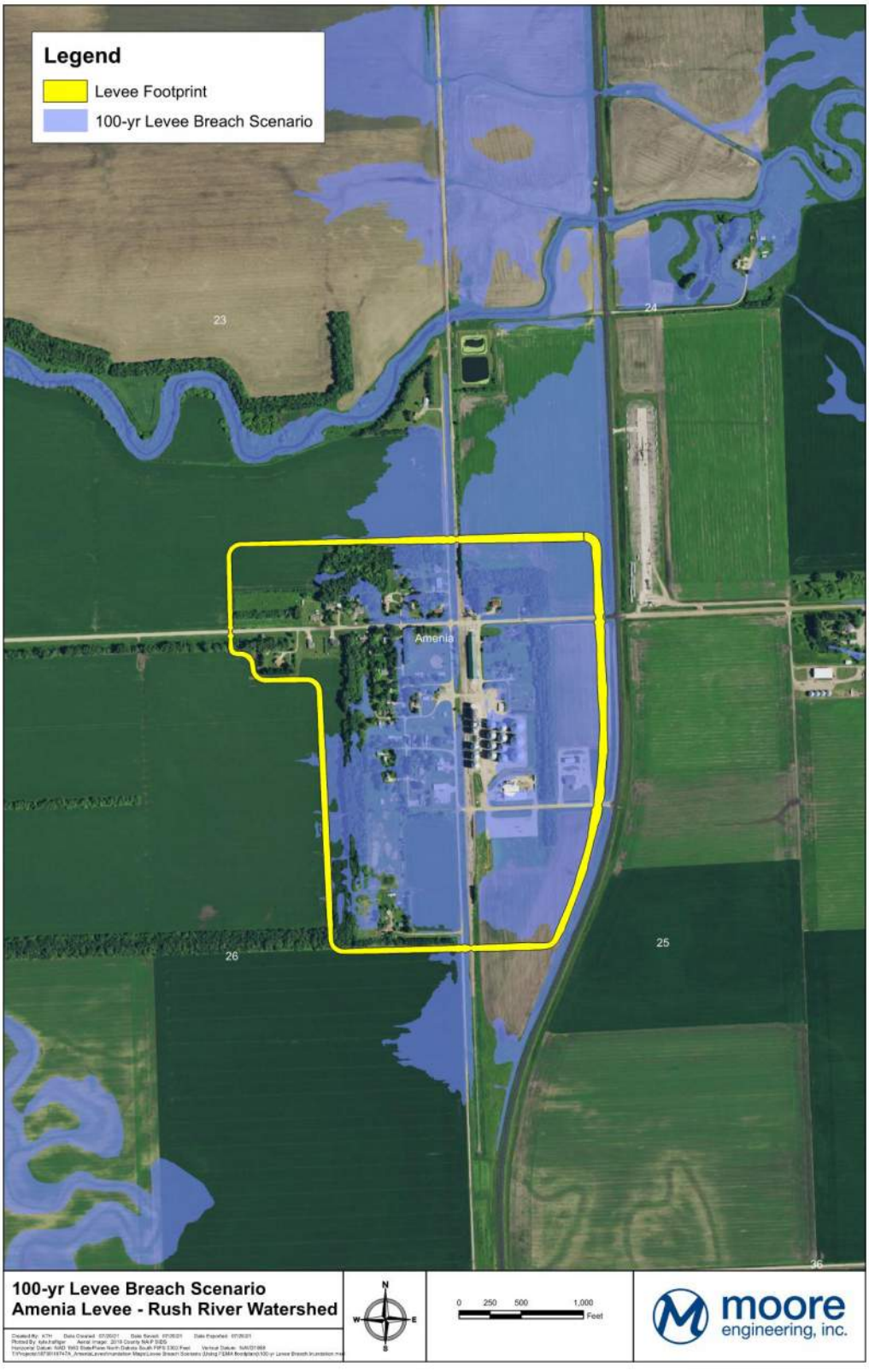


Figure 3-11 - Levee Breach

A simulation of the pump station failing was conducted using a coincident rainfall event. Should the pump fail during a 1 percent-chance event and a coincident rainfall event, water would begin to inundate the town and would impact approximately two commercial structures, one public structure and five private structures. Figure 3-12 shows the inundation resulting from pump failure Emergency response to a pump failure could be addressed by removable pumps brought in on a temporary basis until pump station can be repaired.

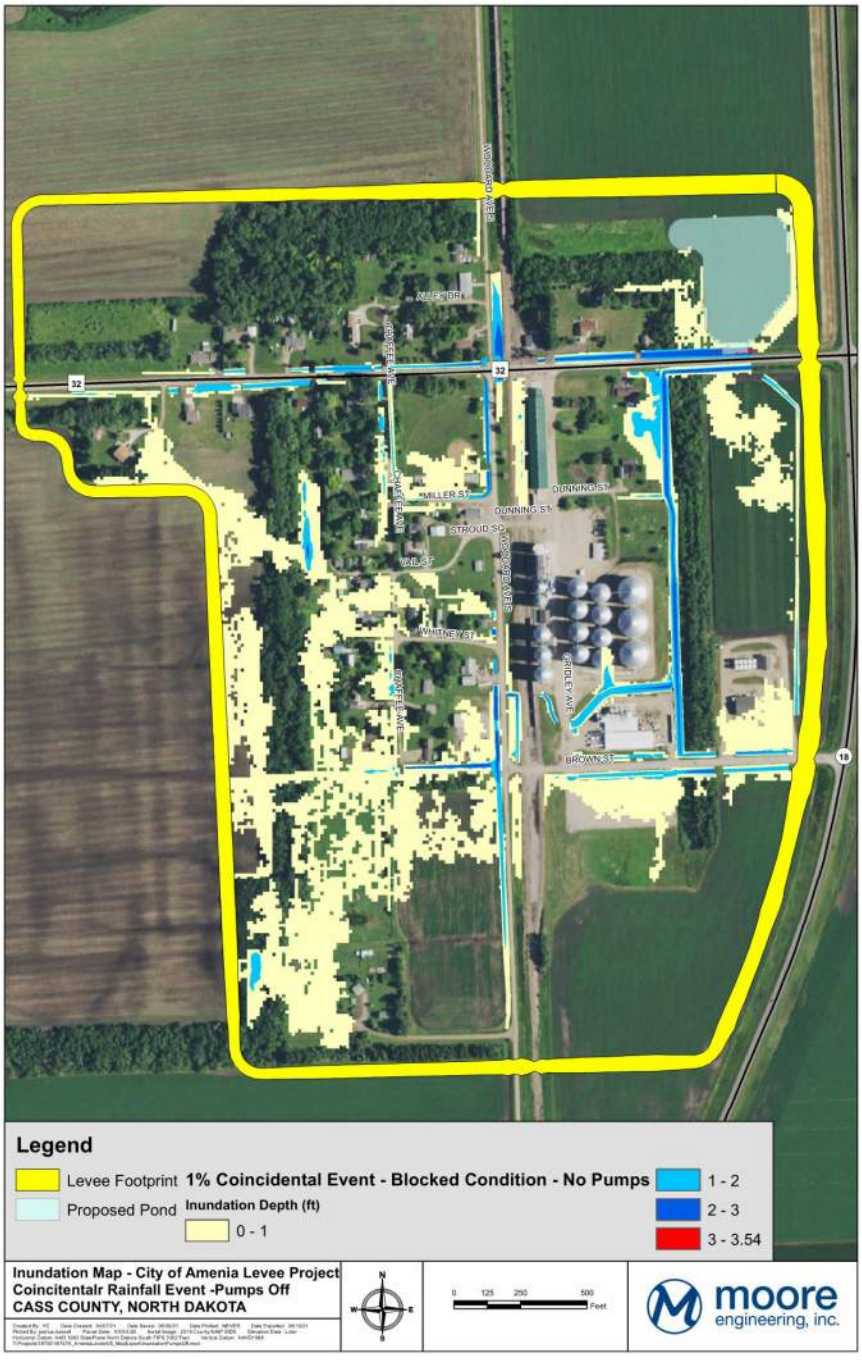


Figure 3-12 - Pump Failure

3.4 Cost Estimate

A comparison of the cost for Alternatives 1 and 2 is shown below in Table 3.2.

Table 3.2 - Levee Alternatives Cost Estimate Comparison

Item	Levee Alternative 1	Levee Alternative 2
Construction	$2,149,800	$4,105,755
Engineering – Civil Design	$353,200	$663,245
NRCS – Technical Assistance	$40,000	-
Land Surveying	$40,000	$40,000
CLOMR/LOMR	$130,000	$130,000
Utility Relocation	$175,000	$0.00
Right-of-Way Acquisition	$212,000	$378,000
Wetland Mitigation	$67,200	$68,000
Legal & Adm. Fees	$50,000	$50,000
Right-of-Way Negotiations	$20,000	$20,000
Permitting	$5,000	$5,000
Fiscal	$40,000	$40,000
Total Project Cost	**$3,282,000**	**$5,445,000**

3.5 Operation & Maintenance

Operation & maintenance activities will occur over the life of the project. All activities will be completed by the Project Owner, or a designated representative with experience in these activities. Specific responsibilities will be identified and further defined with the Project Owner during final design. Annual maintenance items that have been factored into these costs are mowing, rodent abatement, lift station maintenance and electricity costs. In addition, the operation and maintenance costs include the replacement of the lift station pumps after 25 years or half of the design life. Lastly, it is assumed that temporary road closures will be utilized once in the lifetime of the project and will be depended on water surface elevations on the exterior side of the levee. It is assumed that annual inspections will occur regardless of a flood event to identify potential issues. The frequency of inspection during a flood will likely be daily or more frequent depending on the water surface elevation adjacent to the levee.

Table 3.3 - Annual Maintenance Cost

Item	Cost
Mowing	$5,000
Rodent Abatement	$1,000
Lift Station Maintenance	$3,000
Electricity	$1,000
Lift Station – Pump Replacement (every 25 years)	$50,000
Temporary Road Closure	$25,000
Total Annualized	**$13,050**

4. Project Impacts (Results)

Alternative 1 results in the elimination of the flooding seen in the city of Amenia for the 1% chance event within the protected area of the levee. This option reduces the flood risk for approximately 93 acres, while increasing the risk on 72 acres of undeveloped agricultural land, for a net decrease of 21 acres from the floodplain. The areas directly adjacent to the levee see between 0.3 to 0.67 feet of impacts during the 1% chance event due to a reduction in the available storage from the levee. The largest impacts seen in areas not adjacent to the levee were less than 0.1 feet. Peak water surface elevations and areas impacted during the 1% event for alternative 1 can be seen in Figure 4-1 and Figure 4-2.

Alternative 2 results in a significant reduction to the peak 1% chance event water surface elevations within Amenia. A small volume of water is still reaching Amenia with this alternative from breakout flows from the Lower Rush River southwest of Amenia. This alternative results in impacts to lands in the vicinity of the levee due to the elimination of breakout flow from the Rush River that results in the flooding seen in the city of Amenia for the existing conditions. There is a reduced risk for approximately 188 acres, and an increase in risk for 140 acres, for a net decrease of 48 acres from the floodplain. The largest impacts present occur directly to the north of the alternative levee where a 0.33 foot increase occurs during the 1% event. Peak water surface elevations and areas impacted during the 1% event for alternative 2 can be seen in Figure 4-3 and Figure 4-4.

The effects of the alternatives on the flow rates at the Rush River at Amenia USGS gage were also analyzed. Figure 4-5 shows little difference between existing conditions and Alternative 1 with the ring levee around Amenia. However, Alternative 2 restricts the channel flow from breaking out, so more flow is reaching the USGS gage.

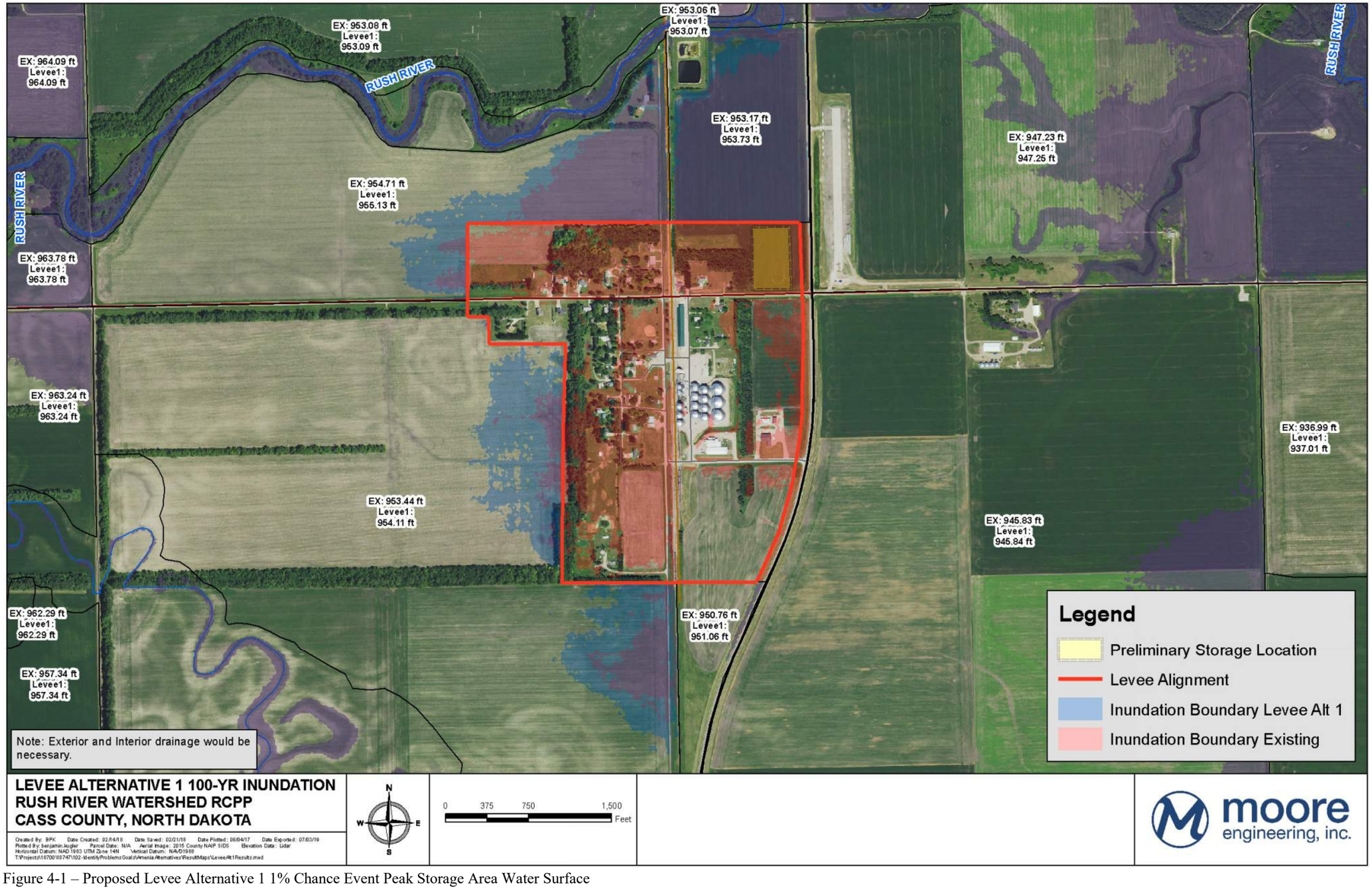


Figure 4-1 – Proposed Levee Alternative 1 1% Chance Event Peak Storage Area Water Surface

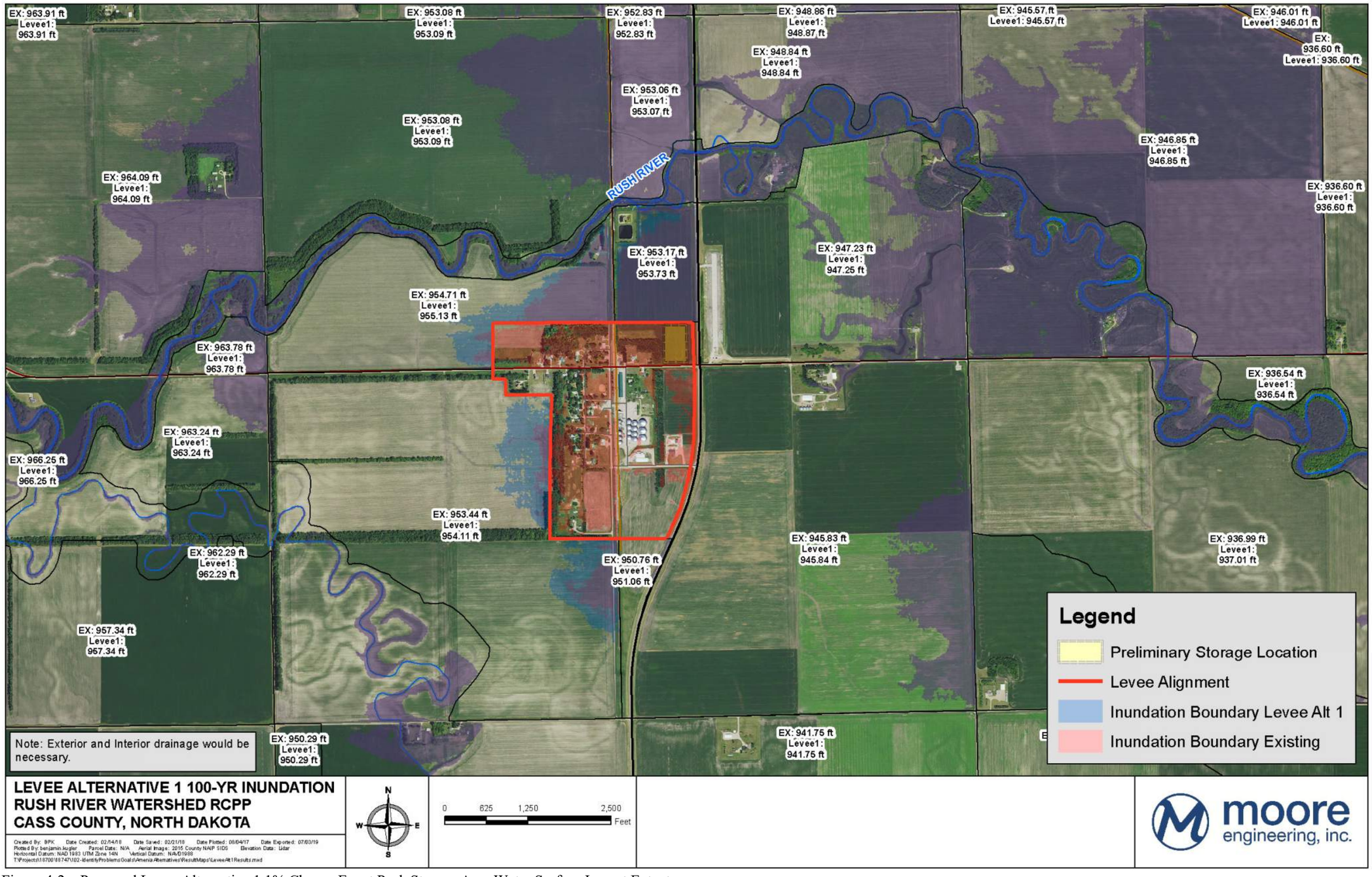


Figure 4-2 – Proposed Levee Alternative 1 1% Chance Event Peak Storage Area Water Surface Impact Extents

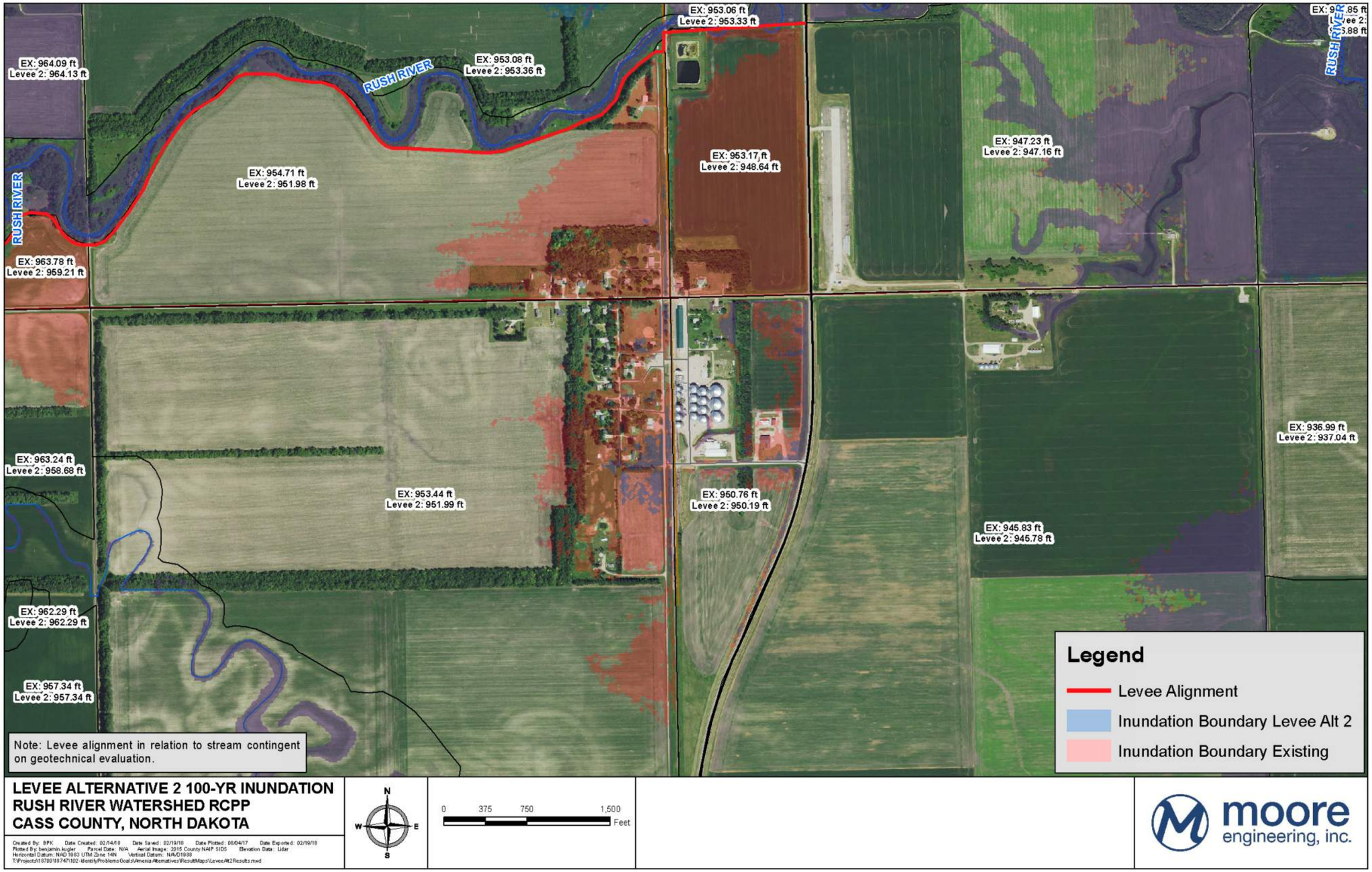


Figure 4-3 – Proposed Levee Alternative 2 1% Chance Event Peak Storage Area Water Surface

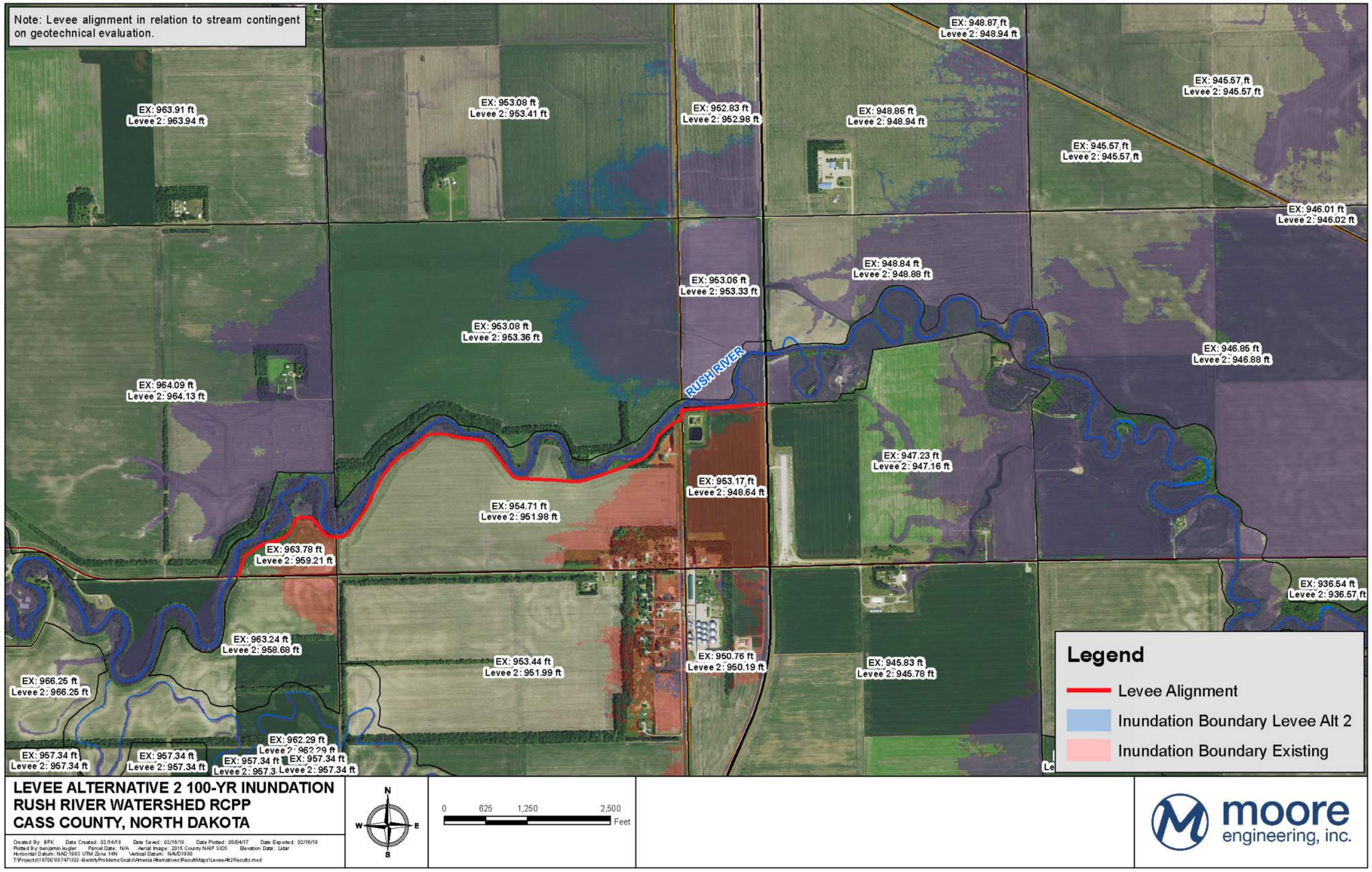


Figure 4-4 – Proposed Levee Alternative 2 1% Chance Event Peak Storage Area Water Surface Impact Extents

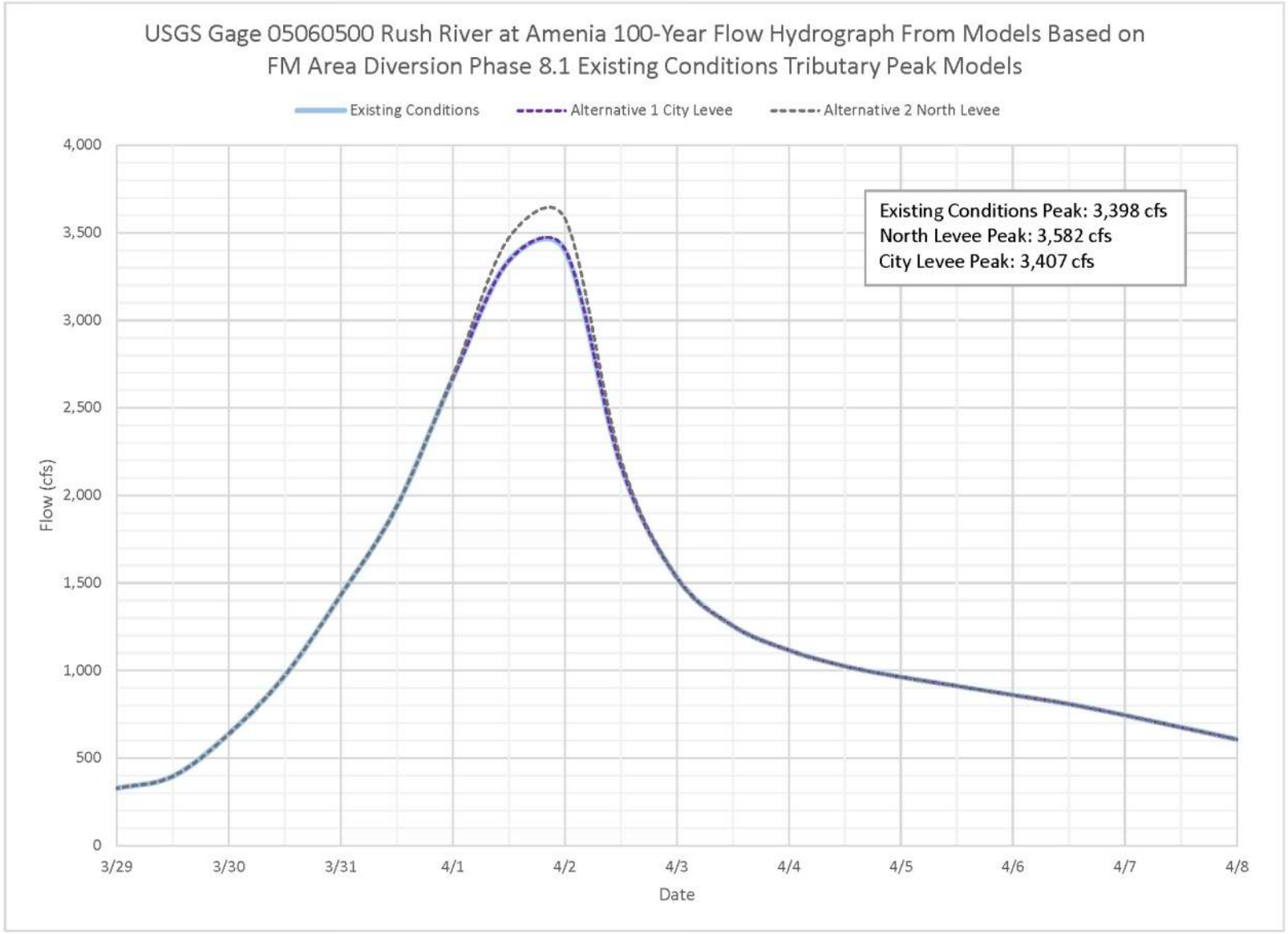


Figure 4-5 – Proposed Levee Alternatives 1% Chance Event Hydrograph at USGS Gage Rush River at Amenia

5. Bibliography

[1] US Army Corps of Engineers, "Supplemental Draft Feasibility Report and Environmental Impact Statement - Appendix A-4b: Hydrology," St Paul, MN, April 2011.

[2] U.S. Army Corps of Engineers, "EM-1110-2-1413 - Hydrologic Analysis of Interior Areas," 1987.

[3] NRCS, "Title 210 - National Engineering Manual Part 520 - Soil and Water Resource Development Subpart C - Dams," 2017.

[4] FM Diversion Authority, "FM Diversion CLOMR Submittal," 2017.

[5] Barr Engineering Company, "Preliminary Geotechnical Engineering Report Rush River Watershed - Amenia Levee Alternative Sites Alt1 and Alt2 Cass County, North Dakota," 2019.

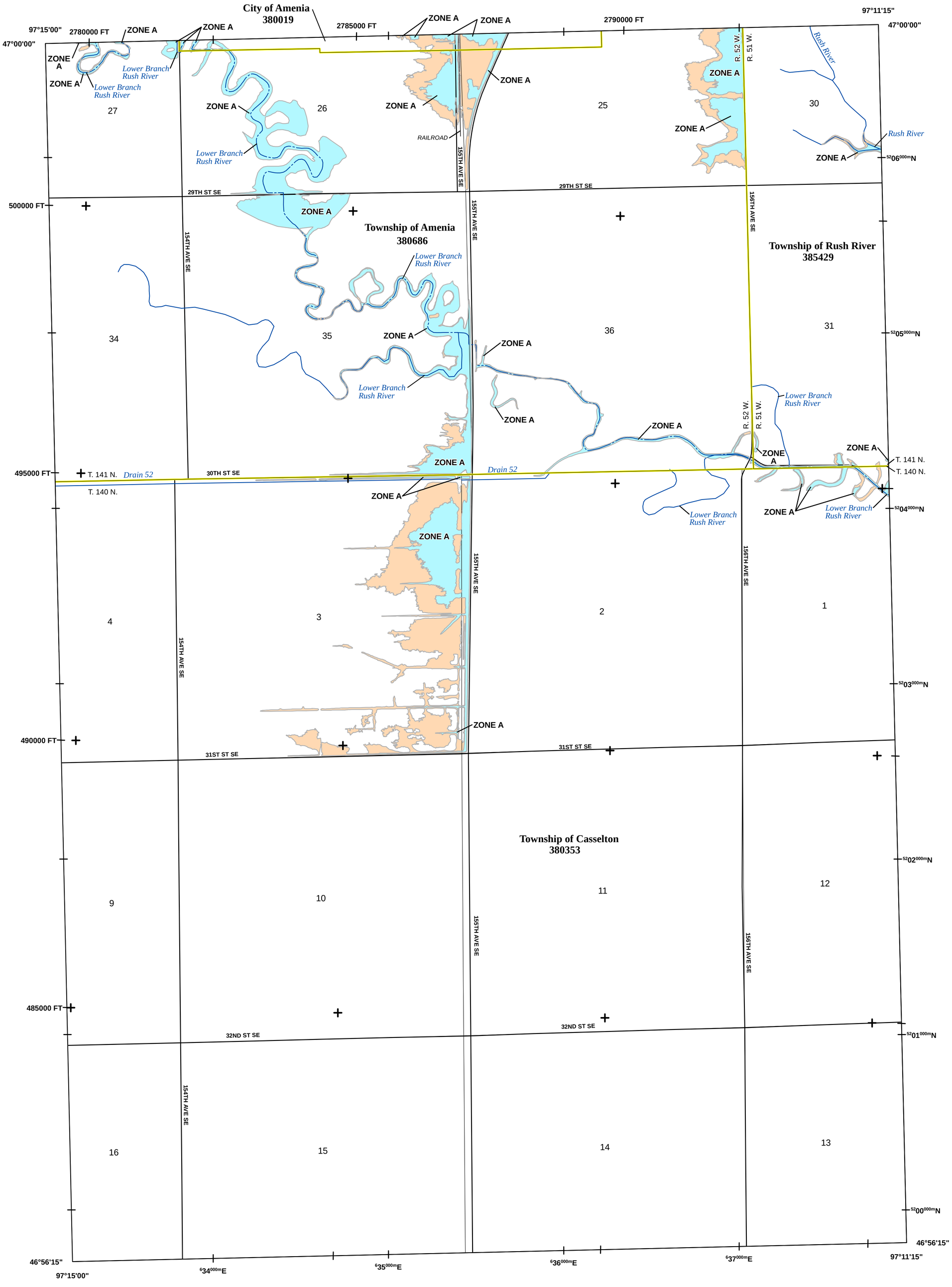
[6] NWS NOAA, "NOAA Atlas 14 Point Precipitation Frequency Estimates," 2020. [Online]. Available: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html.

[7] USDA NRCS, "National Engineering Handbook Chapter 4 Storm Rainfall Depth and Distribution," 2019.

[8] MnDOT Bridge Hydraulics, "Tips for Using Atlas 14 - Precipitation Data Frequency Server," 5 April 2013. [Online]. Available: http://www.dot.state.mn.us/bridge/pdf/hydraulics/Atlas14_PrecipitationDataFrequencyServer.pdf. [Accessed 15 January 2014].

Appendix A Preliminary FEMA Flood Insurance Rate Maps

Appendix D-1-A



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS
- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert or Storm Sewer
- Levee, Dike or Floodwall

OTHER FEATURES
- 18.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation (BFE)
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to 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.

Base map information shown on this FIRM was provided in digital format by the Cass County GIS Department dated January 2009. Corporate Boundaries and Transportation features were updated January 2015 based on Cass County GIS Department data.

SCALE

N

Map Projection:
Universal Transverse Mercator Zone 14N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 1,000 feet 1:12,000

0 1,000 2,000 4,000 feet

0 250 500 1,000 meters

PANEL LOCATOR

*PANEL NOT PRINTED

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

CASS COUNTY, NORTH DAKOTA
(All Jurisdictions)

PANEL 505 OF 995

FEMA

Panel Contains:

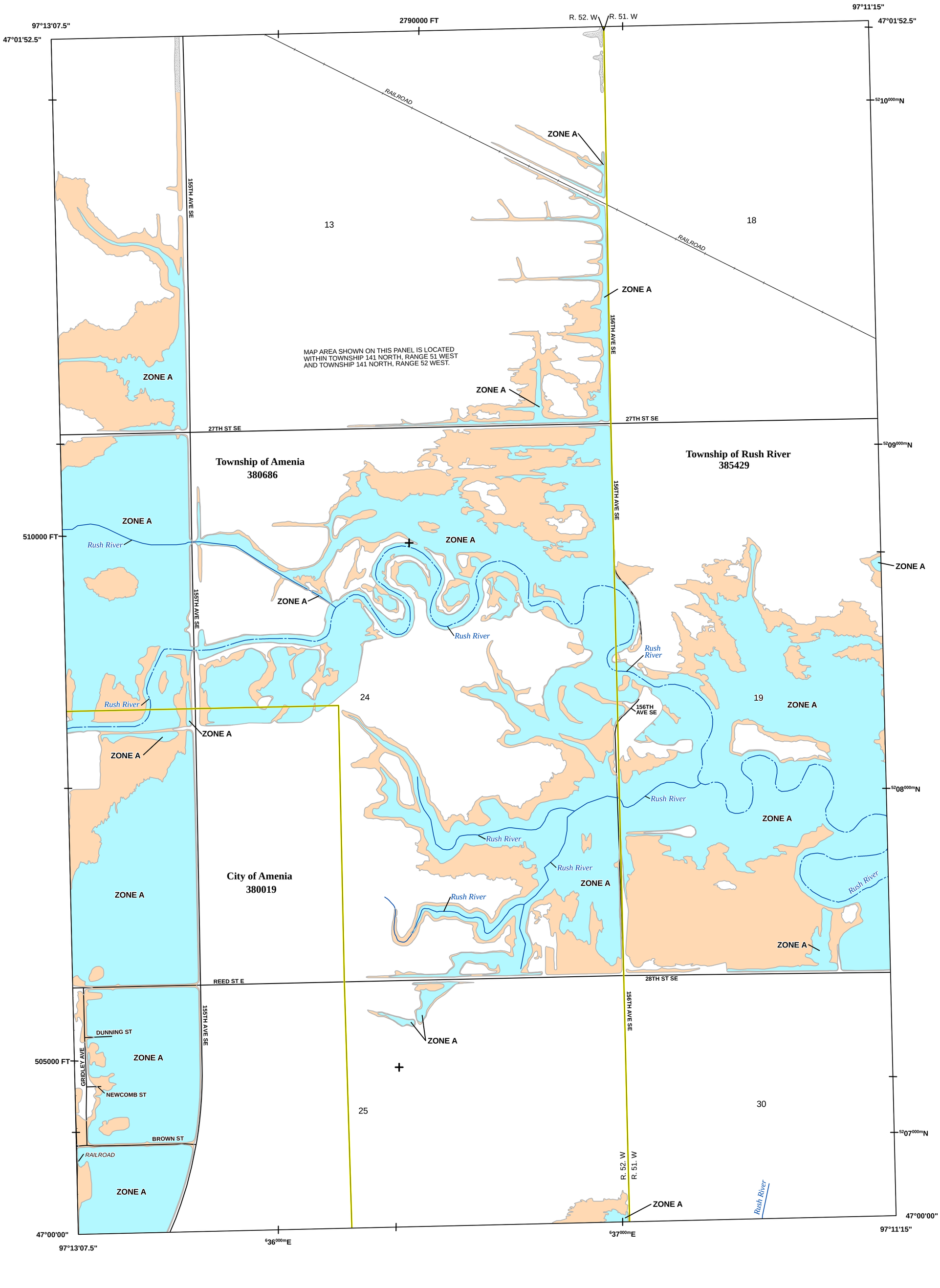
COMMUNITY	NUMBER	PANEL	SUFFIX
AMENIA, CITY OF	380019	0505	H
AMENIA, TOWNSHIP OF	380686	0505	H
CASSELTON, TOWNSHIP OF	380353	0505	H
RUSH RIVER, TOWNSHIP OF	385429	0505	H

REVISED PRELIMINARY 7/18/2018

VERSION NUMBER
2.3.3.2

MAP NUMBER
38017C0505H

MAP REVISED



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS
- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert or Storm Sewer
- Levee, Dike or Floodwall

OTHER FEATURES
- E 18.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to 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.

Base map information shown on this FIRM was provided in digital format by the Cass County GIS Department dated January 2009. Corporate Boundaries and Transportation features were updated January 2015 based on Cass County GIS Department data.

SCALE

N

Map Projection:
Universal Transverse Mercator Zone 14N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR

*PANEL NOT PRINTED

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

CASS COUNTY, NORTH DAKOTA
(All Jurisdictions)

PANEL 314 OF 995

FEMA

Panel Contains:

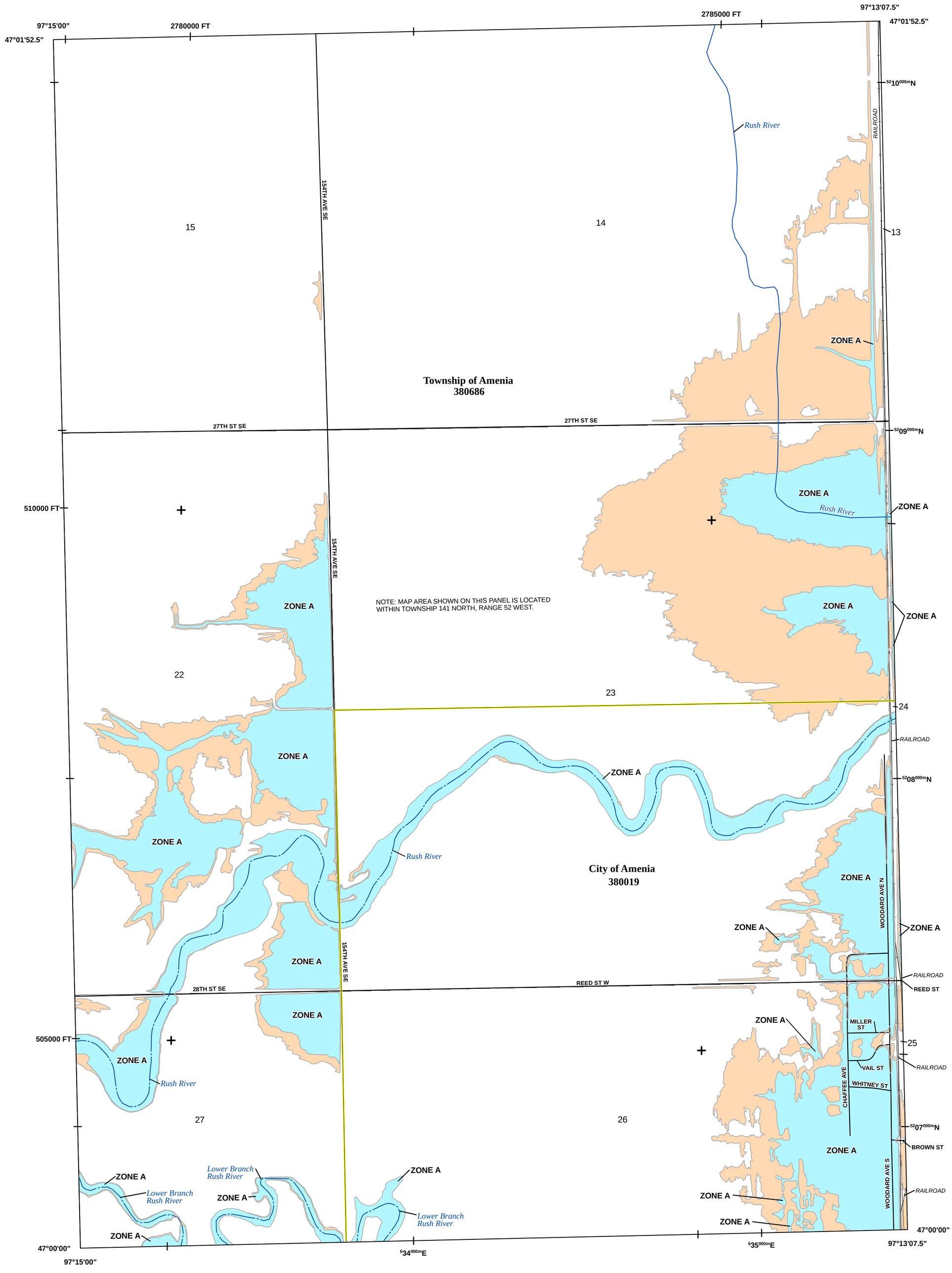
COMMUNITY	NUMBER	PANEL	SUFFIX
AMENIA, CITY OF	380019	0314	H
AMENIA, TOWNSHIP OF	380686	0314	H
RUSH RIVER, TOWNSHIP OF	385429	0314	H

REVISED PRELIMINARY 7/18/2018

VERSION NUMBER
2.3.3.2

MAP NUMBER
38017C0314H

MAP REVISED



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

OTHER AREAS
- NO SCREEN — Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert or Storm Sewer
- Levee, Dike or Floodwall

OTHER FEATURES
- E 18.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation (BFE)
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to 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.

Base map information shown on this FIRM was provided in digital format by the Cass County GIS Department dated January 2009. Corporate Boundaries and Transportation features were updated January 2015 based on Cass County GIS Department data.

SCALE

N

Map Projection:
Universal Transverse Mercator Zone 14N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR

*PANEL NOT PRINTED

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

CASS COUNTY, NORTH DAKOTA
(All Jurisdictions)

PANEL 313 OF 995

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
AMENIA, CITY OF	380019	0313	H
AMENIA, TOWNSHIP OF	380686	0313	H

REVISED PRELIMINARY 7/18/2018

VERSION NUMBER
2.3.3.2

MAP NUMBER
38017C0313H

MAP REVISED

Appendix B Alternative 1 Plans & Cost Estimate

Appendix D-1-B

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-SOUTH-LEVEE-ALT.dwg

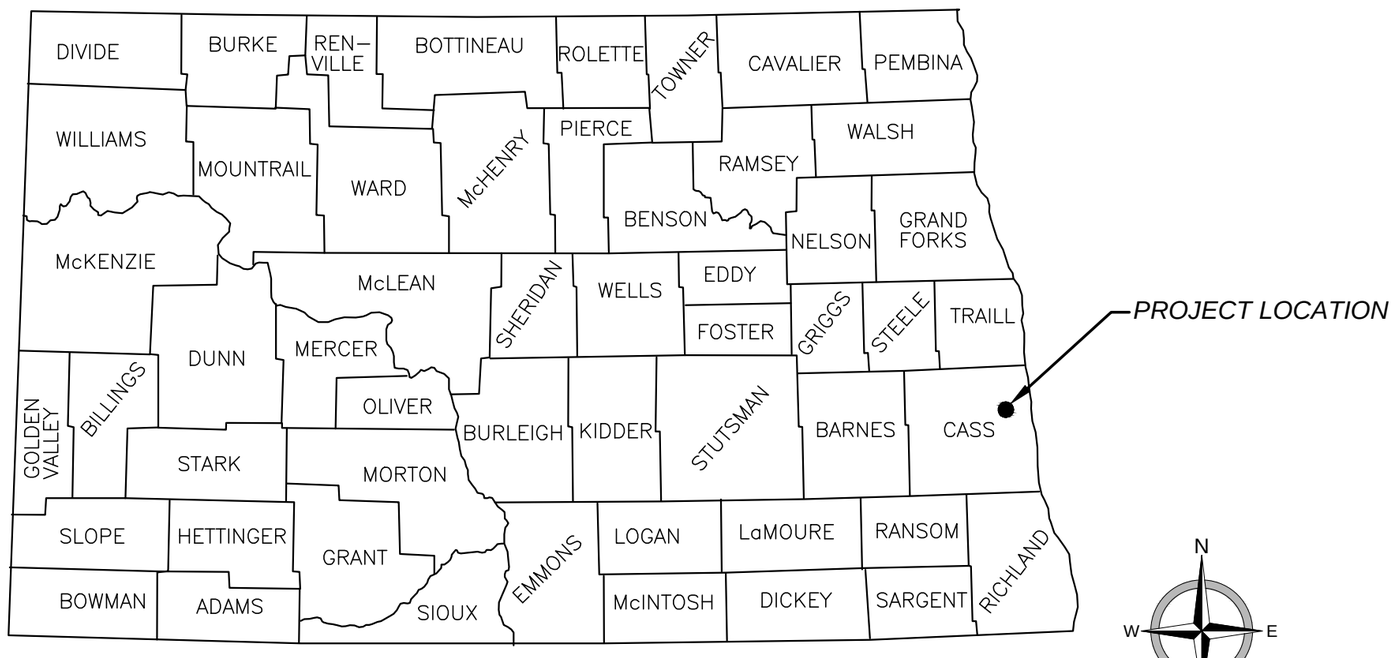
RCPP/PL566
RUSH RIVER - AMENIA
SOUTH LEVEE ALTERNATIVE

CASS COUNTY JOINT
WATER RESOURCE DISTRICT

CASS COUNTY, NORTH DAKOTA

moore engineering, inc.
Consulting Engineering • Land Surveying
925 10th Avenue East • West Fargo, North Dakota
www.mooreengineeringinc.com

VICINITY MAP



N
W
E
S

D-1-B-1

PRELIMINARY

PROJECT No. 18747

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-SOUTH-LEVEE-ALT.dwg

TABLE OF CONTENTS

PRELIMINARY

moore engineering, inc.

