

June 18, 2019

Project B1904193 (Activity 1.5)

Mr. Blake Holland, Project Manager
ONEOK, Inc.
100 West 5th Street
Tulsa, OK 74103

Re: Field Reconnaissance Report MP 38.1 and MP47.2 HDD Sites
Demicks Lake Pipeline Right-of-Way
McKenzie County, North Dakota

Dear Mr. Holland:

As requested by Mr. Holland, Braun Intertec is presenting this Field Reconnaissance Report for horizontal directional drilling (HDD) locations MP38.1 and MP47.2. The content of this report will be included in our Final Comprehensive Field Reconnaissance Report.

A. Introduction

A.1. Project Description

The project consists of the installation of approximately 75 miles of new 20-inch-diameter pipeline to transport Natural Gas Liquids (NGL) from the Demicks Lake Plant near Keene, North Dakota to a tie-in location near the North Dakota/Montana border, east of Savage, Montana.

A.2. Purpose

As part of the original scope of work, we performed 6 exploratory soil borings at designated locations along the pipeline as instructed by JTAM Engineering. We then were requested to perform a desktop study and site reconnaissance of designated locations along the pipeline route that were identified by North Dakota Geological Survey (NDGS) as having the potential for future slope instability. We performed a reconnaissance of all such designated locations and will be providing a Comprehensive Field Reconnaissance Report containing information from our site reconnaissance, construction plans review, and recommendations. Two of the locations, MP38.1 and MP47.2, have an accelerated construction timeline, so this report contains our findings and recommendations for those specific locations.

A.3. Site Conditions and Desktop Review

We reviewed the following information in advance of our reconnaissance to obtain historical and current existing conditions at the sites:

- Aerial photographs of the site from Google Earth™ dated December 30, 1994 to June 14, 2017.
- North Dakota Geological Survey Landslide Maps, 24k Map Quadrangles: Bear Butte and Moline School.
- Demicks Lake Pipeline Potential Geologically Unstable Areas Workbook received from JTAM Engineering on May 16, 2019.
- Horizontal Directional Drill Cherry Creek, Two PEM Wetlands & Ephemeral Stream M.P. 37.88 Demicks Lake Pipeline Index #10597 construction plans/diagram dated and provided by JTAM Engineering on June 14, 2019.
- Horizontal Directional Drill Two PEM Wetlands W-18042D-005 and W-18042D-004 M.P. 47.21 Demicks Lake Pipeline Index #10597 construction plans/diagram dated and provided by JTAM Engineering on June 14, 2019.
- Conversations with ONEOK's Blake Holland and JTAM Engineering's Christopher Rust and Calvin Krall, PE.

A.4. Scope of Services

We performed our scope of services for the project in accordance with our Change Order, provided to ONEOK on May 20, 2019, and authorized via email on May 29, 2019, to our original Proposal QTB098648, dated April 25, 2019. The additional scope of services included performing a desktop study of the 15 site locations identified by NDGS as having the potential for future slope instability. The desktop work was performed prior to our site reconnaissance of each site.

In addition to our desktop study and site reconnaissance work, we were asked to review the construction plans, planned depths, topographic data, and/or cross-sections prepared by JTAM Engineering and make recommendations or comments regarding the impact on construction of confirmed or suspected geologic hazards. This work was submitted as a 2nd Change Order on June 7, 2019 and authorized on June 11, 2019.

B. Results

B.1. Desktop Study

Based on available aerial photography and USGS Landslide Hazard maps, we noted the potential for unstable conditions impacting only the site at MP38.1. The information gathered indicated either visible failures or various levels of land scarring within or nearby the pipeline right-of-way.

