Appendix 3-D: Co-Located Infrastructure Crossing Packages

CONTAINS REDACTED INFORMATION IN CASE 10-T-0139

CHAMPLAIN HUDSON POWER EXPRESS

CROSSING ARRANGEMENT - LAKE CHAMPLAIN

Unknown CI Owner
CHPE Crossing Reference LC-20, LC-20A & LC-20B

Area:	Lake Champlain – between Port Douglass, NY and Burlington, VT		
CHPE Crossing Reference	**Crossing Location**		**Crossing Description**
	Northing	**Easting**	
LC-20	[redacted]	[redacted]	NOAA Charts and Identified by S.T. Hudson Q2 2023 Survey.
LC-20A	[redacted]	[redacted]	
LC20B	[redacted]	[redacted]	

[redacted]

LC-20, LC-20A & LC-20B GIS Screenshot – September 2023

REVISION HISTORY

REV.	DATE	AUTHOR	APPROVAL	COMMENT
0	01/18/2024	K. Peoples	N. Henderson	Issued for DPS Approval
A	07/26/2023	K. Peoples	N. Henderson	For Internal Review

CONTENTS

1 INTRODUCTION

The Champlain Hudson Power Express is a 1,250-megawatt underwater/underground high-voltage direct current (“HVDC”) transmission system that will deliver clean hydropower from resources in Quebec, Canada directly to New York City. The Facility was issued a Certificate of Environmental Compatibility and Public Need under Article VII of the New York State Public Service Law (“Certificate”) in April 2013; this Certificate is held by CHPE LLC and CHPE Properties, Inc. (“Certificate Holders”).

CHPE LLC will construct, operate, and maintain the U.S. facilities. The HVDC transmission line runs approximately 339 miles from the New York/Canada border to a converter station located in Astoria, Queens. The HVDC cable system will consist of two 400KV solid dielectric cables with a fiber optic control. The route runs through Lake Champlain, terrestrial upland sections, the Hudson and Harlem rivers to a converter station located in Astoria, Queens

As part of the construction of the Marine Transmission Facilities the cable will cross a number of existing third-party assets.

This document details the proposed arrangement for crossing of collocated infrastructure (“CI”) here, an unknown diameter line, suspected to be a Telecom or Power Cable (referred to on plans as LC-20, LC-20A & LC-20B) where CHPE, after making commercially reasonable efforts described herein, have been unable to identify and connect with an owner.

This document demonstrates the commercially reasonable efforts made by CHPE to identify the CI owner. Given the lack of an identifiable CI owner, it also details the measures CHPE proposes to utilize to protect the CI at the location of the CHPE Facility’s crossing by installing pre- and post-installation utility protection measures appropriate to this type of utility.

[redacted]

Figure 1-1: LC-20, LC-20A & LC-20B GIS Screenshot - July 2023

2 CROSSING ARRANGEMENT

As part of the construction of the CHPE Marine Facilities, the CHPE HVDC Cable will be laid along the Lake Champlain lakebed. Where possible, the Cable route has been selected to avoid crossing or impacting third party CI assets to the maximum extent practicable, as directed in CHPE's Article VII Certificate. In the case of the LC-20, LC-20A & LC-20B cable running nominally east-west across Lake Champlain, no viable alternative to crossing this CI was identified.

The crossing design has been selected based on industry best practice and the crossing of similar assets in the vicinity of this unknown owner crossing.

2.1 CROSSING DESIGN

The crossing design will utilize a protective duct (UraGuard or similar shown in Figure 2-1 and APPENDIX B) that will bundle the CHPE cables and provide additional impact and abrasion resistance to both CHPE and the unknown owner assets. The protective duct will extend ~100' to the north of the northern crossing (LC-20) and 100-foot south of the southern crossing (LC-20B) for a total of ~520' of ducting Figure 2-2.

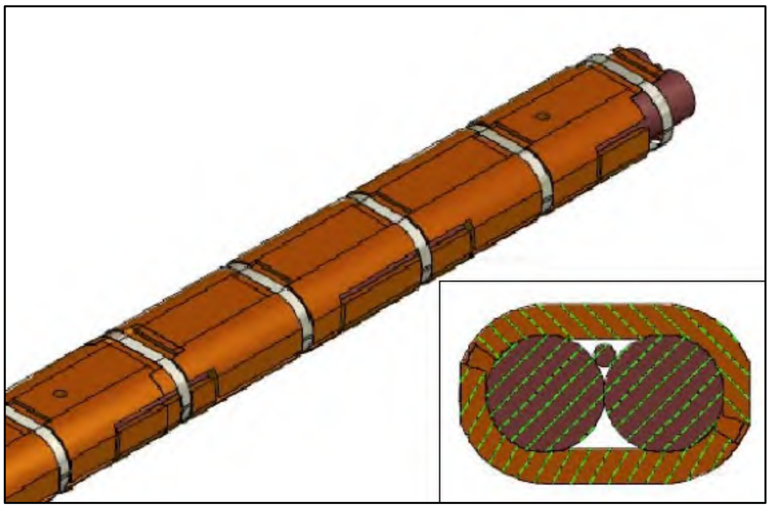


Figure 2-1: UraDuct (or Similar) Cable Bundle

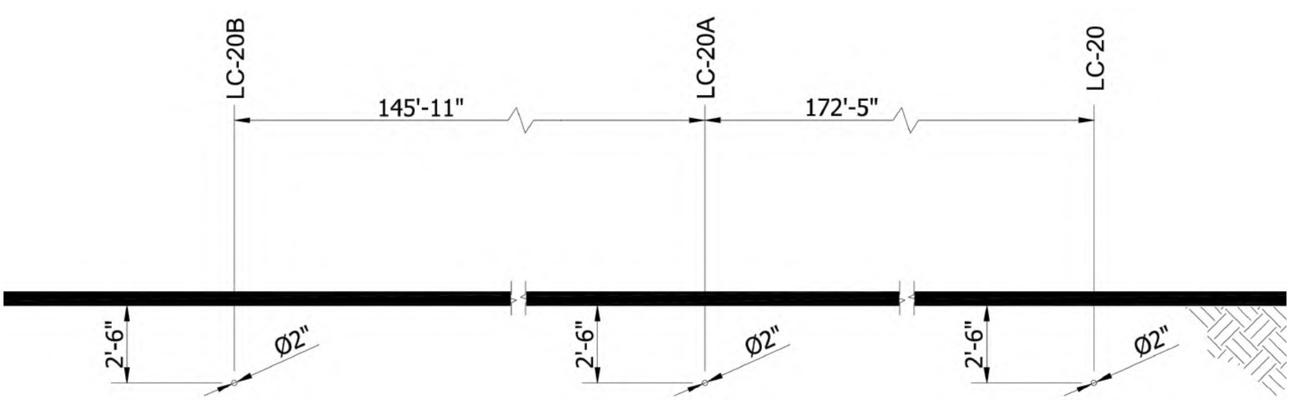


Figure 2-2: LC-20, LC-20A & LC-20B Crossing Design Profile

The CHPE cables will cross the LC-20, LC-20A & LC-20B cable with a relative crossing angle between 100° and 120° at a water depth of approximately 160-170-feet.

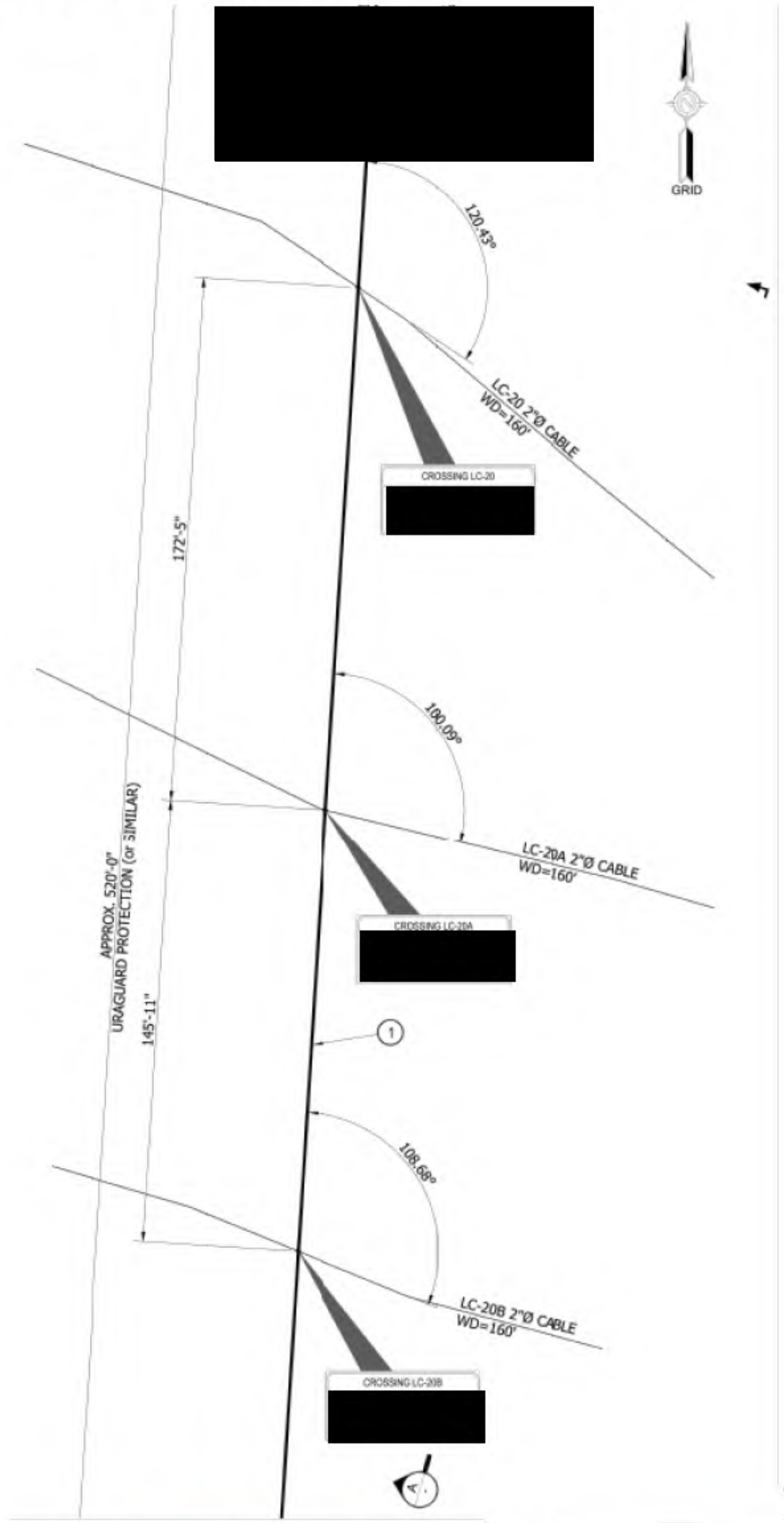


Figure 2-3: LC-20, LC-20A & LC-20B Crossing Arrangement Plan

2.2 INSTALLATION

2.2.1 PRE-LAY WORKS

Prior to installation of any permanent works, a significant number of surveys and investigations have been undertaken to aid the route design and optimization (further detailed in Section 3).

No pre-lay intervention works are foreseen for the agreed crossing arrangement of the Unknown cables (LC-20, LC-20A & LC-20B) in Lake Champlain.

2.2.2 CABLE LAY

During CHPE cable laying activities the bundled cables will be laid using a dynamically positioned (DP2) barge.

Due to water depth, the cable in this location will be laid on the lakebed surface either side of the Unknown cables.

During cable lay, the touchdown point of the cable will be monitored by a remotely operated vehicle (ROV).

On completion of cable lay, as-built locations of the CHPE cables will be accurately recorded and used to update:

- CHPE Project GIS system;
- Cable installation route overlays for cable; and,
- Relevant Authorities (USACE, USCG, NOAA etc.).

2.3 SCHEDULE

The activities and expected schedule/durations related to the crossing of the LC-20, LC-20A & LC-20B crossing are detailed in Table 2-1.

Table 2-1: Schedule

Activity	Duration (Days)	Scheduled Date
Cable Lay	1	July 2024

3 SURVEY

Extensive surveys have been undertaken to facilitate design and routing of the CHPE project, including the locating of third-party assets' collocated infrastructure.

The Unknown cable has been confirmed using survey techniques described below. Note that no diver locates have been conducted on the Unknown asset due to water depths.

Surveys conducted include:

2012

- Desktop study: to research existing information on as-built positions and utility ownership for charted cable and pipeline areas.
- Hydrography (multibeam depth sounder): to determine water depths and reveal any topographic relief that may be associated with an exposed utility.
- Bottom imaging (side scan sonar): to identify geomorphologic variations and man-made targets marking linear trends suggestive of an exposed utility.
- Magnetic intensity measurements (magnetometer): to measure variations in the earth's total magnetic field to identify the magnetic signature of a utility.
- Sub-bottom profiling (chirp): to reveal shallow subsurface seismic reflectors that might be characteristic of a buried utility and its surrounding construction features.

