Houston-Moore Group HMG

Fargo-Moorhead Metro Diversion Project

Utility Relocation Plans
Reaches 1 through 3

Prepared for: US Army Corps of Engineers

Prepared by: HMG, LLC

Date: August 8, 2012

925 10th Ave E • West Fargo • ND • 58078 | (701) 282-4692

Memorandum

To: R. Greg Fischer
From: Chris Gross
Subject: Task Order No. 10
Date: 8/8/2012
Project: Fargo-Moorhead Diversion

Re: Utility Relocation Plans – Reaches 1 through 3

Purpose:
The purpose of this memo is to provide the USACE with preliminary utility relocation plans for the Fargo-Moorhead Metro Diversion Project (the "Project"), specifically Reaches 1 through 3. Further, this memorandum has been revised to address questions and comments that the USACE posted during their initial review process of the draft memorandum provided on July 16, 2012. The responses to the USACE's questions and comments can be found throughout the text of this memo and/or in the appendices.

Location:
Reaches 1 through 3 of the Project is an area of the channel that starts at the outlet to the Red River and continues southwesterly to the West side of Interstate 29 or channel Station 325+00. A map of this location is included in Appendix A.

History:
Houston-Moore Group (HMG) was contracted by the FM Flood Diversion Authority (the Authority) to identify and field locate existing utility facilities impacted by the Project, coordinate meetings with utility companies impacted by the Project, obtain existing easement documents for impacted utilities, and assist utility companies in preparing utility relocation plans for the utility facilities impacted by the Project.

On June 7, 2012, a kickoff meeting was held with representatives from HMG, representatives from CH2M Hill, the Project Management Consultant (PMC), and representatives from six utility companies. The utility companies in attendance included: Cass County Electric, Cass Rural Water, Centurylink, Magellan, Midcontinent Communications, and Minnkota Power. A list of attendees along with contact information for each utility company is included in Appendix B. An update of the current Project status was given to each company, maps were reviewed, and the process of creating relocation plans was discussed. Discussions were limited to only utility facilities.

Existing Crossings:
There are a total of 19 existing utility crossings that will be impacted by the Project in these Project reaches. Impacted utility facilities include six rural water lines, four single phase/3-phase electrical distribution power lines (both overhead and underground), six telecommunications lines, one high pressure petroleum line, and two 3-phase electrical transmission power lines. Maps showing the locations of existing utilities are included in Appendix C. Each utility company reviewed their existing facilities and determined how to best maintain their systems while minimizing the number of necessary

diversion crossings. A result of this review is that six of the existing crossings will be eliminated during design to minimize the number of crossings placed under the channel and EMBs. The result of the elimination of crossings will ultimately be a cost savings to the Project. The eliminated crossings include four rural water lines, one single phase electrical distribution line, and one telecommunications line.

Proposed Crossings:

and/or abandon their own facilities. Neither the USACE's nor the Diversion Authority's contractors will be required to relocate or abandon existing utilities, however, the abandoned underground power lines will need to be removed from the Project footprint by the USACE's contractor during construction of the channel. Overhead power lines and poles, existing pedestals, and existing gate valves will be removed and/or relocated by the individual utility companies. All utilities are proposed to be relocated prior to the start of channel construction. As stated above, six existing utility crossings will be eliminated during final design. The remaining utilities will either be placed underground or lowered at their existing location with the exception of the two electrical transmission lines that will remain overhead and will be realigned to cross the Project at a perpendicular angle. Further, the two overhead electrical transmission lines will span the entire footprint of the Project and will not have structures installed inside the EMBs. The table below lists each crossing by its location, Owner, type of utility being relocated, the existing stationing of each utility, the proposed crossing to be relocated, and the approximate stationing of each relocated utility. All horizontal borings under the channel and EMBs will be in compliance with the Memorandum for Record ("MFR") and its attachments. A copy of the MFR can be found in Appendix D.

Location (S-T-R)	Owner	Existing Crossing Type	Existing Stationing	Proposed Crossing Type	Proposed Stationing
35-142N-49W	Cass Rural Water	1 ½" water pipe	55+00	None	N/A
35-142N-49W	Cass Rural Water	3" water pipe	84+00	3" water pipe	86+50
3-141N-49W	Cass Rural Water	1 ½" water pipe	154+00	None	N/A
9-141N-49W	Cass Rural Water	2" water pipe	204+00	None	N/A
17-141N-49W	Cass Rural Water	1 ½"water pipe	305+00	None	N/A
17/20-141N-49W	Cass Rural Water	6" water pipe	309+00	6" water pipe	309+00
36-142N-49W	Cass County	Single phase UG	40+00	None	N/A
36-142N-49W	Cass County	Single phase UG	52+00	Single phase UG	52+00
10-141N-49W	Cass County	Single phase OH	203+00	Single phase UG	203+00
17/20-141N-49W	Cass County	Three-phase OH	310+00	Three-phase UG	310+00
36-142N-49W	Centurylink	One 6-pair copper	40+00	None	N/A
36-142N-49W	Centurylink	One 6-pair copper	52+00	One 6-pair copper	52+00
10-141N-49W	Centurylink	Two 25-pair copper	156+00	One 50-pair copper	164+00
10-141N-49W	Centurylink	Two single pair copper	202+50	One 3-pair copper	213+00
16-141N-49W	Centurylink	One 11-pair copper	285+00	One 25-pair copper	290+00
17/20-141N-49W	Centurylink	6 fiber (toll line)	310+00	6 fiber (toll line)	310+00
17/20-141N-49W	Magellen	6" petroleum	296+00	6" petroleum	296+00
35-142N-49W	Minnkota Power	69 kV transmission	55+00	69 kV transmission	100+00
9/16-141N-49W	Minnkota Power	69 kV transmission	210+00	69 kV transmission	259+00

Cost Estimates:

All impacted utilities provided cost estimates for relocating and/or abandoning their facilities through the Project. The total cost to relocate the impacted utilities in Reaches 1 through 3 is estimated by the utility companies at $3,435,000. The total estimated cost associated with each utility company affected is shown below. A more detailed breakdown of these estimated costs can be found in the individual utility company relocation plans that are attached as appendices to this memorandum.

Cass Rural Water	$180,000
Cass County Electric	$348,000
Centurylink	$137,000
Magellan	$900,000
Minnkota Power	$1,870,000
Total Estimated Cost	$3,435,000

Timelines:

All utility companies propose that they be noticed as soon as possible so that they may begin their final engineering, design, and cost estimating. After that time, material ordering and construction may begin. Cass Rural Water will require 2 months to complete the relocation work, Centurylink and Magellan will require 3 months to complete the relocation work, and Cass County Electric and Minnkota Power will require 12 months to complete the relocation work. More detail on each company's timeline can be found in the appendices.

Sincerely,
Houston-Moore Group, LLC

Christopher M. Gross, PE
Project Engineer

Cc Jon Diebel
Cc Mark Lambrecht

Enclosures – Appendix A through I

CMG
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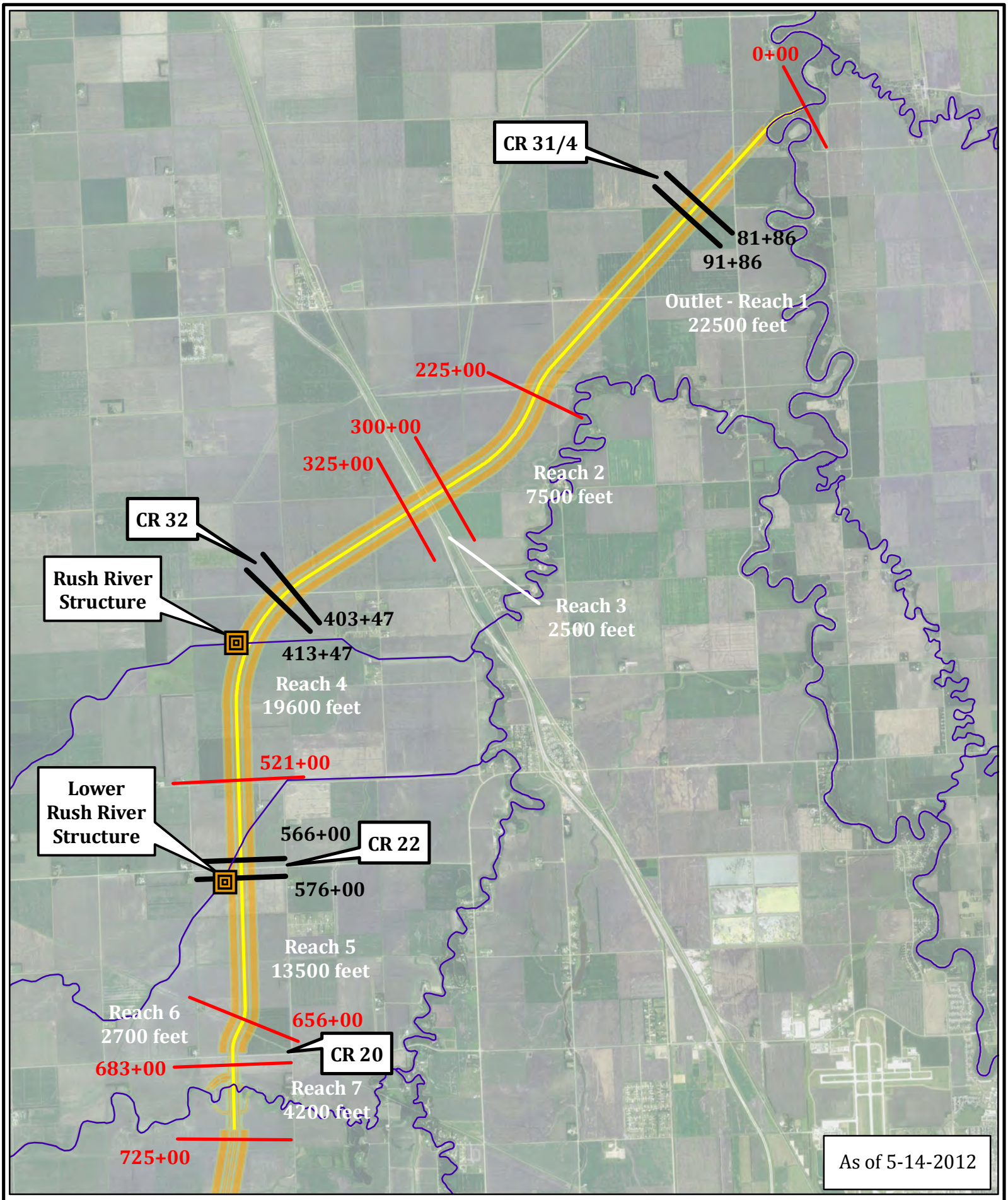
Appendix A – Project Reach Map



Design Reaches
Fargo Moorhead Metro Study

St. Paul District GIS CENTER
US Army Corps of Engineers

0 0.5 1 2 3 4 Miles

N

FIGURE 1

IFW \\mvp-netapp2\shares\Shares2\projects\SA\SA_Fargo_Moorhead_Metro(PED)-370365\GIS\MXDs - 14MAY2012

Appendix B – List of Attendees

Kickoff Meeting – June 7, 2012

moore engineering, inc.

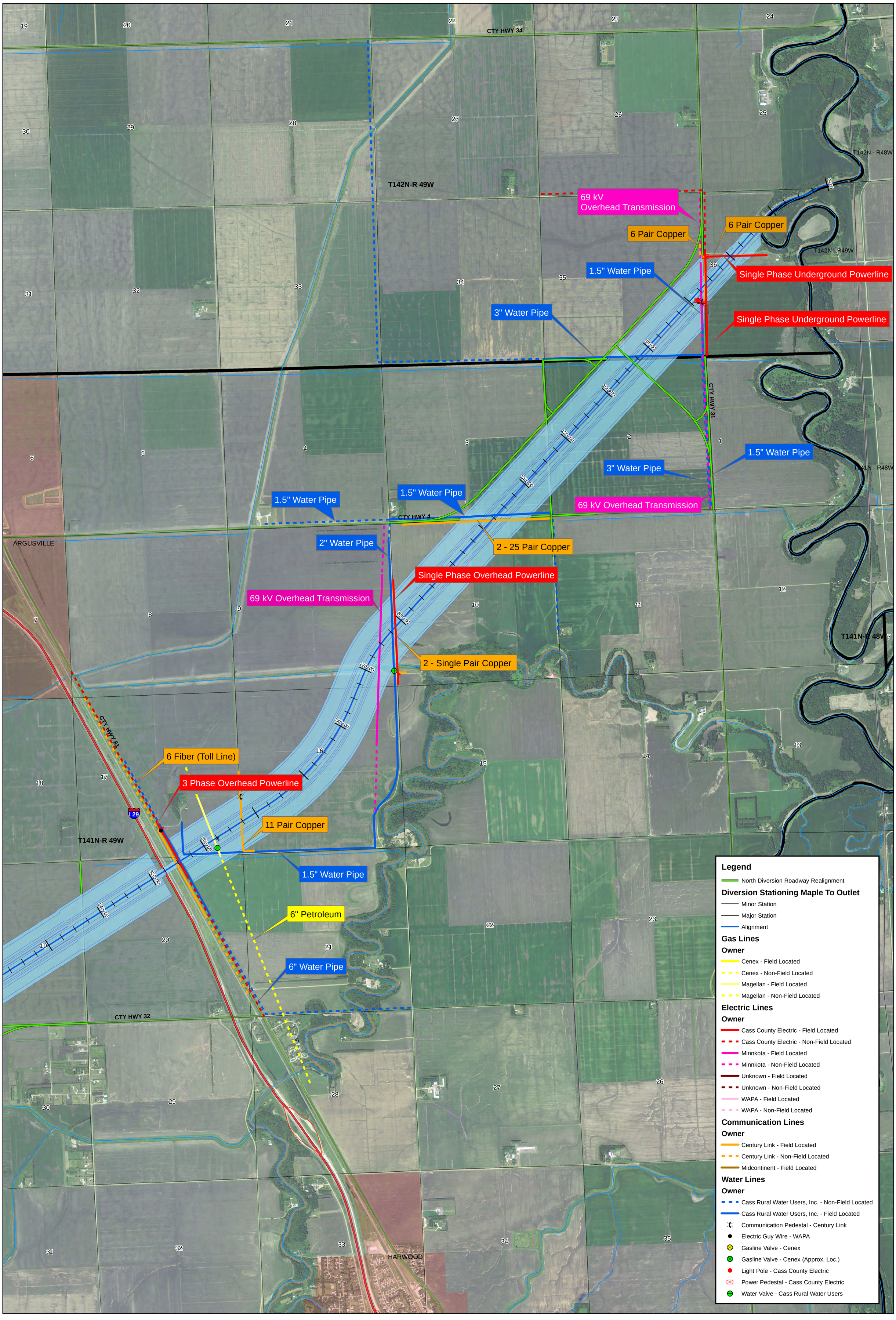
sign-in sheet

Fargo-Moorhead Metropolitan Study

Date: June 7, 2012 *Time: 1:00-5:00 PM*

name	representing	phone	email
Kyle Volk	HMG	(701) 499-5861	kvolk@mooreengineeringinc.com
Mark Lambrecht	AE2S	(701) 746-8087	mark.lambrecht@ae2s.com
Kenn Haugen	CCEC	(701) 356-4467	khaugen@kwh.com
Daryl Brandt	CCEC	(701) 356-4476	dbrandt@kwh.com
Cindy Titus	PMC-CH2M Hill	(907) 947-2665	cindy.titus@ch2m.com
John Diebel	PMC-CH2M Hill	(303) 888-3486	jon.diebel@ch2m.com
Chris Gross	HMG	(701) 499-5857	cgross@mooreengineeringinc.com
Tyler Johnson	HMG	(701) 499-5890	tjohnson@mooreengineeringinc.com
John Thompson	MPC	(701) 795-4320	jmthompson@minnkota.com
Paul Klabunde	Magellan Pipeline	(701) 793-8377	paul.klabunde@magellanlp.com
Corey Wixo	Midcontinent Communications	(701) 212-5682	corey_wixo@mmi.net
Brendan Christenson	CenturyLink	(701) 241-3771	brendan.christenson@centurylink.com
Gregg Christensen	Cass Rural Water	(701) 428-3139	gregg.christensen@cassruralwaterdistrict.com

Appendix C – Existing Utilities Map



UTILITY MAP - OVERVIEW
FM METRO DIVERSION
CASS COUNTY, NORTH DAKOTA

Created By: GZ, EM, DMR Created: 12/20/2011 Date Updated: 08/08/2012 Date Printed: 08/09/2012
Parcel Date: N/A Aerial Image: 2010 County SIDS Elevation Data: IWI Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
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N W E S

0 600 1,200 2,400 3,600 Feet

1 in = 1,400 feet

HMG

69 kV
Overhead Transmission

6 Pair Copper

6 Pair Copper

Single Phase Underground Powerline

1.5" Water Pipe

3" Water Pipe

Single Phase Underground Powerline

1.5" Water Pipe

3" Water Pipe

69 kV Overhead Transmission

T142N-R 49W

T142N - R49W

T141N - R49W

T141N-R 49W

CTY HWY 31

CTY HWY 4

26

25

27

35

34

36

3

2

1

11

10

20+00

40+00

80+00

100+00

120+00

Legend

North Diversion Roadway Realignment

Diversion Stationing Maple To Outlet

Minor Station

Major Station

Alignment

Gas Lines

Owner

Cenex - Field Located

Cenex - Non-Field Located

Magellan - Field Located

Magellan - Non-Field Located

Electric Lines

Owner

Cass County Electric - Field Located

Cass County Electric - Non-Field Located

Minnkota - Field Located

Minnkota - Non-Field Located

Unknown - Field Located

Unknown - Non-Field Located

WAPA - Field Located

WAPA - Non-Field Located

Communication Lines

Owner

Century Link - Field Located

Century Link - Non-Field Located

Midcontinent - Field Located

Water Lines

Owner

Cass Rural Water Users, Inc. - Non-Field Located

Cass Rural Water Users, Inc. - Field Located

Communication Pedestal - Century Link

Electric Guy Wire - WAPA

Gasline Valve - Cenex

Gasline Valve - Cenex (Approx. Loc.)