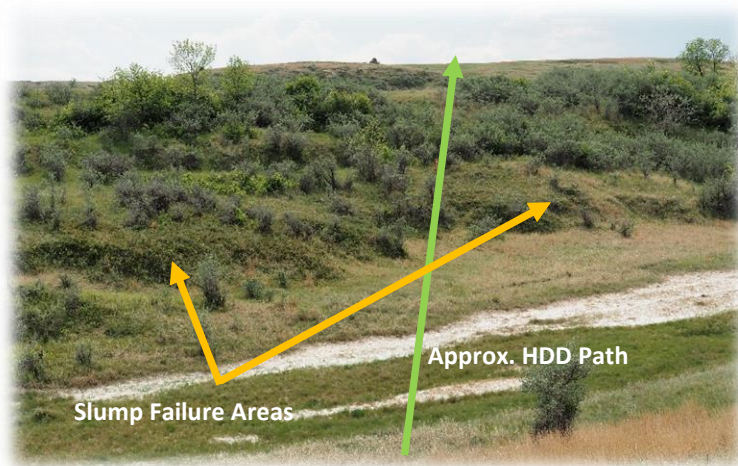
B.2. Reconnaissance Results

The following sections indicate the existing conditions and a brief discussion of our visit for the two accelerated sites which were labeled as being host to potential geologic hazards. Based on our site reconnaissance, additional soil borings or testing was not deemed warranted.

B.2.a. MP38.1

Horizontal directional drilling (HDD) installation techniques are planned for this section of the pipeline due to various deep valleys and generally rough terrain. Based on our nearby boring, the near surface geology consists mainly of a thin layer of topsoil underlain by Sentinel Butte Formation sandstone, siltstone, claystone, and lignite. As illustrated in Photograph 6 below, we observed some areas containing historic slump failures, generally on the north facing slopes in the valleys.

Photograph 6: MP38.1



View facing southwest slightly oblique to alignment illustrating existing slumping.

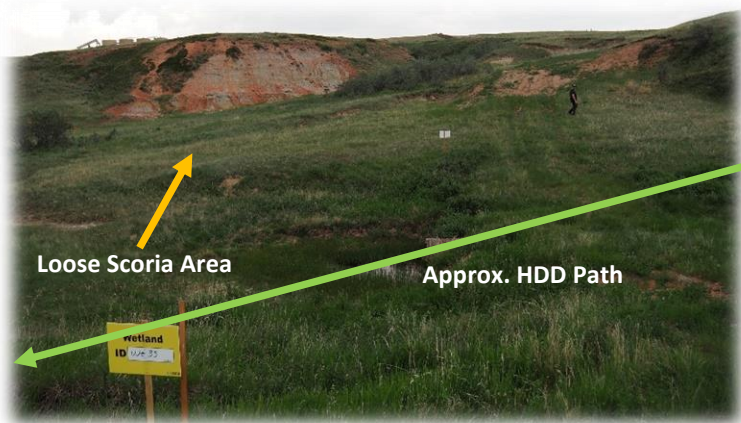
The slump failures appeared to be shallow in nature. Based on information provided by JTAM ENGINEERING, the HDD will be no less than 20 feet below the lowest point across this area. Due to the

planned HDD installation technique and depth, it is our opinion there is little risk of short- or long-term slope instability impacting the pipeline as it is proposed to be installed.

B.2.b. MP47.2

Due to an existing wetland area (yellow sign in Photograph 7 below), HDD installation is planned for this site as well. The elevated portion of the ground in the area is comprised of scoria, which was observed to be cascading down the slopes. The slopes in the area appeared to show no signs of failure, and since the site is planned for HDD installation of the pipeline, it is our opinion that there is little risk of instability at this site.

Photograph 7: MP47.2



View facing northeast oblique to alignment towards the outcropping bank.

C. Construction Plan Review and Recommendations

C.1. Design Considerations

As mentioned, the Demicks Lake Pipeline at the two noted locations will be constructed using HDD installation techniques. Table 1 below summarizes the maximum/minimum elevations in the area and planned depth below the lowest elevation for HDD installation.

Table 1: Proposed Pipeline Installation Details

Site Location	Highest Nearby Elevation, ft*	Lowest Nearby Elevation, ft*	HDD Min. Depth Below Low Points, ft
MP38.1	2,370	2,237	25
MP47.2	2,394	2,326	20

*Elevations obtained from construction information/diagrams and were rounded to the nearest foot.