2020

- Diver locates by Caldwell Marine International LLC (CMI).

2022

- Ocean Surveys Inc. completed a multi-sensor survey of route on behalf of CMI.

2023

- S.T. Hudson completed a multi-sensor survey of route on behalf of CHPE using sophisticated and upgraded equipment compared to previous studies.
- Follow up diver locates by Caldwell Marine International LLC (CMI) to all shallow water S.T. Hudson targets.
- FOIA requests to NOAA, USACE and USCG.

Formal third-party surveys are detailed in Table 3-1 below.

Table 3-1: Formal 3rd Party Surveys

Survey Date	Company	Description
July 2010	Rogers Surveying LLC	Geophysical, Sediment and Benthic Not used for locating Co-Located Infrastructure (CI)
Sep to Oct 2012	Ocean Surveys Inc.	The 2012 MRS was designed to provide pertinent data and results in support of the CHPE Project to: (1) characterize/evaluate bottom conditions and underlying shallow stratigraphy along segments of the route that had not been previously surveyed, (2) acquire additional detail to better understand areas exhibiting complex or unique site conditions, (3) acquire additional geophysical detail at sites where potential cultural resources were identified from the 2010 MRS, and (4) locate existing submarine utilities. Ref: OSI_CHPE_2012-Utility-Report_Final-Vol3_01-29-13
Q3 2020	Caldwell Marine International LLC (CMI)	Diving investigation of utilities identified by previous reports. Ref: C1208-CHPE(LAKE)-UTILITY LOCATE REPORT-ISSUE 2.0-20201006 (1)
Q3 2022	Ocean Surveys Inc. for CMI	Multi sensor survey of the Lake Champlain Marine route Ref: Submittal 060-01-0 Pre-Lay Survey Results - Lake Champlain & 060-01-0 Appendix 1 - Magnetic Anomalies
Q2 2023	S.T. Hudson	Multi sensor survey of Lake Champlain Route Ref: 23-076_TDI_HRG_Lake_Champlain_Final_Report_Rev1
Q2 2023	Caldwell Marine International LLC (CMI)	Diving investigation of utilities identified by previous reports. Following the S.T. Hudson survey. C1235-CHPE(LC)-UTILITY LOCATE REPORT-ISSUE 1.0-20230728

Survey data obtained, relevant to LC-20, LC-20A & LC-20B, is presented in APPENDIX C for information.

3.1 CHPE MARINE IDENTIFICATION AND CONFIRMATION PROCESS

CHPE has attempted to ascertain the owners of CI identified in the CI locate efforts described above through a number of methods, including outreach to other nearby submarine CI owners, submission of Freedom of Information Act/Law (FOIA/L) requests to state and federal agencies, review of terrestrial property records along the shore of Lake Champlain to identify on-shore CI-owned tax parcels in the vicinity of unidentified submarine CI assets.

- Email received from AT&T on 2/28/23 confirming that the unknown crossings are not owned by AT&T.
- Virtual meeting with Vermont Telephone (VT) held 4/3/23 confirming that the unknown crossings are not owned by VT.
- Virtual meeting with NYPA held 5/11/23 confirming that the unknown crossings are not owned by NYPA.
- FOIL request made to NYSOGS on 3/1/23 for easement information on submarine cables and utilities crossing the CHPE route. Response documents received 4/4/2023. No owners of unknown crossings were identified following review of NYSOGS documents.
- FOIA request made to National Oceanic and Atmospheric Administration (NOAA) on 3/1/23 for owner information on charted submarine cables and utilities crossing the CHPE route. Response documents received 4/26/2023. No owners of unknown crossing were identified following review of NOAA documents.
- FOIA request made to USACE on 3/1/23 and revised on 4/4/23 for permit information on submarine cables and utilities crossing the CHPE route. Response documents received 5/11/2023. No owners of unknown crossings were identified following review of USACE documents.
- FOIA request made to USDOD NGA on 3/1/23 for ownership information on submarine cables and utilities crossing the CHPE route. No response documents received to date. Seven follow-up calls made between 6/1/23 and 7/31/23 requesting status update. No response expected.
- NYS UDig engineering tickets submitted 7/12/2023 requesting notification of all crossed utilities along Lake Champlain. Responses pending. No owners of unknown crossings were identified based on responses received to date.
- Calls with Plattsburgh Airforce Museum, SAC/STRATCOM, and Former Airforce Base Engineering Supervisor between 7/14/23 and 7/28/23 requesting information on ownership information of LC-08, LC-08A, LC-09A, LC-09B, LC-10, LC-11, LC-12, and LC-13. None had records of utilities or easements.
- Calls and emails with Lake Champlain Ferry Company requesting easement records and owner information for LC-20, LC-20A & LC-20B from 7/14/23 to 7/28/23. Owner was identified as historic NY Telephone Company by easements provided by Lake Champlain Ferry Company. Cable is abandoned with no active owner.

<u>CHPE will retain all records of these efforts as part of the Project completion documentation package.</u>

These efforts, taken together, constitute all commercially reasonable efforts to identify the owners of CI assets identified in the vicinity of the CHPE Facility during the submarine identification process described above, including LC-20, LC-20A & LC-20B.

At this time, it is not practicable to require further efforts to identify the owners of these CI assets, particularly in light of the New York Independent Systems Operator’s (NYISO’s) findings that the CHPE Facility must be constructed and placed in service by spring 2026 to aid in avoiding significant threats to reliability within the New York State electric grid.

While it is possible that CI assets like LC-20, LC-20A & LC-20B are abandoned and that owners cannot be located because they no longer exist, CHPE has opted to take a conservative approach and to install standard pre- and post-lay utility protection measures materially similar to those utilized for other submarine utilities of the same type (telecommunications, electric, gas, etc.), which will ensure the identified CI is protected consistent with CHPE”s Certificate and as though it is still an actively used utility asset.

4 TECHNICAL DATA

Condition 162 of CHPE's Certificate requires technical analysis demonstrating that the colocation of the CHPE Facility with other nearby CI will not adversely affect that CI, including an assessment of potential ampacity and thermal impacts, induction, impedance, and corrosive potential, and so on. While the owner of the CI addressed in this package is unknown, CHPE has nevertheless performed these analyses to demonstrate no adverse impact to the CI in question and provides the results of those analyses herein. Technical data related to the CI crossing location is summarized in this section; full reports included as appendices.

4.1 CHPE CABLE SPECIFICATION

The CHPE Facility includes a DC cable circuit with two 2,500mm^2 copper conductor cross-linked polyethylene (XLPE) insulated cables rated ±400 kV DC to ground and a 48 core fiber optic control and monitoring cable.

See APPENDIX D for CHPE Marine Cable Specifications.

4.2 CHPE SPLICING

The CHPE cable splice is presented for information only. Splice locations are designed to avoid CI crossing locations. (See APPENDIX E for cable splice layout).

Note that there are 7 (seven) planned submarine splice locations in Lake Champlain.

4.3 AMPACITY & THERMAL IMPACTS

Thermal and ampacity effects at the crossing location are presented in APPENDIX F.

4.4 INDUCTION, IMPEDANCE & CORROSIVE POTENTIAL

The electrical effects of the CHPE cables on CI is presented in APPENDIX G.

5 SAFETY SYSTEMS

A break or severing of the HVDC conductor is referred to as a DC line fault. The magnitude of the DC fault current will depend on the impedance of the DC circuit, the location of the fault, the capacitance of the DC cable as well as the sizing of the converter arm reactors. However, since the cable itself does not contain any combustible material there is negligible risk of explosion. In the case of a fault, the converter protection system will disconnect the converter and cable system from the electrical transmission system within 100ms. The fault path will be from the conductor to the cable metallic sheath and then back to the source.

If the HVDC cable is severely damaged, for example by an anchor strike, and an electrical breakdown occurs in the cable, the power on the cable will be isolated as mentioned above. At the position of the electrical breakdown, a flashover will occur between the conductor and the metallic screen due to the discharge of the cable. The conductor and the metallic screen is designed to carry the fault current.

A fiber optic cable system is being installed as part of the cable bundle along the entire route to monitor the power cables within the terrestrial and submarine sections. The fiber optic cable monitors temperature and any acoustic noises and/or vibrations near the cable. In addition, there will be two (2) communication 1 GB ethernet channels between HQ's Hertel Converter Station and the Astoria Converter Station with feeds to 5 in-line, land-based monitoring stations spread along the route.

The monitoring system will be capable of detecting:

- Hot-spot detection along cables: Monitoring of power cables for potential hot-spot along the whole circuit using the installed fiber-optic sensing system.
- External hot-spot detection: Monitoring of potential unwanted external thermal sources to the integrity of the underground surroundings.
- Mechanical Intrusion detection: Monitoring of vessels anchoring or third-party intrusion ("TPI") all along the underground lines to protect the asset against unwanted activities in the vicinities of the circuit such as manual and mechanical digging.

In the event of any detected faults, the system may be shut down by either Hertel or Astoria converter stations.

6 CABLE REPAIR

From time to time throughout the CHPE Facility's life, repairs above or near the Unknown CI crossing may be necessary. Detailed design and procedures for repair of the facility will be developed based on the type of repair and the extent of damage. General procedures for how a repair will be performed are included in the following sections. Further details on planned repair procedures will be contained in the Maintenance and Emergency Action plan, to be submitted with the overall facility Operations and Maintenance manual, prior to operations. However, the CI protection measures to be used with respect to this Unknown CI owner's crossing during operations will be consistent with those used for submarine CI of a similar utility type (telecommunications, gas, electricity, etc.) elsewhere in Lake Champlain to ensure that this CI is protected from damage during the operation of the CHPE Facility.

In general, repair-related maintenance will require careful planning and regulatory coordination by CHPE Qualified repair contractor(s) would be dispatched to the work location. A portion of the transmission cable would be raised to the surface, the damaged portion of the cable cut and removed, and a replacement section of spare cable would be spliced.

Once repairs were completed, the transmission cable would be re-laid on the lakebed and re-buried using ROV/diver jetting devices or laid on bottom with additional protection (as required), depending on location. In the event repairs are required, they will comply with regulatory requirements and permit conditions.

6.1 CHPE CABLE REPAIR

6.1.1 NOT IMPACTING CROSSING(S)

If a repair of the CHPE cable(s) does not impact any utility crossing, is the CHPE cable will be cut and recovered for splicing. A section of cable would be spliced in to accommodate replacing the damaged section, and the repaired cable lowered to the seabed. The repaired cable would be deployed and reburied to the required depth using remedial burial techniques, i.e., ROV or diver operated jet sled, or protected using articulated concrete mattresses (as required).

6.1.2 IMPACTING CI CROSSING(S)

If a repair is required which impacts the collocated infrastructure, the utility owner would typically first be notified of the repair. In the case of Unknown CI owners, CHPE will notify NYSDPS and other regulators as appropriate, affirming that repairs near an Unknown CI asset will be undertaken consistent with this plan. Repair will be completed using standard industry practices with pre- and post-lay protection used as necessary to protect both the CHPE Facility and the Unknown CI.

6.2 CI CABLE REPAIR

6.2.1 NOT IMPACTING CHPE

If a repair of the collocated infrastructure does not impact CHPE Cables, CHPE is to be notified of the requirement for a repair and location to determine if it may impact existing cable protection arrangements. Schedules and notifications of repair start/completion dates for purposes of monitoring the CHPE system for service disruptions shall also be provided. CHPE will file as-built drawings and other information to appropriate State and Federal regulators to ensure the location of the CHPE Facility is known by other CI owners, and will register with the New York UDig program as required by the Certificate, to ensure other current or future CI owners are aware of the CHPE Facility and contact CHPE of nearby repair work.

6.2.2 IMPACTING CHPE CROSSING

In general, if a repair of collocated infrastructure impacts CHPE cables, the collocated infrastructure should be cut on either side of the CHPE cables to prevent disturbance to CHPE and crossing protection. The existing utility should be repaired using standard industry practices and then laid back out. Pre- and post-lay protection shall be agreed in a formal crossing agreement between both owners and installed as necessary to protect both utilities. If, in the future, an Unknown CI owner comes forward to claim ownership of LC-20, LC-20A & LC-20B, CHPE will require discussion of crossing arrangements and work near the CHPE line before such work could proceed.

7 OPERATIONS AND MAINTENANCE

As the owner, CHPE LLC will be responsible for ensuring the long-term successful operation of the Project over its 80+year design life. System performance will be continuously monitored from several locations by a dedicated O&M Team to ensure proper operation of the system. This monitoring will allow for immediate fault detection and instantaneous feedback on any operational deviations which may prevent the system from functioning optimally.

The Astoria (NY) and Hertel (Quebec) Converter Stations will be continuously staffed by the O&M Team with notifications, monitoring, and control protocols established and integrated as part of the overall automated operation of the system.

The CHPE Project is projected to come online in May 2026.

The transmission line's facilities in Canada, including an HVDC converter station in Hertel, Quebec, will be constructed, operated, and maintained by Hydro Quebec and its affiliates. CHPE LLC will construct, operate, and maintain the U.S. facilities including marine and terrestrial cable sections, the Astoria Converter Station, and the Operations Control Center.