Light Pole - Cass County Electric

Power Pedestal - Cass County Electric

Water Valve - Cass Rural Water Users

UTILITY MAP - OVERVIEW
FM METRO DIVERSION
CASS COUNTY, NORTH DAKOTA

Created By: GZ, EM, DMR Created: 12/20/2011 Date Updated: 08/08/2012 Date Printed: 08/01/2012
Parcel Date: N/A Aerial Image: 2010 County SIDS Elevation Data: IWI Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
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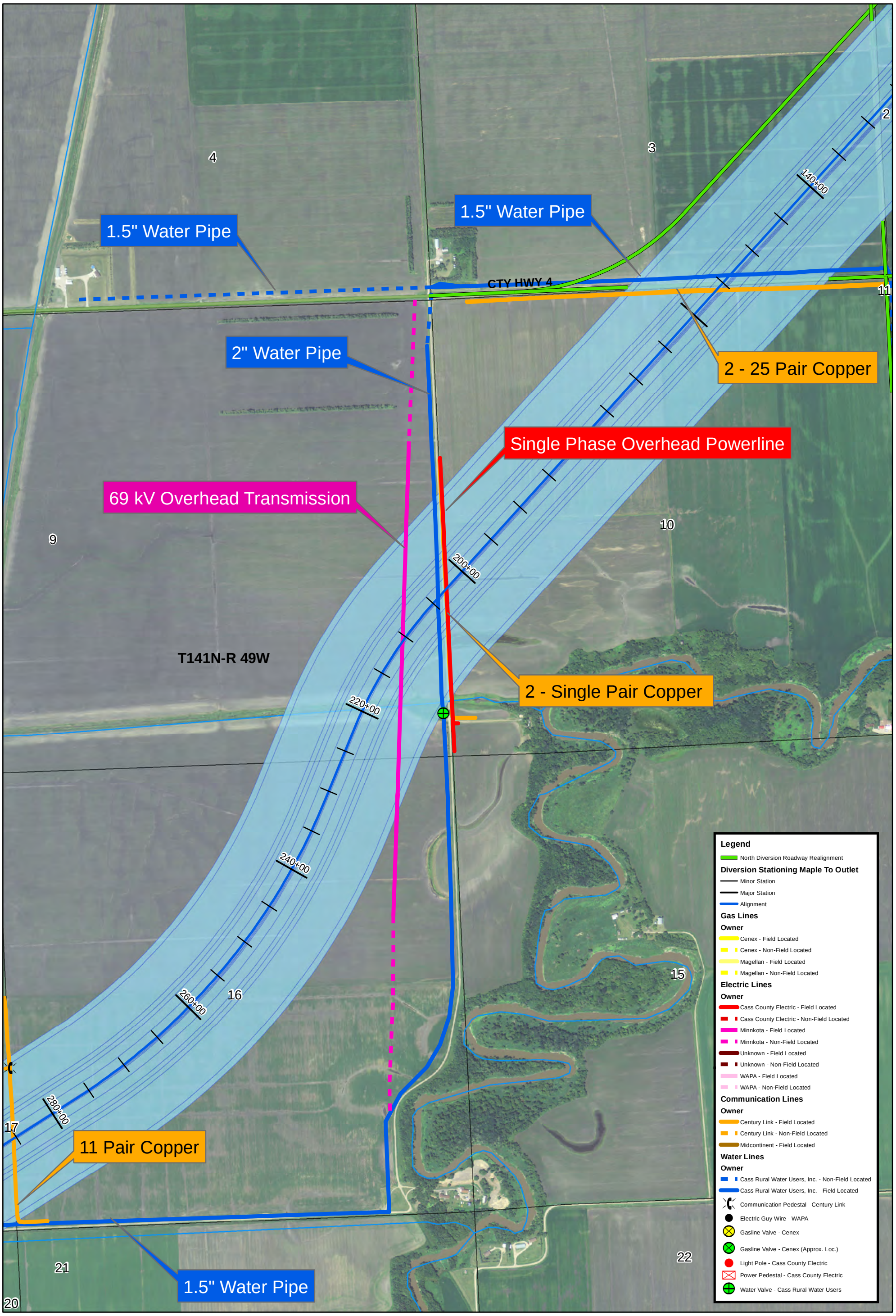
N W E S

0 300 600 1,200 Feet

1 in = 1,000 feet

HMG



UTILITY MAP - OVERVIEW
FM METRO DIVERSION
CASS COUNTY, NORTH DAKOTA

Created By: GZ, EM, DMR Created: 12/20/2011 Date Updated: 08/08/2012 Date Printed: 08/01/2012
Parcel Date: N/A Aerial Image: 2010 County SIDS Elevation Data: IWI Lidar
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N W E S

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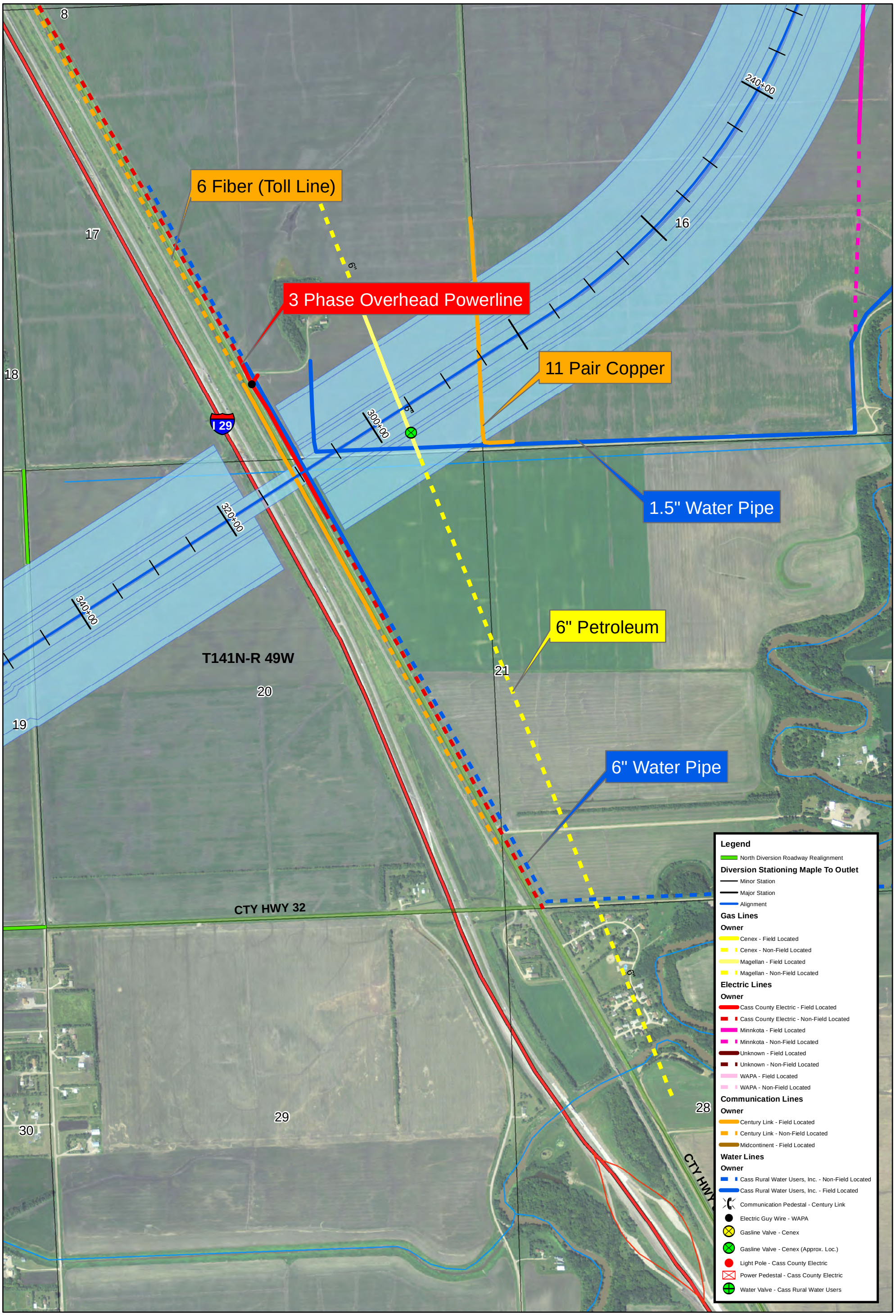
1 in = 1,000 feet

HMG



UTILITY MAP - OVERVIEW
FM METRO DIVERSION
CASS COUNTY, NORTH DAKOTA

Created By: GZ, EM, DMR Created: 12/20/2011 Date Updated: 08/08/2012 Date Printed: 08/01/2012
Parcel Date: N/A Aerial Image: 2010 County SIDS Elevation Data: IWI Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
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N
W E
S

0 300 600 1,200
Feet
1 in = 1,000 feet

HMG

Appendix D – Memorandum for Record

Fargo-Moorhead Metropolitan Area Flood Risk Management Utility Relocation Requirements

MEMORANDUM FOR RECORD

SUBJECT

Fargo-Moorhead Metropolitan Area Flood Risk Management Utility Relocation Requirements

REFERENCE

EM 1110-2-1913, Design and Construction of Levees

PURPOSE OF THIS MFR

This memorandum discusses general requirements for utility relocations within the FMM Flood Risk Management Project. These requirements will aid impacted utility owners in developing a relocation plan. These requirements are general; each utility relocation shall be reviewed by the Corps of Engineers (COE) on a case-by-case basis.

The proposed diversion project consists of a wide, deep diversion channel flanked on both sides by excavated material berms (Berms) and drainage channels. In addition, a levee will be included within the right bank (facing downstream) berm. To facilitate project completion, all existing utilities within the project work limits shall be either temporarily or permanently relocated outside grading limits prior to the start of construction activities. Utilities not permanently relocated prior to construction, shall be relocated after substantial completion of project features or during construction with prior COE approval.

This memorandum does not discuss proposed utility crossings of "Tieback Embankments" near the diversion inlet on the upstream end of the project. Requirements for these crossings will be discussed in a separate Memorandum for Record.

RESPONSIBILITIES

The COE shall be responsible for the flood diversion project design, identification of potential utility conflicts and for review and comment on utility relocation plans. The Local Sponsor shall be responsible for coordination with utility owners impacted by the proposed project and insuring that utility relocation plans are developed in a timely manner to insure relocations and abandonments are completed prior to diversion channel construction. The COE design schedule requires submittal of preliminary utility relocation plans a minimum of 30 days prior to the applicable diversion channel reach 65% design completion date.

ALIGNMENT

Utility owners shall develop a plan for relocation of utilities (electric, water, sewer, communication, gas, etc.) that cross or lie within the limits of the proposed work. Utility companies shall submit proposed utility relocation plans to the COE for review and comment prior to utility relocation construction. It is desired that the number of utility crossing locations be minimized, so the use of utility corridors where multiple utilities cross on the same general

location, is encouraged. If possible, all proposed utility crossings shall be aligned to cross perpendicular to the channel centerline at the crossing location. Variations to the crossing angle may be dictated by field conditions and the location of connecting utilities. Final crossing location and orientation relative to the proposed channel alignment shall be approved by the COE during project design stages.

Because of the large project footprint, and the need to keep the footprint clear of encroachments, overhead utility crossings within project limits will be limited to utility corridors at bridge locations. This requirement may be waived for electrical transmission lines where relocation to corridors at bridge crossings would be considered impractical due to cost or other considerations. All overhead utility crossings and relocations within the limits of the project shall be approved by the COE prior to construction.

ABANDONMENT AND REMOVAL

Responsible utility companies shall disconnect, cap and abandon existing underground utility lines located within the project limits. Abandoned underground utility lines will be removed as necessary by the Flood Risk Management Project construction Contractor. Underground utility lines not scheduled for removal by the Contractor, shall be capped and grouted in place. Abandoned underground lines may be removed by the utility owner prior to construction with approval of the COE. Overhead utility lines and poles shall be removed from project limits by the responsible utility owner prior to construction.

CONSTRUCTION

1. Diversion Channel Crossings

a. Depth: The depth of channel excavation for most areas of the project exceeds 20 feet at channel center. It is anticipated that some erosion of the channel may occur and an assumption that 5 feet of erosion occurs shall be used when locating the minimum elevation of the utilities. Heavy equipment will operate within the channel during construction and during future maintenance activities. To protect utilities from erosion and equipment surface loads, utilities crossing below the channel should be located a minimum of 10 feet below the low flow channel invert. Utilities susceptible to freezing (water & sewer) shall be located a minimum of 12.5 feet below the low flow channel invert.

b. Method of Construction: Utilities placed in this area can be directionally drilled or open cut.

    i. When installed using an open cut, bedding of utility lines within the pipe zone shall be in accordance with State and Local guidance/regulations. Backfill above the pipe zone shall consist of material excavated for utility placement. At a minimum, the COE requires backfill to be compacted to 90% maximum density. It is suggested that laboratory tests for moisture-density relations be made in accordance with ASTM D698 (Standard Proctor); and field density tests be

determined in accordance with ASTM D 2167 (Rubber Balloon Method) or ASTM D 6938 (Nuclear Method), the density test results shall be verified by performing an ASTM D 1556 density test at the start of the job and for every 10 ASTM D 6938 density tests.

ii. When installed using directional drilling, drilling practices shall be in accordance with ASTM F 1962.

c. Calculations are required to show that the line has adequate strength/flexibility to withstand heavy equipment loading during construction and possible future channel maintenance.

2. Levee Crossings

a. Method of Construction: Both open cut and horizontal directional drilling are acceptable methods.

i. If open cut is utilized, the trench shall extend beneath and 20' beyond the proposed levee prism. At the COE's discretion, the new utility line may be required to be encased in Controlled Low-Strength Material (CLSM) (specification attached). When CLSM is required, the new utility line shall be placed on firm ground at the bottom of the trench and CLSM shall be placed in the trench to 1 foot above the top of pipe. The trench above the CLSM shall be backfilled with material excavated from the trench. At a minimum, the COE requires backfill to be compacted to 90% maximum density. It is suggested that laboratory tests for moisture-density relations be made in accordance with ASTM D698 (Standard Proctor); and field density tests be determined in accordance with ASTM D 2167 (Rubber Balloon Method) or ASTM D 6938 (Nuclear Method), the density test results shall be verified by performing an ASTM D 1556 density test at the start of the job and for every 10 ASTM D 6938 density tests.

ii. If horizontal directional drilling is utilized, it shall be accomplished pursuant to the attached "Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling", June 2002 and the St. Paul District's "Requirements for Horizontal Directional Drilling Under a Flood Barrier in the Red River Valley." The pipe entry or exit location shall be located no less that 300' from the centerline of the proposed levee on the protected side of the levee, and no less that 20' from the centerline of the levee on the unprotected (channel) side.

b. Depth: Depth of lines shall be a minimum of 10 feet below existing ground.

c. Geotechnical analyses indicate that foundation materials are generally cohesive materials not susceptible to piping. Calculations are required to show that the line has adequate strength/flexibility to withstand the expected loading/settlement. Levees will be up to 15 feet high and settlement of the foundation materials is expected.

3. Excavated Material Berm/Local Drainage Ditch Crossings (Below and 50 feet beyond the proposed Berm/Ditch)

a. Method of Construction: Utilities placed in this area can be directionally drilled or open cut.

i. When installed using an open cut, bedding of utility lines within the pipe zone shall be accordance with State and Local guidance/regulations. Backfill above the pipe zone shall consist of material excavated for utility placement. At a minimum, the COE requires backfill to be compacted to 90% maximum density. It is suggested that laboratory tests for moisture-density relations be made in accordance with ASTM D698 (Standard Proctor); and field density tests be determined in accordance with ASTM D 2167 (Rubber Balloon Method) or ASTM D 6938 (Nuclear Method), the density test results shall be verified by performing an ASTM D 1556 density test at the start of the job and for every 10 ASTM D 6938 density tests.

ii. When installed using directional drilling, drilling practices shall be in accordance with ASTM F 1962.

b. Depth: Depth of bury shall be set by the utility company assuming that the area under the material berm will be stripped of topsoil (average thickness 18"– 24") prior to berm construction, and heavy equipment will be operated over the entire area. The excavated material berm will be up to 15 feet high, and could possibly be excavated to existing ground at some point in the future. In addition, there will be local drainage ditches constructed along the outside toe of the berm; ditches may be constructed to a depth of 6 feet or more below grade. It is recommended that the depth of bury for utilities in this area be a minimum of 3.5 feet below stripped topsoil, and 3.5 feet below ditch inverts where utilities cross drainage ditches. In the case of water and sewer lines that must be protected from frost, the recommended minimum depth should be 7.5 feet below stripped topsoil depth and 7.5 feet below ditch inverts at ditch crossings.

c. Calculations are required to show that each utility line has adequate strength/flexibility to withstand the expected loading/settlement. Berms will be up to 15 feet high and settlement of the foundation materials is expected.

4. Other Areas

a. Utility crossings for all areas not covered by levee, berm or channel crossing shall be designed to withstand heavy loading from construction equipment and shall meet minimum frost protection depths as required.

b. Utilities running parallel to the channel alignment must be located a minimum of 20 feet outside the outer most toe of levee/berm/ditch as applicable.

5. Submittal Requirements: Note that the Corps may take up to 30 days to review and accept

submittal documents. Acceptance is required before relocation construction commences.

a. Alignments as described in paragraph ALIGNMENT above
b. Design calculations (as necessary)
c. Locations of utility line markers or above ground appurtenances
d. Work Plan: Indicate the intended sequence of work. Describe how connection to existing utility line will be accomplished. Include the type of and number of pieces of equipment that will be used during construction. Include a schedule which outlines construction, testing and start-up dates.
e. Testing reports:

i. Results of leak and/or burst test testing, and any other testing shall be submitted;
ii. When directional drilling is used submittals and testing referenced in "Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling", Chapter 2, paragraph "Permit Application Submittal" will be required. (Please note that the utility will not be applying for a COE permit as mentioned in this document. For this project, the COE will be approving submittals in lieu of issuing a permit).

f. Product Data-Materials: Pipe, valves, fittings & appurtenances.
g. As-Built Drawings: Submit As-Built drawings for the complete utility line relocation showing complete detail, including trench dimensions, pipe profile, valve locations, connection box locations, manholes, etc..
h. The Corps of Engineers shall be notified a minimum of 30 days prior to start of construction. COE may view and inspect the relocation during construction, and shall be allowed access to the site to perform such activities.
i. Letter from designer of record verifying that project design meets all applicable governmental, COE and industry design standards.

RAPID CLOSURE VALVES

The need for rapid closure valves is dependent upon the type of utility relocation. Generally, rapid closure valves will be required on each side of pressure pipe crossings. The purpose of the valves is to provide pipeline isolation in the event of leakage, rupture, repairs or relocation. The rapid closure valves shall be located a minimum of 20 feet beyond the outermost project feature (i.e., levee, berm or drainage ditch).

CASING FOR UTILITY LINES

It is recommended that all pressurized utility lines (sewer, water and gas) crossing under the channel and levee be cased. The use of casing pipe should also be considered for other utility crossings. In general, casing pipe material shall be limited to one that can be joined together continuously, while maintaining sufficient strength to resist the high tensile stresses imposed during the pullback operation. When used, the COE recommends the use of HDPE or steel pipe. All casing specifications shall be submitted to the COE for review and comment prior to installation.

Casings shall serve the following two purposes:

1) If a line ruptures under the project, the casing pipe protects the project from damage from the escaping fluids and;

2) If a line needs repair, the carrier pipe can be pulled and repaired/replaced, then installed back within the casing pipe; avoiding the need for excavation to repair utility lines.

MAINTENANCE AND ABANDONMENT PLAN

Responsible utility owners shall prepare a maintenance and abandonment plan for all utilities located within the limits of the subject project. The plan shall address applicable facility maintenance, leakage, repair (if applicable) and abandonment. All piping shall be provided with metallic marking tape or other applicable passive marking system to facilitate utility location by field personnel for future maintenance and repair.

CROSSING IDENTIFICATION

Color coded fiberglass service line marker posts shall be provided for all underground utilities at each crossing point (wet and dry side). Markers (Length 72"; width 1".) shall identify service lines, valves & underground property

AS BUILT REQUIREMENTS

Utility owner shall provide As-Built plans and As-Built survey data to COE for all relocations within the limits of the subject project. As-Built drawings shall be submitted in electronic format (Microstation is preferred). SDSFIE-compliant survey point data shall be submitted in ASCII text or shape file format. FGDC-compliant metadata files shall be submitted which describes, in general, when the as-built survey was conducted, who conducted the survey, how it was conducted, and the accuracy of the survey data. Surveys should be done in the project spatial reference system:

NAD83 (NSRS2007), North Dakota State Plane Coordinate System, South Zone
NAVD 88 (GEOID09)
US Survey Feet

SIGNATURES:

5/16/12

Terry Williams Date
Project Manager, MVP
USACE

5/17/12

Marsha Mose Date
Chief, Design Branch, MVP
USACE

5-16-12

Gary Wolf Date
Co-Technical Manager, MVP
USACE

31 MAY 2012

Bruce Spiller Date
CH2MHill
Sponsor's Program Management Consultant

ATTACHMENTS

1. Guidance Pertaining to Horizontal Directional Drilling Under a Flood Barrier/Channel
2. Draft Controlled Low-Strength Material (CLSM) Specification
3. Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling.

ATTACHMENT 1

Guidance Pertaining to Horizontal Directional Drilling Under a Flood Barrier/Channel

GUIDANCE

Pertaining to

Horizontal Directional Drilling Under a Flood Barrier/Channel

The following information and guidance pertains to horizontal directional drilling (HDD) under an engineered flood barrier (i.e floodwall, levee embankment, diversion channel).

The two primary concerns with horizontal directional drilling (HDD) beneath a levee or floodwall are:

1. Hydrofracturing (drilling fluid pressure exceeding the tensile strength of the soil) the foundation soils beneath the flood barrier during drilling operations.

2. Development of a preferential seepage path along the pipeline/utility after installation.

Generally, the COE would require the following information in the permit application for any utilities installed by HDD that pass beneath a flood barrier.

1. Proposed drill path alignment (both plan and profile views).

2. Location of entry and exit points.

3. Proposed depth of cover.

4. Diameter of the borehole, diameter of pipe and type of pipe to be installed, if used, or diameter of utility.

5. Proposed method to fill annulus.

6. Location, elevations, and clearances of all utility crossings and structures.

Based on our recent experience, we feel comfortable with the following recommendations/guidelines:

- Allow the Contractor to proceed without actively monitoring the drill pressures. Suggest that only fresh drilling mud be used. It may not be necessary to insist on this provision depending on the length of flood barrier to be traversed, however it will be easier to maintain a proper viscosity if clean mud is used.

- If “mud motor” HDD technology is used, hold the density of the drilling fluid as close as possible to 8.4 lbs/gallon (or 45seconds/quart in a Marsh Funnel).

- Bentonite can be used to fill the annulus.

- Generally, depth of burial should be at least 10 feet below grade where the utility passes under the flood barrier.

- Fluid jetting methods should not be used as a means of cutting beneath a flood protection project.

- The Contractor will be responsible for repairing any soil fracturing, drilling fluid reaching the surface, etc. as well as any slope failure resulting from the drilling process. The Contractor should note any spots where fluid loss occurs, and the COE should get a record of the amount of fluid loss as well as the location.

- Prior to commencing, the Contractor should explain their method for maintaining directional control during drilling operations. In other words, how will he/she verify where the bit is horizontally and vertically so that it does not accidentally wander beneath the levee foundation any more than absolutely necessary?

- The Contractor should provide an "as-built" drawing upon completion of the directional drilling and installation of the line. This drawing should include alignment & profile data.

- It should be plainly stated that any foundation or flood barrier damage resulting from the directional drilling will be repaired by the Contractor to City/Gov't. specifications at Contractor expense.

- The Contractor should be informed that the suspension of the requirement to actively monitor downhole pressures does not relieve them of the ultimate responsibility of leaving the flood barrier foundation in the same condition, as it was before the horizontal drilling procedure was undertaken.

