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Technical Memorandum

Date: 24 August 2023

To: Summit Carbon Solutions

From: Jeff Schneider and Bailey Theriault

Cc: David Vance (Geosyntec)

Subject: Summit Carbon Solutions Pipeline System, Phase I Hydrotechnical Hazard Assessment (Rev. 01)
Geosyntec Project No. TXG0353

INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) was retained by Summit Carbon Solutions (SCS) to conduct a desktop Phase I Hydrotechnical Hazard Assessment (Phase I Assessment) for 72 waterbody crossings on the proposed Summit Carbon pipeline system. The following memorandum provides a summary of the assessment, methodology utilized for assigning hazard classifications, and the resultant hazard classifications for the 72 water body crossings that were provided to us by SCS.

DESKTOP REVIEW

Geosyntec conducted a desktop review of the proposed water body crossings. The purpose of the desktop review was to conduct a screening level review of the waterbody crossings along the proposed pipeline system to identify potential sites that should be considered for additional review or evaluation or crossing design modifications due to potential hydrotechnical hazards. The following data sources were reviewed as part of the Phase I Assessment as of the date of this memorandum:

- Available Google Earth™ aerial imagery, generally spanning the timeline from 1991 to 2022.
- United States Geologic Survey (USGS) 7.5-minute topographic quadrangle maps for the segment.

- Geospatial data (.kmz files) and crossing details provided by SCS and Gulf Interstate Engineering (GIE) including:
    - 72 water body crossing locations
    - Pipeline centerlines
    - Proposed installation method at crossing consisting of either horizontal direction drill (HDD) or open cut
    - Preliminary HDD plan and profile design drawings for each of the proposed HDD crossings (most recent revisions as of August 24, 2023).

The Phase I Assessment focused on identifying potential issues related to channel migration, stream bank slides, vertical streambed instability, and proximity of upgradient impoundment features, that may present potential future pipeline integrity issues related to pipe exposure or unsupported span lengths.

As part of the desktop review, Geosyntec obtained measurements in Google Earth™ based on aerial imagery of reach sinuosity (stream length/valley length), meander belt width, bankfull width, and pipe crossing length within bankfull (e.g., between left and right banks) and document the orientation between the pipeline and the stream alignments (e.g., perpendicular, or oblique) to aid in the hazard evaluation. Measurements were based on the most current available imagery where the existing channel and visual evidence of historic channels can be identified. Geomorphic evidence of hydrotechnical hazards (e.g., historical lateral instabilities and possible encroachment hazards on the pipeline alignment) were also documented.

HAZARD CLASSIFICATION RATINGS

Geosyntec developed a hazard classification rating system that qualitatively categorized the potential hydrotechnical threat for the proposed pipeline crossing as either low, moderate, or high. The rating system was based on a combination of factors including the following:

- Stream Morphology at crossing including sinuosity, meander belt width, bankfull width.
- Crossing orientation (e.g. perpendicular crossing, oblique crossing, parallel encroachment) and length within active channel.
- Proposed installation method (HDD or open cut) and preliminary crossing design. If HDD was proposed, Geosyntec reviewed the preliminary HDD plan and profile drawings to evaluate the proposed burial depth and lateral extents of the HDD relative to the waterbody crossing and hydrotechnical risks.
- Engineering/scientific judgement based on experience with similar type projects, pipeline construction, and principals of fluvial geomorphology and hydrology.

The hazards classifications were defined as follows:

- **Low Hazard** = Low likelihood for pipeline to be exposed due to hydrotechnical hazards within design life of project (assumed to be 50-years).
- **Moderate Hazard** = Moderate likelihood for pipeline to be exposed due to hydrotechnical hazards within design life of project.
- **High Hazard** = High likelihood for pipeline to be exposed due to hydrotechnical hazards within design life of project.

The hazards classifications defined for each crossing were based on the below assumptions.

Classification Assumptions:

- Pipeline would be installed using the techniques identified by SCS in the information provided to Geosyntec.
- For crossings identified as HDD installations, the proposed extents of the HDD would match those provided in the preliminary HDD plan and profile drawings.
- For crossings identified as open cut, the top of pipe would have a minimum depth of cover of 5-feet beneath the channel thalweg and the sag bends would be set back 15-feet from top of bank.
- HDD profile drawings show an accurate representation of channel bottom and proposed depth of cover for HDD crossings.
- River and creek crossings will be integrated into a pipeline system integrity management monitoring program to monitor potential changes in hydrologic and conditions.