TABLE OF CONTENTS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TABLE OF CONTENTS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

D-1-B-2

G-002

SHEET 2 OF 2

CIVIL LEGEND

- BENCHMARK
- IRON MONUMENT FOUND
- EXISTING GAS LINE MARKER
- EXISTING GAS GATE VALVE
- EXISTING POWER POLE
- EXISTING LIGHT POLE
- EXISTING LIGHT POLE W/SIGN
- EXISTING GUY WIRE
- EXISTING TRAFFIC SIGNAL ARM
- EXISTING SIGN
- EXISTING CULVERT W/FLARED END SECTION (F.E.S.)
- EXISTING FLARED END SECTION (F.E.S.)
- EXISTING CURB STOP
- EXISTING HYDRANT W/GATE VALVE
- EXISTING GATE VALVE
- EXISTING FITTINGS
- EXISTING PLUG
- EXISTING PROPANE TANK
- EXISTING SANITARY SEWER MANHOLE
- EXISTING SANITARY SEWER CLEANOUT
- EXISTING STORM SEWER CATCH BASIN
- EXISTING STORM SEWER MANHOLE
- W — EXISTING WATER MAIN
- EXISTING WATER SERVICE W/CURB STOP
- SS — EXISTING SANITARY SEWER
- SS–FM — EXISTING SANITARY FORCEMAIN
- EXISTING SANITARY SEWER SERVICE
- ST — EXISTING STORM SEWER
- ST–FM — EXISTING STORM SEWER FORCEMAIN
- STEAM — EXISTING STEAM PIPE
- EXISTING AIR CONDITIONER
- U — EXISTING UTILITY PEDESTAL
- EXISTING UTILITY MANHOLE
- C — EXISTING UNDERGROUND COMMUNICATIONS
- F — EXISTING UNDERGROUND FIBER
- T — EXISTING UNDERGROUND TELEPHONE
- OHT — EXISTING OVERHEAD TELEPHONE
- TV — EXISTING UNDERGROUND TELEVISION
- OHTV — EXISTING OVERHEAD TELEVISION
- G — EXISTING UNDERGROUND GAS
- E — EXISTING UNDERGROUND ELECTRIC
- OHP — EXISTING OVERHEAD POWER
- X — EXISTING BARBED WIRE FENCE
- EXISTING CHAIN LINK/STEEL FENCE
- EXISTING PVC/WOOD FENCE
- EXISTING SHRUB
- EXISTING STUMP
- EXISTING TREE/TREE CLUSTER
- EXISTING SPRINKLER HEAD
- 12 — EXISTING CLUSTER BOX UNIT (CBU)
- EXISTING MAILBOX
- EXISTING CURB AND GUTTER
- CURB AND GUTTER REMOVAL & REPLACEMENT
- REMOVE EXISTING SURFACE
- EXISTING ASPHALT SURFACE
- EXISTING CONCRETE SURFACE
- EXISTING DECORATIVE COLORED CONCRETE
- EXISTING GRANULAR SURFACE
- EXISTING SIDEWALK/MULTI–USE PATH (UNKNOWN SURFACE)
- EXISTING LANDSCAPING
- EXISTING RIPRAP
- EXISTING WETLANDS
- EXISTING PERMANENT POOL

- NEW LIGHT POLE
- NEW LIGHT POLE W/SIGN
- NEW GUY WIRE
- NEW SIGN
- TRAFFIC CONTROL – DRUM
- TRAFFIC CONTROL – TUBULAR MARKER
- NEW CULVERT W/FLARED END SECTION (F.E.S.)
- NEW FLARED END SECTION (F.E.S.)
- NEW CURB STOP
- NEW HYDRANT W/GATE VALVE
- NEW GATE VALVE
- NEW TAPPING SLEEVE
- NEW FITTINGS
- NEW PLUG
- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER CLEANOUT
- NEW STORM SEWER CATCH BASIN
- NEW STORM SEWER MANHOLE
- W — NEW WATER MAIN
- NEW WATER SERVICE W/CURB STOP (S.B. ELEV.)
- SS — NEW SANITARY SEWER
- SS–FM — NEW SANITARY FORCEMAIN
- NEW SANITARY SEWER SERVICE (S.S. ELEV.)
- ST — NEW STORM SEWER
- ST–FM — NEW STORM SEWER FORCEMAIN
- STEAM — NEW STEAM PIPE
- IN — INSULATION PER DETAIL
- X — NEW BARBED WIRE FENCE
- NEW CHAIN LINK/STEEL FENCE
- NEW PVC/WOOD FENCE
- NEW INFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
- NEW OUTFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
- NEW INFLOW CURB AND GUTTER (HIGHBACK)
- NEW OUTFLOW CURB AND GUTTER (HIGHBACK)
- NEW CURB PAINT
- NEW ASPHALT SURFACE
- NEW CONCRETE SURFACE
- NEW CONCRETE APPROACH/DRIVEWAY
- NEW DECORATIVE COLORED CONCRETE
- NEW GRANULAR SURFACE
- NEW CRUSHED CONCRETE SURFACE
- NEW CONCRETE SIDEWALK/MULTI–USE PATH
- NEW DETECTABLE WARNING PANEL
- NEW RIPRAP
- NEW PERMANENT POOL
- NEW LANDSCAPING
- MILLING – 2" UNIFORM
- MILLING – 2" TAPERED
- ASPHALT PATCH
- LEVELING COURSE
- OVERLAY
- CHIPSEAL AND FOG COAT
- NEW CONCRETE VALLEY GUTTER
- NEW MEDIAN NOSE APRON
- NEW ADA RAMP W/WARNING PANEL
- 12 — NEW CLUSTER BOX UNIT (CBU)
- NEW MAILBOX
- NEW LARGE DECIDUOUS TREE
- NEW SMALL DECIDUOUS TREE
- NEW SHRUB
- NEW LARGE EVERGREEN TREE
- NEW SMALL EVERGREEN TREE

- DRAINAGE BREAK LINE
- EXISTING DRAINAGE DIRECTION
- 2.0% — FINISHED DRAINAGE DIRECTION & SLOPE
- 4:1 — FINISHED GRADE
- 895 — EXISTING CONTOUR ELEVATION
- 895 — FINISHED CONTOUR ELEVATION
- 900.07 FL — GRADE ELEVATIONS
- GRASS BUFFER
- PERMANENT STABILIZATION AREA
- SEDIMENTATION CONTROL WATTLE
- SEDIMENTATION CONTROL FENCE
- ROCK CHECK
- S.C.E. — STABILIZED CONSTRUCTION ENTRANCE
- CONCRETE WASHOUT
- INLET PROTECTION DEVICE

ABBREVIATIONS:

BOC = BACK OF CURB
BOW = BACK OF WALK
C = COMMUNICATION
CB# = STORM SEWER CATCH BASIN
CL = CENTERLINE
CSP = CORRUGATED STEEL PIPE
CO# = SANITARY SEWER CLEANOUT
CS# = CONTROL STRUCTURE
DIA = DIAMETER
DIP = DUCTILE IRON PIPE
E = ELECTRICAL
ECC = EDGE OF CRUSHED CONCRETE
EG = EXISTING GRADE
EOC = EDGE OF CONCRETE
EOP = EDGE OF PAVEMENT
EOW = EDGE OF WALK
EG= EXISTING GRADE
EX = EXISTING
F = FIBER OPTIC
FES = FLARED END SECTION
FG = FINISHED GRADE
FL = FLOWLINE
FM = FORCEMAIN
G = GAS LINE
HP = HIGH POINT
INV = INVERT
LP = LOW POINT
MATCH = MATCH
M# = STORM SEWER MANHOLE
MT# = STORM SEWER TEE MANHOLE
MM# = STORM SEWER MULTI–MANHOLE
MC = MIDPOINT OF CURVE
OHP = OVERHEAD POWER
OHT = OVERHEAD TELEPHONE
OHTV = OVERHEAD TELEVISION
PC = POINT OF CURVATURE
PRC = POINT OF REVERSE CURVE
PVC = POLYVINYL CHLORIDE PIPE
PT = POINT OF TANGENCY
RIM = RIM OF STRUCTURE
S# = SANITARY SEWER MANHOLE
S.B. ELEV. = STOP BOX ELEVATION
S.S. ELEV. = SANITARY SEWER SERVICE INVERT
S.S. = SANITARY SEWER
S.T. = STORM SEWER
STA = ALIGNMENT STATION
T = TELEPHONE
TOC = TOP OF CONCRETE
TOP = TOP OF PAVEMENT
TOP = TOP OF PIPE
TOW = TOP OF WALK
TR# = SANITARY TELEVISING RISER
TRANS = TRANSFORMER
TV = TELEVISION
U = UTILITY (UNKNOWN UTILITY)

D-1-B-3

PRELIMINARY

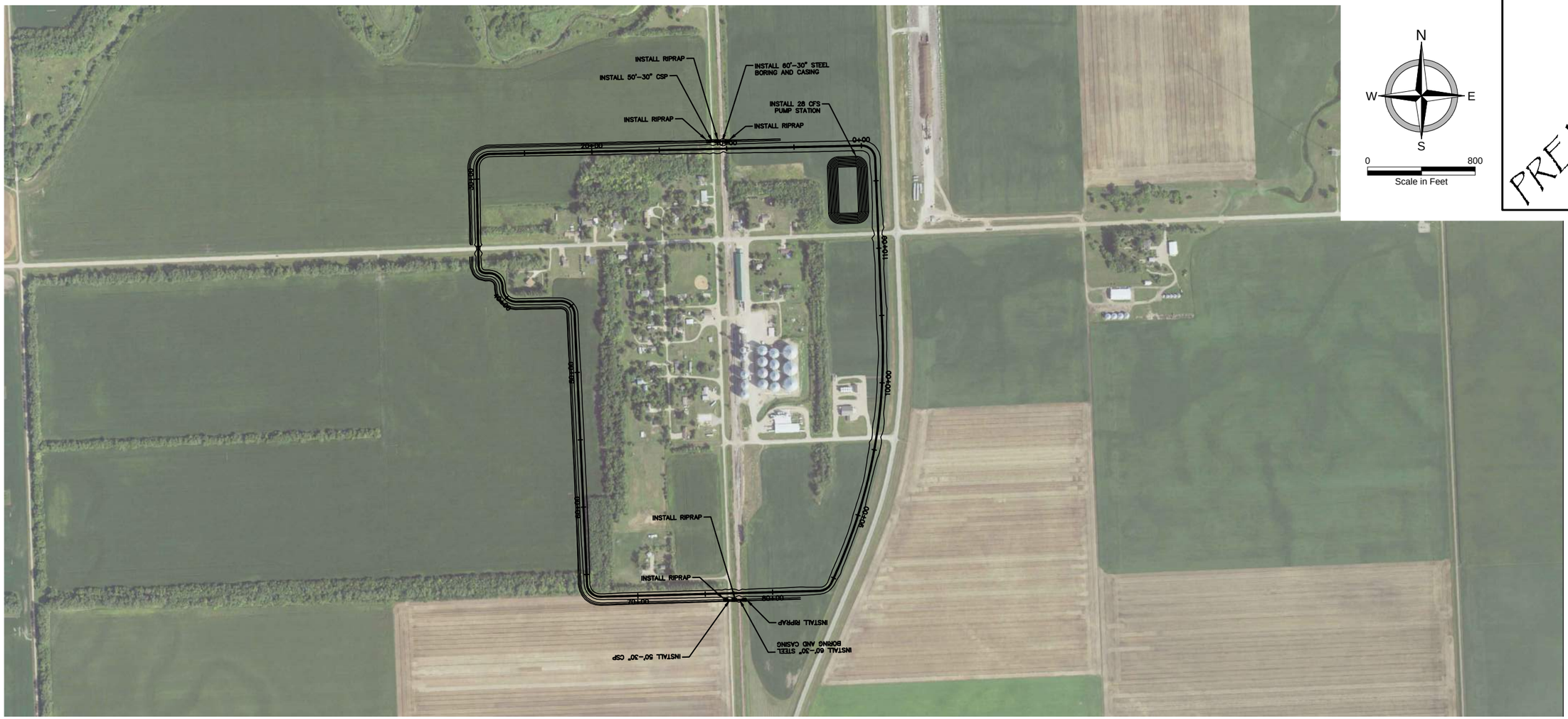
moore engineering, inc.

CIVIL LEGEND
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CIVIL LEGEND

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-001

SHEET 1 OF 10



N
W
E
S
0
800
Scale in Feet

PRELIMINARY

moore engineering, inc.

ALIGNMENT LAYOUT AND CONTROL
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
ALIGNMENTS, LINE AND CURVE TABLES AND SURVEY CONTROL

HORIZONTAL CONTROL

NORTH DAKOTA COORDINATE SYSTEM OF 1983, NAD83, SOUTH ZONE
COMBINATION FACTOR (cf) = .9998875
ALL COORDINATES ARE CASS COUNTY GROUND COORDINATES

VERTICAL CONTROL

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

BENCHMARKS/SURVEY CONTROL

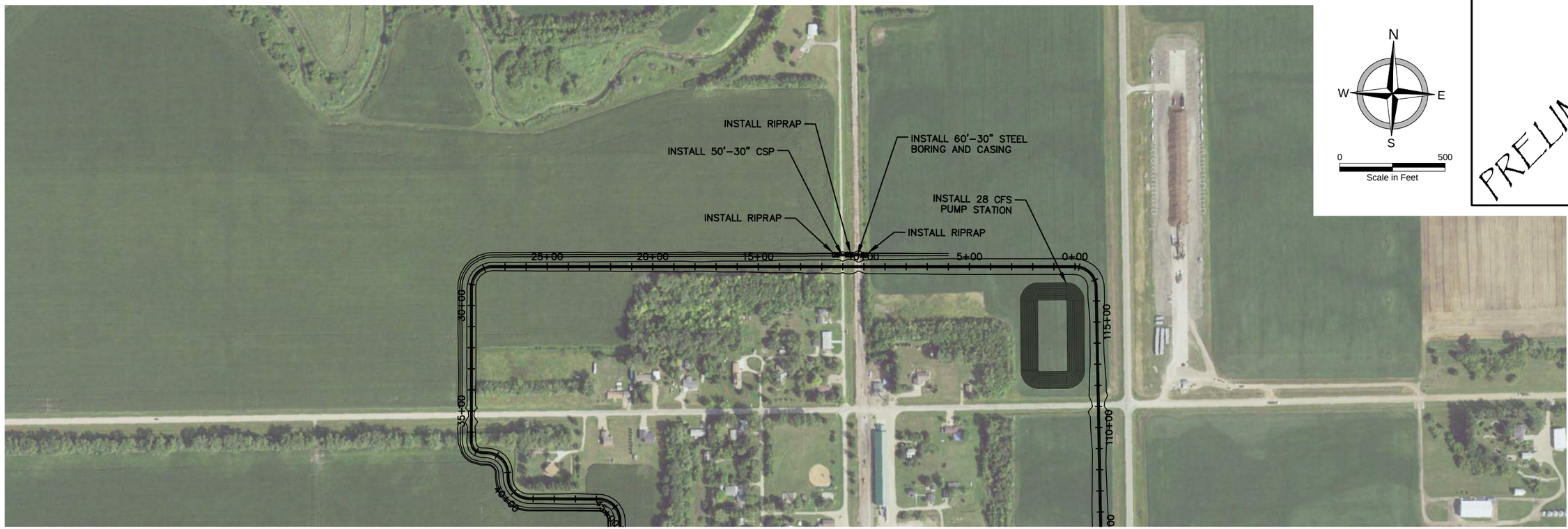
PRIOR TO PROJECT START, OWNER WILL SET AND ESTABLISH BENCHMARKS AND SURVEY CONTROL FOR THE PROJECT, AND CLEARLY MARK RIGHT-OF-WAY.

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

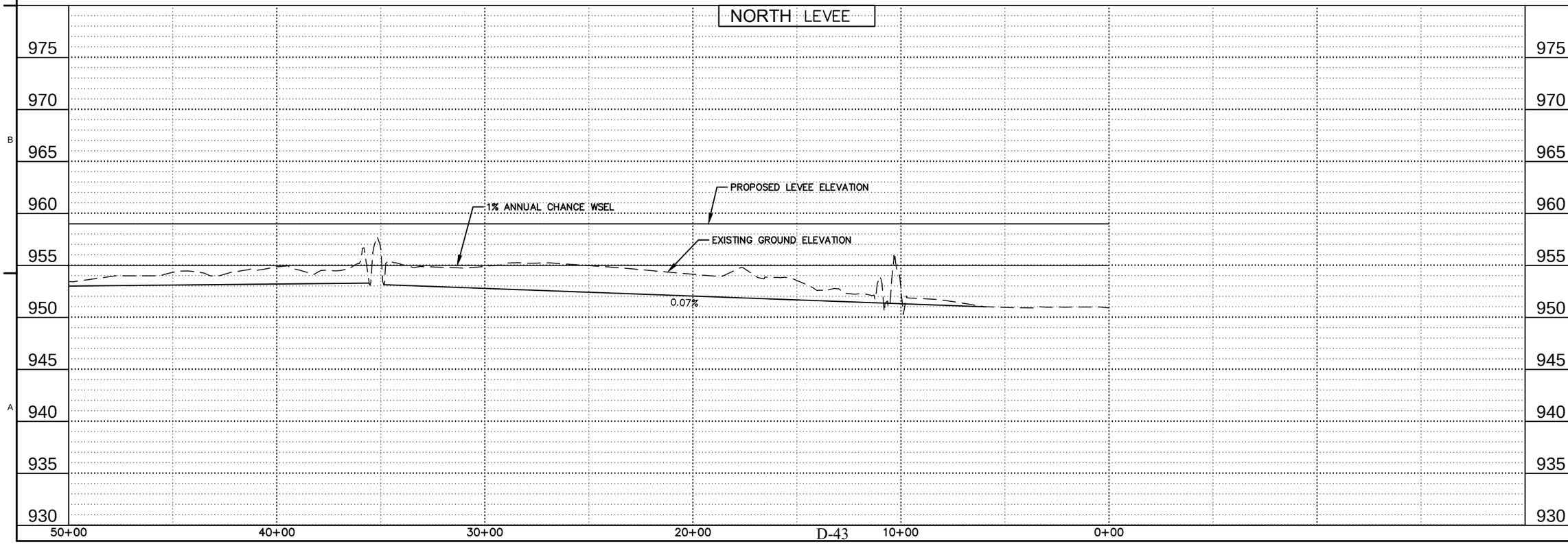
C-101

SHEET 2 OF 10

D-1-B-4



PRELIMINARY



moore engineering, inc.

PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE

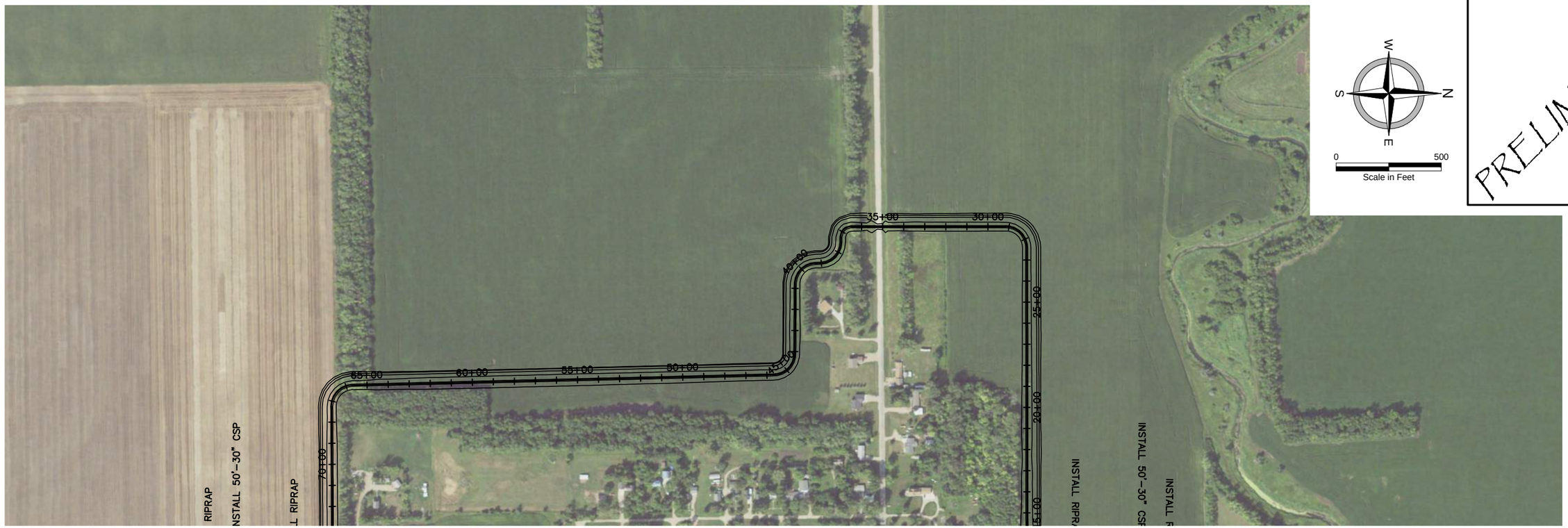
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-201

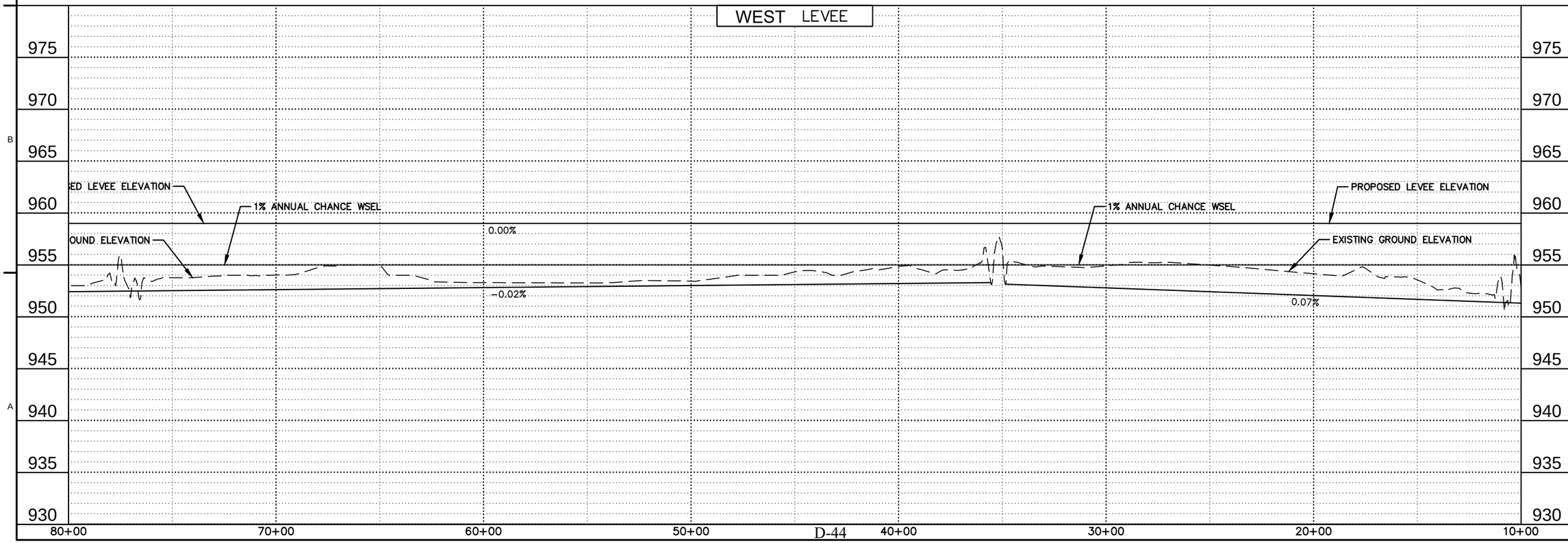
SHEET 3 OF 10

D-1-B-5

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-SOUTH-LEVEE-ALT.dwg



PRELIMINARY



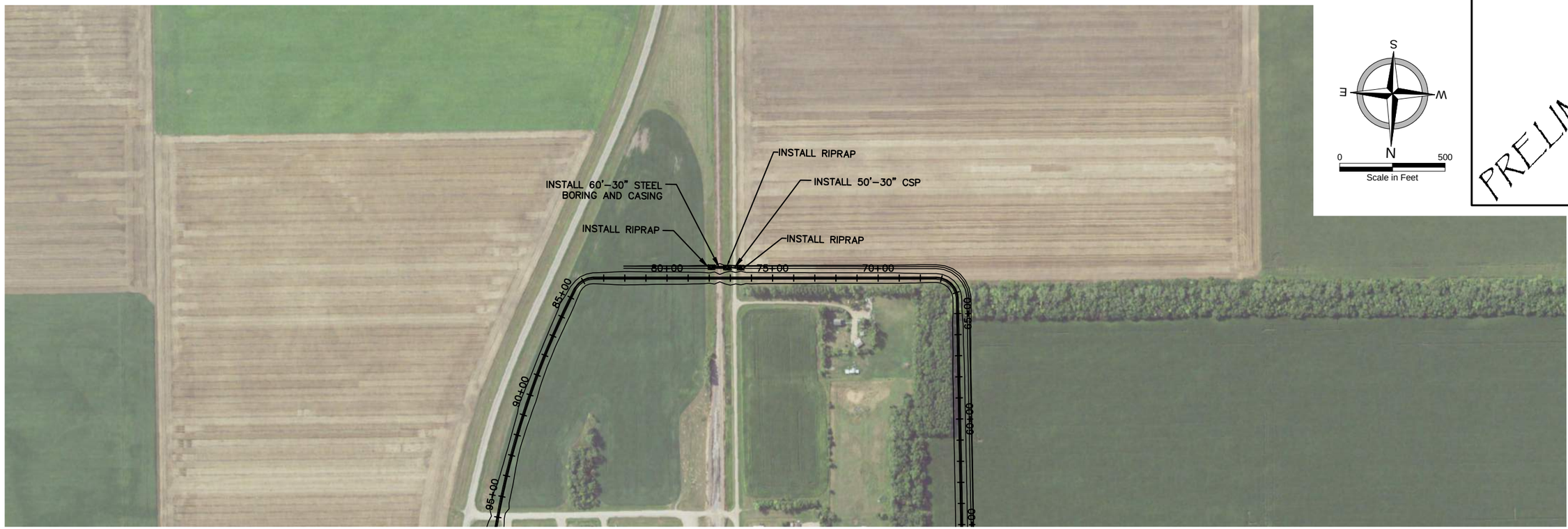
moore engineering, inc.

PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE

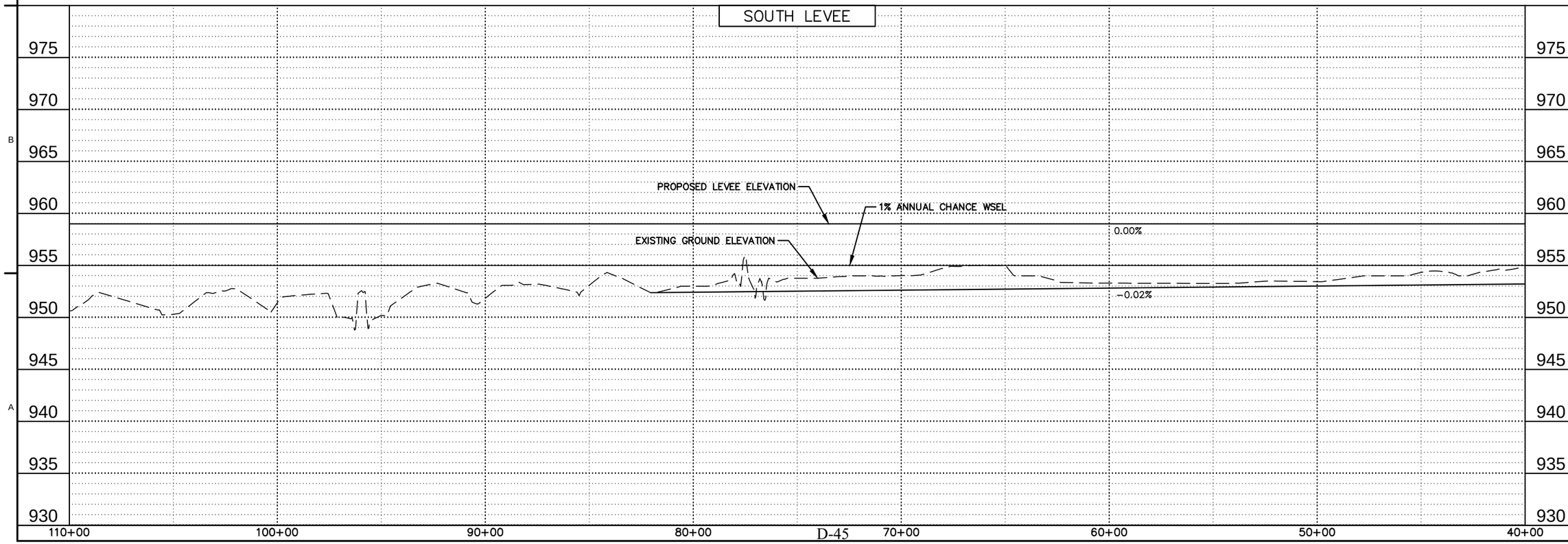
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-202

SHEET 4 OF 10



PRELIMINARY



moore engineering, inc.

PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE

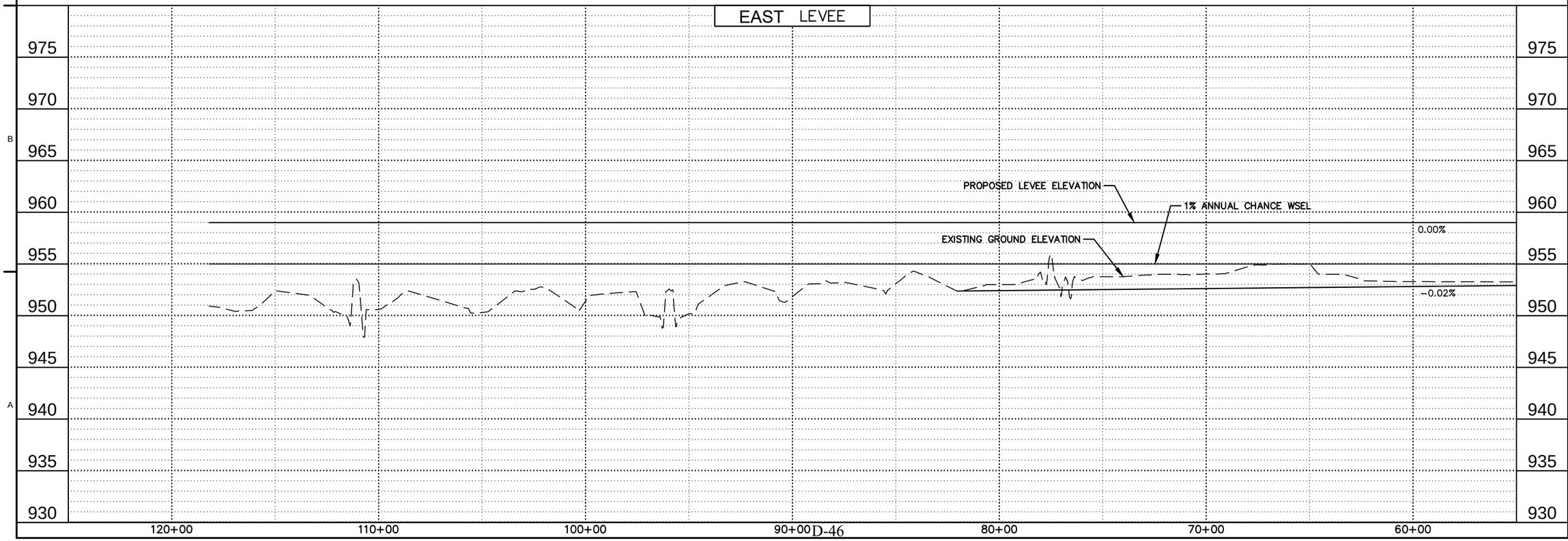
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-203

SHEET 5 OF 10

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-SOUTH-LEVEE-ALT.dwg

PRELIMINARY



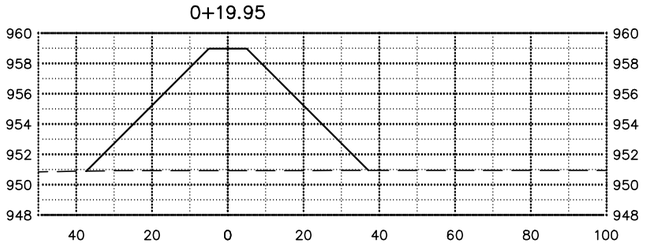
moore engineering, inc.

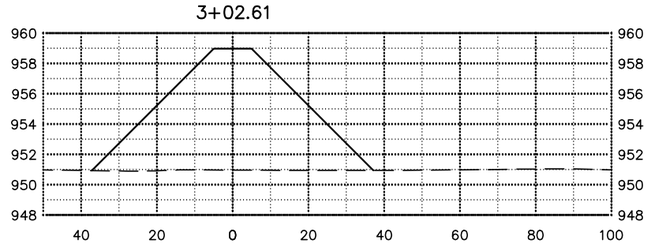
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE

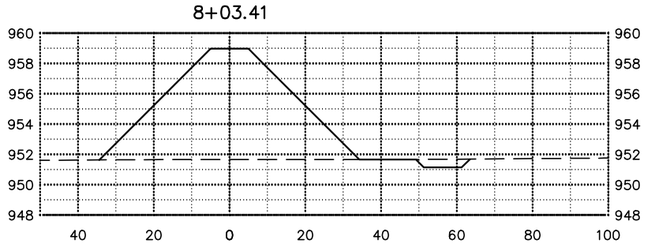
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

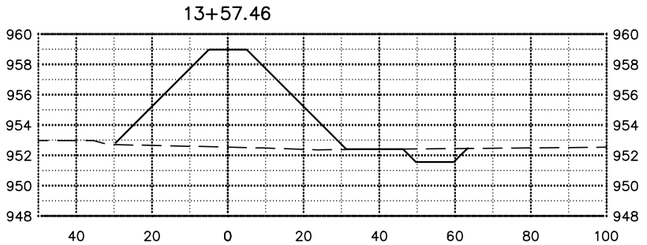
C-204

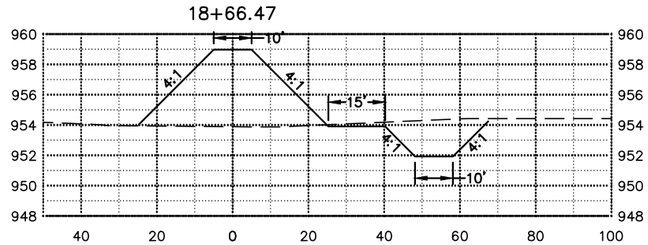
SHEET 6 OF 10

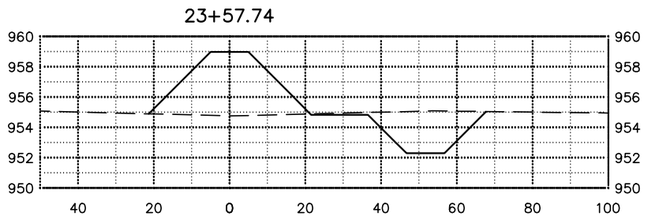


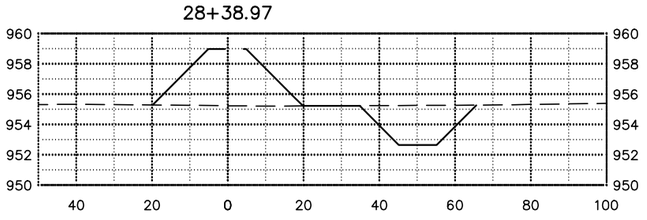


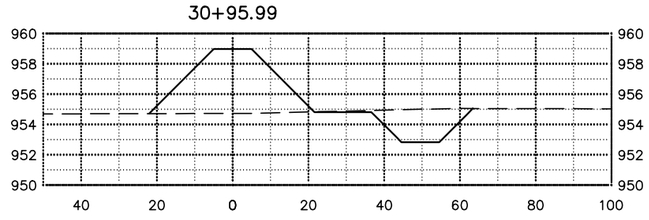


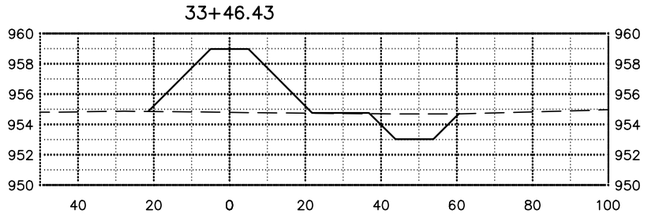


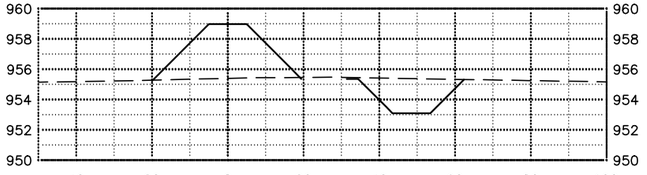


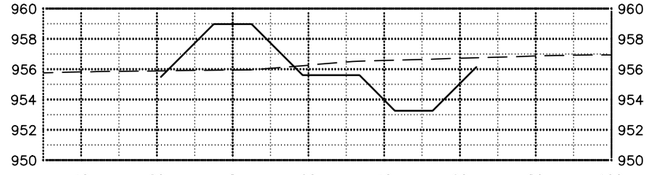


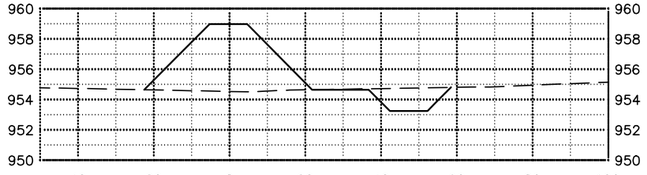


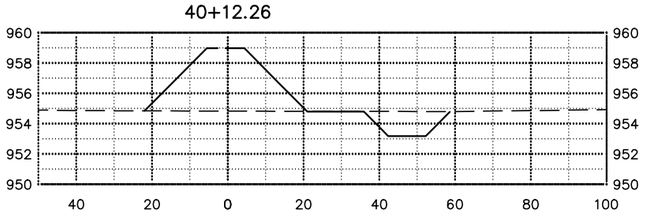


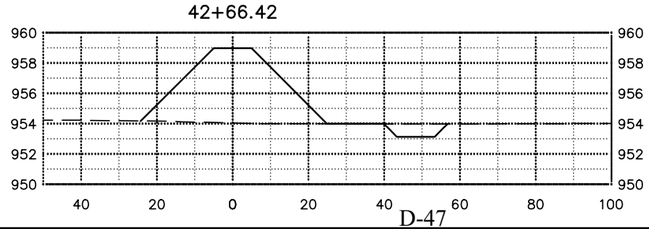


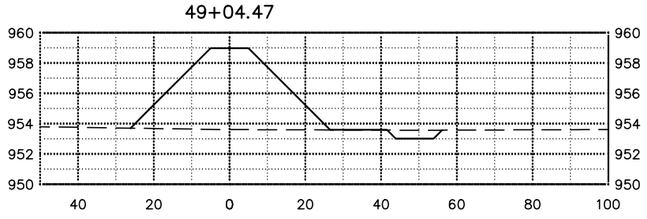












PRELIMINARY

moore engineering, inc.

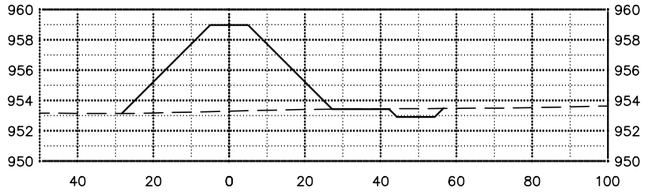
CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

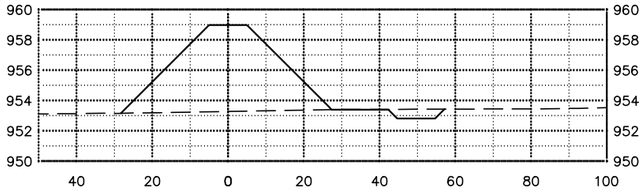
C-301

SHEET 7 OF 10

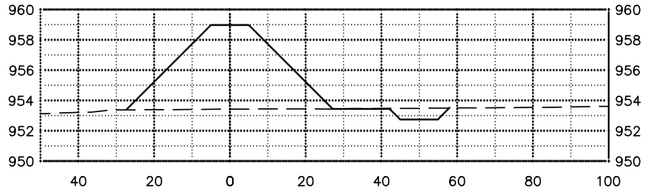
54+03.66



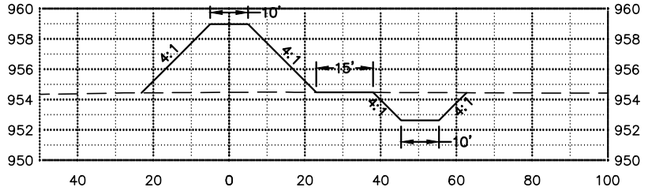
59+23.99



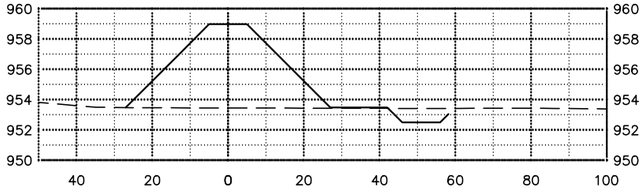
62+44.65



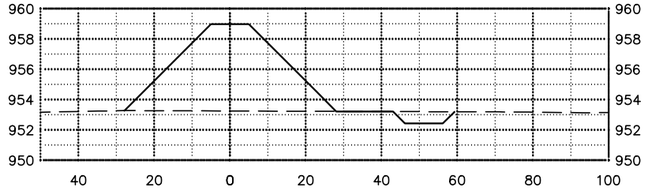
68+38.05



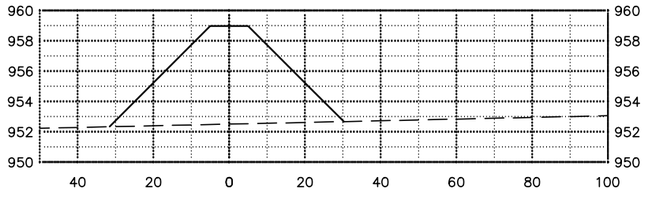
75+90.29



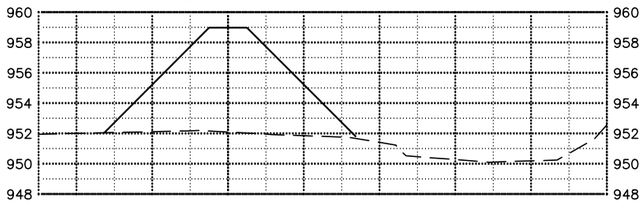
78+80.92



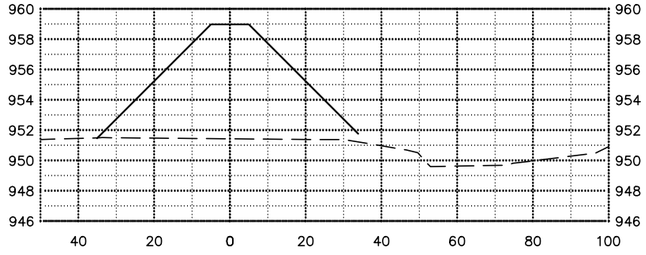
82+18.72



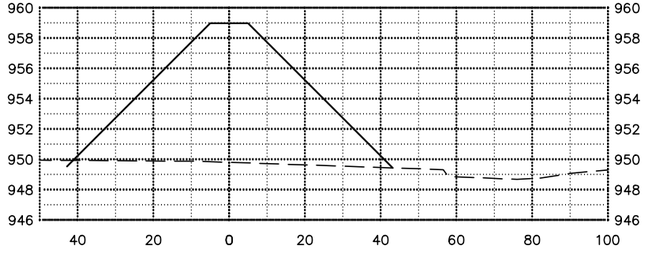
85+48.55



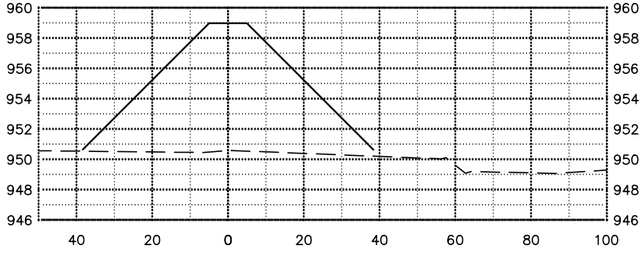
90+61.43



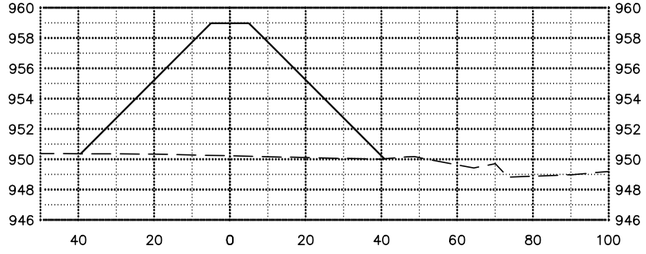
95+38.52



100+34.89



105+47.61



PRELIMINARY

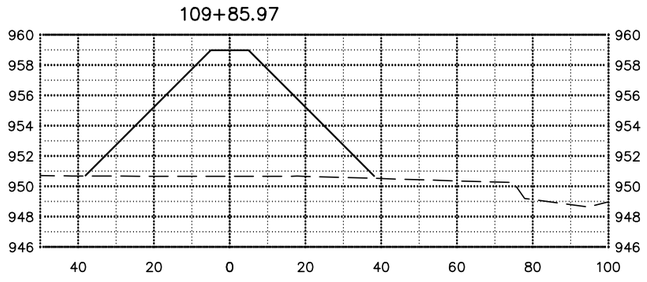
moore engineering, inc.

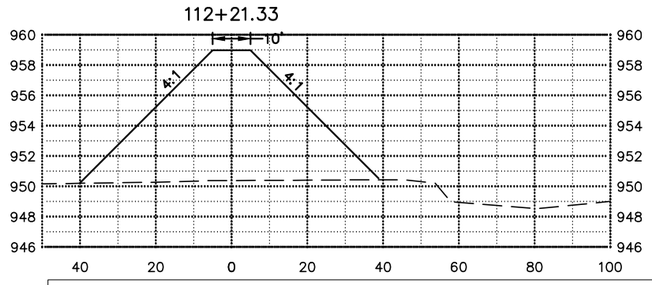
CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

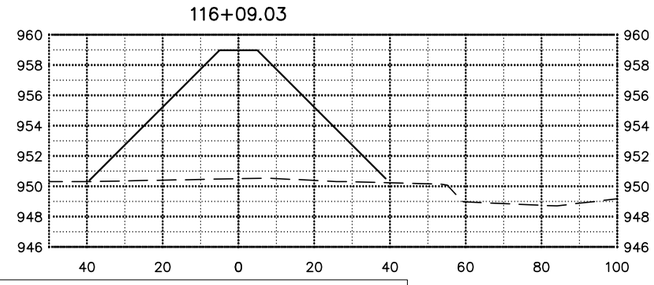
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

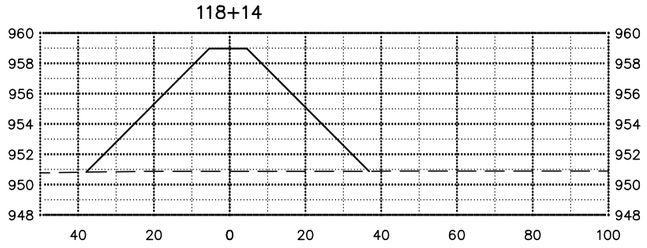
C-302

SHEET 8 OF 10









EARTHWORK VOLUMES

Station	Cut Area (Ft^2)	Fill Area (Ft^2)	Cut Vol (Yd^3)	Fill Vol (Yd^3)	Total Cut (Yd^3)	Total Fill (Yd^3)
0+19.95	0.00	339.39	0.00	0.00	0.00	0.00
3+02.61	0.00	338.32	0.00	3547.43	0.00	3547.43
8+03.41	6.52	287.23	60.48	5801.49	60.48	9348.92
13+57.46	11.88	230.45	188.80	5311.50	249.28	14660.42
18+66.47	49.67	152.82	580.14	3612.77	829.42	18273.19
23+57.74	59.39	110.44	992.18	2395.11	1821.60	20668.30
28+38.97	53.46	74.35	1090.83	1646.34	2912.42	22314.64
30+95.99	41.29	113.88	518.06	895.20	3430.48	23209.84
33+46.43	27.92	112.00	320.99	1047.63	3751.47	24257.46
34+54.99	43.99	87.31	144.58	400.70	3896.05	24658.16
35+91.86	89.57	65.77	338.52	388.01	4234.57	25046.17
36+82.38	24.45	120.33	257.33	311.22	4491.90	25357.39
40+12.26	26.79	100.92	321.68	1351.27	4813.58	26708.66
42+66.42	11.35	145.85	202.37	1161.53	5015.95	27870.19
49+04.47	6.83	168.18	189.62	3708.31	5205.57	31578.50
54+03.66	6.75	186.33	125.48	3277.11	5331.05	34855.61
59+23.99	7.77	187.01	139.85	3597.46	5470.90	38453.07
62+44.65	9.64	179.16	103.38	2174.39	5574.28	40627.46
68+38.05	31.64	126.27	513.19	3355.69	6087.48	43983.15
75+90.29	12.49	178.58	614.73	4246.62	6702.21	48229.77
78+80.92	10.16	188.74	121.89	1976.94	6824.09	50206.71
82+18.72	0.00	232.58	63.53	2635.54	6887.63	52842.25
85+48.55	0.00	264.20	0.00	3035.17	6887.63	55877.42
90+61.43	0.00	303.36	0.02	5391.07	6887.65	61268.49
95+38.52	0.33	432.69	2.88	6503.73	6890.52	67772.21
100+34.89	0.00	376.25	2.97	7436.79	6893.49	75209.01
105+47.61	0.00	394.70	0.00	7320.70	6893.49	82529.70
109+85.97	0.00	360.80	0.00	6132.95	6893.49	88662.65
112+21.33	0.00	384.29	0.00	3247.47	6893.49	91910.12
116+09.03	0.00	379.80	0.00	5485.92	6893.49	97396.04
118+14	0.00	342.13	0.00	2736.48	6893.49	100132.52

PRELIMINARY

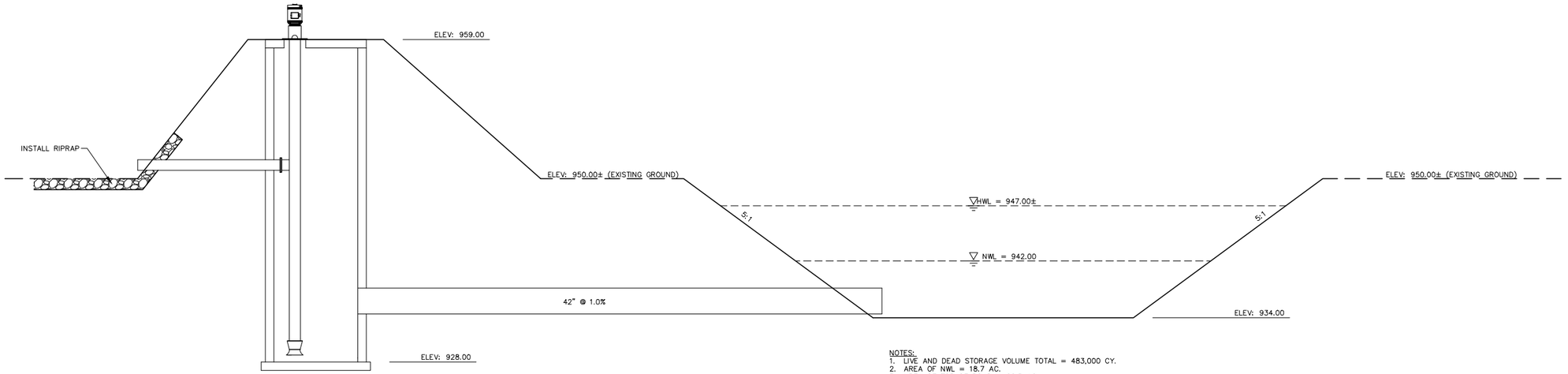
moore
engineering, inc.

CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-303

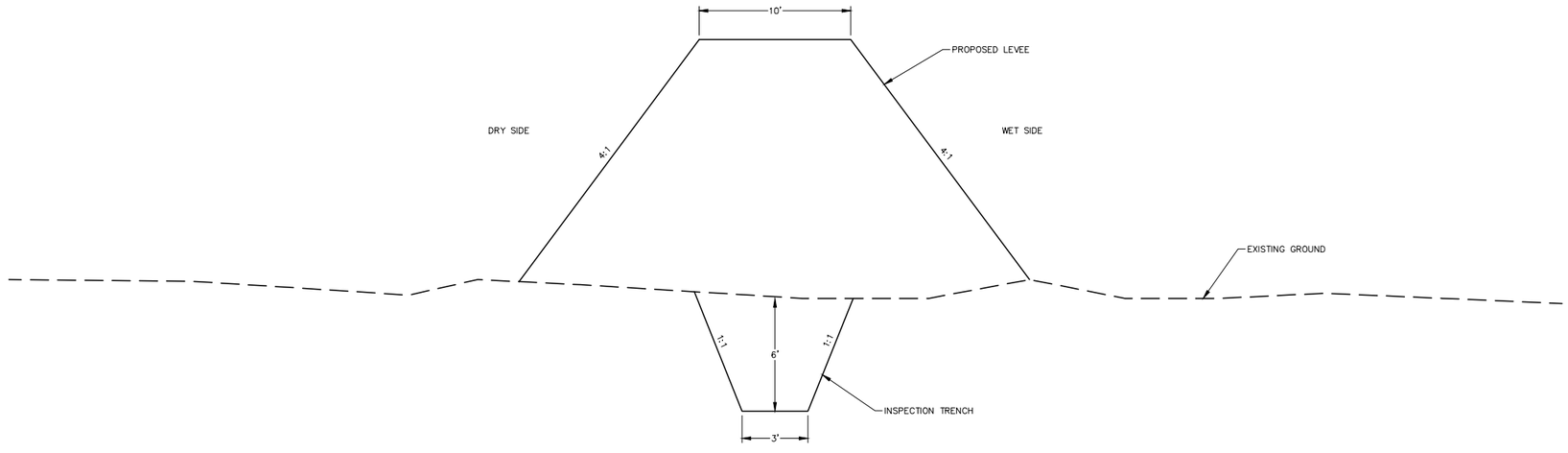
SHEET 9 OF 10



NOTES:
1. LIVE AND DEAD STORAGE VOLUME TOTAL = 483,000 CY.
2. AREA OF NWL = 18.7 AC.
3. AREA OF TOP OF POND = 22.3 AC.
4. DUPLEX LIFT STATION WITH PEAK FLOW = 28 CFS.
5. 1% CHANCE RAINFALL DURING FLOOD = 2.8"/24 HR.
6. CONSTRUCT INTERNAL DRAINAGE DITCH TO FLOW INTO POND PER PLANS.

STORM POND DETAIL - SOUTH LEVEE ALTERNATIVE

NO SCALE



TYPICAL LEVEE SECTION

NO SCALE

PRELIMINARY

moore engineering, inc.

TYPICAL DETAILS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TYPICAL DETAILS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJK
REVIEWER:	KRL

C-501

SHEET 10 OF 10

moore engineering, inc.

Amenia Flood Risk Reduction

Amenia, ND

Rush River RCPP

2/13/2020

Engineer's Preliminary Opinion of Probable Cost - Low Estimate

Alternate 1- Certified Levee Around City of Amenia

						POTENTIAL FUNDING SOURCES			
	ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL	Federal	NDSWC	County Sales Tax	LOCAL
	Levee								
1.	Inspection Trench	CY	21,000	$6.00	$126,000.00	$126,000.00	$0.00	$0.00	$0.00
2.	Excavation - Pond	CY	100,135	$2.40	$240,324.00	$240,324.00	$0.00	$0.00	$0.00
3.	Embankment - Levee	CY	100,135	$3.60	$360,486.00	$360,486.00	$0.00	$0.00	$0.00
4.	Gatewell Structure	EA	2	$180,000.00	$360,000.00	$360,000.00	$0.00	$0.00	$0.00
5.	Storm Sewer - 48" RCP	LF	100	$150.00	$15,000.00	$15,000.00	$0.00	$0.00	$0.00
6.	Storm Sewer - 48" Flapgate	EA	2	$6,000.00	$12,000.00	$12,000.00	$0.00	$0.00	$0.00
7.	Lift Station - 1	LS	1	$420,000.00	$420,000.00	$420,000.00	$0.00	$0.00	$0.00
	Road Crossings								
8.	Remove Pavement All Thickness Asphalt	SY	175	$18.00	$3,150.00	$3,150.00	$0.00	$0.00	$0.00
9.	Gravel - Stripping and Spreading	CY	60	$36.00	$2,160.00	$2,160.00	$0.00	$0.00	$0.00
10.	Geotextile Fabric	SY	425	$3.60	$1,530.00	$1,530.00	$0.00	$0.00	$0.00
11.	Concrete Pavement - 8"	SY	60	$120.00	$7,200.00	$7,200.00	$0.00	$0.00	$0.00
12.	Sleeper Slab	LS	2	$6,000.00	$12,000.00	$12,000.00	$0.00	$0.00	$0.00
13.	Storm Sewer - 30" CMP	LF	100	$60.00	$6,000.00	$6,000.00	$0.00	$0.00	$0.00
14.	Storm Sewer - 30" Flapgate	EA	2	$1,200.00	$2,400.00	$2,400.00	$0.00	$0.00	$0.00
15.	Road Crossing - Gravel - Keyway	EA	2	$6,000.00	$12,000.00	$12,000.00	$0.00	$0.00	$0.00
	General Items								
16.	Railroad Crossing - Keyway	EA	2	$6,000.00	$12,000.00	$12,000.00	$0.00	$0.00	$0.00
17.	Boring - 30" Steel Casing	LF	120	$1,020.00	$122,400.00	$122,400.00	$0.00	$0.00	$0.00
18.	Mobilization	LS	1	$11,530.00	$11,530.00	$11,530.00	$0.00	$0.00	$0.00
19.	Ditching - Internal	LS	1	$120,000.00	$120,000.00	$120,000.00	$0.00	$0.00	$0.00
20.	Ditching - External	CY	7,250	$12.00	$87,000.00	$87,000.00	$0.00	$0.00	$0.00
21.	Sanitary Sewer Gate Valve & Box - 6"	EA	2	$4,200.00	$8,400.00	$8,400.00	$0.00	$0.00	$0.00
22.	Water Main Gate Valve & Box - 6"	EA	2	$4,200.00	$8,400.00	$8,400.00	$0.00	$0.00	$0.00
23.	Riprap - Class III	CY	50	$120.00	$6,000.00	$6,000.00	$0.00	$0.00	$0.00
24.	Riprap Filter Blanket	SY	120	$6.00	$720.00	$720.00	$0.00	$0.00	$0.00
25.	Topsoil Stripping and Spreading	AC	50	$1,800.00	$90,000.00	$90,000.00	$0.00	$0.00	$0.00
26.	Rock Check - Temporary	EA	5	$2,400.00	$12,000.00	$12,000.00	$0.00	$0.00	$0.00
27.	Seeding - Type III	AC	50	$912.00	$45,600.00	$45,600.00	$0.00	$0.00	$0.00
28.	Silt Fence - Standard	LF	1,000	$3.50	$3,500.00	$3,500.00	$0.00	$0.00	$0.00
29.	Storm Water Management	LS	1	$6,000.00	$6,000.00	$6,000.00	$0.00	$0.00	$0.00
30.	Traffic Control	LS	1	$6,000.00	$6,000.00	$6,000.00	$0.00	$0.00	$0.00
31.	Material Testing	Invoice	Allowance	$30,000.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00
				Total Construction	$2,149,800.00	$2,149,800.00	$0.00	$0.00	$0.00
				Engineering - Design & Construction	$353,200.00	$353,200.00	$0.00	$0.00	$0.00
				NRCS - Technical Assistance	$40,000.00	$40,000.00	$0.00	$0.00	$0.00
				Land Surveying	$40,000.00	$0.00	$20,000.00	$15,000.00	$5,000.00
				CLOMR/LOMR	$130,000.00	$0.00	$65,000.00	$48,750.00	$16,250.00
				Utility Relocation	$175,000.00	$175,000.00	$0.00	$0.00	$0.00
				Real Property Rights Acquisition	$212,000.00	$0.00	$106,000.00	$79,500.00	$26,500.00
				Wetland Mitigation	$67,200.00	$33,600.00	$16,800.00	$12,600.00	$4,200.00
				Legal & Adm. Fees	$50,000.00	$0.00	$25,000.00	$18,750.00	$6,250.00
				Real Property Rights Negotiations	$20,000.00	$0.00	$10,000.00	$7,500.00	$2,500.00
				Permitting	$5,000.00	$0.00	$2,500.00	$1,875.00	$625.00
				Fiscal	$40,000.00	$0.00	$20,000.00	$15,000.00	$5,000.00
				TOTAL PROJECT COST	**$3,282,200.00**	**$2,751,600.00**	**$265,300.00**	**$198,975.00**	**$66,325.00**

Assumptions:

1) Unit prices reflect estimated 2019 prices.
2) Federal cost share assumed at 100% for construction and engineering costs and 50% for wetland mitigation costs.
3) North Dakota State Water Commission cost share of 50% for eligible construction costs of remaining costs.
4) Cass County Flood Sales Tax will cover 75% of local cost share.
5) Excavated pond material will be suitable for levee material.
6) Project design includes no new storm sewer or improvements to the existing system internally in the City of Amenia.
7) Construction Engineering fee assumes full time Resident Project Representative (inspector) will be provided. One construction season.
8) The levee footprint was assumed to include a 150 foot wide corridor which includes the levee, drainage ditches and 15-foot clear zone on each side of levee.
9) Estimated right-of-way aquisition cost assumes 50 acres of land will be needed for levee and pond at purchase price of $4,107 per acre and 15 acres of temporary construction easement at $400 per acre.
10) Fiscal costs are the estimated cost for financing.
11) Cost opinion is based on a conceptual design only. Unit prices were selected based on past projects and contingencies were estimated at 20% in an effort to have estimated costs slightly conservative. Actual costs could be higher or lower than estimated.
12) Pond and ditch excavation material is suitable for levee material. Unit price to include placing the material for the levee.
13) Wetland mitigation costs assumed to be purchased credits at $60,000 per acre for 1.12 acres.
14) Utility relocation cost assumed for the relocation of private (Cass Rural Water, Otter Tail Power and Centurylink) utilities.