ATTACHMENT 2

Draft Controlled Low-Strength Material (CLSM) Specification

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SECTION 03 22 70.01 13

CONTROLLED LOW-STRENGTH MATERIAL (CLSM)
04/12

PART 1 GENERAL

1.1 REFERENCES

All publications referenced shall be the most current version, edition, standard, latest revision, or reapproval unless otherwise stated. The following publications and standards listed below will be referred to only by the basic designation thereafter, and shall form a part of this specification to the extent indicated by the references thereto:

ASTM INTERNATIONAL (ASTM)

ASTM C 33/C 33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C 94	(2011b) Ready-Mixed Concrete
ASTM C 150	(2011) Standard Specification for Portland Cement
ASTM C 220	(1991; R 2009) Standard Specification for Flat Asbestos-Cement Sheets
ASTM C 618	(2008) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 685	(2010) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 940	(2010a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM D 4832	(2010) Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D 5971	(2007) Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material
ASTM D 6023	(2007) Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)
ASTM D 6103	(2004) Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

1.2 DESIGN REQUIREMENTS

Controlled Low-Strength Material (CLSM) mixture proportion shall consist of 100 pounds or less of portland cement plus fly ash per cubic yard; pozzolan; sand; water; and a fluidifier, if required to obtain the required slump. The CLSM fill mixture proportion shall have a flow consistency of more than 8 inches. The flow consistency shall be determined in accordance with ASTM D 6103. CLSM fill shall have a compressive strength of 100 psi at 28 days. The compressive strength of the CLSM shall be determined in accordance with ASTM D 4832 after being made and cured in accordance with ASTM D 4832. The mixture proportions shall be reported in accordance with ASTM C 94. If the CLSM is to be placed using a concrete pump, the mixture proportions shall be designed so that it will not segregate in the pump line under pressure or when there is an interruption in flow.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Data

On-Site Batching and Mixing

Water Reducing

Concrete Mixture Proportions

The Contractor shall submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for all equipment and materials.

SD-07 Schedules

Placing

The methods and equipment for transporting, handling, and depositing the CLSM backfill and CLSM fill shall be submitted to the Contracting Officer prior to the first placement.

SD-08 Statements

Concrete Mixture Proportions

CLSM mixture proportions shall be the responsibility of the Contractor and shall be designed in accordance with the criteria in paragraph DESIGN REQUIREMENTS. Ten days prior to placement of CLSM, the Contractor shall submit to the Contracting Officer the mixture proportions that will produce CLSM of the qualities required. Mixture proportions shall include the dry weights of cementitious material(s); and saturated surface-dry weights of the fine aggregate; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project.

SD-09 Reports

CLSM Mixture Proportions Tests

Applicable test reports shall be submitted to verify that the CLSM mixture proportions selected will produce CLSM of the quality specified. The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the Contracting Officer within 3 days after the end of each weekly reporting period.

SD-13 Certificates

Cement

Cementitious Material will be accepted on the basis of a manufacturer's certificate of compliance.

Aggregates

Aggregates will be accepted on the basis of certificate of compliance that the aggregates meet the requirements of the specifications under which it is furnished.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94, except as otherwise specified.

2.1.1.1 Volumetric Batching and Continuous Mixing

Volumetric batching and continuous mixing shall conform to ASTM C 685.

2.1.1.2 On-Site Batching and Mixing

The Contractor shall have the option of using an on-site batching and mixing facility. The method of measuring materials, batching operation, and mixer shall be submitted for review by the Contracting Officer. On-site plant shall conform to the requirements of either ASTM C 94 or ASTM C 685.

2.1.2 Portland Cement

Portland Cement shall conform to ASTM C 150, Type I or II, low alkali.

2.1.3 Pozzolan

Pozzolan shall be Class F or C fly ash conforming to ASTM C 618.

2.1.4 Sand

Sand shall meet the requirements of fine aggregate of ASTM C 33/C 33M.

2.1.5 Fluidifier

The fluidifier shall give the CLSM fill the following salient characteristics:

a. must have less than 1 percent bleed water in accordance with ASTM C 940

b. have an initial set time of more than 5 hours in accordance with ASTM C 220 modified by using a Ferioli apparatus

c. have a flow consistency equal to or more than 8 inches in accordance with ASTM D 6103

d. have a compressive strength of 100 psi at 28 days in accordance with ASTM D 4832

e. maintain a homogeneous mixture during pumping

1. Quantity of admixture(s) required in the mixture proportion is governed by the salient characteristics specified.

2. The admixture shall be added as directed by the manufacturer, in most cases it added to the CLSM at the job site and mixed for a minimum of 5 minutes at mixing speed.

2.1.6 Water

Water shall be potable water that is fresh, clean, and free from sewage, oil, acid, alkali, salts, or organic matter.

2.2 MIXING AND TRANSPORTING

The CLSM shall be mixed and transported in accordance with ASTM C 94.

PART 3 EXECUTION

3.1 TRENCH PREPARATION

Once the trench has been dug it shall be cleaned of all loose material and debris to the satisfaction of the Contracting Officer before any CLMS fill is placed. The new utility pipeline shall be placed on firm ground at the bottom of the trench and a minimum of 1 foot of CLSM fill shall be placed above the top of the pipeline. The pipeline shall be securely anchored to maintain its position and prevent it from any movement during placement of the CLSM.

3.2 PLACEMENT

3.2.1 General

CLSM placement shall not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement. When CLSM is mixed and/or transported by a truck mixer, the CLSM shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours (or 45 minutes when the placing temperature is 85 degrees F or greater unless a retarding admixture is used). The fluidifier shall not be added to the Ready Mix trucks until they have arrived onsite. The fluidifier shall be added to each truck at the proper dosage rate and mixed

for 5 minutes and no more than 15 minutes before it is placed. CLSM shall be conveyed from the mixer to point of placement as rapidly as practicable by methods which prevent segregation or loss of ingredients.

3.2.2 Consolidation

Consolidation of the CLSM will not be required.

3.3 TESTS

3.3.1 General

The individuals who sample and test CLSM as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to ACI minimum guidelines for certification of concrete Field Testing Technicians, Grade I.

3.3.2 Inspection Details and Frequency of Testing

3.3.2.1 Flow Consistency

Flow consistency shall be checked once during each shift that CLSM is produced for each class of concrete required. Samples shall be obtained in accordance with ASTM D 5971 and tested in accordance with ASTM D 6103. Whenever a test result is outside the specifications limits, the CLSM shall not be delivered to the placement and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted CLSM mixture proportion.

3.3.2.2 Compressive-Strength Specimens

At least one set of test specimens shall be made each day on CLSM placed during the day or every 10 cubic yards placed. Additional sets of test cylinders shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths are detected. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is accomplished in a completely random and unbiased manner. A set of test specimens for concrete with strength as specified in paragraph DESIGN REQUIREMENTS shall consist of six cylinders, one tested at 7 days, one tested at 14 days, and two tested at 28 days. Two cylinders shall be tested as directed. Test specimens shall be molded and cured in accordance with ASTM D 4832 and tested in accordance with ASTM D 4832. All compressive strength tests shall be reported immediately to the Contracting Officer.

3.3.3 Density

At least one set of test specimens shall be made each day on CLSM placed during the day or every 20 cubic yards placed. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is accomplished in a completely random and unbiased manner. Test procedures and calculations shall be in accordance with ASTM D 6023.

3.3.4 Reports

The Contractor shall prepare reports of all tests and inspections conducted

at the project site.

-- End of Section --

ATTACHMENT 3

Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling

ERDC/GSL TR-02-9

US Army Corps of Engineers®
Engineer Research and Development Center

Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling

Carlos A. Latorre, Lillian D. Wakeley, and Patrick J. Conroy

June 2002

Geotechnical and Structures Laboratory

Approved for public release; distribution is unlimited.

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The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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June 2002

Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling

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SF 298

Preface

The work documented in this report was performed during May through October 2001 as part of the technology transfer component of the Geotechnical Engineering Research Program (GTERP), specifically in the work unit entitled Applications of Trenchless Technology to Civil Works. Funding for preparation and publication of this report was provided by the U.S. Army Corps of Engineers as part of its ongoing support of civil works research. Mr. Carlos Latorre, U.S. Army Engineer Research and Development Center (ERDC), Geotechnical and Structures Laboratory (GSL), is principal investigator for this work unit. The research team also includes Dr. Lillian D. Wakeley, GTERP Manager (ERDC, GSL), Mr. Patrick J. Conroy, U.S. Army Engineer District (USAED), St. Louis (MVS), and Mrs. Nalini Torres (ERDC, GSL). Mr. Jim Chang, CECW, is GTERP Technical Monitor.

The guidelines and specifications provided in this report are based on work completed previously by Dr. R. David Bennett, formerly GSL, ERDC; and Mr. Joseph M. Morones, State of California, Department of Transportation; and modified with their cooperation by Mr. Latorre. This report was prepared by Messrs. Latorre and Conroy and Dr. Wakeley. The authors gratefully acknowledge technical review of this document by Mr. George Sills, USAED, Vicksburg, Mr. Pete Cali, USAED, New Orleans; and Mr. John Wise, USAED, Fort Worth.

This report was completed at ERDC under the general supervision of Dr. Wakeley, Chief, Engineering Geology and Geophysics Branch, Dr. Robert L. Hall, Chief, Geosciences and Structures Division, GSL, and Dr. Michael J. O'Connor, Director, GSL.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

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1 Introduction

Background

Early methods of installing pipelines and utilities across rivers and streams involved excavation of trenches. After the placement of the pipeline, the trenches were backfilled to protect the pipeline from hazards. These early dredged crossings were generally sited at the channel crossing of the thalweg between bends of the river. Here the river is generally a wide, shallow rectangle. This location is chosen because of its hydraulic stability and the economic limitation of the dredging equipment.

In and across the U.S. Army Engineer Division, Mississippi Valley (MVD), lies the heart of the pipeline transmission network of the United States. Hundreds of individual pipelines traverse from Texas and out of the Gulf of Mexico across the numerous rivers, bayous, and wetlands of Louisiana to service the northeast population centers on the Atlantic coast. Along the leveed banks of the lower Mississippi River, pipeline crossings exist between almost every bendway. The crossings of these earthen flood control structures present a difficult and expensive construction problem resulting from concerns about the integrity of the levee which may be subjected to sliding, piping, and erosion failures.

Horizontal Directional Drilling Method

In the early 1970s, a new process was introduced to install pipelines by use of horizontal directional drilling (HDD) techniques acquired from the oil and gas industry. The method has steadily grown to achieve worldwide acceptance and has been used in over 3,000 installations totaling over 1,288 km (800 miles) of pipelines. Today pipeline installations increasingly rely upon HDD technology as the primary method for crossings of watercourses, wetlands, utility corridors, roads, railroads, shorelines, environmental areas, and urban areas.

The placement of pipelines by the HDD method requires the drilling of a guided pilot bore, generally using a 7.3- to 11.43-cm- (2-7/8- to 4-1/2-in.-) diam drill pipe. At the lead, or downhole, end of the pilot string is a fluid powered cutting tool. The cutting tool is either a drill motor to which a bit is connected or a jet bit with nozzles. Drilling fluid is pumped through the string, and fluid causes the motor to rotate which turns the bit to cut the hole. With jet bits, the velocity from the jet nozzle erodes the hole in front of the drill pipe. Located

behind the drill head is a section of the drill pipe with a small bend or angular deviation. This section, known as a bent sub or bent housing, allows the motor or jet nozzle to be directed. A steering tool is latched onto a locking tool on the drill pipe. In this steering tool are a magnetometer and other devices to determine the azimuth, inclination, and orientation of the tool or tool face. Position determinations are made, and the data from the steering tool are plotted in the field to determine the profile and alignment of the bore. Analysis of this position plot is then used to determine drilling progress and path. At a desired location, the pilot drill pipe exits the ground. The pilot bore is then enlarged by pulling reaming tools back through the bore. Once this operation is completed, the pipeline or conduit is attached to the drill pipe and pulled back through the predrilled bore. This is accomplished as the drill pipe is removed, joint by joint, from the drilled path until the pipeline reaches the ground surface at the entry end of the bore.

One of the primary parameters in horizontal directional drilling is the drilling fluid or mud. The drilling mud is usually comprised of a bentonite and water mixture with the main function to power the downhole cutting tool used to open the bore. Secondary functions of the drilling mud are to serve as a lubricant for the pipeline during installation and, in cases of rock or hard ground bores, to remove cuttings from the bore.

The use of HDD has been restricted, in part, by major misunderstandings of how the HDD process actually functions. It is assumed by many that it is similar to well drilling or tunneling in that an open bore is required. This is true only in hard geologic materials such as rock. The majority of HDD pipeline crossings installed to date have been performed in soft ground comprised chiefly of alluvial deposits of silts, sand, and clay. In these types of soils, the process begins with a small pilot bore from which various cutters are inserted to loosen the soil as it is mixed into a slurry by injection of the drilling mud. Once this slurry pathway has been made large enough, generally 25.4 to 30.5 cm (10 to 12 in.) greater than the diameter of the pipeline, the installation of the pipeline commences by pulling the pipeline back through the soft slurry pathway. Some of the in situ soil and fluid are then compressed into the formation, and the remainder of the soil is actually pumped out of the path.

The information in this report represents some of the experiences of the Corps of Engineer (CE) Districts involving HDD for installation of utilities under levees. The experience of the U.S. Army Engineer District (USAED), St. Louis, in dealing with installation of communications systems was identified as having wide applicability to the Corps. Engineering documentation from two St. Louis District projects, the set of guidelines presented in “Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling” (Staheli et al. 1998), Engineer Manual (EM) 1110-2-1913 (Headquarters, Department of the Army (HQDOA) 2000), and the State of California Department of Transportation (CalTrans) Encroachment Permits, “Guidelines and Specifications for Horizontal Directional Drilling Installations” (Morones 2000), provided the basis for this report. A paper on the subject was presented at the Corps Infrastructure Systems Conference in August 2001.

Problem Identification

Although horizontal directional drilling could offer cost-effective, safe alternatives to installing pipelines with open trenching, the CE has no standard guidelines allowing the installation of pipelines with this construction method. As a result, permitting policies are extremely varied and some districts strictly prohibit the use of this technique. While recommended guidelines for pipeline installation using HDD were developed for use by the CE Districts through this work unit back in 1998, as part of a lengthy and detailed EM, the guidelines were not readily recognized by permitting offices as applicable to the questions they face. Also, there is growing pressure on Corps offices particularly by communications companies to install cables under levees.

Objectives

The objectives are to provide and distribute this information to targeted potential users like the CE District permitting offices and engineers that receive applications from utility companies to install utilities under levees. This report addresses those questions and helps CE offices with the growing pressure they are receiving from private companies to allow them to install cables/pipelines under levees. These guidelines are presented in a quick and organized manner that will provide criteria by which to evaluate proposals (e.g., application review, approving, disapproving, and/or making recommendations) for levee crossings, beneath rivers, and within levee rights-of-way using HDD techniques without endangering the levees; and the use of HDD for pipeline installation in areas where the installation technique might be applicable and capable of providing a tremendous cost savings to the Corps of Engineers and the pipeline industry. These guidelines will also help to demonstrate that, very often, these techniques offer substantial economic and operational advantages over current practices. Last but not least, these guidelines will help us stay involved in the development of this fast and fairly new emerging technology.

Potential Benefits

The pipeline industry would realize a tremendous benefit from the use of HDD in crossing of flood control levees. This benefit would include significant cost reduction in construction and maintenance presently required for levees and adjacent road crossings such as bridges, concrete boxes, earthen cover, and ramps. The use of the technique could also benefit the Corps of Engineers by: (a) eliminating blockage of levee crown from buried pipelines, pipeline bridges, or conduit boxes, (b) eliminating differential settlement imposed on levees by the construction of buried pipelines, pipeline bridges, or conduit boxes, (c) improving the operation and safety of grass cutting and other maintenance equipment on the levees, and (d) reducing risk of rupture of pipelines located above or near ground surface on levee slopes, (e) reducing disruption in urban areas, and (f) providing better public acceptance and increasing environmental consciousness.

Potential Problem

While considering any alteration request, the District's prime objective is to protect the integrity of the flood protection systems. In the case of HDD, designers must be aware and take into account during the design stage the following:

a. Hydrofracture during installation.

b. Preferred seepage path after construction.

To allow third parties to utilize HDD techniques, the District needed methods and processes to prevent these problems from occurring.

2 HDD Guidelines and Specifications

Permit Application Submittal

The permit application package should contain the following information in support of the permit application.

a. Location of entry and exit point.

b. Equipment and pipe layout areas.

c. Proposed drill path alignment (both plan and profile view).

d. Location, elevations, and proposed clearances of all utility crossings and structures.

e. Proposed depth of cover.

f. Soil analysis.

g. Product material (HDPE/steel), length, diameter-wall thickness, reamer diameter.

h. Detailed pipe calculations, confirming ability of product pipe to withstand installation loads, and long-term operational loads.

i. Proposed composition of drilling fluid (based on soil analysis) viscosity and density.

j. Drilling fluid pumping capacity, pressures, and flow rates proposed.

k. State right-of-way lines, property, and other utility right-of-way or easement lines.

l. Elevations.

m. Type of tracking method/system.

n. Survey grid establishment for monitoring ground surface movement (settlement or heave) because of the drilling operation.

o. Contractor's work plan (see page 11 in this document).

All additional permit conditions shall be set forth in the special provisions of the permit.

Table 1 outlines recommended depths for various pipe diameters:

Table 1
Recommended Minimum Depth of Cover[1]

Diameter	Depth of Cover
50 mm (2 in.) to 150 mm (6 in.)	1.2 m (4 ft)
200 mm (8 in.) to 350 mm (14 in.)	1.8 m (6 ft)
375 mm (15 in.) to 600 mm (24 in.)	3.0 m (10 ft)
625 mm (25 in.) to 1,200 mm (48 in.)	4.5 m (15 ft)

[1] These depths do not apply for crossing under flood protection projects.
(Permission to reprint granted by California Department of Transportation, Office of Encroachment Permits, January 10, 2001).

The permittee/contractor shall, prior to and upon completion of the directional drill, establish a Survey Grid Line and provide monitoring.

Upon completion of the work, the permittee shall provide an accurate as-built drawing of the installed pipe.

Soil Investigations

A soil investigation should be undertaken. This investigation must be suitable for the proposed complexity of the installation to confirm ground conditions.

Soil analysis

Common sense must be utilized when requiring the extensiveness of the soil analysis. A soil analysis is required in order to obtain information on the ground conditions that the contractor will encounter during the HDD operation.

If the contractor can go to the project site and complete an excavation with a backhoe to 0.03 m (1 ft) below the proposed depth of the bore, that is a soil investigation. In all cases when an excavation is made in creating an entrance and exit pit for an HDD project, that is also an example of a soil investigation. The HDD process is in itself a continual and extensive soil analysis as the pilot bore is made. As the varying soils and formations are encountered, the drilling slurry will change colors, therefore providing the contractor with continual additional information.

The purpose and intent of the soil analysis is to assist the contractor in developing the proper drilling fluid mixture and to ensure the CE and the Levee Board that the contractor is aware of the conditions that do exist in the area of the proposed project. This prepares the contractor in the event they should encounter a zone of pretectonics and that they would need additives or preventive measures in dealing with inadvertent returns (hydrofractures).

The discretion on the extensiveness of the soil analysis is left to each individual CE District permitting office and/or Levee Board, respectfully, for their respective areas. The HDD inspector/geotechnical engineer plays a large role in assisting the District Permitting Office and Levee Board in making decisions on the extensiveness. Each individual HDD inspector/geotechnical engineer has a general knowledge of the soil conditions in their area of responsibility.

In many circumstances, the soil information has already been prepared, either by the CE District, Levee Board, or by City and County Entities. This information, if available, should be provided to the requesting permittee.

Determination of soil investigations

The CE District Geotechnical Engineer (DGE) should determine the extensiveness of the Soil Investigation to be performed based on the complexity of the HDD operation. DGE may recommend, according to the guidelines listed below, a combination of or modification to the guideline to fit the following respective areas:

a. Projects less than 152 mm (500 ft) in length, where the product or casing is 20 cm (8 in.) or less in diameter.[1]

(1) A field soil sampling investigation to a depth of 0.3 m (1 ft) below the proposed drilling.

(2) Subsurface strata, fill, debris, and material.

b. Projects less than 244 m (800 ft) in length, where the product or casing is 36 cm (14 in.) or less in diameter.[1]

(1) A field soil sampling investigation to a depth of 0.3 m (1 ft) below the proposed drilling.

(2) Subsurface strata, fill, debris, and material.

(3) Particle size distribution (particularly, percent gravel and cobble).

c. Projects where the product or casing is 41 cm (16 in.) or greater in diameter. A geotechnical evaluation by a qualified soil engineer is necessary to determine the following:[1]

[1] Does not apply when crossing a flood protection project.

(1) Subsurface strata, fill, debris, and material.

(2) Particle size distribution (particularly percent gravel and cobble).

(3) Cohesion index, internal angle of friction, and soil classification.

(4) Plastic and liquid limits (clays), expansion index (clays), soil density.

(5) Water table levels and soil permeability.

d. Projects where the product or casing is 61 cm (24 in.) or greater in diameter, or when project crosses flood control projects. A geotechnical evaluation by a qualified soil engineer is required to determine the following:

(1) Subsurface strata, fill, debris, and material.

(2) Particle size distribution (particularly, percent gravel and cobble).

(3) Cohesion index, internal angle of friction, and soil classification.

(4) Plastic and liquid limits (clays), expansion index (clays), soil density, and standard penetration tests.

(5) Rock strength, rock joint fracture and orientation, water table levels, and soil permeability.

(6) Areas of suspected and known contamination should also be noted and characterized.

