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April 28, 2023

HAND DELIVERED

Mr. Steve Kahl
Executive Secretary Director
North Dakota Public Service Commission
600 E. Boulevard, Dept. 408
Bismarck, ND 58505-0480

RE: SCS Carbon Transport LLC
Midwest Carbon Express Project
Case No. PU-22-391

Dear Mr. Kahl:

In response to certain requests made at the public hearings in the above-captioned matter, please find enclosed herewith for filing with the North Dakota Public Service Commission, an original and five (5) copies of the following:

1. Frost Heave Study;
2. Mahler Structure Report; and
3. Investor Information.

Also enclosed herewith, please find a Compact Disc (CD) containing this letter and the above-referenced documents in PDF format.

Should you have any questions, please advise.

Sincerely,

LAWRENCE BENDER

LB/tjg
Enclosures
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SUMMIT CARBON SOLUTIONS

SUMMIT CARBON SOLUTION PIPELINE PROJECT

GULF PROJECT NUMBER: 1927

FROST HEAVE STUDY

GULF INTERSTATE ENGINEERING
Houston, Texas F-2830

GULF DOCUMENT NO.: 1927-000-PL-STY-0004

SCS DOCUMENT NO.: GPLUS-GENL-ENG-STY-GIE-0004

Revision	Date	Revision Description	Prepared By	Reviewing Engineer	Project Manager	Client Approval
0	04/17/2023	Issued for Information	David Ammerman	Lance Thomas	David Ammerman	

PROJECT:	MIDWEST CARBON EXPRESS PROJECT		
REPORT NUMBER:	GPLUS-GENL-ENG-STY-GIE-0004	GULF PROJECT NO.:	1927
TITLE:	Frost Heave Study		
Provide a brief description of changes for all revisions following Rev. 0			

Filename: GPLUS-GENL-ENG-STY-GIE-0004-E-Frost Heave-23-04-06

REV.	DATE	REVISION DESCRIPTION

TABLE OF CONTENTS

1 PURPOSE

The purpose of this Frost Heave Study is to address Summit Carbon Solutions Pipeline Project objectives involving pipeline integrity when installing and operating pipelines in regions where frozen soil and frost depths may require additional consideration.

2 PROJECT DESCRIPTION AND SCOPE OF STUDY

Summit Carbon Solutions (SCS) plans to develop a new interstate CO_2 capture, transportation, and sequestration project. The Project will capture CO_2 from multiple sources throughout Iowa, Minnesota, Nebraska, South Dakota, and North Dakota and deliver the CO_2 to injection sites in North Dakota for permanent geological sequestration.

The main objectives of this Study are to assess potential impacts to the proposed pipeline from permafrost and frost heave across the five-state footprint.

3 PERMAFROST POTENTIAL IMPACTS

Permafrost is rock or soil that remains completely frozen for at least two straight years. Areas shaded in blue in Figure 3-1 are underlain by permafrost. As Figure 3-1 shows, the SCS pipeline system does not traverse any areas underlain by either continuous or discontinuous permafrost.

Therefore, permafrost is not an issue that needs to be addressed by this project and will not be discussed further in this study.