Appendix C Alternative 2 Plans & Cost Estimate

Appendix D-1-C

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-NORTH-LEVEE-ALT.dwg

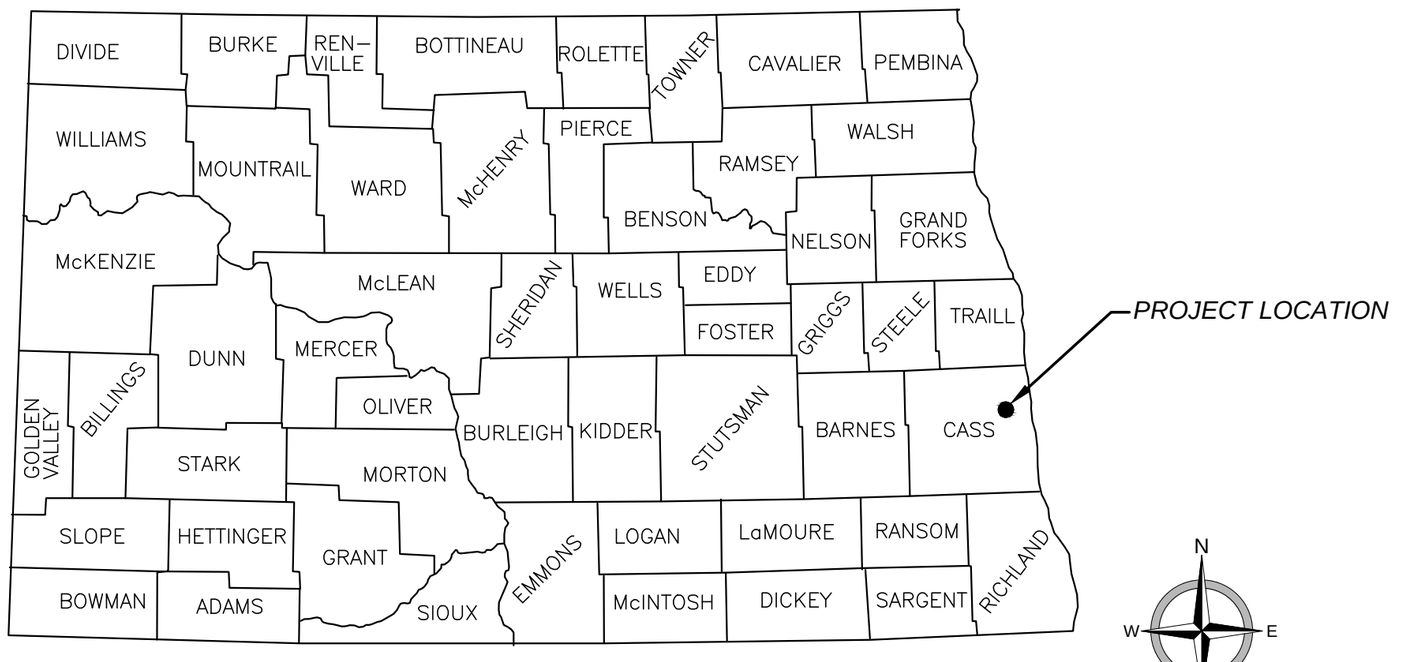
RCPP/PL566
RUSH RIVER - AMENIA
NORTH LEVEE ALTERNATIVE

CASS COUNTY JOINT
WATER RESOURCE DISTRICT

CASS COUNTY, NORTH DAKOTA

moore engineering, inc.
Consulting Engineering • Land Surveying
925 10th Avenue East • West Fargo, North Dakota
www.mooreengineeringinc.com

VICINITY MAP



N
W E
S

PRELIMINARY

PROJECT No. 18747

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-NORTH-LEVEE-ALT.dwg

TABLE OF CONTENTS

PRELIMINARY

moore engineering, inc.

TABLE OF CONTENTS
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TABLE OF CONTENTS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

G-002

SHEET 2 OF 2

CIVIL LEGEND

- BENCHMARK
- IRON MONUMENT FOUND
- EXISTING GAS LINE MARKER
- EXISTING GAS GATE VALVE
- EXISTING POWER POLE
- EXISTING LIGHT POLE
- EXISTING LIGHT POLE W/SIGN
- EXISTING GUY WIRE
- EXISTING TRAFFIC SIGNAL ARM
- EXISTING SIGN
- EXISTING CULVERT W/FLARED END SECTION (F.E.S.)
- EXISTING FLARED END SECTION (F.E.S.)
- EXISTING CURB STOP
- EXISTING HYDRANT W/GATE VALVE
- EXISTING GATE VALVE
- EXISTING FITTINGS
- EXISTING PLUG
- EXISTING PROPANE TANK
- EXISTING SANITARY SEWER MANHOLE
- EXISTING SANITARY SEWER CLEANOUT
- EXISTING STORM SEWER CATCH BASIN
- EXISTING STORM SEWER MANHOLE
- W — EXISTING WATER MAIN
- EXISTING WATER SERVICE W/CURB STOP
- SS — EXISTING SANITARY SEWER
- SS-FM — EXISTING SANITARY FORCEMAIN
- EXISTING SANITARY SEWER SERVICE
- ST — EXISTING STORM SEWER
- ST-FM — EXISTING STORM SEWER FORCEMAIN
- STEAM — EXISTING STEAM PIPE
- EXISTING AIR CONDITIONER
- U — EXISTING UTILITY PEDESTAL
- EXISTING UTILITY MANHOLE
- C — EXISTING UNDERGROUND COMMUNICATIONS
- F — EXISTING UNDERGROUND FIBER
- T — EXISTING UNDERGROUND TELEPHONE
- OHT — EXISTING OVERHEAD TELEPHONE
- TV — EXISTING UNDERGROUND TELEVISION
- OHTV — EXISTING OVERHEAD TELEVISION
- G — EXISTING UNDERGROUND GAS
- E — EXISTING UNDERGROUND ELECTRIC
- OHP — EXISTING OVERHEAD POWER
- X — EXISTING BARBED WIRE FENCE
- EXISTING CHAIN LINK/STEEL FENCE
- EXISTING PVC/WOOD FENCE
- EXISTING SHRUB
- EXISTING STUMP
- EXISTING TREE/TREE CLUSTER
- EXISTING SPRINKLER HEAD
- 12 — EXISTING CLUSTER BOX UNIT (CBU)
- EXISTING MAILBOX
- EXISTING CURB AND GUTTER
- CURB AND GUTTER REMOVAL & REPLACEMENT
- REMOVE EXISTING SURFACE
- EXISTING ASPHALT SURFACE
- EXISTING CONCRETE SURFACE
- EXISTING DECORATIVE COLORED CONCRETE
- EXISTING GRANULAR SURFACE
- EXISTING SIDEWALK/MULTI-USE PATH (UNKNOWN SURFACE)
- EXISTING LANDSCAPING
- EXISTING RIPRAP
- EXISTING WETLANDS
- EXISTING PERMANENT POOL

- NEW LIGHT POLE
- NEW LIGHT POLE W/SIGN
- NEW GUY WIRE
- NEW SIGN
- TRAFFIC CONTROL - DRUM
- TRAFFIC CONTROL - TUBULAR MARKER
- NEW CULVERT W/FLARED END SECTION (F.E.S.)
- NEW FLARED END SECTION (F.E.S.)
- NEW CURB STOP
- NEW HYDRANT W/GATE VALVE
- NEW GATE VALVE
- NEW TAPPING SLEEVE
- NEW FITTINGS
- NEW PLUG
- NEW SANITARY SEWER MANHOLE
- NEW SANITARY SEWER CLEANOUT
- NEW STORM SEWER CATCH BASIN
- NEW STORM SEWER MANHOLE
- W — NEW WATER MAIN
- NEW WATER SERVICE W/CURB STOP (S.B. ELEV.)
- SS — NEW SANITARY SEWER
- SS-FM — NEW SANITARY FORCEMAIN
- NEW SANITARY SEWER SERVICE (S.S. ELEV.)
- ST — NEW STORM SEWER
- ST-FM — NEW STORM SEWER FORCEMAIN
- STEAM — NEW STEAM PIPE
- IN — INSULATION PER DETAIL
- X — NEW BARBED WIRE FENCE
- NEW CHAIN LINK/STEEL FENCE
- NEW PVC/WOOD FENCE
- NEW INFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
- NEW OUTFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
- NEW INFLOW CURB AND GUTTER (HIGHBACK)
- NEW OUTFLOW CURB AND GUTTER (HIGHBACK)
- NEW CURB PAINT
- NEW ASPHALT SURFACE
- NEW CONCRETE SURFACE
- NEW CONCRETE APPROACH/DRIVEWAY
- NEW DECORATIVE COLORED CONCRETE
- NEW GRANULAR SURFACE
- NEW CRUSHED CONCRETE SURFACE
- NEW CONCRETE SIDEWALK/MULTI-USE PATH
- NEW DETECTABLE WARNING PANEL
- NEW RIPRAP
- NEW PERMANENT POOL
- NEW LANDSCAPING
- MILLING - 2" UNIFORM
- MILLING - 2" TAPERED
- ASPHALT PATCH
- LEVELING COURSE
- OVERLAY
- CHIPSEAL AND FOG COAT
- NEW CONCRETE VALLEY GUTTER
- NEW MEDIAN NOSE APRON
- NEW ADA RAMP W/WARNING PANEL
- 12 — NEW CLUSTER BOX UNIT (CBU)
- NEW MAILBOX
- NEW LARGE DECIDUOUS TREE
- NEW SMALL DECIDUOUS TREE
- NEW SHRUB
- NEW LARGE EVERGREEN TREE
- NEW SMALL EVERGREEN TREE

- DRAINAGE BREAK LINE
- EXISTING DRAINAGE DIRECTION
- 2.0% — FINISHED DRAINAGE DIRECTION & SLOPE
- 4:1 — FINISHED GRADE
- 895 — EXISTING CONTOUR ELEVATION
- 895 — FINISHED CONTOUR ELEVATION
- 900.07 FL — GRADE ELEVATIONS
- GRASS BUFFER
- PERMANENT STABILIZATION AREA
- SEDIMENTATION CONTROL WATTLE
- SEDIMENTATION CONTROL FENCE
- ROCK CHECK
- S.C.E. — STABILIZED CONSTRUCTION ENTRANCE
- CONCRETE WASHOUT
- INLET PROTECTION DEVICE

ABBREVIATIONS:

BOC = BACK OF CURB
BOW = BACK OF WALK
C = COMMUNICATION
CB# = STORM SEWER CATCH BASIN
CL = CENTERLINE
CSP = CORRUGATED STEEL PIPE
CO# = SANITARY SEWER CLEANOUT
CS# = CONTROL STRUCTURE
DIA = DIAMETER
DIP = DUCTILE IRON PIPE
E = ELECTRICAL
ECC = EDGE OF CRUSHED CONCRETE
EG = EXISTING GRADE
EOC = EDGE OF CONCRETE
EOP = EDGE OF PAVEMENT
EOW = EDGE OF WALK
EG= EXISTING GRADE
EX = EXISTING
F = FIBER OPTIC
FES = FLARED END SECTION
FG = FINISHED GRADE
FL = FLOWLINE
FM = FORCEMAIN
G = GAS LINE
HP = HIGH POINT
INV = INVERT
LP = LOW POINT
MATCH = MATCH
M# = STORM SEWER MANHOLE
MT# = STORM SEWER TEE MANHOLE
MM# = STORM SEWER MULTI-MANHOLE
MC = MIDPOINT OF CURVE
OHP = OVERHEAD POWER
OHT = OVERHEAD TELEPHONE
OHTV = OVERHEAD TELEVISION
PC = POINT OF CURVATURE
PRC = POINT OF REVERSE CURVE
PVC = POLYVINYL CHLORIDE PIPE
PT = POINT OF TANGENCY
RIM = RIM OF STRUCTURE
S# = SANITARY SEWER MANHOLE
S.B. ELEV. = STOP BOX ELEVATION
S.S. ELEV. = SANITARY SEWER SERVICE INVERT
S.S. = SANITARY SEWER
S.T. = STORM SEWER
STA = ALIGNMENT STATION
T = TELEPHONE
TOC = TOP OF CONCRETE
TOP = TOP OF PAVEMENT
TOP = TOP OF PIPE
TOW = TOP OF WALK
TR# = SANITARY TELEVISING RISER
TRANS = TRANSFORMER
TV = TELEVISION
U = UTILITY (UNKNOWN UTILITY)

PRELIMINARY

moore engineering, inc.

CIVIL LEGEND
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CIVIL LEGEND

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

C-001

SHEET 1 OF 8

PRELIMINARY

moore engineering, inc.

ALIGNMENT LAYOUT AND CONTROL
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
ALIGNMENTS, LINE AND CURVE TABLES, AND SURVEY CONTROL

HORIZONTAL CONTROL

NORTH DAKOTA COORDINATE SYSTEM OF 1983, NAD83, SOUTH ZONE
COMBINATION FACTOR (cf) = .9998875
ALL COORDINATES ARE CASS COUNTY GROUND COORDINATES

VERTICAL CONTROL

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

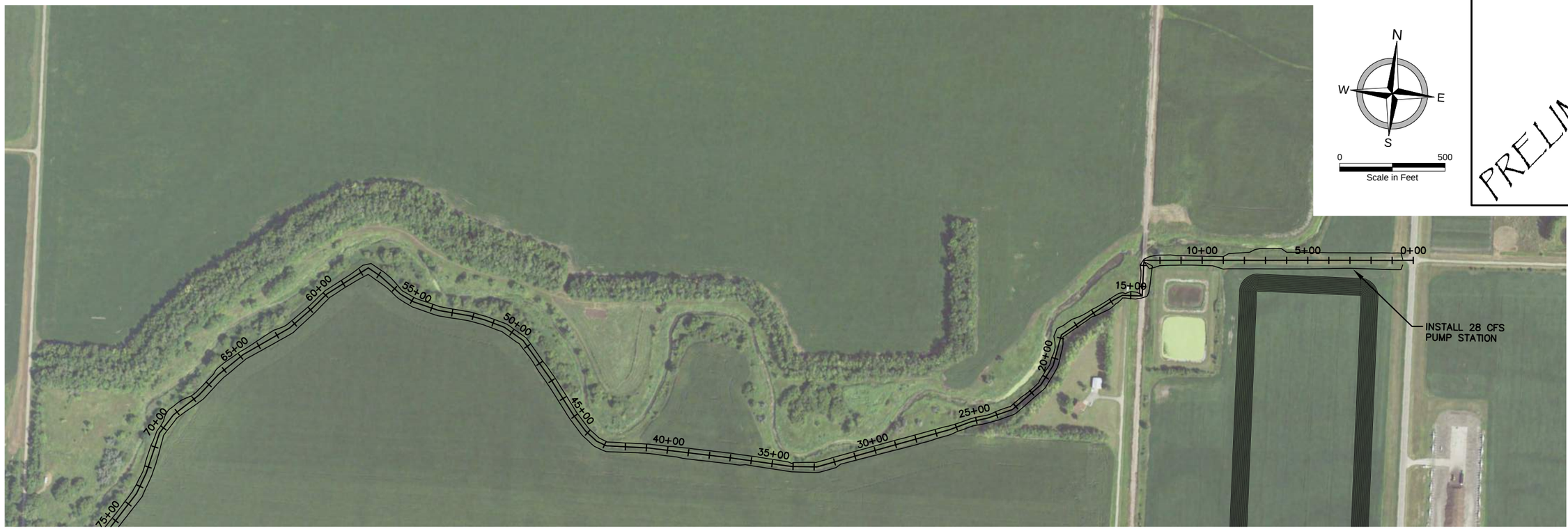
BENCHMARKS/SURVEY CONTROL

PRIOR TO PROJECT START, OWNER WILL SET AND ESTABLISH BENCHMARKS AND SURVEY CONTROL FOR THE PROJECT, AND CLEARLY MARK RIGHT-OF-WAY.

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

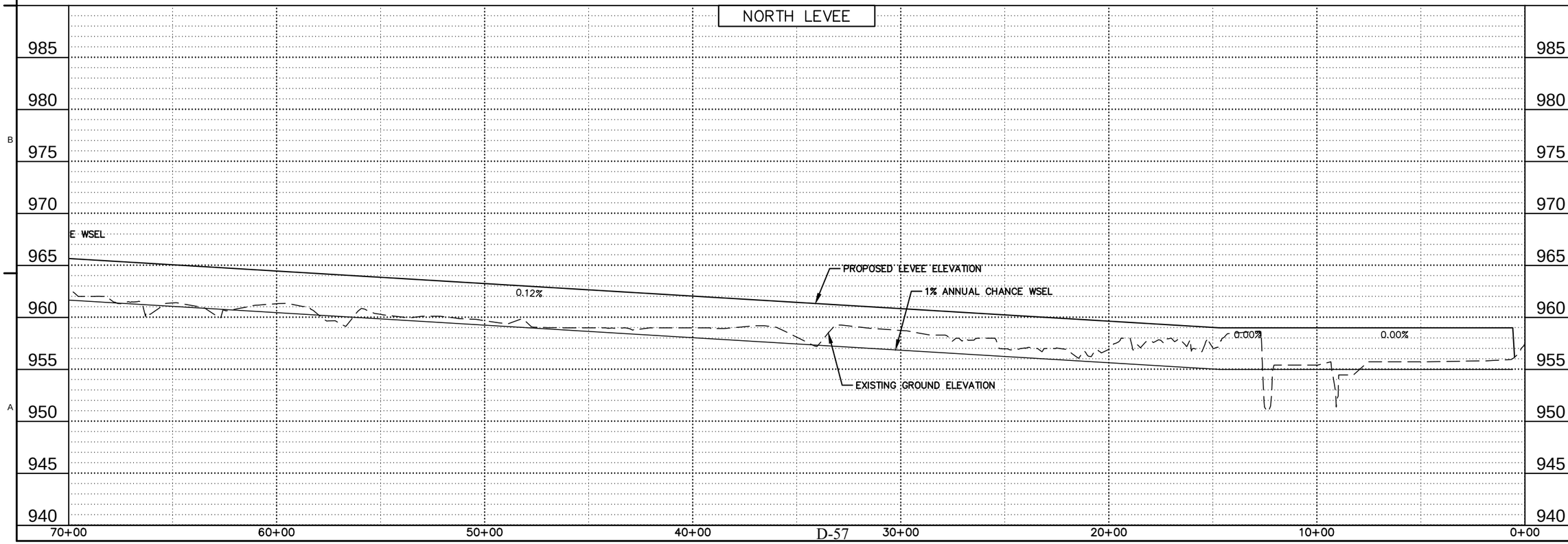
C-101

SHEET 2 OF 8



PRELIMINARY

moore engineering, inc.



PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
NORTH LEVEE

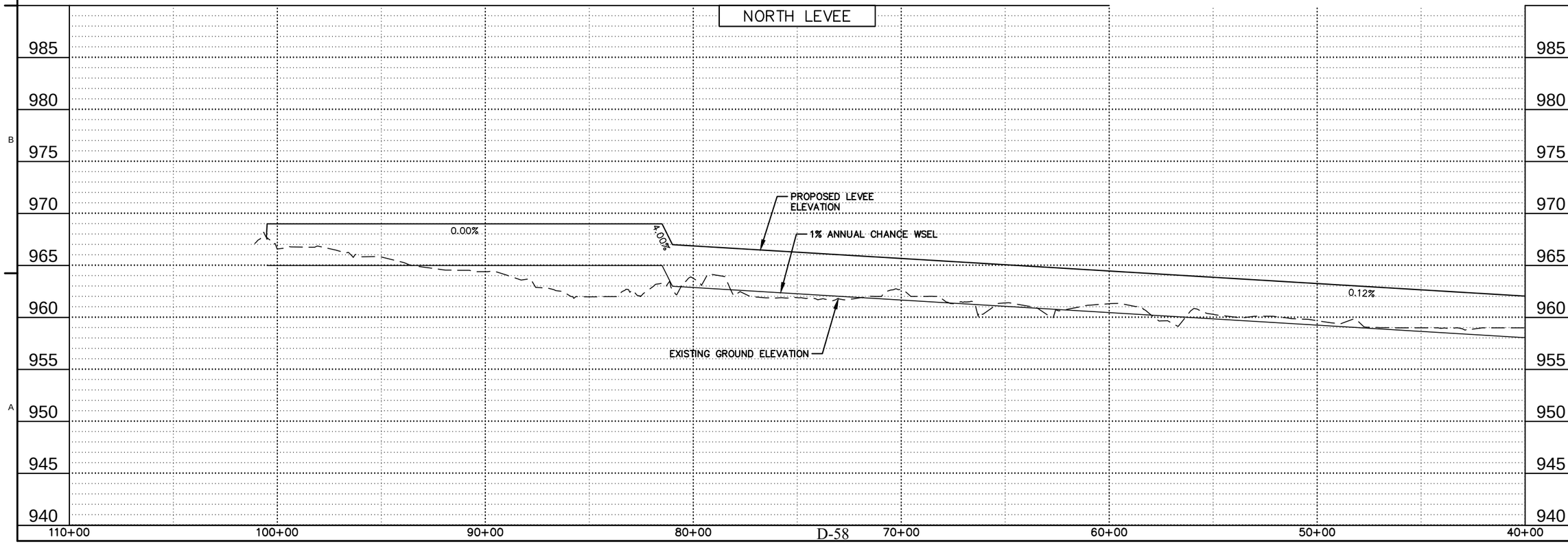
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

C-201

SHEET 3 OF 8

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-NORTH-LEVEE-ALT.dwg

PRELIMINARY



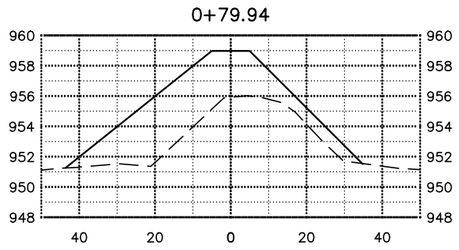
moore engineering, inc.

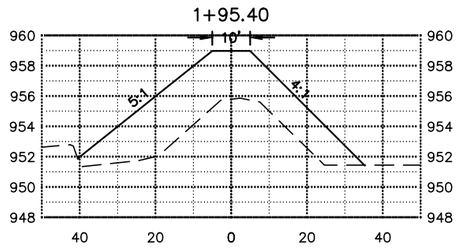
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
NORTH LEVEE

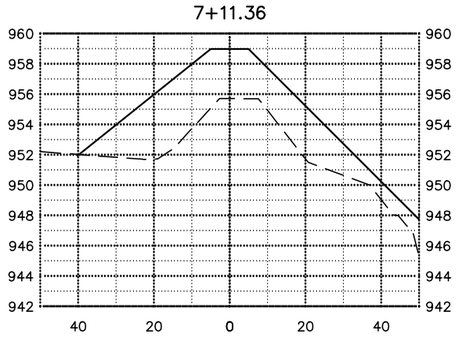
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

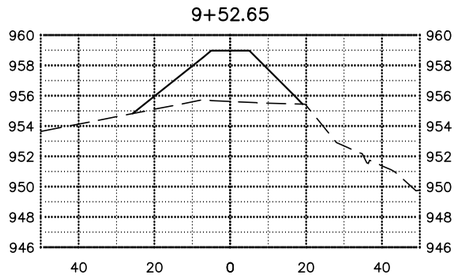
C-202

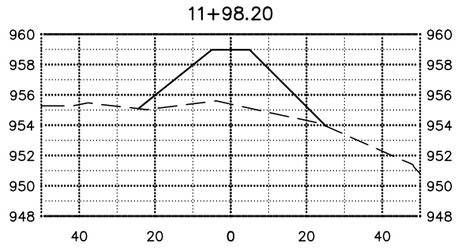
SHEET 4 OF 8

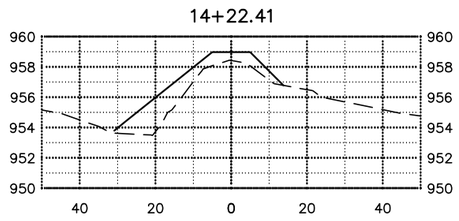


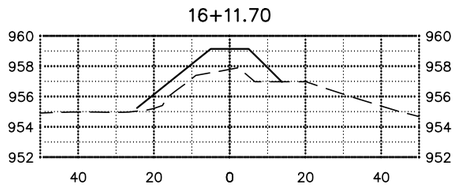


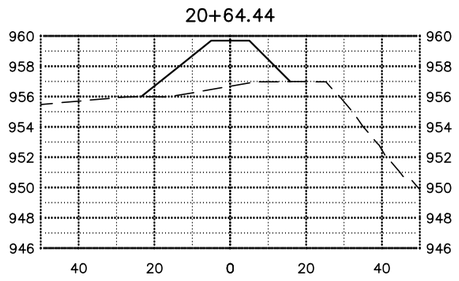


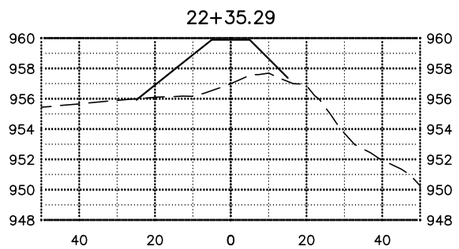


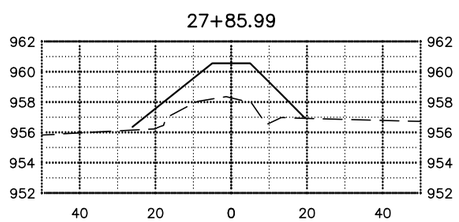


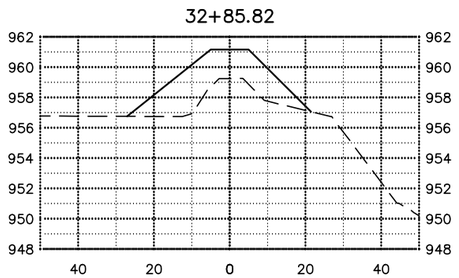


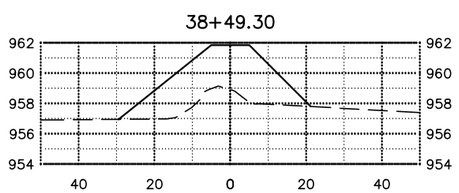


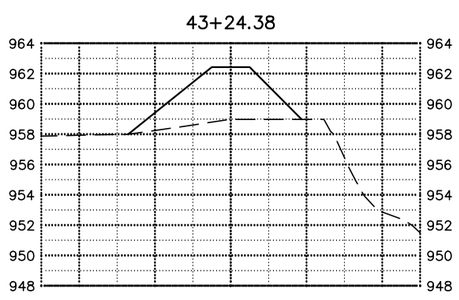


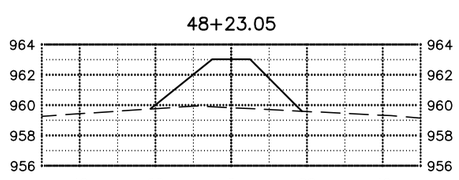


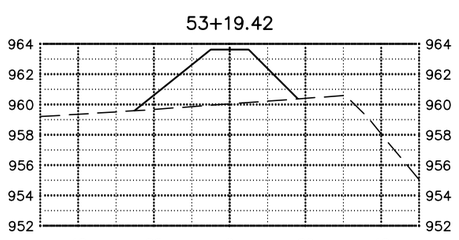


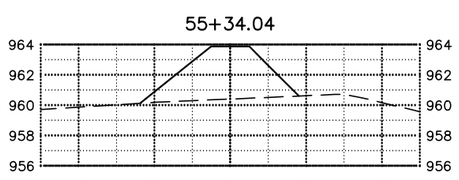












PRELIMINARY

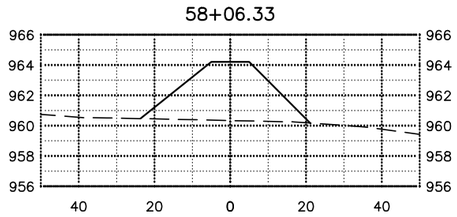
moore engineering, inc.

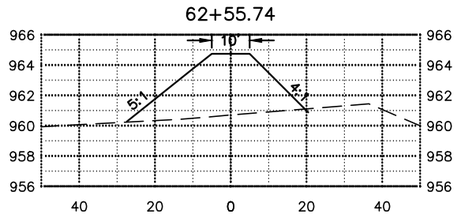
CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

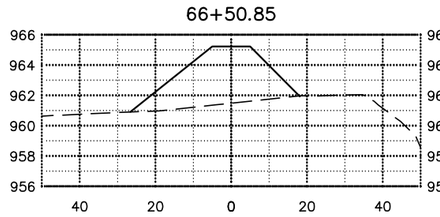
DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

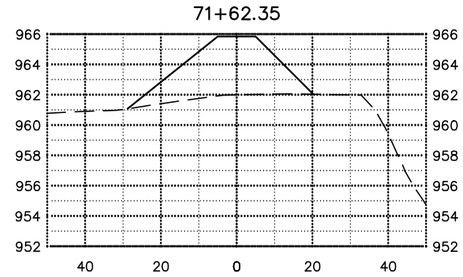
C-301

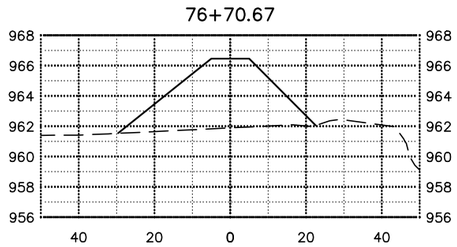
SHEET 5 OF 8

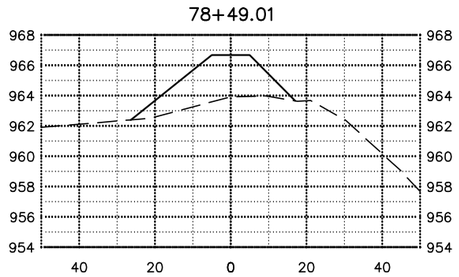


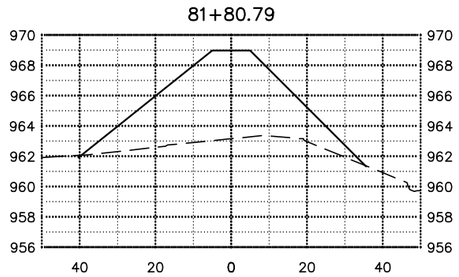


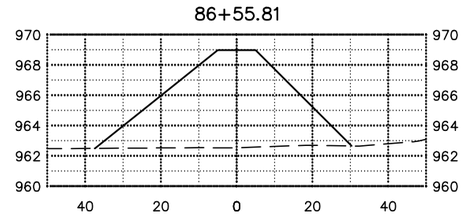


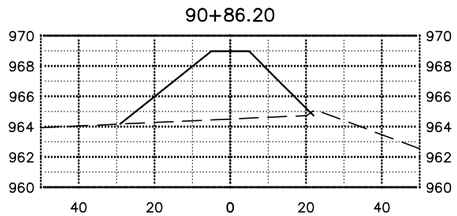


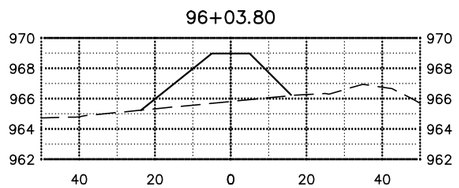


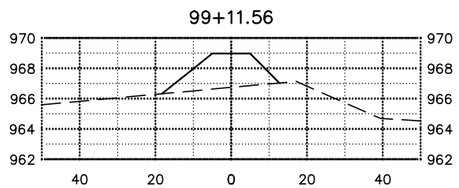












PRELIMINARY

moore engineering, inc.

CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

C-302

SHEET 6 OF 8

FILE LOCATION: R:\Civil 3D Projects\18747\DRAWINGS\DESIGN\18747-NORTH-LEVEE-ALT.dwg

PRELIMINARY

EARTHWORK VOLUMES

Station	Cut Area (Ft^2)	Fill Area (Ft^2)	Cut Vol (Yd^3)	Fill Vol (Yd^3)	Total Cut (Yd^3)	Total Fill (Yd^3)
0+79.94	0.00	184.04	0.00	0.00	0.00	0.00
1+95.40	0.00	206.11	0.01	834.19	0.01	834.19
7+11.36	0.01	243.35	0.14	4294.48	0.15	5128.68
9+52.65	0.00	90.44	0.05	1491.51	0.20	6620.19
11+98.20	0.00	107.93	0.00	902.02	0.20	7522.21
14+22.41	0.00	45.96	0.00	623.88	0.20	8146.09
16+11.70	0.00	42.12	0.00	321.99	0.20	8468.07
20+64.44	0.00	76.64	0.02	992.32	0.22	9460.40
22+35.29	0.02	74.90	0.05	482.44	0.27	9942.84
27+85.99	0.00	77.57	0.16	1558.51	0.44	11501.35
32+85.82	0.00	87.16	0.00	1524.75	0.44	13026.10
38+49.30	0.00	111.88	0.00	2081.92	0.44	15108.02
43+24.38	0.00	98.93	0.00	1858.56	0.44	16966.58
48+23.05	0.00	79.10	0.00	1647.05	0.44	18613.63
53+19.42	0.00	95.46	0.00	1600.71	0.44	20214.33
55+34.04	0.00	90.31	0.00	740.91	0.44	20955.25
58+06.33	0.00	105.53	0.01	982.58	0.45	21937.83
62+55.74	0.11	116.61	0.91	1848.98	1.36	23786.81
66+50.85	0.00	103.64	0.82	1608.18	2.18	25394.99
71+62.35	0.00	113.79	0.02	2054.40	2.19	27449.39
76+70.67	0.00	141.80	0.00	2410.16	2.19	29859.55
78+49.01	0.00	78.72	0.00	729.10	2.19	30588.66
81+80.79	0.07	235.85	0.47	1950.36	2.67	32539.02
86+55.81	0.00	248.29	0.61	4257.67	3.27	36796.69
90+86.20	0.12	136.22	1.02	3055.13	4.29	39851.82
96+03.80	0.00	78.99	1.20	2061.68	5.50	41913.50
99+11.56	0.00	46.03	0.00	708.53	5.50	42622.03

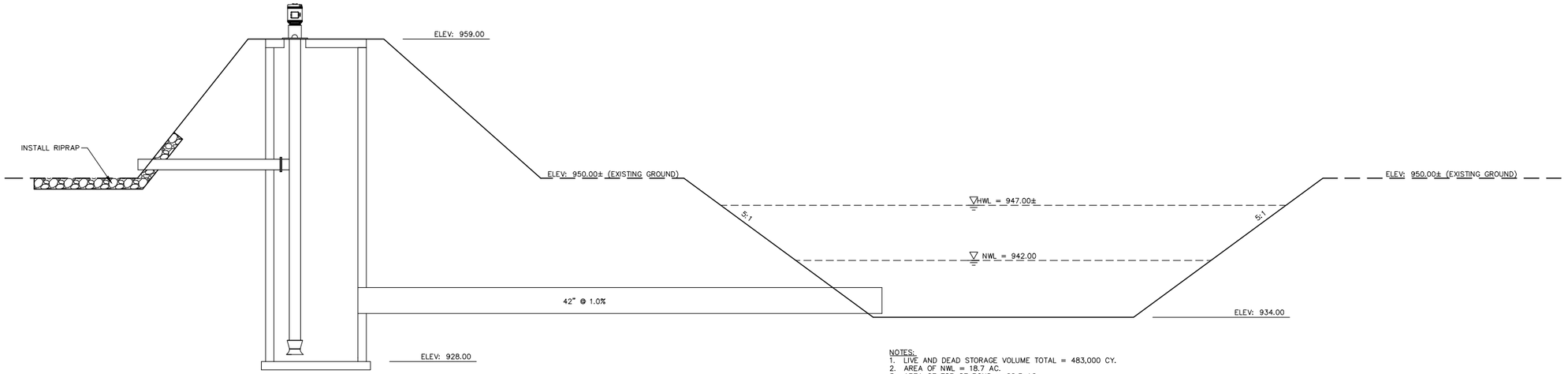
moore engineering, inc.

CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

C-303

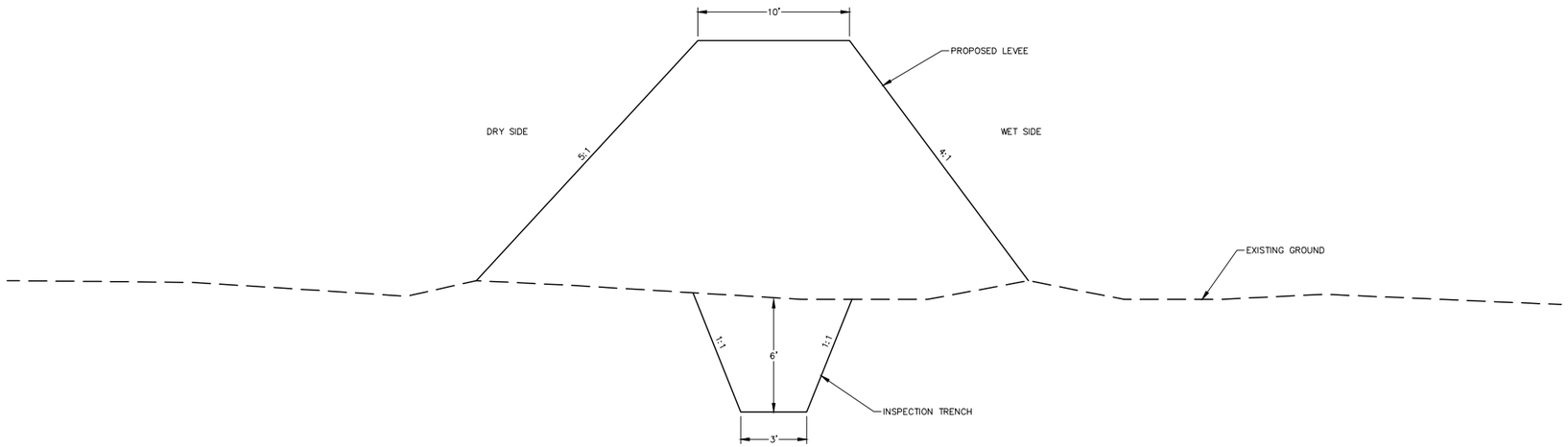
SHEET 7 OF 8



NOTES:
1. LIVE AND DEAD STORAGE VOLUME TOTAL = 483,000 CY.
2. AREA OF NWL = 18.7 AC.
3. AREA OF TOP OF POND = 22.3 AC.
4. DUPLEX LIFT STATION WITH PEAK FLOW = 28 CFS.
5. 1% CHANCE RAINFALL DURING FLOOD = 2.8"/24 HR.
6. CONSTRUCT INTERNAL DRAINAGE DITCH TO FLOW INTO POND PER PLANS.

STORM POND DETAIL - NORTH LEVEE ALTERNATIVE

NO SCALE



TYPICAL LEVEE SECTION

NO SCALE

PRELIMINARY

moore engineering, inc.

TYPICAL DETAILS
RCPP/PL566 RUSH RIVER - AMENIA NORTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TYPICAL DETAILS

DATE:	01.24.19
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
REVISED:	----
RECORD:	----
PROJECT No.	18747
MANAGER:	MMO
DESIGNER:	JMH
DRAFTER:	RJK
REVIEWER:	KRL

C-501

SHEET 8 OF 8

moore engineering, inc.

Amenia Flood Risk Reduction

Amenia, ND

Rush River RCPP

3/1/2019

Engineer's Preliminary Opinion of Probable Cost - Low Estimate

Alternate 2- Certified Levee Along River - Larger Pond, Smaller Lift Station

						POTENTIAL FUNDING SOURCES			
	ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL	Federal	NDSWC	County Sales Tax	LOCAL
	Levee								
1.	Inspection Trench	CY	7,820	$5.00	$39,100.00	$25,415.00	$6,842.50	$3,421.25	$3,421.25
2.	Excavation - Pond	CY	482,450	$2.00	$964,900.00	$482,450.00	$241,225.00	$120,612.50	$120,612.50
3.	Excavation - Pond - Stockpile On Site	CY	451,600	$3.00	$1,354,800.00	$677,400.00	$338,700.00	$169,350.00	$169,350.00
4.	Embankment - Levee	CY	30,850	$3.00	$92,550.00	$46,275.00	$23,137.50	$11,568.75	$11,568.75
5.	Gatewell Structure	EA	3	$150,000.00	$450,000.00	$225,000.00	$112,500.00	$56,250.00	$56,250.00
6.	Storm Sewer - 48" RCP	LF	150	$125.00	$18,750.00	$9,375.00	$4,687.50	$2,343.75	$2,343.75
7.	Storm Sewer - 48" Flapgate	EA	3	$5,000.00	$15,000.00	$7,500.00	$3,750.00	$1,875.00	$1,875.00
8.	Lift Station - 1	LS	1	$350,000.00	$350,000.00	$175,000.00	$87,500.00	$43,750.00	$43,750.00
	Road Crossing								
9.	Gravel - Stripping and Spreading	CY	20	$30.00	$600.00	$300.00	$150.00	$75.00	$75.00
10.	Geotextile Fabric	SY	80	$3.00	$240.00	$120.00	$60.00	$30.00	$30.00
	General Items								
11.	Railroad Crossing - Keyway	EA	1	$5,000.00	$5,000.00	$2,500.00	$1,250.00	$625.00	$625.00
12.	Mobilization	LS	1	$10,000.00	$10,000.00	$5,000.00	$2,500.00	$1,250.00	$1,250.00
13.	Ditching - Internal	LS	1	$150,000.00	$150,000.00	$75,000.00	$37,500.00	$18,750.00	$18,750.00
14.	Riprap - Class III	CY	30	$100.00	$3,000.00	$1,500.00	$750.00	$375.00	$375.00
15.	Riprap Filter Blanket	SY	80	$5.00	$400.00	$200.00	$100.00	$50.00	$50.00
16.	Topsoil Stripping and Spreading	AC	90	$1,500.00	$135,000.00	$67,500.00	$33,750.00	$16,875.00	$16,875.00
17.	Rock Check - Temporary	EA	5	$2,000.00	$10,000.00	$5,000.00	$2,500.00	$1,250.00	$1,250.00
18.	Seeding - Type III	AC	90	$760.00	$68,400.00	$34,200.00	$17,100.00	$8,550.00	$8,550.00
19.	Silt Fence - Standard	LF	10,000	$3.00	$30,000.00	$15,000.00	$7,500.00	$3,750.00	$3,750.00
20.	Storm Water Management	LS	1	$5,000.00	$5,000.00	$2,500.00	$1,250.00	$625.00	$625.00
21.	Traffic Control	LS	1	$5,000.00	$5,000.00	$2,500.00	$1,250.00	$625.00	$625.00
22.	Material Testing	Invoice	Allowance	$25,000.00	$25,000.00	$12,500.00	$6,250.00	$3,125.00	$3,125.00
				Total Construction	$3,732,740.00	$1,872,235.00	$930,252.50	$465,126.25	$465,126.25
				Contingencies (10%)	$373,021.60	$242,464.04	$65,278.78	$32,639.39	$32,639.39
				Project Development/Funding	$30,000.00	$19,500.00	$5,250.00	$2,625.00	$2,625.00
				Engineering - Civil Design	$298,619.20	$194,102.48	$52,258.36	$26,129.18	$26,129.18
				Geotechnical Engineering	$15,000.00	$9,750.00	$2,625.00	$1,312.50	$1,312.50
				Structural Engineering	$15,000.00	$9,750.00	$2,625.00	$1,312.50	$1,312.50
				Electrical Engineering	$6,000.00	$3,900.00	$1,050.00	$525.00	$525.00
				Construction Engineering	$298,619.20	$194,102.48	$52,258.36	$26,129.18	$26,129.18
				Land Surveying	$40,000.00	$26,000.00	$7,000.00	$3,500.00	$3,500.00
				CLOMR/LOMR	$130,000.00	$84,500.00	$22,750.00	$11,375.00	$11,375.00
				Right-of-Way Acquisition	$378,000.00	$245,700.00	$66,150.00	$33,075.00	$33,075.00
				Wetland Mitigation	$13,000.00	$8,450.00	$2,275.00	$1,137.50	$1,137.50
				Legal & Adm. Fees	$50,000.00	$32,500.00	$8,750.00	$4,375.00	$4,375.00
				Right-of-Way Negotiations	$20,000.00	$13,000.00	$3,500.00	$1,750.00	$1,750.00
				Permitting	$5,000.00	$3,250.00	$875.00	$437.50	$437.50
				Fiscal	$40,000.00	$26,000.00	$7,000.00	$3,500.00	$3,500.00
				TOTAL PROJECT COST	**$5,445,000.00**	**$2,985,000.00**	**$1,230,000.00**	**$615,000.00**	**$615,000.00**

Assumptions:

1) Unit prices reflect estimated 2019 prices.
2) Federal cost share assumed at 65% North Dakota State Water Commission cost share of 50% for eligible construction costs of remaining costs.
3) Cass County Flood Sales Tax will cover 50% of local cost share.
4) Excavated pond material will be suitable for levee material.
5) Project design includes no new storm sewer or improvements to the existing system internally in the City of Amenia.
6) Construction Engineering fee assumes full time Resident Project Representative (inspector) will be provided. One construction season.
7) The levee footprint was assumed to include a 150 foot wide corridor which includes the levee, drainage ditches and 15-foot clear zone on each side of levee.
8) Estimated right-of-way aquisition cost assumes 90 acres of land will be needed for levee and pond at purchase price of $4,107 per acre and 25 acres of temporary construction easement at $400 per acre.
9) Fiscal costs are the estimated cost for financing.
10) Cost opinion is based on a conceptual design only. Unit prices were selected based on past projects and contingencies were estimated at 20% in an effort to have estimated costs slightly conservative. Actual costs could be higher or lower than estimated.
11) Wetland Mitigation - estimated disturbed area 0.25 acres, with 2 to 1 mitigation area required, at $26,000/acre.

Preliminary Geotechnical Engineering Report

Rush River Watershed – Amenia
Levee Alternative Sites Alt1 and Alt2
Cass County, North Dakota

Prepared for
Moore Engineering, Inc.
West Fargo, North Dakota

May 2019

Appendix D-2

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435-4803
Phone: 952.832.2600
Fax: 952.832.2601

Preliminary Geotechnical Engineering Report
Rush River Watershed – Amenia
Levee Alternative Sites Alt1 and Alt2
Cass County, North Dakota

May 2019

Contents

List of Tables

List of Figures

List of Appendices

Note: all geotechnical report appendices have been removed from the EA Appendix D version of this report, however they are available upon request to ND NRCS.

Certifications

I hereby certify that this 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 North Dakota.

Eric Brandner, P.E.
PE #: PE-10374

May 17, 2019
Date

1 Introduction

Barr Engineering Co. (Barr), under authorization and contract with Moore Engineering, Inc. (Moore), completed a geotechnical investigation of two potential levee embankment alternatives to increase flood protection for the town of Amenia from the nearby Rush River. Barr understands that Moore is working in conjunction with the Cass County Joint Water Resource District to reduce the flood risk for the town of Amenia. At the time of this report, two proposed levee alternatives have been selected for preliminary geotechnical evaluation.

Barr performed a preliminary geotechnical investigation of both alternatives. This data was used for creating geotechnical models and performing analysis at representative locations across the project area. This report describes the preliminary geotechnical investigations and laboratory results and presents feasibility-level geotechnical evaluations, conclusions, and recommendations for levee embankment alternatives Alt1 and Alt2 for the town of Amenia in Cass County, North Dakota.

1.1 Site Location

The town of Amenia is located in north central Cass County, North Dakota (Figure 1). The two potential levee alternatives currently are located in fields consisting of agricultural farmland. Some trees and thicker vegetation is present near the existing river, and elevation generally decreases towards the river. The Rush River is located about 1/3 mile north of the town of Amenia, and many oxbows are present. The region is relatively flat, with occasional hills and valleys on the order of 10 feet of relief in a few locations, excluding the area near the Rush River. Figure 2 provides the location of the alternatives. Further discussion is provided in Section 1.3.

1.2 Geology

The following sections discuss the general geology of the project site.

1.2.1 Regional Physiography

The site is located in the Red River Valley region of North Dakota, within the Central Lowland physiographic province of the United States, and the soil is formed primarily from sediment that settled out of ancient glacial Lake Agassiz. Figure 3 shows the topography of the site. The surface elevation generally ranges between 940 to 970 feet.

1.2.2 Surficial Geology

Figure 4 indicates that the surficial geology consists primarily of the Oahe Formation, which was deposited during the Quaternary as a windblown silt, primarily along upland slopes. The thickness at the site is estimated to be between 0.2 to 1 meters (Clayton et al, 1976). Figure 5 indicates that the soil texture is mapped as various types of loam.

Sediment of glacial Lake Agassiz deposited in the Red River Valley has been recognized over an area of 200,000 square miles and is Quaternary in age (Harris et al, 1995). The area of the Red River Valley is a

bedrock lowland with regional slope to the north. At least eight Pleistocene stratigraphic units underlie the Agassiz basin in North Dakota. The units vary significantly in texture and behavior. The town of Amenia is located on the outskirts and margins of the valley. The western edge of the valley is defined by beaches or shores of the ancient lake bed, primarily sand and gravel deposits, while the interior of the basin is comprised of Pleistocene lake-plain deposits (Arndt, 1977). The stratigraphy of the Red River Valley is well-known nearer the Red River where the deposits are thicker; however, towards the margins, the stratigraphy can become irregular and intermixed. Figure 6 indicates that the soil parent material at the site is mapped primarily as deposits of glaciolacustrine and alluvial deposits.

Near the town of Amenia, glacial sediment, the shallowest of which is anticipated to be derived from the Red Lake Falls Formation, underlies the Lake Agassiz sediment (Harris et al, 1995).

1.2.3 Bedrock Geology

Glacial deposits extend down to rock, which is anticipated to be on the order of 100 to 200 feet below the existing ground surface (Harris et al, 1995). According to the Geologic Bedrock Map of North Dakota (Bluemle, 1988), the shallowest bedrock is likely Cretaceous in age, consisting of the Belle Fourche, Mowry, Newcastle, and Skull Creek Formations. These formations are primarily observed as silty to sandy shale, with the exception of the Newcastle Formation, which is identified as a sandstone (Anderson, 2010). Bedrock is not anticipated to affect the design of either alternative.

1.2.4 Seismicity and Faults

No Quaternary faults are mapped at the site (USGS, 2019). Overall, seismic activity in the area is considered low.

1.3 Potential Alternative Levee Locations and Embankment Configuration

Based on communications with Moore, two potential alternatives are being evaluated to reduce the risk of flooding for the town of Amenia. The first, identified herein as Alt1, consists of a levee embankment around the town of Amenia (Figure 2). The crest elevation is 959.0 feet, with 3 feet of freeboard and side slopes of 4H:1V. The second alternative, identified herein as Alt2, consists of a levee embankment just south of the Rush River (north of the town of Amenia; Figure 2). The crest elevation ranges from 969.0 feet at the west portion and 959.0 feet at the east portion, with a general slope of 0.12 percent. The side slopes are 4H:1V and 3 feet of freeboard was assumed (Moore, 2018). Barr was provided preliminary plan sets for both alternatives dated January 24, 2019. It is possible that the final design elevations and embankment configurations may be different than the criteria used for this report.

The levee alternatives are not intended to impound a permanent pool but are only intended to temporarily retain water during flood conditions. Both levees will have storm water ponds to retain runoff during flood events. The proposed alignments of levee alternatives Alt1 and Alt2 at the time of this report are indicated on Figure 2.The ground surface elevation and geographic coordinates of the completed borings was taken from a survey performed by Moore upon completion of the geotechnical field work.

1.4 Previous Geotechnical Investigation

Barr was not aware of any previous geotechnical investigations conducted within the project boundaries. However, Barr has performed several geotechnical investigations within Cass County.

1.5 Geotechnical Investigation and Analysis

To support the design of the two proposed levee alternatives, a subsurface investigation, laboratory testing, and preliminary geotechnical engineering analysis were performed by Barr. The geotechnical components of the project are detailed below:

- Evaluation of soil stratigraphy based on field investigations
- Evaluation of soil parameters for seepage and stability modeling and analysis
- Preliminary modeling of seepage for the levee embankment system alternatives
- Underseepage mitigation evaluation
- Preliminary modeling of slope stability for the levee embankment system alternatives
- Evaluation of anticipated settlement for the levee embankment system alternatives
- Report discussing overall feasibility of the Amenia levee embankment alternatives Alt1 and Alt2

2 Preliminary Geotechnical Investigation Methods

2.1 Site Exploration

The preliminary geotechnical investigation consisted of soil borings, standard penetration testing (SPT), split-spoon soil sampling, undisturbed thin-wall tube sampling, and general soil laboratory testing. This program of geotechnical investigation was selected to accurately and efficiently evaluate the strength, compressibility, and density characteristics of the soils at the project site. The site investigation was conducted in August 2018, and laboratory testing was completed in October 2018. The following sections discuss the site work performed for the project.

2.1.1 Soil Borings

A total of nine soil borings were performed along the proposed alignments for Alt1 and Alt2. The soil boring locations are shown on Figure 7 and boring logs are included in Appendix A.

Soil borings along the proposed alignments were completed to a nominal depth of 40 feet below the existing ground surface. The boring locations were selected by Barr and approved by Moore to provide spatial coverage across the project area and to avoid unharvested crops. Figure 7 and Table 1-1 indicate the surveyed locations of the soil borings and elevations. Moore surveyed the borehole locations and provided the survey results to Barr.