Boreholes or test pits should be undertaken at approximately 75- to 125-m (250- to 410-ft) intervals where a proposed installations greater than 305 m (1,000 ft) in length and parallel to an existing road. Additional boreholes or test pits should be considered if substantial variations in soil conditions are encountered.

Should the soil investigation determine the presence of gravel, cobble, and/or boulders, care should be exercised in the selection of drilling equipment and drilling fluids. In such ground conditions, the use of casing pipes or washover pipes may be required or specialized drilling fluids utilized. Fluid jetting methods used as a means of cutting **should only be considered** where soils have a high cohesion such as stiff clays. Jetting should not be allowed when crossing under a flood protection project.

Preconstruction and Site Evaluation

The following steps should be undertaken by the permittee/contractor in order to ensure safe and efficient construction with minimum interruption of normal, everyday activities at the site:

a. Notify owners of subsurface utilities along and on either side of the proposed drill path of the impending work through USA alert (the one-call program). All utilities along and on either side of the proposed drill path are to be located.

b. Obtain all necessary permits or authorizations to carry construction activities near or across all such buried obstructions.

c. Expose all utility crossings using a hydroexcavation, hand excavation, or other approved method (potholing) to confirm depth.

d. Arrange construction schedule to minimize disruption (e.g., drilling under major highways and/or river crossings).

e. Determine and document the proposed drill path, including horizontal and vertical alignments and location of buried utilities and substructures along the path.

The size of excavations for entrance and exit pits should be of sufficient size to avoid a sudden radius change of the pipe and consequent excessive deformation at these locations. Sizing the pits is a function of the pipe depth, diameter, and material. All pits, over 1.52 m (5 ft) in depth must abide by Occupational, Safety, and Health Administration (OSHA) regulations.

Prior to commencement of the project, the area should be physically walked over and visually inspected by District Geotechnical Engineer, the driller, and members of the Levee Board for potential entry/exit sites. The following should be addressed:

a. When on CE/Levee Board property, it should be established whether or not there is sufficient room at the site for: entrance and exit pits; HDD equipment and its safe unimpeded operation; support vehicles; fusion machines; aligning the pipe to be pulled back in a single continuous operation.

b. Suitability of soil conditions should be established for HDD operations. (The HDD method is ideally suited for soft subsoils such as clays and compacted sands. Subgrade soils consisting of large grain materials like gravel, cobble, and boulders make HDD difficult to use and may contribute to pipe damage.)

c. The site should be checked for evidence of substructures, such as manhole covers, valve box covers, meter boxes, electrical transformers, conduits or drop lines from utility poles, and pavement patches. HDD may be a suitable method in areas where the substructure density is relatively high.

Installation Requirements

The permittee shall ensure that appropriate equipment is provided to facilitate the installation: in particular, the drill rig shall have sufficient pulling capacity to meet the required installation loads determined by the detailed pipe calculations. The drill rig should have the ability to provide pull loads, push loads, torque, and the permittee shall ensure that they are monitored during the drilling operation. The permittee shall ensure the drill rod can meet the bend radii required for the proposed installation (a general rule of thumb is 100 times, in feet, the diameter of the installed pipe in inches).

During construction, continuous monitoring and plotting of pilot drill progress shall be undertaken. This is necessary to ensure compliance with the proposed installation alignment and allow for the undertaking of appropriate course corrections that would minimize "dog legs," should the bore begin to deviate from the intended bore path. The actual path of the pilot hole should be plotted against the design drill path.

Monitoring shall be accomplished by manual plotting based on location and depth readings provided by the onboard locating/tracking system or by hand-held walkover tracking systems. These readings map the bore path based on information provided by the locating/tracking system. Readings or plot points shall be undertaken on every drill rod.

For installations where tight control of alignment and grade is required, readings shall be undertaken every 1.0 to 1.5 m (3 to 5 ft). At the completion of the bore, an as-built drawing shall be provided. Prior to commencement of a directional drilling operation, proper calibration of the sonde equipment shall be undertaken.

Monitoring of the drilling fluids such as the pumping rate, pressures at the drill rig and pressures in the annular space behind the drill bit (when drilling under flood control projects), viscosity, and density during the pilot bore, back reaming, and/or pipe installation stages shall be undertaken to ensure adequate removal of soil cuttings and the stability of the borehole is maintained. Excess drilling fluids shall be contained at entry and exit points until recycled or removed from the site. Entry and exit pits should be of sufficient size to contain the expected return of drilling fluids and soil cuttings.

The permittee shall ensure that all drilling fluids are disposed of in a manner acceptable to the appropriate local, state, or federal regulatory agencies. When drilling in contaminated ground, the drilling fluid shall be tested for contamination and disposed of appropriately. Restoration of damage to a levee caused by hydrofracture or any other aspect of the directional drilling operation shall be the responsibility of the permittee. Plans for all restoration or repair work shall be submitted for approval by the Levee District or Corps of Engineers District.

To minimize heaving during pullback, the pullback rate shall be determined by which maximizes the removal of soil cuttings and which minimizes compaction of the ground surrounding the borehole. The pullback rate shall also

minimize overcutting of the borehole during the back reaming operation to ensure that excessive voids are not created and result in postinstallation settlement.

The permittee shall, prior to and upon completion of the directional drill, establish a Survey Grid Line and provide monitoring as outlined in their submitted detailed monitoring plan. Subsurface monitoring points shall be established along the HDD centerline and along any flood protection project that the HDD crosses under to provide early indications of settlement, since large voids may not materialize during drilling as a result of pavement bridging.

Should settlement occur, all repairs would be the responsibility of the permittee. To prevent future settlement should the drilling operation be unsuccessful, the permittee shall ensure the backfill of any void(s) with grout or backfilled by other means. Plans for all restoration or repair work shall be submitted for approval.

Considerations

The following considerations must be taken into account.

a. *Different ground conditions:* The availability of adequate geotechnical information is invaluable in underground construction; it acts to reduce the risk born by the permittee/contractor. However, even in the presence of good geotechnical data, unexpected ground conditions may be encountered. The Contractor's plan should describe the response to different ground conditions.

b. *Turbidity of water and inadvertent returns:* During construction, events like drill bit lockup or being off the design drill path may lead to work stoppage. The permittee/contractor should offer a mechanism to mutually address and mitigate these problems if and when they should arise. For example, contingency plans for containment and disposal of inadvertent returns or hydrofractures.

Permittee/contractor responsibilities

The permittee/contractor should provide the following items: construction plan, site layout plan, project schedule, communication plan, safety procedures, emergency procedures, company experience record, contingencies plan, and drilling fluid management plan.

Construction plan requirements. The permittee shall identify in the construction plan:

a. Location of entry and exit pits.

b. Working areas and their approximate size.

c. Proposed pipe fabrication and layout areas.

d. State right-of-way lines, property lines.

e. Other utility right-of way and easement lines.

f. Pipe material and wall thickness.

g. Location of test pits or boreholes undertaken during the soil investigation.

h. Identify the proposed drilling alignment (both plan and profile view) from entry to exit.

i. Identify all grades and curvature radii.

j. All utilities (both horizontal and vertical).

k. Structures with their clearances from the proposed drill alignment.

l. Confirm the minimum clearance requirements of affected utilities and structures.

m. Required minimum clearances from existing utilities and structures.

n. Diameter of pilot hole, and number and size of prereams/backreams.

o. Access requirements to site (if required).

p. Crew experience.

q. Type of tracking equipment.

Locating and tracking. The permittee shall describe the method of locating and tracking the drillhead during the pilot bore. Systems include walkover, wire-line, or wireline with wire surface grid. The locating and tracking system shall be capable of ensuring the proposed installation can be installed as intended.

Typical walkover sondes have an effective range of 10 to 15 m, depending on the Electro-magnetic properties of the soil and the extent of local magnetic interference. Depending on the profile of the borehole, the driller may lose contact with the sondes over certain sections of the alignment. As much as practically possible, the sonde should maintain contact with the drill bit. If the "blind" section is expected to be too long or in the vicinity of a buried object, the project engineer may specify the use of a wire-line system or a magnetic navigation tool.

The locating and tracking system shall provide the following information:

a. Clock and pitch information.

b. Depth.

c. Beacon temperature.

d. Battery status.

e. Position (x,y).

f. Azimuth: Where direct overhead readings (walkover) are not possible.

Figure 1 shows a universal housing that will work with any drill-string on all HDD rigs. The placement of the sonde should be before the backreamer. This housing can be utilized in the initial pilot bore. After exiting, the cutting head can be removed and the reamer installed. This housing chamber can utilize any of the sonde batteries manufactured, regardless of manufacturer. There is also a 6-cm (2.5 in.) mini-sonde combination available for smaller rigs.

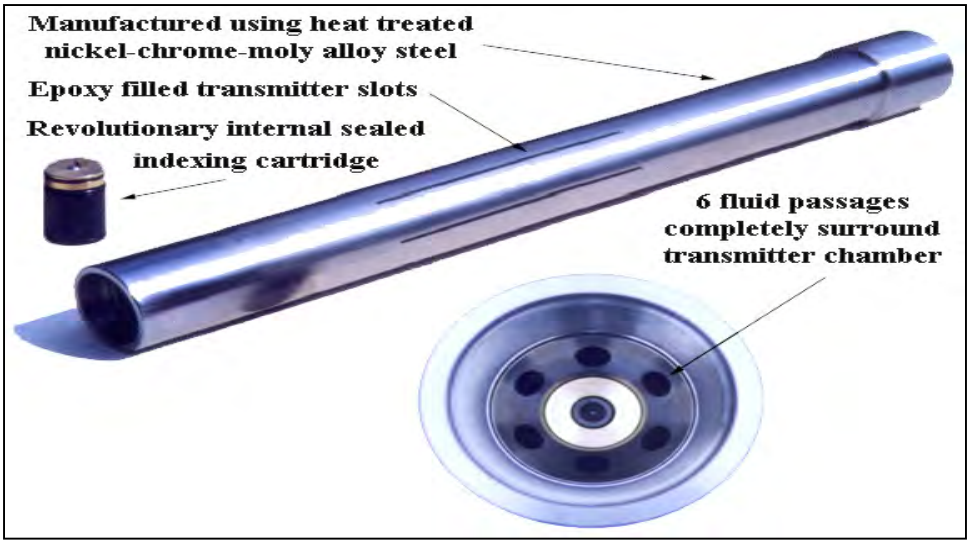

Figure 1. Universal housing for drill-string on HDD rigs (Permission to reprint granted by California Department of Transportation, Office of Encroachment Permits, January 10, 2001)

Drilling fluids management plan. The following information should be provided as part of the drilling fluid management plan. The proposed viscosities for soil transportation to the entry and exit pits are:

a. Pumping capacity and pressures must be estimated.

b. Source of fresh water for mixing the drilling mud must be identified. (Necessary approvals and permits are required for sources such as streams, rivers, ponds, or fire hydrants.)

c. Method of slurry containment must be described and detailed.

d. Method of recycling drilling fluid and spoils (if applicable) must be explained.

e. Method of transporting drilling fluids and spoils offsite must be described.

Drilling fluid pressures in the borehole should not exceed that which can be supported by the foundation soils. Calculation of maximum allowable pressures shall be done for all points along the drill path, taking into account the shear strength of the foundation soils, the depth of the drill path, the bore diameter, and the elevation of the groundwater table. Drilling fluids serve the following functions:

a. Remove cuttings from the bottom of the hole and transport them to the surface.

b. Hold cuttings in suspension when circulation is interrupted.

c. Release cuttings at the surface.

d. Stabilize the hole with an impermeable cake.

e. Cool and lubricate the drill bit and drill string.

f. Control subsurface pressures.

g. Transmit hydraulic horsepower.

h. Cool the locating transmitter sonde preventing burnout.

Previous experience. The permittee's contractor should provide a list of projects completed by his company, location, project environment (e.g., urban work, river crossing), product diameter, and length of installation. The permittee's contractor should also provide a list of key personnel.

Safety. The drilling unit should be equipped with an electrical strike safety package. The package should include warning sound alarm, grounding mats (if required), and protective gear. The permittee/contractor should have a copy of the company safety manual that includes:

a. Operating procedures that comply with applicable regulations, including shoring of pits and excavations when required.

b. Emergency procedures for inadvertently boring into a natural gas line, live power cable, water main, sewer lines, or a fiber-optic cable, which comply with applicable regulations.

c. Emergency evacuation plan in case of an injury.

Contingency plans. The Contingency plan should address the following:

a. Inadvertent return, spill (e.g., drilling fluids, and hydraulic fluids), including measures to contain, clean, and repair the affected area.

b. Cleanup of surface seepage of drilling fluids and spoils (i.e., hydrofracture).

Communication plan. The communication plan should address the following:

a. The phone numbers for communication with owner or his representative on the site.

b. Identification of key person(s) who will be responsible for ensuring that the communications plan is followed.

c. Issues to be communicated including safety, progress, and unexpected technical difficulties.

Traffic control.

a. When required, the permittee/contractor is responsible for supplying and placing warning signs, barricades, safety lights, and flags or flagmen, as required for the protection of pedestrians and vehicle traffic.

b. Obstruction of the roadway, on major road, should be limited to off-peak hours.

Additional Requirements

Information that may be required, include other permits, bonding, and certification as listed in the following sections.

Additional permits

a. Obtaining water (i.e., hydrants, streams, etc.)

b. Storage, piling, and disposal of material.

c. Water/bentonite disposal.

d. Any other permits required carrying out the work.

Bonding and certification requirements

a. Payment bond (if required).

b. Performance bond (if required).

c. Certificate of insurance.

d. WCB certificate letter.

e. ACSA certificate of recognition.

Drilling Operations

The following points provide general remarks and rules of thumb related to the directional boring method.

a. Only operators who have "Proof of Training" by the North American Society of Trenchless Technology (NASTT) should be permitted to operate the drilling equipment in CE/Levee Board property.

b. Drilling mud pressure in the borehole should not exceed that which can be supported by the foundation soils to prevent heaving or a hydraulic fracturing of the soil (i.e., hydrofracture). Allowing for a sufficient cover depth does not necessarily guarantee against hydrofracture. Sound, cautious drilling practice minimizes the chance of hydrofracture occurrence. Also, measuring mud pressures in the annular space behind the drill bit and comparing these mud pressures with the calculated maximum allowable pressures help minimize the occurrence of hydrofracture. Typical bore depth of 0.75 to 1.0 m gives pipes with an Outside Diameter (O.D.) of 50-200 mm a minimum cover of 0.65 m. While circumstances may dictate greater depths, shallower depths are not recommended.

c. The drill path alignment should be as straight as possible to minimize the fractional resistance during pullback and to maximize the length of the pipe that can be installed during a single pull.

d. It is preferable that straight tangent sections be drilled before the introduction of a long radius curve. Under all circumstances, a minimum of one complete length of drill rod should be utilized before starting to level out the borehole path.

e. The radius of curvature is determined by the bending characteristics of the product line, and it is increasing with diameter.

f. Entrance angle of the drill string should be between 8 and 20 deg, with 12 deg being considered optimal. Shallower angles may reduce the penetrating capabilities of the drilling rig, while steeper angles may result in steering difficulties, particularly in soft soils. A recommended value for the exit angle of the drill string is within the range of 5 to 10 deg.

g. Whenever possible, HDD installation should be planned so that back reaming and pulling for a leg can be completed on the same day. If necessary, it is permissible to drill the pilot hole and preream one day, and complete both the final ream and the pullback on the following day.

h. If a drill hole beneath a levee must be abandoned, the hole should be backfilled with grout or bentonite to prevent future subsidence.

i. Pipe installation should be performed in a manner that minimizes the over-stressing and straining of the pipe. This is of particular importance in the case of a polyethylene pipe.

Equipment setup and site layout

a. Sufficient space is required on the rig side to safely set up and operate the equipment. The workspace required depends on the type of rig to be used. A small rig may require as little as 3- by 3-m working space, while a large river crossing unit requires a minimum of 30- by 50-m working area. A working space of similar dimensions to that on the rig side should be allocated on the pipe side, in case there is a need to move the rig and attempt drilling from this end of the crossing.

b. If at all possible, the crossing should be planned to ensure that drilling proceed downhill, allowing the drilling mud to remain in the hole, minimizing inadvertent return.

c. Sufficient space should be allocated to fabricate the product pipeline into one string, thus enabling the pullback to be conducted in a single continuous operation. Tie-ins of successive strings during pullback may considerably increase the risk of an unsuccessful installation.

Drilling and back-reaming

a. Drilling mud should be used during drilling and back reaming operations. Using water exclusively may cause collapse of the borehole in unconsolidated soils. While in clays, the use of water may cause swelling and subsequent jamming of the product.

b. Heaving may occur when attempting to back-ream a hole that is too large. This can be avoided by using several prereams to gradually enlarge the hole to the desired diameter.

c. A swivel should be included between the reamer and the product pipe to prevent the transfer of rotational torque to the pipe during pullback.

d. In order to prevent over stressing of the product during pullback, a weak link, or break-away pulling head, may be used between the swivel and the leading end of the pipe. More details regarding breakaway pulling heads can be found in paragraph entitled “Break-away Pulling Head.”

e. The pilot hole must be back-reamed to accommodate and permit free sliding of the product inside the borehole. A rule of thumb is to have a borehole 1.5 times the outer diameter of the product. This rule of thumb should be observed particularly with the larger diameter installations (≥ 250-mm O.D.). Some recommended values for final preream diameter

as a function of the product O.D. are given in Table 2. These values should be increased by 25 percent if excessive swelling of the soil is expected to occur or the presence of boulders/cobbles is suspected.

f. The conduit must be sealed at either end with a cap or a plug to prevent water, drilling fluids, and other foreign materials from entering the pipe as it is being pulled back.

g. Pipe rollers, skates, or other protective devices should be used to prevent damage to the pipe from the edges of the pit during pullback, eliminate ground drag, or reduce pulling force and subsequently reduce the stress on the product.

h. The drilling mud in the annular region should not be removed after installation but permitted to solidify and provide support for the pipe and neighboring soil.

Table 2
Recommended Back-Ream Hole Diameter (after Popelar et al. 1997)

Nominal Pipe Diameter, mm	Back-Ream Hole Diameter, mm
50	75 to 100
75	100 to 150
100	150 to 200
150	250 to 300
200	300 to 350
250	350 to 400
≥300	At least 1.5 times product OD

Drilling Fluid - Collection and Disposal Practices

The collection and handling of drilling fluids and inadvertent returns, along with the need to keep drilling fluids out of streams, streets, and municipal sewer lines, have been among the most debated topics. These points include:

a. Drilling mud and additives to be used on a particular job should be identified in the permit package, and their Material Safety Data Sheets (MSDS) should be provided to the Permit Office.

b. Excess drilling mud slurry shall be contained in a lined pit or containment pound at exit and entry points, until recycled or removed from the site. Entrance and exit pits should be of sufficient size to contain the expected return of drilling mud and spoils.

c. Methods to be used in the collections, transportation, and disposal of drilling fluids, spoils, and excess drilling fluids should be in compliance with local ordinances, regulations, and environmentally sound practices in an approved disposal site.

d. The slurry should be tested for contamination and disposed of in a manner which meets government requirements when working in an area of contaminated ground.

e. Precautions should be taken to keep drilling fluids out of the streets, manholes, sanitary and storm sewers, and other drainage systems, including streams and rivers.

f. Recycling drilling fluids is an acceptable alternative to disposal.

g. All diligent efforts should be made by contractor to minimize the amount of drilling fluids and cuttings spilled during the drilling operation, and complete cleanup of all drilling mud overflows or spills shall be provided.

There are legitimate concerns associated with the fluid pressures used for excavation during the horizontal directional drilling process and the risk of hydraulic fracturing. Reasonable limits must be placed on maximum fluid pressures in the annular space of the bore to prevent inadvertent drilling fluid returns to the ground surface. However, it is equally important that drilling pressures remain sufficiently high to maintain borehole stability, since the ease in which the pipe will be inserted into the borehole is dependent upon borehole stability. Limiting borehole pressures are a function of pore pressure, the pressure required to counterbalance the effective normal stresses acting around the bore (depth), and the undrained shear strength of the soil.

Tie-Ins and Connections

Trenching may be used to join sections of conduits installed by the directional boring method. An additional pipe length, sufficient for joining to the next segment, should be pulled into the entrance pit. This length of the pipe should not be damaged or interfere with the subsequent drilling of the next leg. The contractor should leave a minimum of 1 m of conduit above the ground on both sides of the borehole.

Alignment and Minimum Separation

The product should be installed to the alignment and elevations shown on the drawings within the prespecified tolerances (tolerance values are application dependent, for example, in a major river crossing, a tolerance of ±4 m from the exit location along the drill path center line may be an acceptable value). This tolerance is not acceptable when installing a product line between manholes. Similarly, grade requirements for a water forcemain are significantly different from those on a gravity sewer project.

When a product line is installed in a crowded right-of-way, the issue of safe minimum separation distance arises. Many utility companies have established regulations for minimum separation distances between various utilities. These

distances needed to be adjusted to account for possible minor deviation when a line product is installed using HDD technology. As a rule of thumb, if the separation distance between the proposed alignment and the existing line is 5 m or more, normal installation procedures can be followed. If the separation is 1.5 m or less, special measures, such as observation boreholes are required. The range between 1.5 and 5 m is a "gray" area, typically subject to engineering judgment (a natural gas transmission line is likely to be treated more cautiously than a storm water drainage line).