7.1 OPERATIONS MONITORING

A fiber-optic cable monitoring system is being integrated into the cable bundle to actively monitor the HVDC cables along the entire HVDC power cable route, both terrestrial and submarine. As well as the main stations in Hertel and Astoria there are 5 land-based monitoring stations linked to both.

HVDC-system-related control functions are coordinated by both converter stations (Hertel and Astoria), such as starting/stopping power transmission, power/current reference value setting, and controlling DC voltage.

7.2 SCHEDULED MAINTENANCE (MARINE)

Physical Inspections will be undertaken as a minimum every 5 years by remotely operated vehicles ("ROV"), including verification of depth of burial and the integrity of post-lay mattress protection. CHPE plans to undertake these inspections using TSS trackers following an injected tone using the main cores when down for service, or a tone injected in the armoring when in service.

7.3 UNSCHEDULED MAINTENANCE

Two repair equipment storage facilities will be constructed along the Project's route to store and maintain an inventory of long lead items required for repairing possible cable faults. One storage location will have direct access to Lake Champlain and will contain suitable sections of marine cable and associated equipment required for repairs.

Section 6 further describes the expect repair scenarios. Dedicated repair procedures and plans will be shared in the event of a required repair in proximity to facilities described in this document.

8 DECOMISSIONING

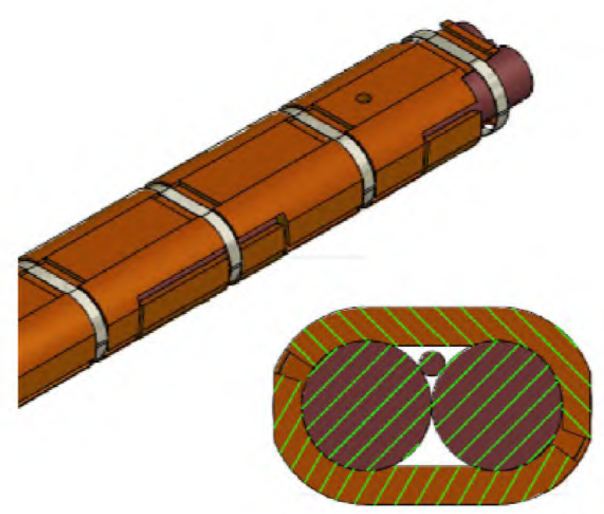
Decommissioning of the CHPE cables will involve the permanent abandonment on the lakebed, consistent with CHPE's permits.

APPENDIX A. CROSSING DESIGN

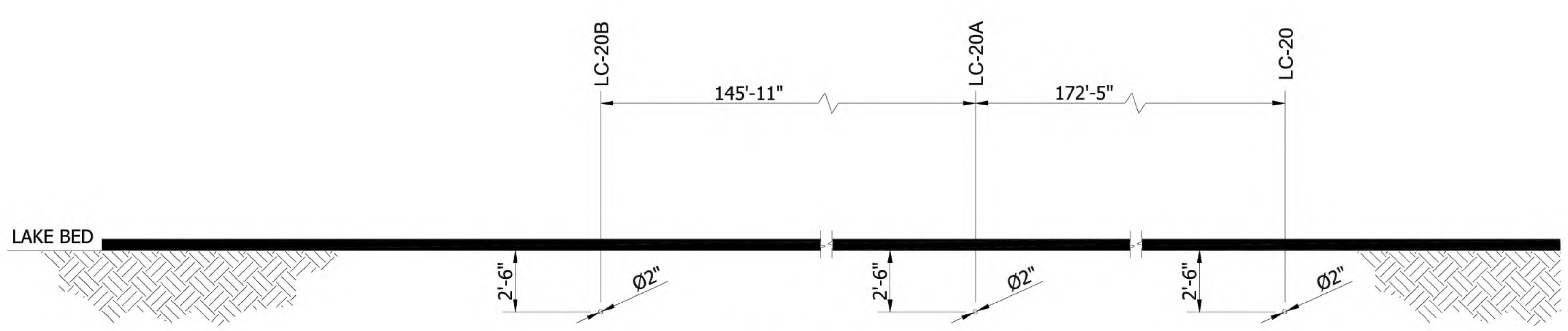
[2 Pages]

[redacted]

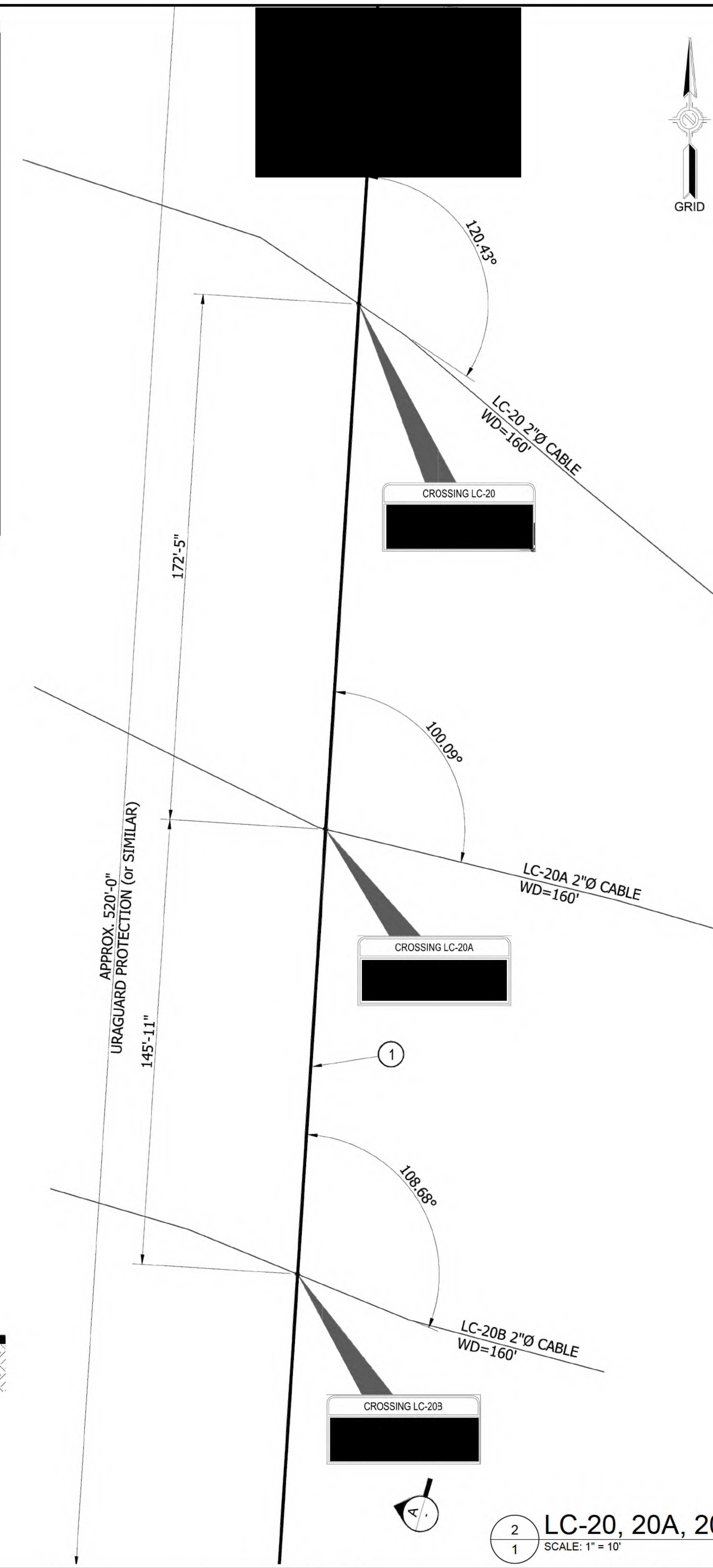
20B - PLAN VIEW SCALE PLAN: 0 100'



W/URAGUARD PROTECTION (or SIMILAR)
SCALE: N.T.S.



CROSSING ARRANGMENT
VIEW A
SCALE: 1:4



LC-20, 20A, 20B URAGUARD CROSSING DETAIL (2/1)
SCALE: 1" = 10'
SCALE PLAN: 0 10'

GRID

LEGEND

- 2530+00 — STATIONING (FEET)
- PROPOSED CABLE ROUTE
- 48 — MILE POSTS (STATUTE MILE)
- SUBMARINE CABLE — CHARTED UTILITY
- NEW YORK - VERMONT STATE LINE
- LIMIT OF ALLOWED DEVIATION ZONE (20-FT WATER DEPTH IN NOAA LOW WATER DATUM = +72.5-FOOT ELEVATION - NAVD88)
- +75 — 5-FOOT CONTOUR (NAVD88)
- +72 — 1-FOOT CONTOUR (NAVD88)

REFERENCE NOTES

1. LAKE CHAMPLAIN BASE PLAN AND BATHYMETRIC DATA PREPARED BY OCEAN SURVEYS INC. AND PROVIDED BY CALDWELL MARINE IN FEBRUARY 2023.
2. CHARTED UTILITIES MAPPED BY OCEAN SURVEYS AND INCLUDED IN ABOVE REFERENCED BASE PLAN. CHARTED UTILITY LOCATIONS SHOWN IN GRAY WITH ITALICIZED TEXT.
3. UTILITY CROSSING LOCATION INFORMATION PROVIDED BY THE CERTIFICATE HOLDERS IN MARCH AND JUNE 2023.
4. UTILITY CROSSING PROTECTION DETAILS PROVIDED BY NKT, INC. ON AUGUST 14, 2023.

COORDINATE SYSTEM NOTES:

1. HORIZONTAL: UTM WITH NAD83 DATUM, ZONE 18, U.S. SURVEY FOOT (UTM83-18F).
2. VERTICAL: NAVD88.

INSTALLATION NOTES:

1. REFER TO SECTION 11.2 OF THE PROCEDURAL DOCUMENT, CHAMPLAIN HUDSON POWER EXPRESS, SHALLOW MATTRESS PLACEMENT (<150FT WATERDEPTH), (LAKE CHAMPLAIN SEGMENT), DATED JANUARY 30, 2023, PREPARED BY CALDWELL MARINE INTERNATIONAL, LLC, APPENDIX F OF THE EM&CP, FOR ADDITIONAL PRE-LAY MATTRESSING INSTALLATION DETAILS.
2. FOR UTILITY CROSSINGS IN WATER DEPTHS GREATER THAN (>) OR EQUAL TO (=) 150', PROPOSED USE OF POLY-SHELL CLADDING (URADUCT PRODUCT OR SIMILAR) SHALL BE INSTALLED ON PROPOSED SUBMARINE CABLE DURING SUBMARINE CABLE INSTALLATION OVER THE EXISTING UTILITY CROSSING LOCATION(S). REFER TO SECTION 11.2 OF THE PROCEDURAL DOCUMENT, CHAMPLAIN HUDSON POWER EXPRESS, SHALLOW MATTRESS PLACEMENT (<150FT WATERDEPTH), (LAKE CHAMPLAIN SEGMENT), DATED JANUARY 30, 2023, PREPARED BY CALDWELL MARINE INTERNATIONAL, LLC, APPENDIX F, NOTE:2-BULLET 2 OF THE EM&CP.

DOCUMENT USE:

1. THESE PLANS AND THE CORRESPONDING CAD DOCUMENTS ARE INSTRUMENTS OF PROFESSIONAL SERVICE PREPARED BY TRC ENGINEERS, INC., AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY PURPOSE OTHER THAN FOR WHICH IT WAS CREATED WITHOUT THE EXPRESSED WRITTEN CONSENT OF TRC ENGINEERS, INC. ANY UNAUTHORIZED USE, REUSE, MODIFICATION, OR ALTERATION, INCLUDING AUTOMATED CONVERSION OF THIS DOCUMENT, SHALL BE AT THE USER'S SOLE RISK WITHOUT LIABILITY OR LEGAL EXPOSURE TO TRC ENGINEERS, INC.
2. CONTRACTOR SHALL NOT RELY SOLELY ON ELECTRONIC VERSIONS OF PLANS, SPECIFICATIONS, OR DATA FILES THAT ARE OBTAINED FROM THE DESIGNERS OR OWNER, BUT SHALL VERIFY LOCATIONS OF PROJECT FEATURES IN ACCORDANCE WITH THE PAPER COPIES OF THE PLANS AND SPECIFICATIONS THAT ARE SUPPLIED AS PART OF THE CONTRACT DOCUMENTS.
3. SYMBOLS AND LEGENDS OF PROJECT FEATURES ARE GRAPHIC REPRESENTATIONS, AND ARE NOT NECESSARILY SCALED TO THEIR ACTUAL DIMENSIONS OR LOCATIONS ON THE DRAWINGS. THE CONTRACTOR SHALL REFER TO THE DETAIL SHEET DIMENSIONS, MANUFACTURER'S LITERATURE, SHOP DRAWINGS, AND FIELD MEASUREMENTS OF SUPPLIED PRODUCTS FOR LAYOUT OF THE PROJECT FEATURES.