Table 1-1 Summary of Soil Boring Locations

Boring ID	UTM Coordinates, Zone 14N NAD83 [meters]		Ground Surface Elevation [feet]	Total Depth of Boring [feet]
	Northing	Easting		
SB-01	5207455.7	635738.9	950.4	40.0
SB-02	5207424.4	634832.7	955.2	40.0
SB-03	5206970.0	635161.4	952.4	40.0
SB-04	5206941.5	635445.0	950.9	40.0
SB-05	5207394.6	633342.3	966.4	40.0
SB-06	5207591.0	633848.9	962.2	40.0
SB-07	5207831.4	634663.7	960.0	40.0
SB-08	5207883.3	635090.9	957.0	40.0
SB-09	5208169.9	635606.4	951.1	40.0

The soil borings were completed by Interstate Drilling Services, LLP, of Grand Forks, North Dakota, with a track-mounted drill rig using hollow-stem auger techniques. The augers used for the investigation were 4.25 inches in inner diameter, and the borehole was on the order of 9 inches in diameter. The soil borings were performed in general accordance with ASTM D1452, "Standard Practice for Soil Exploration and Sampling by Auger Borings." Standard penetration testing (SPT) and split-spoon sampling was performed in accordance with ASTM D1586, "Standard Test Method for Penetration Test and Split-Barrel Sampling of

Soils." Samples were collected continuously in order to determine the entire soil profile and evaluate for the presence of changing stratigraphy, sand or gravel seams, changing moisture content, and organic soils.

Three-inch-diameter Shelby tube samples were also collected at various depths for laboratory testing in accordance with ASTM D1587, "Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes." Where granular soils or stiff clays were encountered, Modified California sampling was performed in accordance with ASTM D3550, "Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils."

Based on the most recent autohammer calibration, which was performed in 2015, the minimum hammer efficiency was 68 percent. This indicates that the corrected *N*-values (N_{60}) are likely to be higher than the raw values if corrected to industry standards of 60-percent hammer efficiency. Hence, the raw *N*-values are reported on the boring logs.

The soil borings were observed and logged by Barr personnel in accordance with ASTM D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)." Soil samples were delivered to Soil Engineering Testing, Inc. (SET) in Bloomington, Minnesota, for laboratory testing. The soil boring logs are provided in Appendix A.

2.1.2 Laboratory Testing

The following geotechnical laboratory analyses were completed by SET:

- Moisture content tests were performed in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"
- Dry unit weight tests were performed in accordance with ASTM D7263, "Standard Test Method for Laboratory Determination of Density (Unit Weight) of Soil Specimens"
- Grain Size and Hydrometer analysis in accordance with ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils"
- Atterberg Limit determinations in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
- Unconfined compressive strength in accordance with ASTM D2166, "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil"
- Unconsolidated-Undrained (UU) Triaxial compressive strength in accordance with ASTM D2850, "Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils"
- Consolidated-Undrained (CU) Triaxial compressive strength in accordance with ASTM D4767, "Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils"

- Consolidation tests in accordance with ASTM D2435, "Standard Test Methods for One-Dimensional Consolidation Properties Using Incremental Loading"
- Shrink-swell testing in accordance with ASTM D4546, "Standard Test Methods for One-Dimensional Swell or Collapse of Cohesive Soils"
- Dispersion testing in accordance with ASTM D4221, "Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer"
- Permeability testing in accordance with ASTM D5084, "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"
- Soil pH in accordance with ASTM D4972, "Standard Test Method for pH of Soils"
- Soil chemical analysis of soluble chloride and sulfate concentration in accordance with USEPA methods

Laboratory test reports and a summary of the laboratory tests completed are included in Appendix B.

3 Results

This section presents the data collected as part of the preliminary geotechnical investigation and provides further analysis of these results.

3.1 Subsurface Stratigraphy

Geologic information (Section 1.2), soil boring logs (Appendix A), laboratory test results Appendix B were reviewed to obtain an understanding of the project area subsurface stratigraphy.

The results of the soil borings indicated that the soils generally consisted of a thin layer of clayey topsoil overlying a layer of lean clay, which was underlain by softer clayey sediment of Lake Agassiz. Clayey glacial till soil deposits were encountered underneath the softer lake-plain deposits which extended to the termination depth of the soil borings. Silt soils were observed at three borings along the proposed alignment for Alternative 2 along the Rush River.

The soil types discussed in the following sections are the soil types used in seepage and stability modeling completed for the feasibility-level analysis.

3.1.1 Topsoil

Topsoil at the site consisted primarily of organic lean to fat clay with lesser amounts of sand. The topsoil was generally dark brown and the thickness ranged from 3 to 18 inches. The topsoil contained roots and other organic material consistent with planted agricultural fields.

3.1.2 Shallow Lean Clay

The results of the soil borings indicated the presence of shallow lean clay at all soil borings. The shallow lean clay extended to a depth ranging from 4 to 14.5 feet below the existing grade. The color of the shallow lean clay soils was observed to be primarily brown to dark brown with occasional gray zones. Lesser amounts of sand and gravel were observed throughout the shallow lean clay. The shallow lean clay deposits are anticipated to be deposits of the Oahe Formation.

Moisture content values for the shallow lean clay ranged from 11.9 to 29 0 percent, with an average of about 20 percent.

Atterberg limit testing on samples of the shallow lean clay indicated plastic limit values ranging from 19 to 24 percent, liquid limit values ranging from 37 to 40 percent, and plasticity index values ranging from 16 to 18 percent. According to the Plasticity Chart (Das, 2010), these soils plot as CL (lean clay).

Mechanical grain size testing in the shallow lean clay indicated no gravel content, the sand content was 29.4 percent, and the fines (silt and clay) content was 70.6 percent (dry weight).

Standard Penetration Test (SPT) *N*-values in the shallow lean clay ranged from 4 to 11 blows per foot, indicating that the shallow lean clay is in a soft to stiff condition. Hand penetrometer measurements on

shallow lean clay indicated that the unconfined compressive strength ranged from 0.25 to 4.5 tons per square foot (tsf), with a typical range of about 1.5 to 2 tsf.

3.1.3 Sand

Sand was encountered at one of the soil borings (SB-08) between a depth of 3 to 4 feet. The shallow sand was observed to be tan. The sand was classified in the field as a silty to clayey sand. Sand is not widely anticipated at the project site, but may be encountered at isolated locations.

3.1.4 Fat Clay

The results of the soil borings indicated the presence of fat clay at all soil borings. The color of the fat clay was observed to be brown to tan towards the surface of the soil borings, and graded into gray to dark gray at depth, and contained very few sand inclusions. It is anticipated that the majority of the fat clay consists of various units of the Lake Agassiz sediment. Within the fat clay, occasional deposits and mineralization were observed which ranged in color from gray to white to orange.

Moisture content values for the fat clay ranged from 25.0 to 60.6 percent, with an average of about 44 percent.

Dry unit weights of the fat clay ranged from about 63.4 to 77.1 pounds per cubic foot (pcf). Moist unit weights for these soils were computed using the moisture content test results described above from the same samples tested for dry unit weight. The calculated moist unit weight ranged from 101.8 to 110.4 pcf, with an average of approximately 107 pcf.

Atterberg limit testing on samples of the fat clay indicated plastic limit values ranging from 25 to 29 percent, liquid limit values ranging from 71 to 107 percent, and plasticity index values ranging from 46 to 80 percent. According to the Plasticity Chart (Das, 2010), these soils plot as CH (fat clay).

Mechanical grain size testing in fat clay indicated no gravel content, the sand content was 2.1 percent, and the fines (silt and clay) content was 97.9 percent (dry weight). Hydrometer testing indicated that the silt content was 11.9 percent, and the clay content was 86.0 percent.

Seven laboratory unconsolidated-undrained (UU) triaxial compression tests were performed on samples of fat clay. Test results indicated that the maximum deviator stress ranged from 0.68 to 1.24 tsf. Hand penetrometer measurements on fat clay indicated that the unconfined compressive strength ranged from 0.25 to 4.5 tsf, with a typical range of about 0.5 to 2.0 tsf.

SPT *N*-values in the fat clay ranged from 2 to 16 blows per foot, with a typical range of 3 to 7 blows per foot, indicating that the fat clay is generally in a soft to medium stiff condition.

Three laboratory hydraulic conductivity tests were performed on intact samples of the fat clay. The results indicated that the hydraulic conductivity ranged from 1.10×10^{-8} to 4.30×10^{-8} cm/sec (3.61×10^{-10} to 1.41×10^{-9} ft/sec), with a geometric mean of 2.00×10^{-8} cm/sec (6.56×10^{-10} ft/sec).

Two laboratory direct shear tests were performed on intact samples of the fat clay, and the results indicated that the peak friction angle ranged from 5.9 degrees with an apparent cohesion of 0.341 tsf to 15.5 degrees with an apparent cohesion of 0.155 tsf.

One consolidated-undrained (CU) triaxial compressive strength test was performed on a sample of fat clay. Using the maximum deviator stress as the failure condition, the results indicated that the effective friction angle of the fat clay was 18.4 degrees, with an apparent cohesion of 0.16 tsf.

3.1.5 Silt

Native silt was observed at three soil borings (SB-05, SB-08, and SB-09), which were all observed along the alignment for Alt2 near the Rush River. The thickness of the silt layers ranged from about 5 to 10 feet. The silt was observed to be tan to orangish tan, with trace amounts of sand.

Moisture content values for the silt ranged from 34.3 to 41.0 percent, with an average of about 39 percent.

Atterberg limit testing on samples of the silt indicated plastic limit values ranging from 29 to 32 percent, liquid limit values ranging from 33 to 41 percent, and plasticity index values ranging from 4 to 9 percent. According to the Plasticity Chart (Das, 2010), these soils plot as ML (silt).

Mechanical grain size testing was performed on two samples of silt. Test results indicated no gravel content, the sand content ranged from 3.6 to 5.8 percent, and the fines (silt and clay) content ranged from 94.2 to 96.4 percent. Hydrometer analyses indicated that the silt content ranged from 69.4 to 86.8 percent, and the clay content ranged from 9.6 to 24.8 percent.

SPT *N*-values in the silt ranged from 2 to 7 blows per foot, indicating that the silt is in a very loose to loose condition.

3.1.6 Glacial Till

The results of the investigation indicated the presence of glacial till at all soil borings. The glacial till was observed to consist of low to moderate plasticity lean clay soil and was encountered at depths ranging from 11 to 31 feet below the existing ground surface. The color of the glacial till was observed to be brown to tan to gray. Lesser amounts of sand and gravel were observed throughout the glacial till. Occasional orange and gray mineralization were observed interbedded with the glacial till.

Moisture content values for the glacial till ranged from 18.7 to 25.1 percent, with an average of about 22 percent.

Dry unit weights of the glacial till ranged from 95.2 to 106.8 pcf. Moist unit weights for these soils were computed using the moisture content test results described above from the same samples tested for dry unit weight. The calculated moist unit weight ranged from 119.1 to 128.6 pcf, with an average of approximately 125 pcf.

Atterberg limit testing on one sample of the glacial till indicated a plastic limit value of 18 percent, a liquid limit value of 41 percent, and a plasticity index value of 23 percent. According to the Plasticity Chart (Das, 2010), this soil plot as CL (lean clay).

Mechanical grain size testing in glacial till indicated that the gravel content was 4.0 percent, the sand content was 35.3 percent, and the fines content was 60.7 percent (dry weight). Hydrometer testing indicated that the silt content was 39.4 percent, and the clay content was 21.3 percent.

Two laboratory unconfined compressive strength tests were performed, and the results indicated that the unconfined compressive strength ranged from 2.55 to 4.36 tsf. Hand penetrometer measurements performed on glacial till samples indicated that the unconfined compressive strength ranged from 1.25 to 4.5 tsf, with a typical range of 2.5 to 4.5 tsf.

SPT *N*-values in the glacial till ranged from 7 to 25 blows per foot, with a typical range of 12 to 20 blows per foot, indicating that the glacial till is generally in a stiff to very stiff condition.

One laboratory hydraulic conductivity test was performed on an intact sample of the glacial till. The results indicated that the hydraulic conductivity was 6.20×10^{-8} cm/sec (2.03×10^{-9} ft/sec).

3.1.7 Reworked Glacial Till

Visually, the glacial till appeared relatively consistent once encountered, but the results of SPT and hand penetrometer testing indicated that there was a thinner zone at the top of the glacial till unit at borings SB-01, SB-02, SB-03, SB-06, SB-07, and SB-09 that was much softer than the underlying glacial till. The weaker zones are anticipated to be a reworked zone of glacial till and are anticipated to behave in a slightly different way than the intact glacial till.

Moisture content values for the reworked glacial till ranged from 19.2 to 39.0 percent, with an average of about 32 percent.

Dry unit weights of the reworked glacial till ranged from 82.1 to 89.9 pcf. Moist unit weights for these soils were computed using the moisture content test results described above from the same samples tested for dry unit weight. The calculated moist unit weight ranged from 114.1 to 117.6 pcf, with an average of approximately 115 pcf.

Atterberg limit testing on one sample of the reworked glacial till indicated a plastic limit value of 38 percent, a liquid limit value of 22 percent, and a plasticity index value of 16 percent. According to the Plasticity Chart (Das, 2010), this soil plots as CL (lean clay).

Two laboratory unconsolidated-undrained (UU) triaxial compression tests were performed on samples of the reworked glacial till. Test results indicated that the maximum deviator stress ranged from 1.17 to 1.95 tsf, slightly weaker than the underlying material. Hand penetrometer measurements performed on samples of reworked glacial till indicated that the unconfined compressive strength ranged from 0.25 to 2.5 tsf, with a typical range of 0.5 to 1.5 tsf.

SPT *N*-values in the reworked glacial till ranged from 2 to 9 blows per foot.

One consolidated-undrained (CU) triaxial compressive strength test was performed on a sample of reworked glacial till. Using the maximum deviator stress as the failure condition, the results indicated that the effective friction angle of the clay was 36.8 degrees with no apparent cohesion.

3.2 Groundwater Conditions

Groundwater was encountered at all soil borings while drilling or immediately after drilling at depths ranging from 11.0 to 35.0 feet. Upon completion of drilling when the augers were removed from the borehole, the soils caved in to a depth ranging from 4.8 to 18.4 feet. Groundwater measurements from the field investigation are provided in Table 3-1. All depths are referenced from below the existing ground surface at the time of the investigation.

Table 3-1 Summary of Groundwater Levels from Soil Borings

Boring ID	Groundwater Measurement Depth [feet]		
	While Drilling	End of Drilling	Cave-in Depth
SB-01	NE	NE	NE
SB-02	27.5	NE	18.1
SB-03	19.0	NE	17.1
SB-04	35.0	NE	6.1
SB-05	15.0	NE	4.9
SB-06	17.0	NE	4.8
SB-07	25.0	NE	18.4
SB-08	35.0	NE	9.9
SB-09	11.0	13.2	14.1

NE – Not Encountered

Given the lower permeability of the primarily clayey soils encountered at the site, it is possible that the groundwater levels did not have time to stabilize in the short time the boreholes were open. As a result, the groundwater level may be shallower than observed. In general, the high moisture content of the fat clay tends to indicate that the soils are saturated, and the groundwater level is anticipated to be near the shallow lean clay/fat clay interface.

Many factors contribute to water level fluctuations, such as heavy rainfall events, dry periods, sand seams, etc. Based upon the observations made during drilling, the groundwater at both potential alternative alignments is anticipated to be in the upper 10 feet of soil.

3.3 General Soil Laboratory Testing

The laboratory test results from the soil borings are provided in Appendix B. Test results are summarized in Table B1 of Appendix B.

3.3.1 Moisture Content

A total of 51 moisture content tests were performed on samples collected from the soil borings. The soils tested included sands, clays, and silts. The native soil had moisture contents ranging from 11.9 to 60.6 percent, with an overall average of about 34 percent. The fat clay, reworked glacial till, and silt typically had higher moisture contents and the shallow lean clay and intact glacial till generally exhibited lower moisture contents.

3.3.2 Atterberg Limits

Atterberg Limits testing was performed on fine-grained soil samples and used to classify the material encountered in the borings. A total of 11 Atterberg Limits tests were conducted.

Atterberg Limits test results indicated that the liquid limit ranged from 33 to 107 percent, the plastic limit ranged from 18 to 32 percent, and the plasticity index ranged from 4 to 80 percent. According to the Plasticity Chart (Das, 2010), the soils tested are classified as CL (lean clay), CH (fat clay), and ML (silt).

3.3.3 Unit Weight

A total of 17 dry unit weight tests were performed on intact soil samples obtained during the investigation. Dry unit weight test results on all samples ranged from 63.4 to 106.8 pcf. Moist unit weight estimations using moisture contents from samples with dry unit weight results ranged from 101.8 to 128.6 pcf, with an average of about 111 pcf.

The fat clay exhibited the lowest dry unit weight, while the glacial till tended to exhibit the higher dry unit weight.

3.3.4 Mechanical Grain Size Analysis

Mechanical grain size testing was performed on five soil samples collected during the investigation. Test results indicated that the gravel content ranged from none to 4.0 percent, the sand content ranged from 2.1 to 35.3 percent, and the fines (silt and clay) content ranged from 60.7 to 97.9 percent (dry weight). Hydrometer analysis indicated that the silt content ranged from 11.9 to 86.8 percent and the clay content ranged from 9.6 to 86.0 percent.

3.3.5 Compressibility

Fine-grained soils (clay and silt) experience long-term consolidation if saturated and subjected to increased loading. Some of the fine-grained soils observed at the site were observed to be saturated, and are anticipated to experience long-term settlement as the increased stress from the proposed embankment squeezes out the water from the pore spaces.

Compressibility of the existing clayey soils was evaluated using laboratory one-dimensional consolidation testing. One sample of lean clay and one sample of fat clay were selected for laboratory testing. The consolidation test results are provided in Table 3-2.

Table 3-2 Summary of Laboratory Consolidation Test Results

Boring ID	Depth [ft]	Soil Type	P_c' [tsf]	OCR	C_c	C_r	e_0
SB-08	30-32	CL (glacial till)	5.00	4.4	0.18	0.02	0.624
SB-04	15-17	CH (fat clay)	3.70	5.5	0.68	0.16	1.597

Based on the test results, the clay soils appear to be overconsolidated (i.e., the current existing stress on the soil is less than the maximum stress that the soil has encountered throughout its history). Overconsolidated soils generally have a lower potential for settlement than normally consolidated soils. Glacial deposits are typically overconsolidated because the glaciers have previously compressed the material. Test results indicate that the clay soils have a relatively low to moderate compressibility.

3.3.6 Chemical Testing

Chemical testing was performed on two soil samples collected from the project site. Test results indicated that the soil pH ranged from 8.2 to 8.3, the soluble chloride concentration ranged from 64.0 to 576.0 mg/kg, and the soluble sulfate concentration ranged from 1,640.0 to 2,360.0 mg/kg. Soil chemical test results are summarized in Table 3-3.

Table 3-3 Summary of Chemical Tests on Soil Samples

Boring ID	Depth [ft]	Soil Type	pH	Soluble Chloride [mg/kg]	Soluble Sulfate [mg/kg]
SB-01	5-7.5	CH	8.3	64.0	1640.0
SB-04	2.5-4	CH	8.2	576.0	2360.0

3.3.7 Hydraulic Conductivity

Hydraulic conductivity tests were performed on selected samples to determine the permeability of the material for seepage analysis. The hydraulic conductivity tests were performed with the flexible-wall permeameter method according to ASTM D5084. Clay was the predominant soil type observed at the project site, and so four clay samples were tested. Impact sample test results indicated that the hydraulic conductivity of the clay soils ranged from 1.10×10^{-8} to 6.20×10^{-8} cm/sec (2.03×10^{-9} to 3.61×10^{-10} ft/sec), with a geometric mean of 2.66×10^{-8} cm/sec (8.72×10^{-10} ft/sec).

The hydraulic conductivity results from laboratory testing are considered a measure of vertical permeability as the water is forced to flow through the sample from the bottom face to the top face of the cylindrical specimen.

3.3.8 Double Hydrometer Testing

One double hydrometer test was performed on a sample of silt to evaluate the dispersion potential. Test results indicated that the dispersion potential was approximately 2 percent.

3.3.9 Soil Shrink-Swell

One laboratory shrink-swell test was performed on a sample of fat clay from the site. The specimen was inundated with distilled water in order to determine the free swell potential (swell percentage). The specimen was then incrementally loaded until the initial specimen height was achieved (swell was eliminated by loading). The results indicate that the sample tested free-swelled 5.4 percent, with no potential swell (defined as the vertical swell under a pressure equal to the overburden stress). The associated swell pressure (amount of pressure required to negate the swell) was 0.73 tsf.

3.4 Soil Shear Strength

The strength of the soils was determined from field and laboratory testing. Laboratory strength testing results are provided in Appendix B. The following sections discuss the soil strength in terms of friction angle (for the drained condition) and undrained shear strength (for the undrained condition).

3.4.1 Drained Shear Strength

Laboratory direct shear testing was performed on two samples of fat clay. The peak friction angles of drained shear strength ranged from 5.9 degrees with an apparent cohesion of 0.341 tsf to 15.5 degrees with an apparent cohesion of 0.155 tsf, respectively.

Two consolidated-undrained (CU) triaxial compressive strength tests were performed on samples of clay soil. Using the maximum deviator stress as the failure condition, the results indicated that the effective friction angle of the clay ranged from 18.4 to 36.8 degrees and the apparent cohesion ranged from 0.16 tsf to none, respectively.

3.4.2 Undrained Shear Strength

The undrained shear strength values for cohesive soils were derived from unconfined compressive strength testing and unconsolidated undrained (UU) triaxial strength tests on Shelby tube samples from the borings. Hand penetrometer measurements were also considered for the analysis. Undrained shear strength values are considered to be half of the unconfined compressive strength or maximum deviator stress of the soil at failure. SPT *N*-values are indicated on the boring logs in Appendix A.

The results from laboratory unconfined compressive strength testing, unconsolidated undrained triaxial compressive strength testing, and hand penetrometer testing indicated that the undrained shear strength ranged from approximately 680 to greater than 4,360 psf.

4 Preliminary Geotechnical Analysis

Geotechnical models were created for representative cross sections across the project area where varying conditions of subsurface stratigraphy were encountered. The primary goal of the preliminary analysis was to evaluate the slope and seepage stability across the project alignment for typical and worst-case conditions and, if necessary, provide a preliminary design to alleviate slope stability concerns.

4.1 Geometry and Design Considerations

The geometry of the cross sections is discussed in the following sections. For the preliminary analysis, two cross sections were evaluated: one for Alt1 and one for Alt2. The locations of these cross sections were selected to evaluate the varying conditions below the proposed embankment. The location of the modeled cross sections is shown on Figure 8.

The levee embankment configurations provided to Barr by Moore indicated that the Alt1 embankment height should be at an elevation of about 959 feet (mean sea level) and the Alt2 embankment height ranges from 959.0 to 969.0 feet (mean sea level) (Moore, 2018). The levee embankments are not planned to have an upstream pool under "normal conditions." Based on conversations with Moore, the levees are planned to be designed for 3 feet of freeboard (Moore, 2018). For the purposes of this report, the hydraulic loading condition of water at the freeboard height is referred to as "normal flood conditions" and the hydraulic loading condition of water at the crest is referred to as "maximum flood conditions."

The embankment fill was assumed to be clay from an on-site borrow pit. The location has not been identified at the time of this report.

The ground surface geometry used in the models was constructed based on available data from public sources and from measured elevations by Moore at the completed soil boring locations. As such, there is likely some variability between the modeled cross sections and the actual ground elevations. Barr recommends collecting additional survey information via traditional methods or light detecting and range (LiDAR) and bathymetric survey of the river for a more precise representation of the existing conditions for use in final analysis and construction depending on which alternative is selected.

4.1.1 Soil Profile Alignment

To assist in visualizing the soil stratigraphy along the proposed embankment, Barr prepared a profile drawing of the proposed alignments which took into account the stratigraphy of the recent soil borings. The apparent soil profile along the Alt1 and Alt2 alignments is provided in Appendix C1 and Appendix C2, respectively. Based on the results of the investigation, the main types of soil encountered were shallow lean clay, fat clay, silt, reworked glacial till, and glacial till. SPT *N*-values are indicated on the alignment. Because the seasonal water levels have not been studied (or provided to Barr), the assumed groundwater level is not provided on the profile alignment.

4.1.2 Cross Section 1 – Alt1

Soil stratigraphy for Alt1 was based on the results of the geotechnical investigations and represents Barr's interpretation of the existing soil conditions near the selected cross section. This cross section is labeled *CS1* for Alt1 on Figure 8, and stratigraphy was estimated primarily from soil boring SB-04 and other nearby information. The elevation of the existing ground surface is approximately 950.9 feet. This location was selected for analysis because of the thick fat clay deposits and relatively deep glacial till soil. To evaluate the factors of safety with respect to slope stability and seepage (including heave and erosion) of the cross section, a clay fill levee embankment with a crest width of 10 feet, upstream and downstream side slopes of 4H:1V, and crest elevation of 959.0 feet was analyzed per the provided embankment configuration. Barr examined no flood conditions, normal flood conditions, maximum flood conditions, and rapid drawdown scenarios.

4.1.3 Cross Section 2 – Alt2

Soil stratigraphy for Alt2 was based on the results of the geotechnical investigations and represents Barr's interpretation of the existing soil conditions near the selected cross section. This cross section is labeled *CS2* for Alt2 as shown on Figure 8, and stratigraphy was estimated primarily from soil boring SB-08 and other nearby information. The elevation of the existing ground surface at the cross section location is approximately 957.0 feet. The crest height varies for Alt2. Barr assumed that the crest height at Cross Section 2 was 969.0 feet, which is anticipated to be slightly higher than the actual crest elevation at that location. This location was selected for analysis because of the presence of the silt layer. To evaluate the factors of safety with respect to slope stability and seepage (including heave and erosion) of the cross section, a clay fill levee embankment with a crest width of 10 feet, upstream and downstream side slopes of 4H:1V, and crest elevation of 969.0 feet was analyzed per the provided embankment configuration. Barr examined no flood conditions, normal flood conditions, maximum flood conditions, and rapid drawdown scenarios.

4.2 Seepage Analysis

The main objective of the seepage analysis was to develop an understanding of the seepage flow through and under the levee embankment and its relationship to stability of the embankment slopes. Seepage through an embankment plays a major role in the stability and construction sequence of the embankment. Simulations were made to estimate seepage flow conditions for the proposed embankment.

The seepage simulations presented in this report modeled seepage flow through and under the levee embankment under steady-state conditions and rapid drawdown conditions. The seepage analyses for the hydraulic loading conditions were performed at each of the preliminary design sections identified in Section 4.1. In the analyses, each was evaluated for the final construction configuration (assuming no flood events during the construction process).

4.2.1 Seepage Analysis Background

The seepage analysis used for the levee embankment was conducted using SEEP/W, a computer modeling program developed by GEO-SLOPE International, Ltd. SEEP/W uses the finite-element analysis technique to model the water movement and pore-water pressure distribution within porous materials such as soils. This method was chosen because comprehensive formulation allows evaluation of highly complex seepage problems. SEEP/W can formulate saturated and unsaturated flow, steady-state and transient conditions, and a variety of boundary conditions. Model integration allows the use of seepage files in limit-equilibrium slope-stability analysis. SEEP/W generates an output file containing the heads at the nodes of the finite-element mesh. The integration of GEO-SLOPE products allows the use of the SEEP/W head file in the slope stability program (SLOPE/W) to compute the effective stress. Therefore, it allows evaluation of the seepage impact on stability. SLOPE/W also has an imbedded analysis method to conduct rapid drawdown evaluations.

4.2.2 SEEP/W Parameters

The following sections summarize the hydraulic conductivity parameters selected for seepage modeling (discussed in Section 3.3.7). The main parameter associated with soils relevant to the seepage analysis is the hydraulic conductivity, which is also referred to as permeability. The laboratory testing performed provided estimates of the vertical permeability, but that value was assumed for the horizontal permeability as well, which for well-graded soils is generally appropriate.

4.2.2.1 Shallow Lean Clay

The parameters for the shallow lean clay were assumed based on correlations to the soil type (Das, 2010). A value of 3.28×10^{-9} ft/s (1.00×10^{-7} cm/s) was selected.

4.2.2.2 Embankment Fill

Because the shallow lean clay may be used as the embankment fill, a permeability of 3.28×10^{-9} ft/s (1.00×10^{-7} cm/s) was used for the embankment fill.

4.2.2.3 Fat Clay

The parameters for the fat clay were taken from laboratory testing performed during the geotechnical investigation. The geometric mean of the data was selected for analysis, corresponding to a value of 6.56×10^{-10} ft/s (2.00×10^{-8} cm/s).

4.2.2.4 Silt

The permeability of the silt was evaluated using the Kozeny-Carman formula (outlined in Carrier, 2003), which is based on the grain-size distribution and void ratio. Based on the results of the analysis, the permeability of the silt was estimated to range from 3.51×10^{-5} to 2.26×10^{-5} ft/s (1.07×10^{-3} to 6.88×10^{-4} cm/s). A value of 2.26×10^{-5} ft/s (6.88×10^{-4} cm/s) was selected for silt, which generally agrees with published values for silts as identified in Freeze, et al. (1979).

4.2.2.5 Glacial Till and Reworked Glacial Till

The parameters for the glacial till and reworked glacial till were taken from laboratory testing performed during the geotechnical investigation. A value of 2.03×10^{-9} ft/s (6.20×10^{-8} cm/s) was selected.

4.2.2.6 Summary of Seepage Parameters

All soils were modeled using the "Saturated Only" model type, which assumes all soils used in the model are saturated. A summary of inputs used for seepage modeling is provided in Table 4-1.

Table 4-1 Recommended Seepage Parameters

Material Type	Model Type	Saturated Hydraulic Conductivity cm/s	Saturated Hydraulic Conductivity ft/s
Embankment Fill	Saturated Only	1.00E-07	3.28E-09
Shallow Lean Clay	Saturated Only	1.00E-07	3.28E-09
Fat Clay	Saturated Only	2.00E-08	6.56E-10
Silt	Saturated Only	6.88E-04	2.26E-05
Reworked Glacial Till	Saturated Only	6.20E-08	2.03E-09
Glacial Till	Saturated Only	6.20E-08	2.03E-09

*The anisotropy (Ky'/Kx' ratio) was assumed to be 1.0 for all materials.

4.2.3 Boundary Conditions and Assumptions

Boundary conditions and assumptions for the seepage simulations are as follows:

- Under normal flood conditions, the entire upstream portion of the embankment was modeled as constant total head of 956.0 feet for Alt1 and 966.0 feet for Alt2 (corresponding to the freeboard height, which is assumed to be 3 feet below the planned embankment height).
- Under maximum flood conditions, the upstream portion of the embankment was modeled as having groundwater up to the embankment crest elevation of 959.0 feet for Alt1 and 969.0 feet for Alt2.
- The proposed embankment was assumed to consist of recompacted on-site lean clay collected from the near-surface soil. A compaction level of 95 percent was assumed for the analysis.
- The embankment configurations were modeled as described in Sections 4.1.2 and 4.1.3.

4.2.4 Results of Seepage Analysis

The USACE provides specific guidance in regard to design of seepage control measures for levees in EM 1110-2-569 (2005), "Design Guidance for Levee Underseepage." The cross sections were modeled and analyzed for seepage, exit gradients, heave, and piping/erosion.

The calculated seepage flow through the proposed embankment was assessed to understand if additional seepage measures were required, such as underdrains or filters. The estimated water flux through the entire embankment was estimated based on the modeling results.

The recommended minimum required seepage factors of safety against piping/erosion and heave at the downstream toe of the levee are 1.6 for the normal flood water elevation (equal to the freeboard height) (ETL 1110-2-569, 2005), and a reduced factor of safety of 1.3 for the maximum flood water elevation (assumed to be the top of the embankment) (ETL 1110-2-575, 2011). The factor of safety for piping / erosion was estimated by dividing the critical gradient (buoyant soil unit weight divided by unit weight of water) by the exit gradient (change in total head divided by distance between measured total heads). The exit gradient was calculated between the toe of the embankment and approximately 2 feet below the toe when the embankment is founded on homogeneous materials. Alternatively, if the embankment is founded on low-permeability materials that are underlain by higher permeability materials, calculations were performed across the entire thickness of the uppermost low permeability clay layer.

The factor of safety for piping/erosion was only applied at cross sections where groundwater was passing through the ground surface at or near the downstream toe of the levee embankment. When groundwater was not passing through the ground surface at or near the downstream toe of the levee embankment, only the factor of safety for heave was calculated. The factor of safety for heave is determined by dividing total vertical stress by pore-water pressure at the interface between a high-permeability material overlain by a low-permeability material. Water above the ground surface was accounted for in the heave calculation by subtracting the pore-water pressure at the ground surface from the total vertical stress and pore-water pressure at the interface between the high and low permeability material.

The results from the analysis for piping/erosion, exit gradient, and heave without seepage mitigation are provided in Table 4-2.

Table 4-2 Summary of Factors of Safety for Heave and Erosion of Embankment

Cross Section	Analysis No.	Hydraulic Condition	Downstream Side Slope	Erosion FOS	Heave FOS	Target FOS	Estimated Water Flux Rate Under Embankment [ft^3/sec/ft of embankment]
CS1	2.0	Normal Flood	4H:1V	6.8	2.1	1.6	2.00E-09
	3.0	Maximum Flood	4H:1V	5.9	2.0	1.3	8.15E-09
CS2	2.0	Normal Flood	4H:1V	3.6	1.6	1.6	1.03E-07
	3.0	Maximum Flood	4H:1V	3.0	1.5	1.3	1.32E-07

The results of the piping/erosion and heave factors of safety indicated that both alternatives meet the required factor of safety for all hydraulic loading conditions, and additional considerations during final design to control seepage may not be required.

The results of the analysis at Cross Section 2 for Alt2 indicated that the factor of safety against erosion and heave at the downstream toe of the embankment would meet the required values. At that cross section, a layer of more permeable silt is present interbedded with the cohesive soil. This soil layering was one of the reasons this cross section was selected, as it was perceived to potentially be a risk for lower factors of safety. From a feasibility-level perspective, this cross section has a higher potential for seepage concerns since the factor of safety is near the recommended values.

4.3 Slope Stability Analysis

Two types of stability analyses are typically performed for slopes: the Undrained Strength Stability Analysis (USSA) and the Effective Stress Stability Analysis (ESSA). The USSA case is performed to analyze the case in which loading or unloading is applied rapidly, and excess pore-water pressures do not have sufficient time to dissipate during shearing. This scenario typically applies to loading from, for example, embankment construction where the loading takes place quickly relative to the permeability of the soils. Loading from flood waters also qualifies for USSA scenarios. This is often referred to as the "end-of-construction" case.

The ESSA case is performed to account for much slower loading or unloading, no external loading, or the case where excess pore pressures developed during rapid loading or unloading are fully dissipated, in which the drained shear strength of the materials is mobilized and no excess shear-induced pore pressures are present. Final design cases of embankments and excavated slopes also fall into this case. For this reason, the ESSA is often referred to as the "long term" case.

Both USSA and ESSA analyses were performed as part of the slope stability analysis for each of the hydraulic loadings on each cross section. This is because the initial construction case and flood water levels will cause excess pore-water pressures to develop and undrained shear strengths could be mobilized. Long-term design cases based on very slow or no fluctuation of water levels will generally allow for the possibility of drained shear strengths to be mobilized.

In addition to the USSA and ESSA analyses, Barr analyzed the embankment assuming that the water level dropped rapidly from the normal loading condition. This is considered a rapid drawdown condition, which occurs when the stabilizing pressure of the water on the upstream is lost, but the pore pressures within the levee embankment do not dissipate as quickly. This leads to potential instability of the embankments. It was considered unlikely that the embankment at the site will ever undergo a rapid drawdown from the maximum (crest height) hydraulic conditions to a water level which provides no support.

The stability of a slope is reported using a factor of safety value. The factor of safety is the ratio of the summation of forces and moments that are resisting slope movement to the summation of forces and moments that cause slope movement. These forces and moments could result from increased loading or decreased resistance, which may be caused by variation in pore-water pressure and the buttressing effect induced by changes in river levels. The point of "stability" is defined as a factor of safety equal to 1.0, where the driving forces equal the resisting forces, indicating theoretical failure.

4.3.1 SLOPE/W Parameters

Field and laboratory testing was conducted on native materials from the site to evaluate shear strength parameters under drained and undrained conditions. The following sections summarize the reasoning for the selected parameters.

4.3.1.1 Shallow Lean Clay

The undrained shear strength of the shallow lean clay were estimated from laboratory testing, hand penetrometer testing, and correlations to SPT testing. A summary of the laboratory testing was provided in Section 3.4. The shallow lean clay at the site typically has moderate SPT values and hand-penetrometer values. Hand-penetrometer testing indicated that the undrained shear strength ranged from 250 psf to greater than 4,500 psf, with most values exceeding 1,250 psf. An undrained shear strength of 1,250 psf was used for the shallow lean clay at the site.

The drained shear strength of the shallow lean clay was estimated based on correlations to the soil's plasticity index, provided by Terzaghi et al (1996). Laboratory testing results indicated that the plasticity index for the shallow lean clay ranged from 16 to 18 percent. This corresponds to a friction angle ranging from approximately 31 to 32 degrees. A drained shear strength (i.e., friction angle) of 31 degrees was used for the shallow lean clay.

Under rapid drawdown scenarios, the pore pressure is anticipated to remain elevated, while the buoyant force from the water is removed. Laboratory testing was not extensively performed on the shallow lean clay soil because it is relatively thin at the project site. For rapid drawdown scenarios, the effective stress parameters used for the shallow lean clay were a friction angle of 31 degrees and no apparent cohesion, and the total stress parameters were a friction angle of 30 degrees and an assumed cohesion of 100 psf.

The moist unit weight of the shallow lean clay was estimated to be approximately 110 pcf, and the saturated unit weight was estimated to be approximately 115 pcf.

4.3.1.2 Clay Embankment Fill

The shear strength of the embankment fill was estimated largely on the results of testing for the shallow lean clay soil, which is anticipated to be a suitable borrow source for the project, although a borrow pit location has not been identified at this time.

The drained shear strength of the embankment soils was estimated to be similar to the shallow lean clay, which was based on correlations to the soil's plasticity index, provided by Terzaghi et al (1996). Laboratory testing results indicated that the plasticity index for the shallow lean clay ranged from 16 to 18 percent. This corresponds to a friction angle ranging from approximately 31 to 32 degrees. A friction angle of 31 degrees was used for the clay embankment fill.

The undrained shear strength was assumed to be 1,000 psf for the clay embankment fill. This should be confirmed during final design for the project, once a borrow source has been identified.

The shear strength of the clay embankment fill during rapid drawdown conditions was assumed to be similar to the parameters used for the shallow lean clay. For rapid drawdown scenarios, the effective stress parameters used for the clay embankment fill were a friction angle of 31 degrees and no apparent cohesion, and the total stress parameters were a friction angle of 30 degrees and an assumed cohesion of 100 psf.

The recompacted moist unit weight was assumed to be 110 pcf (assuming that the backfill is compacted to approximately 95 percent of the maximum dry density according to standard Proctor), and the saturated unit weight was estimated to be approximately 115 pcf.

As part of the final design, additional laboratory testing should be performed to develop a more accurate determination of the shear strength of the recompacted clay used for the actual proposed embankment fill material.

4.3.1.3 Silt

For the purposes of this analysis, the silt was treated as a cohesionless drained material, since the clay content was relatively low. The shear strength of the silt was estimated from correlations to SPT testing (Das, 2007).

SPT test results in the silt layers ranged from 2 to 7 blows per foot. Based on the correlation, the friction angle was approximately 28 degrees. A friction angle of 28 degrees was used for both undrained and drained scenarios.

For rapid drawdown scenarios, the effective stress parameters used for the silt were a friction angle of 28 degrees and no apparent cohesion, and the total stress parameter was a friction angle of 27 degrees and a cohesion of 100 psf.

The moist unit weight of the silt was estimated to be 105 pcf, and the saturated unit weight was estimated to be approximately 110 pcf.

As part of the final design, additional laboratory testing should be performed to develop a more accurate determination of the silt shear strength.

4.3.1.4 Fat Clay

The undrained shear strength of the fat clay was estimated from laboratory testing. A laboratory testing summary was provided in Section 3.4. Based on the test results, the fat clay had an undrained shear strength ranging from 680 to 1,240 psf, with an average of 910 psf. The average value of 910 psf was used for analysis.

The drained shear strength of the fat clay was estimated based on laboratory direct shear testing and laboratory consolidated undrained triaxial compressive strength testing. Laboratory direct shear testing was also performed on two intact fat clay samples, which indicated that the peak friction angle ranged from 5.9 to 15.5 degrees. The samples also exhibited an apparent cohesion ranging from 310 to 682 psf.

The failure envelope selected for the fat clay from a laboratory triaxial compressive strength test indicated that the drained friction angle was approximately 24.5 degrees. Plotting all the test results indicated that the behavior was generally similar and matched closely with correlations to the fully softened shear strength developed by Stark and Hussain (2013) at low normal stresses, which depend on the clay fraction and liquid limit. As the triaxial test is considered a more refined test method, the drained shear strength used for analysis was a friction angle of 24.5 degrees.

Under rapid drawdown scenarios, the pore pressure is anticipated to remain elevated, while the buoyant force from the water is removed. A consolidated undrained triaxial compressive strength test was performed on one fat clay sample to simulate these conditions. Using the maximum deviator stress as the failure criteria, test results indicated that the effective friction angle was 24.5 degrees. The effective stress parameter used for the fat clay was a friction angle of 24.5 degrees, and the total stress parameters were a friction angle of 11.7 degrees and a cohesion of 360 psf based on laboratory testing using the maximum deviator stress as the failure condition.

The moist unit weight of the fat clay was estimated from laboratory testing to be approximately 104 pcf, and the saturated unit weight was estimated to be approximately 107 pcf.

4.3.1.5 Glacial Till

The undrained shear strength of the glacial till was estimated from laboratory testing. A laboratory test summary was provided in Section 3.4. Based on test results, the glacial till had an undrained shear strength ranging from 2,550 to 4,360 psf. An undrained shear strength of 2,550 psf was used for analysis.

The drained shear strength of the glacial till was estimated based on correlations to the soil's plasticity index, provided by Terzaghi et al (1996). Laboratory test results indicated that the plasticity index for the glacial till ranged from 16 to 23 percent. This corresponds to a friction angle ranging from approximately 30 to 32 degrees. A friction angle of 30 degrees was used for the glacial till.

Under rapid drawdown scenarios, the pore pressure is anticipated to remain elevated, while the buoyant force from the water is removed. No testing was performed in the intact glacial till, but one consolidated undrained triaxial compressive strength test was performed on a reworked glacial till sample to simulate these conditions, which are considered applicable to the stiffer glacial till. Using the maximum deviator stress as the failure criteria, test results indicated that the effective friction angle was 36.8 degrees, with no apparent cohesion. The effective stress parameters used for the glacial till were a friction angle of 30 degrees and no cohesion, and the total stress parameters were a friction angle of 29 degrees and a cohesion of 1,460 psf, using the maximum deviator stress as the failure condition.

The moist unit weight of the glacial till was estimated from laboratory testing to be approximately 120 pcf, and the saturated unit weight was estimated to be approximately 125 pcf.

4.3.1.6 Reworked Glacial Till

The undrained shear strength of the reworked glacial till was estimated from laboratory testing. A laboratory test summary was provided in Section 3.4. Based on test results, the reworked glacial till had an

undrained shear strength ranging from 1,170 to 1,950 psf. An undrained shear strength of 1,170 psf was used for analysis.

The drained shear strength of the reworked glacial till was estimated based on correlations to the soil's plasticity index, provided by Terzaghi et al (1996). Laboratory test results indicated that the plasticity index for the reworked and stiffer glacial till (since the plasticity was similar) ranged from 16 to 23 percent. This corresponds to a friction angle ranging from approximately 30 to 32 degrees. A friction angle of 30 degrees was used for the reworked glacial till.

Under rapid drawdown scenarios, the pore pressure is anticipated to remain elevated, while the buoyant force from the water is removed. A consolidated undrained triaxial compressive strength test was performed on a reworked glacial till sample to simulate these conditions. Test results indicated that the effective friction angle was 36.8 degrees, with no apparent cohesion. The effective stress parameters used for the glacial till were a friction angle of 30 degrees and no cohesion, and the total stress parameters were a friction angle of 29 degrees and a cohesion of 1,460 psf based on laboratory testing.

The moist unit weight of the reworked glacial till was estimated from laboratory testing to be approximately 110 pcf, and the saturated unit weight was estimated to be approximately 115 pcf.

4.3.1.7 Sand

Because the sand at the project site was very isolated and limited in quantity, analysis was performed for the more typical cases for the project, and sand was not included in the analyses.

4.3.1.8 Summary of Shear Strength Parameters

The soils were treated as Mohr-Coulomb materials in the modeling program using the parameters in the table below:

Table 4-3 Shear Strength Parameters

Material Type	Moist Unit Weight [pcf]	Saturated Unit Weight [pcf]	Drained Condition (ESSA)		Undrained Condition (USSA)		RDD Condition		
			Friction Angle [deg]	Undrained Shear Strength [psf]	Friction Angle [deg]	Undrained Shear Strength [psf]	Total Stress Friction Angle [deg]	Total Stress Undrained Shear Strength [psf]	Effective Stress Friction Angle [degrees]
Embankment Fill	110	115	31	0	0	1000	30	100	31
Shallow Lean Clay	110	115	31	0	0	1250	30	100	31
Fat Clay	104	107	24.5	0	0	910	11.7	360	24.5
Silt	105	110	28	0	28	0	27	100	28
Reworked Glacial Till	110	115	30	0	0	1170	29	1460	30
Glacial Till	120	125	30	0	0	2550	29	1460	30

4.3.2 Stability Analysis

The slope stability analyses were conducted using SLOPE/W, a computer modeling program developed by GEO-Slope International. SLOPE/W uses limit equilibrium theory to compute the factor of safety (FOS) of earth and rock slopes. It is capable of using a variety of methods to compute the FOS of a slope while analyzing complex geometry, stratigraphy, and loading conditions. The pore-water pressure head file produced by SEEP/W during seepage analysis was imported into SLOPE/W to compute effective stress. As a result, this approach incorporates the effect of pore pressures when computing the FOS.

Pore-water pressures for the slope stability calculations are computed from the flow net during the SEEP/W analyses. Therefore, the integration of SEEP/W seepage pore-water pressures in a SLOPE/W analysis results in a more accurate calculation of factor of safety than traditional limit equilibrium software, which uses a phreatic line to simulate groundwater.

4.3.2.1 Factor of Safety Calculation and Requirements

Spencer's method was used to calculate the FOS of the slopes in this stability analysis. This method is typically used because it satisfies both the force and moment equilibrium in determining the factor of safety. For typical long-term conditions (ESSA) under steady seepage without seismic forces, Barr used the minimum recommended factor of safety of 1.5 based on requirements from the NRCS (NRCS, 2005). Barr used the minimum recommended end-of-construction (or short-term case, USSA) factor of safety of 1.3 (NRCS, 2005), where pore pressure within the soil has not dissipated when subjected to a shear force. This is recommended for both upstream and downstream slopes. For the hydraulic loading conditions where the water will reach the height of the embankment crest, a long-term factor of safety of 1.4 was used, since this is considered to be a less-likely loading condition (EM 1110-2-1902, 2003). For the rapid draw down case, where the water drains out quickly but the pore-water pressure remains in the slope, a factor of safety of 1.2 is recommended (NRCS, 2005), assuming that the water is at the freeboard height, which is considered more likely to occur than a significant draw down from the embankment crest height. Rapid draw down conditions from the full embankment height were assumed to not be considered routine for this site and proposed levee embankment alternatives.

Primarily circular potential failure surfaces were used in the analysis. Potential failure surfaces were defined using the entry and exit method. This allows the location of the trial slip surfaces to be chosen manually, or where it is anticipated to enter and exit the ground surface, with a selected number of entry and exit points.

4.4 Results of Slope Stability Modeling

Limit equilibrium stability modeling results are provided in this section. For these modeling scenarios, a minimum slip surface thickness of 2 feet was used, therefore small-scale surface sloughing was not considered in the analysis as surficial failures should not affect overall slope stability (commonly assumed to be the maintenance condition). This global stability case is identified in the summary tables.

The assumptions made for the two cross sections analyzed were provided at the beginning of this section.

4.4.1 Slope Stability Results at Cross Section 1 – Alt1

The analysis for Cross Section 1 at Alt1 was performed for an embankment configuration assuming downstream and upstream side slopes of 4H:1V, a crest width of 10 feet, and a crest height of 959.0 feet. Based on the analyses completed, the dam configuration meets the required factors of safety for all analyzed hydraulic loading scenarios, with the exception of the drained condition under maximum flooding conditions (Analysis 3.1).

The failure envelope used for the embankment fill in the analysis is likely conservative. Use of a modest amount of cohesion in the geotechnical model increased the factor of safety to meet the recommended value (Analysis 3.1a). Therefore, additional strength testing should be performed on the proposed embankment fill material from the final borrow pit location during the final design to verify that the shear strength of the material meets what was estimated in the model.

Table 4-4 summarizes the various analyses performed and corresponding factors of safety.

Table 4-4 Slope Stability Results for Cross Section 1

Analysis No.	Scenario	Upstream Side Slope	Down-stream Side Slope	Upstream Water Elevation	Embank-ment Height [feet]	Downstream FOS	Upstream FOS	Required FOS
1.1 / 1.2	ESSA; No Flood	4H:1V	4H:1V	--	8.1	2.37	2.37	1.50
1.3 / 1.4	USSA; No Flood			--		6.92	6.45	1.30
2.1 / 2.2	ESSA; Normal Flood			956.0		1.50	2.20	1.50
2.3 / 2.4	USSA; Normal Flood			956.0		6.75	10.04	1.30
3.1 / 3.2	ESSA; Maximum Flood			959.0		1.22 (1.45 with 100 psf cohesion)	2.61	1.40
3.3 / 3.4	USSA; Maximum Flood			959.0		6.46	14.44	1.30
4.1	Rapid Draw Down			956.0		--	2.35	1.20

The model outputs for Cross Section 1 are included in Appendix E1.

4.4.2 Slope Stability Results at Cross Section 2 – Alt2

The analysis for Cross Section 2 for Alt2 was performed for an embankment configuration assuming downstream and upstream side slopes of 4H:1V, a crest width of 10 feet, and a crest height of 969.0 feet. Based on the analyses completed, the dam configuration does not meet the required factor of safety for the ESSA case under normal and maximum flood conditions in the downstream direction (Analysis 2.1 and 3.1).

The failure envelope used for the embankment fill in the analysis is likely conservative. Use of a modest amount of cohesion (110 psf) in the geotechnical model increased the factor of safety to meet the recommended level (Analysis 2.1a and 3.1a). Therefore, additional strength testing should be performed on the proposed embankment fill material from the final borrow pit location during the final design to verify that the shear strength of the material meets what was estimated in the model.

Table 4-5 summarizes the various analyses performed and corresponding factors of safety.

Table 4-5 Slope Stability Results for Cross Section 2

Analysis No.	Scenario	Upstream Side Slopes	Down-stream Side Slopes	Upstream Water Elevation	Embank-ment Height [feet]	Downstream FOS	Upstream FOS	Required FOS
1.1 / 1.2	ESSA; No Flood	4H:1V	4H:1V	--	12.0	2.46	2.43	1.50
1.3 / 1.4	USSA; No Flood			--		4.62	4.26	1.30
2.1 / 2.2	ESSA; Normal Flood			966.0		1.23 (1.62 with 110 psf cohesion)	2.30	1.50
2.3 / 2.4	USSA; Normal Flood			966.0		3.52	7.54	1.30
3.1 / 3.2	ESSA; Maximum Flood			969.0		1.05 (1.40 with 110 psf cohesion)	2.79	1.40
3.3 / 3.4	USSA; Maximum Flood			969.0		3.28	9.02	1.30
4.1	Rapid Draw Down			966.0		--	2.43	1.20

The model outputs for Cross Section 2 are included in Appendix E2.

4.4.3 Commentary on Slope Stability Analysis Results

Based on Barr's experience, other slopes constructed on the high plasticity clay of the Red River Valley typically are designed at flatter slopes—on the order of 5H:1V or 6H:1V. To achieve the required factors of safety with more conventional side slopes, significant construction methods would be required to improve or properly construct the slopes and reinforcement may be needed. If Moore decides to pursue these options, Barr can provide guidance, but construction of flatter slopes may be more cost-effective and easier to implement during construction.

The analysis performed to date assumed that steady-state conditions are present, which is considered unlikely to be the case, as the water is anticipated to drain quickly. A transient analysis would more closely represent the anticipated conditions, but additional information would be required to perform the analysis. Transient analyses can also be difficult to calibrate.

The embankments could also be designed using a zoned embankment, or a filter blanket or drain could be used on the downstream slope to draw the phreatic surface away from the downstream face of the

slope. Design and implementation of these methods are considered relatively minor with regard to the cost of the entire structure and are considered appropriate options during final design depending on which alternative is selected for development.

4.5 Settlement of Existing Soils Due to New Embankment

The construction of an embankment on native soil will increase stress on the soils. As mentioned in Section 3.2, the clay soils are likely saturated at shallow depths due to the anticipated shallow water table and high moisture contents. As such, the clay soils are anticipated to experience long-term consolidation settlement, as well as immediate, elastic settlement due to the weight of the fill used to construct the embankment. Barr performed settlement estimations based on the anticipated embankment configurations. Settlement was estimated at the center of the embankment, where the impact of the increased load is greatest. The total settlement of a levee or embankment is not necessarily limited by existing codes, but the total settlement of the embankment should be considered during final design to ensure that the required height of the embankment does not fall to below the anticipated hydraulic conditions (i.e., maximum groundwater height and required freeboard).

4.5.1 Long-Term Settlement from Consolidation Test Results

The subsurface conditions encountered during the field work indicated that the material encountered at the locations of Alt1 and Alt2 generally consists of layers clay and silt. The groundwater, as observed during the soil borings, was as shallow as 11 feet below the existing grade, but may be shallower based on the presence of primarily clayey soils, which due to the low permeability, likely did not allow seepage into the borehole in the short amount of time the borehole was open for measurement of an accurate long-term groundwater level.

The long-term settlement of clay soils supporting the embankment can be computed using consolidation characteristics and the following equation:

$$S = \frac{C_r}{1+e_o} \cdot L \cdot \log\left(\frac{\sigma' p}{\sigma' vo}\right) + \frac{C_c}{1+e_o} \cdot L \cdot \log\left(\frac{\sigma' f}{\sigma' p}\right) \qquad \text{(Das, 2007)}$$

where:

C_r = recompression index
C_c = compression index
e_o = initial void ratio
L = height of soil layer
σ'_p = maximum past effective stress where soil transitions from overconsolidated to normally consolidated
σ'_{vo} = existing effective stress at the midpoint of the clay layer below embankment
σ'_f = final effective stress equal to $\sigma'_{vo} + \Delta\sigma'$, where $\Delta\sigma'$ = average pressure increase to the clay layer caused by the added load

Using this formula, the long-term settlement of an embankment can be calculated. To calculate the consolidation settlement, the soil was split into multiple layers, with the effective stress recalculated at the midpoint of each layer. The stress dissipates at greater depth in the ground according to the Poulos and Davis method (FHWA, 1974). The total depth of calculation was taken as twice the approximate base width of the embankment.