Break-Away Pulling Head

Recent reports from several natural gas utility companies reveal concerns regarding failure experienced on HDPE pipes installed by horizontal directional drilling. These failures were attributed to deformation of the pipe due to the use of excessive pulling force during installation. A mitigation measure adopted by some gas companies involves the use of break-away swivels to limit the amount of force used when pulling HDPE products. Some details regarding these devices and their applications are given below.

a. The weak link used can be either a small diameter pipe (but same SDR) or specially manufactured break-away link. The latter consists of a breaking pin with a defined tensile strength incorporated in a swivel. When the strength of the pin is exceeded it will break, causing the swivel to separate. A summary of pulling head specifications is given in Table 3 (all products are SDR 11). Note that the values provided in Table 3 could be considered conservative.

Table 3
Pulling Head Specifications

Pipe Diameter (in.)[1]	Diameter of Break-Away Swivel (in.)	Maximum Allowable Pulling Force (lb)[2]
1-1/4	7/8	850
2	1-1/4	1,500
4	1 3/8	5,500
6	2-1/2	12,000
8	3	18,500

[1]To convert inches to centimeters, multiply by 2.54.
[2]To convert pounds to kilograms, multiply by 0.4535.

b. The use of break-away swivels is particularly warranted when installing small diameter HDPE pipes (up to 10-cm (4 in.) O.D.). Application of such devices in the installation of larger diameter products is not currently a common practice.

c. If the drilling equipment-rated pulling capacity is less than the safe load, the use of a weak link may not be required.

d. Exceeding the product elastic limit can be avoided simply by following good drilling practices, namely: regulating pulling force; regulating pulling speed; proper ream sizing; and using appropriate amounts of drilling slurry fluid.

Protective Coatings

In an HDD installation, the product may be exposed to extra abrasion during pullback. When installing a steel pipe, a form of coating which provides a corrosion barrier as well as an abrasion barrier is recommended during the operation, the coating should be well bonded and have a hard smooth surface to resist soil stresses and reduce friction, respectively. A recommended type of coating for steel pipes is mill applied Fusion Bonded Epoxy.

Site Restoration and Postconstruction Evaluation

All surfaces affected by the work shall be restored to their preconstruction conditions. Performance criteria for restoration work will be similar to those employed in traditional open excavation work. If required, the permittee/ contractor shall provide a set of as-built drawings including both alignment and profile. Drawings should be constructed from actual field readings. Raw data should be available for submission at any time upon request. As part of the "As-Built" document, the contractor shall specify the tracking equipment used, including method or confirmatory procedure used to ensure the data were captured.

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14. ABSTRACT

Applications for permits to drill beneath levees are increasing in permitting offices of the U.S. Army Corps of Engineer Districts. This report provides a basis for consistent and science-based consideration of these permit applications. It describes methods of horizontal directional drilling (HDD) beneath levees and lists the types of geotechnical and other data that are essential to judging the safety of proposed drilling for infrastructure modifications and installation of utilities. Critical considerations include setback distances, levee toe stability, thickness and integrity of the top stratum, and other geotechnical parameters. Data provided for vertical and horizontal permeabilities, top stratum thickness, hydraulic gradient at levee toe, and other parameters are based on experience in the U.S. Army Engineer Districts, Vicksburg and St. Louis, and the California Department of Transportation. In appropriate geotechnical settings with appropriate operational care, utilities can be installed beneath flood-control levees using HDD without compromising the integrity and function of the levee.

15. SUBJECT TERMS

Annular space
Directional drilling
Fiber-optic cables
Geotechnical engineering
HDD
Hydrofracture
Residual pressure
Trenchless technology

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Appendix E – Preliminary Relocation Plans

Cass County Electric

Transmission & Distribution Services

Cass County Electric Cooperative

Date: June 25, 2012

To: Chris Gross, Moore Engineering

From: Troy Knutson and Kenn Haugen, Cass County Electric

Re: Cost Estimate for Relocation of CCEC Facilities Reach 1 through Reach 3

CCEC is providing a cost estimate along with a description of the work that would be required to relocate distribution plant for Reach 1 through Reach 3 of the proposed FM Diversion. The cost estimates for CCEC will depend on the final footage but will be given on a per foot basis to help in the evaluation process. CCEC also requests at the minimum a one year advanced notice on construction to make sure material can be acquired within appropriate lead times.

Below you will find distribution plant crossings that CCEC has for Reach 1-3 of the current proposed route of the FM Diversion. All crossings will be directional bored and replaced with underground cable in conduit whether the original line was overhead or underground. All estimates are based on CCEC contract labor doing the installation, CCEC is open to the idea of attaching to bridges if applicable or having the Diversion contractor dig in conduits during construction to help keep the costs down.

The estimate does not include inflation. CCEC would need to provide another estimate closer to the date of construction to determine the final costs. In some cases, it may be possible to reroute cable to avoid crossing the Diversion entirely.

Twp	Range	Sect	Description	Estimate
142 N	49 W	36 W	Bury single phase UD line	$66/ft
141 N	49 W	10 W	Bury single phase OH line (possible reroute)	$66/ft
141 N	49 W	17 SW	Bury three phase OH line near I-29 and Hwy 81	$100/ft

If you have any questions, feel free to contact me at 701-356-4542.

Sincerely,

Troy Knutson, P.E.
Cass County Electric Cooperative
4100 32 Ave SW
Fargo ND 58104
701-356-4542
tknutson@kwh.com

Cass County Electric Cooperative

Your Touchstone Energy® Partner

July 31, 2012

Chris Gross
Moore Engineering
925 10th Ave E
West Fargo, ND 58078

RE: USACE Required Additional Information for FM Diversion

Dear Mr. Gross,

CCEC has received your notice of the USACE requiring additional information for Reach 1 through 3 of the FM Diversion. Below you will find the answers/responses to those questions/comments:

- For all crossings which CCEC needs to relocate its distribution plant, CCEC will be either crossing the diversion with underground cable or rerouting to feed from another direction, in either case all poles and overhead conductors will be removed from the project right of way.
- The realignment of CO Rd 4 & 31 will cause CCEC to have to move 1 single phase underground line. This line would need to be relocated due to the construction of the Diversion anyway so the road realignment is not causing any extra work.
- CCEC has 4 easements, all of which recorded for Section 2 of Township 140 and Range 50W. Copies of each have been enclosed with this letter.
- All relocations are being done to continue to provide service to CCEC members. None of the relocations are on abandoned or non-active lines.
- CCEC utilizes 1/0 cable as its minimum engineering design standard for medium voltage underground cable. Due to this standard, if the overhead line is smaller than 1/0, it will be replaced with 1/0 underground conductor. Otherwise the underground conductor will be sized to have a similar capacity to the overhead line it will be replacing.
- On March 11, 1968 CCEC completed the purchase a 69 kV line from Northern States Power that runs parallel to US Highway 81. This line is now a 15 kV line and will cross the Diversion in Reach 3. CCEC obtained all of

the old easements for this line through an Assignment of Easement Rights contract dated January 30, 1968. This document is enclosed.

- Cass County Electric Cooperative Inc. is a rural electric cooperative that was incorporated in North Dakota on April 26, 1937.
- The representative from CCEC to sign all legal documents should be
  Bradley Schmidt, P.E.
  Sr. VP Transmission and Distribution Services
  4100 32nd Ave S
  Fargo, ND 58104
  bschmidt@kwh.com

If you have any questions on the above information or you need additional documentation please let me know.

Sincerely,

Troy Knutson, P.E.
Distributed Generation Engineer

Enc.: Easements for Sec 2 of Twp 140 Range 50 (4)
Assignment of Easement Rights

71-W-9

RIGHT OF WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, (whether one or more)

Mrs. Laura Krogh

(unmarried) (husband and wife) for a good and valuable consideration, the receipt whereof is hereby acknowledged, do hereby grant unto Cass County Electric Cooperative, Inc., a cooperative corporation, whose Postoffice Address is Kindred, N. D., and to its successors or assigns, the right to enter upon the lands of the undersigned, situated in the County of Cass, State of North Dakota and more particularly described as foliows:

North east Quarter (NE¼) section two (2)

North half (N½) of the Northeast Quarter of the Northwest Quarter 2

Section No. 2 Township No. 140 Range No. 50 W

and to construct, operate and maintain on the above described lands and||or in or upon all streets, roads or highways abutting said lands, an electric transmission or distribution line or system, and to cut down and||or trim trees and shrubbery to the extent necessary to keep them clear of said electric line or system and to cut down from time to time all dead, weak, leaning or dangerous trees that are tall enough to strike the wires in falling.

The undersigned agree that all poles, wires and other facilities, including any main service entrance equipment installed on the above described premises at the Cooperative's expense shall remain the property of the Cooperative, removable at the option of the Cooperative upon termination of the service to or on said land.

The undersigned covenant that they are the owners of the above described lands and that the said lands are free and clear of encumbrances and liens of whatsoever character except those held by the following persons:

IN WITNESS WHEREOF, the undersigned have set their hands and seals this 4th day of May, 19 49.

Signed, sealed and delivered in the presence of:

Mrs Laura Krogh (L. S.)

(L. S.)

(L. S.)

(L. S.)

STATE OF NORTH DAKOTA } SS.
County of Cass }

On this 4th day of May in the year 1949 before me personally appeared Mrs. Laura Krogh

known to me (or proved to me on oath of) to be the person described in and who executed the within instrument, and acknowleged to me that he (or they) executed the same.

John E Stenmo

Notary Public, County of Cass N. D.
My Commission Expires Dec. 30, 1950

NORTH DAKOTA 11-W-CASS

28

71-W 11

RIGHT OF WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, (whether one or more)

Chas. A. Rust

(unmarried) (husband and wife) for a good and valuable consideration, the receipt whereof is hereby acknowledged, do hereby grant unto Cass County Electric Cooperative, Inc., a cooperative corporation, whose Postoffice Address is Kindred, N. D., and to its successors or assigns, the right to enter upon the lands of the undersigned, situated in the County of Cass, State of North Dakota and more particularly described as follows:

Northwest Quarter (NW¼) of section One (1)
Northwest Quarter of the Northwest Quarter

Section No. 2 Township No. 140 N Range No. 50 W

and to construct, operate and maintain on the above described lands and||or in or upon all streets, roads or highways abutting said lands, an electric transmission or distribution line or system, and to cut down and||or trim trees and shrubbery to the extent necessary to keep them clear of said electric line or system and to cut down from time to time all dead, weak, leaning or dangerous trees that are tall enough to strike the wires in falling.

The undersigned agree that all poles, wires and other facilities, including any main service entrance equipment installed on the above described premises at the Cooperative's expense shall remain the property of the Cooperative, removable at the option of the Cooperative upon termination of the service to or on said land.

The undersigned covenant that they are the owners of the above described lands and that the said lands are free and clear of encumbrances and liens of whatsoever character except those held by the following persons:

IN WITNESS WHEREOF, the undersigned have set their hands and seals this 3rd day of May, 19 49.

Signed, sealed and delivered in the presence of:

Chas A. Rust (L. S.)

_____ (L. S.)

_____ (L. S.)

_____ (L. S.)

STATE OF NORTH DAKOTA }
County of Cass } SS.

On this 3rd day of May in the year 1949 before me personally appeared Chas. A. Rust

known to me (or proved to me on oath of _____) to be the person described in and who executed the within instrument, and acknowleged to me that he (or they) executed the same.

John C Stennes
Notary Public, County of Cass N. D.
My Commission Expires Dec. 30, 1950

NORTH DAKOTA 11-W-CASS

30

533

RIGHT-OF-WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS, that Aug. Nelson Estate

(hereinafter called the "grantor"),

and Nelson, wife-husband of the grantor, of the County

of Cass, State of North Dakota, (the grantor and his wife or her husband, as the case may be, hereinafter collectively called the "grantors") for a good and valuable consideration, the receipt whereof is hereby acknowledged, do hereby grant unto Cass County Electric Cooperative, Inc., a corporation, and to its successors or assigns, the right to enter upon the lands of the grantors situated in the County of Cass, State of North Dakota, and described as follows:

Southwest quarter (SW¼) Section two (2) Township one hundred forty (140) Range fifty (50) 19S

and to place, construct, operate, repair, maintain, relocate and replace thereon and in and upon all streets, roads or highways abutting said lands, an electric transmission or distribution line or system, including the right to cut or trim trees to the extent necessary to keep them clear of said electric line or system.

The grantors covenant that the above described lands are free and clear of incumbrances and liens of whatsoever character other than taxes and assessments; except

And Nelson, the wife or husband of the grantor, hereby relinquishes and releases any right or interest she or he may have inconsistent with the right-of-way easement herein granted, including the right of homestead in the above described lands.

IN WITNESS WHEREOF, the grantors have hereunto set their hands this day of , 193 .

Witnesses:

Aug Nelson by A Olson Administrator

State of North Dakota }
County of Cass } SS

On this 7 day of Sept., in the year nineteen hundred and thirty 37, before me personally appeared Aug. Nelson Estate A. Olson Administrator, known to me to be the persons who are described in and who executed the within and foregoing instrument and acknowledged to me that they executed the same.

My commission expires 1/23 1939

Notary Public Cass County, North Dakota.

A001088

4

RIGHT-OF-WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS, that John Gray, State Treasurer, as Trustee for the State of North Dakota (hereinafter called the "grantor"), and ~~wife of the grantor~~, of the County of Burleigh, State of North Dakota, (~~the grantor and his wife or husband, as the case may be, hereinafter collectively called the grantors~~) for a good and valuable consideration, the receipt whereof is hereby acknowledged, do hereby grant unto Cass County Electric Cooperative, Inc., a corporation, and to its successors or assigns, the right to enter upon the lands of the grantor situated in the County of Cass, State of North Dakota, and described as follows:

Along the highway on the Southerly side of:
The Southeast Quarter (SE¼) of Section Two (2),
Township 140, Range 50;

and to place, construct, operate, repair, maintain, relocate and replace thereon and in and upon all streets, roads or highways abutting said lands, an electric transmission or distribution line or system, including the right to cut or trim trees to the extent necessary to keep them clear of said electric line or system.

The grantor covenants that the above described lands are free and clear of incumbrances and liens of whatsoever character other than taxes and assessments ~~except~~ by him given or permitted.

~~And~~ ~~wife or husband of the grantor, hereby relinquishes and releases all right, title, interest, claim or demand in the right of way easement herein granted, including the right of homestead in the above described lands.~~

IN WITNESS WHEREOF, the grantors have hereunto set their hands this ____ day of September, 1937.

Witnesses:

C. H. Lamb

R. E. Wynkoop

John Gray

State of North Dakota)
) SS
County of Burleigh)

On this 24 day of September, in the year nineteen hundred and thirty seven, before me personally appeared John Gray, known to me to be the person who is described in and who executed the within and foregoing instrument and acknowledged to me that they executed the same. as State Treasurer, as Trustee for the State of North Dakota.

Samuel M. Hager
Notary Public, Burleigh County, N. Dak.
My Commission Expires 1943

My commission expires ____ Notary Public Burleigh County, North Dakota.

AG01087

ASSIGNMENT OF EASEMENT RIGHTS

KNOW ALL MEN BY THESE PRESENTS that Northern States Power Company, a Minnesota corporation, duly authorized to transact business of the State of North Dakota, hereinafter called "NSP", in consideration of the sum of One Dollar and other valuable considerations in hand paid by Cass County Electric Cooperative, Inc., of Fargo, North Dakota, hereinafter called "CCEC", has sold, assigned, transferred and set over, and by these presents does sell, assign, transfer and set over unto CCEC, its successors and assigns, the following described electric transmission line easements located within the County of Cass, State of North Dakota, to-wit:

Doc. No.	Grantor	Description	Sec.	Twp.	Rge.	Book of Misc.	Page	Date Recorded
256734	Brentzel, Wm. et ux	$NW\frac{1}{4}$	26	140	49	U-1	485	05-07-46
297971	Brentzel, Wm. et ux	$NW\frac{1}{4}$	26	140	49	D-2	395	03-04-52
298044	Glasrud, H. A. et ux	Pt. $SW\frac{1}{4}$	23	140	49	D-2	404	03-10-52
261775	Glasrud, H. A. et ux	Pt. $SW\frac{1}{4}$	23	140	49	W-1	334	12-03-46
256751	Johnson, Nels, Estate	Pt. $NE\frac{1}{4}$ &	22	140	49			
	Fred Loomis Sr. Adm.	Pt. $SW\frac{1}{4}$	23	140	49	U-1	494	05-07-46
394741	Stockman, G. F. et ux	$W\frac{1}{2}$	23	140	49			
		$NE\frac{1}{4}$	22	140	49	F-4	420	10-30-64
393654	Simonson, T., et ux	Pt. $NE\frac{1}{4}$	22	140	49	E-4	657	09-17-64
256750	Steele, Matthew et al	$E\frac{1}{2}$	15	140	49	U-1	493	05-07-46
393237	Holmquist, K. R. et ux	Pt. $E\frac{1}{2}$	15	140	49	E-4	464	09-01-64
259381	Slocum, Roy et ux	$SW\frac{1}{4}$	15	140	49	W-1	167	08-22-46
256840	Slocum, Roy et ux	$NW\frac{1}{4}$	15	140	49	U-1	507	05-10-46
257271	Haatvedt, E. B.	$SW\frac{1}{4}$ of $SW\frac{1}{4}$	10	140	49	U-1	580	05-27-46
256841	Westlund, G. T.	$NW\frac{1}{4}$-$NW\frac{1}{4}$-$SW\frac{1}{4}$	10	140	49	U-1	508	05-10-46
256749	Shure, W. H.	$NE\frac{1}{4}$, $SE\frac{1}{4}$ &						
		$SE\frac{1}{4}$, $NE\frac{1}{4}$	9	140	49	U-1	493	05-07-46
256842	Spaulding, D. B.	Part of	9	140	49	U-1	508	05-10-46
257567	Lind, Alice Bender	Part of	4	140	49	U-1	620	06-07-46
257554	Sheppard, A. T.	$SW\frac{1}{4}$	4	140	49	U-1	615	06-06-46
256843	Sheppard, A. T.	$NW\frac{1}{4}$	4	140	49	U-1	509	05-10-46
258271	Schneider, M. C. et ux	$SW\frac{1}{4}$, $SW\frac{1}{4}$	34	141	49	W-1	70	07-02-46
256847	Carnine, Mrs. J. C.	$NW\frac{1}{4}$ $SW\frac{1}{4}$	34	141	49	U-1	511	05-10-46
257312	Lind, Nels John et ux	Part of	33	141	49	U-1	587	05-29-46
256733	Hoag, Stephen H.	Pt. of $NE\frac{1}{4}$	33	141	49	U-1	484	05-07-46
257270	Hoag, Stephen H.	$SE\frac{1}{4}$ $NE\frac{1}{4}$	33	141	49	U-1	579	05-27-46
256732	Hoag, Veeder H.	Pt. of $NE\frac{1}{4}$	33	141	49	U-1	484	05-07-46
256731	Mortenson, Kenneth	Pt. of $SW\frac{1}{4}$						
		Pt. of $SE\frac{1}{4}$	28	141	49	U-1	483	05-07-46
256846	Soberg, Henry A.	$NW\frac{1}{4}$	28	141	49	U-1	511	05-10-46
256839	Mortenson, P. M. et ux	$NW\frac{1}{4}$	28	141	49	U-1	507	05-10-46
256747	Lewis, R. C.	All of	20	141	49			
		All of	21	141	49	U-1	492	05-07-46
256746	Simonson, J. V. et al	All of	17	141	49	U-1	491	05-07-46
257146	Ziegler, Adolph et ux	$SW\frac{1}{4}$	8	141	49	U-1	558	05-22-46
257145	Payne, S. A. et ux	$E\frac{1}{2}$	7	141	49	U-1	557	05-22-46
257144	Payne S. A. et ux	Pt. of $SW\frac{1}{4}$	6	141	49	U-1	557	05-22-46
257143	Veitch, William et ux	$SE\frac{1}{4}$	6	141	49	U-1	556	05-22-46
259254	McGarty, M. A. et ux	$NW\frac{1}{4}$	6	141	49	W-1	156	08-15-46
257844	Hanson, H. H.	Pt. of $NE\frac{1}{4}$	36	142	50	U-1	642	06-17-46
256905	Proctor, J. C. Estate	$SE\frac{1}{4}$	25	142	50	U-1	519	05-13-46
256742	Ondracek, Albert	$NE\frac{1}{4}$	25	142	50	U-1	489	05-07-46
257142	Green, Cora	$SE\frac{1}{4}$	24	142	50	U-1	556	05-22-46
256906	Proctor, John C. Estate	$NE\frac{1}{4}$	24	142	50	U-1	519	05-13-46
257843	Waterfall, Leonard	Pt. of $W\frac{1}{2}$	24	142	50	U-1	641	06-17-46
256741	Erickson, A. F.	$SW\frac{1}{4}$	13	142	50	U-1	489	05-07-46
256844	Nelson, Millie et al	$NW\frac{1}{4}$	13	142	50	U-1	510	05-10-46
256740	Larson, William et al	$NW\frac{1}{4}$-$SW\frac{1}{4}$	12	142	50	U-1	488	05-07-46
257269	Larson, William et al	$NW\frac{1}{4}$	12	142	50	U-1	579	05-27-46
256735	Barker, O. A., et ux	All of	1	142	50	U-1	485	05-07-46
259115	Barker, O. A., et ux	All of	1	142	50	W-1	145	08-09-46
259255	Waterfall, Edward et ux	$NE\frac{1}{4}$ $NE\frac{1}{4}$	2	142	50	W-1	156	08-15-46

Doc. No.	Grantor	Description	Sec.	Twp.	Rge.	Book of Misc.	Page	Date Recorded
257141	Robinson, P. T. Trustee	E½	35	143	50			
		SW¼	26	143	50	U-1	555	05-22-46
256980	Golliet, Mary	NW¼	26	143	50	U-1	530	05-15-46
256989	Heller, Henry et ux	SW¼	23	143	50	U-1	531	05-16-46
258272	Gronvold, Thor	Pt. NE¼ NE¼	22	143	50	W-1	70	07-02-46
263793	Pratt, Park et ux	NW¼	23	143	50			
		NE¼ & SE¼	15	143	50	W-1	503	03-04-60
256738	Falconer, Thomas et ux	SE¼	10	143	50	U-1	487	05-07-46
256737	Lindgren, Oscar	NE¼	10	143	50	U-1	487	05-07-46
256736	Gunkelman, Ralph et ux	W½	3	143	50	U-1	486	05-07-46
259043	Gunkelman, Ralph	W½	3	143	50	W-1	138	08-06-46
259380	Gunkelman, Ralph F.	W½	3	143	50	W-1	166	08-22-46

and also the following described electric transmission line easements located within the County of Traill, State of North Dakota, to-wit:

Doc. No.	Grantor	Description	Sec.	Twp.	Rge.	Book of Deeds	Page	Date Recorded
70803	McFarlane, Neil	SW¼	34	144	50	44	425	05-29-46
71025	McFarlane, Neil	SW¼	34	144	50	44	516	08-07-46
73218	Lockhart, R. D. et al	NW¼	34	144	50	47	580	03-16-48
73212	Fergerson, C. L. et ux	NE¼ & SE¼	28	144	50	47	574	03-16-48

It is the intention of NSP to assign to CCEC all and singular of the rights and privileges granted to it in the easements herein described, said CCEC to assume all obligations and liabilities imposed upon NSP by the terms of said easements, and to indemnify and hold NSP harmless from any damage or injury caused to the grantors in said easements, by virtue of the construction and maintenance of an electric transmission line thereon, by CCEC.