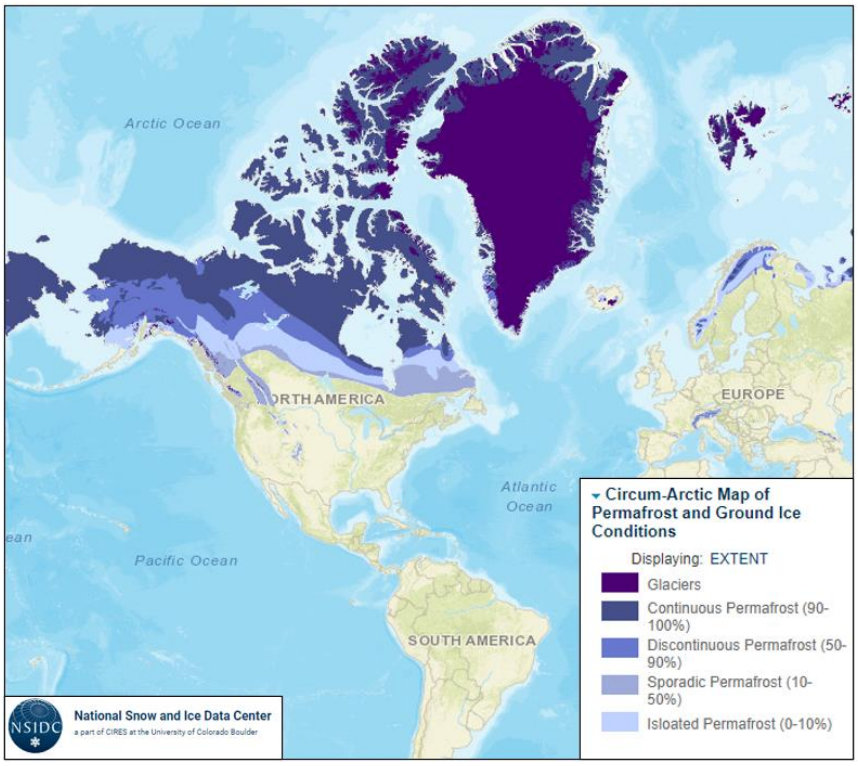

Figure 3-1: Arctic Map of Permafrost and Ground Ice Conditions

4 FROST HEAVE

4.1 Description

Frost heave is the result of the formation of ice lenses by segregation of water from the soil as the ground freezes[1]. Ice lenses are lens-shaped masses of almost pure ice that form in frozen soil or rock. Lens formation takes place at, or a short distance behind, the freezing front at any depth where conditions are favorable and continues until those conditions change.[2] Lens growth may be sustained by the addition of groundwater drawn from warmer zones below the freezing front. The amount of vertical displacement (heave) is roughly equal to the combined thicknesses of the underlying ice lenses. This results in greater displacement at the surface when compared to areas of greater depth.

4.2 Frost Heave Conditions

Three conditions must be met to create the possibility of frost heave to the extent that it would threaten the pipelines integrity:

1. The soil must contain a significant amount of silt (i.e. Silty Clay, Clayey Silt, Sandy Silt, Silty Sand, or Silt), to promote upward groundwater movement, via capillary action, to the freezing front;
2. There must be a source of groundwater near (immediately below) the freezing front; and
3. Soil freezing and ice lensing both need to occur at a depth below the bottom of the pipe.

If any of the three conditions listed above are not met, frost heave should not occur.

4.3 Frost Penetration

Several factors influence seasonal frost penetration depth:

1. Vegetation cover (vegetation tends to insulate and retard frost penetration);
2. Snow cover (snow cover tends to insulate and retard frost penetration);
3. The number of degree days below freezing;
4. Soil grain size (coarse grained soils are more conductive, allowing greater frost penetration than fine grained soils); and
5. Moisture content (the higher the moisture content, the more time it takes for a given soil to freeze).

The United States Department of Agriculture records soil temperature at various depths at monitoring stations located throughout the US[3]. Five USDA locations spread throughout the project footprint were utilized to gather ground temperature data. Each location was reviewed, but the Mandan location was selected for this report as it is the furthest north and most likely to see the greatest frost depth.

This station records soil moisture and temperature to a depth of 40-inches.

Figure 4-2 depicts daily soil temperature at a depth of 40-inches over the last decade. As the graph shows, the soil approaches freezing conditions in most years but does not drop below the freezing point for any extended duration.

Figure 4-1: USDA's Mandan Station

[1] Taber,S.,1929,Frost heaving: Journal of Geology, v. 37, p. 428-461.
[2] Manz, L., July 2011, Frost Heave, Geo News, p. 18-24
[3] https://www.nrcs.usda.gov/resources/data-and-reports/soil-climate-analysis-network