Note that if the installation method is modified, or the preliminary HDD layout changes, the relative hazard rating for the crossing may change. Additionally, the HDD crossings were evaluated with respect to potential hydrotechnical hazards and not evaluated based on potential geotechnical or constructability risks associated with the HDD installation.

RESULTS

Geosyntec conducted an initial review of 59 of the 72 crossings in October and November of 2022 and an additional 13 crossings in July and August of 2023. After the initial review and preliminary hazards ranking, Geosyntec had design review meetings with SCS and GIE to provide recommended modifications to crossing designs to lower the crossing hazards ranking if feasible. Geosyntec then reviewed the updated designs as the basis for the hazard rating results presented in this memo.

A summary of the Phase I Assessment and hydrotechnical hazard classifications is provided in Table 1. Complete results of the Phase I Assessment, including geomorphic observations/measurements are provided in an Excel spreadsheet included with this submittal. After design modifications to various crossings, all 72 water body crossings, were classified as

"low hazard," for hydrotechnical hazard. Definitions for the are fields included in Table 1, Excel spreadsheet, Geographic Information System (GIS) geodatabase (.gdb) and Google Earth™ file (.kml) are provided with this submittal.

RECOMMENDATIONS

The primary focus of this desktop hydrotechnical assessment was to evaluate the 72 waterbody crossings provided by SCS and assess the potential for hydrotechnical hazards at each crossing which could potentially result in pipeline exposures. Based on the review and the crossing design changes made to date, Geosyntec recommends that if the proposed installation method or crossing designs change, that hydrotechnical hazards be re-evaluated. Geosyntec also recommends that these water body crossing be incorporated into the pipeline integrity management monitoring program for the proposed pipeline system.

CLOSING

We greatly appreciate the opportunity to support Summit Carbon Solutions on this project. Should you have any questions or need additional information, please do not hesitate to contact us.

Sincerely,

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Tables: 1: Phase 1 Hydrotechnical Assessment Summary Results

Appendices: A: Phase 1 Hydrotechnical Assessment Attribute Definitions

Tables

Table 1: Summit Carbon Solutions Phase I Hydrotechnical Assessment Summary Results