GENERAL NOTES:

1. CROSSING DESIGNS DEPICTED IN THESE PLANS MAY CHANGE IN RESPONSE TO OWNER-SPECIFIC REQUIREMENTS IDENTIFIED DURING ANY ONGOING NEGOTIATIONS. IF NECESSARY, A CHANGE NOTICE WILL BE SUBMITTED AS NEEDED TO UPDATE THE PLANS.
2. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE ALL NECESSARY CONSTRUCTION NOTIFICATIONS, PERMITS AND ACTIVITIES WITH THE CERTIFICATE HOLDERS PRIOR TO AND DURING CONSTRUCTION.
3. LOCATIONS OF EXISTING FACILITIES SHOWN ARE APPROXIMATE. CONTRACTOR TO LOCATE AND/OR CONFIRM THE LOCATIONS AND DEPTH OF ALL UTILITIES, PIPELINES OR OTHER OBSTACLES PRIOR TO EXCAVATION. THE CONTRACTOR SHALL NOTIFY THE OWNER AND ENGINEER AND OF A NY UTILITY FOUND THAT MAY AFFECT THE DESIGN DEPICTED HEREIN.
4. CONTRACTOR TO CONTACT THE NEW YORK 811 OR DIG SAFELY NEW YORK, STATE ONE CALL SYSTEM AT LEAST 72 HOURS PRIOR TO CONSTRUCTION.

STATE OF NEW YORK — SHARON LENZ BURKE — 066651 — LICENSED PROFESSIONAL ENGINEER

Sharon L. Burke

REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

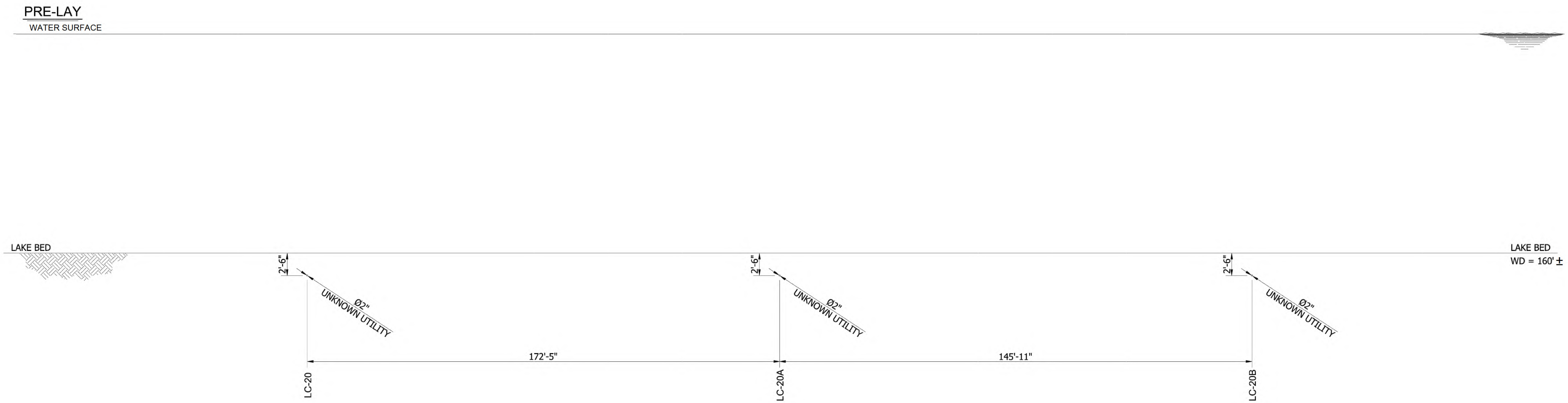
NO.	DESCRIPTION	DATE	DRAWN	CHK	APPR

DRAWING APPROVALS

	DATE
DRAWN: LC	8/25/2023
CHECKED: GJR	8/28/2023
ENGINEER: SB	8/30/2023

CHPE - CROSSING PROTECTION PLANS
LAKE CHAMPLAIN
CROSSING LC-20 20A 20B

SCALE	PROJECT NO.	DRAWING NO.	SHT.NO.
AS NOTED	532345	LC-20 20A 20B	1



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FIRM REGISTRATION NO.:
NY 0010187

PREPARED FOR:
NKT
We connect a greener world

STATE OF NEW YORK · SHARON LENZ BURKE · 066651 · LICENSED PROFESSIONAL ENGINEER

Sharon L. Burke

REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	DESCRIPTION	DATE	DRAWN	CHK	APPR

DRAWING APPROVALS

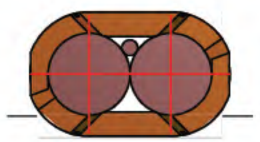
	DATE
DRAWN	DATE
LC	8/25/2023
CHECKED	DATE
GJR	8/28/2023
ENGINEER	DATE
SB	8/30/2023

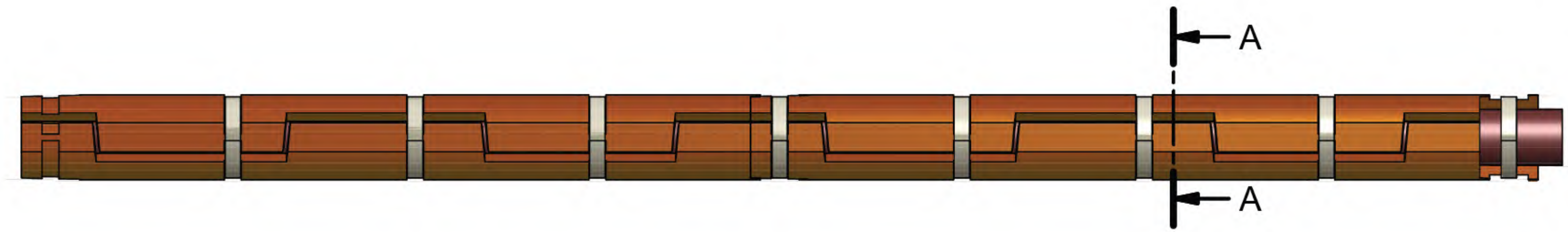
CHPE - CROSSING PROTECTION PLANS
LAKE CHAMPLAIN
CROSSING LC-20 20A 20B

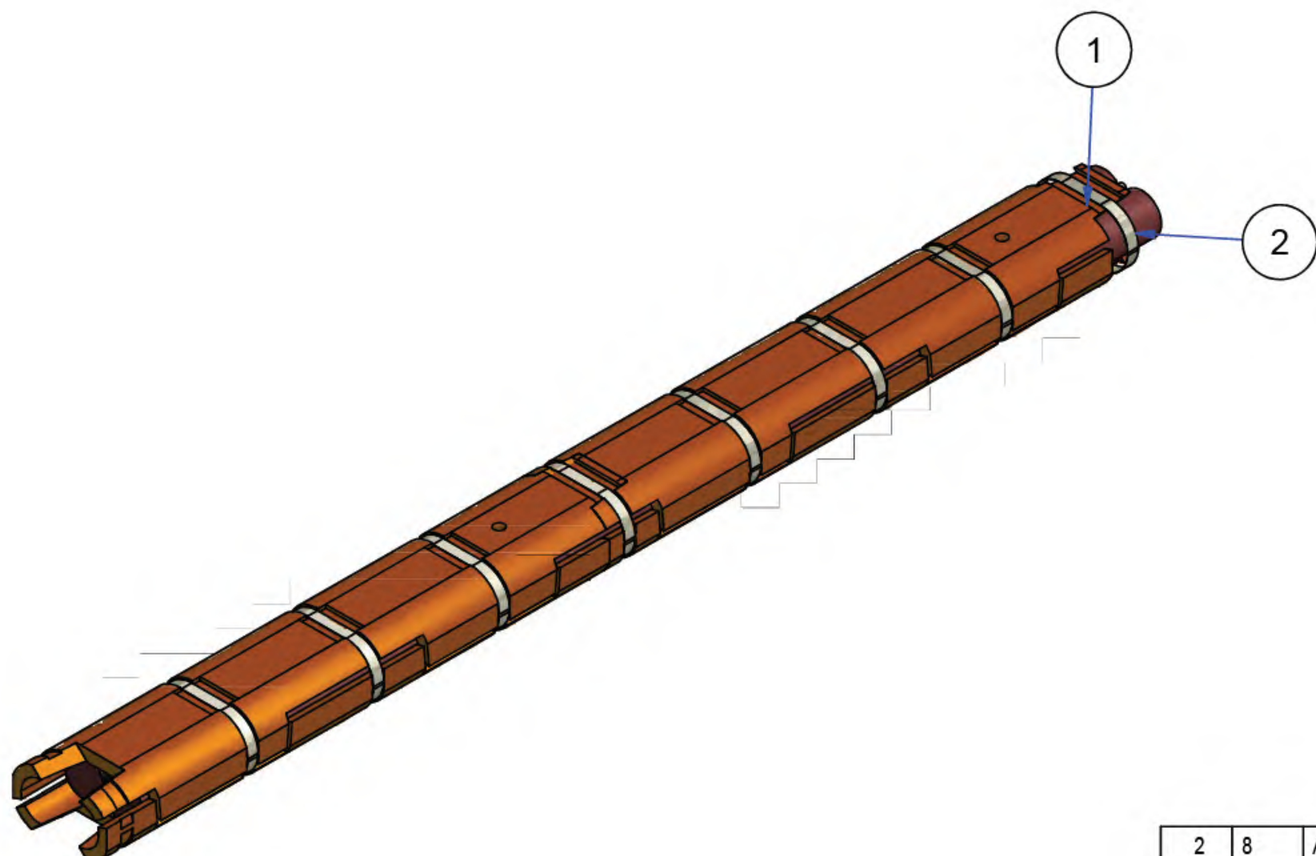
SCALE	PROJECT NO.	DRAWING NO.	SHT.NO.
NTS	532345	LC–20 20A 20B	2

APPENDIX B. URAGUARD DUCT SYSTEM

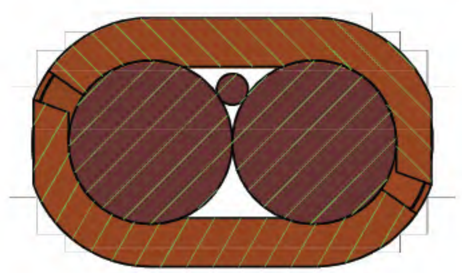
[1 Pages]







A-A (1 : 5)



ITEM	QTY	DESCRIPTION	MEASUREMENTS	DWG-NO.	MATERIAL/REMARKS	MASS
2	8	ALLOY STRAPPING	31,75x0,8 L= 1100 (NET CIRC. 750+350		ALLOY 625, SILVER	0,1 kg
1	4	URAGUARD BUNDLED Ø115x2	1620x279.4x117.4	88F11577-Q	PU, ORANGE SHORE 85A	15,9 kg

PROPRIETARY & CONFIDENTIAL

REV	DATE	BY	DESCRIPTION	CHK	APPR
02	4-6-2012	GL	EXTRA STRAPRECESSES	AW	AvB
01	21-3-2012	GL	UPDATE DESIGN	AW	AvB
00	12-1-2012	MS	FIRST ISSUE	AW	

TITLE: URAGUARD-BUNDLED CABLES Ø115x2 mm

SUBJECT: ASSEMBLY, 2X DC + FO CABLE

PROJECT:

CLIENT:

DWG.NO.:

REV: 02

PARTNO.:

SHEET: 1 OF 1

SCALE: 1:10

UNITS: MM

SIZE: A3

PROJ. METHOD

COMMENTS:

TOLERANCES UNLESS SPECIFIED: DIMENSIONAL: ±2% WEIGHT: ±10% < 5 kg > ±5%

Lankhorst Mouldings Sneek Holland

APPENDIX C. SURVEY DATA

[28 Pages]

7.2.3 MP23.7 – CM3

NAVD88 elevations in Area CM3 ranged from -70.30 to -100.53 ft (Figure 28). This area was generally shallower along the western extents. Of the eight (8) alignments in the area, four were not clearly defined on the surface in the MBE grid (Figure 29). The other four alignments (CM3_05 through CM3_08), noted to be the NYPA cables, were only clearly seen in the MBE dataset (Figure 30).

Magnetometer and SBP data indicated the presence of four (4) alignments in the area (Table 14). The 4 alignments were clearly defined in the magnetic data (Figure 31), and SBP data showed significant subsurface disturbance in these areas. The alignment CM3_04 was noted near the expected location of the Vermont Telephone fiber optic cable. Information provided by TDI suggested the cable was originally surface laid on the lakebed. The geophysical sensors did not indicate the cable was laid on the surface, but this cannot be completely ruled out. There are quite a few cables crossing in this area, and sensors showed substantial subsurface disturbance. It is possible that the Vermont cable is covered by only a few inches of silt/sediment. However, based on the MAG alignment noted here, the most likely candidate was selected for DoB measurement (4-7ft across the alignment).