C.2. HDD Construction Recommendations

C.2.a. MP38.1

This section of pipeline near MP38.1 extends horizontally from east to west for approximately 4,731 feet. Based on the construction plans, the minimum depth below low points (wetlands, valleys, etc.) is 25 feet. The pipeline in this area crosses two wetlands, Cherry Creek, and several eroded valleys. The geologically unstable area was identified between Stations 33+00 and 38+00. Based on our site reconnaissance in this area, there were several north/northeast facing slopes, particularly near Stations 16+00 (directly west of Cherry Creek) and 36+00 (within the 'unstable' area), which indicated slope instabilities. However, the slopes containing dense tree cover and indicate slump failures appeared to be shallow in nature and likely caused by historic erosion at the toe.

The planned depths below these areas' low points are about 28 feet (Station 16+00) and 81 feet (Station 36+00) below the existing ground surface. Based on the geologic conditions of these areas and the planned HDD depths, construction may proceed as planned. Geotechnically, the planned depth below wetland areas is sufficient.

C.2.b. MP47.2

The pipeline near MP47.2 is planned to extend horizontally from east to west for approximately 1,062 feet. Based on the provided plans, the minimum depth below the wetland and potentially geologically unstable area (lowest point) is approximately 20 feet. The area of concern was identified between Stations 4+00 and 5+00. Based on our site reconnaissance in this area, there were no signs of slope instability or distress other than varying degrees of erosion/degradation within the surface scoria stratum.

The planned depth below the lowest point in this area is about 20 feet (Station 4+78) below the existing ground surface. Since there were no signs of slope instabilities and the HDD depth is sufficient, construction may proceed as planned.

D. Qualifications

D.1. Continuity of Professional Responsibility

D.1.a. Plan Review

We based this report on a limited amount of information, and a number of assumptions were made to develop these recommendations. Braun Intertec should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether the design was

anticipated correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

D.1.b. Construction Observations and Testing

Braun Intertec recommends being retained to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

D.2. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

D.3. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

D.4. Remarks

This report should be attached to and considered a part of our Site Summary Report, which will be completed later.

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions about this report, please contact Corey Lindeman at 701.241.5029 or clindeman@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Professional Certification:

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



Charles Hubbard
Jun 18 2019 9:28 AM



Charles Hubbard
Jun 18 2019 9:28 AM

Charles D. Hubbard, PE
Principal Engineer/Geologist
Registration Number: PE-6168

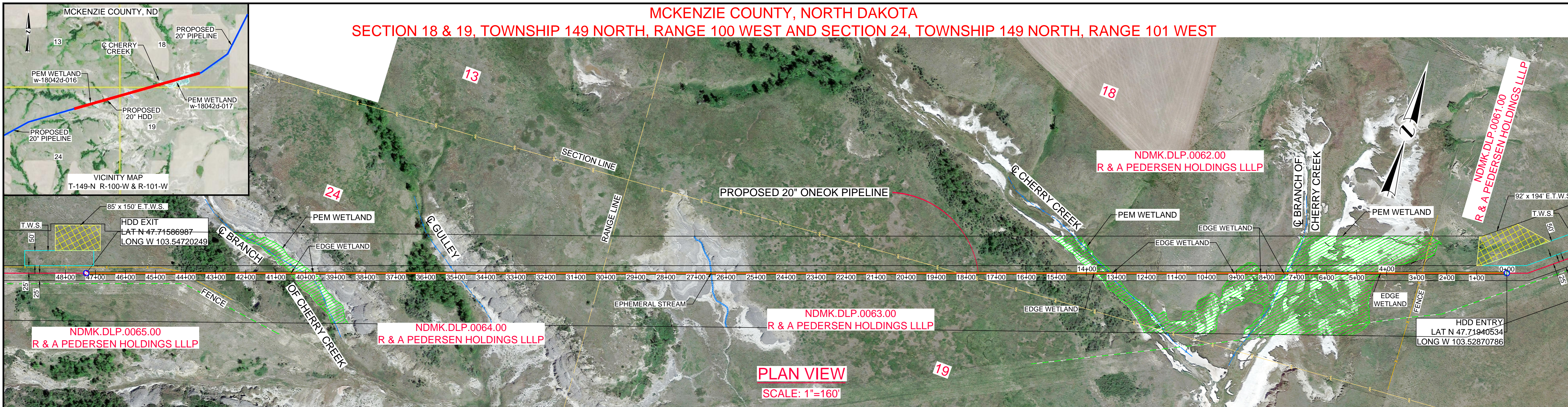


Corey D. Lindeman, PE
Staff Engineer

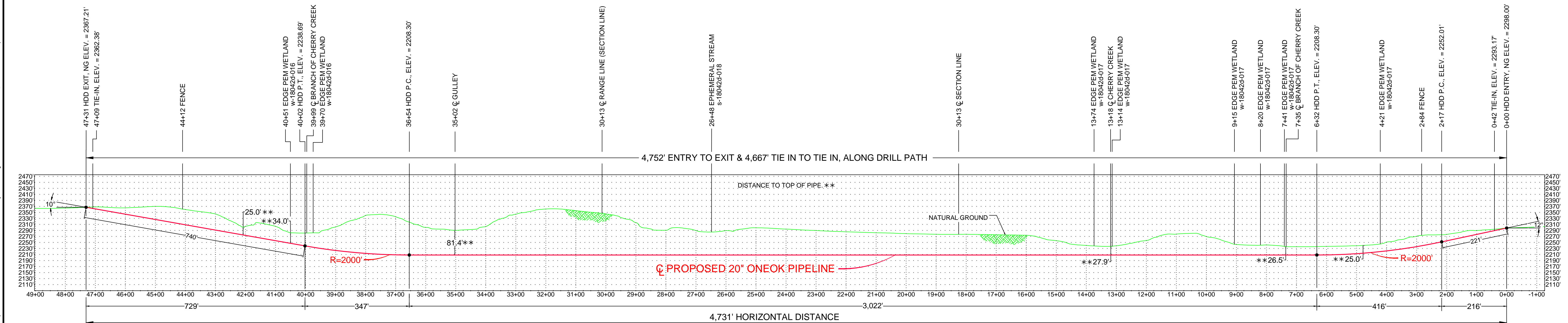
Attachments: Exhibit A – Cross Section/Construction Plans for MP38.1
Exhibit B – Cross Section/Construction Plans for MP47.2

c: Calvin Krall, PE (JTAM Engineering)
Christopher Rust (JTAM Engineering)

MCKENZIE COUNTY, NORTH DAKOTA
SECTION 18 & 19, TOWNSHIP 149 NORTH, RANGE 100 WEST AND SECTION 24, TOWNSHIP 149 NORTH, RANGE 101 WEST



PLAN VIEW
SCALE: 1"=160'



PROFILE VIEW

SCALE: 1"= 160' HORIZONTAL & VERTICAL

CHERRY CREEK
PEM WETLAND w-18042d-017
EPHEMERAL STREAM s-18042d-018
PEM WETLAND w-18042d-016

**2 HR PRE-TEST
REQUIRED**

**ISSUED FOR
CONSTRUCTION**

NOTE:
IMAGE DATA DERIVED FROM PUBLICLY AVAILABLE DATA SOURCES. ELEVATIONS ARE BASED ON THE SURVEY DATA FROM LWS & LIDAR DATA FROM GEODIGITAL.

PRODUCT:
NATURAL GAS LIQUID

CONSTRUCTION METHOD:
HORIZONTAL DIRECTIONAL DRILL (HDD)

PIPE SPECIFICATIONS:
20.000" OD X 0.375" WT, "API-5L" PSL-2, ERW, X-65, 14-16 MILS FBE & 30 MILS ARO QRL

MAOP:
1,480 PSIG

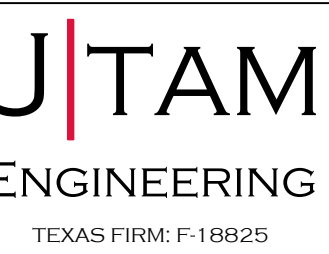
MAX ALLOWABLE PULL FORCE:
1,277,389 LBS = 639 TONS

DESIGN SPECIFICATIONS COMPLY WITH U.S. DOT TITLE 49 CFR 195: TRANSPORTATION OF HAZARDOUS LIQUIDS BY PIPELINE AND ASME B31.4

COORDINATE SYSTEMS NOTE:
ALL BEARINGS, DISTANCES AND COORDINATES ARE REFERENCED TO THE "UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM" ZONE 13, NORTH AMERICAN DATUM OF 1983; U.S. SURVEY FEET.