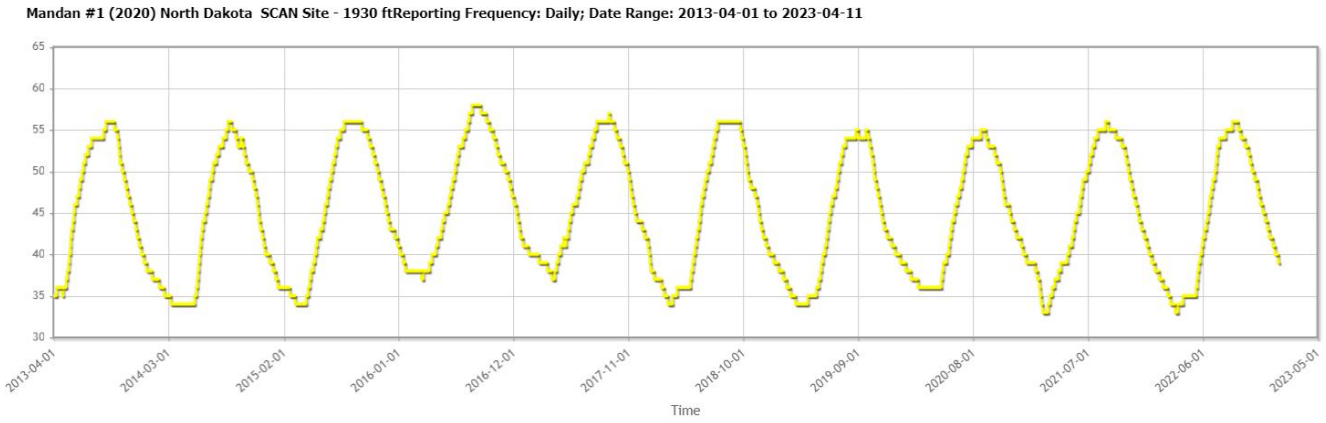

Figure 4-2: Soil Temperature at 40-inches Depth During Last Decade

5 Frost Heave Considerations

5.1 Soil Types and Ground Water

Based on the USDA Soil Survey Geographic Database, there are soils that could be classified as frost susceptible where 10% or more particles pass through a No. 200 sieve[4].

Ground water heights can range significantly across the pipeline route and can also fluctuate seasonally. Geotechnical reports reviewed show ground water ranging from 6.5 to over 100 feet below ground surface[5].

5.2 Pipeline Depth of Cover

SCS will be installing the pipelines with a minimum depth of cover of 48 inches from top of pipe. The bottom of the pipelines will range from 51 inches to 72 inches minimum dependent upon the diameter of the pipe installed. This depth of cover significantly reduces the risk of multiple underlying ice lenses forming beneath the pipeline and resulting frost heave. As shown by the USDA monitoring station data, the historical data for each of the five monitoring stations across the project footprint shows that the soil temperatures necessary to create frost to a depth greater than 51 inches is not probable. At the Mandan location, which is the most likely to see the greatest frost depths, the soil temperature nears the freezing point at 40 inches of soil depth over some of the years reviewed but not for extended durations that would indicate frost penetration beyond 51 inches.

5.3 Construction Practices and Operating History

While vintage pipelines operating in similar areas and conditions have a proven track record of reliability, the implementation of modern pipeline materials, welding practice and installation procedures only further increase the starting integrity of modern pipeline systems. SCS pipe materials all meet specific ductility requirements, and the installed pipeline welds will be fully evaluated by non-destructive testing. Due to the advancement of material testing and construction requirements, the ability of a pipeline to withstand deformation (plastic strain) due to external loads such as frost heave is increased due to better ductility of the pipe material and better welding practices.

6 Conclusion

For frost heave to occur three conditions must be met. The soil needs to contain a significant amount of silt, groundwater needs to be present, and the depth of freezing must occur below the pipe. Due to the depth of

[4] https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
[5] Professional Service Industries, Inc., Geotechnical Data Report, PSI Project No. 599103-1

burial alone, the likelihood of frost heave on any buried portion of the SCS system is highly unlikely. Where conditions may allow frost to reach beyond 51 inches, the likelihood of the soil being susceptible to frost heave (silt) is also unlikely given that frost penetration occurs more slowly with fine-grained soils of high moisture content.