Just like CM1 and CM 2, SBP showed that consolidated bedrock was present 5-15 ft below the natural lakebed and just below some very well defined sub-horizontal sediment bedding. A disconformity between the sediment and interpreted crystal basement was seen in the SBP data (Figure 32). In this area specifically, the thickness of the sediment over the bedrock had grown to the point where no significant outcrops of bedrock were noted in the area. There was at least 5 ft of sediment overlying the bedrock in this area. Additionally, the transitional layer between the sediment and crystal basement increased in thickness. The disconformity in places was not well defined at all, and significant structural features were seen in the bedrock. The bedrock near the disconformity was less competent than in CM1 and CM2, but still present below this transition.

Lakebed sediments in this area showed a near homogenous surface of medium reflective intensity. Some lineation of higher intensity were seen, but it was dramatically different than the lakebed composition found in CM1 and CM2. The surface in this area could be considered completely sediment.

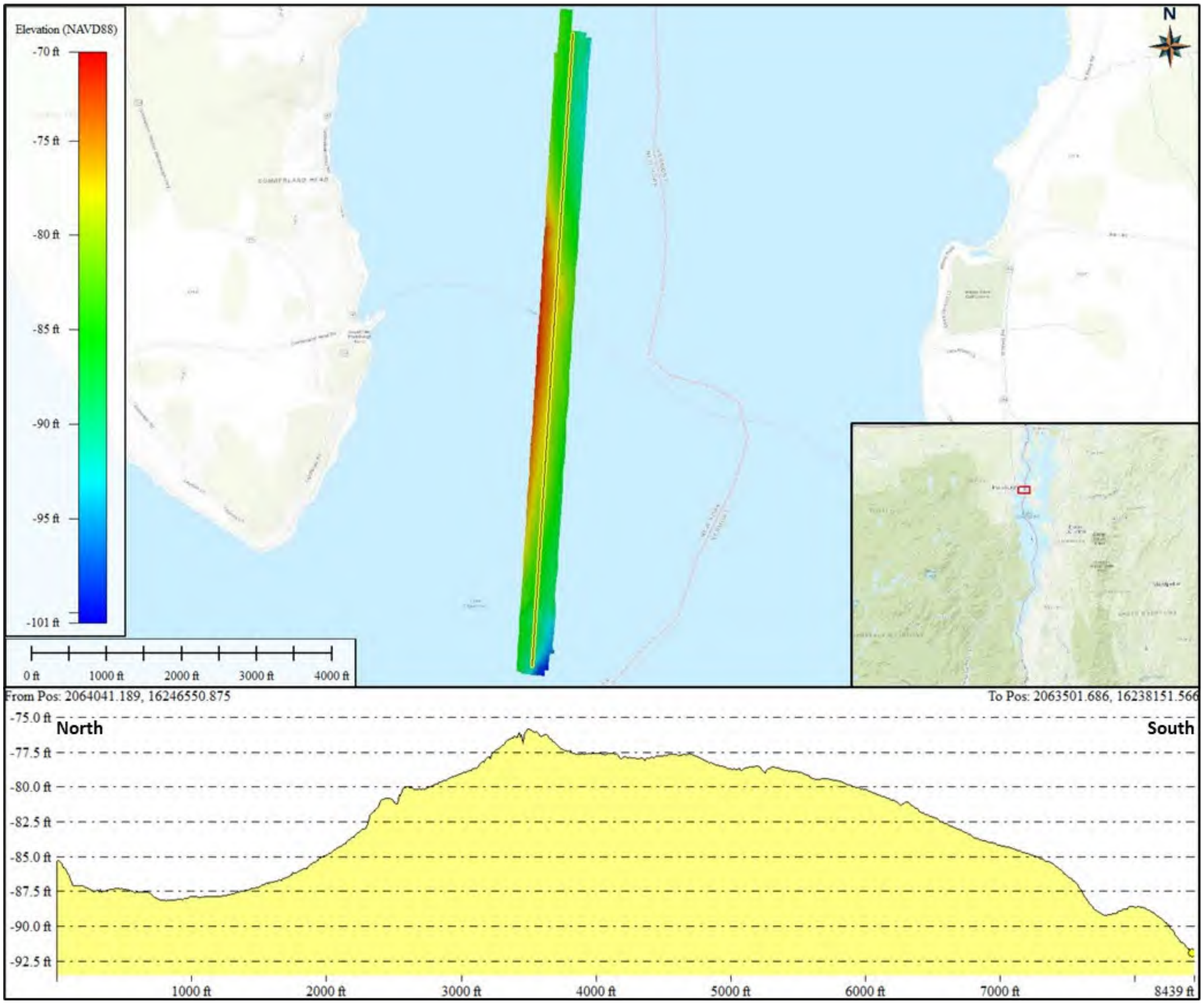


Figure 28. Bathymetric Grid and Profile for Area CM3

[redacted]

Figure 29. Location of the four (4) alignments in CM3, nonvisible in the MBE grid

[redacted]

Table 14. Alignments Found in the Area CM3, MP23.7

NAME	AREA	COMMENTS	DETECTED	POSITIONED	DoB WEST	DoB MID	DoB EAST
CM3_01	LC-20	N/A	MAG, SBP	MAG	5.25	8.86	7.55
CM3_02	LC-20A	TWO ANOMALIES IN RECORD IN EAST, TWO POSSIBLE BURIAL DEPTHS	MAG, SBP	MAG	2.59	UNKNOWN	4.1 or 11.48
CM3_03	LC-20B	N/A	MAG, SBP	MAG	2.46	UNKNOWN	7.55
CM3_04	CM3	N/A	MAG, SBP	MAG	3.58	6.23	7.22
CM3_05	CM3	CONVOLUTED MAG/SBP, UNABLE TO RELIABLY CONFIRM	MBE	UNKNOWN	MBE	UNKNOWN	UNKNOWN
CM3_06	CM3	CONVOLUTED MAG/SBP, UNABLE TO RELIABLY CONFIRM	MBE	UNKNOWN	MBE	UNKNOWN	UNKNOWN
CM3_07	CM3	CONVOLUTED MAG/SBP, UNABLE TO RELIABLY CONFIRM	MBE	UNKNOWN	MBE	UNKNOWN	UNKNOWN
CM3_08	CM3	CONVOLUTED MAG/SBP, UNABLE TO RELIABLY CONFIRM	MBE	UNKNOWN	MBE	UNKNOWN	UNKNOWN

[redacted]

Figure 31. MAG ASIG for Area CM3

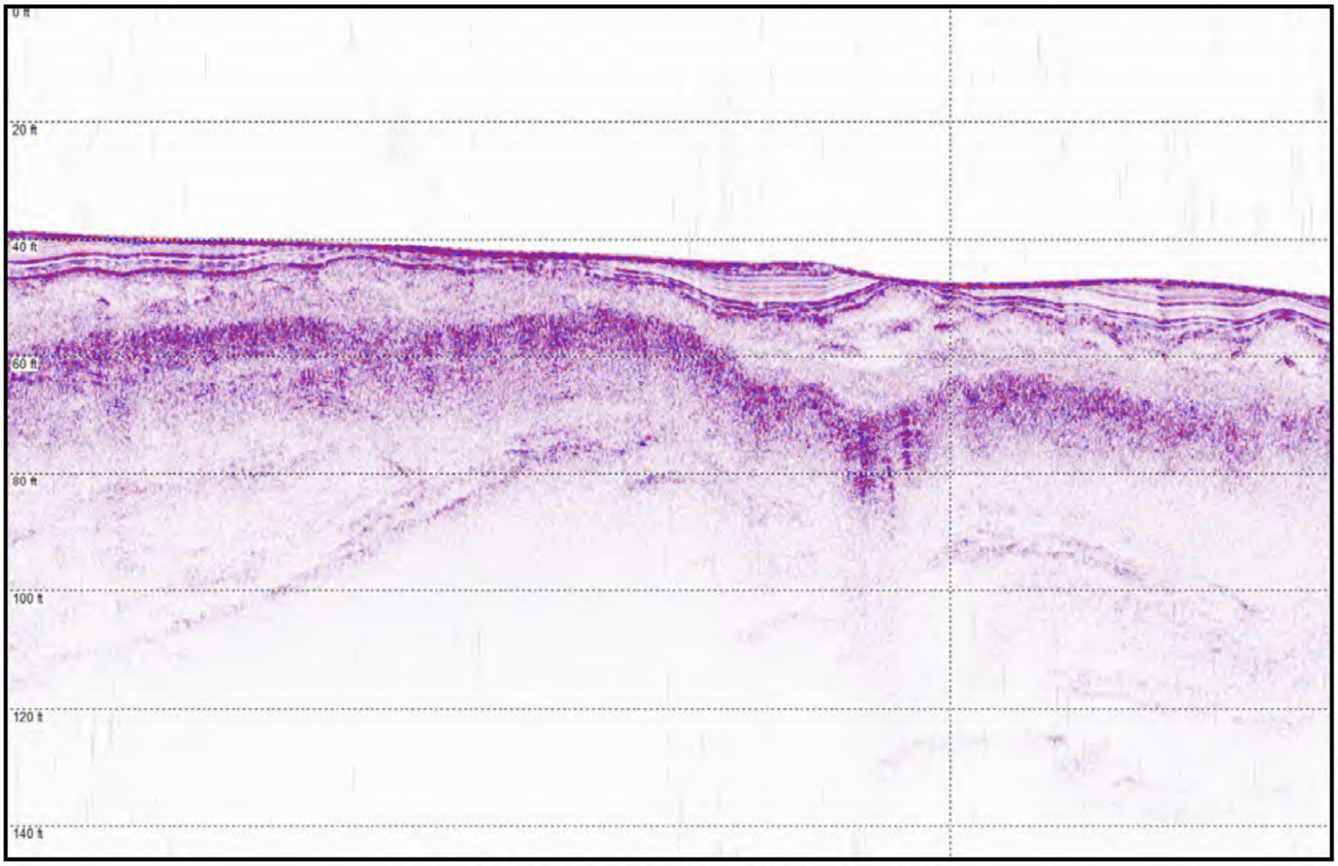


Figure 32. Representative SBP Profile in Area CM3 (0528-YT_JD131_CM300_20230511_163505_MF_CH0_LF-CH1.sgy)

[redacted]

Figure 33. Backscatter Mosaic for Area CM3

[redacted]

LOCALITY PLAN

GEODETIC PARAMETERS

GRID PROJECTION	UTM 18 NORTH
HORIZONTAL DATUM	NAD83 (2011) 2010.00 EPOCH
ELLIPSOID	GRS80
UNITS	U.S. SURVEY FEET
VERTICAL DATUM	NAVD 88
GEOID MODEL	GEOID 12B

GENERAL NOTES

1. ELEVATIONS ARE IN FEET AND ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88) DATUM.
2. NAVIGATION CORRECTIONS PROVIDED BY SMARTNET REAL-TIME SERVICE AND POST-PROCESSED USING APPLANIX POSPAC SMARTBASE SOLUTION. HORIZONTAL AND VERTICAL POSITIONS ARE REFERENCED TO THE NATIONAL SPATIAL REFERENCE SYSTEM (NSRS) AS PROVIDED TRIMBLE SMARTNET CONTINUOUSLY OPERATING REFERENCE STATIONS (CORS).
3. BACKGROUND IMAGES OBTAINED FROM NOAA AND DEPICT APPROXIMATE SHORELINE LOCATION FOR REFERENCE ONLY. DEPTHS REFERENCED ON THESE IMAGES ARE SUPERCEDED BY BATHYMETRY DATA COLLECTED DURING THIS SURVEY AND ARE NOT REFERENCED TO PROJECT DATUM .
4. THE INFORMATION PRESENTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS PERFORMED BY S.T. HUDSON ENGINEERS, INC. IN APRIL AND MAY 2023, AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO STHE.
5. ALIGNMENT LOCATIONS AND DEPTH OF BURIAL WERE DETERMINED THROUGH GEOPHYSICAL INVESTIGATION AND INTERPRETATION OF MAGNETIC AND SUB-BOTTOM ACOUSTIC DATA. ALIGNMENT AND DEPTH OF BURIAL ARE REPORTED AS THE COLLECTION OF ANOMALIES MOST LIKELY TO REPRESENT THE POTENTIAL ASSETS. INCLUSION OF REPRESENTATIONS OF ANOMALIES (TARGET LOCATIONS, CABLE LOCATIONS, HAZARDS, INFRASTRUCTURE, DEBRIS, ETC.) AT A SPECIFIC LOCATION DOES NOT INDICATE OR SUGGEST THE ABSENCE OF HAZARDS, ANOMALIES, INFRASTRUCTURE, APPURTENANCES, AND OTHER OBJECTS ON OR BENEATH THE SEABED IN ANY OTHER LOCATION.
6. MAGNETIC ANALYTIC SIGNAL (ASIG) SHOWN HEREON IS THE DIFFERENTIAL GRADIENT OF MAGNETIC FIELD STRENGTH WITH RESPECT TO DISTANCE AND REPORTED IN NANOTESLAS PER FOOT.
7. SUB-BOTTOM PROFILES ACQUIRED ALONG SURVEY PATHS SHOWN AND MAY REFLECT SOME DISCREPANCIES DUE TO HORIZONTAL DIRECTIONAL CHANGES OF SURVEY PATHS.