- CONSTRUCTION NOTES:**
- The types, locations, sizes, and/or depths of existing underground utilities as shown on the improvement plans were obtained from sources of varying reliability. The contractor is cautioned that only actual excavation will reveal the types, extent, sizes, locations, and depths of such underground utilities. (A reasonable effort has been made to locate and delineate all known underground utilities.) The engineer, however, can assume no responsibility for the completeness or accuracy of the delineation of such underground utilities that might be encountered but which are not shown on these drawings.
 - The contractor shall ascertain and verify the true location and elevation of underground utility pipes and/or structures prior to the start of construction and locate and protect utility lines and structures whether shown or not. Also, the contractor shall notify the owners of utilities and/or structures concerned before starting work. Any underground facilities damaged by the contractor or contractor's agent during the course of work shall be replaced at contractor's own expense.
 - Minor adjustments required in the field at proposed pipeline locations due to conflicts with existing utilities shall be done with the approval of the client and the engineer without additional expenses to the client or the engineer.

Scale: 1" = 160'



MK	DATE	REVISIONS	BY	AP.	MK	DATE	REVISIONS	BY	AP.
1	04/19/19	ISSUED FOR CONSTRUCTION	EP	CR					
1	06/05/19	REVISED 4 HR TO 2 HR PRE-TEST	EP	CR					

MK	DATE	REVISIONS	BY	AP.

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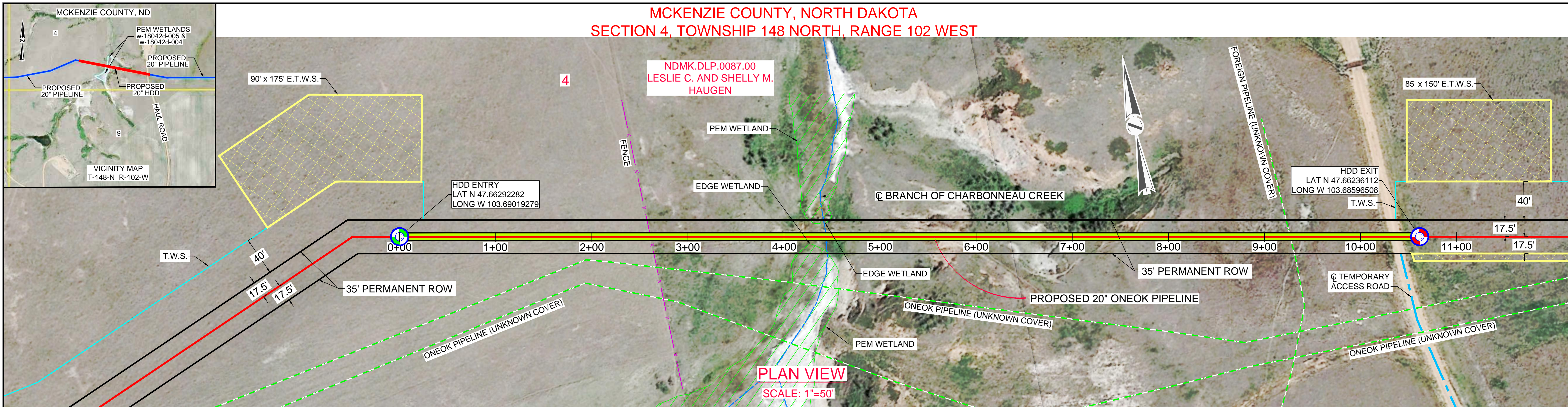
DWG. NO.	REFERENCE DRAWINGS



HORIZONTAL DIRECTIONAL DRILL CHERRY CREEK, TWO PEM WETLANDS & EPHEMERAL STREAM M.P. 37.88 DEMICKS LAKE PIPELINE INDEX #10597			
DES.: EP	AFE#:	DATE: 04/19/19	
DR.: EP	DWG. NO.:		
CH.: CR	SCALE: NOTED		
AP.: CR	CAD#:	OPL008JTAM-MP-20-006	REV. 1