GEO ID	Feature_ID	Name	County	State	Latitude	Longitude	Route	Sta	Mile Post	Flow Regime	Crossing Method	HDD Drawing Number	Hazard Level
IO-01	**S_1_HD_008_DT**	South Fork Iowa River	HARDIN	IOWA	42.324394	-93.170262	IAL-301B	1529+24	29	Perennial	HDD	1927-100-PL-DWG-0036	Low
IO-02	**S1017HD010**	Iowa River	HARDIN	IOWA	42.437148	-93.069391	IAL-301B	2071+49	39.2	Perennial	HDD	1927-100-PL-DWG-0038	Low
IO-03	**S1017WR001**	Iowa River	WRIGHT	IOWA	42.637864	-93.507575	IAL-301A	3606+60	68.3	Perennial	HDD	1927-100-PL-DWG-0042	Low
IO-04	**S1005WE001**	Des Moines River	WEBSTER	IOWA	42.346304	-94.035222	IAL-302	1272+49	24.1	Perennial	HDD	1927-100-PL-DWG-0046	Low
IO-05	**S1019WR004**	Boone River	WRIGHT	IOWA	42.657008	-93.945866	IAL-302	2535+64	48	Perennial	HDD	1927-100-PL-DWG-0050	Low
IO-06	**S1015FM002**	East Nishnabotna River	FREMONT	IOWA	40.772480	-95.399492	IAL-306	69+34	1.3	Perennial	HDD	1927-100-PL-DWG-0053	Low
IO-07	**S1006PO031**	West Nishnabotna River	POTTAWATTAMIE	IOWA	41.365666	-95.388571	IAL-308	706+74	13.4	Perennial	HDD	1927-100-PL-DWG-0058	Low
IO-08	**S1014CR027**	Boyer River	CRAWFORD	IOWA	41.995942	-95.393747	IAL-308	3085+19	58.4	Perennial	HDD	1927-100-PL-DWG-0062	Low
IO-09	**S1014ID001**	Soldier River	IDA	IOWA	42.234724	-95.410201	IAL-308	3979+71	75.4	Perennial	Open Cut	1927-100-PL-DWG-0251	Low
IO-10	**S1002WO001**	Missouri River	WOODBURY	IOWA	42.353875	-96.417434	IAL-318A	620+86	11.8	Perennial	HDD	1927-000-PL-DWG-0033	Low
IO-11	**S1015PL009**	Floyd River	PLYMOUTH	IOWA	42.709874	-96.248723	IAL-318A	2261+34	42.8	Perennial	HDD	1927-100-PL-DWG-0068	Low
IO-12	**S1005CS001**	East Fork Wapsipinloon River	CHICKISAW	IOWA	43.078323	-92.296144	IAM-101	300+20	5.7	Perennial	HDD	1927-100-PL-DWG-0002	Low
IO-13	**S1005CS003**	Little Wapsipinicon River	CHICKASAW	IOWA	43.053425	-92.388469	IAM-101	615+33	11.7	Perennial	HDD	1927-100-PL-DWG-0003	Low
IO-14	**S1024CS002**	Wapsipinicon River	CHICKASAW	IOWA	43.052715	-92.436351	IAM-101	746+96	14.1	Perennial	HDD	1927-100-PL-DWG-0004	Low
IO-15	**S1024CS003**	Cedar River	CHICKASAW	IOWA	43.051292	-92.501116	IAM-101	921+16	17.4	Perennial	HDD	1927-100-PL-DWG-0006	Low
IO-16	**S1003FL008**	Cedar River	FLOYD	IOWA	43.050679	-92.644745	IAM-101	1328+17	25.2	Perennial	HDD	1927-100-PL-DWG-0008	Low
IO-17	**S1005FL002**	Shell Rock River	FLOYD	IOWA	43.061484	-92.957485	IAM-101	2207+62	41.8	Perennial	HDD	1927-100-PL-DWG-0011	Low
IO-18	**S1005FL004**	Winnebago River	FLOYD	IOWA	43.065630	-92.998247	IAM-101	2325+88	44.1	Perennial	HDD	1927-100-PL-DWG-0013	Low
IO-19	**S1003HC001**	East Branch Iowa River	HANCOCK	IOWA	43.038251	-93.642596	IAM-101	4160+65	78.8	Perennial	HDD	1927-100-PL-DWG-0018	Low
IO-20	**S1018HC004**	West Branch Iowa River	HANCOCK	IOWA	43.032263	-93.734015	IAM-101	4413+84	83.6	Perennial	HDD	1927-100-PL-DWG-0019	Low