REVISION	DATE	DESCRIPTION
REV0	6/21/23	DRAFT FOR INITIAL REVIEW
REV1	7/07/23	ALIGNMENTS CM3–05 TO CM3–08 ADDED

SCALE: 1"=300'

300 0 300 600 900

CHECK GRAPHIC SCALE BEFORE USING

ALIGNMENT DATA:

NAME	POSITIONED BY	DETECTED BY	DEPTH OF COVER (FEET)			NOTES
			WEST	CENTER	EAST	
CM3_01	MAG	MAG, SBP	5.25	8.86	7.55	
CM3_02	MAG	MAG, SBP	2.59	Unknown	4.1 or 11.48	Two anomalies in record in East, two possible burial depths
CM3_03	MAG	MAG, SBP	2.46	Unknown	7.55	
CM3_04	MAG	MAG, SBP	3.58	6.23	7.22	
CM3_05	MBE	MBE	Unknown	Unknown	Unknown	Convoluted MAG/SBP, unable to reliably confirm
CM3_06	MBE	MBE	Unknown	Unknown	Unknown	Convoluted MAG/SBP, unable to reliably confirm
CM3_07	MBE	MBE	Unknown	Unknown	Unknown	Convoluted MAG/SBP, unable to reliably confirm
CM3_08	MBE	MBE	Unknown	Unknown	Unknown	Convoluted MAG/SBP, unable to reliably confirm

COLOR MAPPINGS:

MULTIBEAM BATHYMETRY (ELEVATION IN FEET)

–70' –75' –80' –85' –90' –95' –100'

MAGNETIC ANALYTIC SIGNAL (GRADIENT)

INCREASING (–) RATE OF CHANGE -->

<-- INCREASING (+) RATE OF CHANGE

LEGEND:

MAJOR CONTOURS (10' INTERVAL)
MINOR CONTOURS (2' INTERVAL)
ALIGNMENTS
MATCHLINES
325 MILE POST (APPROX. STATUTE MILES)
1190+00 ORIGINAL CHPE STATIONING
TP-041 ORIGINAL TURNING POINTS
ORIGINAL ROUTE CORRIDOR
PROPOSED NEW ROUTE
SBP SURVEY PATH

EQUIPMENT:

TYPE	MANUFACTURER/MODEL
MAGNETOMETER/TVG	GEOMETRICS G–882 (X2)
SUB–BOTTOM PROFILER	INNOMAR MEDIUM
MULTIBEAM ECHOSOUNDER	NORBIT WINGHEAD I77H

SUB-BOTTOM PROFILE NOTES

1. VERTICAL SCALE SHOWN ON SBP IMAGES INDICATES DEPTH BELOW BLANKING LINE SETTINGS AND IS NOT INDICATIVE OF RIVER BED DEPTH. DISCONTINUITIES, IF ANY, ARE THE RESULTS OF THE MODIFICATION OF THESE SETTINGS DURING DATA ACQUISITION.
2. SOME SBP ALIGNMENTS AND TARGETS MAY HAVE BEEN DISCERNED FROM PROFILES ADJACENT TO THE CENTERLINE PROFILES SHOWN HEREON.

ABBREVIATIONS:

ASIG – ANALYTIC SIGNAL (MAGNETIC)
CORS – CONTINUOUSLY OPERATING REFERENCE STATION
CHPE – CHAMPLAIN HUDSON POWER EXPRESS
GIS – GEOGRAPHIC INFORMATION SYSTEM
MAG – MAGNETOMETER
MBES – MULTIBEAM ECHOSOUNDER
NAD – NORTH AMERICAN DATUM
NAVD – NORTH AMERICAN VERTICAL DATUM
NGS – NATIONAL GEODETIC SURVEY
NOAA – NATIONAL OCEANIC AND ATMOSPHERIC ASSN.
NSRS – NATIONAL SPATIAL REFERENCE SYSTEM
SBP – SUB–BOTTOM PROFILER
STHE – S. T. HUDSON ENGINEERS
UTM – UNIVERSAL TRANSVERSE MERCATOR

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PLAN & PROFILE VIEW - SHEET 3

BATHYMETRIC AND GEOPHYSICAL SURVEY
CHPE LAKE CHAMPLAIN UTILITY INVESTIGATION
PORT DOUGLASS TO FORT MONTGOMERY, N. Y.

PROJECT MANAGER: SJM	SURVEY DATE: APRIL – MAY 2023	DRAWING: 23–076_LAKE_CHAMPLAIN_CHPE_TDI_N.DWG	
DRAFTED BY: PAS	DRAWING DATE: JULY 7, 2023	STHE PROJ. #: 23–076	SHEET: 3 OF 4

S. T. HUDSON ENGINEERS, INC.
PROFESSIONAL ENGINEERS & CONSULTANTS

CHPE Utility Investigation
Mobilization Report

Survey Date:

April – May 2023

Project:

23-076

Report Status:

Rev 0

Report for:

CHPE
Champlain Hudson Power Express

Report Authorization and Distribution

Authored: L. Andrews, L. Quas

Approved: S. MacDonald

Date	Rev	Description
5-June-2023	0	Issued for Initial Comment

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1 Project Summary

1.1 Mobilization Summary

The following report discusses the mobilization of the M/V *Yeti* by S.T. Hudson Engineers, Inc. (Hudson) for Champlain Hudson Power Express (CHPE) as part of the development of a potential cable route between Lake Champlain and the Hudson River. The mobilization was completed prior to the project operations and included two parts: a series of alongside checks in port and calibrations performed while underway near the survey area. The alongside mobilization and checks were completed at Atlantic Highlands, NJ and Liberty Landing Marina, NJ. All mobilization activities were completed and verified by March 10, 2023.

1.2 Personnel

The following project team has been assembled and have been assigned to the roles listed below for project execution for the duration of the project phase (Table 1).

Table 1. Hudson Project Management Team

Name	Role
William Jenkins	VP of Marine Services
Steven MacDonald	Project Manager
William Busey	Technical Manager
Lawrence Andrews	Lead Technical Advisor - Survey
Scott Hiller	Geophysical Manager
Lauren Quas	Data and Reporting Manager

The following personnel were present onsite during the mobilization of the survey vessel for the project (Table 2).

Table 2. Key Field Personnel

Name	Role
Konner Williams	Party Chief
Sean Singley	Vessel Captain
Sam Bright	Surveyor
Mark Carter	Surveyor

1.3 Survey Equipment

The following survey equipment and software were used for the survey aboard the M/V *Yeti* to complete the project (Table 3 and Table 4).

Table 3. Survey Equipment

Equipment Type	Equipment Model
Primary Navigation, Motion, & Heading	Applanix POSMV OceanMaster w/RTK; Supplemented with RTK
Position Corrections	PPK from VRS Network
Secondary Positioning System	Hemisphere Atlas GNSS
Online Navigation Suite	QPS Qinsy
Multibeam Echosounder	Norbit i77h
Magnetometer	Geometrics G-882
Sub-bottom Profiler	Innomar Medium
Sound Velocity Probe	AML-3
Cable Counter	Hydrographic Consultants TCount

Table 4. QA/QC Offline Software

Software Type	Software Make/Model
Overlap Data QC and integration	Blue Marble Global Mapper
Bathymetric Data	QPS Qimera
Magnetic Data	Oasis Montaj
SBP Data	CTI SonarWiz
Post-processed GNSS	Applanix POSPac (w/ PP-RTX service)

2 Vessel Configuration, Offsets, and Interfacing

The M/V *Yeti* is a custom-built research and survey platform designed to operate in the ultra-shallow nearshore and intra-coastal environment (Figure 1). With a cruising speed of 25 knots and less than 3' draft, the vessel can access a variety of survey areas. The vessel was mobilized with the survey equipment mentioned above in the configuration shown in Figure 2.

Figure 1. M/V *Yeti*

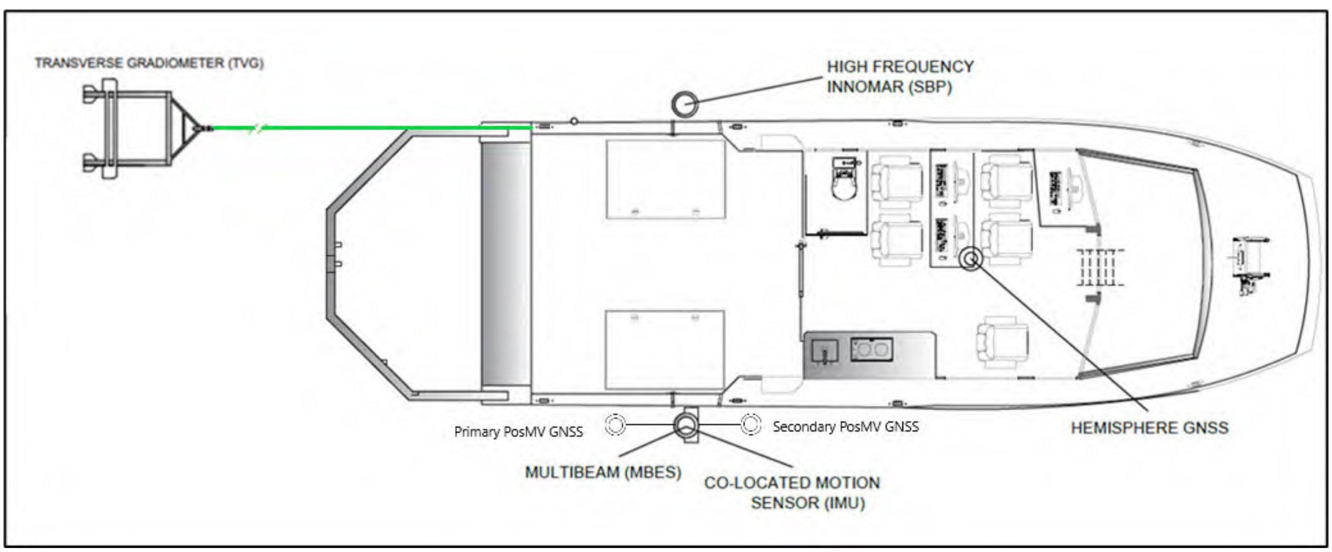

Figure 2. M/V *Yeti* Survey Configuration

2.1 Offsets

All equipment offsets were surveyed using a combination of conventional land survey techniques and ultra-high resolution 3D laser scanning. These offsets for primary equipment and vessel nodes are shown in Table 5.

Table 5. Survey Sensor Offsets

Survey Sensor Offsets			
FWD	**STBD**	**UP**	**Description**
0.000	0.000	0.000	Norbit MBE
0.000	0.000	0.000	Applanix POSMV Ref Pt (CRP)
0.029	0.000	0.027	Portus Pole Reference Point
-0.926	0.000	3.659	POSMV Primary Antenna
1.075	0.000	3.659	POSMV Secondary Antenna
2.602	-1.842	3.223	Hemisphere GNSS
-1.996	-3.595	-0.210	Innomar SBP
-3.964	-2.365	1.640	TVG Tow Pt

2.2 Navigation Suite Interfacing

Qinsy interfacing from the survey sensors was performed using serial and UDP connections as listed below in Table 6.

Table 6. QPS Qinsy I/O

Navigation – I/O QPS Qinsy	Settings
SBP – custom string	UDP
MAG Nav	Internal Qinsy Layback
MAG Data	9600/8/n/1
Applanix POS, HRP, HDT	UDP
MBE	UDP
ZDA PPS	UDP
GNSS Secondary	19200/8/n/1

3 Geodetic Parameters

All data were collected in NAD83 (2011) UTM Zone 18 North. Real-time Kinematic (RTK) corrections were received from the Trimble KeyNet VRS system over a cellular connection. Data were projected in UTM Zone 18 North and referenced to NAVD88 using NOAA's VDatum. Horizontal and vertical units were in US survey feet.

Table 7. Geodetic Parameters

Project Specific Geodetic Parameters	
Datum	NAD83 (North American Datum of 1983) – 2011
Ellipsoid	GRS 1980
Semi-Major Axis	a = 6878137.000 m
Semi-Minor Axis	b = 6356752.314 m
Conversion Factor to Meters	1.000000
Eccentricity	e = 0.0818191910435
Inverse Flattening	1/f = 298.257222101
Projection	Universal Transverse Mercator (North Oriented)
UTM Zone Number	18 N
Latitude of Grid Origin	0° N
Longitude of Grid Origin	75° W
False Easting (m)	500,000
False Northing (m)	0
Scale Factor at Natural Origin	0.9996
Vertical Datum	North American Vertical Datum of 1988 (NAVD88)

Offshore satellite based corrected GNSS systems operating in ITRF14 were transformed to real time coordinates in NAD83 (2011) in Qinsy. The transformation was time-dependent for the current date of collection.