Based on consolidation test results as discussed in Section 3.3.5 and an assumed loading consistent with the embankment design assumed for this report, settlement was estimated for the two cross sections evaluated. Therefore, the analysis consisted of layers of soils with variable compressibility, which closely estimates the in-situ conditions. The parameters selected represent the anticipated properties of the clay soils at the site based on a review of all available laboratory consolidation data.

The results of the consolidation analysis indicated that the estimated total long-term settlement ranged from 5.0 to 6.3 inches, as indicated in Table 4-6.

Table 4-6 Summary of Settlement Analysis

Cross Section ID	Estimated Long Term Settlement at Center of Crest [inches]
CS1	5.0
CS2	6.3

The actual total long-term settlement will likely be slightly higher. The immediate, or elastic settlement, was not considered for this analysis, but will likely be realized during construction. Therefore, the total long-term settlement is estimated to be a maximum of 7 to 9 inches at the center of the embankment, depending on location and embankment height. A minimum 9-inch overbuild would be recommended for settlement concerns (not including freeboard, superiority, etc.).

4.6 Additional Geotechnical Considerations

The following sections describe some additional considerations for further design of the levee embankment alternatives.

4.6.1 Slope Protection

It is recommended that slope protection be utilized for the constructed embankment. The slope protection should be selected to avoid erosion of the newly constructed embankment, particularly along any slope that will be exposed to moving water during flood events. Slope protection could consist of vegetation, rip-rap, or turf reinforcement. Barr recommends use of a more resilient method (i.e., rip-rap or turf reinforcement) on the upstream slope due to the rural location, potential for erosion due to contact with flood waters, and limited inspection anticipated for the project once constructed.

4.6.2 Seismic Site Requirements

The following seismic design criteria are recommended for the design of structures at this site based on the 2012/2015 International Building Code (IBC) (USGS, 2018). The seismic values below are recommended for both Alt1 and Alt2 at the site.

- S_s = 0.050 *g* (Site Class B)
- S_1 = 0.020 *g* (Site Class B)
- Recommended Site Classification: Site Class D

A Site Class D is recommended for foundation design at the site. The above seismic values need to be adjusted accordingly for Site Class D for structural design (if required). However, seismicity in this area is generally low and likely will not control the design.

4.6.3 Cement Type

The results from the tests indicate that the soluble sulfate content ranged from 1,640.0 to 2,360.0 mg/kg, which indicates severe sulfate exposure (ACI, 2014). If concrete structures are used for the project, cement with an exposure class of S2 is recommended.

4.6.4 In-Situ Shrink/Swell Potential

The shrink/swell potential of a soil is related to its liquid limit and plasticity index. Soils with liquid limit values less than 50 and plasticity index values less than 25 are considered to have low shrink-swell potential. Soils with liquid limit values of 50 to 60 and plasticity index values of 25 to 35 are considered to have moderate shrink-swell potential. Soils with liquid limit values greater than 60 and plasticity index values greater than 35 are considered to have high shrink-swell potential (Das, 2007).

Based on laboratory test results, the measured range of liquid limit values was 33 to 107 percent, the measured range of plasticity index values was 18 to 32 percent, and the plasticity index ranged from 4 to 80 percent. Therefore, some soils at the site are considered to have a high shrink-swell potential, particularly those identified as fat clay in the boring logs, which was encountered at some locations as shallow as 2 feet and extended to a maximum depth of approximately 31 feet.

One laboratory swell test was performed on a sample of fat clay and indicated that the maximum free swell was 5.4 percent and the corresponding swell pressure was 0.73 tsf. This corresponds to no potential swell (swell under a loading equal to the overburden stress). As a result, the embankment will provide a higher bearing pressure than simply the overburden stress, and shrink/swell of the subgrade should not affect the embankment design. Care should be taken by the contractor to prevent significant moisture content change during construction to avoid drying and cracking of the soil.

Discussion of shrink/swell potential of the potential fill material is discussed in Section 4.6.7.

4.6.5 Earthwork Shrink-Swell Factor

The soils will have an earthwork shrink-swell factor and this should be considered during determination of final design quantities. A typical preliminary estimate of 15 to 25 percent shrinkage can be used for the feasibility cost analysis.

4.6.6 Frost Depth

The frost penetration depth for the proposed alignment is a depth of 72 inches (US Army, 1992). The frost depth is not anticipated to affect the proposed embankment, but structures or infrastructure associated with the proposed embankment should be protected from frost to a depth of at least 6 feet. As a general recommendation, fill should not be placed on frozen subgrades, and frozen materials should not be used as fill.

4.6.7 Dispersion Potential

Dispersive soils have their parcels disassociate with some amount of particles going into suspension when immersed in relatively still water. Silt and clay particles exhibit dispersion when the repulsive forces between the particles exceed the attractive forces when saturated. These particles are then carried away with flowing water, weakening the soils and creating seepage paths. For embankments and other water-retention structures, the dispersion potential of the foundation and embankment soils should be addressed, as saturation of the soils may lead to dispersion and internal erosion (Maharaj, 2013). Silt and clay soils were observed in the project site soil borings. Silt soils often have a lower fraction of clay particles, lack capillary forces within the soil structure, and are at greater risk for dispersion. In general, the dispersion potential of clayey glaciolacustrine and glacial till is considered to be low due to the higher clay content.

The dispersion potential of the silt was measured through laboratory double hydrometer testing to be approximately 2 percent. According to Elges (1985), dispersion ratios less than 15 percent are considered non-dispersive. Therefore, the silt can be considered non-dispersive based on the available data, although additional testing should be performed during the final design.

In general, the hydraulic loading conditions on the proposed embankment are anticipated to be relatively short, and steady-state conditions may not develop during the short loading periods, which is not considered likely to lead to an internal erosion failure. In addition, the silt layers were observed at depths of 11 to 12 feet below the existing grade and not near the surface. Therefore, the velocity gradient of groundwater at those depths is likely to be very low. Accounting for the available information, the risk of dispersion of the silt is considered low for the project site for the perceived function with no normal upstream pool. Using a properly filtered drainage blanket on the lower portion of the downstream slope would further reduce the potential for piping and internal erosion.

As part of the final design, dispersion potential of the proposed embankment material should be performed.

4.6.8 Selection of Embankment Fill Material

The results of the borings indicate that there is a thin mantle of shallow lean clay underlain by high plasticity fat clay. The shallow lean clay nearer to the surface has lower moisture content and very occasional sand seams, but appears suitable for use as borrow material. However, the limited thickness may not provide enough volume to construct the embankment. It is recommended to construct the embankment out of homogeneous material to avoid differences in soil behavior and performance. Additional borings should be performed to evaluate the potential borrow source and material volume.

The fat clay at the site may be used as fill, but would likely need to be moisture conditioned to dry the material to an acceptable level to be placed. Consideration could be given to placing the material at slightly above the optimum moisture content in order to allow the material to shrink in the event that it dries out. If designed and placed properly, the embankment may not shrink below the desired crest elevation and require a re-build. Conversely, under hydraulic loading events, which are anticipated to be of short durations (although the duration has not been provided to Barr), the embankment should have a low enough permeability such that swelling of the soil should not lead to swelling and cracking. If the fat clay is used, it would be recommended to monitor the crest height of the embankment after completion of construction to ensure that the embankment is behaving as planned.

Use of the fat clay as fill may also require flatter slopes given the high plasticity and lower shear strength of the material. This may lead to a need for more volume to construct the embankments.

5 Summary

5.1 Summary

Barr was retained by Moore to complete a preliminary geotechnical investigation and feasibility-level geotechnical evaluation of the Amenia Levee Embankment Alternatives Alt1 and Alt2. Upon the completion of the field investigation and subsequent laboratory testing, Barr performed geotechnical modeling and evaluation of representative cross sections for each alternative. In addition, Barr analyzed the long-term settlement along the proposed levee embankment alternative.

The results of the analysis indicate that the long-term settlement is estimated to range between about 5 to 7 inches. Actual total settlement will likely be on the order of 7 to 9 inches taking into account immediate elastic settlement.

Seepage and slope stability modeling results indicate that an embankment configuration using 4H:1V downstream side slopes and 4H:1V upstream side slopes for Alt1 and Alt2 is generally suitable pending further laboratory testing to confirm the drained shear strength of the embankment and foundation soil. The computed factors of safety indicate that slope stability and seepage are expected to meet recommended values.

The shallow lean clay should be further evaluated for shear strength and permeability during final design, but this material should be suitable for use as embankment fill. Additional investigation should be performed to identify locations where this material exists based on proximity to whichever alternative is considered. Use of the fat clay will likely result in a need for flatter slopes, which will lead to higher construction costs. The condition of using the fat clay for embankment material was not evaluated for this report.

5.2 Future Geotechnical Investigation and Analysis

As part of the design phase geotechnical investigation, Barr recommends the following program to further evaluate the potential alternatives:

- CPT soundings in between the previously investigated soil borings along the final alignment to a depth of 40 feet.
- Flat plate dilatometer testing (DMT) soundings at locations along the proposed final alignment to a depth of 40 feet to determine settlement estimations.
- Pore pressure dissipation testing (PPD) at locations along the proposed final alignment to a depth of 40 feet to estimate in-situ permeability.
- Soil borings coinciding with select CPT soundings to verify lithology and to collect additional samples for laboratory testing. Conversely the CPT soundings could be performed near the location of the soil borings completed for this investigation.

- Evaluation of hydraulic conductivity of the silt soil along Alt2.
- Soil borings and laboratory testing to evaluate potential borrow sources.
- Installation of standpipe or vibrating wire piezometers along the alignment to determine the long-term groundwater level and monitoring of pore-water pressure during construction.
- Shear and compression wave velocity testing to determine elastic soil parameters.
- Additional seepage and slope stability modeling to verify that the assumptions in this report were correct and to evaluate additional critical cross sections (if necessary).
- Identification and further testing of potentially dispersive soil if identified.
- Evaluation of shrink/swell potential if fat clay is considered for use as embankment fill.
- Evaluation of groundwater control during construction via test pits.

6 Limitations of Analysis

This report is for the exclusive use of Moore Engineering, Inc. Without written approval by Barr, no responsibility to other parties regarding this report is assumed. Barr's evaluation, analysis, and recommendations may not be appropriate for other parties or projects. The proposed designs and analysis provided herein should be considered for preliminary use only and will need to be verified prior to implementation.

No established national standards exist for data retrieval and geotechnical evaluations. Barr has used the methods and procedures described in this report, which generally comply with NRCS recommendations (NRCS, 2005). In performing its services, Barr used the degree of care, skill, and generally accepted engineering methods and practices ordinarily exercised under similar circumstances and under similar budget and time restraints by reputable members of its profession currently practicing in the same locality. Reasonable effort was made to characterize the project site based on the site-specific field work, however, the analyses represent a large area, and variations in stratigraphy, strength, and groundwater conditions from any of the locations at which testing was performed may occur. It is important that engineering and operations personnel regularly observe the pond slopes and embankments and note any changes in strata or water conditions as these may require modification of the mine operation requirements to maintain slope stability. No warranty of the investigation, analysis, or design presented herein, expressed or implied, is made.

7 References

American Concrete Institute, Building Code Requirements for Structural Concrete (ACI 318-14), 2014.

Anderson, Sidney, 2010. "The Newcastle Formation in North Dakota," Montana Geological Society: 20th Annual Conference.

Arndt, Michael, 1977. Stratigraphy of Offshore Sediment, Lake Agassiz – North Dakota. Report of Investigation, North Dakota Geological Survey; No. 60.

Bluemle, John, and Bob Biek, "No Ordinary Plain: North Dakota's Physiography and Landforms", North Dakota Geological Survey, https://www.dmr.nd.gov/ndgs/ndnotes/ndn1.asp, Accessed August 2018.

Carrier, W. D., 2003. "Goodbye, Hazen; Hello, Kozeny-Carman," Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers.

Clayton, Lee, Moran, S. R., and Bickley Jr., W. B., 1976. "Stratigraphy, Origin, and Climatic Implications of Late Quaternary Upland Silt in North Dakota," North Dakota Geological Survey, Miscellaneous Series No. 54.

Das, B. M., 2010. Fundamentals of Geotechnical Engineering, 7th Edition, Cengage Learning.

Das, B. M, 2007. Principles of Foundation Engineering, 6th Edition, Cengage Learning.

Elges, H.F.W.K, 1985. "Problem Soils in South Africa – State of the Art," The Civil Engineer in South Africa 27 (7).

Freeze, R. A., and Cherry, J. A., 1979. Groundwater, Prentice Hall, New Jersey.

Federal Highway Administration (FWHA) Embankment Software Manual, 1974, Poulos and Davis Method.

Harris, Kenneth L., West, S. A., Lusardi, B. A., and Tipping, R. G., 1995. "Quaternary Stratigraphy: Lithostratigraphic Map of the Greater Red River Valley, Minnesota and North Dakota ,"Plate 2, University of Minnesota, Minnesota Geological Survey.

Maharaj, Amrita, and Paige-Green, P., 2013. "The SCS Double Hydrometer Test in Dispersive Soil Identification," Proceedings of the 18th International Conference on Soil Mechanics and Geotechnical Engineering, Paris.

Moore, 2018. Personal communication to Robb Roy. Electronic correspondence on October 30, 2018.

Stark T.D., and Hussain, M., 2013. Empricial Correlations: Drained Shear Strength for Slope Stability Analysis".

Terzaghi, Karl, Peck, R. B., and Gholamreza, M., 1996. *Soil Mechanics in Engineering Practice - Third Ed*., John Wiley and Sons, Inc.

US Army Corp of Engineers, Engineering Manual (EM) 1110-2-1902, Slope Stability, October 31, 2003.

US Army Corp of Engineers, Engineering Manual (EM) 1110-1-1905, Bearing Capacity of Soils, October 30, 1992.

US Army Corp of Engineers ETL 1110-2-569. *Design Guidance for Levee Underseepage*, 2005.

US Army Corp of Engineers, Engineering Manual (EM) 1110-2-575, Evaluation of I-Walls, September 1, 2011.

United States Department of Agriculture, National Resources Conservation Service, 2005. Earth Dams and Reservoirs. Technical Release 60, July 2005.

United States Geological Survey. Design Ground Motions. Accessed March 13, 2019. https://earthquake.usgs.gov/hazards/designmaps/

United States Geological Survey. Quaternary Fault and Fold Database of the United States. Accessed March 13, 2019. https://earthquake.usgs.gov/hazards/qfaults

Rush River – Project Team RCPP/PL 566 Watershed Planning

Rush River -Watershed
Cass County Joint Water Resource District

Economic Appendix

Updated 8/10/2021

Appendix D-3

Tables and Figures

Tables:

Figures

Exhibits

Introduction

This analysis follows the procedures outlined in the Water Resources Council Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G), the Natural Resource Conservation Services Economics Handbook Part 611 – Water Resources, the National Watershed Program Handbook (April, 2014), and Red River Regional Conservation Partnership Program Selection Criteria under PL 83-566 dated 8/23/2019. Unless otherwise noted, all values in the analysis are in 2020 prices and all annual values have been discounted using the Fiscal Year (FY) 2020 federal discount rate for water resources projects of 2.75 percent.

An additional budgeting summary has been added to the end of the report to reflect more detailed design costs and the Fiscal Year (FY) 2020 federal discount rate for water resources projects of 2.75 percent.

Scope of the Study

The initial study included the Rush River Basin but as the meetings with the local planning committee progressed the focus became the town of Amenia, ND. While seeing little historic flooding, FEMA designated the community to be mapped for the first time. The analysis of flooding issues for the FEMA mapping effort identified a fairly substantial area of the community with in the 100-year flood plain. Exhibit 1 shows the floodplain map for the City of Amenia and the study area.

Purpose and Need:

To prevent flood damage to homes, businesses and infrastructure within the City of Amenia from the 100-year (1% chance) recurrence interval event.

The City of Amenia

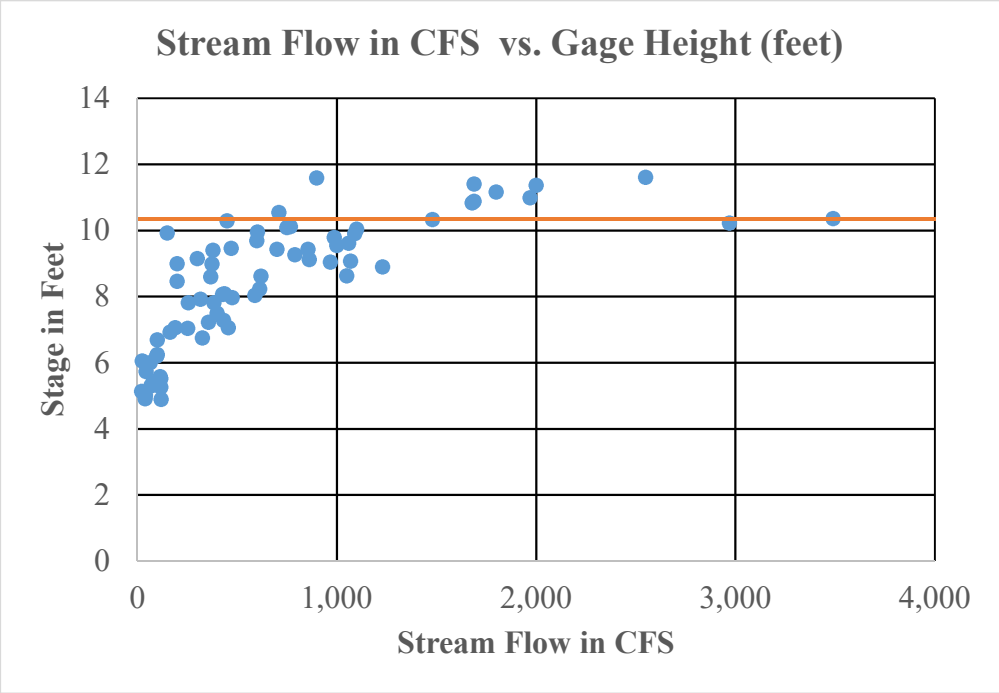
The City of Amenia was founded in 1880 near the home of Eban W. Chaffe a representative of east coast investors from Amenia, New York who looked at the land and an opportunity to participate in the bonanza farming enterprises of that time. The town grew with the addition of a grain mill and depot and by the mid 1880's had a large enough population to attract a church and to build a school.

The population of The City of Amenia reached a recorded peak in 1950 of 127, and currently stands at 96 as of the 2019 census update. Eighty-seven people reported white as their sole race. The community has a broad age distribution of people it cannot be classified as a retirement community nor a young family community. The 2019 census reported that there were approximately 38 occupied residential units. There is no longer a school or church in the community, there is a small building used for government file storage and one business is co located there. Businesses located in Amenia are primarily agricultural service related, and serve a much wider area. Most workers commute by vehicle to jobs outside of Amenia with the average commute estimated at between approximately 21 minutes (2017 American Community Service- ACS). Income is normally distributed with a median income estimated at approximately $74,000 and mean income at approximately $67,000 by the ACS 2017.

The Nature of Flooding

Only one instance of flooding was reported by residents of the community. They have vivid memories of canoeing down the streets in town. While the memory is vivid the date is obscure. They hydrologic and hydraulic analysis estimates the current 50 -year event at 3,365 cfs and the 100 -year event at 4,215 cfs. The highest estimated flow historically was in 1974 at 3,490 just slightly over the 50-year event. However, ice flows and obstructions in the channel have caused 9 or 12% of the historic floods to have elevations higher than the 1974 flood. Figure 1 below shows a plot of the gage data for historic events.

Figure 1



Details on the elevation of those 9 floods below the can be found in the H&H appendix. Based on the anecdotal evidence it is suspected that the remembered flood was either the 1965 or 1969 flood. Gage data for these events may be higher than recorded. There are no actual damage events on which to base the flood damage analysis.

When flooding does occur, it can come directly from the channel north of town or cross country from upstream break outs. The Red River Basin that contains the Rush River is fairly flat and very large floods form a flooded area that looks like the return of Glacial Lake Agassi. From the air the valley looks like a large lake with islands of protected areas. Transportation systems including interstates are inundated often making travel within the valley almost impossible.

The current analysis is based on the FEMA hydrology and hydraulics (H&H) which was the best available at the time of this report. See the H&H appendix for a more detailed discussion.

Floodplain Inventory

To identify the study areas vulnerable properties within the recently mapped FEMA zone A 100 year floodplain and FEMA zone X – outside of the 100 year floodplain but with int the 500 year floodplain were analyzed. There are also some properties in Amenia that are outside of the 500-year floodplain, based on the FEMA analysis. Geographic Information Systems (GIS) tax parcel data was obtained from the Cass County, North Dakota Tax Assessors Offices. The parcels were then allocated using the Assessor's Use Code descriptions into the following categories:

- Residential properties
- Commercial/Industrial businesses (made up of several structures)
- Public (government-owned properties)

The accuracy of the parcels database and Use Codes was verified through a field review, and current photographs of each parcel, and an examination of aerial photography. The structure and type of business was noted.

Structures

Amenia

Exhibit 2 shows the land use in the City of Amenia.

A total of 105 separate structures, with many of them being associated groups of commercial structures, fell within the 500-year floodplain. These structures consist of 41 residential structures (there are three additional structures that are outside the 500 floodplain but within the city boundaries), 16 with basements, 10 commercial properties (there are also some commercial properties and portions of commercial properties outside of the FEMA 500 year boundaries) and 4 vacant residential structures; one 1 public facility and 1 municipal park. An

exterior visual inspection was also done on all properties to estimate the level of the first floor above the ground elevation and to determine whether the structure had a basement and the number of floors.

Those structures are summarized in Table 1.

Table 1 - Parcels by FEMA Flood Zone

Parcels by FEMA flood Zone		
Residential, Business and Public Inventory	**Zone A Parcels**	**Zone X Parcels**
Residential		
No Basement		
One story	9	4
Two story and Split Entry	6	6
With Basement		
One story	5	3
Two story	3	5
Commercial	9	1
Public	2	0
Total	**34**	**19**

Tax assessment data for structure values was validated through field inspection discussions with the County Assessor, a review of current sales and offered properties, and are considered representative of depreciated replacement value. Table 2 sums up the total value of structures in the Amenia 500-year floodplain.

Table 2 - Total value of structures in the Amenia 500-year floodplain

Market Value (Depreciated Replacement Value) of Structures in the Amenia 500-Year Flood Plain		
Structure Type	**Value**	**Percentage**
Residential	$ 3,403,600	33.4%
Garages	$ 111,400	1.1%
Public	$ 8,200	0.1%
Commercial	$ 6,658,220	65.4%
Total	**$ 10,181,420**	**100.0%**

Project Damages and Benefits

Methodology

Based on guidance provided in the in the Red River Regional Conservation Partnership Program Selection Criteria under PL 83-566 dated 8/23/2019 and without a more detailed analysis of the effects of channel blockage and overland flow an abbreviated analysis is used to estimated the benefits for the project. It is the analysis permitted by the above guidance to use the flood insurance data as a proxy for flood damages. For the purpose of this analysis, it is assumed that all businesses and residential properties in Zone A will purchase flood insurance. While those using traditional financing will comply almost immediately there will be a lag time for those that have no current debt relationship with a finance institution. Risk and uncertainty in this methodology will be discussed under the benefit section of the report.

The development of content values in Zone A was done with a mix of interviews for commercial properties and standardized tables. All commercial property owners were contacted by phone and in person if available for interviews. For those that did not respond standardized ratios were used to estimate the content value based on the Table 3. Residential structures were divided into four categories with and without basement, and with one or two stories.

Table 3 - Depth Percent Damage, Content to Structure Value Ratio (CSVR) by Structure Type for the City of Amenia

Depth Percent Damage, Content to Structure Value Ratio (CSVR) by Structure Type For the City of Amenia.		
Description		**CSVR**
1-Story without basement	C	0.46
1-Story with basement	C	0.46
2-Story without basement	C	0.56
2-Story with basement	C	0.56
Split Level	C	0.56
Mobile home	C	0.64
Auto Repair	C	0.7
Beauty Shop	C	1.7
Construction Company	C	0.07
Garage	C	0.068
Office - General	C	1.45
Restaurant	C	0.4
Tavern	C	interview
Warehouse	C	interview

1. Final Report: DEPTH-DAMAGE RELATIONSHIPS FOR STRUCTURES, CONTENTS, AND VEHICLES AND CONTENT-TO-STRUCTURE RATIOS (CSVR) IN SUPPORT OF THE LOWER ATCHAFALAYA REEVALUATION AND MORGANZA TO THE GULF, LOUISIANA FEASIBILITY STUDIES; Dated May, 1997.
2. Analysis for Nonresidential Content Value and Depth Damage Data for Flood Damage Reduction Studies: IWR Report 96-R-12; May, 1996.
3. Final Report DEPTH-DAMAGE RELATIONSHIPS FOR STRUCTURES, CONTENTS, AND VEHICLES AND CONTENT -TO -STRUCTURE RATIOS (CSVR) IN SUPPORT OF THE DONALDSONVILLE TO GULF LOUISIANNA FEASIBILITY STUDY; March, 2006.

Using only those structures in Zone A the structure value and content value is shown in table 4. Included in the commercial total are several large agricultural products and crop input dealers with multiple structure facilities. Interviews with some of those owners indicated that during the

flood season the estimates of the contents at that time of year is equal or in some cases greatly exceed the value of the pole building structure.

Table 4 - Estimated Damages by Event Amenia – Existing Conditions

Structure and Content Value in Zone A to the nearest $100		
Residential, Business and Public Values	**Structure**	**Contents**
Residential	$ 1,590,600	$ 798,000
Commercial/Public	$ 2,187,400	$ 1,839,000
Total	$ 3,778,000	$ 2,637,000

Total Damages Base Year

Estimate Annual Insurance Costs

For the purpose of this analysis, it is assumed that all businesses and residential properties in Zone A will purchase flood insurance. While those with financing will comply almost immediately. Other assumptions will be addressed in the risk and uncertainty analysis.

The most applicable rates for flood insurance can be found in FEMA memo W18021a, dated October 1, 2019, titled "Write Your Own (WYO) Principal Coordinators and the National Flood Insurance Program (NFIP) Servicing Agent" Appendix J Table 2A. Exhibits #3 & #4.

https://nfipservices.floodsmart.gov/sites/default/files/w-18021a.pdf

Annual estimated insurance costs for only those structures in Zone A, the 100-year flood zone, are shown in

Table 5.

Table 5 - Insurance Assuming In Zone A

Insurance Assuming In Zone A	
Using 2020 rate sheet	
Structure	**Without project**
Residential	
Annual Premium	$ 29,600
Administrative Costs	$ 4,200
Subtotal	$ 33,800
Zone A only	**W/0**
Commercial/Public	$ 165,600
Administrative Costs	$ 1,600
Sub Total	$ 167,200
Total All Insurance	**$ 201,000**

This proxy method of analyzing average annual damages for the without project condition estimates that the average annual damages are $201,000.

Benefits Base Year Condition

There are two proposed levee alternatives for Amenia: Alternative 1, the south option shown in Exhibit #5, and Alternative 2, the north option shown in Exhibit #6. Both of these levees will provide protection for the 100-year event and some freeboard protection for the 500-year event. The construction period is one year and the base year for project completion is two years from now given the provision of total construction funding.

Average Annual Benefits for 100-year protection

There is no regulatory requirement for insurance purchase for Zone X. So that portion of the floodplain is not included in either the damages or benefit calculation. It is unlikely that anyone will continue with flood insurance after the project is in place. For this analysis the average annual benefits for either alternative is the benefit of reduced flood insurance payments

is estimated at $ 201,000.

Risk and Uncertainty

Risk and uncertainty in the estimated proxy for damages and benefits comes from a number of factors.

The actual probabilities or risk of stages exceeding those identified by the FEMA study will be completed in the design stage of the project. The available H&H analysis does not account for cross country flow evidence of which can be seen in Google Earth maps for the latest year. Given the trends in the basin it is likely that higher flows and more frequent flooding is a possibility. Until there is a further refinement of the infrequent flood analysis to account for overland flow and channel obstruction flood risk cannot be more accurately assessed which is why the FEMA insurance method was chosen to approximate the damages. The lack of clarity in risk also doesn't allow for an accurate estimate of other damages such as vehicle damages although they likely to occur because of the inundated transportation system makes it unlikely they will be moved.

Uncertainty is present in all economic analysis. The estimate is based on the proxy of insurance costs. There is of course uncertainty as to whether the insurance premiums actually represent the annualized flood damages but that is unknowable without different hydrology. But even if it is an accurate representation of insurable losses it does not represent all losses nor compensating payments. Separate residential garages are not insurable under the national flood insurance program nor is basement content. Therefore, additional losses could be incurred that are not covered by insurance compensation. In addition, because there is no good way at this time to estimate actual damages resulting in insurance pay outs that would be subtracted from this total. There are additional unknowns as to the percentage of structures that would immediately be required to purchase flood insurance. While estimates of residential mortgages in communities are made by the census the formulation and selection of an alternative is not sensitive to the residential portion of the insurance payments. Residential payments could be eliminated from the benefits and the same alternative would still be selected and the project would still be feasible. Commercial insurance payments used are based on the best available information which is the FIA rate table but is likely to be presented as a package with the

individual insurers calculating the overall risk for the property from all perils and including it in a lump sum quote. This is likely unknowable because this is information businesses are unlikely to disclose.

Based on a 50-year project life these benefits support capital costs of $ 6,991,300 at an interest rate of 2.75%, and $ 2,871,400 at an interest rate of 7.0%.

Benefits Future Conditions

The City of Amenia has been fairly stable in population with new houses replacing some of the old and older structures being remodeled. There is no current demand internally or externally to develop the City. Although both alternatives inadvertently protect additional land to provide sound levee design and that does present some opportunity for intensification, other constraints such as sewer and water limitations from fairly new systems represent a significant constraint. No future intensification benefits have been taken for this analysis.

Regional Losses and Benefits

The loss of income to households and increased cost for businesses will ripple through the Cass County economy. A simple analysis of the impact on the Cass County economy was done by Dean Bangsund, a regional economist at North Dakota State University, using the IMPLAN model for Cass County. For the purposes of this analysis the damages were broken into two categories residential and commercial.

Only one commercial sector was selected the warehouse sector which was assumed to be fairly representative of the activity of the largest contributor to the economic loss and similar to other businesses. Buildings included as warehouses are metal pole buildings and large agricultural bins which store agricultural inputs and products which can exceed the value of the structure. It was also assumed that it would be a loss to business expenses not in return to shareholders.

Additional regional losses over and above their direct expenditure in the residential sector were $33,800.

Table 6 - Cass County - Reduction on Regional Household expenditures flood insurance

Cass County - Reduction on Regional Household expenditures flood insurance				
Impact Type	**Employment**	**Labor Income**	**Total Value Added**	**Output**
Direct Effect	0.0	$ -	$ -	$ -
Indirect Effect	0.6	$ 14,000	$ 29,900	$ 43,800
Induced Effect	0.2	$ 3,400	$ 6,000	$ 10,000
Total Effect	**0.8**	**$ 17,400**	**$ 35,900**	**$ 53,800**

The losses in additional expenditures in the business sector assuming a change in operating costs are shown in Table 7.

Table 7 - Cass County - Impact of decreased business spending

Cass County - Impact of decreased business spending				
Impact Type	**Employment**	**Labor Income**	**Total Value Added**	**Output**
Direct Effect	0.0	$ -	$ -	$ -
Indirect Effect	2.0	$ 94,700	$ 140,500	$ 220,600
Induced Effect	0.5	$ 23,200	$ 40,200	$ 68,100
Total Effect	**2.5**	**$ 117,900**	**$ 180,700**	**$ 288,700**

If the assumption is made that administrate costs stayed in the community the RED losses would be approximately 2.8 % lower.

Estimated total annual regional economic loss, including NED loss, equals $ 543,500.

Benefit-Cost Summary

Table #8 presents a summary of project benefits, costs, and benefit-cost ratios applicable to the alternatives considered for implementation and interest rate. The applicable interest rate used for discounting and amortization purposes for 2020 planning studies is 2.75%. A benefit-

cost ratio using a rate of 7% is also presented.

Project costs – Total project cost for Alternative 1, the levee around Amenia, is estimated at $3,282,200. For Alternative 2, the levee along the river, total project cost is estimated at $5,500,000. These costs include the costs of emergency closures during floods. Although it is uncertain when or how frequently they would be used to insure that the costs are covered they were added to the first costs and thus have the greatest impact on the benefit cost ratio. Costs are expressed in October 2020 price level.

Interest during construction – Interest during construction accounts for the opportunity cost of funds set aside during the construction season that could otherwise be applied to alternative investments. The construction season over which this cost is generated is one year in length. The applicable interest rate is 2.75%.

Operation, maintenance, replacement costs – Annual operation and maintenance costs include mowing ($5,000), rodent abatement ($1,000), lift station maintenance ($3,000) and electricity ($1,000). In addition, pump replacements ($50,000 total cost with an annual cost of $2,000 per year) will be necessary midway through the 50-year project life. Lastly, there will be a cost to provide temporary road closure of approximately $25,000 likely occurring once during the project life to provide additional freeboard during a 100 year flood event (with a cost of $1,050 per year for the temporary road closures). In total, these costs amount to $13,050 per year.

Benefit-cost ratio – Of the four alternative/interest rate combinations presented in Table #8, only Alternative 1 at 2.75% appears to be an economically feasible option. This is also the only option with positive Net Benefits, the metric used for the purpose of plan selection.

Table 8 - Benefit – Cost Summary

Benefit – Cost Summary				
	BCRs @ 2.75%		**BCRs @7%**	
Item	**Alt 1**	**Alt 2**	**Alt 1**	**Alt 2**
Project Cost	$ 3,282,200	$ 5,500,000	$ 3,282,200	$ 5,500,000
Interest during Construction	$ 44,800	$ 75,300	$ 112,900	$ 189,700
Total Investment	**$ 3,3247,00**	**$ 5,575,300**	**$ 3,395,100**	**$ 5,689,700**
Int. & Amort. Over 50 years	$ 123,200	$ 207,100	$ 246,000	$ 413,300
Avg. Annual OM&R	$ 13,050	$ 13,050	$ 13,050	$ 13,050
Total Avg. Annual Cost	**$ 136,250**	**$ 220,150**	**$ 259,050**	**$ 426,350**
Avg. Annual Benefits	$ 201,000	$ 201,000	$ 201,000	$ 201,000
Net Benefits	**$ 64,750**	**$ -19,150**	**$ -58,050**	**$ -225,350**
Benefit-Cost Ratio	**1.475**	**0.91**	**0.77**	**0.47**

Alternative 1 is the NED plan and the preferred plan.

Regional Economic Development Benefits

In addition to the prevention of annual losses of $ 543,500 to the regional economy identified above the preferred alternative would provide a one time increase in household income from local labor hired for the project. The estimated labor cost for the project. The labor portion of project costs is estimated to be $594,100. Given that Cass County is the heart of the metro region and contains all of the essential services it is likely that this labor will come from the local area. Unlike the other RED benefits which will be annual these are a one time boost to the local economy.

Table 9 - Cass County - Increase in Regional Household expenditures from local labor for construction

Cass County - Increase in Regional Household expenditures from local labor for construction				
Impact Type	**Employment**	**Labor Income**	**Total Value Added**	**Output**
Direct Effect	0.0	$ -	$ -	$ -
Indirect Effect	0.6	$ 246,400	$ 525,500	$ 769,100
Induced Effect	0.2	$ 60,200	$ 104,400	$ 177,100
Total Effect	**0.8**	**$ 306,600**	**$ 629,900**	**$ 946,200**

Exhibits

Appendix D-3-E

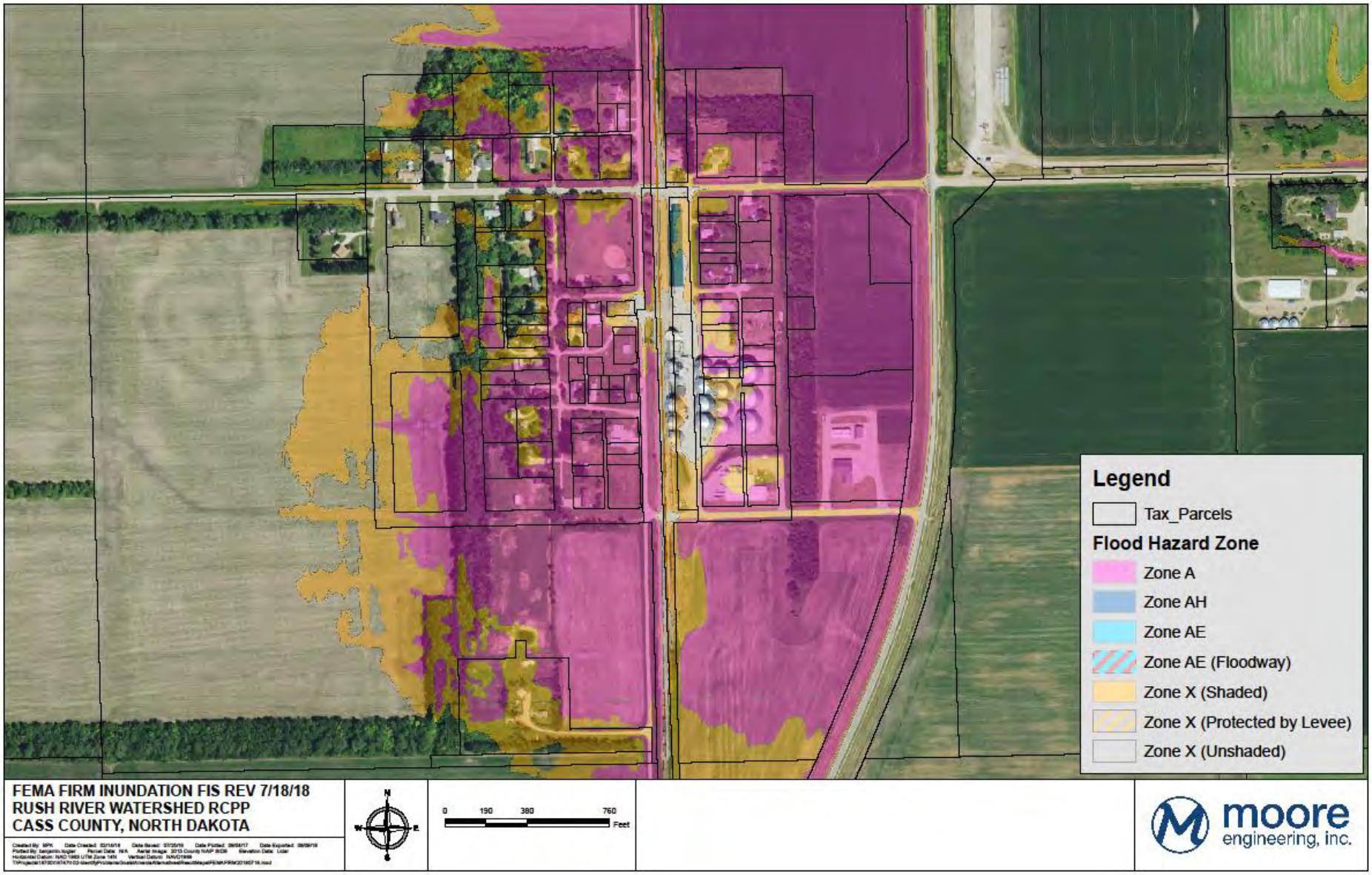

Legend
Tax_Parcels
Flood Hazard Zone
Zone A
Zone AH
Zone AE
Zone AE (Floodway)
Zone X (Shaded)
Zone X (Protected by Levee)
Zone X (Unshaded)
FEMA FIRM INUNDATION FIS REV 7/18/18
RUSH RIVER WATERSHED RCPP
CASS COUNTY, NORTH DAKOTA
N
W
E
0
190
380
760
Feet
moore
engineering, inc.

Exhibit 1

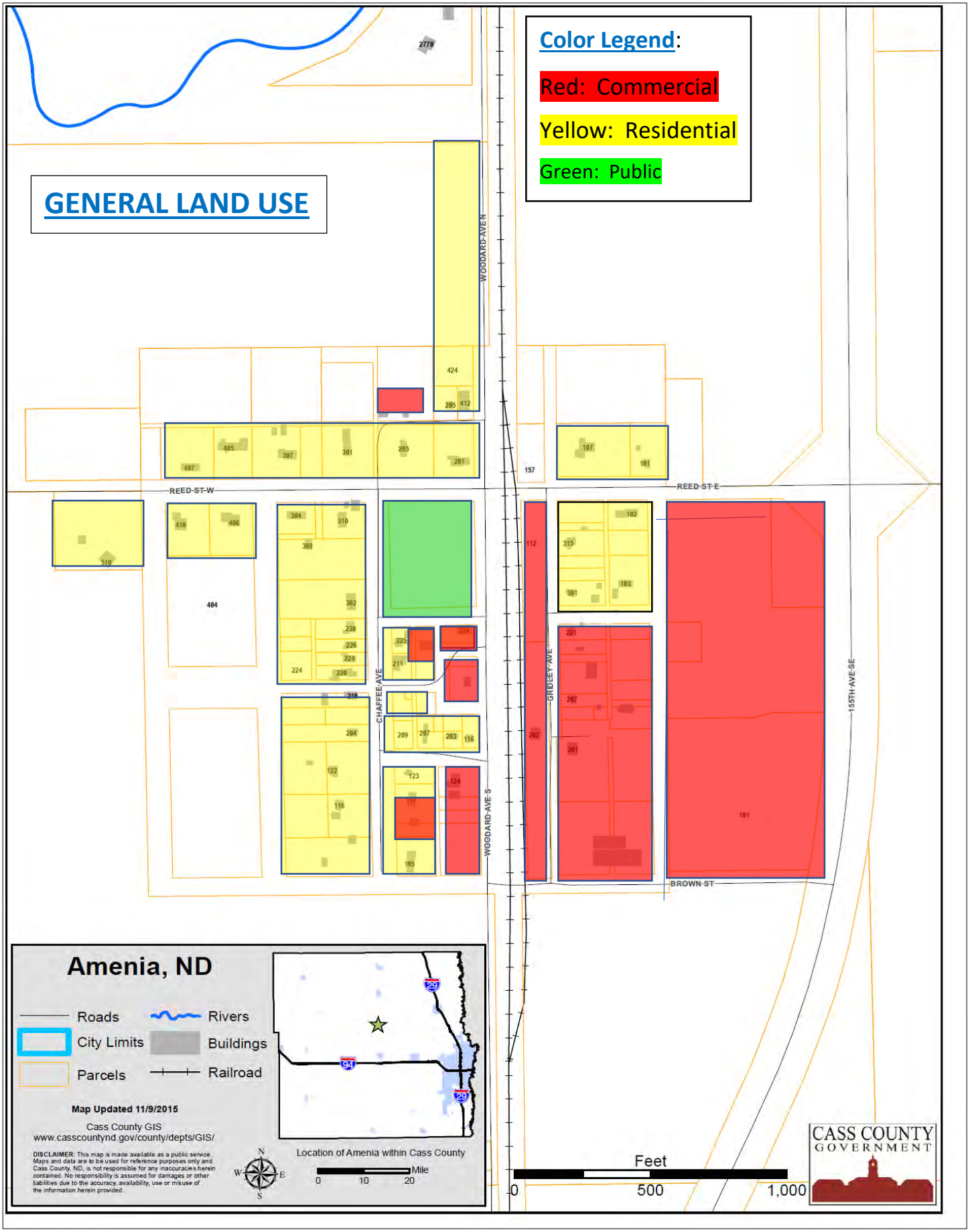

GENERAL LAND USE
Color Legend:
Red: Commercial
Yellow: Residential
Green: Public
WOODARD-AVE-N
REED-ST-W
REED-ST-E
CHAFFEE-AVE
GRIDLEY-AVE
155TH-AVE-SE
WOODARD-AVE-S
BROWN-ST
Amenia, ND
Roads
Rivers
City Limits
Buildings
Parcels
Railroad
Map Updated 11/9/2015
Cass County GIS
www.casscountynd.gov/county/depts/GIS/
DISCLAIMER: This map is made available as a public service. Maps and data are to be used for reference purposes only and Cass County, ND, is not responsible for any inaccuracies herein contained. No responsibility is assumed for damages or other liabilities due to the accuracy, availability, use or misuse of the information herein provided.
Location of Amenia within Cass County
Mile
0 10 20
Feet
0 500 1,000
CASS COUNTY GOVERNMENT

Exhibit 2

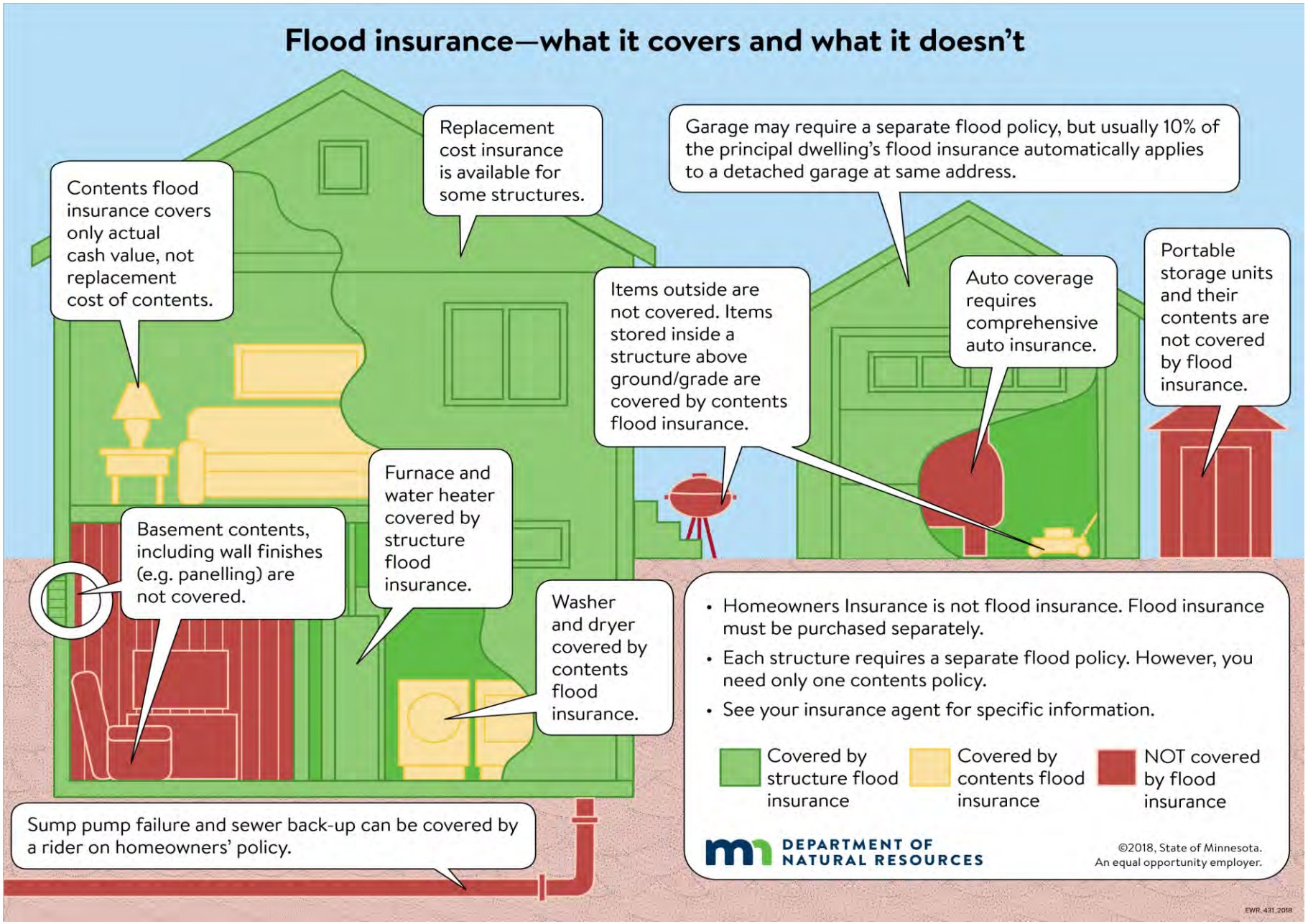

Flood insurance—what it covers and what it doesn't
Contents flood insurance covers only actual cash value, not replacement cost of contents.
Replacement cost insurance is available for some structures.
Garage may require a separate flood policy, but usually 10% of the principal dwelling's flood insurance automatically applies to a detached garage at same address.
Items outside are not covered. Items stored inside a structure above ground/grade are covered by contents flood insurance.
Auto coverage requires comprehensive auto insurance.
Portable storage units and their contents are not covered by flood insurance.
Furnace and water heater covered by structure flood insurance.
Basement contents, including wall finishes (e.g. panelling) are not covered.
Washer and dryer covered by contents flood insurance.
Sump pump failure and sewer back-up can be covered by a rider on homeowners' policy.
• Homeowners Insurance is not flood insurance. Flood insurance must be purchased separately.
• Each structure requires a separate flood policy. However, you need only one contents policy.
• See your insurance agent for specific information.
Covered by structure flood insurance
Covered by contents flood insurance
NOT covered by flood insurance
DEPARTMENT OF NATURAL RESOURCES
©2018, State of Minnesota.
An equal opportunity employer.
EWR-431-2018

Exhibit 3

RATE TABLE 2A. REGULAR PROGRAM – PRE-FIRM CONSTRUCTION RATES[1, 2]

ANNUAL RATES PER $100 OF COVERAGE (Basic/Additional)

FIRM ZONES A, AE, A1–A30, AO, AH, D[3]

	OCCUPANCY	SINGLE FAMILY		2–4 FAMILY		OTHER RESIDENTIAL		NON-RESIDENTIAL BUSINESS[4]		OTHER NON-RESIDENTIAL[4]	
		Building	Contents	Building	Contents	Building	Contents	Building	Contents	Building	Contents
BUILDING TYPE	No Basement/Enclosure	1.12 /1.03	1.41 /1.84	1.12 /1.03		1.12 /2.16		2.36 /4.43		1.22 /2.26	
	With Basement	1.20 /1.51	1.41 /1.55	1.20 /1.51		1.12 /1.80		2.49 /4.32		1.28 / 2.22	
	With Enclosure[5]	1.20 /1.81	1.41 /1.84	1.20 /1.81		1.20 /2.24		2.49 /5.47		1.28 /2.79	
	Elevated on Crawlspace	1.12 /1.03	1.41 /1.84	1.12 /1.03		1.12/2.16		2.36/4.43		1.22 /2.26	
	Non-Elevated with Subgrade Crawlspace	1.12 /1.03	1.41 /1.55	1.12 /1.03		1.12/2.16		2.36/4.43		1.22 /2.26	
	Manufactured (Mobile) Home[6]	1.12 /1.03	1.41 /1.84					2.36/4.43		1.22 /2.26	
CONTENTS LOCATION	Basement & Above[7]				1.41 /1.55		1.41/1.55		4.68 / 7.42		2.39 /3.78
	Enclosure & Above[8]				1.41 /1.84		1.41/1.84		4.68 / 8.90		2.39 /4.52
	Lowest Floor Only – Above Ground Level				1.41/1.84		1.41/1.84		4.68 / 3.89		2.39/ 1.99
	Lowest Floor Above Ground Level and Higher Floors				1.41 /1.28		1.41/1.28		4.68 / 3.31		2.39 /1.71
	Above Ground Level – More Than 1 Full Floor				.35 / .12		.35 / .12		.24/ .12		.24/ .12
	Manufactured (Mobile) Home[6]								4.68 / 3.89		2.39 /1.99

FIRM ZONES V, VE, V1–V30

	OCCUPANCY	SINGLE FAMILY		2–4 FAMILY		OTHER RESIDENTIAL		NON-RESIDENTIAL BUSINESS[4]		OTHER NON-RESIDENTIAL[4]	
		Building	Contents	Building	Contents	Building	Contents	Building	Contents	Building	Contents
BUILDING TYPE	No Basement/Enclosure	1.46 / 2.57	1.81/ 4.39	1.46 / 2.57		1.46 / 4.72		3.14 /10.75		1.63 / 5.46	
	With Basement	1.56 / 3.80	1.81 / 3.72	1.56/ 3.80		1.56 / 7.02		3.31 /15.99		1.71/ 8.10	
	With Enclosure[5]	1.56 / 4.49	1.81 / 4.37	1.56 / 4.49		1.56 / 7.85		3.31 /17.83		1.71/ 9.04	
	Elevated on Crawlspace	1.46 / 2.57	1.81/ 4.39	1.46 / 2.57		1.46 / 4.72		3.14 /10.75		1.63 / 5.46	
	Non-Elevated with Subgrade Crawlspace	1.46 / 2.57	1.81 / 3.72	1.46 / 2.57		1.46 / 4.72		3.14 /10.75		1.63 / 5.46	
	Manufactured (Mobile) Home[6]	1.46/ 8.00	1.81 / 4.37					3.14 /30.38		1.63 /15.36	
CONTENTS LOCATION	Basement & Above[7]				1.81/ 3.72		1.81/ 3.72		6.17 /18.86		3.14 / 9.55
	Enclosure & Above[8]				1.81 / 4.37		1.81 / 4.37		6.17 /20.40		3.14 /10.31
	Lowest Floor Only – Above Ground Level				1.81 / 4.37		1.81 / 4.37		6.17 /17.09		3.14 / 8.66
	Lowest Floor Above Ground Level and Higher Floors				1.81 / 3.84		1.81 / 3.84		6.17 /14.75		3.14/ 7.48
	Above Ground Level – More Than 1 Full Floor				.54 / .47		.54 / .47		.52/ .67		.52/ .67
	Manufactured (Mobile) Home[6]								6.17 /28.41		3.14 /14.37

FIRM ZONES A99, B, C, X

	OCCUPANCY	SINGLE FAMILY		2–4 FAMILY		OTHER RESIDENTIAL		NON-RESIDENTIAL BUSINESS[4]		OTHER NON-RESIDENTIAL[4]	
		Building	Contents	Building	Contents	Building	Contents	Building	Contents	Building	Contents
BUILDING TYPE	No Basement/Enclosure	1.10 / .30	1.69 / .53	1.10 / .30		1.04 / .30		1.04 / .30		1.04/ .30	
	With Basement	1.23 / .42	1.89 / .62	1.23 / .42		1.32 / .42		1.32 / .42		1.32 / .42	
	With Enclosure[5]	1.23 / .46	1.89 / .70	1.23 / .46		1.32 / .46		1.32 / .46		1.32 / .46	
	Elevated on Crawlspace	1.10 / .30	1.69 / .53	1.10 / .30		1.04 / .30		1.04 / .30		1.04/ .30	
	Non-Elevated with Subgrade Crawlspace	1.10 / .30	1.69 / .53	1.10 / .30		1.04 / .30		1.04 / .30		1.04/ .30	
	Manufactured (Mobile) Home[6]	1.10 / .54	1.69 / .53					1.32 / .58		1.32 / .58	
CONTENTS LOCATION	Basement & Above[7]				2.13 / .80		2.13 / .80		2.18 / .87		2.18 / .87
	Enclosure & Above[8]				2.13 / .91		2.13 / .91		2.18 /1.01		2.18 /1.01
	Lowest Floor Only – Above Ground Level				1.69 / .84		1.69 / .84		1.35 / .62		1.35 / .62
	Lowest Floor Above Ground Level and Higher Floors				1.69 / .53		1.69 / .53		1.35 / .43		1.35 / .43
	Above Ground Level – More Than 1 Full Floor				.35 / .12		.35 / .12		.22 / .12		.22 / .12
	Manufactured (Mobile) Home[6]								1.18 / .75		1.18 / .75

1. Pre-FIRM construction refers to a building that has a date of construction or substantial improvement date on or before 12/31/74, or before the effective date of the initial Flood Insurance Rate Map (FIRM), whichever is later. If there has been a lapse in coverage, refer to Table 10, Pre-FIRM Subsidized Rate Ineligibility Determination, to confirm whether Pre-FIRM subsidized rates can be used.
2. Refer to Table 11, Pre-FIRM Rate Table Hierarchy, to determine which Pre-FIRM rate table to use.
3. Pre-FIRM buildings may use Post-FIRM elevation rating if more favorable to the insured. However, when the lowest floor elevation is below the Base Flood Elevation (BFE), follow the Submit-for-Rate procedures for policy processing.
4. For further guidance on Non-Residential Business and Other Non-Residential occupancies, refer to the Before You Start section of this manual.
5. For an elevated building on a crawlspace with an attached garage without openings, use “With Enclosure” rates.
6. Manufactured (Mobile) Homes include travel trailers that meet the definition of a building; refer to Appendix L: Definitions in this manual.
7. Includes subgrade crawlspace.
8. Includes crawlspace.