IO-21	**S1018HC006**	East Branch Boone River	HANCOCK	IOWA	43.024369	-93.802644	IAM-101	4604+45	87.2	Perennial	Open Cut	N/A	Low
IO-22	**S1022HC001**	Boone River	HANCOCK	IOWA	43.023026	-93.940879	IAM-102	52+28	1	Perennial	HDD	N/A	Low
IO-23	**S1001KO003**	East Fork Des Moines River	KOSSUTH	IOWA	43.018207	-94.208517	IAM-102	784+99	14.9	Perennial	HDD	1927-100-PL-DWG-0020	Low
IO-24	**S1001PA002**	Des Moines River	PALO ALTO	IOWA	43.020497	-94.590294	IAM-102	1825+75	34.6	Perennial	HDD	1927-100-PL-DWG-0022	Low
IO-25	**S1001CL005**	Little Sioux River	CLAY	IOWA	43.022563	-95.050770	IAM-103A	70+43	1.3	Perennial	HDD	1927-100-PL-DWG-0023	Low
IO-26	**S1015SI009**	Floyd River	SIOUX	IOWA	43.047813	-95.938046	IAM-103B	2480+92	47	Perennial	HDD	1927-100-PL-DWG-0024	Low
IO-27	**S1002SI017**	West Branch Floyd River	SIOUX	IOWA	43.103490	-96.086619	IAM-103B	2956+69	56	Perennial	HDD	1927-100-PL-DWG-0262	Low
IO-28	**S1019WR008**	Boone River	WRIGHT	IOWA	42.889152	-93.912585	IAT-202	584+03	11.1	Perennial	HDD	1927-100-PL-DWG-0029	Low
IO-29	**S1019HC002**	Boone River	HANCOCK	IOWA	42.973181	-93.921144	IAT-202	901+80	17.1	Perennial	HDD	1927-100-PL-DWG-0202	Low
IO-30	**S1016ID021**	Maple River	IDA	IOWA	42.495307	-95.437168	IAT-204	93+84	1.8	Perennial	HDD	1927-100-PL-DWG-0261	Low
IO-31	**S1016CK002**	Little Sioux River	CHEROKEE	IOWA	42.639767	-95.629580	IAT-204	845+85	16	Perennial	HDD	1927-100-PL-DWG-0030	Low
IO-32	**S1016CK013**	West Fork Little Sioux River	CHEROKEE	IOWA	42.806847	-95.753812	IAT-204	1593+31	30.2	Perennial	HDD	1927-100-PL-DWG-0250	Low
IO-33	**S1001EM002**	Des Moines River	EMMET	IOWA	43.488704	-94.880658	MNL-305	1425+44	27	Perennial	HDD	1927-100-PL-DWG-0074	Low
IO-34	**S1020SI002**	Rock River	SIOUX	IOWA	43.242215	-96.253959	SDM-104A	486+70	9.2	Perennial	HDD	1927-100-PL-DWG-0071	Low
IO-35	**S1003LY012**	Big Sioux River	LYON	IOWA	43.350665	-96.526907	SDM-104A	1406+03	26.6	Perennial	HDD	1927-100-PL-DWG-0072	Low
IO-36		Pilot Creek	CERRO GORDO	Iowa	43.016578	-94.781153	IAM-102	2350+60	44.5189	Perennial	HDD	1927-100-PL-DWG-0199	Low
IO-37		Otter Creek	WRIGHT	Iowa	42.778475	-93.907658	IAT-202	163+08	3.08864	Perennial	HDD	1927-100-PL-DWG-0028	Low
IO-38	**S_1_HD_002_DT**	Honey Creek	HARDIN	Iowa	42.275961	-93.235603	IAL-301B	1251+05	23.6941	Perennial	HDD	1927-100-PL-DWG-0035	Low
IO-39		Beaver Creeek	HARDIN	Iowa	42.362163	-93.141329	IAL-301B	1718+06	32.539	Perennial	HDD	1927-100-PL-DWG-0037	Low
IO-40		White Fox Creek	WRIGHT	Iowa	42.671925	-93.715506	IAL-301A	4201+97	79.5828	Perennial	HDD	1927-100-PL-DWG-0043	Low
IO-41	**S1014MO004**	Walnut Creek	MONTGOMERY	Iowa	40.914418	-95.372492	IAL-306	635+24	12.0311	Perennial	HDD	1927-100-PL-DWG-0055	Low
IO-42		Coon Creek	CRAWFORD	Iowa	41.980999	-95.391703	IAL-308B	3022+97	57.2532	Perennial	HDD	1927-100-PL-DWG-0196	Low