4 Mobilization Acceptance Tests

The dockside and sea-trial acceptance tests were completed in accordance with industry best practices, manufacturers' recommendations, and Hudson's standard operating procedures.

4.1 Positioning

Primary navigation for the project was provided by the Applanix POSMV OceanMaster system (integrated into the Norbit MBE head) supplemented with PPK from the VRS network.

4.1.1 GAMS Calibration

The GAMS Calibration was completed three (3) times to ensure no bias or offset errors in the system (Table 8).

Table 8. GAMS Calibration Results versus DIMCON

GAMS Calibration		
	STBD	**UP**
DIMCON	0.000	2.000
GAMS 1	0.010	2.000
GAMS 2	0.010	2.010
GAMS 3	0.030	2.010
GAMS AVG	0.015	2.006
DELTA	0.015	0.006

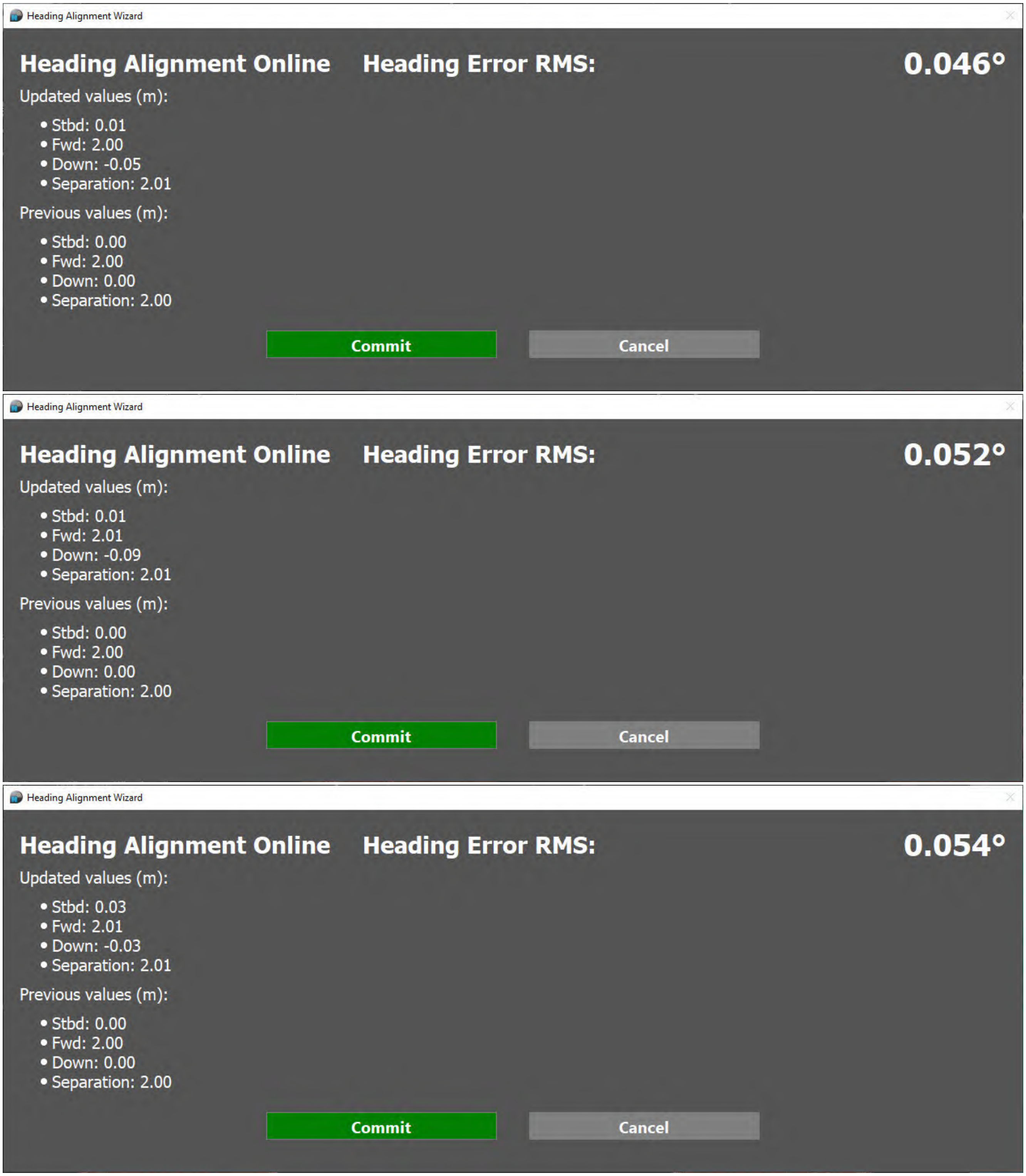

Figure 3. Online GAMS Calibration Results

4.1.2 Positioning Check

While at dock, data were recorded in QPS Qinsy at the M/V *Yeti* CoG output point using both the POSMV and the Hemisphere Atlas GNSS. Results are shown in Figure 4.

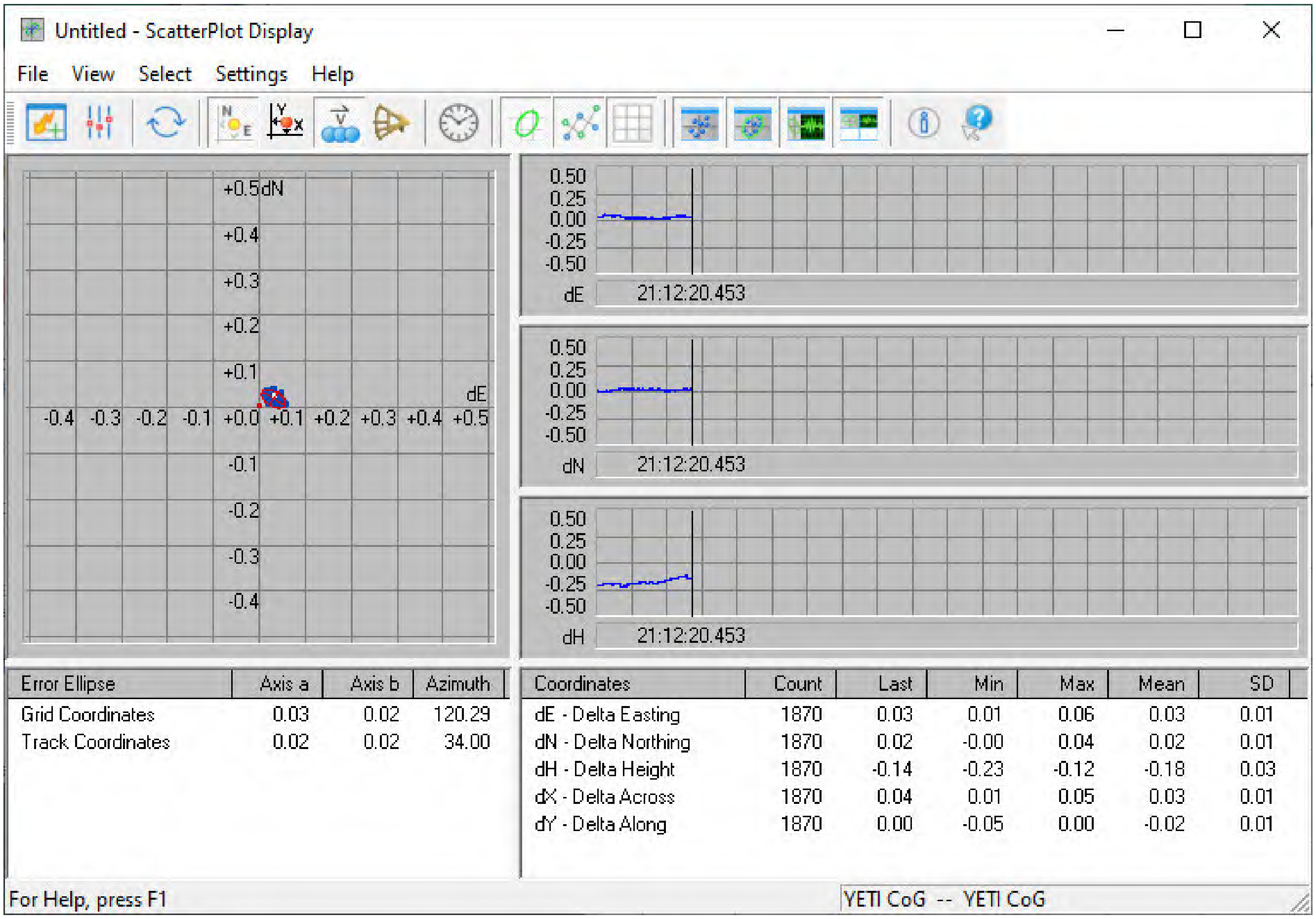

Figure 4. Primary v. Secondary Positions at M/V *Yeti* CoG

4.2 Multibeam Echosounder

The installed multibeam echosounder (MBE) on the vessel was a Norbit i77h (narrow 0.5° @ 400kHz) with fully integrated Applanix POSMV.

4.2.1 Patch Test

A patch test was performed on the M/V *Yeti* MBE system at a known location near the survey area. Two lead processors performed the patch test calibration in QPS Qimera; results showed good alignment between the two sets of results and were then averaged for final application in Qinsy. Table 9 shows the final patch values applied for the project. The integrated MBE/IMU were factory aligned and therefore required very little angular alignment.

Figure 5, Figure 6, and Figure 7 show the cross sections of the patch test results.

Table 9. Patch Test Results

Roll	Pitch	Yaw	Time Delay
-0.103°	0.176°	-0.04°	0.00s

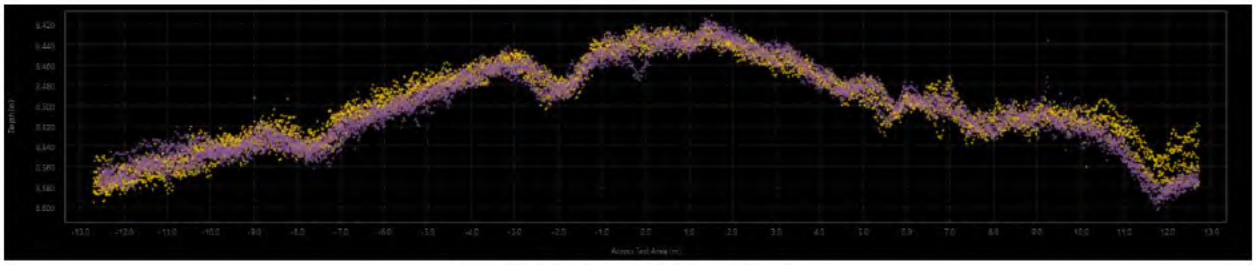

Figure 5. Norbit Roll Calibration

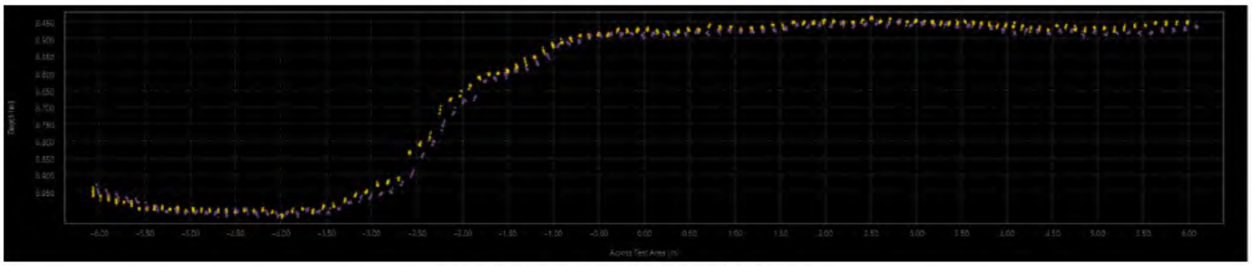

Figure 6. Norbit Pitch Calibration

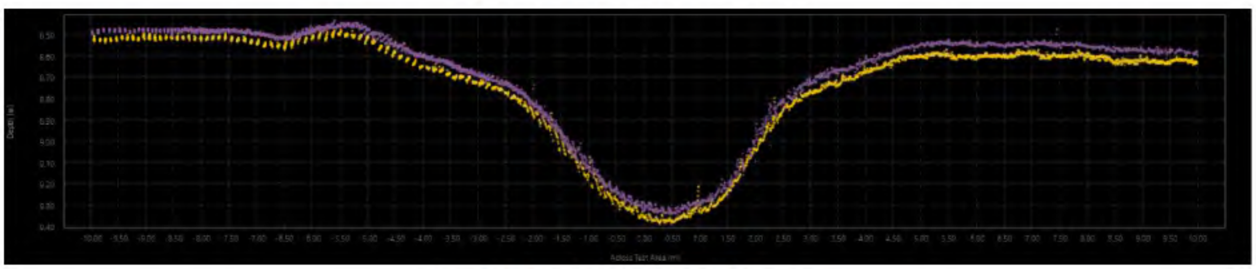

Figure 7. Norbit Heading Calibration

4.2.2 Draft Check

Alongside the dock, the MBE system was lowered into the water and data were recorded while simultaneously performing a measure down from a known point to the seafloor adjacent to the MBE. The data were used to determine an independent sounding to compare with real-time seafloor elevations (Table 10 and Figure 8).