NSP warrants that it has a good right and lawful authority to sell and assign the easements hereinbefore described.

IN WITNESS WHEREOF, the said Northern States Power Company has caused these presents to be executed in its corporate name by its proper officers thereunto duly authorized and its corporate seal to be hereunto affixed this 30th of January, 1968.

In Presence of:

Jacqueline Muffelman

Garnet Rogge

NORTHERN STATES POWER COMPANY

By D. F. McElroy
Vice President-Engineering

And M. D. Vance
Secretary

STATE OF MINNESOTA)
) ss
COUNTY OF HENNEPIN)

On this 30th day of January, 1968, before me, a Notary Public within and for said County, personally appeared D. F. McElroy and M. D. Vance, to me personally known, who, being each by me duly sworn, did say that they are respectively the Vice President-Engineering and the Secretary of the corporation named in the foregoing instrument, and that the seal affixed to said instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and said D. F. McElroy and M. D. Vance acknowledged said instrument to be the free act and deed of said corporation.

Evelyn M. Allen

EVELYN M. ALLEN
Notary Public, Hennepin County, Minn
My Commission Expires Dec. 6, 1968

Appendix F – Preliminary Relocation Plans

Cass Rural Water

Cass Rural Water Users District

BOX 98 • 131 MAPLE STREET
KINDRED, NORTH DAKOTA 58051
PHONE: 701-428-3139 • TOLL FREE: 800-922-2798
FAX: 701-428-3130
www.cassruralwater.com

July 6, 2012

Christopher M. Gross
Project Engineer
Houston - Moore Group
925 10th Ave. E
West Fargo, ND 58078

Dear Chris:

Based on our email communications I have revised my letter from yesterday as follows:

Reaches 1-3

1.	3,280 feet of 3 inch PVC waterline @ $5.00 per foot	$16,400.00
2.	5,280 feet of 2 inch PVC waterline @ $4.00 per foot	$21,120.00
3.	1,000 feet of 2 inch PVC waterline @ $4.00 per foot	$4,000.00
4.	Capping lines – 7 @ $2,400 per cap	$16,800.00
5.	Tie-ins – 6 locations @ $2,400 per location	$14,400.00
		$72,720.00

Reaches 4-7

6.	Tie-ins – 8 locations @ $2,400 per location	$19,200.00
	TOTAL	**$87,120.00**

It was my understanding that you getting estimates from a boring company for the actual bores for both maps which will be an additional cost above what we are providing you here.

If you have any questions regarding the estimates please feel free to call me.

Sincerely.

Jerry Blomeke
General Manager
Cass Rural Water District

We are an Equal Opportunity Provider and Employer

Quality On Tap!

Armadillo NORTH CORE

Date: July 18, 2012

TO: Rush River Water Resource District
ATTN: Estimator
PROJECT: FMM Diversion Reaches 1-3
BID DATE: July 18, 2012

PLEASE NOTE THE FOLLOWING:

1. **NORTH CORE IS A NDDOT & MN DBE/ MBE CONTRACTOR.**
2. This quote is SUBJECT TO THE CONDITIONS AND RENTAL CONTRACT ATTACHED, which must form part of any contract with the contractor and North Core Corp.
3. Soil conditions must be clay or silt NOT SAND, ROCK, OR SHALE.
4. If soil conditions are sand, rock, or shale which create a problem with the boring process, EXTRA CHARGES will be applied to the quoted price.
5. Contractor will be billed the amount of quoted footage and size of pipe unless a change order has been decided by the engineering firm and negotiations have taken place with North Core's management.
6. Any extra footage bored will be at the unit price quoted unless negotiation has taken place with North Core's office management

QTY PER FEET	DESCRIPTION	COST PER FOOT	TOTAL
1500	4" WATER LINE DIRECTIONALLY DRILLED FPVC	$33.00	**$49,500.00**
1500	6" WATERLINE DIRECTIONALLY DRILLED FPVC	$38.00	**$57,000.00**
		TOTAL	**$106,500.00**

PRICE INCLUDES:

Price above includes furnishing all materials and directionally drilling the above stated footages and price. All bores will be surface to surface coming out of the ground at an approximate 40 degree angle. Each end of the product being pulled in will be capped after the drilling has been done. North Core will be pulling in FPVC. Prices above include tracer wire.

PRICE DOES NOT INCLUDE:

Seeding, finish grading of site, permits, dewatering if needed, and removals of excess spoils.

PLEASE SIGN BELOW WITH ACCEPTANCE OF QUOTE AND FAX TO.
701 281 2955 (quote valid for 7 days after Bid date)

---------- ----------

Contractor North Core

4208 3rd Avenue NW Fargo, ND 58102-3907
Phone: 701-281-2186 Fax: 701-281-2955 Toll Free: 866-281-2186

Cass Rural Water Users District

BOX 98 • 131 MAPLE STREET
KINDRED, NORTH DAKOTA 58051
PHONE: 701-428-3139 • TOLL FREE: 800-922-2798
FAX: 701-428-3130
www.cassruralwater.com

August 2, 2012

Mr. Christopher M. Gross
Project Engineer
Moore Engineering
925 10th Ave
West Fargo, ND 58078

Dear Chris:

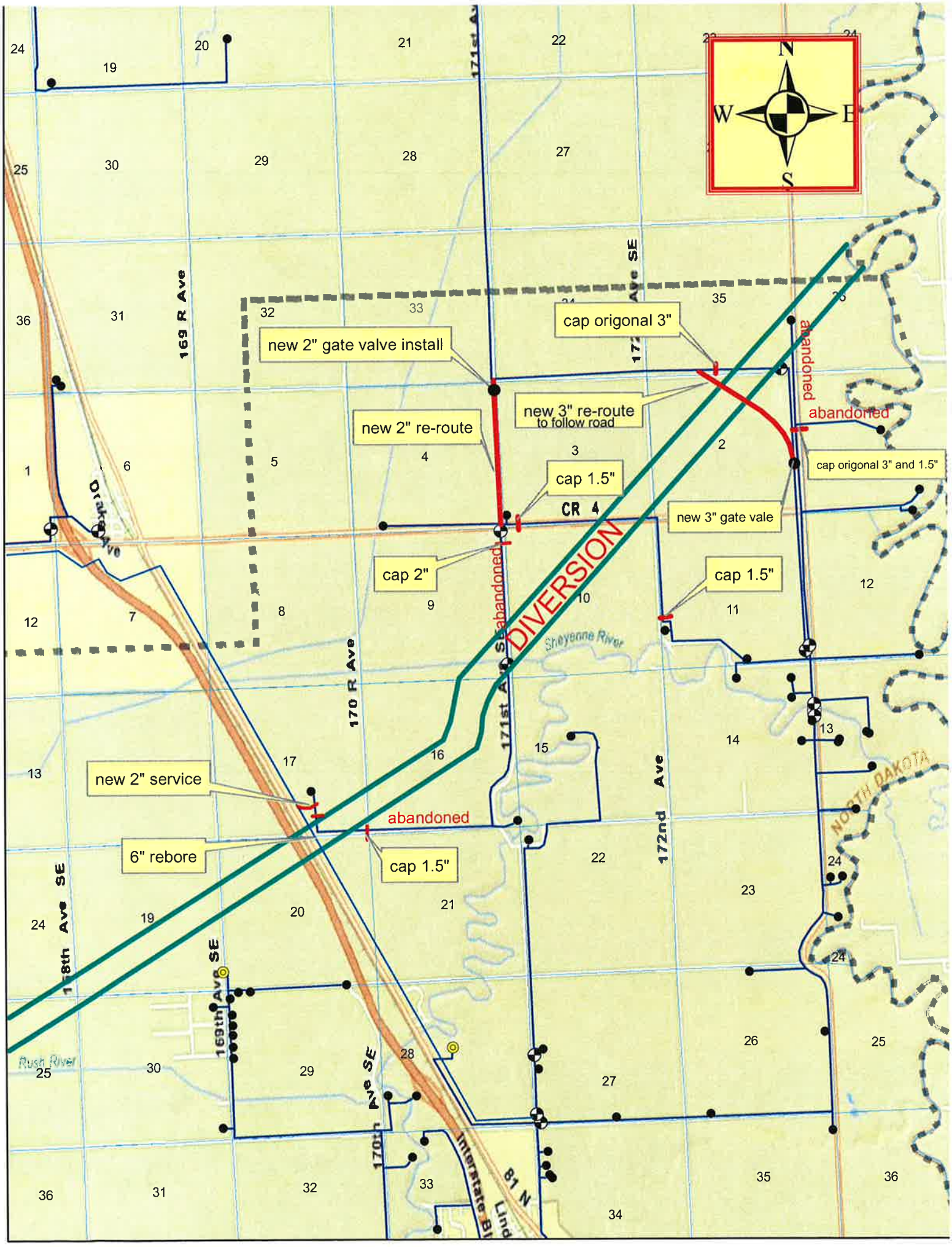
Gregg and I have reviewed the comment letter for reaches 1-3 of the FM Diversion Project. We have responded to each item of your letter in the same order as they appeared in your letter.

1. We are submitting a revised map for reaches 1-3. The new map shows the 6" water line along County Road 81. The 3" and 1 ½" water lines will be capped as shown on the map. It is our understanding that the property in section 1 will be bought out. Our assumption is that no water service from Cass Rural Water District (CRWD) will be required at this location after the buy-out.
2. The existing valves in the NE ¼ of section 9 T141-R49 and section 35 T142-R49 will be abandoned. To abandon these valves we will dig up and remove the valve riser and turn the valve to the off position. There are two new valves planned. The first is needed for the 3" line to accommodate the road re-route in the SE ¼ of section 2 T141-R49. The second will be installed on the 2" line that will be constructed in the NE ¼ of section 4 T141-R49.
3. The re-routing of county roads 4 and 31 will impact CRWD. As a result the map shows the re-routing of our water line.
4. We have no unrecorded easements in E ½ section 9 T141-R49, E ½ section 16 T141-R49, S ½ section 16 T141-R49 or SE ¼ section 2 T140-R50. I believe these lines are located in the public rights-of-way. If it is necessary for us to obtain any easements we will take the necessary steps to accomplish that.
5. All of the work we are proposing is necessary to continue providing water service to existing customers. As I indicated earlier we are assuming we will lose the user in section 1. Consequently, the work to abandon that line is very minimal.
6. None of the proposed improvements are an upgrade for future use or expanded development.
7. CRWD is a political subdivision established under North Dakota Century Code Title 61-35. I am authorized to sign documents of this nature. Most of my contact information is included on the letterhead. My email address is jerry.blomeke@cassruralwaterdistrict.com.

As always if you have any further question feel free to contact me.

Sincerely,

Jerry Blomeke
General Manager
Cass Rural Water District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E
S
new 2" gate valve install
cap origonal 3"
new 3" re-route
to follow road
new 2" re-route
cap 1.5"
CR 4
new 3" gate vale
cap 2"
cap 1.5"
abandoned
abandoned
abandoned
cap origonal 3" and 1.5"
DIVERSION
new 2" service
abandoned
6" rebore
cap 1.5"
169 R Ave
170 R Ave
171st Ave SE
172nd Ave
169th Ave SE
170th Ave SE
178th Ave SE
Oraker Ave
Cheyenne River
Rush River
NORTH DAKOTA
Interstate Hwy 81 N

Appendix G – Preliminary Relocation Plans

Centurylink

FMM Utility Relocations Reaches 1-3 (Centurylink)

This document is being put together to determine the estimated costs to relocate Centurylink facilities in conflict with the FMM Diversion project for reaches 1-3. For this part of the project Centurylink has 5 locations that will be in conflict with the diversion project which can be seen on a separate map that will show the current cable routes, and the proposed cable routes. The proposed routes are shown in blue, numbered, and are subject to change.

Locations:

1. The first location that Centurylink has utilities in conflict with the proposed diversion is located along 173rd Ave SE between 23rd St SE and 24th St SE. Centurylink currently has 1-6 pair drop wire that feeds from 23rd St SE south to 24th St SE. Along the way this wire is feeding a residential customer so we must keep it in service unless otherwise determined. In order to relocate this drop Centurylink will need approximately 2,818' of drop wire which will need to be bored the entire way to get underneath the proposed diversion channel. Estimated costs for this relocation are $26,945.10.

2. The next place that Centurylink has utilities in conflict with the proposed diversion is located along county road 4 between 171st Ave SE and 172nd Ave SE. At this location Centurylink has 2-25 pair cables paralleling county road 4 on the south side. It has been decided to remove the 2-25 pair cables, and replace them with a single 50 pair cable and place a 1.25" conduit underneath the diversion to provide a future path if needed. In order to do so Centurylink will need to replace 2-6" closures, place 2 new 8" closures, and place approximately 7,000' of ANAW-50. Again this design is subject to change, but estimated costs for this relocation are $40,385.89

3. The third location that Centurylink has utilities in conflict with the proposed diversion is located along 171st Ave SE between county road 4 and 26th St SE. At this location Centurylink has 2 single pair copper wires that feed south from county road 4 to 26th St SE. There is a working service a 2595 171st Ave SE that needs to be saved at this time so it has been decided to intercept the existing wires using pits, and tie them back together with a single 3 pair drop wire. The estimated cost to perform this work is $18,961.17.

4. At this location Centurylink has a single 11 pair cable that feeds south from 26th St SE to 27th St SE along 170th Ave SE. In order to relocate this cable Centurylink will need to replace a section of the 11 pair cable with a section of 25 pair cable because 11 pair cables are no longer manufactured and a 25 pair is the smallest cable that one can get. In addition Centurylink is proposing to place a 1.25" duct underneath the proposed diversion channel to provide a future path if needed. Estimated costs for this relocation are $26,562.76.

5. The fifth location where Centurylink has facilities in conflict with the proposed diversion channel is located at highway 81 and 27th St SE. At this location Centurylink has a direct buried 6 fiber (toll) which will need to be relocated. In order to relocate this fiber Centurylink is proposing to follow the exact same path, but bore the cable deeper to accommodate the needs of the proposed diversion. In order to perform this relocation Centurylink will need to bore in a new 1.25" armored innerduct, expose 50' of the existing cable on both sides of the proposed diversion, set 2 new hand holes, pull a new 24 fiber through the duct, and cutover over the existing cable to the new cable. Estimated costs for this relocation are $24,480.39.

*Total estimated costs to relocate Centurylink facilities in conflict with the FMM diversion channel, reaches 1-3, are $137,335.31. These costs were figured on current contract pricing, and proposed designs which are both subject to change. These costs are high level estimates and are subject to change.

CENTURY LINK RELOCATION MAP
FM METRO DIVERSION
CASS COUNTY, NORTH DAKOTA

Created By: GZ, EM, DMR Created: 12/20/2011 Date Updated: 07/09/2012 Date Printed: 05/23/2012
Parcel Date: N/A Aerial Image: 2010 County SIDS Elevation Data: IWI Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
T:\Numbered Projects\14491\14491_341\gis\UtilityMaps_20120606\14491_341_Utility_Locations_COMMUNICATION_CenturyLink.mxd

N
W E
S

0 600 1,200 2,400 3,600 Feet
1 in = 1,200 feet

HMG

Legend

- North Diversion Roadway Realignment

Diversion Stationing Maple To Outlet

- Minor Station
- Major Station
- Alignment

Communication Lines

Owner

- Century Link - Field Located
- Century Link - Non-Field Located
- Century Link - Proposed
- Midcontinent - Field Located
- Communication Pedestal - Century Link

CenturyLink™

USACE Comments - FMM Diversion Utility Relocation - Reaches 1 through 3

1. **Will road realignments impact any of your utilities? As you know, CR4 and CR 31 are being realigned.**
   - The road realignments will impact our facilities, and the original design estimates included the work necessary to follow the road realignments.

2. **Need a statement in writing explaining what Centurylink plans to do with existing pedestals (if any) as well as if any new pedestals are being proposed to be installed and at what locations.**
   - In any event where there is an existing pedestal in conflict with the proposed diversion it will be eliminated or relocated so it is no longer in conflict. Every place that Centurylink is intending to cross the diversion channel, there will be a pedestal on both sides of the diversion to provide troubleshooting access points.

3. **Does Centurylink have any unrecorded easements? I was unable to find ROW documents for your lines in the NW ¼ Sec 36-142-49, W ½ Sec 10-141-49, and the toll fiber in Sec 17&20-141-49. Please provide easement documentation of this area. We did not find them at the courthouse.**
   - I was unable to find easements for NW ¼ Sec 36-142-49, I was able to find some documents for W ½ Sec 10-141-49 which I submitted to Chris Gross, but no documents for Sec 17&20-141-49 either.

4. **Need a statement that all utilities are being relocated in order to continue providing service to Centurylink's customers. They just need confirmation that a line isn't being relocated for no reason.**
   - All cables that I have shown to be relocated are being relocated to continue providing service to existing customers.

5. **If lines are being upgraded (not applicable to all companies), the USACE needs a reason for the upgrade.**
   a. **Upgrading a utility line for future use or expected land development is not a reimbursable expense.**
      i. **This may be negotiated with the local funding agency if Centurylink chose to do so.**
   b. **Upgrading a utility line due to new engineering guidelines or because existing materials aren't produced/used anymore is a reimbursable expense.**
   - As of right now no cables have been upgraded. There were a couple instances where the existing cable size was no longer available so Centurylink had to go to the next cable size up, but that is being driven by cable manufacturers, not Centurylink.

6. **Has Centurylink taken over interest of previous communication service providers? If so, who and when? Did Centurylink acquire their old easements? Please provide this documentation if applicable.**
   - Centurylink has superseded a number of different companies over the years. I cannot provide you the exact dates of when these transactions took place, but some of the previous company names were: Northwestern Bell, US West, and Qwest.

7. **Need a description the Centurylink's current company structure (Coop, Corporation, etc.). If incorporated, in what states and when? We also need a name, title, address, phone number, email, etc. of someone capable of signing agreements, legal documents, etc. for Centurylink as the project moves forward.**
   -Contact for legal documents:
   Tina Colvin
   CenturyLink Law Department
   Network Paralegal
   1801 California Street
   9th Floor
   Denver, Colorado 80202
   (w) 303-992-5783
   (c) 303-514-8792
   (fax) 303-383-8469

(2) 26

RIGHT OF WAY EASEMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, WM. LARSON

for HIM SELF HIS heirs and assigns, hereby grant and convey unto Northwestern Bell Telephone Company, its successors and assigns, a right of way and easement to construct, operate, maintain, replace, enlarge and remove a communications system consisting of buried cables or wires, surface terminals, repeaters, repeater housings, markers and associated equipment together with the right of access thereto for the purpose of exercising the rights herein granted upon, over, and under a strip of land 10 feet wide across the following described property in the Township of Harwood, County of Cass, State of North Dakota:

N½ NW¼ and N½ W½ NE¼ Section 10 T141N R49W

N W B
R/W PERMIT
No. 63731

along the following route:
Parallel to and approximately 80' south of the centerline of the road bordering said Section 10 on the north.