Water table depths vary from location to location across the pipeline from over a hundred feet below the pipe to depths above assumed trench bottom. The likelihood of frost depths significantly beyond 51 inches with a water table slightly below is probabilistically small. In a situation where frost could reach beyond 51 inches, the amount of movement expected at such a depth would be very small given the relation to the thickness of any underlying ice lenses and the unconstrained expansion that would occur above.

Today's materials and construction practices have evolved including the introduction of more ductile steels allowing greater allowable deformation (strain) due to external loads (frost heave) thus further preventing any likelihood of frost heave creating a pipeline integrity issue.

North Dakota Mahler Structure Report

Revision: 1

4/28/2023

1 Purpose

Public testimony was given by Tia Bopp and Troy Mahler during the April 11, 2023, Wahpeton hearing. During this testimony, it was stated that the proposed Midwest Carbon Express (MCE) pipeline route is “well-within” five hundred feet from the residence of Curtis and Violet Mahler in Section 12-131-54. SCS has completed a structure report to ensure compliance with the references listed in Section 2.

2 State Law and Requirements

North Dakota Century Code Chapter 49-22.1 titled **Energy Conversion and Transmission Facilities**, subsection 03, reads as follows:

> **49-22.1-03. Exclusion and avoidance areas - Criteria.** The commission shall develop criteria to be used in identifying exclusion and avoidance areas and to guide the site, corridor, and route suitability evaluation and designation process. Except for oil and gas transmission lines in existence before July 1, 1983, areas within five hundred feet [152.4 meters] of an inhabited rural residence must be designated avoidance areas. This criterion does not apply to a water pipeline. The five hundred foot [152.4 meter] avoidance area criteria for an inhabited rural residence may be waived by the owner of the inhabited rural residence in writing. The criteria also may include an identification of impacts and policies or practices which may be considered in the evaluation and designation process.

North Dakota Administrative Code Chapter 69-06-08-02 titled **Transmission Facility Corridor and Route Criteria**, subsection 2e, reads as follows:

> **69-06-08-02.2. Avoidance areas.** The following geographical areas may not be considered in the routing of a transmission facility unless the applicant shows that under the circumstances there is no reasonable alternative. In determining whether an avoidance area should be designated for a facility, the commission may consider, among other things, the proposed management of adverse impacts; the orderly siting of facilities; system reliability and integrity; the efficient use of resources; and alternative routes. Economic considerations alone will not justify approval of these areas. A buffer zone of a reasonable width to protect the integrity of the area will be included unless a distance is specified in the criteria. Natural screening may be considered in determining the width of the buffer zone.
>
> e. Within five hundred feet [152.4 meters] of a residence, school, or place or business. This criterion shall not apply to a water pipeline transmission facility.

3 Measurement and Data Collection Process

The distance to centerline (CL) was measured utilizing a Geographic Information System (GIS) based off the nearest definitive boundary of a structure. In Section 4.1.1, the edge of the structure is signified by the yellow box and includes the accompanying distance to centerline in feet.

4 Structure Report

4.1 ID #32

ID #	Tract ID	Latitude	Longitude	County	Landowner	Description	Distance to Pipeline CL (FT)	Waiver Executed
32	ND-SA-211-048.210	46.18014855	-97.4015854	Sargent	Curtis W. Mahler	Residence	519.64	NA