Exhibit 4

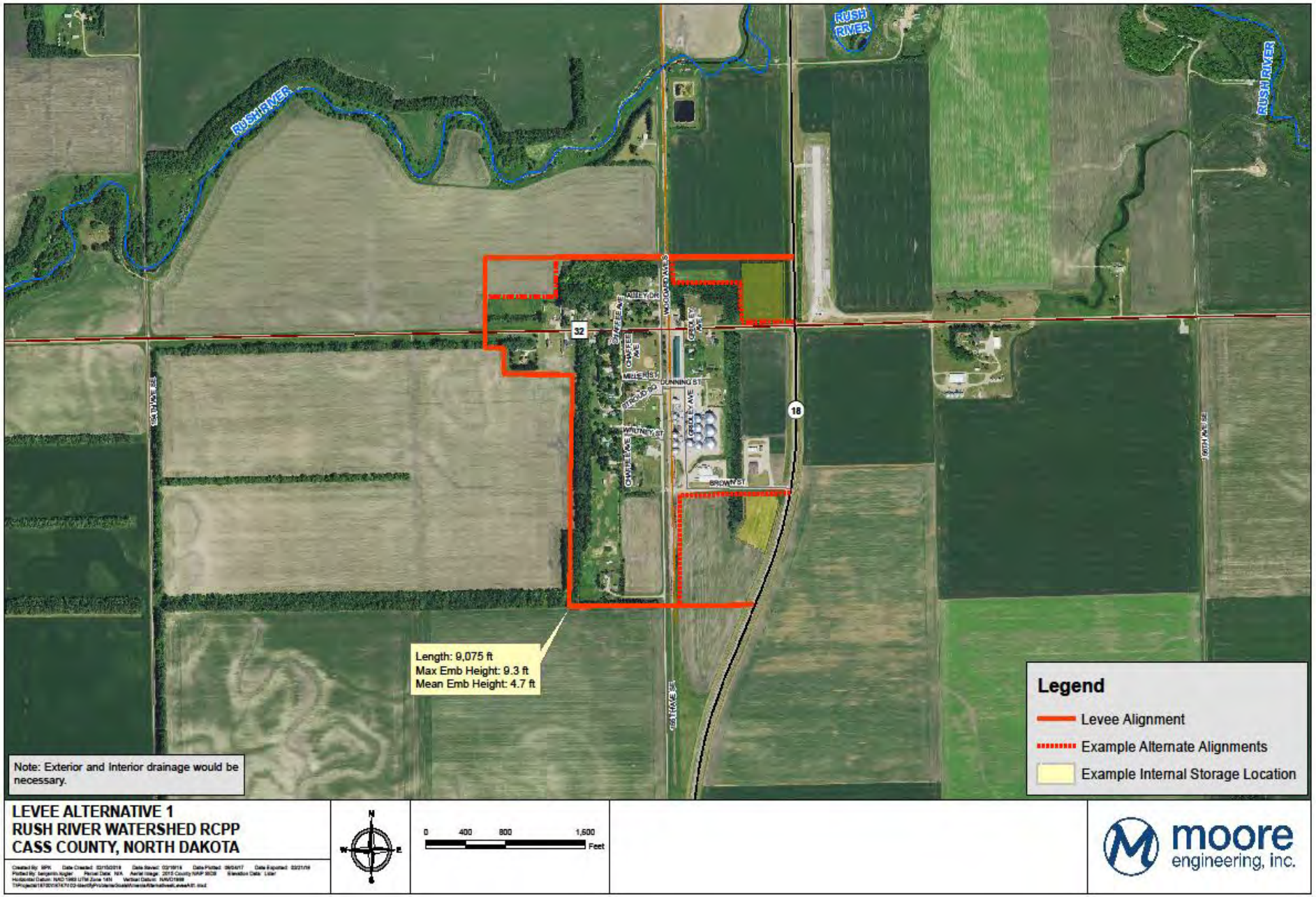

RUSH RIVER
RUSH RIVER
RUSH RIVER
32
18
DUNNING ST
MILLER ST
WHITNEY ST
BROWN ST
Length: 9,075 ft
Max Emb Height: 9.3 ft
Mean Emb Height: 4.7 ft
Note: Exterior and Interior drainage would be necessary.
Legend
Levee Alignment
Example Alternate Alignments
Example Internal Storage Location
LEVEE ALTERNATIVE 1
RUSH RIVER WATERSHED RCPP
CASS COUNTY, NORTH DAKOTA
N
W
E
0
400
800
1,600
Feet
moore
engineering, inc.

Exhibit 5


Length: 10,085 ft
Max Emb Height: 4.9 ft
Mean Emb Height: 2.1 ft
RUSH RIVER
RUSH RIVER
32
18
Note: Levee alignment in relation to stream contingent on geotechnical evaluation.
Legend
Levee Alignment
LEVEE ALTERNATIVE 2
RUSH RIVER WATERSHED RCPP
CASS COUNTY, NORTH DAKOTA
0 400 800 1,600
Feet
moore engineering, inc.

Exhibit 6

Wetland Delineation Report

Amenia, North Dakota

Prepared for
Moore Engineering, Inc.

June 2019

Appendix D-4

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435-4803
Phone: 952.832.2600
Fax: 952.832.2601

Amenia, North Dakota

Wetland Delineation Report

June 2019

Contents

List of Tables

List of Figures

List of Appendices

Note: appendices and some figures have been removed from this report for Appendix D of the EA, however they are available upon request to the ND NRCS.

1.0 Introduction

Barr Engineering Co. (Barr) was retained by Moore Engineering, Inc. to complete a wetland delineation in preparation for evaluation of potential impacts associated with features of a levee system that will be built around the town of Amenia, North Dakota. The proposed project is located west of County Road 18 in Cass County. The evaluation area is within Sections 23, 24, 25, and 26 of Township 141 North, Range 52 West. See **Figure 1** for a project location map.

On May 30, 2019, Barr conducted a wetland delineation within the evaluation area to assist with the planning activities. This Wetland Delineation Report has been prepared in accordance with the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual ("1987 Manual", USACE, 1987), the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (USACE, 2010).

This report includes general environmental information (Section 2.0), descriptions of the delineated wetland area (Section 3.0), and a discussion of regulations and the administering authorities (Section 4.0). The **Tables** section includes the precipitation data. The **Figures** section includes the Site Location Map, Site Topography Map, Water Resources Map (NWI and NHD) Maps, Soil Survey Map, Wetland Delineation Maps, and Hydrologic Connections Map. **Appendix A** includes Wetland Data Forms, site photographs are included in **Appendix B,** and an aerial imagery review is provided in **Appendix C**.

2.0 General Environmental Setting

2.1 Site Description

The wetland evaluation area includes the construction limits for the levee system. The project area is located around the town of Amenia, North Dakota. A majority of the evaluation area consists of active agriculture land (**Figure 1**).

2.2 Site Topography

The topography within the evaluation area and the surrounding area is relatively flat. The evaluation area slopes slightly from west to east. Elevations within the evaluation area ranges from 948 to 956 feet (**Figure 2**).

2.3 Precipitation

Recent precipitation data were compared to historic data for evaluating annual and monthly deviations from normal conditions. Precipitation data were obtained from the Natural Resources Conservation Service, Agricultural Applied Climate Information Service (http://agacis.rcc-acis.org/?fips=38017) for wetlands in Cass County, Township 140 North, Range 49 West, Section 24.

Antecedent (preceding) moisture conditions were above the normal range based on precipitation during the three months prior to the May 30, 2019 site visit (**Table 1**). The annual precipitation for 2017 was below the normal range and the annual precipitation for 2018 was within the normal range. (**Table 2)**.

2.4 National Wetland Inventory and Water Resources

The NWI Map identifies one wetland within the evaluation area (**Figure 3**). The wetland community mapped within the evaluation area is freshwater emergent wetland and is located on the east side of the evaluation area. This wetland is listed with the Cowardin "x" modifier suggesting that this wetland was formed by excavation. The wetland is located in a roadside ditch adjacent to County Road 18. The USGS does not map any rivers, streams, or ditches within the evaluation but does map the Rush River just north of the evaluation area and several tributaries to the Rush River around the evaluation area.

2.5 Soil Resources

Soil information for the project site was obtained from the Natural Resources Conservation Service SSURGO Database. The soil map unit ID is labeled on **Figure 4**. The following table summarizes the associated map unit name, hydric classification presence, and hydric classification rating.

Map Unit ID	Map Unit Name	Hydric Classification Presence (%)	Hydric Classification Rating
I119A	Bearden silty clay loam, 0 to 2 percent slopes	10	Somewhat poorly drained
I233A	Fargo silty clay loam, 0 to 1 percent slopes	100	Poorly drained
I371A	Bearden-Kindred silty clay loam, 0 to 2 percent slopes	15	Somewhat poorly drained
I472A	Perella silty clay loam, 0 to 1 percent slopes	90	Poorly drained
I490A	Glyndon-Tiffany silt loams, 0 to 2 percent slopes	20	Poorly drained
I491A	Glacutt-Fargo silty clay loams, 0 to 2 perecnt slopes	35	Somewhat poorly drained
I507A	Glyndon loam, 0 to 2 percent slopes	8	Somewhat poorly drained
I518A	Overly silt loam, 0 to 2 percent slopes	2	Moderately well drained

3.0 Wetland Delineation

3.1 Wetland Delineation and Classification Methods

Wetlands within the evaluation area were delineated and classified during a site visit on May 30, 2019. The wetland delineation was established according to the Routine On-Site Determination Method specified in the U.S. Army Corps of Engineers Wetlands Delineation Manual (1987 Edition) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (USACE, 2010).

The delineated wetland boundaries and sample points were surveyed using a Global Positioning System (GPS) with sub-meter accuracy (**Figures 5.1 and 5.2 provide the location of each wetland in relation to the evaluation area**).

Wetlands were classified using the U.S. Fish and Wildlife Service (USFWS) Cowardin System (Cowardin et al., 1979), the USFWS Circular 39 system (Shaw and Fredine, 1956), and the Eggers and Reed Wetland Classification System (Eggers and Reed, 1977).

Soil borings were conducted in and around wetland areas, to a depth of at least 24 inches below the ground surface where possible. Representative soil samples from each boring were examined for the presence of hydric soil indicators using the Natural Resources Conservation Service (NRCS) hydric soil indicators (Version 8.1). Soil colors (e.g., 7.5YR 4/2, etc.) were determined using a Munsell® soil color chart and noted on the Wetland Data Forms **Appendix A**.

Hydrologic conditions were evaluated at each soil boring, and this information was also noted on the Wetland Data Forms. The dominant plant species were identified, and the corresponding wetland indicator status of each plant species was determined and noted on the Wetland Data Forms (**Appendix A**). Photographs taken at the time of the site visit are provided in **Appendix B**.

3.2 Wetland Descriptions

Eight wetlands were delineated within the wetland evaluation area. These wetlands consisted of four different community types: deep marsh, shallow marsh, fresh (wet) meadow, and seasonally flooded basin. A description of each wetland is provided below, with representative photographs in **Appendix B**. A Wetland Summary Table is provided in **Table 3**. Wetland IDs are labeled on the wetland delineation maps (**Figures 5.1 and 5.2)**.

3.2.1 Wetland A

Wetland A consists of a network of roadside ditches located north of 28th Street SE and east and west of 155th Avenue SE in the town of Amenia (**Figure 5.1**). This wetland consists of a fresh (wet) meadow and shallow marsh communities. The dominant vegetation in the wetland consists of flat-stem spike-rush (*Eleocharis compressa* – FACW), reed canary grass (*Phalaris arundinacea* – FACW), and narrow-leaf cat-tail (*Typha angustifolia* – OBL). Soils in the wetland typically consisted of loam over clay loam and met the hydric soil criteria for A11 depleted below dark surface and F3 depleted matrix. Wetland A receives hydrology from run off. Hydrology in the wetland varied from saturation at the ground surface to approximately 8 inches of inundation during the May 30th visit. The wetland boundary was typically well defined by a steep change in topography that coincided with a change in vegetation to a smooth brome (*Bromus inermis*) dominated grassland or upland agricultural field. Sampling point SP-2 documents the conditions of Wetland A and sampling point SP-1 documents the adjacent upland conditions. The ditches of this wetland are connected via culverts that flow under roads and driveways. Water generally flows from north to south into the ditch located just north of 28th Street SE. The ditch north of 28th Street SE then flows east into an intermittent tributary that drains into the Rush River east of the evaluation area (**Figure 6**).

3.2.2 Wetland B

Wetland B is a seasonally flooded basin located in an enclosed depression in the northeast part of the evaluation area (**Figure 5.1**). The northern 2/3 of the wetland is located in a tilled agriculture field and no vegetation was present. The vegetation in the southern 1/3 of the wetland consists of eastern cottonwood (*Populus deltoides* – FAC) in the shrub layer and flat-stem spike rush, green ash (*Fraxinus pennsylvanica* – FAC), fowl bluegrass (*Poa palustris* – FACW), and reed canary grass in the herbaceous layer. Soils in the wetland typically consisted of silt loam over clay loam and met the hydric soil criteria for A11 depleted below dark surface. Wetland B receives hydrology from precipitation and overland flow. Hydrology in the wetland varied from saturation at the ground surface to approximately 1 - 2 inches of inundation during the May 30th visit. The wetland boundary was defined by a saturation line in the farmed area and a change to weedy upland species and slightly bermed soils in the southern 1/3. Sampling point SP-3 documents the conditions of Wetland A and sampling point SP-4 documents the adjacent upland conditions.

3.2.3 Wetland C

Wetland C is located in a ditch adjacent to a railroad grade and consists of a deep marsh community (**Figure 5.1**). The vegetation in this wetland was dominated by narrow-leaf cat-tail and reed canary grass. South of the evaluation area the wetland also includes green ash trees. Soils consisted of a mucky silt loam that met the hydric soil criteria for F1 loamy mucky mineral. Wetland C receives hydrology from run off. Hydrology in the wetland was observed as inundation of up to two feet during the May 30th visit. The wetland boundary was typically well defined by a steep change in topography. Sampling point SP-5 documents the conditions of Wetland C and sampling point SP-6 documents the adjacent upland conditions. The wetland slopes to the south but appears to be impounded at the southern end of the wetland. No outlet was observed in the wetland.

3.2.4 Wetland D

Wetland D consists of a fresh (wet) meadow community located in a roadside ditch south of 28th Street SE in the western portion of the evaluation area (**Figure 5.1**). The dominant vegetation in the wetland is reed canary grass. Soils in the wetland typically consisted of sandy loam over clay loam and silt loam and met the hydric soil criteria for F6 redox dark surface. Wetland D receives hydrology from run off. Hydrology in the wetland varied from saturation at the ground surface to approximately 1-2 inches of inundation during the May 30th visit. The wetland boundary was typically well defined by a steep change in topography that coincided with a change in vegetation to a smooth brome dominated grassland. Sampling point SP-8 documents the conditions of Wetland D and sampling point SP-9 documents the adjacent upland conditions. Wetland D flows from west to east along 28th Street SE through a series of culverts under driveways and roads. Wetland D flows north into Wetland A via culvert located east of 155th Avenue SE (**Figure 6**).

3.2.5 Wetland E

Wetland E is a seasonally flooded basin located in a depression in the western part of the evaluation area (**Figure 5.2**). Most of the wetland is located in a tilled agriculture field and did not have any vegetation during the May 30th site visit. The eastern fringe of the wetland was located at the edge of the field and the vegetation in this area was dominated by green ash, European buckthorn (*Rhamnus cathartica* - FACU), and reed canary grass. Soils in the wetland typically consisted of loam over clay loam and met the hydric soil criteria for F6 redox dark surface. Wetland E receives hydrology from precipitation and overland flow. Hydrology in the wetland varied from saturation at the ground surface to approximately 12 inches of inundation during the May 30th visit. The area generally slopes from west to east. There is a slight berm located at the eastern field edge that impounds water in Wetland E. The wetland extends outside of the evaluation area to the southeast into a forested area. Based on a review of topography data and site observations there does not appear a surficial outlet for Wetland E. The wetland boundary was defined by a change in topography and lack of saturation during the site visit.

3.2.6 Wetland F

Wetland F is a seasonally flooded basin located in a depression in the southwestern part of the evaluation area (**Figure 5.2**). Most of the wetland is located in a tilled agriculture field and did not have any vegetation during the May 30th site visit. Soils in the wetland typically consisted of clay loam over silt loam over silty clay and met the hydric soil criteria for F6 redox dark surface. Wetland F receives hydrology from precipitation and overland flow. Hydrology in the wetland varied from saturation at the ground surface to approximately 1 - 2 inches of inundation during the May 30th visit. The area generally slopes from west to east. There is a slight berm located at the eastern field edge that impounds water in Wetland F. Based on a review of topography data and site observations there does not appear a surficial outlet for Wetland F. The wetland boundary was defined by a change in topography and lack of saturation during the site visit.

3.2.7 Wetland G

Wetland G is located in a ditch west of 155th Avenue SE and consists of a shallow marsh community (**Figure 5.2**). The vegetation in this wetland was dominated by flat-stem spike-rush and fowl bluegrass. Soils consisted of a loam over silt loam and met the hydric soil criteria for A12 thick dark surface. Wetland G receives hydrology from run off. Hydrology in the wetland was observed as inundation of up to 12 inches during the May 30th visit. The wetland boundary was typically well defined by a steep change in topography and a change in vegetation to a Kentucky blue grass (*Poa pratensis* – FACU) and dandelion (*Taraxacum officinale* – FACU) dominated grassland. Sampling point SP-14 documents the edge of Wetland G and sampling point SP-15 documents the adjacent upland conditions. The wetland slopes to the north and flows through a series of culverts along 155th Avenue SE. The ditch appears to have intermittent flow to the north and appears to go subsurface.

3.2.8 Wetland H

Wetland H consists of a network of roadside ditches located west of County Road 18 near the town of Amenia (**Figures 5.1 and 5.2**). This wetland consists of a fresh (wet) meadow and deep marsh communities. The dominant vegetation in the wetland consists of fowl bluegrass, flat-stem spike-rush, reed canary grass, narrow-leaf cat-tail, and uptight sedge (*Carex stricta* – OBL). Soils in the wetland typically consisted of clay loam and met the hydric soil criteria for A12 thick dark surface. Wetland H receives hydrology from run off. Hydrology in the wetland varied from saturation at the ground surface to approximately 18 inches of inundation during the May 30th visit. The wetland boundary was typically well defined by a steep change in topography that coincided with a change in vegetation to a smooth brome dominated grassland or agricultural field. Sampling point SP-16 documents the conditions of Wetland H and sampling point SP-17 documents the adjacent upland conditions. The ditches are connected via culverts that flow under roads and driveways. Water generally flows from west to east into the ditch located west of County Road 18, then flows north toward 28th Street SE. Wetland H flow under 28th Street SE via culvert into Wetland A (**Figure 6**).

4.0 Regulatory Overview

The USACE regulates the placement of dredge or fill materials into wetlands that are located adjacent to or are hydrologically connected to interstate or navigable waters under the authority of Section 404 of the Clean Water Act. If the USACE has jurisdiction over any portion of a project, they may also review impacts to wetlands under the authority of the National Environmental Policy Act. The USACE should be contacted before altering any wetlands.

This report requests wetland boundary and type concurrence from the USACE. This submittal also is requesting a jurisdictional determination from the USACE with respect to administration of Section 404 of the Clean Water Act.

5.0 References

Cowardin, L.M., V. Carter, F.C. Golet, and R.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, FWS/OBS079/31, 103 pp.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X.

Shaw, S.P., and C.G. Fredine. 1956. Wetlands of the United States. U.S. Fish and Wildlife Service, Circular 39. 67pp.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2019. Soil Survey Geographic (SSURGO) Database, Version 1.1.

U. S. Department of Agriculture, Natural Resources Conservation Service. 2018. *Field Indicators of Hydric Soils in the United States, Version 8.2*. G.W. Hurt and L.M. Vasilas (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

U.S. Army Corps of Engineers. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region*. March 2010. Wetlands Regulatory Assistance Program.

U.S. Army Corps of Engineers. 1987. *1987 U.S. Army Corps of Engineers Wetland Delineation Manual*. Wetlands Research Program Technical Report Y-87-1 (on-line edition). Waterways Experiment Station, Vicksburg, Mississippi.

U.S. Fish and Wildlife Service. 1956. *Wetlands of the United States Circular 39*. U.S. Government Printing Office, Washington, D.C.

U.S. Army Corps of Engineers and Minnesota Board of Water & Soil Resources. July 1, 2016. *Guidance for Offsite Hydrology/Wetland Determinations*.

Table 1

Antecedent Moisture Conditions Prior to May 30, 2019

Precipitation Worksheet Using NRCS

Precipitation data for target wetland location:

county: **Cass**

nearest community: **Amenia**

township number: **141N**

range number: **52W**

section number: **23, 24, 25, 26**

Aerial photograph or site visit date:

30-May-19

Score using 1971-2000 normal period

values are in inches	first prior month: **Apr-17**	second prior month: **Mar-17**	third prior month: **Feb-17**
estimated precipitation total for this location:	**1.27**	**1.58**	**1.69**
there is a 30% chance this location will have less than:	0.52	0.79	0.34
there is a 30% chance this location will have more than:	1.69	1.4	0.71
type of month: dry normal wet	**normal**	**wet**	**wet**
monthly score	**3 * 2 = 6**	**2 * 3 = 6**	**1 * 3 = 3**
multi-month score: 6 to 9 (dry) 10 to 14 (normal) 15 to 18 (wet)	**15 (Wet)**		

Table 2

Precipitation in Comparison to WETS Data

1971-2000 Summary Statistics													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
30%	0.43	0.34	0.79	0.52	1.61	1.94	1.66	1.51	1.21	0.72	0.49	0.35	18.18
70%	0.98	0.72	1.4	1.69	3.15	4.28	3.51	3.06	2.65	2.37	1.3	0.72	23.79
Average	0.81	0.59	1.17	1.4	2.61	3.51	2.88	2.52	2.18	1.97	1.09	0.59	21.32

Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2000	0.33	0.99	1.77	1.33	2.69	11.72	2.44	3.07	3.64	1.96	4.13	0.69	34.76
2001	0.20	0.74	0.26	2.70	2.88	2.73	3.14	2.19	1.45	2.74	1.00	0.22	20.25
2002	0.21	0.12	1.06	1.26	3.87	4.76	5.65	3.73	1.73	1.44	0.15	0.83	24.81
2003	0.26	0.18	0.63	1.32	4.24	4.56	1.72	1.06	1.40	1.34	0.53	1.18	18.42
2004	0.73	0.72	1.58	0.16	6.22	1.07	4.21	2.01	4.69	3.54	0.05	1.01	25.99
2005	1.12	0.61	0.13	0.87	2.42	8.47	1.06	7.52	1.69	2.39	2.84	1.32	30.44
2006	0.37	0.46	1.22	1.28	1.99	1.34	2.23	2.21	3.91	0.96	0.12	1.06	17.15
2007	0.10	0.73	2.18	3.16	3.87	5.78	1.20	2.39	3.39	1.76	0.09	1.59	26.24
2008	0.09	0.67	0.98	2.33	1.89	6.06	1.78	4.55	5.08	4.46	1.13	1.80	30.82
2009	0.55	1.29	4.62	0.81	1.62	2.93	1.18	2.13	2.06	5.44	0.41	1.85	24.89
2010	1.57	0.86	1.41	1.49	2.69	4.26	4.23	2.76	5.82	1.91	0.73	1.75	29.48
2011	0.90	0.08	1.84	2.02	4.30	4.41	4.35	4.26	0.23	0.94	0.26	0.36	23.95
2012	0.58	0.95	0.78	1.10	1.51	2.50	2.88	0.92	0.12	2.22	0.59	0.37	14.52
2013	0.97	1.22	1.44	2.11	7.16	7.73	0.90	0.39	4.39	4.18	0.40	1.21	32.10
2014	0.77	0.11	0.72	3.43	1.99	5.69	1.64	2.11	2.45	0.33	0.71	0.25	20.20
2015	0.40	0.57	0.30	0.98	7.85	2.75	2.78	1.29	1.23	1.19	1.33	0.64	21.31
2016	0.69	0.30	0.96	2.11	1.42	2.45	5.98	1.56	2.60	2.39	1.80	1.27	23.53
2017	0.98	0.79	0.33	1.40	1.14	2.50	1.06	2.30	2.83	0.77	0.33	0.77	15.20
2018	0.21	0.83	1.93	0.37	1.94	4.03	2.86	2.52	2.50	2.70	0.61	1.13	21.63
2019	0.59	1.69	1.58	1.27	M2.04								

Precipitation data from the Fargo Hector Intl AP station located east of the project area.

"M" values refer to missing precipitation data. "T" values indicate trace precipitation amounts.

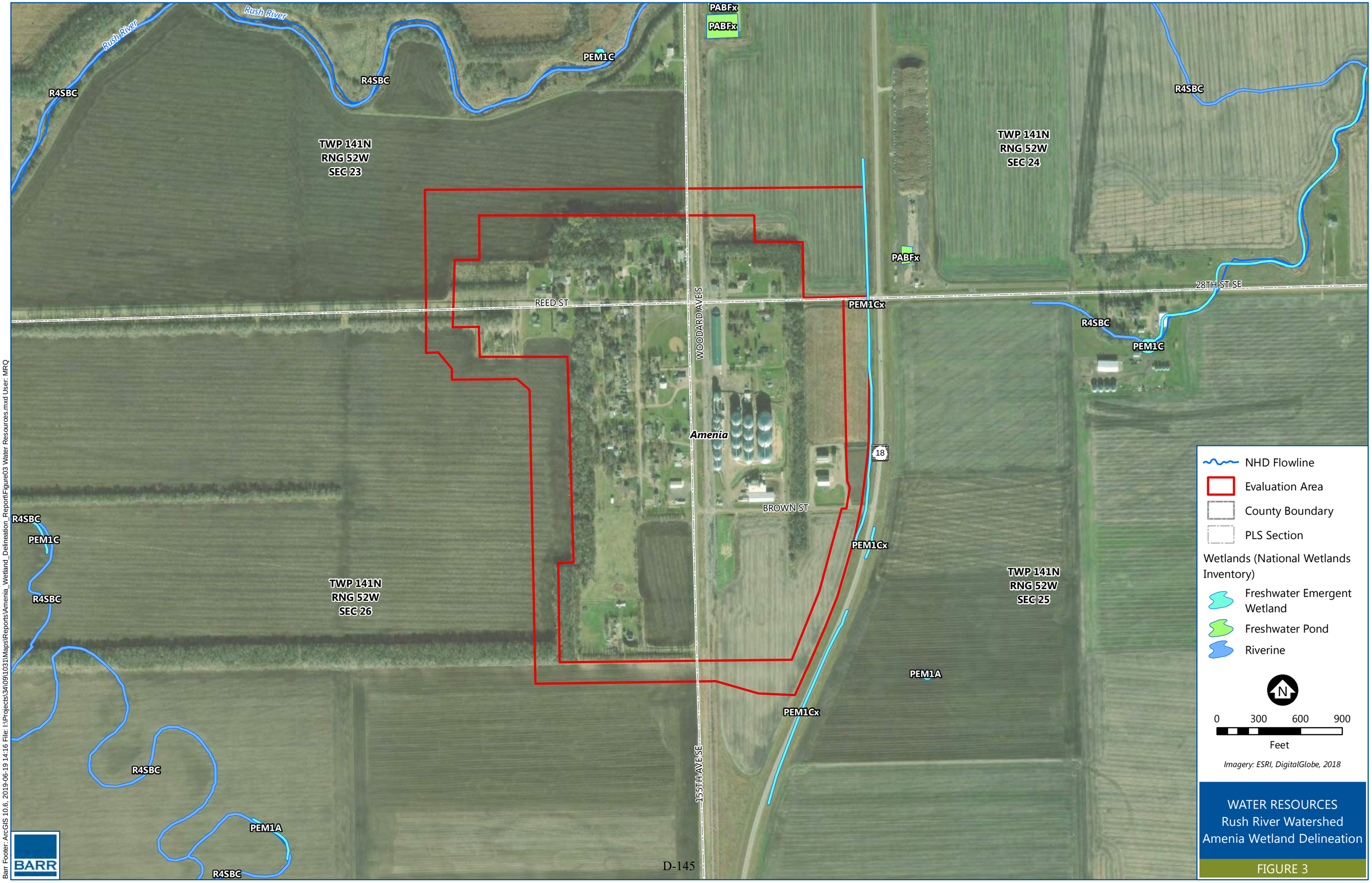
Above normal

Below normal

Normal

Wetland ID	Cowardin	Circular 39	Eggers and Reed	Acres*
A	PEM1B/C	Type 2/3	Fresh (wet) Meadow/Shallow Marsh	0.42
B	PEM1A	Type 1	Seasonally Flooded Basin	0.28
C	PEM1F	Type 4	Deep Marsh	0.10
D	PEM1B	Type 2	Fresh (wet) Meadow	0.02
E	PEMA	Type 1	Seasonally Flooded Basin	1.07
F	PEMA	Type 1	Seasonally Flooded Basin	0.14
G	PEMC	Type 3	Shallow Marsh	0.02
H	PEM1B	Type 2	Fresh (wet) Meadow	0.05
H	PEM1F	Type 4	Deep Marsh	0.05
			Total	2.15

*Area only includes wetland located inside of the evaluation area.



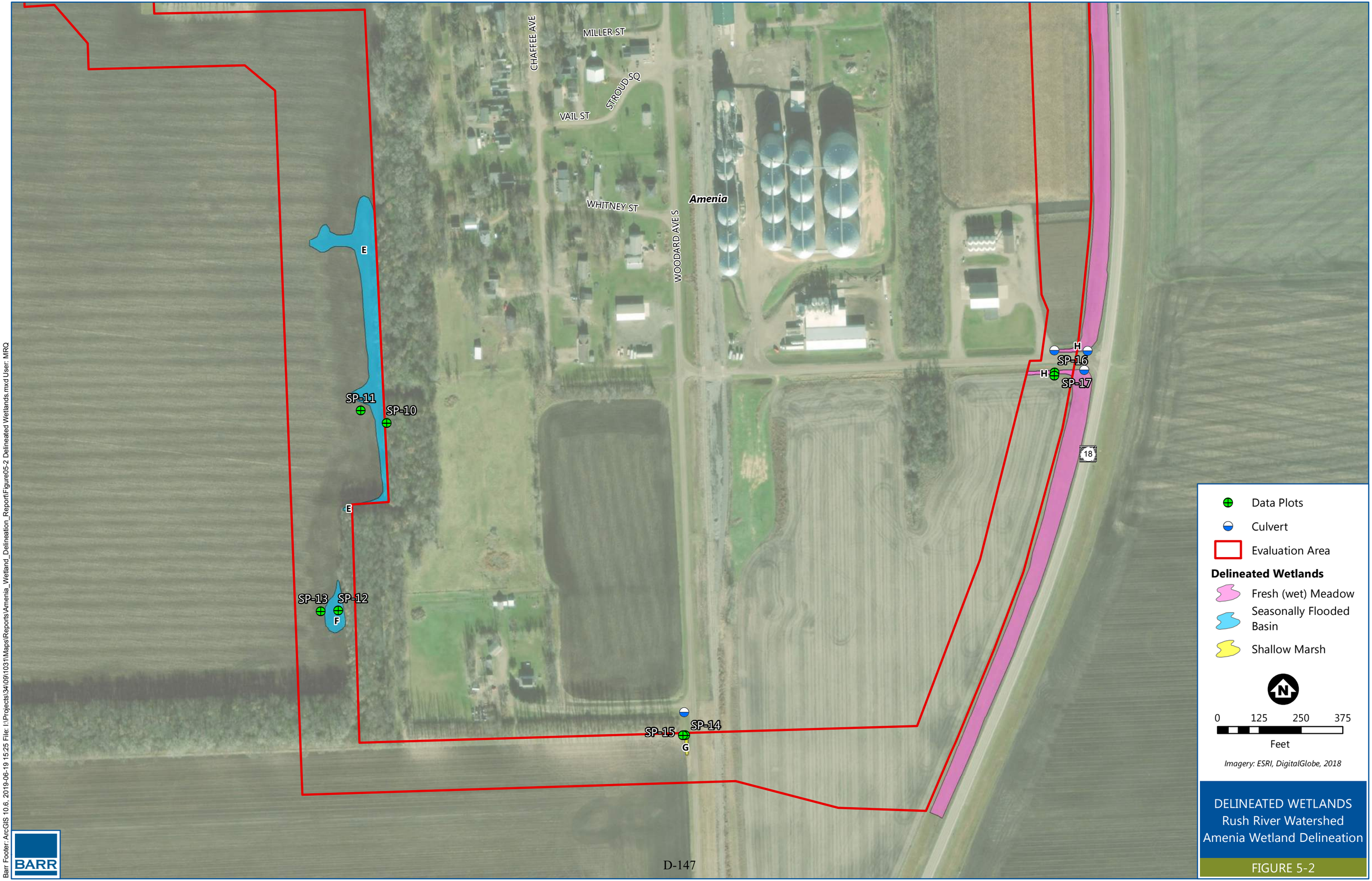
Barr Footer: ArcGIS 10.6, 2019-06-19 14:16 File: I:\Projects\34\09\10\31\Maps\Reports\Amenia_Wetland_Delineation_Report\Figure03 Water Resources.mxd User: MRQ

BARR

WATER RESOURCES
Rush River Watershed
Amenia Wetland Delineation

FIGURE 3


A
A
SP-7
SP-5
SP-6
C
A
B
SP-3
SP-4
WOODARD AVE S
A
SP-2
SP-1
A
18
H
A
SP-8
D
SP-9
REED ST
CHAFFEE AVE
MILLER ST
STROUD SQ
VAIL ST
WHITNEY ST
Amenia
E
Data Plots
Culvert
Evaluation Area
Delineated Wetlands
Deep Marsh
Fresh (wet) Meadow
Seasonally Flooded Basin
N
0
125
250
375
Feet
Imagery: ESRI, DigitalGlobe, 2018
DELINEATED WETLANDS
Rush River Watershed
Amenia Wetland Delineation
FIGURE 5-1
BARR
Barr Footer: ArcGIS 10.6, 2019-06-19 15:15 File: I:\Projects\34109\1031\Maps\Reports\Amenia_Wetland_Delineation_Report\Figure05-1 Delineated Wetlands.mxd User: MRQ


CHAFFEE AVE
MILLER ST
STROUD SQ
VAIL ST
WHITNEY ST
WOODARD AVE S
Amenia
E
SP-11
SP-10
E
SP-13
SP-12
F
SP-15
SP-14
G
H
SP-16
H
SP-17
18
Data Plots
Culvert
Evaluation Area
Delineated Wetlands
Fresh (wet) Meadow
Seasonally Flooded Basin
Shallow Marsh
N
0
125
250
375
Feet
Imagery: ESRI, DigitalGlobe, 2018
DELINEATED WETLANDS
Rush River Watershed
Amenia Wetland Delineation
FIGURE 5-2
BARR
Barr Footer: ArcGIS 10.6, 2019-06-19 15:25 File: I:\Projects\34\09\10311\Maps\Reports\Amenia_Wetland_Delineation_Report\Figure05-2 Delineated Wetlands.mxd User: MRQ

Wetland Functional Assessment for Rush River-Amenia Levee Alternative 1

A wetland delineation was conducted across the project area by Barr Engineering Co. (Barr) on May 30, 2019. Wetlands are located within the Rush River floodplain as well as adjacent to Highway 18 on the east side of the city of Amenia (see Wetland Delineation Report Amenia, North Dakota).

As a follow up to the wetland delineation, field delineated wetlands were assessed using the hydrogoemoprhic approach to wetland functional assessment (HGM) in February 2020. The HGM approach is a method to assess the functional conditions of a specific wetland referenced to data collected from wetlands across a range of physical conditions. Due to the project location within the prairie pothole region, the delineated wetlands were assessed using the NRCS Prairie Pothole HGM Worksheet. The assessment evaluates each wetland on the 6 primary functions of prairie pothole wetlands;

- Water storage
- Groundwater recharge
- Retain particulates
- Remove, convert and sequester dissolved substances
- Plant community residence and carbon cycling
- Faunal habitat

Each wetland function is evaluated in the field and from a desktop perspective. The functions are then scored and given a Functional Capacity Index (FCI) value. The FCI values range from 0 to 1. A score of 0 indicates the wetland has been significantly impacted and no longer functions naturally and 1 meaning the wetland functions naturally. The FCI value is then combined with the wetland area to produce a Functional Capacity Unit (FCU), which in turn provides a basis for determination of impact and mitigation. Each wetland was assessed for its pre-project condition and its projected post-project condition.

The pre-project HGM assessment determined the delineated wetlands have a relatively low functional capacity when compared to other prairie pothole wetlands. Most of the wetlands have been significantly disturbed by agricultural practices or from the creation of roadside ditches. The attached table provides a summary of the FCI and FCU values for each wetland.

A post-project HGM assessment was conducted for wetland impacts associated with Levee Alternative 1 and concluded that the project would result in a loss of functional capacity. Specifically a loss in groundwater storage, removal of dissolved substances, and vegetative diversity. However, the project would also result in an overall increase in nutrient cycling, practical retention vegetative structure, and faunal habitat. This benefit in function would occur as wetlands B and E, two of the largest wetlands would be protected from further agricultural disturbance as majority of the wetland area is located within the leveed area. It is anticipated these wetlands will be reseeded with a native seed mix resulting in an increased wetland function.

In February 2020, the field delineated wetlands were assessed using the hydrogoemoprhic approach to wetland functional assessment (HGM). The HGM approach is a method to assess the functional conditions of a specific wetland referenced to data collected from wetlands across a range of physical conditions. Due to the project location within the prairie pothole region, the delineated wetlands were assessed using the NRCS Prairie Pothole HGM Worksheet. The assessment evaluates each wetland on the 6 primary functions of prairie pothole wetland s;

- Water storage
- Groundwater recharge
- Retain particulates
- Remove, convert and sequester dissolved substances
- Plant community residence and carbon cycling
- Faunal habitat

Each wetland function is evaluated in the field and from a desktop perspective. The functions are then scored and given a Functional Capacity Index (FCI) value. The FCI values range from 0 to 1. A score of 0 indicates the wetland has been significantly impacted and no longer functions naturally and 1 meaning the wetland functions naturally. The FCI value is then combined with the wetland area to produce a Functional Capacity Unit (FCU), which in turn provides a basis for determination of impact and mitigation. Each wetland was assessed for its pre-project condition and its projected post-project condition.

The pre-project HGM assessment determined the delineated wetlands have a relatively low functional capacity when compared to other prairie pothole wetlands. Most of the wetlands have been significantly disturbed by agricultural practices or from the creation of roadside ditches. The attached table provides a summary of the FCI and FCU values for each wetland.

A post-project HGM assessment was conducted for wetland impacts associated with Levee Alternative 1 and concluded that the project would result in a loss of functional capacity. Specifically a loss in groundwater storage, removal of dissolved substances, and vegetative diversity. However, the project would also result in an overall increase in nutrient cycling, practical retention vegetative structure, and faunal habitat. This benefit in function would occur as wetlands B and E, two of the largest wetlands would be protected from further agricultural disturbance as majority of the wetland area is located within the leveed area. It is anticipated these wetlands will be reseeded with a native seed mix resulting in an increased wetland function.

Wetland Functional Assessment Summary

Wetland ID	Functions	Pre Project Assessment			Post Project Assessment			Gain or Loss	
		Wetland Acres	FCI	FCU	Wetland Acres	FCI	FCU	FCI	FCU
A	Static	0.42	0.13	0.05	0.29	0.25	0.07	0.13	0.02
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.13	0.05		0.64	0.19	0.52	0.13
	Removal		0.11	0.05		0.23	0.07	0.12	0.02
	Retention		0.12	0.05		0.49	0.14	0.38	0.09
	Plants		0.23	0.10		0.59	0.17	0.36	0.07
	Structure		0.13	0.06		0.55	0.16	0.42	0.10
	Habitat		0.10	0.04		0.20	0.06	0.10	0.01
B	Static	0.28	0.62	0.17	0.19	0.56	0.11	-0.06	-0.07
	Dynamic		0.47	0.13		0.40	0.08	-0.07	-0.05
	Cycling		0.28	0.08		0.28	0.05	0.00	-0.03
	Removal		0.48	0.13		0.42	0.08	-0.05	-0.05
	Retention		0.29	0.08		0.29	0.06	0.00	-0.03
	Plants		0.52	0.15		0.52	0.10	0.00	-0.05
	Structure		0.29	0.08		0.29	0.06	0.00	-0.03
	Habitat		0.20	0.06		0.20	0.04	0.00	-0.02
C	Static	0.1	0.13	0.01	0.05	0.22	0.01	0.09	0.00
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.13	0.01		0.81	0.04	0.68	0.03
	Removal		0.11	0.01		0.06	0.00	-0.05	-0.01
	Retention		0.12	0.01		0.44	0.02	0.32	0.01
	Plants		0.23	0.02		0.58	0.03	0.34	0.01
	Structure		0.13	0.01		0.57	0.03	0.44	0.02
	Habitat		0.10	0.01		0.52	0.03	0.42	0.02
D	Static	0.02	0.13	0.00	0.01	0.21	0.00	0.08	0.00
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.13	0.00		0.61	0.01	0.48	0.00
	Removal		0.11	0.00		0.09	0.00	-0.03	0.00
	Retention		0.12	0.00		0.50	0.00	0.38	0.00
	Plants		0.23	0.00		0.44	0.00	0.21	0.00
	Structure		0.13	0.00		0.45	0.00	0.32	0.00
	Habitat		0.10	0.00		0.49	0.00	0.39	0.00
E	Static	1.07	0.46	0.49	1.01	0.40	0.40	-0.06	-0.09
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.28	0.30		0.28	0.28	0.00	-0.02
	Removal		0.45	0.48		0.36	0.36	-0.09	-0.12
	Retention		0.29	0.31		0.29	0.29	0.00	-0.02
	Plants		0.47	0.50		0.47	0.47	0.00	-0.03
	Structure		0.22	0.23		0.22	0.22	0.00	-0.01
	Habitat		0.15	0.16		0.15	0.15	0.00	-0.01
F	Static	0.14	0.54	0.08	0.00	0.00	0.00	-0.54	-0.08
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.37	0.05		0.00	0.00	0.00	0.00
	Removal		0.49	0.07		0.00	0.00	-0.49	-0.07
	Retention		0.20	0.03		0.00	0.00	-0.20	-0.03
	Plants		0.49	0.07		0.00	0.00	-0.49	-0.07
	Structure		0.22	0.03		0.00	0.00	-0.22	-0.03
	Habitat		0.15	0.02		0.00	0.00	-0.15	-0.02

Wetland ID	Functions	Pre Project Assessment			Post Project Assessment			Gain or Loss	
		Wetland Acres	FCI	FCU	Wetland Acres	FCI	FCU	FCI	FCU
G	Static	0.02	0.13	0.00	0.00	0.00	0.00	-0.13	0.00
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.13	0.00		0.00	0.00	0.00	0.00
	Removal		0.11	0.00		0.00	0.00	-0.11	0.00
	Retention		0.12	0.00		0.00	0.00	-0.12	0.00
	Plants		0.23	0.00		0.00	0.00	-0.23	0.00
	Structure		0.13	0.00		0.00	0.00	-0.13	0.00
	Habitat		0.10	0.00		0.00	0.00	-0.10	0.00
H	Static	0.1	0.13	0.01	0.04	0.18	0.01	0.05	-0.01
	Dynamic		0.00	0.00		0.00	0.00	0.00	0.00
	Cycling		0.13	0.01		0.60	0.02	0.48	0.01
	Removal		0.11	0.01		0.05	0.00	-0.06	-0.01
	Retention		0.12	0.01		0.25	0.01	0.13	0.00
	Plants		0.23	0.02		0.41	0.02	0.18	-0.01
	Structure		0.13	0.01		0.35	0.01	0.21	0.00
	Habitat		0.10	0.01		0.49	0.02	0.39	0.01

ACREAGE			
	Pre-project (ac)	Post-Project (ac)	Mitigation Required (ac)
A	0.42	0.29	0.13
B	0.28	0.19	0.09
C	0.1	0.05	0.05
D	0.02	0.01	0.01
E	1.07	1.01	0.06
F	0.14	0	0.14
G	0.02	0	0.02
H	0.1	0.04	0.06
Net	2.15	1.59	0.56

FUNCTIONS			
	Pre-project (FCU)	Post-Project (FCU)	Mitigation Required (FCU)
Static	0.83	0.60	0.22
Dynamic	0.13	0.08	0.05
Cycling	0.51	0.59	-0.08
Removal	0.76	0.51	0.24
Retention	0.50	0.53	-0.03
Plants	0.87	0.79	0.08
Structure	0.43	0.48	-0.05
Habitat	0.29	0.30	-0.01

A Class III Reconnaissance Survey

Rush River-Amenia South Levee Alternative Project

Cass County Joint Water Resource District

T141N; R52W, Portions of Section 23, 24, 25 and 26

Cass County, North Dakota

Christopher A. Plount
State Cultural Resources Specialist-East Zone
May 29, 2020

US Department of Agriculture
Natural Resources Conservation Service
North Dakota State Office

Appendix D-5

Abstract:
The Cultural Resources Survey: Rush River-Amenia South Levee Alternative investigates the potential impacts the construction of a pumping plant, levee and diversion system will have on cultural resources and historic properties eligible for listing on the National Register. The undertaking, as designed, completely encircles the town of Amenia, North Dakota, defining the area of potential effect (APE), and includes portions of four Public Land Survey System Sections. The report concludes that there are no known cultural resources nor properties eligible for the National Register of Historic Places within the APE. The undertaking, as proposed, has benefited from a literature review, pedestrian survey encompassing the entirety of the APE, limited shovel probeing and produced no cultural material. Therefore, a finding of "***No Effect***" to historic properties is recommended.

Table of Contents

Figures and Tables

Project Title: Rush River-Amenia South Levee Alternative
Legal Location: T141N; R52W, Portions of Section 23, 24, 25 and 26
County: Amenia Township**,** Cass County
USGS 7.5' Quadrangle: Arthur, North Dakota 2018
Personnel: Christopher A. Plount (Principal Investigator), Joshua Monson (Fargo District Conservationist), Pat Downs (Moore Engineering Representative).
Proposed Total Acres Surveyed: Approx. 133 linear acres

Project Description:
Construction of a pumping plant, levee and diversion system to control potential flooding. NRCS Practice 587 (Water Control), 356 (Dike), 362 (Diversion) listed in Appendix B.

Introduction:
The USDA Natural Resources Conservation Service North Dakota (NRCS) desires to construct a water pumping facility and associated control structure encircling the town of Amenia, North Dakota. The town has recently been mapped by the Federal Emergency Management Agency into a high-risk flood zone and the increased probability of flood damage will be alleviated by the construction of the proposed undertaking.

On May 19, 2020 the State Cultural Resources Specialist-East Zone completed a pedestrian survey and limited shovel testing of the APE. Representatives of the NRCS Fargo Field Office and Moore Engineering were present. Several sites listed with the North Dakota State Historic Preservation Office and located within the area of potential effect (APE) are destroyed or unlocatable due to generalized site form data. A literature review was conducted in 2016 by SWCA Environmental Consultants (Appendix A) and its findings were reconfirmed by NRCS in 2020.

Research Goals and Methods:
Historic maps, topographic maps, literature review, oral histories and in person interviews were combined with LiDAR, satellite imagery and engineering plans to pinpoint areas of interest. Field reconnaissance was designed to achieve four goals:

- Positive location and identification of known cultural resources.
- Discovery and recordation of unknown cultural resources.
- Field assessment of NRHP eligibility of any cultural resources.
- Determine effects of the undertaking on any NRHP eligible properties.

Environment:
The project is in western Cass County, North Dakota within the boundaries of glacial lake Agassiz and east of the Pembina Escarpment. The proposed APE is south of the Rush River channel which has been heavily modified by both natural and anthropogenic forces since the original 1874 mapping (Figure 1). Clay loam (I518A) and silty loam (I490A) soils dominate the area (Figure 2, Table 1) and rest above deeply buried glacial sediment of the Coleharbor Group (Bluemle, 1977). The thick lake bottom clay is impregnated with humic material primarily of historic agricultural origin. The material includes domesticated varieties of corn, soy and sugar beets. Elevation of the APE is relatively constant at 945 feet above sea level.

Native flora and fauna are negligible due to the heavy agricultural use of the APE but, as of 20 May 2020, no known Native American traditional medicine or culturally significant plants needing protection are known to be in the area (NRCS-Plants 2020). Faunal resources include White-tailed Deer (*Odocoileus virginanus*), common rabbit (*Leporidae*), racoon (*Procyon lotor*), common pheasant (*Phasianidae*) and turkey (*Meleagridinae*).

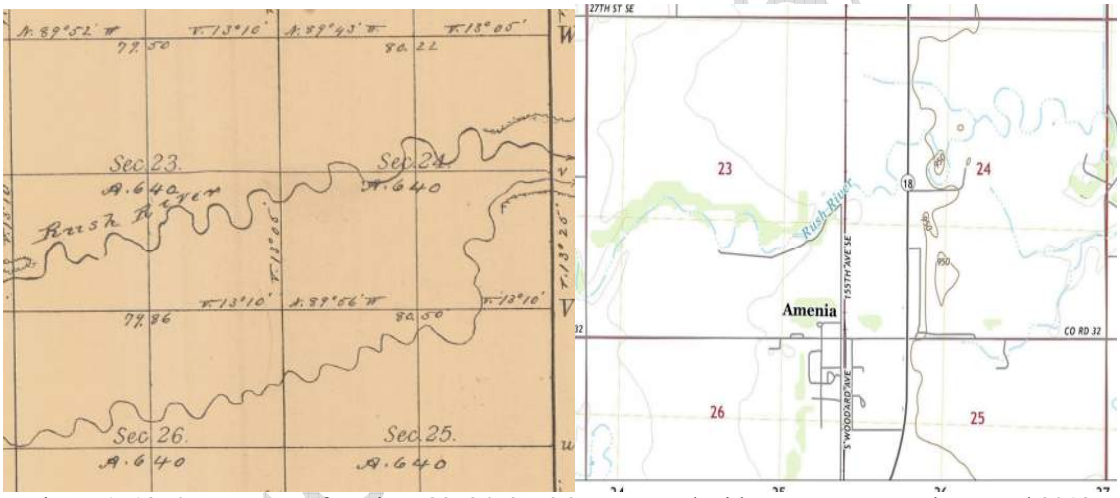


Figure 1: 1874 GLO map of sections 23, 24, 25, 26. Compared with USGS Topo Arthur Quad 2018
Source: North Dakota State Water Commission Archives; USGS Topo View

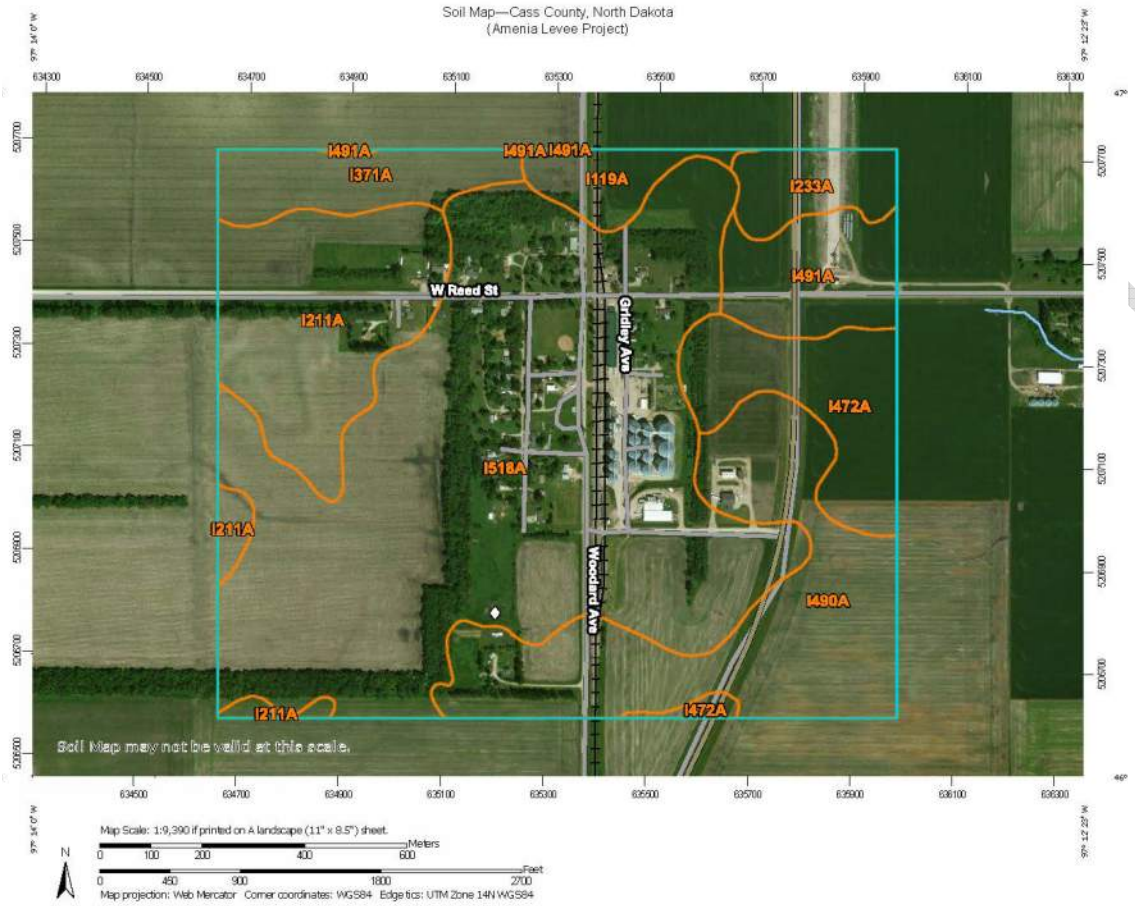


Figure 2: Soil Map of Amenia APE. Map expands beyond APE for clarity.
Source: USDA Web Soil Survey

Soil Type	Soil Classification	Total Acres On Map	Percentage Of Acres
I119A	Bearden silty clay loam, 0 to 2 percent slopes	8.8	2.4%
I211A	Wyndmere loam, 0 to 2 percent slopes	46.3	12.7%
I233A	Fargo silty clay loam, 0 to 1 percent slopes	10.9	3.0%
I371A	Bearden-Kindred silty clay loams, 0 to 2 percent slopes	16.5	4.5%
I472A	Perella silty clay loam, 0 to 1 percent slopes	25.8	7.1%
I490A	Glyndon-Tiffany silt loams, 0 to 2 percent slopes	59.6	16.3%
I491A	Galchutt-Fargo silty clay loams, 0 to 2 percent slopes	18.5	5.1%

I518A	Overly silt loam, 0 to 2 percent slopes	178.8	49.0%
Totals for Area of Interest		**365.2**	**100.0%**

Table 1: Soil types of the APE
Source: USDA Web Soil Survey

Literature Review and Reconnaissance Inventory:
The APE is mixed use industrial-agricultural-residential. Residential structures are concentrated in the NE, NE of Section 26 and industrial structures in the NW, NW of Section 25. The APE is bisected by the Burlington Northern Railway. The area has been subjected to heavy ground disturbance through intensive agricultural production, demolition of structures deemed no longer of use, building of residential homes on the footprint of prior structures and the construction of industrial infrastructure, county roads and state highways (Figure 2).