The south boundary of said strip shall be a line parallel to and 5 feet south of the first cable laid, which shall have its location indicated upon surface markers set at intervals on the land of the undersigned or on adjacent lands. The grantees agree to pay for damage to fences and growing crops arising from the construction and maintenance of the aforesaid systems.

Signed and sealed this 18 day of MAY, 19 74, at COON RAPIDS, MINN

Witness:

Signed:
X William G. Larson

X STATE OF Minnesota
County of Anoka SS

On this ~~May~~ 18 day of May, 19 74, before me, a Notary within and for said County, personally appeared William Larson to me known to be the person described in, and who executed the foregoing instrument, and acknowledged that he executed the same as free act and deed.

Notary Public CAROL J. OLSON Anoka
My Commission Expires Dec. 26, 1974

My commission expires 12 [illegible] 19 74

STATE OF
County of SS

On this day of , 19 , appeared before me to me personally known to be the person whose name is subscribed to this instrument as a subscribing witness, who being first duly sworn, says that , whose name is subscribed to the instrument as party of the first part, and is the person described in it, that such persons executed it in his presence and that the witness subscribed his name thereto as a witness.

Notary Public County,
My commission expires 19

Form NDE-117
Rev. Aug. 73 (2)

47820

THIS INSTRUMENT WAS DRAFTED BY
NORTHWESTERN BELL TELEPHONE COMPANY
FARGO DISTRICT ENGINEERING
44 South Fourth Street
FARGO, NORTH DAKOTA

502454
300 Chg.

For Telephone Company Use Only—
Name of Exchange Gardner
Job Order #
Project ot Est. # 9810
L.S. #
R/W Secured By

Compared
Grantor
Grantee
Indexed
Checked

BOOK Y-6 PAGE 325

STATE OF NORTH DAKOTA
COUNTY OF
REGISTERED
I hereby certify that the instrument was filed in this office for record on the 17 day of May A.D. 19 76 at 3:05 o'clock P.M. and was duly recorded in Book Y-6 of Mixed Page 325
Register of Deeds
By Karen Lura Deputy

N.W. Bell Telephone Co.

NDP - 74
Rev. 4-1-37

NWB
R/W PERMIT
No 24768

11564

RIGHT-OF-WAY EASEMENT

KNOW ALL MEN BY THESE PRESENTS, That we, the undersigned, (whether one or more) The Merchants National Bank & Trust Co. of Fargo, trustee under the will of William H. Larson, deceased. (unmarried) (husband and wife) for a good and valuable consideration, the receipt whereof is hereby acknowledged, do hereby grant unto the Northwestern Bell Tel Co, a corporation, its successors or assigns, the perpetual right to construct, operate and maintain its telephone lines consisting of poles, wires, fixtures and anchors, upon or adjacent to that certain piece of real estate hereinafter described, in the following manner:

* ____ feet South of center line of the east-west ~~and/or north-south~~ section road bordering Section 10 on the South-North Poles to be set on edge of ditch together with the right to cut down and/or trim trees and shrubbery to the extent necessary to keep them clear of said telephone line or system, and to cut down from time to time all dead, weak, leaning or dangerous trees that are tall enough to strike and/or damage the wires in falling.

The foregoing right is granted upon the express condition that the Telephone Company will assume liability for all damage to the hereinafter described property caused by said Company's failure to use due care in its exercise of the granted right.

The real estate referred to is specifically described as follows:

*County Cass, Section 10, Range 49, Township 141, NW 1/4 and E 1/2 of NE 1/4

The undersigned covenant that they are the owners of the above described lands and that the said lands are free and clear of encumbrances and liens of whatsoever character except those held by the following persons:

IN WITNESS WHEREOF, The undersigned have set their hands and seal this 7th, day of October, 1957.

The Merchants National Bank & Trust Co. of Fargo, trustee under the will of William H. Larson, deceased.

James E. Leahy, Trust Officer

IN PRESENCE OF:

Harry L. Moe

Anita Ganske

(N.W. Bell only --
(Exchange Argusville
(L.S. No's. 400
(Pole No's. 48-56, 62-5

*Cross out if not applicable.

BOOK 0U-6 PAGE 436

RIGHT OF WAY EASEMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, KENNETH AND FRANCES SOBERG ~~SOBERG~~

for THEM SELVES THEIR heirs and assigns, hereby grant and convey unto Northwestern Bell Telephone Company, its successors and assigns, a right of way and easement to construct, operate, maintain, replace, enlarge and remove a communications system consisting of buried cables or wires, surface terminals, repeaters, repeater housings, markers and associated equipment together with the right of access thereto for the purpose of exercising the rights herein granted upon, over, and under a strip of land 10 feet wide across the following described property in the Township of Harwood, County of Cass, State of North Dakota:

W½ N½ SW¼ Section 11 T141N R49W

NWB R/W PERMIT No. 63425

along the following route:

Parallel to and approximately 80' east of the centerline of the road bordering said Section 11 on the west.

The east boundary of said strip shall be a line parallel to and 5 feet east of the first cable laid, which shall have its location indicated upon surface markers set at intervals on the land of the undersigned or on adjacent lands. The grantees agree to pay for damage to fences and growing crops arising from the construction and maintenance of the aforesaid systems.

Signed and sealed this 28 day of FEB, 19 74, at Argusville N.D.

Witness:

Byron Rossum

Byron Rossum

Signed:

Kenneth Soberg

Frances Soberg

STATE OF NO DAK
County of CASS. } SS

On this 28 day of Feb, 19 74, before me, a NOTARY public within and for said County, personally appeared KENNETH AND FRANCES SOBERG to me known to be the person s described in, and who executed the foregoing instrument, and acknowledged that They executed the same as THEIR free act and deed.

Byron Rossum

Notary Public County,
BYRON ROSSUM, Notary Public
RICHLAND COUNTY, N. Dak.
My commission expires My Commission expires June 7, 1979.

STATE OF
County of } SS

On this day of , 19 , appeared before me to me personally known to be the person whose name is subscribed to this instrument as a subscribing witness, who being first duly sworn, says that , whose name are/is subscribed to the instrument as party of the first part are/is the person described in it, that such persons executed it in his presence and that the witness subscribed his name thereto as a witness.

Notary Public County,
My commission expires 19

Form NDE-117
Rev. Aug. 73

47415

THIS INSTRUMENT WAS DRAFTED BY
NORTHWESTERN BELL TELEPHONE COMPANY
FARGO DISTRICT ENGINEERING
44 South Fourth Street
FARGO, NORTH DAKOTA

Compared
Mentor
Mailed
Checked

For Telephone Company Use Only—
Name of Exchange Gardner
Job Order #
Project ot Est. # 9810
L.S. #
S/W Secured By

DOCUMENT NO 499096
(Recording 20 Aug
FEES

STATE OF NORTH DAKOTA
COUNTY OF [illegible]
REGISTER OF DEEDS
I hereby certify that the above instrument was filed in this office for record on the 12 day of Feb A. D. 19 76 at 10:02 o'clock A. M. and was duly recorded in Book 476 of Misc. Page 436
Leanna Kemmerer
REGISTER OF DEEDS
By _____ Deputy

Appendix H – Preliminary Relocation Plans

Magellan Pipeline

MAGELLAN®
MIDSTREAM PARTNERS, L.P.

July 16, 2012

VIA E-MAIL: tjohnson@mooreengineeringinc.com

Mr. Tyler Johnson
Project Engineer
Moore Engineering, Inc.
925 10th Ave. E.
West Fargo, ND 58078

RE: Magellan Pipeline Company Cost Estimate
Cass County Flood Diversion Project- Utility Relocation-
FMM Reach 1 through Reach 3

Dear Mr. Johnson:

Magellan Pipeline Company will relocate the approximately 2,600 feet of new 6 inch pipeline by boring.

It will take **approximately 90 days** to get this project started and completed. There is an approximately 3 to 4 week lead time on material. The survey and plans for the new pipeline take approximately 3 weeks. The contractor bidding and approval process take approximately 3 weeks. The process of obtaining Magellan in-house approvals takes 3 weeks. The project will take approximately 4 weeks. After the project is completed, it will take a couple of weeks to receive a completed job book with red lines.

The original cost for this project was a **rough estimate** based off of previous similar projects.

Material: $50,000
Drilling: $290,000
Survey and Plans: $75,000
Miscellaneous: $35000

To obtain a more accurate estimate, I would have to send this project out to our 3rd party engineering firm. Due to future inflation and other contingencies not originally placed in this rough cost estimate, this project could cost more than I have predicted.

Cory R. Davis
Asset Integrity Engineer
Magellan Midstream Holdings GP, LLC
Phone: (918) 574-7266
Cell: (918) 230-6716
Fax: (918) 574-7248

CASS COUNTY, NORTH DAKOTA

MAGELLAN MIDSTREAM PARTNERS, L.P.

811 Know what's below. Call before you dig.

N
W E
S

Legend

- Magellan Valve Sites
- Magellan Pipeline (Approx. Location)
- Estimated Project Area
- Magellan Property
- States
- County
- Sections

For Actual Pipeline Location Contact Local Field Rep.

0 312.5 625 1,250 1,875
Feet

This copy is not a survey and has been furnished by Magellan Pipeline Company, L.P. (Magellan) for information as to approximate locations only of any pipelines or other facilities shown thereon. Magellan disclaims any representations as to accuracy or completeness of the information depicted on this copy and makes no warranties regarding accuracy or completeness of such information depicted hereon. Actual locations of pipelines and facilities must be determined on-site through timely contact with the appropriate One Call agency - Call 811 - and coordination with Magellan. Excavation, grading, construction and/or vehicle traffic in the vicinity of the pipeline(s) and facilities shown on this copy are prohibited without written permission from Magellan or other owners of pipelines or facilities depicted hereon.

Drawn By:	Darwin Henrichsen
Real Estate Rep:	Cynthia Pierce (918) 574-7464
Local Field Rep:	Paul Klabunde (701) 793-8377
MPL Project #:	12-590
Date:	06-20-2012

MAGELLAN®
MIDSTREAM PARTNERS, L.P.

August 8, 2012

VIA E-MAIL: cgross@mooreengineeringinc.com & tjohnson@mooreengineeringinc.com

Mr. Chris Gross & Mr. Tyler Johnson
Project Engineers
Moore Engineering, Inc.
925 10th Ave. E.
West Fargo, ND 58078

RE: Magellan Pipeline Company Information & Cost Estimate Revision
Cass County Flood Diversion Project- Utility Relocation-
FMM Reach 1 through Reach 3 (MPL PRJ-12-590)

Gentlemen:

First, be advised that we have re-examined the cost estimate for Magellan Pipeline to relocate the 6-inch pipeline and valve box facilities (see GIS drawing attached). **We herein revise the July 16, 2012 rough estimate to $900,000.00.** Please adjust your records accordingly.

The following are the questions from your July 30, 2012 e-mail and the **Magellan response in red**:

1. Does Magellan intend to remove the abandoned 6" petroleum line once a new one is in place and functional? Yes. Magellan will remove all abandoned pipe after the new pipeline is installed.
2. Need a statement in writing explaining what Magellan plans to do with existing valves/closure structures as well as stating that rapid closure structures will be installed on the relocated petroleum line. There is a 6 inch valve box located at MP114 on the Alexandria to Grand Forks #1-6" pipeline. This valve will be relocated outside of the diversion channel and connected to the new 6 inch pipeline and we will need to install an additional valve box on the opposite side of the diversion channel.
3. Has Magellan taken over interest of previous petroleum providers? If so, who and when? Did Magellan acquire their old easements? Please provide this documentation if applicable. Magellan's predecessor in title for the two (2) easements, Exhibit "A" involved in this project is Great Lakes Pipe Line Company. Please see attached Exhibit "B" for the Magellan chain of title/corporate history.

4. Need a description of Magellan's current company structure (Coop, Corporation, parent company, etc.). If incorporated, in what state and when? Magellan Pipeline Company, L.P., formed in September 9, 2004, is a Delaware limited partnership company; managed by Magellan Pipeline GP, LLC, its general partner, which in turn is managed by Magellan Midstream Partners, L.P., its sole member, which in turn is managed by Magellan GP, LLC, its general partner.
5. We also need a name, title, address, phone number, email, etc. of someone capable of signing into agreements, legal documents, etc. for Magellan as the project moves forward. **For Project Contact (legal documents etc):** H. Cynthia Pierce, Senior Real Estate Representative, One Williams Center, MD-27, Tulsa, OK 74172, PO Box 22186, MD-27, Tulsa, OK 74121-2186; cynthia.pierce@magellanlp.com; (918) 574-7464-office; (918) 574-7249-fax. **For Project Location:** Paul Klabunde, (701) 793-8377-cell, paul.klabunde@magellanlp.com. **For Engineering Information:** Cory Davis, (918) 574-7266, cory.davis@magellanlp.com.

H. Cynthia Pierce
Senior Real Estate Representative
Phone: (918) 574-7464
Fax: (918) 574-7249
cynthia.pierce@magellanlp.com

cc: Cory Davis
Paul Klabunde

w/attach

CASS COUNTY, NORTH DAKOTA

MAGELLAN
MIDSTREAM PARTNERS, L.P.

811 Know what's below. Call before you dig.

N
W E
S

Legend

- Magellan Valve Sites
- Magellan Pipeline (Approx. Location)
- Estimated Project Area
- Magellan Property
- States
- County
- Sections

For Actual Pipeline Location Contact Local Field Rep.

0 312.5 625 1,250 1,875
Feet

This copy is not a survey and has been furnished by Magellan Pipeline Company, L.P. (Magellan) for information as to approximate locations only of any pipelines or other facilities shown thereon. Magellan disclaims any representations as to accuracy or completeness of the information depicted on this copy and makes no warranties regarding accuracy or completeness of such information depicted hereon. Actual locations of pipelines and facilities must be determined on-site through timely contact with the appropriate One Call agency - Call 811 - and coordination with Magellan. Excavation, grading, construction and/or vehicle traffic in the vicinity of the pipeline(s) and facilities shown on this copy are prohibited without written permission from Magellan or other owners of pipelines or facilities depicted hereon.

Drawn By:	Darwin Henrichsen
Real Estate Rep:	Cynthia Pierce (918) 574-7464
Local Field Rep:	Paul Klabunde (701) 793-8377
MPL Project #:	12-590
Date:	06-20-2012

EXHIBIT "A"

MAGELLAN EASEMENTS & GATE VALVE AGREEMENT

A 30
REV. 8-46

RIGHT OF WAY AGREEMENT

For and in consideration of the sum of Five Dollars ($5.00)

to us in hand paid by GREAT LAKES PIPE LINE COMPANY, a corporation, of Kansas City, Missouri, the receipt of which is hereby acknowledged Robert C Lewis + Lou Ceil Lewis, Husband Wife,

do hereby grant to GREAT LAKES PIPE LINE COMPANY, its successors or assigns, the right to lay, maintain, operate, re-lay and remove at any time a pipe line or pipe lines for the transportation of oil or oil products, gas and water, and if necessary, to construct, maintain, operate and remove telegraph and telephone lines, with right of ingress and egress to and from the same, on, over and through certain lands situate in the County of Cass and State of North Dakota,

and described as follows All of the SE 1/4 + NE 1/4 of Sec 20, east of R.R.; also W 1/2, Sec 21 - less R R R/W - all in Township 141 N - R. 49 W

The said grantor their heirs or assigns are to fully use and enjoy the said premises except the easement for the purposes hereinbefore granted to the said GREAT LAKES PIPE LINE COMPANY, its successors and assigns.

The said GREAT LAKES PIPE LINE COMPANY for itself and its successors or assigns hereby covenants to bury the lines of pipes so that the same will not interfere with the cultivation of said premises.

All damages to crops, surfaces, fences, or other improvements on said premises for and because of the laying of each line of pipe and each telegraph and telephone line shall be paid for as soon as said line or lines are completed. In addition to this there shall be paid on the laying of the first line of pipe an additional compensation at the rate of $1.00 per rod for each rod or fraction thereof of land on these premises, across which said line is laid. Additional lines shall be laid for a consideration the same as for the first. If the amount of damages to fences, crops or other improvements, which may be suffered by reason of laying, maintaining, operating, altering or removing said pipe line or telegraph and telephone lines, cannot be mutually agreed upon, then same shall be ascertained and determined by three disinterested persons, one thereof to be appointed by the owner of the premises, one by GREAT LAKES PIPE LINE COMPANY, its successors or assigns, and the third by the two so appointed as aforesaid, the award of two of such persons being final and conclusive.

Telephone or Telegraph lines if constructed above ground shall be located along the property line

Dated this 16 day of April, 1946

Robert C Lewis (SEAL)

Lou Ceil Lewis (SEAL)

(SEAL)

(SEAL)

x 1878

CK 6076 E 2 1

6149

STATE OF North Dakota }
COUNTY OF Cass } ss.

Before me, the undersigned, a Notary Public in and for the County aforesaid on this 17 day of April, 1946, personally appeared Robert C Lewis & Lou Ceil Lewis Husband & Wife

to me known to be the identical persons who executed the within and foregoing instrument and acknowledged to me that they executed the same as their free and voluntary act and deed, for the uses and purposes set forth.

Witness my hand and official seal.

[signature]
Notary Public.

My Commission expires Nov 17, 1949

Document No. 256400

Sec. ..... Twp. ..... Rge. ..... Line

County ..... Compared ..... Grantee ..... Grantee ..... Indexed ..... Checked

Right of Way

FROM

TO

Great Lakes Pipe Line Company

Kansas City, Missouri

STATE OF NORTH DAKOTA, } ss.
COUNTY OF CASS.
REGISTER'S OFFICE
I hereby certify that the above Instrument was filed in this office for record on the 26 day of April, A.D. 1946, at 2:11 o'clock P. M., and was duly recorded in Book 71, Page 421

[signature]
REGISTER OF DEEDS

..... Deputy

RIGHT OF WAY AGREEMENT

KNOW ALL MEN BY THESE PRESENTS:

THAT, THE UNION CENTRAL LIFE INSURANCE COMPANY of Cincinnati, Ohio, a corporation organized under the laws of the State of Ohio, for and in consideration of the sum of Five ($5.00) Dollars, receipt of which is hereby acknowledged, does hereby grant unto Great Lakes Pipe Line Company, a corporation, of Kansas City, Missouri, the right to lay, maintain, and operate One (1) Eight (8) inch pipe line for the transportation of oil or oil products, gas and water, over and through the following described land situated in the County of Cass and State of North Dakota, to-wit:

All of Section Seventeen (17), excepting drainage ditches, railroad and highways, and all of the Southwest Quarter (SW¼) of Section Eight (8) lying south of Jim Hill Drainage Ditch #30 and east of the G. N. Railroad excepting railroad and highway, all being in Township One Hundred Forty-one (141) North, Range Forty-nine (49) West, Cass County, North Dakota;

The route of said pipe line shall be as follows: Beginning at a point 800 feet west of the Southeast corner of the Southeast Quarter (SE¼) of Section 17, thence in a northwesterly direction to a point approximately 200 feet north and 1300 feet west of the Southeast corner of the Southwest Quarter (SW¼) of Section 8, said point being on the North boundary of the 16.41 acres lying south of Jim Hill Drainage Ditch #30 and east of the Great Northern Railway right-of-way in the Southwest Quarter (SW¼) of Section Eight, covering a distance of approximately 390 rods.

The Grantee at any and all reasonable times shall have the right of ingress to and egress from such pipe line and also the right to lay, construct, maintain, operate, alter, repair, replace and remove same.

TO HAVE AND TO HOLD the said easement unto said Great Lakes Pipe Line Company, its successors and assigns, so long as such pipeline is maintained, subject, however, to all rent contracts, agreements for sale and the rights of occupants, if any, in said land, and grantee by the acceptance of this grant covenants and agrees to bury such pipeline so that it will not interfere with the cultivation of the land, and to replace the surface on a level with adjoining land; also to pay for any damage done to the buildings, fences, crops and land owned by the grantor, its successors and assigns in maintaining, operating or removing said pipeline. In addition to this there shall be paid before the pipeline is laid, an additional compensation at the rate of $1.00 per rod for each rod or fraction thereof of land on these premises across which said pipeline is laid. No additional lines shall be laid without the consent of the grantor.

The right above granted shall continue from the date hereof so long as said Great Lakes Pipe Line Company, or its successors and assigns shall maintain said line, but in the event that it abandon any part, the right shall cease as to that part of the land on which said line has been abandoned.

IN WITNESS WHEREOF, the said, THE UNION CENTRAL LIFE INSURANCE COMPANY, has hereunto caused its name to be subscribed and its corporate seal to be affixed this 20th day of May, 1946.

THE UNION CENTRAL LIFE INSURANCE COMPANY

By _____
J. C. Hatfield Vice President

By _____
R. E. Thayer Asst. Treasurer

We hereby consent to this Easement:

_____

_____

(OVER FOR ACKNOWLEDGEMENT)

6150

STATE OF OHIO,)
COUNTY OF HAMILTON,) ss.

On this 20th day of May in the year 1946, before me Robert Alfred Kisker, a Notary Public, within and for the aforesaid County and State, personally appeared J. C. Hatfield and R. H. Thayer , known to me to be the Vice-President and Assistant Treasurer, respectively, of the corporation that is described in and that executed the within instrument, and acknowledged to me that such borporation executed the same.

In witness whereof I have hereunto subscribed my name and affixed my official Seal the day and year in this certificate above written.