4.1.1 Map

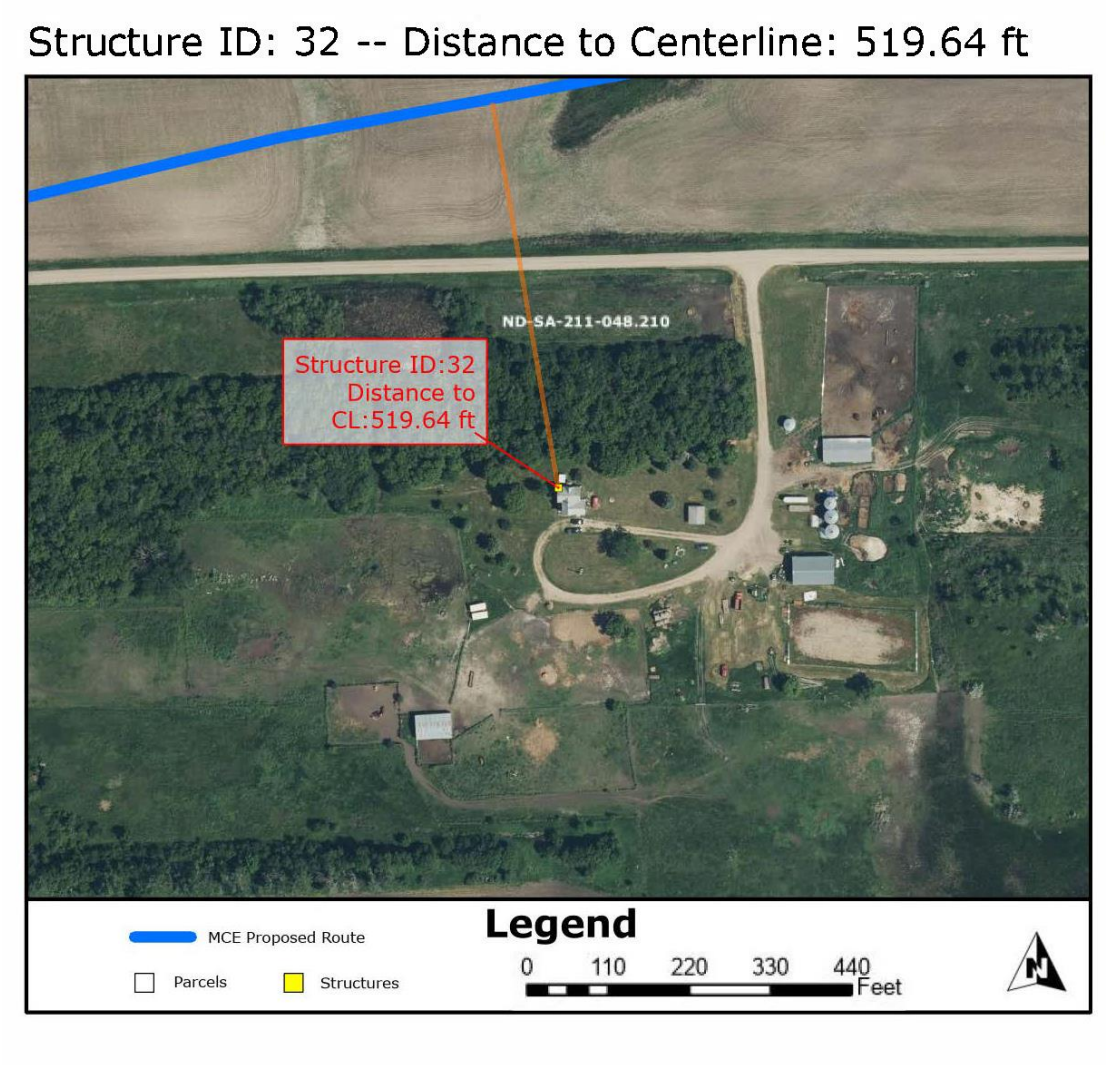

Figure 1: Structure ID #32

4.1.2 Waiver

Structure ID #32 does not require a waiver for an avoidance area as described in Section 2 due to the edge of the structure being **519.64** feet from the centerline of the pipeline.

SUMMIT CARBON SOLUTIONS, LLC

INVESTOR LIST

Investor	Website
Continental Resources, Inc	https://www.clr.com
TPG Rise Climate	https://therisefund.com/tpgriseclimate
Summit Agricultural Group	https://www.summitag.com
SK Group	https://www.sk-perspectives.com
Tiger Infrastructure Partners	https://www.tigerinfrastructure.com

STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMISSION

SCS Carbon Transport LLC **CASE NO. PU-22-391**
Midwest Carbon Express CO2 Project
Sitting Application

CERTIFICATE OF SERVICE

I, the undersigned, hereby certify that a true and correct copy of the following:

1. Letter to S. Kahl forwarding documents for filing;
2. Frost Heave Study;
3. Mahler Structure Report; and
4. Investor Information.

were, on April 28, 2023, filed with the North Dakota Public Service Commission and served electronically to the following:

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Dated this 28th day of April, 2023.

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By: _____

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