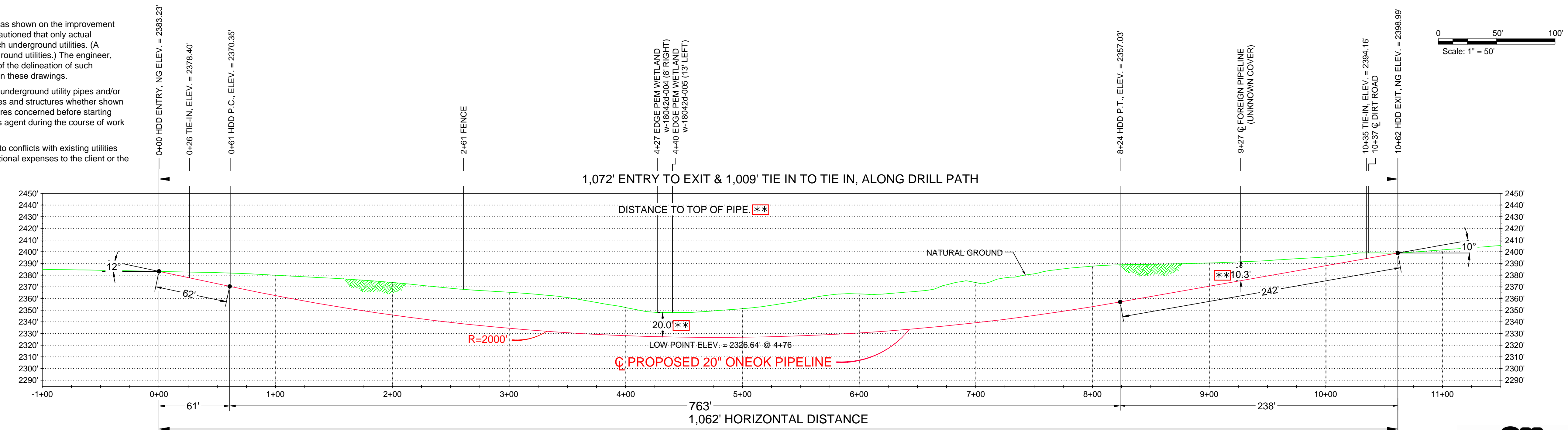
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MCKENZIE COUNTY, NORTH DAKOTA
SECTION 4, TOWNSHIP 148 NORTH, RANGE 102 WEST



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PROFILE VIEW
SCALE: 1"=50' HORIZONTAL & VERTICAL
PEM WETLAND w-18042d-005
PEM WETLAND w-18042d-004

NOTE:
IMAGE DATA DERIVED FROM PUBLICLY AVAILABLE DATA SOURCES. ELEVATIONS ARE BASED ON THE SURVEY DATA FROM LWS & LIDAR DATA FROM GEODIGITAL.

PRODUCT:
NATURAL GAS LIQUID

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PIPE SPECIFICATIONS:
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MAOP:
1,480 PSIG

MAX ALLOWABLE PULL FORCE:
1,277,389 LBS = 639 TONS

2 HR PRE-TEST REQUIRED

DESIGN SPECIFICATIONS COMPLY WITH U.S. DOT TITLE 49 CFR 195: TRANSPORTATION OF HAZARDOUS LIQUIDS BY PIPELINE AND ASME B31.4

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ISSUED FOR CONSTRUCTION

MK	DATE	REVISIONS	BY	AP	MK	DATE	REVISIONS	BY	AP
0	04/19/19	ISSUED FOR CONSTRUCTION	EP	CR					

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DWG. NO.	REFERENCE DRAWINGS



HORIZONTAL DIRECTIONAL DRILL TWO PEM WETLANDS W-18042D-005 AND W-18042D-004 M.P. 47.21 DEMICKS LAKE PIPELINE INDEX #10597

DES: EP	AFE#: []	DATE: 04/19/19
DR: EP	DWG. NO.:	
CH: CR	SCALE: NOTED	
AP: CR	CAD#:	

OPL008JTAM-MP-20-008

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

JITAM
ENGINEERING
TEXAS FIRM: F-18825

Drawing name: C:\Projects\ONEOK\CP-008 Demicks Lake Pipeline\CA_Des\08_Mapping\01_Const\OPL008JTAM-MP-20-008 MP 47.21 Two PEM Wetlands.dwg
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