My commission expires:

February 6, 1947

Robert Alfred Kisker, Notary Public in and for Hamilton County, Ohio.

Document No. 258516

1.00
Chg

No.

Compared
Grantor
Grantee
Indexed
Checked

The Union Central Life Insurance Company

CINCINNATI, OHIO

TO

STATE OF NORTH DAKOTA, } ss.
COUNTY OF CASS

REGISTER'S OFFICE

I hereby certify that the above instrument was filed in this office for record on the 13 day of July A. D. 1946 at 8:08 o'clock A. M., and was duly recorded in Book N-1 of Mtg. Page 99

REGISTER OF DEEDS

Deputy

Great Lakes Pipe Line
Kansas City Mo.

M-1113

GATE VALVE PERMIT

For and in consideration of the sum of Ten-(10.00) Dollars, in hand paid, receipt of which is hereby acknowledged, J.V. Simonson & Judith Simonson, his wife and Oscar A. Simonson, a single Man

hereby grant to the GREAT LAKES PIPE LINE COMPANY, a corporation of Kansas City, Missouri, its successors and assigns, the right to install, operate, maintain, remove, and replace gate valves and gate boxes in connection with the operation of its pipe lines on the Sec, 17-Twn 141-R49-Cass Co. N.D.

Gate valves and gate boxes to be placed in lines on above property. Any damage to land or crops which may be caused by the repair and maintenance of gate valves or gate boxes to be paid for at time such damages occur.

WITNESS our hands this 18 day of July, 1946

WITNESSES:
G.E. Laughlin

x J.V. Simonson
x Judith Simonson
x Oscar A. Simonson

STATE OF No. Dak)
) SS
COUNTY OF Traill)

On this 18 day of July, 1946 before me personally appeared J.V. Simonson Judith Simonson his wife & Oscar A. Simonson a Singleman to me known to be the persons described in and who executed the foregoing instrument, and acknowledged that they executed the same as their free act and deed.

x 1879

Enoch Kirkeberg
Notary Public

Notary Public, Traill County, N. D.
My Commission Expires Feb 28, 1948

My commission expires:

Hold for copy [illegible]
Union Central

6709

6150

M-1115

GATE VALVE PERMIT

For and in consideration of the sum of Ten ($10.00) Dollars, in hand paid, receipt of which is hereby acknowledged, The Union Central Life Insurance Company, a corp.; J.V. Simonson and Judith Simonson, his wife, Oscar A. Simonson, single,

hereby grant to the GREAT LAKES PIPE LINE COMPANY, a corporation, of Kansas City, Missouri, its successors and assigns, the right to install, operate, maintain, remove, and replace a gate valve and a gate box in connection with the operation of its pipe lines on the Sec.17-Twn.141-R49W Cass Co., N.D.

Gate valve and gate box to be placed in lines on above property. Any damage to land or crops which may be caused by the repair and maintenance of gate valve or gate box to be paid for at time such damages occur.

WITNESS our hands this 11 day of October, 1946

WITNESSES:

x Oscar Simonson
x Judith Simonson
x J.V. Simonson

THE UNION CENTRAL LIFE INSURANCE COMPANY
By R. H. Thayer
R. H. Thayer Asst. Treasurer

December 2, 1946

STATE OF North Dakota,) SS
COUNTY OF Cass)

On this 14 day of October, 1946, before me personally appeared Oscar Simonson Judith Simonson & J.V. Simonson to me known to be the persons described in and who executed the foregoing instrument, and acknowledged that they executed the same as their free act and deed.

John C. Stennes
Notary Public

My commission expires: Dec. 30, 1950

(OVER FOR CORPORATE ACKNOWLEDGEMENT)

6150

STATE OF OHIO)
COUNTY OF HAMILTON) ss.

On this 2nd day of December, in the year 1946, before me personally appeared R. H. Thayer, known to me to be the Assistant Treasurer of the corporation described in and that executed the within instrument, and acknowledged to me that such corporation executed the same.

My commission expires:
February 5, 1947

Robert Alfred Kisker
Robert Alfred Kisker, Notary Public
In and for Hamilton County, Ohio.

#025,314
RHR:ew

Document No. 263339

FEES Recording 1 25 Chg
Land Transfer

Compared
Grantor
Grantee
Indexed
Checked

STATE OF NORTH DAKOTA, COUNTY OF CASS ss.
REGISTER'S OFFICE
I hereby certify that the above instrument was filed in this office for record on the 24 day of February A. D. 1947 at 8 04 o'clock A M, and was duly recorded in Book N-1 of Page 462
REGISTER OF DEEDS
By Deputy

EXHIBIT "B"

Magellan Pipeline Company, L.P. Corporate History

1. On March 15, 1966, Great Lakes Pipe Line Company, by special warranty deed, conveyed all its right title and interests to Williams Brothers Pipe Line Company;

2. On November 23, 1965, Williams Brothers Pipe Line Company was incorporated in the State of Delaware;

3. On March 13, 1974, Williams Brother Pipe Line Company amended its Certificate of Incorporation to change its name to Williams Pipe Line Company;

4. On December 27, 2000, Williams Pipe Line Company filed a Certificate of Conversion and converted to a Delaware limited liability company named Williams Pipe Line Company, LLC;

5. On August 14, 2003, Williams Pipe Line Company, LLC amended its Certificate of Formation to change its name to Magellan Pipe Line Company, LLC;

6. On August 25, 2003, a Certificate of Correction was filed to correct an error in the Company's name, which corrected the name of the Company to Magellan Pipeline Company, LLC;

7. On September 9, 2004, Magellan Pipeline Company, LLC filed a Certificate of Conversion to convert to a Delaware limited partnership named Magellan Pipeline Company, L.P.; and

8. Magellan Pipeline Company, L.P. has made no further filings with the Secretary of State of the State of Delaware since September 9, 2004 and remains, as of August 8, 2012, as Magellan Pipeline Company, L.P.

Appendix I – Preliminary Relocation Plans

Minnkota Power

Minnkota Power
MPC COOPERATIVE, INC.
Your Touchstone Energy® Partner

1822 Mill Road • P.O. Box 13200 • Grand Forks, ND 58208-3200 • Phone (701) 795-4000

July 2, 2012

Christopher Gross, Project Engineer
Houston - Moore Group
Moore Engineering, Inc.
925 10th Ave. E
West Fargo, ND 58078

RE: Fargo-Moorhead Diversion Project
Reaches 1-3 Utility Relocates, Preliminary - Proposal and Estimate
2 – 69 kV Transmission Lines owned and operated by Minnkota Power Cooperative, Inc.

Dear Mr. Gross:

Line Type:

69 kV - 3 Phase Electrical Transmission
This proposal includes only lines #968A and #200T in reaches 1-3

Proposed Relocate:

In order to assist the Fargo-Moorhead Diversion Project Team in the process of securing the LERDS certification prior to appropriation of funds to begin the diversion project Minnkota Power Cooperative, Inc. submits the following proposal and estimate for high voltage overhead electrical power utility relocates to traverse the diversion ROW for the proposed diversion channel crossing our existing easement.

Generally in order to cross the diversion channel we will need to modify the 69 kV lines by adding two deadend structures and two spanning structures capable of supporting the existing line section and a stronger conductor capable of spanning the 1650+/- span. In order to attain the clearance elevation needed we will need to begin grading the line higher prior to the deadend structures. The specific crossing locations of the diversion ditch and our existing lines present a medium and large skew. In order to cross at a perpendicular our transmission line will need to be rerouted to some extent.

The reroute will incur a liability of additional easement or location of our line on an easement that travels along or within the western edge of the diversion ROW. The following estimate will include our estimate of EASEMENT, DESIGN AND CONSTRUCTION costs anticipated at this time for the relocation of line #968A and #200T. Location of the reroute on an easement within the proposed or an expanded diversion ROW on the west side of the channel is preferred to stay clear of existing waterways.

Cost:

Line #200T – Estimate $655,000
Line #968A – Estimate $935,000

Timeline:

In order to complete the reroutes it is estimated that a 12 month period be allowed from notice to proceed to the completion. The 12 months includes 3 months for design, 6 months for material and contracts, and 3 months for construction. The first 9 months may include easement acquisition. A faster schedule may mean additional cost.

Request for information:

In order to more accurately estimate and perform designs a shape file of the actual alignment is needed. If the southern alignment is available it would be helpful as we could begin looking at the other crossings and developing preliminary plans.

Thank you for the opportunity to participate in the early stages of this project development and I look forward to the safe and timely completion of the Fargo-Moorhead Diversion.

Sincerely,

MINNKOTA POWER COOPERATIVE, INC.

John Thompson
Project Engineer

Encl: Estimate, Preliminary Realignment Proposal

Estimate

ESTIMATE FOR MINNKOTA POWER COOPERATIVE, INC. UTILITY RELOCATES IN REACHES 1-3
RELOCATION OF LINES AND SPANNING OF FARGO-MOORHEAD DIVERSION CHANNEL

LINE #200T
1 MILE OF LINE AFFECTED

DESCRIPTION	UNIT	QTY	UNIT COST	LINE	SUB TOTAL
DEADENDS	STRUCTURE	2	$75,000	$150,000	
SPANNING STRUCTURES	STRUCTURE	2	$75,000	$150,000	
LINE RELOCATE	MILE	1	$200,000	$200,000	
					$500,000
EASEMENT	ACRES	10	$3,000	$30,000	
DESIGN AND ADMIN	LUMP SUM %	0.15	$75,000	$75,000	
CONSTRUCTION MGMT	LUMP SUM %	0.1	$50,000	$50,000	
					$155,000

ESTIMATE **$655,000**

LINE #968A
2 MILE OF LINE AFFECTED

DESCRIPTION	UNIT	QTY	UNIT COST	LINE	SUB TOTAL
DEADENDS	STRUCTURE	2	$75,000	$150,000	
SPANNING STRUCTURES	STRUCTURE	2	$75,000	$150,000	
LINE RELOCATE	MILE	2	$200,000	$400,000	
					$700,000
EASEMENT	ACRES	20	$3,000	$60,000	
DESIGN AND ADMIN	LUMP SUM %	0.15	$105,000	$105,000	
CONSTRUCTION MGMT	LUMP SUM %	0.1	$70,000	$70,000	
					$235,000

ESTIMATE **$935,000**

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Minnkota Power
MPC COOPERATIVE, INC.
Your Touchstone Energy® Partner

1822 Mill Road • P.O. Box 13200 • Grand Forks, ND 58208-3200 • Phone (701) 795-4000

August 9, 2012

Christopher Gross, Project Engineer
Houston - Moore Group
Moore Engineering, Inc.
925 10th Ave. E
West Fargo, ND 58078

RE: Fargo-Moorhead Diversion Project
Reaches 1-3 Utility Relocates, Preliminary - Proposal and Estimate
2 – 69 kV Transmission Lines owned and operated by Minnkota Power Cooperative, Inc.

Dear Mr. Gross:

In response to the following questions posed in your email of 7/31/2012:

1. Need a statement that Minnkota will remove abandoned power poles and overhead lines from project site. The MFR covers this but they want to assure it's in writing.

   Minnkota will remove all of the Minnkota-owned abandoned power poles and overhead lines.

2. Does Minnkota have any unrecorded easements? I was unable to find ROW documents for your line in the S½ Sec 2-140-50. Please provide easement documentation of this area if you can.

   In the S½ of Sec. 2-140-50, it appears that Minnkota has no line in this Section. Minnkota has two lines a mile south in Section 11-140-50, which are recorded (345 kV and Pillsbury).

3. Need a statement that all utilities are being relocated in order to continue providing service to Minnkota's customers. They just need confirmation that a line isn't being relocated for no reason.

   All of the Minnkota relocated lines are currently providing wholesale transmission power to local member-owner facilities and will continue to do so after the realignment.

4. If lines are being upgraded (not applicable to all companies), the USACE needs a reason for the upgrade.

   a. Upgrading a utility line for future use or expected land development is not a reimbursable expense.

      i. This may be negotiated with the local funding agency if Minnkota chose to do so.

b. Upgrading a utility line due to new engineering guidelines or because existing materials aren't produced/used anymore is a reimbursable expense.

Only type 4b changes to the line will be considered for structure strength and ground clearance code requirements. Conductor changes are anticipated on the spans over and on either side of the diversion channel. New lines will be built to current company standards.

5. Has Minnkota taken over interest of previous electrical service providers? If so, who and when? Did Minnkota acquire their old easements? Please provide this documentation if applicable.

The lines were built by Minnkota.

6. Need a description the Minnkota's current company structure (Coop, Corporation, etc.). If incorporated, in what states and when? We also need a name, title, address, phone number, email, etc. of someone capable of signing into agreements, legal documents, etc. for Minnkota as the project moves forward.

Minnkota Power Cooperative, Inc. – May 24, 1940 – State of Minnesota – per Minnkota's Articles of Incorporation a "Cooperative Association" - Minnkota is authorized, as a Minnesota corporation, to transact business in North Dakota as certified by the North Dakota Secretary of State as of June 26, 1978.

Robert McLennan, President & CEO
Minnkota Power Cooperative, Inc.
1822 Mill Road
PO Box 13200
Grand Forks ND 58208-3200
701-795-4000

7. I have attached a revised typical section (2nd one down on the page) of the area in Section 35-142-49 where you are proposing to relocate one of your transmission lines. Please note that the EMB is approximately 200' wider than originally shown to you at the original kickoff meeting. Please provide me with an alternative plan for relocation of your affected line in this area. I assume that you can either span the additional 200' feet or run the line parallel to the West to approximate Station 100+00 and then cross the project perpendicular. Either option will more than likely increase the cost of relocation so please provide an updated map and cost estimate for reflecting the additional work needed.

I have attached a revised letter and estimate to replace the letter and estimate sent July 2, 2012.

Sincerely,

MINNKOTA POWER COOPERATIVE, INC.

John Thompson
Project Engineer

Minnkota Power
MPC COOPERATIVE, INC.
Your Touchstone Energy® Partner

1822 Mill Road • P.O. Box 13200 • Grand Forks, ND 58208-3200 • Phone (701) 795-4000

July 2, 2012 (Revised August 9, 2012)

Christopher Gross, Project Engineer
Houston - Moore Group
Moore Engineering, Inc.
925 10th Ave. E
West Fargo, ND 58078

RE: Fargo-Moorhead Diversion Project
Reaches 1-3 Utility Relocates, Preliminary - Proposal and Estimate
2 – 69 kV Transmission Lines owned and operated by Minnkota Power Cooperative, Inc.

Dear Mr. Gross:

Line Type:

69 kV - 3 Phase Electrical Transmission
This proposal includes only lines #968A and #200T in reaches 1-3

Proposed Relocate:

In order to assist the Fargo-Moorhead Diversion Project Team in the process of securing the LERDS certification prior to appropriation of funds to begin the diversion project Minnkota Power Cooperative, Inc. submits the following proposal and estimate for high voltage overhead electrical power utility relocates to traverse the diversion ROW for the proposed diversion channel crossing our existing easement.

Generally in order to cross the diversion channel we will need to modify the 69 kV lines by adding two deadend structures and two spanning structures capable of supporting the existing line section and a stronger conductor capable of spanning the 1650+/- span. In order to attain the clearance elevation needed we will need to begin grading the line higher prior to the deadend structures. The specific crossing locations of the diversion ditch and our existing lines present a medium and large skew. In order to cross at a perpendicular our transmission line will need to be rerouted to some extent.

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Cost:

Line #200T – Estimate $935,000
Line #968A – Estimate $935,000

Timeline:

In order to complete the reroutes it is estimated that a 12 month period be allowed from notice to proceed to the completion. The 12 months includes 3 months for design, 6 months for material and contracts, and 3 months for construction. The first 9 months may include easement acquisition. A faster schedule may mean additional cost.

Request for information:

In order to more accurately estimate and perform designs a shape file of the actual alignment is needed. If the southern alignment is available it would be helpful as we could begin looking at the other crossings and developing preliminary plans.

Thank you for the opportunity to participate in the early stages of this project development and I look forward to the safe and timely completion of the Fargo-Moorhead Diversion.

Sincerely,

MINNKOTA POWER COOPERATIVE, INC.

John Thompson
Project Engineer

Enclosure: Estimate

Estimate

ESTIMATE FOR MINNKOTA POWER COMPANY INC UTILITY RELOCATES IN REACHES 1-3
RELOCATION OF LINES AND SPANNING OF FARGO MOORHEAD DIVERSION CHANNEL

LINE #200T
2 MILE OF LINE AFFECTED

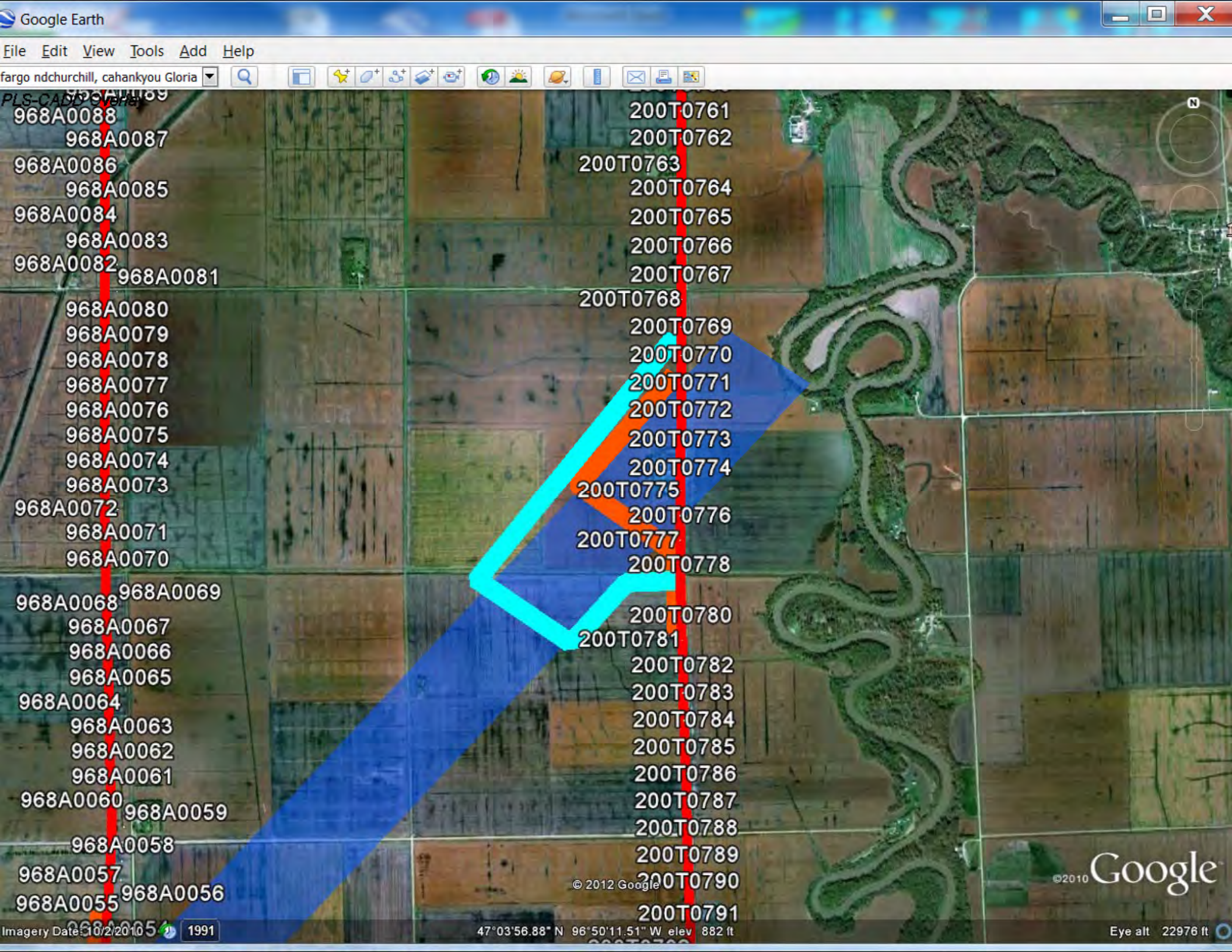
DESCRIPTION	UNIT	QTY	UNIT COST	LINE	SUB TOTAL
DEADENDS	STRUCTURE	2	$75,000	$150,000	
SPANNING STRUCTURES	STRUCTURE	2	$75,000	$150,000	
LINE RELOCATE	MILE	2	$200,000	$400,000	
					$700,000
EASEMENT	ACRES	20	$3,000	$60,000	
DESIGN AND ADMIN	LUMP SUM %	0.15	$105,000	$105,000	
CONSTRUCTION MGMT	LUMP SUM %	0.1	$70,000	$70,000	
					$235,000

ESTIMATE **$935,000**

LINE #968A
2 MILE OF LINE AFFECTED

DESCRIPTION	UNIT	QTY	UNIT COST	LINE	SUB TOTAL
DEADENDS	STRUCTURE	2	$75,000	$150,000	
SPANNING STRUCTURES	STRUCTURE	2	$75,000	$150,000	
LINE RELOCATE	MILE	2	$200,000	$400,000	
					$700,000
EASEMENT	ACRES	20	$3,000	$60,000	
DESIGN AND ADMIN	LUMP SUM %	0.15	$105,000	$105,000	
CONSTRUCTION MGMT	LUMP SUM %	0.1	$70,000	$70,000	
					$235,000

ESTIMATE **$935,000**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