Table 1: Summit Carbon Solutions Phase I Hydrotechnical Assessment Summary Results

GEO ID	Feature_ID	Name	County	State	Latitude	Longitude	Route	Sta	Mile Post	Flow Regime	Crossing Method	HDD Drawing Number	Hazard Level
MN-01	S1017YE002	Minnesota River	RENVILLE / YELLOW MEDICINE	MINNESOTA	44.713426	-95.397863	MNL-303A		11.7	Perennial	HDD	1927-100-PL-DWG-0099	Low
MN-02	S1013RE002	Redwood River	REDWOOD	MINNESOTA	44.502422	-95.399393	MNL-303B	1490+99	28.2	Perennial	HDD	1927-100-PL-DWG-0102	Low
MN-03	S1025RE002	Cottonwood River	REDWOOD	MINNESOTA	44.246956	-95.288989	MNL-303B	2743+76	52	Perennial	HDD	1927-100-PL-DWG-0103	Low
MN-04	S1002CO001	Heron Lake Outlet	COTTONWOOD	MINNESOTA	43.871074	-95.290495	MNL-304	1539+77	29.2	Perennial	HDD	1927-100-PL-DWG-0106	Low
MN-05	S1017MA002	East Fork Des Moines River	MARTIN	MINNESOTA	43.572829	-94.714653	MNL-305	806+50	15.3	Perennial	HDD	1927-100-PL-DWG-0110	Low
MN-06	S1002OT003	Pelican River	OTTER TAIL	MINNESOTA	46.295985	-96.151995	MNL-321A	99+89	1.9	Perennial	HDD	1927-000-PL-DWG-0111	Low
MN-07	S1002WI003	Otter Tail River	WILKIN	MINNESOTA	46.219892	-96.422277	MNL-321A	997+11	18.9	Perennial	HDD	1927-000-PL-DWG-0034	Low
MN-08	S1002WI001	Bois de Sioux River	WILKINS	MINNESOTA	46.212132	-96.588621	MNL-321A	1451+97	27.5	Perennial	HDD	1927-100-PL-DWG-0115	Low
MN-09		Hawk Creek	RENVILLE	MINNESOTA	44.797038	-95.456728	MNL-303A	109+48	2.1	Perennial	HDD	1927-100-PL-DWG-0098	Low
MN-10		Chetomba Creek	RENVILLE	MINNESOTA	44.869213	-95.363075	MNL-337	2105+31	39.9	Perennial	HDD	1927-100-PL-DWG-0208	Low
MN-11		Heron Lake Outlet -1 (Des Moines River)	COTTONWOOD	MINNESOTA	43.881846	-95.291136	MNL-304	1849+45	35.2	Perennial	HDD	1927-100-PL-DWG-0105	Low
ND-01	S2006RI017	Wild Rice River	RICHLAND	NORTH DAKOTA	46.203503	-96.746384	NDL-323	224+84	4.3	Perennial	HDD	1927-100-PL-DWG-0215	Low
ND-02	S_2_CA_042_DT	Maple River	CASS	NORTH DAKOTA	46.753519	-97.222370	NDL-324	641+10	12.1	Perennial	HDD	1927-100-PL-DWG-0192	Low
ND-03	S2006RI001	Sheyenne River	RICHLAND	NORTH DAKOTA	46.573469	-97.094092	NDL-324	1445+61	27.4	Perennial	HDD	1927-100-PL-DWG-0171	Low
ND-04	S2004MO017	Missouri River	MORTON	NORTH DAKOTA	46.963812	-100.933011	NDM-106	7348+00	139.2	Perennial	HDD	1927-000-PL-DWG-0032	Low
ND-05	S2007RI012	Wild Rice River	RICHLAND	NORTH DAKOTA	46.191806	-97.074787	NDT-211		3.3	Perennial	HDD	1927-100-PL-DWG-0211	Low
ND-06	S2006SA022	Wild Rice River	SARGENT	NORTH DAKOTA	46.190325	-97.293802	NDT-211	731+75	13.9	Perennial	HDD	1927-100-PL-DWG-0160	Low
ND-07	S_2_DI_013_DT	James River	DICKEY	NORTH DAKOTA	46.044830	-98.140255	NDT-211	3078+77	58.3	Perennial	HDD	1927-100-PL-DWG-0164	Low
ND-08	S2015DI024	Elm River	DICKEY	NORTH DAKOTA	45.946353	-98.679003	NDT-211	4623+51	87.6	Perennial	HDD	1927-100-PL-DWG-0166	Low
ND-09		Apple Creek	BURLEIGH	NORTH DAKOTA	46.852352	-100.583395	NDM-106	6314+84	119.60	Perennial	HDD	1927-100-PL-DWG-0190	Low
NE-05		Pigeon Creek	DAKOTA	Nebraska	42.366442	-96.615600	NEL-316/IAL-318B		2420+00	0.13 (IAL-318)	HDD	1927-100-PL-DWG-0205	Low
SD-01	S2002LA073	East Fork Vermillion River	LAKE	SOUTH DAKOTA	43.984638	-97.318659	SDM-104B	5091+15	96.4	Perennial	HDD	197-100-PL-DWG-0252	Low
SD-02	S2014SP003	James River	SPINK	SOUTH DAKOTA	45.168335	-98.397001	SDM-105B	2722+38	51.6	Perennial	HDD	1927-100-PL-DWG-0122	Low
SD-03	S_2_BE_046_DT	James River	BEADLE	SOUTH DAKOTA	44.471387	-98.124669	SDT-207	579+49	11.0	Perennial	HDD	1927-100-PL-DWG-0133	Low
SD-04	S2004SP009	James River	SPINK	SOUTH DAKOTA	44.913767	-98.485667	SDT-209	54+18	1.0	Perennial	HDD	1927-100-PL-DWG-0141	Low
SD-05		South Fork Moccasin Creek (Waterbody (S2001BR010)	BROWN	SOUTH DAKOTA	45.275770	-98.562027	SDM-105B	3373+28	63.9	Perennial	HDD	1927-100-PL-DWG-0125	Low
SD-06		Dry Run Creek	SPINK	SOUTH DAKOTA	44.956840	-98.325873	SDT-209	505+25	9.57	Perennial	HDD	1927-100-PL-DWG-0207	Low
SD-07		Big Sioux River	CODINGTON	SOUTH DAKOTA	44.879908	-97.107997	SDT-208	01+50	0.03		HDD	1927-100-PL-DWG-0136	Low
SD-08		Big Sioux River	CODINGTON	SOUTH DAKOTA	44.877242	-97.099405	SDT-208	33+24	0.63	Perennial	HDD	1927-100-PL-DWG-0135	Low
SD-09		Webber Gulch	BROWN	SOUTH DAKOTA	45.935589	-98.694584	NDT-211	4686+86	88.77		HDD	1927-100-PL-DWG-0152	Low