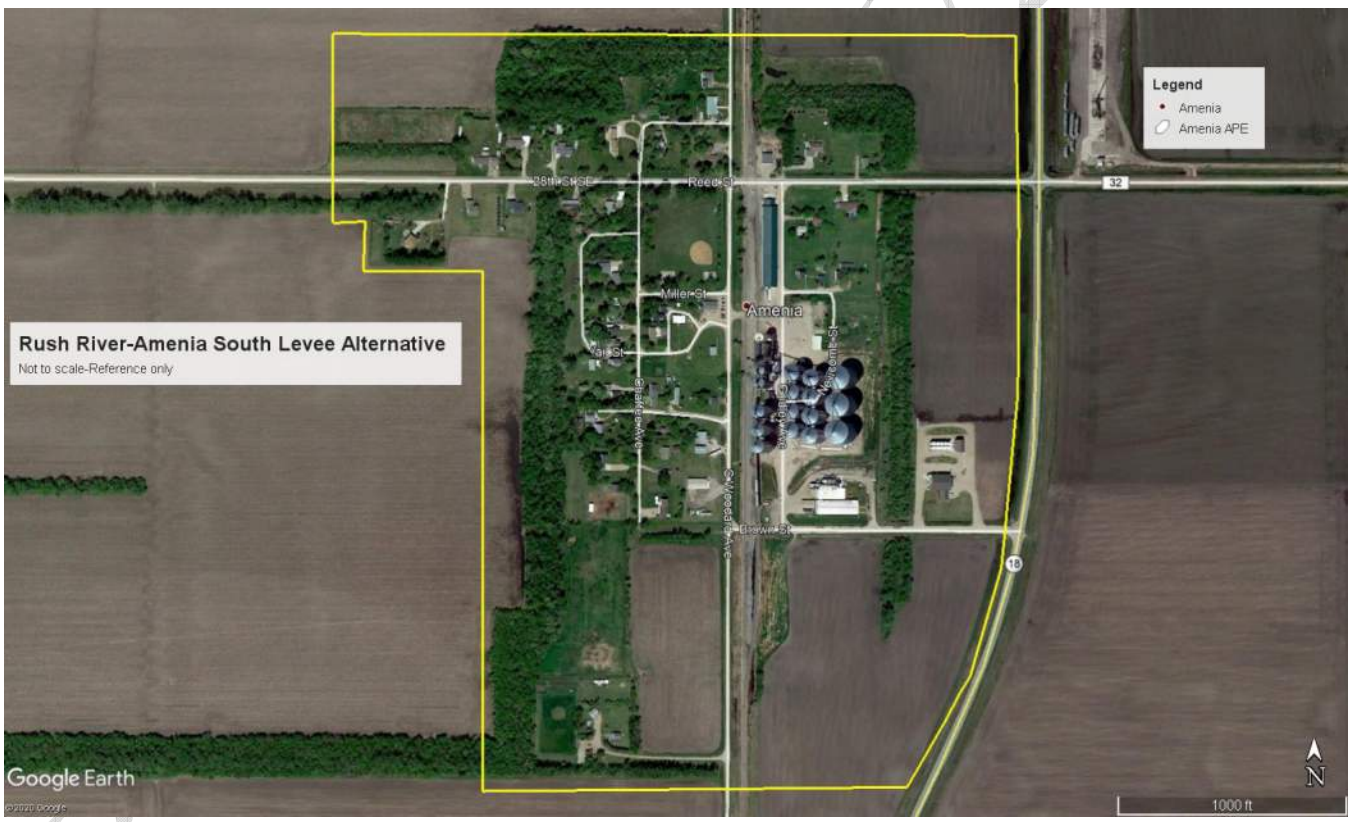


Figure 2: 2018 satellite imagery showing present day Amenia.
Source: Google Earth, 2019.

In 2016 SWCA Environmental Consultants (SWCA) reported that there are seven sites within the APE. The age of the report necessitated a secondary search of NDSHPO records. The search conducted on April 7, 2020 confirmed the findings of the SWCA report. See Table 2, 3 and Figure 3 for APE detail and Appendix C for germane site forms.

Site	Location	Description	Eligibility
32CS7	T141N, R52W, S26	BURLINGTON NORTHERN PACIFIC DEPOT	NOT ELIGIBLE
32CSX142	T141N, R52W, S25	SITE LEAD	NOT ELIGIBLE
32CSX143	T141N, R52W, S25	BURLINGTON NORTHERN SITE LEAD	NOT ELIGIBLE
32CSX144	T141N, R52W, 25	CHAFFEE BONANZA SITE LEAD	NOT ELIGIBLE
32CSX145	T141N, R52W, S26	AMENIA TOWNSITE LEAD	NOT ELIGIBLE
32CS196	T141N, R52W, S26	LUTHERAN CHURCH	NOT ELIGIBLE
32CS5120	T141N, R52W, S23	DWELLING, SINGLE UNIT	UNEVLAUATED

Table 2: Known sites.

MANUSCRIPT NUMBER	AUTHOR	TITLE	SITE WITHIN 1 MILE OF APE
006449	BORCHERT, JEANI L.	North Dakota Department of Transportation Safety Project Cultural Resource Review 1992-1994	N
017394	SNORTLAND BANKS, DIEDRA	Cass County Electric Cooperative's Arthur Service Center AR604 Electric Line: A Class III Cultural Resource Inventory in Cass County, North Dakota	N

Table 3: NDSHPO Manuscripts.

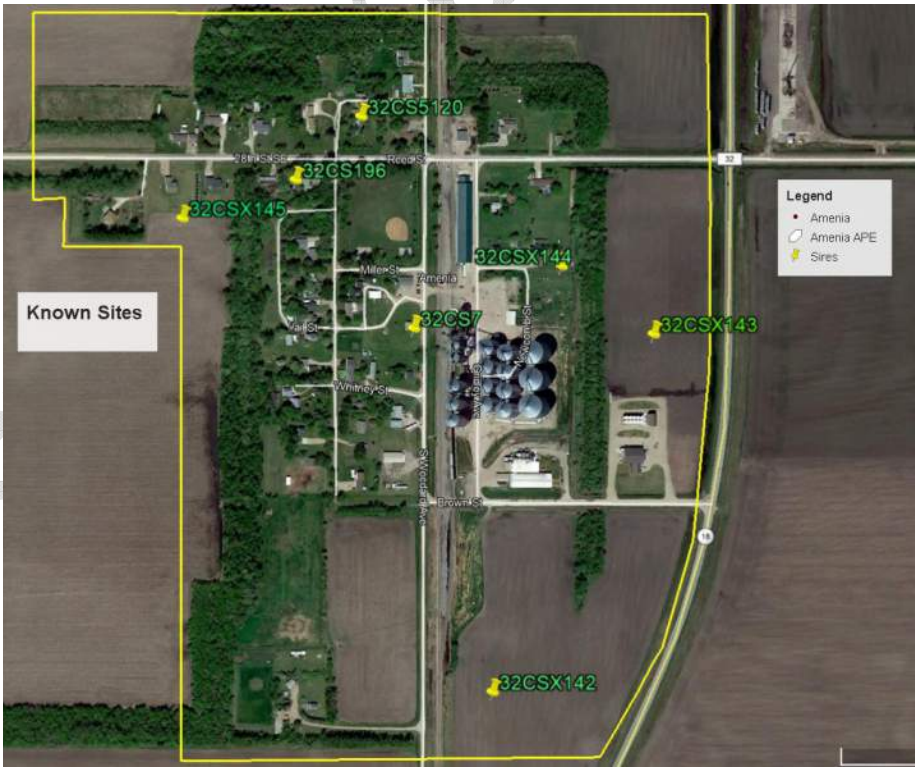


Figure 3: Known sites within the APE
Image Source: Google Earth 2020

Engineering plans (Appendix B) show that there will be no direct effect to NRHP eligible properties and will provide a protective barrier from potential flooding. Known sites and the undertaking's effcts are as follows:

32CS7-
Northern Pacific Depot Burlington Northern: Site form update October 11, 2016 states that structure burned down in approximately 1990.

Undertaking Assessment-No effect.

32CSX0142-
Unknown Site Lead- Site is an active agricultural field. Pedestrian survey revealed no sign of precontact or historic cultural resources. LIDAR imagery (Figure 4) revealed no subsurface structures such as cellars or foundations.

Undertaking Assessment- No effect.

Report continues next page.

Figure 4: Approximate location of 32CSX142
Image Source: North Dakota State Water Commission

32CSX143-
Amenia Burlington Northern: Site form describes exterior boundaries encompassing the entirety of the NW 1/4 of Section 25. The site form, authored January 1980, is assumed to be an attempt of precision over accuracy. Pedestrian survey was restricted to the APE and negative. NRCS has no authority to exceed the APE.

Undertaking Assessment- No effect.

32CSX144:
E. W. Chaffee Bonanza- Site form encompasses the entire eastern portion of Amenia. It is an area where the majority of agricultural infrastructure has been built. While the location of the Chaffee Bonanza farm is documented (Figure 5), as of May 2020 there was no evidence of barns, worker barracks, grain storage or implements from the era. The location is now an active agricultural field with varying plow depths.

Undertaking Assessment-No Effect.

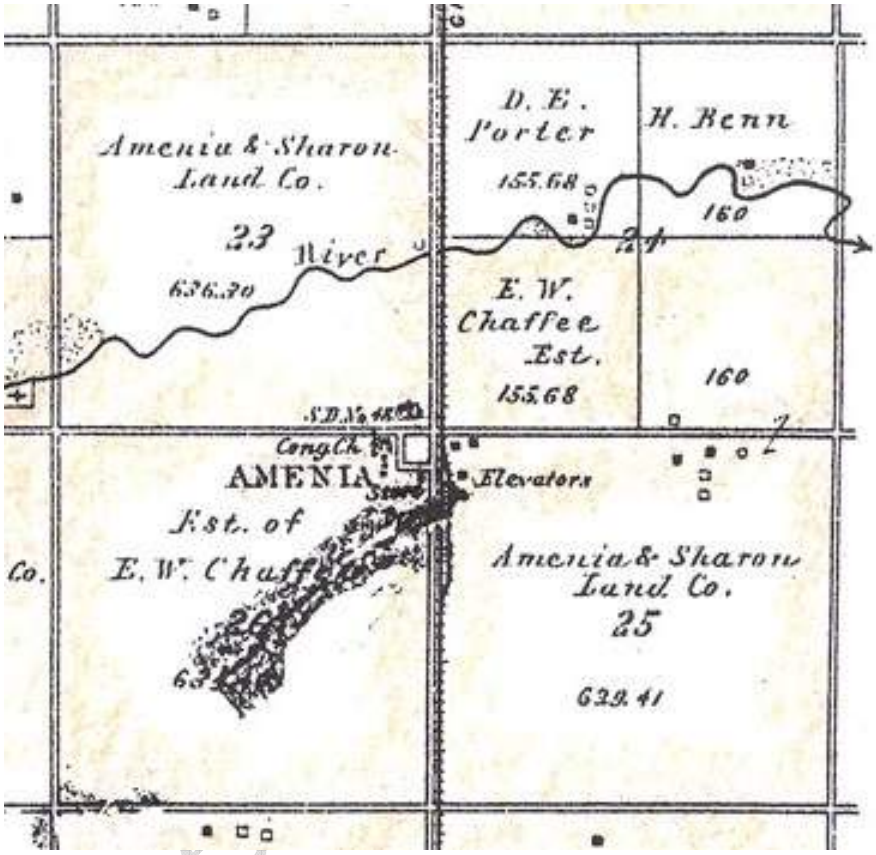


Figure 5: Plat of Amenia Township 1893.
Image Source: North Dakota Historical Society.

32CSX0145:
Amenia Townsite- Includes modern (post 1970) residences and a baseball field. The context of any possible subsurface finds has been disrupted by home construction, sewer, water, natural gas, and telephony installation in addition to agricultural production and engineered street installations. Pedestrian survey revealed no cultural resources (Figure 6, 7). Shovel probes were not permitted as individual homeowner permission had not been obtained.

Undertaking Assessment- No effect.

Figure 6: 32CSX0145 location facing North. 47.005386, -97.223956

Figure 7: 32CSX0145 location facing West. 47.005386, -97.223956

32C190:
Trinity Lutheran Church-Per site form, the church was struck by lightning in 1949 and burned. The steeple survived in private ownership (Chaffee, 1977) until the steeple was donated to the Amenia City Cemetery and is under the care of the cemetery association. Its current condition of the steeple is unknown and possession by the cemetery association is unverified.

Undertaking Assessment- No effect.

32CS5120:
Reed House-Structure bears the characteristics of a Stick Victorian as described by McAllester (pg. 255). While some elements, such as the front gable decorated verge boards, borrow from Queen Anne, the steeply pitched cross gabled roof, curved porch braces, turned porch supports and horizontal bands raised from the exterior wall for emphasis all adhere to type.

The property is damaged. Property may be bank owned (personal communication Keith Peltier, ProSeed General Manager). Brick foundation is being cannibalized. Windows are intact but layers of grime prevented interior view. No permission was obtained to enter the structure. See Appendix C for photographs and updated site form.

Figure 8: 32CS5120 Oblique facing Northwest. 47.006476, - 97.220032

Undertaking Assessment-No direct effect. Visual effect possible during winter.

Results of Field Reconnaissance:
When the 1893 township map is overlaid with current satellite imagery (Figure 9) the consistency of structure type and location choice during the 127 years is striking. The original elevators, mercantile, congregational church and several homes burned prior to 1950 (Chaffee, 1977) and modern equivalents were rebuilt almost on the building's footprints.

Figure 9: 1893 map overlay with 2018 satellite image
Image Source: North Dakota Historical Society; Google Earth 2020.

The levee project will be built by adding elevation to the existing ground except for the retention pond and water pump installation in the far Northeast of the APE. Agricultural operations resulted in heavy ground disturbance and necessitated a large separation between shovel probes to maximize the probability of cultural resource discovery. The five shovel probes were spaced 20 (+/-) meters apart from a central point, following cardinal directions. Each shovel probe was approximately 30-centimeter diameter and 50-centimeter depth divided and into arbitrary 10-centimeter levels. The excavated heavy Red River valley clay was remarkably consistent and had no discernable A-B horizon. The clay prohibited traditional screening through .25-inch mesh cloth and required hand troweling. No cultural material was discovered during the shovel probes.

The entirety of the linear APE was walked by a team of three. One team member on centerline and a team member 15 meters either side. Several machine manufactured bolts, washers and beverage cans,

randomly dispersed, were visible across the APE with no discernable pattern. It is assumed that the material was left behind during cultivation practices. The eastern portion is used by Pioneer Seed as test plots. No cultural material was observed.

Figure 10: Shovel probeing
Image Source: Google Earth, 2020

SHOVEL PROBE	CULTURAL MATERIAL	MUNSELL	TEXTURE	LAT/LON WGS 84 UTM Z14
1	NEGATIVE	10YR 2/1	HEAVY CLAY	47.0073, -97.2150 635680, 5207520
2	NEGATIVE	10YR 2/1	HEAVY CLAY	47.0075, -97.2151 635679, 5207598
3	NEGATIVE	10YR 2/1	HEAVY CLAY	47.0073, -97.2153 635663, 5207520
4	NEGATIVE	10YR 2/1	HEAVY CLAY	47.0073, -97.2148 635701,5207521
5	NEGATIVE	10YR 2/1	HEAVY CLAY	47.0071, -97.2151 635679,5207498

Table 3: Shovel Probe Results

Directly behind 32CS5120 is a side gabled, gambrel roofed 1.5 story, wood structure. The building contains multiple mismatched elements making an accurate date of construction or building style challenging. An original chimney remains in the easternmost portion of the structure, but doors, windows and dormers do not conform to any specific architectural style. Electrical service was installed post construction. It has no known association with the Chaffee Bonanza Farm nor, as a standalone structure, does it qualify for the NRHP under established criteria. Images of the structure are in Appendix C and is assigned field number NRCS 20017001.

Conclusions and Recommendations:

Rush River-Amenia South Levee Alternative undertaking was subjected extensive literature review by both NRCS staff and a contractor. In addition, NRCS staff performed field survey and limited shovel probeing. The investigation resulted in no cultural artifacts or properties that require avoidance. The Burlington Northern Site Lead (32CSX143), Amenia Townsite (32CSX145), Lutheran Church (32CS196), and Chaffee Bonanza Site Lead (32CSX144) have all been either razed, destroyed by fire or built over.

32CS5120 should be evaluated for NRHP eligibility due to a possible connection to the Chaffee Bonanza Farm and a determination of eligibility requested from NDSHPO. Such formal assessment is beyond the scope of this report. While the undertaking will have no direct effect to 32CS5120, the visual effects will be minimal as the 5-7-foot-high, grass covered levee will be obscured in the Summer and Fall due to tree leaf-out and crop growth.

A determination of "***no effect to historic properties"*** is recommended.

Bibliography

Bluemle, William J.
1977 The Face Of North Dakota: The Geologic Story. Educational Series 11, North Dakota Geologic Survey, Bismarck, North Dakota.

Chaffee, Lester
1977 Lester Chaffee, Amenia. North Dakota Oral History Project 1974. North Dakota Historical Society, Bismarck North Dakota.

Herrrmann, Zachary O.
2018 North Branch Park River Watershed Plan Screening of Alternatives for Detailed Review. Houston Engineering. Fargo ND.

Koth, Ronald M.
2016 Class 1 Inventory Results for the Rush River Watershed in Cass County, North Dakota; SCWA project Number 35904. SWCA Environmental Consultants, Bismarck ND.

McAlester, Virginia Savage and Lee.
1984 A Field Guide To American Houses. Knopf, New York.

North Dakota State Historical Society
2020 North Dakota Studies Unit III Waves of Development (1861-1920)/Lesson 2: Making A Living/Topic 3: Farming/Section 4: Bonanza Farms. Northd Datlota State Historical Society, Bismarck ND. (https://www.ndstudies.gov/gr8/ accessed May 17, 2020).

Snortland-Banks, Dierde
2017 Cass County Electric Cooperative's Arthur Service Center AR604 Electric Line: A Class III Cultural Resource Inventory in Cass Coiunty. Metcalf Archaeological Consultants Inc., Bismarck ND.

State Historical Society of North Dakota
2017 NDCRS Site Form Training Manual: Archaeological Sites. Division of Archaeology and Historic Preservation. Bismarck, ND.

USDA-Natural Resources Conservation Service
2020 The PLANTS Database (http://plants.usda.gov, May 10, 2020).National Plant Data Team, Greensboro, NC 27401-4901 USA.

USDA-Natural Resources Conservation Service
2020 Tongue River Channel Stability Assessment Senator Young Damn to Renwick Dam. Pembina and Cavalier Counties, North Dakota

USDA-Natural Resources Conservation Service
2020 Web Soil Survey of Cass County, North Dakota. United States Department of Agriculture. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. (accessed May 20, 2020)

USDA-Natural Resources Conservation Service
2010 Culturally Significant Plants. by P. Allen Casey and Richard L. Wynia. Adapted from PowerPoint presentation by Patrick J. Broyles. Manhattan Plant Materials Center, Manhattan, Kansas. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/kspmcpu9871.pdf. (accessed May11, 2020)

Zimmerman, Bret T.
2019 Draft-North Branch Park River Watershed Plan Existing Conditions Hydrology and Hydraulics Report. Houston Engineering, Fargo, ND.

Appendix A
SWCA Class 1 Report

Appendix B
Engineering Design and NRCS Practices

RCPP/PL566
RUSH RIVER - AMENIA
SOUTH LEVEE ALTERNATIVE

CASS COUNTY JOINT
WATER RESOURCE DISTRICT

CASS COUNTY, NORTH DAKOTA

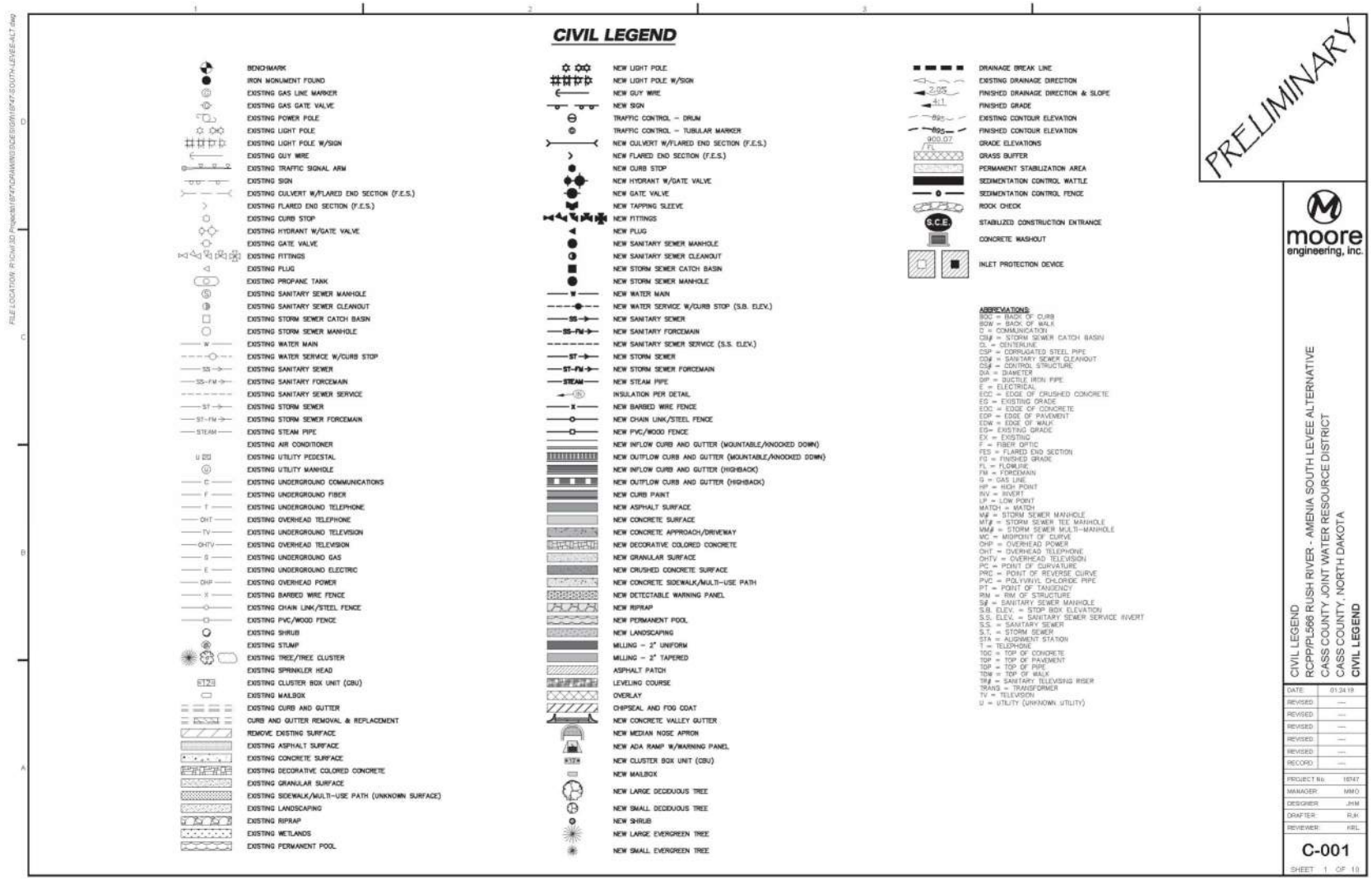
moore engineering, inc.
Consulting Engineering · · Land Surveying
925 10th Avenue East · · West Fargo, North Dakota
www.mooreengineeringinc.com

VICINITY MAP

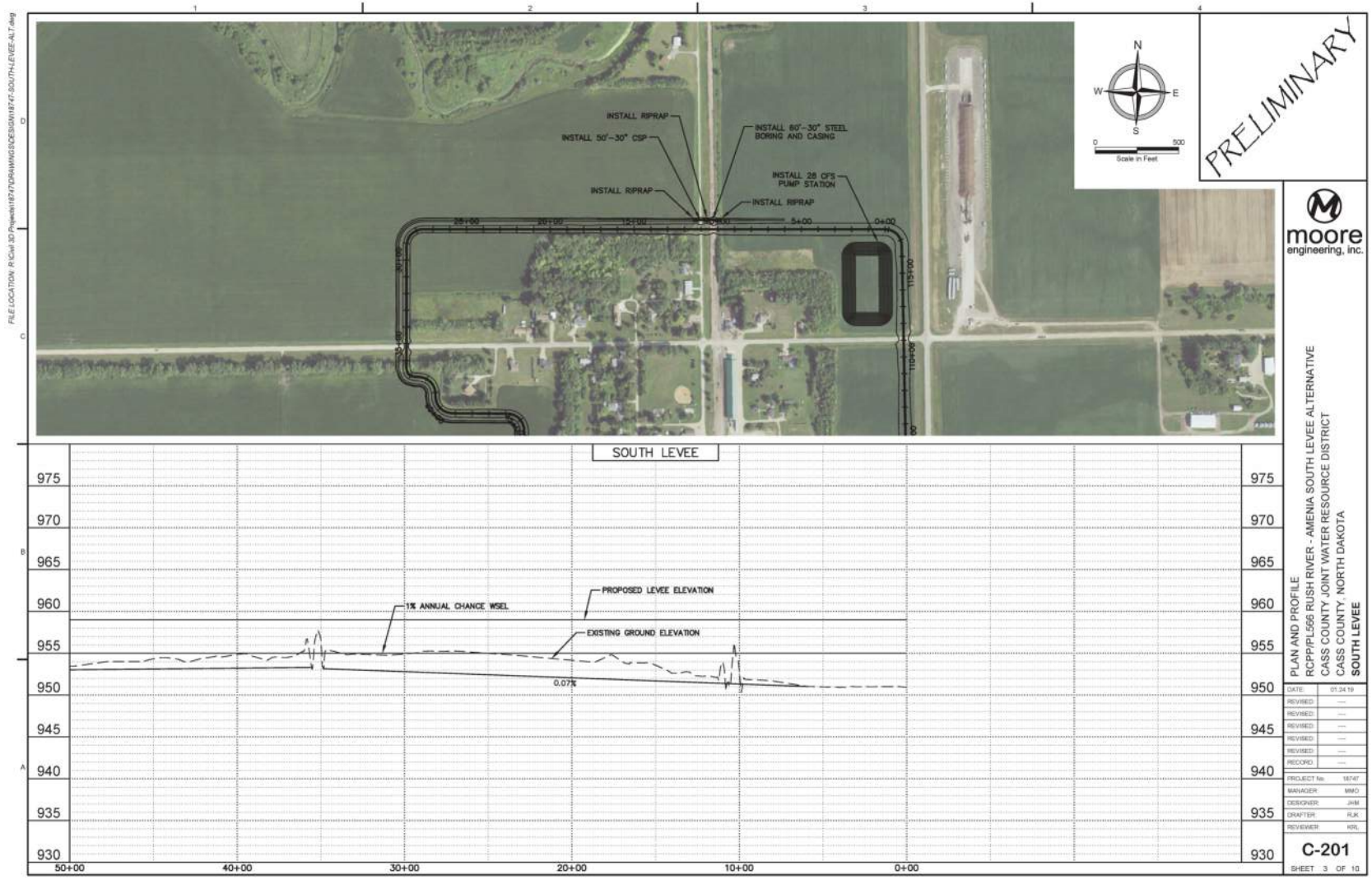
PROJECT No. 18747

PRELIMINARY

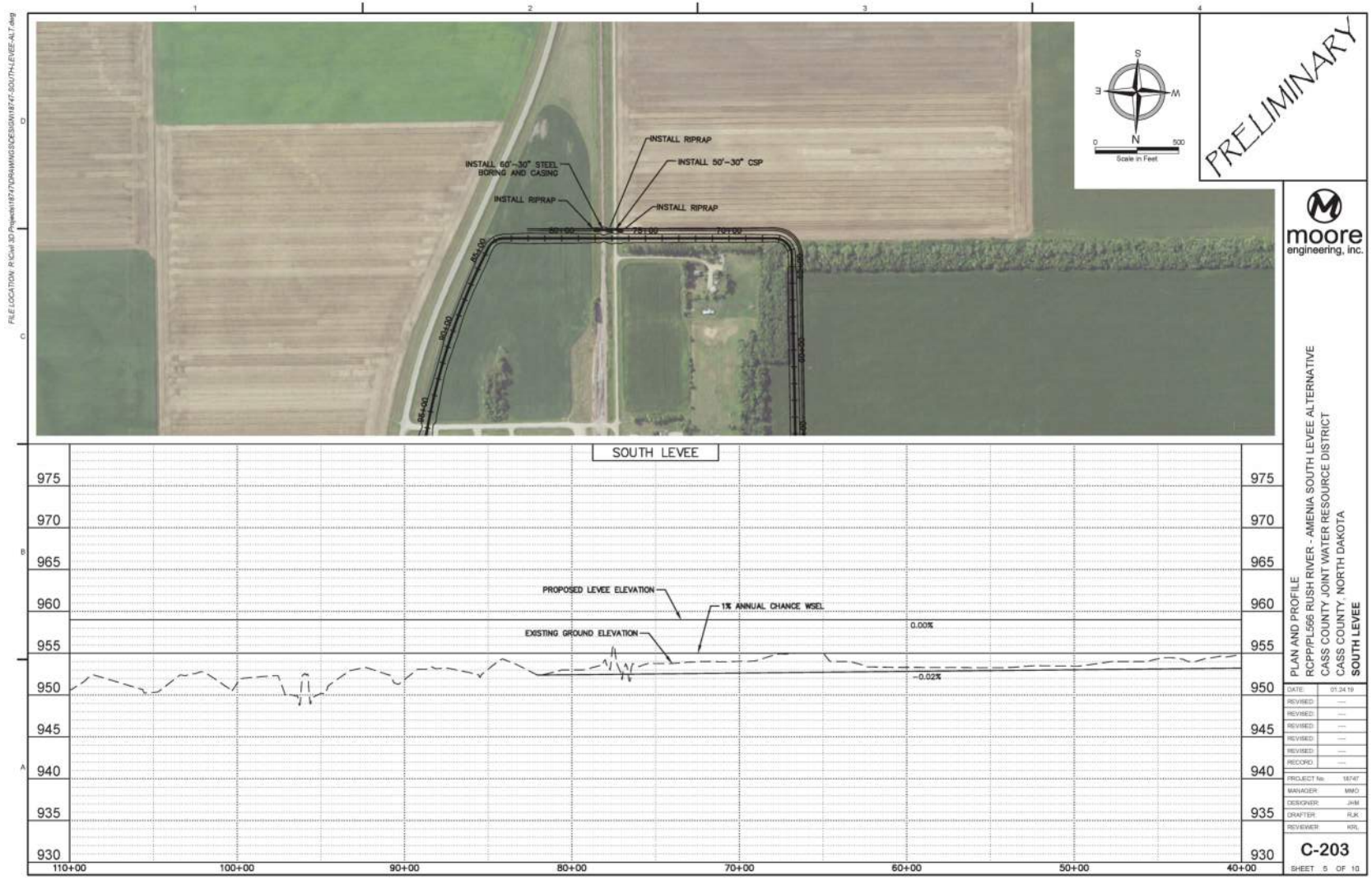
PRELIMINARY
TABLE OF CONTENTS
GENERAL
01.24.19 SHEET 1 OF 2 G-001 COVER SHEET
01.24.19 SHEET 2 OF 2 G-002 TABLE OF CONTENTS
CIVIL
01.24.19 SHEET 1 OF 10 C-001 CIVIL LEGEND
01.24.19 SHEET 2 OF 10 C-101 ALIGNMENT LAYOUT AND CONTROL - ALIGNMENTS, LINE AND CURVE TABLES, AND SURVEY CONTROL
01.24.19 SHEET 3 OF 10 C-201 PLAN AND PROFILE
01.24.19 SHEET 4 OF 10 C-202 PLAN AND PROFILE
01.24.19 SHEET 5 OF 10 C-203 PLAN AND PROFILE
01.24.19 SHEET 6 OF 10 C-204 PLAN AND PROFILE
01.24.19 SHEET 7 OF 10 C-301 CROSS SECTIONS
01.24.19 SHEET 8 OF 10 C-302 CROSS SECTIONS
01.24.19 SHEET 9 OF 10 C-303 CROSS SECTIONS
01.24.19 SHEET 10 OF 10 C-501 TYPICAL DETAIL
TOTAL SHEETS 12
moore engineering, inc.
TABLE OF CONTENTS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TABLE OF CONTENTS
DATE 01.24.19
REVISED —
REVISED —
REVISED —
REVISED —
REVISED —
RECORD —
PROJECT No. 18747
MANAGER: MMO
DESIGNER: JHM
DRAFTER: RJH
REVIEWER: HRL
G-002
SHEET 2 OF 2
FILE LOCATION: R:\civil 3D Projects\BRADDRAWING\DESIGN\BRA\SOUTH-LEVEE-ALT.dwg


CIVIL LEGEND
BENCHMARK
IRON MONUMENT FOUND
EXISTING GAS LINE MARKER
EXISTING GAS GATE VALVE
EXISTING POWER POLE
EXISTING LIGHT POLE
EXISTING LIGHT POLE W/SIGN
EXISTING GUY WIRE
EXISTING TRAFFIC SIGNAL ARM
EXISTING SIGN
EXISTING CULVERT W/FLARED END SECTION (F.E.S.)
EXISTING FLARED END SECTION (F.E.S.)
EXISTING CURB STOP
EXISTING HYDRANT W/GATE VALVE
EXISTING GATE VALVE
EXISTING FITTINGS
EXISTING PLUG
EXISTING PROPANE TANK
EXISTING SANITARY SEWER MANHOLE
EXISTING SANITARY SEWER CLEANOUT
EXISTING STORM SEWER CATCH BASIN
EXISTING STORM SEWER MANHOLE
EXISTING WATER MAIN
EXISTING WATER SERVICE W/CURB STOP
EXISTING SANITARY SEWER
EXISTING SANITARY FORCEMAIN
EXISTING SANITARY SEWER SERVICE
EXISTING STORM SEWER
EXISTING STORM SEWER FORCEMAIN
EXISTING STEAM PIPE
EXISTING AIR CONDITIONER
EXISTING UTILITY PEDESTAL
EXISTING UTILITY MANHOLE
EXISTING UNDERGROUND COMMUNICATIONS
EXISTING UNDERGROUND FIBER
EXISTING UNDERGROUND TELEPHONE
EXISTING OVERHEAD TELEPHONE
EXISTING UNDERGROUND TELEVISION
EXISTING OVERHEAD TELEVISION
EXISTING UNDERGROUND GAS
EXISTING UNDERGROUND ELECTRIC
EXISTING OVERHEAD POWER
EXISTING BARBED WIRE FENCE
EXISTING CHAIN LINK/STEEL FENCE
EXISTING PVC/WOOD FENCE
EXISTING SHRUB
EXISTING STUMP
EXISTING TREE/TREE CLUSTER
EXISTING SPRINKLER HEAD
EXISTING CLUSTER BOX UNIT (CBU)
EXISTING MAILBOX
EXISTING CURB AND GUTTER
CURB AND GUTTER REMOVAL & REPLACEMENT
REMOVE EXISTING SURFACE
EXISTING ASPHALT SURFACE
EXISTING CONCRETE SURFACE
EXISTING DECORATIVE COLORED CONCRETE
EXISTING GRANULAR SURFACE
EXISTING SIDEWALK/MULTI-USE PATH (UNKNOWN SURFACE)
EXISTING LANDSCAPING
EXISTING RIPRAP
EXISTING WETLANDS
EXISTING PERMANENT POOL
NEW LIGHT POLE
NEW LIGHT POLE W/SIGN
NEW GUY WIRE
NEW SIGN
TRAFFIC CONTROL – DRUM
TRAFFIC CONTROL – TUBULAR MARKER
NEW CULVERT W/FLARED END SECTION (F.E.S.)
NEW FLARED END SECTION (F.E.S.)
NEW CURB STOP
NEW HYDRANT W/GATE VALVE
NEW GATE VALVE
NEW TAPPING SLEEVE
NEW FITTINGS
NEW PLUG
NEW SANITARY SEWER MANHOLE
NEW SANITARY SEWER CLEANOUT
NEW STORM SEWER CATCH BASIN
NEW STORM SEWER MANHOLE
NEW WATER MAIN
NEW WATER SERVICE W/CURB STOP (S.B. ELEV.)
NEW SANITARY SEWER
NEW SANITARY FORCEMAIN
NEW SANITARY SEWER SERVICE (S.S. ELEV.)
NEW STORM SEWER
NEW STORM SEWER FORCEMAIN
NEW STEAM PIPE
INSULATION PER DETAIL
NEW BARBED WIRE FENCE
NEW CHAIN LINK/STEEL FENCE
NEW PVC/WOOD FENCE
NEW INFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
NEW OUTFLOW CURB AND GUTTER (MOUNTABLE/KNOCKED DOWN)
NEW INFLOW CURB AND GUTTER (HIGHBACK)
NEW OUTFLOW CURB AND GUTTER (HIGHBACK)
NEW CURB PAINT
NEW ASPHALT SURFACE
NEW CONCRETE SURFACE
NEW CONCRETE APPROACH/DRIVEWAY
NEW DECORATIVE COLORED CONCRETE
NEW GRANULAR SURFACE
NEW CRUSHED CONCRETE SURFACE
NEW CONCRETE SIDEWALK/MULTI-USE PATH
NEW DETECTABLE WARNING PANEL
NEW RIPRAP
NEW PERMANENT POOL
NEW LANDSCAPING
MILLING – 2" UNIFORM
MILLING – 2" TAPERED
ASPHALT PATCH
LEVELING COURSE
OVERLAY
CHIPSEAL AND FOG COAT
NEW CONCRETE VALLEY GUTTER
NEW MEDIAN NOSE APRON
NEW ADA RAMP W/WARNING PANEL
NEW CLUSTER BOX UNIT (CBU)
NEW MAILBOX
NEW LARGE DECIDUOUS TREE
NEW SMALL DECIDUOUS TREE
NEW SHRUB
NEW LARGE EVERGREEN TREE
NEW SMALL EVERGREEN TREE
DRAINAGE BREAK LINE
EXISTING DRAINAGE DIRECTION
FINISHED DRAINAGE DIRECTION & SLOPE
FINISHED GRADE
EXISTING CONTOUR ELEVATION
FINISHED CONTOUR ELEVATION
GRADE ELEVATIONS
GRASS BUFFER
PERMANENT STABILIZATION AREA
SEDIMENTATION CONTROL WATTLE
SEDIMENTATION CONTROL FENCE
ROCK CHECK
S.C.E.
STABILIZED CONSTRUCTION ENTRANCE
CONCRETE WASHOUT
INLET PROTECTION DEVICE
ABBREVIATIONS:
BOC = BACK OF CURB
BSW = BACK OF WALK
C = COMMUNICATION
CB# = STORM SEWER CATCH BASIN
CL = CENTERLINE
CSP = CORRUGATED STEEL PIPE
CO# = SANITARY SEWER CLEANOUT
CS# = CONTROL STRUCTURE
DIA = DIAMETER
DIP = DUCTILE IRON PIPE
E = ELECTRICAL
EOC = EDGE OF CRUSHED CONCRETE
EG = EXISTING GRADE
EOC = EDGE OF CONCRETE
EOP = EDGE OF PAVEMENT
EOW = EDGE OF WALK
EG= EXISTING GRADE
EX = EXISTING
F = FIBER OPTIC
FES = FLARED END SECTION
FG = FINISHED GRADE
FL = FLOWLINE
FM = FORCEMAIN
G = GAS LINE
HP = HIGH POINT
INV = INVERT
LP = LOW POINT
MATCH = MATCH
M# = STORM SEWER MANHOLE
MT# = STORM SEWER TEE MANHOLE
MM# = STORM SEWER MULTI-MANHOLE
MC = MIDPOINT OF CURVE
OHP = OVERHEAD POWER
OHT = OVERHEAD TELEPHONE
OHTV = OVERHEAD TELEVISION
PC = POINT OF CURVATURE
PRC = POINT OF REVERSE CURVE
PVC = POLYVINYL CHLORIDE PIPE
PT = POINT OF TANGENCY
RIM = RIM OF STRUCTURE
S# = SANITARY SEWER MANHOLE
S.B. ELEV. = STOP BOX ELEVATION
S.S. ELEV. = SANITARY SEWER SERVICE INVERT
S.S. = SANITARY SEWER
S.T. = STORM SEWER
STA = ALIGNMENT STATION
T = TELEPHONE
TOC = TOP OF CONCRETE
TOP = TOP OF PAVEMENT
TOP = TOP OF PIPE
TOW = TOP OF WALK
TR# = SANITARY TELEVISING RISER
TRANS = TRANSFORMER
TV = TELEVISION
U = UTILITY (UNKNOWN UTILITY)
PRELIMINARY
moore engineering, inc.
CIVIL LEGEND
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CIVIL LEGEND
DATE: 01.24.19
REVISED: ---
REVISED: ---
REVISED: ---
REVISED: ---
REVISED: ---
RECORD: ---
PROJECT No. 16747
MANAGER: MMO
DESIGNER: JHM
DRAFTER: RJK
REVIEWER: KRL
C-001
SHEET 1 OF 19

PRELIMINARY
moore engineering, inc.
ALIGNMENT, LINE AND CURVE TABLES AND SURVEY CONTROL
CASS COUNTY, NORTH DAKOTA
CASS COUNTY JOINT WATER RESOURCE DISTRICT
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
ALIGNMENT, LAYOUT AND CONTROL
DATE 01.24.19
REVISED —
REVISED —
REVISED —
REVISED —
REVISED —
RECORD —
PROJECT No. 18747
MANAGER MMO
DESIGNER JHM
DRAFTER RJK
REVIEWER KRL
C-101
SHEET 2 OF 10
HORIZONTAL CONTROL
NORTH DAKOTA COORDINATE SYSTEM OF 1983, NAD83, SOUTH ZONE
COMBINATION FACTOR (cf) = 9998875
ALL COORDINATES ARE CASS COUNTY GROUND COORDINATES
VERTICAL CONTROL
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
BENCHMARKS/SURVEY CONTROL
PRIOR TO PROJECT START, OWNER WILL SET, AND ESTABLISH
BENCHMARKS AND SURVEY CONTROL FOR THE PROJECT, AND
CLEARLY MARK RIGHT-OF-WAY.
N
E
S
W
0
600
Scale in Feet
1
2
3
4
A
B
C
D
FILE LOCATION: R:\Civil 3D Projects\18747DRAWINGS\ESIGN\18747-SOUTH-LEVEE-ALT.dwg


PRELIMINARY
INSTALL RIPRAP
INSTALL 50'-30" CSP
INSTALL 60'-30" STEEL BORING AND CASING
INSTALL 28 CFS PUMP STATION
INSTALL RIPRAP
INSTALL RIPRAP
N
W
E
S
0
500
Scale in Feet
SOUTH LEVEE
975
970
965
960
955
950
945
940
935
930
1% ANNUAL CHANCE WSEL
PROPOSED LEVEE ELEVATION
EXISTING GROUND ELEVATION
0.07%
50+00
40+00
30+00
20+00
10+00
0+00
moore engineering, inc.
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE
DATE: 01.24.19
PROJECT No. 16747
MANAGER: MMD
DESIGNER: JHM
DRAFTER: RJK
REVIEWER: KRL
C-201
SHEET 3 OF 10

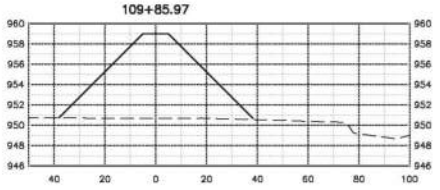
PRELIMINARY
moore engineering, inc.
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE
C-202
SHEET 4 OF 10
SOUTH LEVEE
PROPOSED LEVEE ELEVATION
EXISTING GROUND ELEVATION
1% ANNUAL CHANCE WSEL
0.07%
0.00%
-0.02%
INSTALL 50'-30" CSP
RIPRAP
975
970
965
960
955
950
945
940
935
930
80+00
70+00
60+00
50+00
40+00
30+00
20+00
10+00

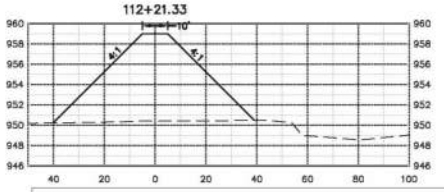

INSTALL 60"-30" STEEL BORING AND CASING
INSTALL RIPRAP
INSTALL RIPRAP
INSTALL 50"-30" CSP
INSTALL RIPRAP
PRELIMINARY
SOUTH LEVEE
PROPOSED LEVEE ELEVATION
1% ANNUAL CHANCE WSEL
EXISTING GROUND ELEVATION
0.00%
-0.02%
975
970
965
960
955
950
945
940
935
930
110+00
100+00
90+00
80+00
70+00
60+00
50+00
40+00
moore engineering, inc.
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE
C-203
SHEET 5 OF 10

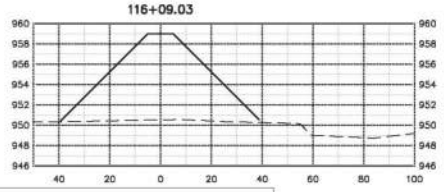
PRELIMINARY
moore engineering, inc.
PLAN AND PROFILE
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
SOUTH LEVEE
C-204
SOUTH LEVEE
PROPOSED LEVEE ELEVATION
EXISTING GROUND ELEVATION
1% ANNUAL CHANCE WSEL
0.02%
0.02%
INSTALL 60"-30" STEEL BORING AND CASING
INSTALL RIPRAP
INSTALL 2@ CFS PUMP STATION
INSTALL RIPRAP
INSTALL 60"-30" STEEL BORING AND CASING
Scale in Feet

PRELIMINARY
moore engineering, inc.
CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS
C-301
0+19.95
3+02.61
8+03.41
13+57.46
18+66.47
23+57.74
28+38.97
30+95.99
33+46.43
34+54.99
35+91.86
36+82.38
40+12.26
42+66.42
49+04.47

PRELIMINARY
moore engineering, inc.
CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS
C-302
54+03.66
59+23.99
62+44.65
68+38.05
75+90.29
78+80.92
82+18.72
85+48.55
90+61.43
95+38.52
100+34.89
105+47.61







EARTHWORK VOLUMES

Station	Cut Area (Ft^2)	Fill Area (Ft^2)	Cut Vol (Yd^3)	Fill Vol (Yd^3)	Total Cut (Yd^3)	Total Fill (Yd^3)
0+19.95	0.00	339.39	0.00	0.00	0.00	0.00
3+02.61	0.00	338.32	0.00	3547.43	0.00	3547.43
8+03.41	6.52	287.23	60.48	5801.49	60.48	9348.92
13+57.46	11.88	230.45	188.80	5311.50	249.28	14660.42
18+66.47	49.67	152.82	580.14	3612.77	829.42	18273.19
23+57.74	59.39	110.44	992.18	2395.11	1821.60	20668.30
28+38.97	53.46	74.35	1090.83	1646.34	2912.42	22314.64
30+95.99	41.29	113.88	518.06	895.20	3430.48	23209.84
33+46.43	27.92	112.00	320.99	1047.63	3751.47	24257.46
34+54.99	43.99	87.31	144.58	400.70	3896.05	24658.16
35+91.86	89.57	65.77	338.52	388.01	4234.57	25046.17
36+82.38	24.45	120.33	257.33	311.22	4491.90	25357.39
40+12.26	26.79	100.92	321.68	1351.27	4813.58	26708.66
42+66.42	11.35	145.85	202.37	1161.53	5015.95	27870.19
49+04.47	6.83	168.18	189.62	3708.31	5205.57	31578.50
54+03.66	6.75	186.33	125.48	3277.11	5331.05	34855.61
59+23.99	7.77	187.01	139.85	3597.46	5470.90	38453.07
62+44.65	9.64	179.16	103.38	2174.39	5574.28	40627.46
68+38.05	31.64	126.27	513.19	3355.69	6087.48	43983.15
75+90.29	12.49	178.58	614.73	4246.62	6702.21	48229.77
78+80.92	10.16	188.74	121.89	1976.94	6824.09	50206.71
82+18.72	0.00	232.58	63.53	2635.54	6887.63	52842.25
85+48.55	0.00	264.20	0.00	3035.17	6887.63	55877.42
90+61.43	0.00	303.36	0.02	5391.07	6887.65	61268.49
95+38.52	0.33	432.69	2.88	6503.73	6890.52	67772.21
100+34.89	0.00	376.25	2.97	7436.79	6893.49	75209.01
105+47.61	0.00	394.70	0.00	7320.70	6893.49	82529.70
109+85.97	0.00	360.80	0.00	6132.95	6893.49	88662.65
112+21.33	0.00	384.29	0.00	3247.47	6893.49	91910.12
116+09.03	0.00	379.80	0.00	5485.92	6893.49	97396.04
118+14	0.00	342.13	0.00	2736.48	6893.49	100132.52

PRELIMINARY

moore engineering, inc.

CROSS SECTIONS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
CROSS SECTIONS

DATE:	01.24.19
REVISED:	---
REVISED:	---
REVISED:	---
REVISED:	---
REVISED:	---
RECORD:	---
PROJECT No.	16747
MANAGER:	MMO
DESIGNER:	JHM
DRAFTER:	RJH
REVIEWER:	KRL

C-303

SHEET 9 OF 10

PRELIMINARY
moore engineering, inc.
TYPICAL DETAILS
RCPP/PL566 RUSH RIVER - AMENIA SOUTH LEVEE ALTERNATIVE
CASS COUNTY JOINT WATER RESOURCE DISTRICT
CASS COUNTY, NORTH DAKOTA
TYPICAL DETAILS
C-501
STORM POND DETAIL - SOUTH LEVEE ALTERNATIVE
TYPICAL LEVEE SECTION

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

DIKE

(Feet)

CODE 356

DEFINITION

A barrier constructed of earth or manufactured materials.

PURPOSES

- To protect people and property from floods.
- To control water level in connection with crop production, fish and wildlife management, or wetland maintenance, improvement, restoration or construction.

CONDITIONS WHERE PRACTICE APPLIES

All sites that are subject to damage by flooding or inundation and where it is desired to reduce the hazard to people and to reduce damage to land and property.

Sites where the control of water level is desired.

The dike standard does not apply to sites where the Pond, Water and Sediment Control Basin, Diversion, or Terrace standards are appropriate. Dikes used to reduce flooding are normally constructed adjacent and/or parallel to a stream, river, wetland or water body and are not constructed across the stream, river or water body. Dikes used to control water levels usually have small interior drainage areas in comparison to the surface area of the regulated water level.

CRITERIA

General Criteria Applicable to All Purposes

Classification. The dike classification is determined by the hazard to life and the value of the protected land, crops, and property. Classification must consider land use changes likely to occur over the life of the dike.

Class I dikes are located on sites where failure of the dike may cause loss of life or serious damage to homes, primary highways, industrial buildings, commercial buildings, major railroads, or important public utilities.

All dikes with a design water height of more than 12 feet (3.7m) above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas shall be Class I.

Class II dikes are located on sites where failure of the dike may cause damage to isolated homes, secondary highways, minor railroads, relatively important public utilities, high value land, or high value crops.

Class III dikes are located on sites where damage likely to occur from failure will be minimal.

Constructed Elevation. The constructed elevation of a dike whose purpose is to prevent flooding shall be the sum of the following:

- The water elevation attained by a flood or high tide of the design frequency in Table 1 with the critical duration and timing. This is the design high water.
- The larger of the minimum freeboard in Table 1 or the wave height caused by wind or boat traffic.
- The allowance for settlement.

The constructed elevation of a dike whose purpose is to control water level shall be the sum of the following:

- The water elevation at the highest water level control.
- The rise in water height above the highest water level control caused by a flood of the design frequency in Table 1. This is the design high water.
- The larger of the minimum freeboard in Table 1 or the wave height caused by wind of the design frequency in Table 1.
- The allowance for settlement.

Settlement. The allowance for settlement of compacted earth fill material shall be a minimum of 5 percent of the dike height unless an analysis shows that a lesser amount is adequate. For fill material that is hauled from off-site, dumped, and shaped (referred to as "dumped and shaped"), the allowance for settlement shall be a minimum of 15 percent of the dike height. For fill material that is excavated adjacent to the dike and dropped from the excavator (referred to as "dropped"), the allowance for settlement shall be a minimum of 20 percent of the dike height. The allowance for settlement of dumped and shaped or dropped organic soil fill material shall be a minimum of 40 percent of the dike height.

For the purpose of this standard, organic soils are described as follows:

- Soil layers that are not saturated with water for more than a few days at a time are organic if they have 20 percent or more organic carbon.
- Layers that are saturated for longer periods, or were saturated before being drained, are organic if:

  they have 12 percent or more of organic carbon and no clay, or

  18 percent or more organic carbon and 60 percent or more clay, or

  a proportional amount of organic carbon, between 12 and 18 percent, if the clay content is between 0 and 60 percent.

- All soils described in the local soil survey as an organic soil.

Top Width and Side Slopes. The minimum top widths and side slopes for earth embankments shall be that shown in Table 1.

Berms. The need for a constructed berm on an embankment will be based on the results of an embankment and foundation stability analysis. If a stability analysis is not done, all earth dikes shall have berms either constructed or occurring naturally on both sides meeting the following criteria:

- Constructed berms shall be at a constant elevation and sloped away from the dike.
- Where dikes cross channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc. they shall have a berm constructed on each side. The top elevation of these berms will be at least 1 foot above the average ground surface on each side of the channel, ditch, borrow area, stream, slough, swales, gully, etc. and slope away from the dike.
- The minimum top width of natural or constructed berms shall be as shown in Table 1.
- The minimum side slope ratio of constructed berms shall be 2:1.
- Slope protection shall be determined and installed based on site conditions.

Dike Materials. Manufactured materials are non-erosive materials such as concrete, PVC, and steel that provides the structural strength for the dike. Manufactured dike materials shall have a structural analysis completed for the various loads the dike will be subjected to during its life. These include hydrostatic, ice, uplift, earth, and equipment. The dike shall be analyzed for stability using acceptable safety factors for each loading condition.

Earth dike materials should be a well-graded mineral soil with a minimum of 95 percent passing the Standard Number 4 Sieve and no fraction being larger than 6 inches in diameter.

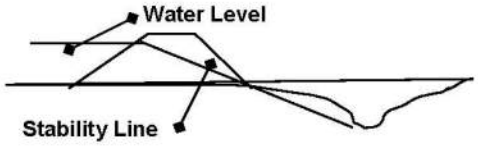
Embankment and Foundation Seepage. Embankment and foundation drainage and seepage control shall be designed on the basis of site investigation, laboratory data, seepage analysis, and stability analysis. The resulting design shall minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

In the absence of more detailed data and analysis, the following criteria for a foundation cutoff apply for Class I dikes less than 6 feet in height, Class II dikes less than 8 feet in height and Class III dikes (H = dike height):

- Minimum of H feet deep for $H<3$ feet
- Minimum of 3 feet deep for $H\geq3$ feet
- Minimum of 4 feet bottom width
- 1:1 or flatter side slopes

A stream, channel, ditch, borrow area, slough, swale, gully, etc. shall be far enough away from the dike so that the extension of a line drawn from the design high water elevation on one side of the dike to the dike toe on the opposite side shall not intersect any stream, channel, etc. This line criterion applies to both sides of the

dike. This criterion will minimize the hazard to the dike caused by piping through the foundation.



Interior Drainage. Dikes to prevent flooding shall be provided with interior drainage systems for the area being protected. The interior drainage system shall prevent flood damage to the interior area from a flood of the design frequency in Table 1 for both the 1-day and the 10-day storm duration. The interior drainage system may include storage areas, gravity outlets, and pumping plants as needed to provide the required level of flood protection.

Pipes. Pipes through a Class I dike below the design high water with a dike height greater than 12 feet shall meet the requirements for principal spillways as found in NRCS Technical Release 60 - Earth Dams and Reservoirs, except for the minimum size requirements.

Pipes through all other Class I and Class II dikes shall meet the requirements for a principal spillway in Practice Standard 378, Ponds.

Dikes shall be protected from scour at pipe inlet and outlet locations by appropriate measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible. Pump discharge pipes shall be equipped with a flexible connection or similar coupling to prevent vibration of the pumping plant being transmitted to the discharge pipe.

Protection. Dikes shall be protected from sheet, rill, and gully erosion, erosion from flowing floodwaters, and wave action created by wind and/or boat traffic.

A protective cover of grasses shall be established on exposed surfaces of the dike and other disturbed areas, as needed to prevent erosion. Seedbed preparation, seeding, fertilizing, mulching, and fencing shall comply with the recommendations in the standard for Critical Area Planting (342).

If grass vegetation will not control erosion, rock riprap, sand-gravel, soil cement, or special vegetation shall be utilized as needed.

Regulatory Requirements. This practice must conform to all Federal, State, and local laws and regulations. Laws and regulations of particular concern include those involving water rights, land use, land disturbance by construction, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

CONSIDERATIONS

Flood of Record. When establishing top of dike elevation for Class I dikes, the flood of record should be considered if it exceeds the minimum 100 year design frequency.

Location. When locating the site for the dike, consider the foundation soils, property lines, setbacks from property lines, exposure to open water, distance to streambanks, availability of outlets by gravity or pumping, buried, utilities, cultural resources, and natural resources such as wetlands, natural areas, and fish and wildlife habitat.

Fluvial geomorphological concepts contained in NEH Part 653, Stream Corridor Restoration Principles, Processes, and Practices should be evaluated when placing a dike near a stream.

Access. All dikes must be accessible for maintenance activities. Typically, this may be along the top of the dike or along the berm. Access roads shall provide adequate width for the maintenance equipment and inspection vehicles. The minimum width for one-way traffic should be 12 feet. Provide wider areas for passing and turning around at regular intervals. Access roads may need to be controlled to prevent vandalism, accidents, and damage.

Berms. Give special consideration to wider berms, additional setbacks, or protecting the berm side slope when adjacent to actively eroding or moving streams to protect the dike for its design life.

Adverse Impacts. Adverse environmental impacts from the proposed dike will be evaluated. Any increases in flood stage caused by dike induced flow restrictions will be evaluated for adverse impacts to unprotected areas. Adverse impacts should be minimized.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and

shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

For Class I dikes with a height greater than 12 feet, an emergency action plan meeting the requirements of 500.70 of the National Operation and Maintenance Manual shall be completed prior to construction of the dike.

For Class I and Class II dikes, a detailed Operation and Maintenance Plan in accordance with 500.40 through 500.42 of the National Operation and Maintenance Manual shall be completed and provided to the owner.

Typical items related to proper operations of a dike include, but are not limited to, the following:

- Inspect regularly for damage, especially after storm events. Items to monitor include settlement, seepage, soil cracking, animal burrows and trails, pipe structures, and control gates.

Typical items related to proper maintenance of a dike include, but are not limited to, the following:

- Vegetation should be maintained by removing or reseeding as needed. Earth fill, riprap, and other structural components need to be repaired in a timely manner.

Table 1 – Minimum Design Criteria

Minimum Dike Class	Dike Material[1]	Height (H) in Feet[2]	Minimum Design Frequency in Years	Minimum Freeboard in Feet	Minimum Top Width in Feet	Minimum Side Slope Ratio[3]	Berm Width in Feet
Class I	Earth	0 to 6	100	H/3	10	2:1	12
		>6 to 12	100	2	10	Note 4	Note 4
		>12 to 25	100	3	12	Note 4	Note 4
		>25	100	3	14	Note 4	Note 4
	Manufactured	0 to 8	100	H/4	N/A	N/A	Note 4
		>8 to 12	100	2	N/A	N/A	Note 4
		>12	100	3	N/A	N/A	Note 4
Class II	Earth	0 to 6	25	H/3	6	2:1	12
		>6 to 12	25	2	8	2:1	15
	Manufactured	0 to 8	25	H/4	N/A	N/A	Note 4
		>8 to 12	25	2	N/A	N/A	Note 4
Class III	Mineral Soils	0 to 3	10	H/3	4	2:1	8
		>3 to 6	10	1	6	2:1	8
		>6 to 12	25	2	8	2:1	8
	Organic Soils[5]	0 to 2	10	H/2	4	2:1	10
		>2 to 4	10	1	6	2:1	10
		>4 to 6	10	2	8	2:1	15

[1] Earth includes rock. Manufactured materials are non-erosive materials such as concrete, PVC, and steel that provides the structural strength for the dike.
[2] Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies
[3] Minimum side slope ratios are for compacted earth fill. Dumped earth fill without compaction will be flatter.
[4] Side slope ratios and berm widths shall be determined by a stability analysis.
[5] Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

DIVERSION

Code 362

(ft)

I. DEFINITION

A channel generally constructed across the slope with a supporting ridge on the lower side.

II. PURPOSE

This practice may be applied to support one or more of the following purposes:

- Break up concentrations of water on long slopes, on undulating land surfaces and on land that is generally considered too flat or irregular for terracing.
- Divert water away from farmsteads, agricultural waste systems, and other improvements.
- Collect or direct water for storage, water-spreading, or water-harvesting systems.
- Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.
- Intercept surface and shallow subsurface flow.
- Reduce runoff damages from upland runoff.
- Reduce erosion and runoff on urban or developing areas and at construction or mining sites.
- Divert water away from active gullies or critically eroding areas.
- Supplement water management on conservation cropping or stripcropping systems.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where surface runoff water control and management are needed, and where soils and topography are such that the diversion can be constructed and a suitable outlet is available or can be provided.

This practice does not apply to:

- **Natural stream channels, except those that meet the NEH Part 654, Chapter 8 definition of threshold channels.**

IV. CRITERIA

Compliance

The installation and operation of this practice shall be planned, designed, and constructed to comply with all Federal, State, and local laws and regulations. Construction specifications and/or drawings will specify that NRCS be provided copies of all required permits prior to construction. Excavation or ridge work within or near streams and wetlands may require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Bismarck Regulatory Office 701-255-0015). Projects that disturb more than 1 acre are required to develop a Stormwater Pollution Prevention Plan, and submit it along with a Notice of Intent to the ND Department of Health

(stormwater@nd.gov). Projects within the ordinary high water mark of navigable lakes and streams require a Sovereign Lands Permit from the ND State Water Commission (sovereignlands@nd.gov). Ensure that proposed ridges and/or overall site gradings involving fill do not increase the Base Flood (100-year recurrence interval) Elevation within Special Flood Hazard Areas (SFHA) by more than the allowable as defined by the local County Floodplain Administrator. Obtain a floodplain development permit through the local County Floodplain Administrator and the ND State Water Commission Floodplain Management Regulatory Program as necessary.

In addressing the National Environmental Policy Act (NEPA) for conservation practices within or near wetlands, sequencing must be conducted as per Executive Order 11990 included in Section G. Wetlands of the NRCS-CPA-052. Sequencing must include avoiding impacts if feasible. If avoidance is not feasible, a determination will be made using the North Dakota Minimal Effect Evaluation Worksheet. If the effects are determined to be minimal, the determination will be included in the NRCS-CPA-052. If the determination is not minimal, wetland mitigation must be completed. Implementation of the conservation practice(s) impacting the wetland(s) may begin upon obtaining all signatures on the wetland mitigation plan and agreement.

Capacity

Diversions as temporary measures, with an expected life-span of less than 2 years, will be designed for a minimum capacity for the peak discharge from the 2-year frequency, 24-hour-duration storm.

Diversions that protect agricultural land must have a minimum capacity for the peak discharge from a 10-year frequency, 24-hour-duration storm.

Diversions designed to protect areas such as urban areas, buildings, roads, and animal waste management systems require a minimum capacity for the peak discharge from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour-duration storm. Freeboard minimum depth is 0.3 ft. **Consider use of 0.5 feet of freeboard for diversions associated with animal waste management systems.**

Design depth is the channel storm-flow depth plus freeboard.

The design storm peak flow should be determined from appropriate methods considering location, drainage basin size, and watershed parameters. Statistical analysis can be used if a streamflow gage is near the site for reasonable number of years for the applicable design storm frequency. Peak discharge for ungaged sites should be calculated from the ND Supplement to NEH Part 650, Chapter 2 (EFH-2) for drainage areas less than 2,000 acres. Refer to USGS ND StreamStats for larger drainage areas where a stream channel is present and the drainage area falls within the regional parameters. Use TR-55 or HEC-HMS when watershed parameters are outside the range of USGS ND StreamStats. Apply Tables 5-1, 5-2, and 5-3 flow adjustment factors for ponding/wetlands present in the drainage area.

Cross Section

The channel may be parabolic, V-shaped, or trapezoidal. The diversion side slopes are based on stability and access requirements for maintenance. **Side slopes and bottom widths shall be selected based on equipment available for construction and maintenance.**

The minimum top width of the supporting ridge is 4 feet **except** for diversions with less than 10 acres of drainage area above cropland, pastureland, or woodland, where the minimum top width of the supporting ridge may be 3 feet.

The top of the constructed ridge at any point must not be lower than the design depth plus the specified overfill for settlement. **The minimum settlement height shall be proportioned from total ridge height at 5% for compacted fill, 15% for dumped and shaped, 20% for dropped, and 40% for organic fill. Organic soils are described CPS 356- Dike.**

The diversion design depth at a culvert crossing must equal the headwater depth for the culvert design storm plus freeboard.

The front and cut slopes for permanent diversions should not be steeper than 3:1 for maintenance purposes and preferably 4:1. The back slope of the ridge is not to be steeper than 2:1 and preferably 4:1. For temporary diversions, the side slope should not be steeper than 1:1 under any conditions.

Farmed diversions should have front slopes, back slopes, and cut slopes which are 5:1 or flatter. Where agricultural equipment must cross, slopes of 8:1 or flatter are recommended.

Channel Stability and Capacity

Channel grades may be uniform or variable. Determine minimum depth and width requirements for channel stability by using the procedures in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 9, Diversions; or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987); or other equivalent methods. The ARS handbook can be found on the USDA National Agricultural Library Digital Collections Web site.

When a retardance class method is used to determine capacity (Q) of the diversion by the relationship

$$Q=AV,$$

and, the velocity (V) is calculated by using Manning's Equation; use the highest expected value of Manning's "n", which represents the flow retardance due to the height, density and type of vegetation.

For vegetated channels, the flow retardance and vegetal cover factor for stability design shall be based on the sparsest and shortest vegetation expected. Vegetal cover factors and retardance values for various vegetative covers and conditions are given in Table 9-2 and Table 9-7, respectively, of the Engineering Field Handbook Chapter 9 – Diversions. A vegetal cover of 0.75 and a Class "D" retardance value shall not be exceeded.

See CPS 468- Lined Waterway or Outlet for roughness values and design criteria for concrete, rock, grid paver, turf reinforcement map, or articulated concrete block lined diversion channels.

Stability of unvegetated, unlined, earthen channels shall be designed utilizing methods outlined in NEH Part 654 Chapter 8.

Protection Against Sedimentation

Diversions normally should not be used below high sediment-producing areas. When they are, a practice or combination of practices for the drainage area are needed to prevent damaging accumulations of sediment in the channel. This may include practices such as land treatment erosion control practices, cultural or tillage practices, vegetated filter strip, or structural measures. Install needed sediment control practices in conjunction with or before the diversion construction.

If movement of sediment into the channel is a problem, include extra capacity for sediment accumulation in the design and instructions for periodic removal in the operation and maintenance plan. **A minimum design**

velocity of 1.5 feet per second during the design storm event is recommended to facilitate sediment transport within channel.

Outlets

Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a lined waterway, vegetated or paved area, a grade stabilization structure, an underground outlet, a stable watercourse, a sediment basin, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Install vegetative outlets before diversion construction to insure establishment of stable vegetative cover in the outlet channel.

When using an underground outlet, the diversion ridge must contain the design storm runoff combined with an underground outlet release rate to protect from overtopping. To prevent the diversion from overtopping, the designed outflow capacity of the outlet(s) must be achieved at, or below, the design depth of the diversion at their junction.

Vegetative Establishment

Vegetate diversions according to NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342) **and the North Dakota ND-CPA-9 – Planning or Data Sheet for Grass and/or Legume Seeding Job Sheet**. Select species suited to the site conditions and intended uses. Use plant species that exhibit the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close-growing crop, (e.g., small grains or millet), on the contributing watershed prior to construction of the diversion can significantly reduce the flow through the diversion during establishment.

Lining

If the soils or climatic conditions preclude the use of vegetation for erosion protection, nonvegetative linings such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems may be used.

Design diversion channel liners in accordance with CPS Lined Waterway or Outlet (Code 468).

V. CONSIDERATIONS

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped.

At noncropland sites, consider planting native vegetation in areas disturbed due to the diversion construction.

Diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology. In analyzing downslope impacts, minimize adverse effects to existing wetland functions and values. Similarly consider how to maximize wetland functions and values with the diversion design.

Provide construction inspection to ensure that the top of the constructed ridge at any point meets the design depth plus the specified overfill for settlement.

Any construction activities should minimize disturbance to wildlife habitat. Opportunities should be explored to restore and improve wildlife habitat, including habitat for threatened, endangered, and other species of concern.

For vegetated diversions, avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where these areas cannot be avoided, seek recommendations from a soil scientist for improving the condition or, if not feasible, consider stock piling the topsoil, over excavating the diversion and replace the topsoil over the excavated area to facilitate vegetative establishment.

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications for diversions that describe the requirements for applying the practice according to this standard. As a minimum, the plans and specifications must include—

1. A plan view of the layout of the diversion.
2. Typical cross sections of the diversion(s).
3. Profile(s) of the diversion(s) that include both the channel bottom and supporting ridge top.
4. Disposal requirements for excess soil material.
5. Vegetative establishment requirements.

VII. OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for use by the client. Include specific instructions for maintaining diversion capacity, storage of runoff water, ridge height, and outlets in the plan.

The minimum requirements to be addressed in the operation and maintenance plan are—

1. Provide periodic inspections, especially immediately following significant storms.
2. Promptly repair or replace damaged components of the diversion as necessary.
3. Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment-yielding regions are in the drainage area above the diversion. Establish necessary clean-out requirements.
4. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
5. Redistribute sediment as necessary to maintain the capacity of the diversion.
6. Maintain vegetation and trees and control brush by hand, chemical, and mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.
7. Control pests that will interfere with the timely establishment of vegetation.
8. Keep machinery away from steep-sloped ridges. Keep equipment operators informed of all potential hazards.

VIII. REFERENCES

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

USDA, NRCS. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 9, Diversions.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STRUCTURE FOR WATER CONTROL

Code 587

(No.)

I. DEFINITION

A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

II. PURPOSE

Apply this practice as a component of a water management system to control the stage, discharge, distribution, delivery, or direction of water flow.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies to a permanent structure needed as an integral part of a water control system to serve one or more of the following functions:

Convey water from one elevation to a lower elevation within, to, or from a water conveyance system such as a ditch, channel, canal, or pipeline. Typical structures include drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.

Control the elevation of water in drainage or irrigation ditches. Typical structures include checks, flashboard risers, and check dams.

Control the division or measurement of irrigation water. Typical structures include division boxes and water measurement devices.

Keep trash, debris or weed seeds from entering pipelines. Typical structures include trash racks and debris screens.

Control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structures include tide and water management gates.

Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection, or manage water levels for wildlife or recreation. Typical structures include water level control structures, flashboard risers, pipe drop inlets, and box inlets.

Convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures include bridges, culverts, flumes, inverted siphons, and long span pipes.

Modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures include chutes, cold water release structures, and flashboard risers.

Provide silt management in ditches or canals. Typical structures include sluice gates and sediment traps.

Supplement a resource management system on land where organic waste or commercial fertilizer is applied.

Create, restore, or enhance wetland hydrology.

IV. CRITERIA

All structures designed under this standard must comply with applicable Federal, Tribal, State, and local laws, rules, and regulations. Obtain all required permits before construction begins.

Construction specifications and/or drawings will specify that NRCS be provided copies of all required permits prior to construction. Excavation or embankment work within or near streams and wetlands may require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Bismarck Regulatory Office 701-255-0015). Projects that disturb more than 1 acre are required to develop a Stormwater Pollution Prevention Plan, and submit it along with a Notice of Intent to the ND Department of Health (stormwater@nd.gov). Projects within the ordinary high water mark of navigable lakes and streams require a Sovereign Lands Permit from the ND State Water Commission (sovereignlands@nd.gov). Ensure that proposed embankments and/or overall site gradings involving fill do not increase the Base Flood (100-year recurrence interval) Elevation within Special Flood Hazard Areas (SFHA) by more than the allowable as defined by the local County Floodplain Administrator. Obtain a floodplain development permit through the local County Floodplain Administrator and the ND State Water Commission Floodplain Management Regulatory Program as necessary.

In addressing the National Environmental Policy Act (NEPA) for conservation practices within or near wetlands, sequencing must be conducted as per Executive Order 11990 included in Section G. Wetlands of the NRCS-CPA-052. Sequencing must include avoiding impacts if feasible. If avoidance is not feasible, a determination will be made using the North Dakota Minimal Effect Evaluation Worksheet. If the effects are determined to be minimal, the determination will be included in the NRCS-CPA-052. If the determination is not minimal, wetland mitigation must be completed. Implementation of the conservation practice(s) impacting the wetland(s) may begin upon obtaining all signatures on the wetland mitigation plan and agreement.

Follow the North Dakota Century Code Section 61-04-02 requirement that structures with a water storage capacity (spillway elevation) exceeding 12.5 acre-feet secure a water permit from the SWC prior to construction or modification activities. The SWC Water Appropriates Division oversees Applications for Conditional Water Permits (SFN 60157). In these instances, construction specifications developed for the project should specify that NRCS be provided a copy of the water permit prior to construction.

Follow the North Dakota Century Code Section 61-04-02 requirement that structures with a water storage capacity (spillway elevation) less than 12.5 acre-feet notify the state engineer (SWC) of the location and capacity of such constructed works, dams, or dugouts. The SWC Water Regulatory Division oversees notifications of structure constructions (SFN 51695). In these instances, construction specifications developed for the project should specify that NRCS be provided a copy of the notification prior to construction.

A. General Criteria Applicable to All Purposes

Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with the criteria in NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342). When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in CPS Mulching (Code 484) to install inorganic cover material such as gravel. **The structure shall be fenced, if cattle are grazed in the area, to protect the vegetation.**

Do not raise the water level upstream of water control structures on adjacent landowners without their permission. **Structures shall not be installed that have an adverse effect on septic filter fields. Structures must be designed to control erosion, keep upstream water levels within planned limits, and take into account the effects of freezing ambient temperatures. Where manufactured structures are used, the hydraulic design shall be provided by the manufacturer. Reinforcement products such as articulated concrete block and turf reinforcement mats, can be used in exit channels- see CPS 468 (Lined Waterway**

Outlet) for design guidance.

All water impoundment structures built under this practice shall meet the requirements of practice standard Pond (378).

All stream crossing structures built under this practice shall meet the requirements of practice standard Stream Crossing (578).

All irrigation water control structures built under this practice shall be designed to supply or measure the irrigation application rates as determined by CPS 443- Irrigation System Surface and Subsurface, CPS 442- Irrigation System Sprinkler, or CPS 441- Irrigation System Microirrigation.

B. Criteria for Drainage Water Management/Subsurface Drainage Systems

The drainage water management system shall be designed in accordance with practice standard Drainage Water Management (554). A water management strategy shall be developed, including target water levels, for applicable crop rooting depths, while meeting non-cropped period operational requirements from practice standard 554. Operational requirements are for managed drainage model within 30 days after season's final field operation, and until at least 30 days before commencement of the next season's field operations.

The rate of outflow and the level of the water table shall be controlled by structures or pumps. Structures or pumps shall be located where they are accessible and subject to convenient control. Designs of critical components shall be in accordance with pertinent NRCS Practice Standards.

Water level control structures shall be sized to provide adequate drainage flow and not to restrict drainage capacity. Drainage flows shall be calculated to adequately design the system. Applicable computer models (i.e. DrainMod) or drainage equations (i.e. van Schilfgaarde or those outlined in Chapter 4 of NEH Section 16, Drainage of Agricultural Land) shall be used for subsurface drain system outflows. The water level control structure shall be designed so as to allow the water table to fluctuate to satisfy the intended purpose. Connect at least 20 feet of solid pipe to the control structure on both the upstream and downstream sides.

C. Structural Design Criteria

Structure designs shall be based on site surveys, required hydraulic function during normal operations and anticipated internal/external loads including hydrostatic uplift, surcharge loads, surface and impact loads, stability during flood and ice jam events, avoidance of downstream erosion, sediment transport, and efficient operation and maintenance.

1. **Geologic investigations for foundations shall be completed, as outlined in NEH Part 631, and appropriate for the project. The geologic investigation shall provide adequate data to support foundation design computations, and evaluate the need for structure cutoffs, drainage, foundation reinforcement, or slope stabilization measures.**
2. **Foundation design will address bearing capacity, sliding, overturning, uplift, settlement, and piping potential. Cutoff requirements shall be determined by use of NEH Section 11, Lane's Theory of Weighted Creep, or flow net procedures outlined in NRCS Soil Mechanics Technical Note 5, Flow Net Construction and Use.**
3. **Lateral earth pressures should be calculated based on NRCS Technical Release 210-74. Small structures may be designed utilizing presumptive lateral earth pressure values in CPS 313- Waste Storage Facility or Table 6.2-1 NEH Section 6.**
4. **Concrete structures shall be designed based the American Concrete Institute 350 Code Requirements for Environmental Engineering Concrete Structures.**
5. **Steel structures shall be galvanized or epoxy coated, and be designed based on the Manual for Steel Construction (American Institute of Steel Construction) or the Handbook of Steel Drainage and Highway Construction Products (American Iron and Steel Institute).**
6. **Timber structures will be designed based on the National Design Specification for Wood Construction.**

D. Safety

Design measures necessary to prevent serious injury or loss of life in accordance with requirements of Title 210, National Engineering Manual (NEM), Part 503, Safety.

E. Cultural Resources

Evaluate the existence of cultural resources in the project area and any project impacts on such resources. Provide conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

V. CONSIDERATIONS

Consider the following items when planning, designing, and installing this practice:

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Potential for a change in the rate of plant growth and transpiration because of changes in the volume of soil water.
3. Effects on downstream flows or aquifers that would affect other water uses or users.
4. Effects on the field water table to ensure that it will provide a suitable rooting depth for the anticipated crop.
5. Potential use for irrigation management to conserve water.
6. Effect of construction on aquatic life.
7. Effects on stream system channel morphology and stability as it relates to erosion and the movement of sediment, solutes, and sediment-attached substances carried by runoff.
8. Effects on the movement of dissolved substances below the root zone and to ground water.
9. Effects of field water table on salt content in the root zone.
10. Short term and construction-related effects of this practice on the quality of downstream water.
11. Effects of water level control on the temperatures of downstream waters and their effects on aquatic and wildlife communities.
12. Effects on wetlands or water-related wildlife habitats.
13. Effects on the turbidity of downstream water resources.
14. Conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.
15. **Saturated buffer and denitrifying bioreactors as primary outlet from structure for water control. These shall be designed in accordance with practice standard Saturated Buffer (604) and Denitrifying Bioreactor (605), respectively. Saturated buffer and denitrifying bioreactors reduce nitrate levels from subsurface agricultural drainage flow to improve water quality of receiving water bodies. Saturated buffer can be used to create, restore, and enhance wetlands; therefore, can be used in conjunction with practice standards Wetland Restoration (657), Wetland Creation (658), and Wetland Enhancement (659).**
16. **Where necessary, design seepage collars or filter diagrams along outlet conduits to reduce likelihood of internal erosion failure mode along conduit.**

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include—

1. A plan view of the layout of the structure for water control.
2. Typical profiles and cross sections of the structure for water control.
3. Structural drawings adequate to describe the construction requirements.
4. Requirements for vegetative establishment and mulching, as needed.
5. Safety features.
6. Site-specific construction and material requirements.

VII. OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

1. Periodic inspections of all structures, earthen embankments, spillways, and other significant appurtenances.
2. Prompt removal of trash from pipe inlets and trash racks.
3. Prompt repair or replacement of damaged components.
4. Prompt removal of sediment when it reaches predetermined storage elevations.
5. Periodic removal of trees, brush, and undesirable species.
6. Periodic inspection of safety components and immediate repair if necessary.
7. Maintenance of vegetative protection and immediate seeding of bare areas as needed.

REFERENCES

USDA NRCS. National Engineering Handbook (NEH), Part 636, Structural Engineering. Washington, DC.

USDA NRCS. NEH, Part 650, Engineering Field Handbook. Washington, DC.

USDA NRCS. National Engineering Manual. Washington, DC.

USDA SCS. May 1971. National Engineering Handbook, Section 16. Washington, D.C.

Appendix C
Site Forms and Imagery

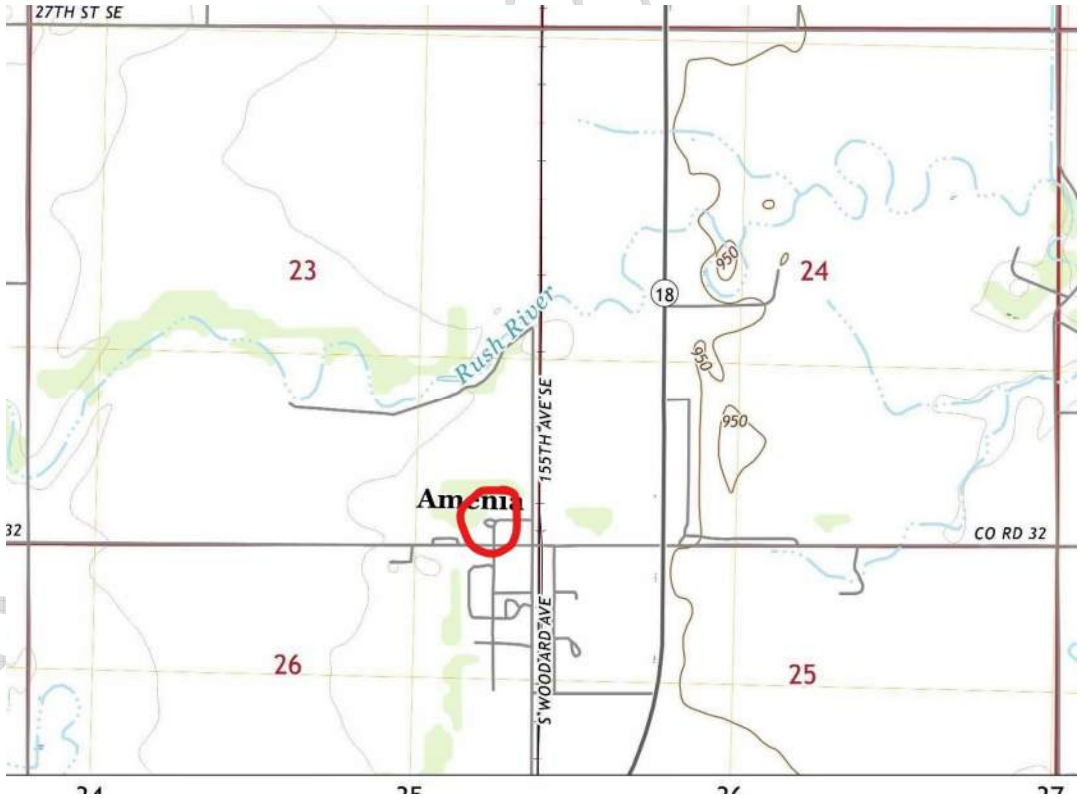
South Side NRCS 20017001

East Side Oblique South Side NRCS 20017001

West Side Oblique South Side NRCS 20017001

North Side South Side NRCS 20017001

Chimney East Side Image facing Northwest NRCS 20017001



USGS Topographic map Arthur Quad (2017)

Image Source: https://ngmdb.usgs.gov/

NDCRS *ARCHITECTURAL* SITE FORM
PAGE 1

UPDATE

Field Code _____ **SITS# 32** 32 5120

SITE IDENTIFICATION

Map Quad ARTHUR Site Name REED HOUSE
Map Quad _____ Site Name _____

LTL	TWP 141	R 52	SEC 23	QQQ 7	QQ 7	Q 7
LTL	TWP	R	SEC	QQQ	QQ	Q
LTL	TWP	R	SEC	QQQ	QQ	Q
LTL	TWP	R	SEC	QQQ	QQ	Q

NAD 1983, UTM 5207466 **N** **ZONE** 14N
NAD 1983, UTM 635271 **E**

Subsection:
1 = N½
2 = E½
3 = S½
4 = W½
5 = NE¼
6 = SE¼
7 = SW¼
8 = NW¼

City: AMENIA

Street Number: _____

Street Name: REED STREET

Urban Legal Description: _____

SITE DATA

Total # ***Architectural*** Features: 1

Fieldwork Date: **05/20/2020**

Reconnaissance Survey ✓ Intensive Survey ___

Project & Principal Investigator:

Amenia Levee System-Christopher A. Plount

Report Title & Author(s):

Cultural Resources Survey: Rush River-Amenia South Levee Alternative
Christopher A. Plount

Contracting firm or Agency completing the form:

US Department of Agriculture Natural Resources Conservation Service North Dakota State Office

Additional Information:

UPDATE TO SITE FORM DATED 10/05/1980 BY LORNA MEIDINGER
EXCEPTING THE UPDATED CONDITION ALL INFORMATION COPIED FROM ORIGINAL

SHSND USE

Area of Significance_____ Ecozone _____ Verified Site _____ CR Type _____
Area of Significance_____ Ecozone _____
Area of Significance_____ Ecozone _____

Recorded By CHRISTOPHER A. PLOUNT **Date Recorded** 05/20/2020
(First Name & Last Name) (mm/dd/year)

Instructions to complete this form: (1) Download ; (2) Save A Copy; (3) Submit a paper copy of the form to the SHSND and a PDF version of the form and corresponding GIS shapefiles to the FTP site of the SHSND.

NDCRS *ARCHITECTURAL* SITE FORM
PAGE 2—*Feature Data*

UPDATE

Field Code _____ SITS# 32 32 5120

Complete one Page 2 for *each* architectural feature at the site.

Architectural Feature # 1

Construction Date _____ Feature Type 40 Condition 6

Feature Date 2 Context 30 Plan Shape 5

Structural System 25 Primary Exterior 26 Style Gabled Front: L/T

Original Owner's Ethnicity _____ Secondary Exterior N/A Architect/Builder _____

Other Information: _____

Foundation STONE SURROUNDED BY CREAM BRICK Stories 2.5

Roof/Cornice GABLE

Window ORIGINAL AND REPAIRED

Dating Method(s): ORIGINAL SITE FORM

***Feature* Preservation Recommendation(s) (Check all that apply):**

___ Individual nomination

___ Contributes to a potential district

___ No nomination potential

___ Will not contribute to a district

___ Potential district—feature would be a contributing element if other properties constitute a district

___ Thematic nomination potential

___ Component of a historic site or landscape

___ Moved (specify all applicable choices)—a) relocation occurred within a historic period; b) recreates original site, orientation, landscape, & spatial relationships; c) compatible in context with neighboring structures; d) relocation has damaged eligibility

✓ Historical associations require further investigation

Recorded By CHRISTOPHER A. PLOUNT **Date Recorded** 05/20/2020
(First Name & Last Name) (mm/dd/year)

Instructions to complete this form: (1) Download ; (2) Save A Copy; (3) Submit a paper copy of the form to the SHSND and a PDF version of the form and corresponding GIS shapefiles to the FTP site of the SHSND.

NDCRS *ARCHITECTURAL* SITE FORM
PAGE 3—*Feature Data*

UPDATE

Field Code _____ SITS# 32 32 5120

Complete a Page 3 for each feature.

1. *Feature* Description, Integrity, Eligibility:

Features mentioned on original site form are germane with the following additions:

There appears to be a stone foundation that is surrounded by cream and red brick.

The brick portion is being cannibalized.

Chimney in need of repair.
Shingles are in need of replacement.

Front porch is beginning to sag on the east side. The porch enclosures appear to be installed after the original construction. Porch posts are lathe turned posts.

Interview with Keith Peltier- GM ProSeed- proffered that structure may be in foreclosure and bank owned.

Site rests within the boundary of a proposed levee system that will encompass Town of Amenia. No direct effect to the structure and during summer months the levee will not be visible but fall/winter will will have a visual effect due to leaf loss creating a clear line of sight.

Recorded By CHRISTOPHER A. PLOUNT **Date Recorded** 05/20/2020
(First Name & Last Name) (mm/dd/year)

Instructions to complete this form: (1) Download ; (2) Save A Copy; (3) Submit a paper copy of the form to the SHSND and a PDF version of the form and corresponding GIS shapefiles to the FTP site of the SHSND.

NDCRS *ARCHITECTURAL* SITE FORM
PAGE 4—*SITE DESCRIPTION*

UPDATE

Field Code _____ **SITS# 32 32 5120**

Complete one Page 4 for the entire *site*.

2. Owner's Contact Information:

3. Access (to rural areas):
ONE MILE WEST OF INTERSECTION HIGHWAY 32 AND 18 CASS COUNTY NORTH DAKOTA

4. Site Area (**ft²**): _____

5. Description of ***SETTING***:
TOWN OF AMENIA

Recorded By CHRISTOPHER A. PLOUNT **Date Recorded** 05/20/2020
(First Name & Last Name) (mm/dd/year)

Instructions to complete this form: (1) Download ; (2) Save A Copy; (3) Submit a paper copy of the form to the SHSND and a PDF version of the form and corresponding GIS shapefiles to the FTP site of the SHSND.

NDCRS *ARCHITECTURAL* SITE FORM
PAGE 5—*SITE DESCRIPTION*

UPDATE

Field Code _____ SITS# 32 **32** **5120**

6. *Summary of ALL* Site Features & Evaluation of Significance:

Significance undetermined. Structure would benefit from evaluation and research by qualified architectural archaeologist/historian.

7. References/Comments:

Site form 32CS5120

Recorded By **CHRISTOPHER A. PLOUNT** **Date Recorded** **05/20/2020**
(First Name & Last Name) **(mm/dd/year)**

Instructions to complete this form: (1) Download ; (2) Save A Copy; (3) Submit a paper copy of the form to the SHSND and a PDF version of the form and corresponding GIS shapefiles to the FTP site of the SHSND.

32CS5120 Southeast Oblique facing Northwest

32CS5120 South West Oblique facing Northeast

32CS5120 East Oblique Facing Southwest

32CS5120 Porch Brick Removal

32CS5120 Brick Removal from Structure Foundation

32CS5120 East Porch and Brick Removal

Appendix D-6 CPA-52 Environmental Evaluation

U.S. Department of Agriculture Natural Resources Conservation Service	NRCS-CPA-52 11/2019	A. Client Name: Cass County Joint Water Resource District
ENVIRONMENTAL EVALUATION WORKSHEET		B. Conservation Plan ID # (as applicable): Program Authority (optional):
D. Client's Objective(s) (purpose): The purpose of the proposed action is to reduce the flood risk for the City of Amenia by removing surface water inundation from the Rush River during the 1 percent annual chance flood, within the city limits.		C. Identification # (farm, tract, field #, etc. as required):

E. Need for Action:	H. Alternatives		
	No Action √ if RMS ☐	*Alternative 1* √ if RMS ☐	*Alternative 2* √ if RMS ☐
Amenia has historic flood risks with overbank flooding from the Rush River, ice jams, and overland flooding.	No change from existing conditions; current flooding conditions.	Dike (356), would be constructed around the north, west, and south sides of the city of Amenia to provide flood protection to residents during a 100-year, 24-hour event. A stormwater pond (378), pump (533) and lined waterway (468) would be developed for Levee Alternative 1 to capture floodwaters and runoff from approximately 180 surface acres within the levee system.	Dike 362would be constructed on the south side of the Rush River, approximately 0.13 miles north of the city of Amenia. A stormwater pond would be developed for Levee Alternative 2 to capture floodwaters and runoff from approximately 860 surface acres in the immediate vicinity of the levee precluded from draining directly to the river by levee construction.

Resource Concerns

In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process. (See FOTG Section III - Resource Planning Criteria for guidance).

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. Effects of Alternatives					
	No Action		*Alternative 1*		*Alternative 2*	
	Amount, Status, Description *(Document both short and long term impacts)*	√ if does NOT meet PC	**Amount, Status, Description** *(Document both short and long term impacts)*	√ if does NOT meet PC	**Amount, Status, Description** *(Document both short and long term impacts)*	√ if does NOT meet PC
SOIL						
Wind erosion Wind erosion will occur during construction phase.	No change from existing conditions.	☐ NOT meet PC	Temporary and permanent impacts from construction activities due to compaction from heavy equipment could occur. Soil erosion may occur if areas of soil remain exposed and bare during and after construction activities. This willl be for a short dutration and alleveated once construction is complete.	☐ NOT meet PC	Temporary and permanent impacts from construction activities due to compaction from heavy equipment could occur. Soil erosion may occur if areas of soil remain exposed and bare during and after construction activities.	☐ NOT meet PC
Compaction Compaction will occur during construction phase.	No change from existing conditions.	☐ NOT meet PC	Compacted areas will be under the dike and no longer farmed and therefore no longer a resource concern. Areas affected by construction not under the dike will have compaction reduced due to cropping systems.	☐ NOT meet PC	Compacted areas will be under the dike and no longer farmed and therefore no longer a resource concern. Areas affected by construction not under the dike will have compaction reduced due to cropping systems.	☐ NOT meet PC
WATER						
Ponding and flooding Current history of flooding over numerous years.	No change from existing conditions will result in continued environmental and property damages.	☐ NOT meet PC	Reduced risk from 100-year flood event for approximately 93 acres. Potential increased risk of flooding from completion of the levee system for approximately 72 additional acres. Overall decrease of flooding during a 100-year event for approximately 21 acres of land.	☐ NOT meet PC	Reduced risk from 100-year flood event for approximately 188 acres. An additional levee on the east side of the city of Amenia may be necessary. Potential increased risk of flooding from completion of the levee system for approximately 140 additional acres. Overall decrease of flooding during a 100-year event for approximately 48 acres of land. Potential impacts from constructing approximately 1,345 feet of the levee within the 100-year floodplain.	☐ NOT meet PC

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)					
	No Action		*Alternative 1*		*Alternative 2*	
	Amount, Status, Description *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**
Sediment transported to surface water Rush River is listed as impaired for fecal coliform, fish bioassessments, physical substrate habitat alteraions, and sedimentation/siltation.	No change from existing conditions.	☐ NOT meet PC	Potential impacts from sedimentation/siltation of downstream waterways during construction activities and until soils are stabilized; potential reduction in downstream sediment/nutrient delivery during stormwater pond operations.	☐ NOT meet PC	Potential impacts from sediment and sediment-related pollutants within or adjacent to the Rush River floodplain during construction activities and until soils are stabilized; potential reduction in downstream sediment/nutrient delivery during stormwater pond operations.	☐ NOT meet PC
AIR						
No resource concern identified		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
PLANTS						
Invasive Species Two noxious weed species were identified within the study area: Canada thistle (Cirsium arvense) and leafy spurge (Euphorbia esula).	Noxious weeds will contiue to be present with no management.	☐ NOT meet PC	Potential impacts from soil disturbance and importing soil-carrying weed seeds during construction activities. Weeds will be controlled after project installation.	☐ NOT meet PC	Potential impacts from soil disturbance and importing soil-carrying weed seeds during construction activities. Weeds will be controlled after project installation.	☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
ANIMALS						
Aquatic habitat for fish and other organisms Existing habitat includes agricultural areas, river, and small wetlands.	No change from existing conditions.	☐ NOT meet PC	Removal of trees, increased noise, and human activity during construction of the levee system could impact habitat or disrupt some wildlife species. The stormwater pond could provide additional habitat for some fish and wildlife species.	☐ NOT meet PC	Removal of trees from within the riparian area along the Rush River could alter habitat for some fish and wildlife species. Temporary impacts could occur from increased noise and human activity. The stormwater pond could provide additional habitat for some fish and wildlife species.	☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
ENERGY						
No resource concern identified		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)					
	No Action		*Alternative 1*		*Alternative 2*	
	Amount, Status, Description *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**
Human Economic and Social Considerations						
Public Health and Safety Access to emergency services can be impeded or delayed due to road closures and detours associated with flooding.	No change from exising conditions.		Reduced risk from 100-year flood events would minimize future road closures, delays, and detours within the levee system. Placement and removal of temporary levees over the road and railroad crossings would briefly restrict access for emergency services. Approximately 72 additional acres outside of the levee system would be at greater risk from flooding.		Reduced risk from 100-year flood events would minimize future road closures, delays, and detours within the levee system. Approximately 140 additional acres would be at greater risk from flooding as a result of the construction of the levee system.	
Social Issues Social issues centered on agriculture	No change from exising conditions. The city of Amenia would not be eligible for exemption from purchasing flood insurance.		Temporary disruption of transportation systems and agricultural practices during construction activities. Residents and businesses within the levee system would be exempt from purchasing flood insurance.		Temporary disruption of transportation systems and agricultural practices during construction activities. Residents and businesses within the levee system would be exempt from purchasing flood insurance.	
Other Amenia Park and snowmobile in APE.	No change from exising conditions.		Construction of the levee system would protect Amenia Park from 100-year flood events. Approximately 0.2 miles of an existing snowmobile trail would be impacted by placement of the levee system.		Compared to Levee Alternative 1, protections for Amenia Park would be less for future 100-year flood events. Impacts to the snowmobile trail are not anticipated.	
Land Use Periodic flooding conditions would continue to impact infrastructure and exisisting land uses.	No change from exising conditions.		Construction impacts: Permanent removal of approximately 4 acres of prime farmland and approximately 0.9 acres of forested land. Temporary impacts to approximately 37 acres of prime farmland are anticipated during construction. Operational impacts: Flood protection for 48 properties within the city of Amenia. Permanent modifications would be required to three road crossings and one railroad crossing.		Construction impacts: Permanent removal of approximately 8 acres of prime farmland and approximately 0.3 acres of forested land. Temporary impacts to approximately 11 acres of prime farmland are anticipated during construction. Operational impacts: Flood protection for 48 properties within the city of Amenia.	
Other Local traffic and agriculture related noise in APE.	No change from exising conditions.		Temporary construction-related noise impacts anticipated.		Temporary construction-related noise impacts anticipated.	

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.

In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. Items with a "●" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.

G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action		*Alternative 1*		*Alternative 2*	
	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action
●Clean Air Act *Guide Sheet* North Daktoa has no identified non-attainement areas.	NA	☐	NA	☐	NA	☐
●Clean Water Act / Waters of the U.S. *Guide Sheet*	No Effect No change from existing conditions.	☐	May Effect If wetlands identified as being impacted by the project are deemed as jurisdictional by the USACE, a 404 permit would be necessary.	☐	May Effect If wetlands identified as being impacted by the project are deemed as jurisdictional by the USACE, a 404 permit would be necessary.	☐
●Coastal Zone Management *Guide Sheet* Not applicable to North Dakota	NA	☐	NA	☐	NA	☐
Coral Reefs *Guide Sheet* Not applicable to North Dakota	NA	☐	NA	☐	NA	☐

G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action		***Alternative 1***		***Alternative 2***	
	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action
●Cultural Resources / Historic Properties *Guide Sheet*	No Effect No change from existing conditions.	☐	May Effect Known sites present. A Class II or III field survey will be needed to be conducted during permitting to avoid or minimize potential impacts.	☐	May Effect Known sites present. A Class II or III field survey will be needed to be conducted during permitting to avoid or minimize potential impacts.	☐
●Endangered and Threatened Species *Guide Sheet* According to USFWS, the following federally-listed species could be present in APE and it's vicinity: whooping crane (federally endangered), , and northern long-eared bat (federally threatened).	No Effect No change from existing conditions.	☐	No Effect According to USFWS, the following federally-listed species could be present in APE and it's vicinity: whooping crane (federally endangered), and northern long-eared bat (federally threatened). Unlikely potential effect on northern long-eared bats from removing trees that serve as habitat. Temporary impacts from increased noise and human activity during construction could disrupt whooping crane and gray wolf in the unlikely event they are present within the vicinity of the levee system. USFWS Programmatic will be followed.	☐	No Effect According to USFWS, the following federally-listed species could be present in APE and it's vicinity: whooping crane (federally endangered),, and northern long-eared bat (federally threatened). Unlikely potential effect on northern long-eared bats from removing trees that serve as habitat. Temporary impacts from increased noise and human activity during construction could disrupt whooping crane and gray wolf in the unlikely event they are present within the vicinity of the levee system. USFWS Programmatic will be followed.	☐
Environmental Justice *Guide Sheet*	No Effect Based on the EJScreen review, the study area does not qualify for environmental justice considerations as either a minority or low-income population.	☐	No Effect Based on the EJScreen review, the study area does not qualify for environmental justice considerations as either a minority or low-income population.	☐	No Effect Based on the EJScreen review, the study area does not qualify for environmental justice considerations as either a minority or low-income population.	☐
●Essential Fish Habitat *Guide Sheet*	No Effect No Essential Fish Habitat in vicinity.	☐	No Effect No Essential Fish Habitat in vicinity.	☐	No Effect No Essential Fish Habitat in vicinity.	☐
Floodplain Management *Guide Sheet*	No Effect Existing flooding conditions would continue.	☐	No Effect There would be an overall decrease of land flooded during a 100-year flood event.	☐	No Effect There would be an overall decrease of land flooded during a 100-year flood event.	☐
Invasive Species *Guide Sheet*	No Effect No change from existing conditions.	☐	No Effect	☐	No Effect	☐
●Migratory Birds/Bald and Golden Eagle Protection Act *Guide Sheet*	No change from existing conditions.	☐	May Effect The alternatives may remove suitable habitat for migratory birds as a result of tree removal. However, no take of migratory birds, including eagles is anticipated. No bald or golden eagles or nests have been identified in the vicinity USFWS programmatic will be followed	☐	May Effect The alternatives may remove suitable habitat for migratory birds as a result of tree removal. However, no take of migratory birds, including eagles is anticipated. No bald or golden eagles or nests have been identified in the vicinity. USFWS Programmatic Agreement will be followed.	☐
Natural Areas *Guide Sheet*	No Effect No designated natural areas present.	☐	No Effect No designated natural areas present.	☐	No Effect No designated natural areas present.	☐

G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action		***Alternative 1***		***Alternative 2***	
	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action
Prime and Unique Farmlands *Guide Sheet*	No Effect No change from existing conditions.	☐	May Effect The majority of Amenia is classified as prime farmland or prime farmland if drained. There is no way to avoid prime farmland in placement of the levee system. Construction of the levee would result in permanent removal of approximately 4 acres of prime farmland.Construction impacts: Permanent removal: - 7 acres cultivated cropland - 4 acres prime farmland Temporary impact during construction: - 43 acres cultivated cropland - 37 acres prime farmland Operational impacts: Flood protection for approximately 31 acres of cultivated cropland, including 64 acres of prime farmland, and 11 acres of prime farmland if drained and increased risk to approximately 55 acres of cultivated cropland, including 40 acres of prime farmland, and 17 acres of prime farmland if drained outside the levee system. During operation of the levee a net increase of 24 acres of prime farmland would be protected from 100-year flood events.	☐	May Effect The majority of Amenia is classified as prime farmland or prime farmland if drained. There is no way to avoid prime farmland in placement of the levee system. Construction of the levee would result in permanent removal of approximately 8 acres of prime farmland. Construction impacts: Permanent removal: - 7 acres cultivated cropland - 4 acres prime farmland Temporary impact during construction: - 43 acres cultivated cropland - 37 acres prime farmland Operational impacts: Flood protection for approximately 31 acres of cultivated cropland, including 64 acres of prime farmland, and 11 acres of prime farmland if drained and increased risk to approximately 55 acres of cultivated cropland, including 40 acres of prime farmland, and 17 acres of prime farmland if drained outside the levee system. During operation of the levee a net increase of 24 acres of prime farmland would be protected from 100-year flood events.	☐
Riparian Area *Guide Sheet* Riparian Area is in the APE.	No Effect No change from existing conditions.	☐	May Effect Tree clearing in the riparian area would be required during construction.	☐	May Effect Direct and indirect impacts to riparian areas include tree clearing and other vegetation removal for the construction of the levee system.	☐
Scenic Beauty *Guide Sheet*	No Effect No change from existing conditions.	☐	No Effect	☐	No Effect	☐
•Wetlands *Guide Sheet*	No Effect No change from existing conditions.	☐	May Effect Loss in wetland acreage and wetland function will be mitigated off site through a Ducks Unlimited wetland mitigation bank. The 0.56 acres of permanently impacted wetlands will be replaced at a 2:1 ratio. A total of 1.12 acres of wetland credits will be purchased.	☐	May Effect Approximately 0.56 acres of permanent wetland impacts and approximately 1.59 acres of temporary impacts are anticipated from construction activities. Operation of the levee would remove approximately 1.1 acres of wetlands from flooding from a 100-year event while potentially increasing flooding on approximately 0.2 additional acres.	☐
•Wild and Scenic Rivers *Guide Sheet* Not applicable to private land in North Dakota	No Effect No Wild and Scenic Rivers in vicinity.	☐	No Effect No Wild and Scenic Rivers in vicinity.	☐	No Effect No Wild and Scenic Rivers in vicinity.	☐

K. Other Agencies and Broad Public Concerns		No Action	Alternative 1	Alternative 2
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted				
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)		As a result of the scoping process and discussions with resource agencies and interested groups, no past, present, or reasonably foreseeable projects that would result in cumulative impacts were identified for this project.	As a result of the scoping process and discussions with resource agencies and interested groups, no past, present, or reasonably foreseeable projects that would result in cumulative impacts were identified for this project. However, a wetland mitigation project associated with this project would be implemented to offset impacts to wetlands due to functional replacement.	As a result of the scoping process and discussions with resource agencies and interested groups, no past, present, or reasonably foreseeable projects that would result in cumulative impacts were identified for this project. However, a wetland mitigation project associated with this project would be implemented to offset impacts to wetlands due to functional replacement.
L. Mitigation (Record actions to avoid, minimize, and compensate)				
M. Preferred Alternative	Preferred alternative	☐	☑	☐
	Supporting reason		Alternative 1 meets the purpose and need in that it provides a certified levee system, allowing the residents of the city of Amenia an exemption from purchasing federal flood insurance and a reduction in risk from a 100-year flood event. Alternative 1 enhances environmental quality by removing the risk of property and infrastructure damage within the city of Amenia, providing continued floodplain management, and reducing sediment and nutrient runoff with the incorporation of a stormwater pond and buffer strips. Additionally, Alternative 1 cost estimates are lower than Alternative 2.	
N. Contax (Record contax of alternativas analysis)		City of Amenia	City of Amenia	City of Amenia

Tha significance of an action must be anelyzad in sevaral contexts such as sociaty as e whola (human, national), the affected region, the affected interasts, and tha locality.

O. To tha best of my knowledge, the date shown on this form is accurate and completa:

In the casa whera a non-NRCS person (e.g. a TSP) assists with planning thay are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.

Signature (TSP if applicable)	Title	Dete
TODD SCHWAGLER Digitally signed by TODD SCHWAGLER Date: 2020.06.16 07:34:46 -05'00'	State Resource Conservationist	4/2/2020
Signature (NRCS)	**Title**	**Dete**

If preferred altarnativa is not a federal action whera NRCS has control or rasponsibility end this NRCS-CPA-52 is shared with somaona othar than the cliant then indicata to whom this is being provided.

The following sections are to be completed by the Responsible Federal Official (RFO)

NRCS is the RFO if the action is subject to NRCS control and responsibility (e.g., actions financed, funded, assisted, conducted, regulated, or approved by NRCS). These actions do not include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance and situations where NRCS is making a technical determination (such as Farm Bill HEL or wetland determinations) not associated with the planning process.

P. Determination of Significance or Extraordinary Circumstances

To answer the questions below, consider the severity (intensity) of impacts in the contexts identified above. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.

Yes	No	
☐	☑	• Is the preferred alternative expected to cause significant effects on public health or safety?
☐	☑	• Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?
☐	☑	• Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial?
☐	☑	• Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment?
☐	☑	• Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration?
☐	☑	• Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time?
☐	☑	• Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species.
☐	☑	• Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment?

Q. NEPA Compliance Finding (check one) The preferred alternative:		Action required
☐	1) is not a federal action where the agency has control or responsibility	Document in "R.1" below. No additional analysis is required.
☐	2) is a federal action **ALL** of which is **categorically excluded** from further environmental analysis **AND** there are **no extraordinary circumstances as identified in Section "O"**.	Document in "R.2" below. No additional analysis is required.
☐	3) is a federal action that has been **sufficiently analyzed** in an existing Agency state, regional, or national NEPA document **and** there are no predicted significant adverse environmental effects or extraordinary circumstances.	Document in "R.1" below. No additional analysis is required.
☐	4) is a federal action that has been sufficiently analyzed in another Federal agency's NEPA document (EA or EIS) that addresses the proposed NRCS action and its' effects **and has been formally adopted by NRCS**. NRCS is required to prepare and publish its own Finding of No Significant Impact for an EA or Record of Decision for an EIS when adopting another agency's EA or EIS document. **(Note: This box is not applicable to FSA)**	Contact the State Environmental Liaison for list of NEPA documents formally adopted and available for tiering. Document in "R.1" below. No additional analysis is required.
☑	5) is a federal action that has **NOT** been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.

R. Rationale Supporting the Finding	
R.1 Findings Documentation	
R.2 Applicable Categoncal Exclusion(s) **(more than one may apply)** 7 CFR Part 650 *Compliance With NEPA*, subpart 650.6 *Categorical Exclusions* states prior to determining that a proposed action is categorically excluded under paragraph (d) of this section, the proposed action must meet six sideboard criteria. See NECH 610.116.	

I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy and based on that made the finding indicated above.

S. Signature of Responsible Federal Official:

TODD SCHWAGLER Digitally signed by TODD SCHWAGLER Date: 2020.06.16 07:35:21 -05'00'	State Resource Conservationist	4/2/2020
Signature	**Title**	**Date**

Additional notes