Appendix A: Phase 1 Hydrotechnical Assessment Attribute Definitions

APPENDIX B: TABLE DEFINITIONS

The following definitions are used for the columns in Tables 1 and Appendix A as well as the provided Excel file, geodatabase, and GoogleEarth file.

GEO_ID: This is a temporary identifier provided to facilitate discussion of the waterbody crossing. Each crossing was assigned a temporary identifier in the format of "State Abbreviation"+<< Unique Number Four Digit Number>>. For example, IO-01.

Feature_ID: Gulf/Summit Carbon unique feature ID for each waterbody crossing

Name: Waterbody crossing name

County: County where waterbody crossing is located

State: The USA state in which the waterbody crossing is located.

Lat/Long: The latitude/longitude of the center of the mapped geohazard.

State: The USA state in which the hydrotechnical hazard is located.

Route: The Summit Carbon pipeline segment/route for which the waterbody crossing is located. .

Sta: The Summit Carbon station for which the waterbody crossing is located.

Mile_Post: The Summit Carbon mile post for which the waterbody crossing is located.

Flow_Regime: The stream flow (perennial or intermittent) regime of the waterbody crossing.

Crossing_method: The proposed installation method (HDD or open-cut) of the waterbody crossing.

Valley_length_ft The straight line valley length, in feet, where waterbody crossing is located.

Valley_length_ft The stream length, in feet, of reach where waterbody crossing is located.

Sinuosity: Ratio of stream length to valley length

Bankfull_width_ft: Measured bankfull width in feet

Meander_Belt_Width_ft: lateral extent of the waterbody meanders as measured from outside bend of one meander to outside bend of upstream or downstream meander

MW_Ratio: Meander width ratio. Ratio of meander belt width to bankfull width.

Pipe_Length_within_bkf: Pipe length measured between desktop assessed left bank and right bank bankfull features.

Angle_of_crossing: Describes whether the pipe crosses the stream perpendicular to flow, oblique, or parallel.

Meander_Pattern: Description of observed meander patterns within reach of waterbody crossing as described in Rosgen, 1996

Deposition_Features: Description of observed depositional features within reach of waterbody crossing as described in Rosgen, 1996

Blockages: Description of channel debris/blockages observed at the crossing as described in Rosgen, 1996

Lateral Instability: Geomorphic evidence of lateral instability or exposure risk (e.g., bank erosion, meander migration, parallel encroachment, etc.) is noted

Hazard Level: Hydrotechnical hazard rating.

Notes: Documentation of observations and/or recommendations based on hazard level.