Table 10. MBE Vertical Check

MBE Vertical Check	
Measurement	**Meters**
Measure Down Point to Seabed	4.981
MBE Seafloor Elevation	3.290
Measure Down Point to MBE Head	1.634
Computed Seafloor Elevation	4.924
Delta	**-0.057**

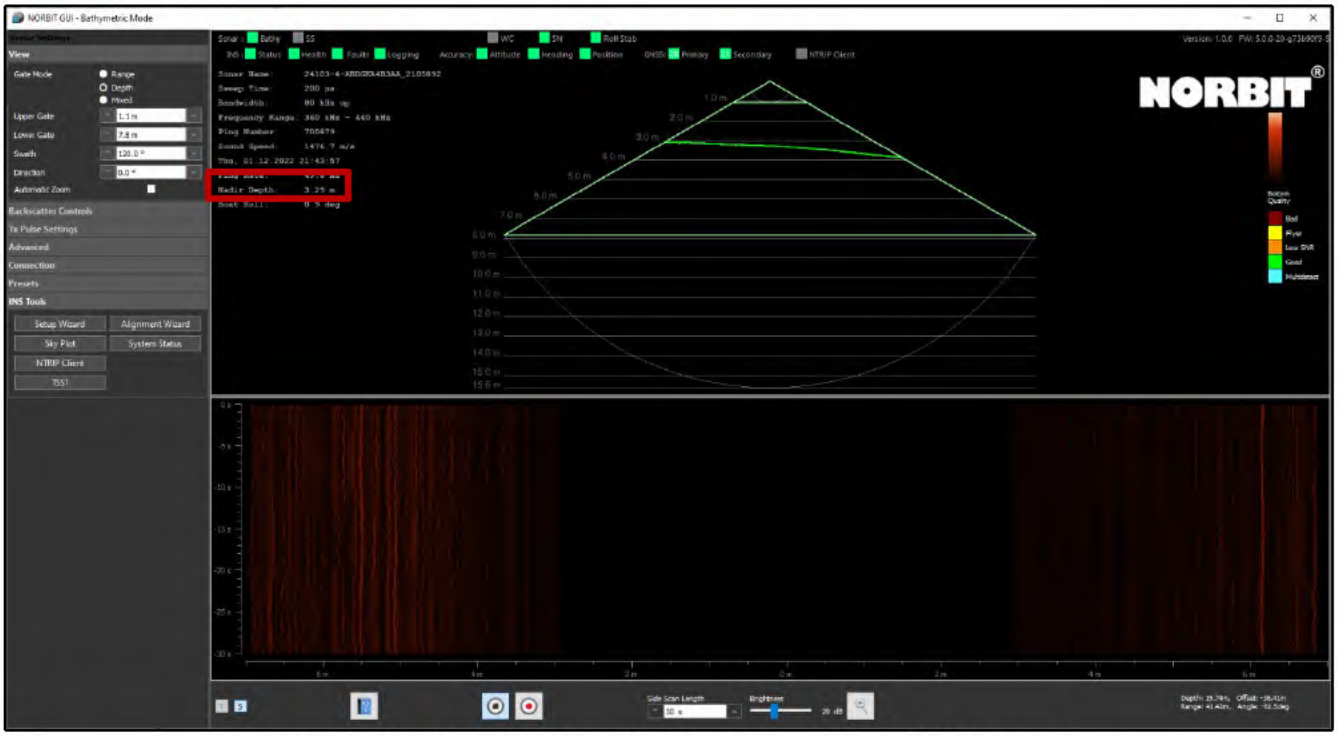

Figure 8. Screenshot of MBE Seafloor Elevation at Time of Recorded Measure Down

4.2.3 Sound Velocity

The AML-3 Sound Velocity Probe (SVP) was lowered near the Norbit MBE system alongside dock and recovered to the surface. The value of the SVP was compared to the reading from the AML SVS installed on the MBE system (Table 11).

Table 11. Sound Velocity Comparison

Sound Velocity Comparison	
System	**Reading at ~1m**
AML-3 SVP	1446.06 m/s
AML SVS (installed on MBE)	1445.90 m/s
Delta	**0.16 m/s**

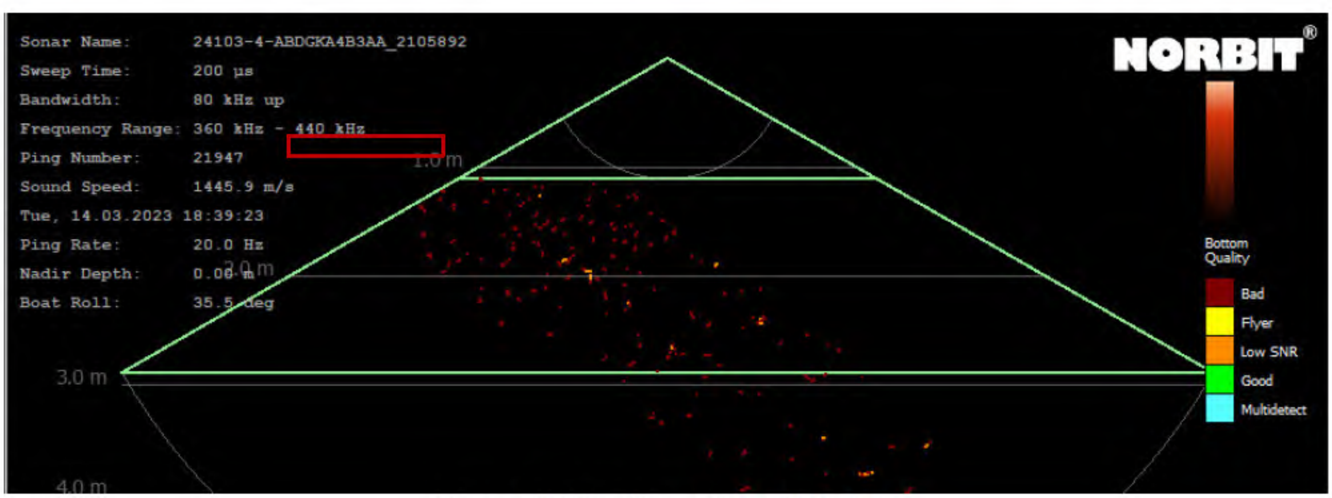

Figure 9. SVS Reading at Time of SVP Casts

4.2.4 Previous Data Comparison

Patch Test data were acquired over a known discrete feature provided by the client. Horizontal and vertical comparisons were made of the M/V *Yeti* data against the provided dataset with acceptable results.

Figure 10 shows the profile over the discreet feature, showing zero horizontal offset and an average vertical offset of less than 0.041m.

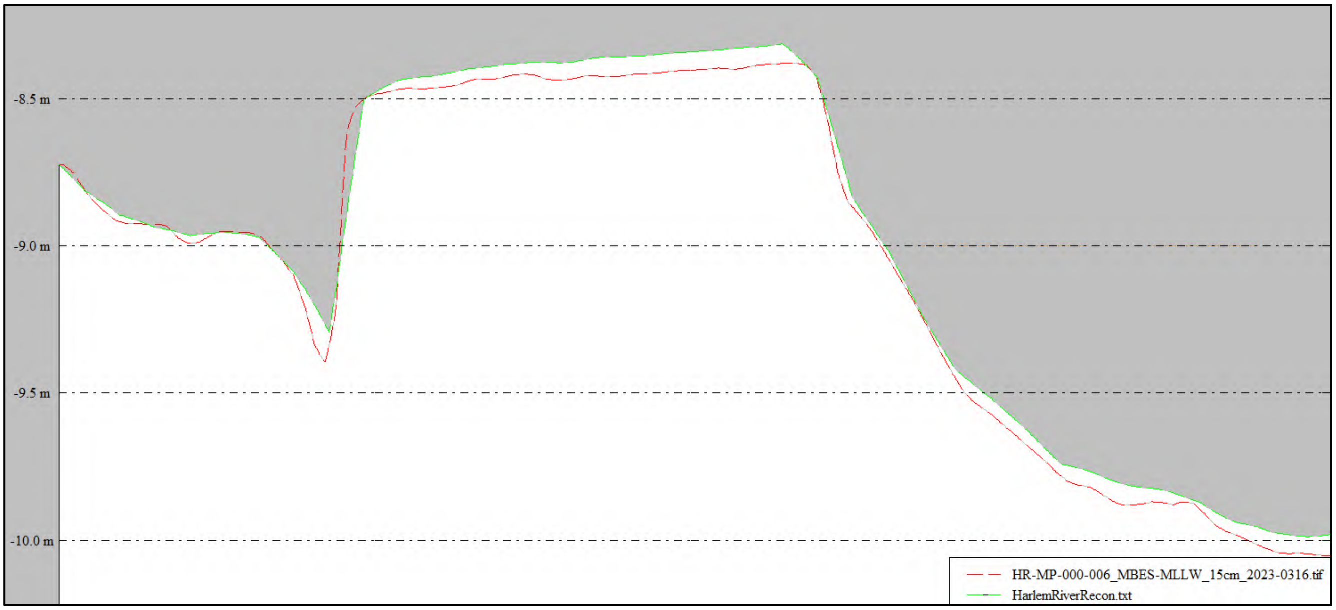

Figure 10. MBE Profile Comparison

4.3 Magnetometer

Two Geometrics' G-822 cesium vapor marine magnetometers in a Transverse Gradiometer (TVG) frame were utilized for the duration of the survey. A wrench test was performed to ensure the magnetometer was in proper working order on deck (Figure 11).

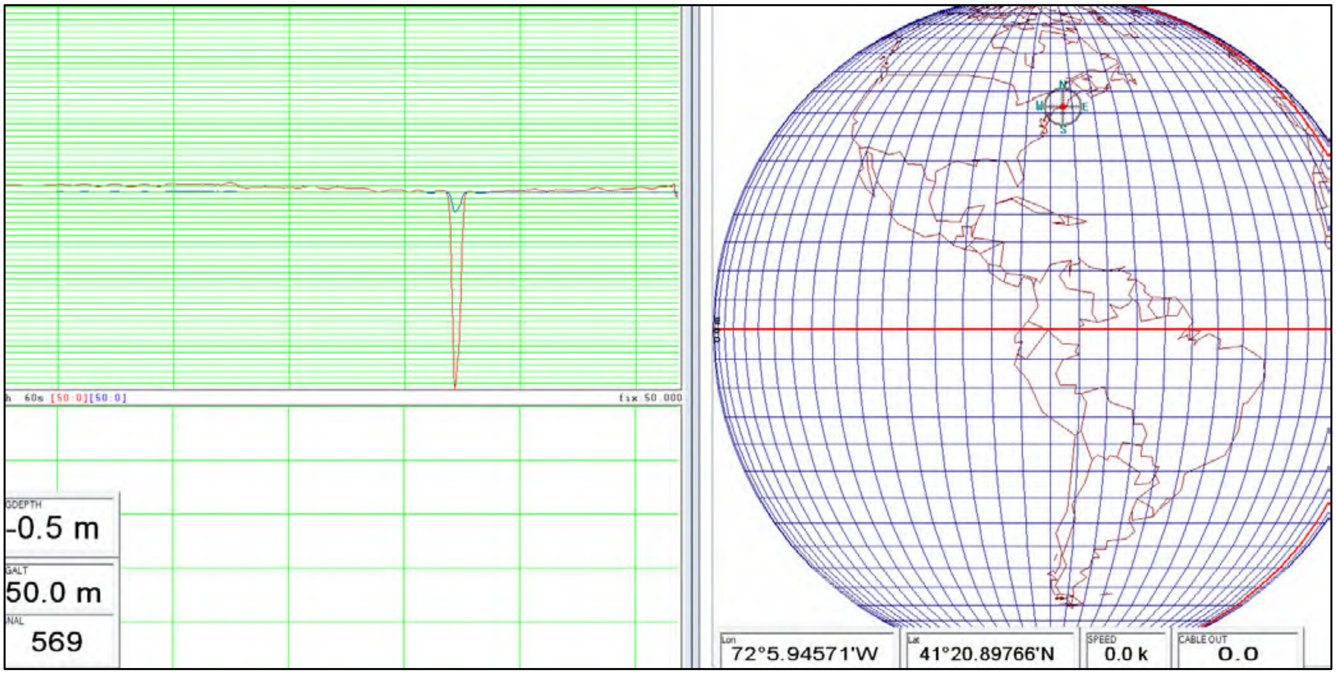

Figure 11. Geometrics G-882 Magnetometer Wrench Test

4.3.1 Altimeter and Depth Sensor Check

During magnetometer wet testing, the TVG was flown at approximately 4.5 m altitude down a shallow slope. The total water depth was recorded along with the MAG depth and altitude. The MAG depth and altitude were combined to compare against the total water depth (Figure 17).

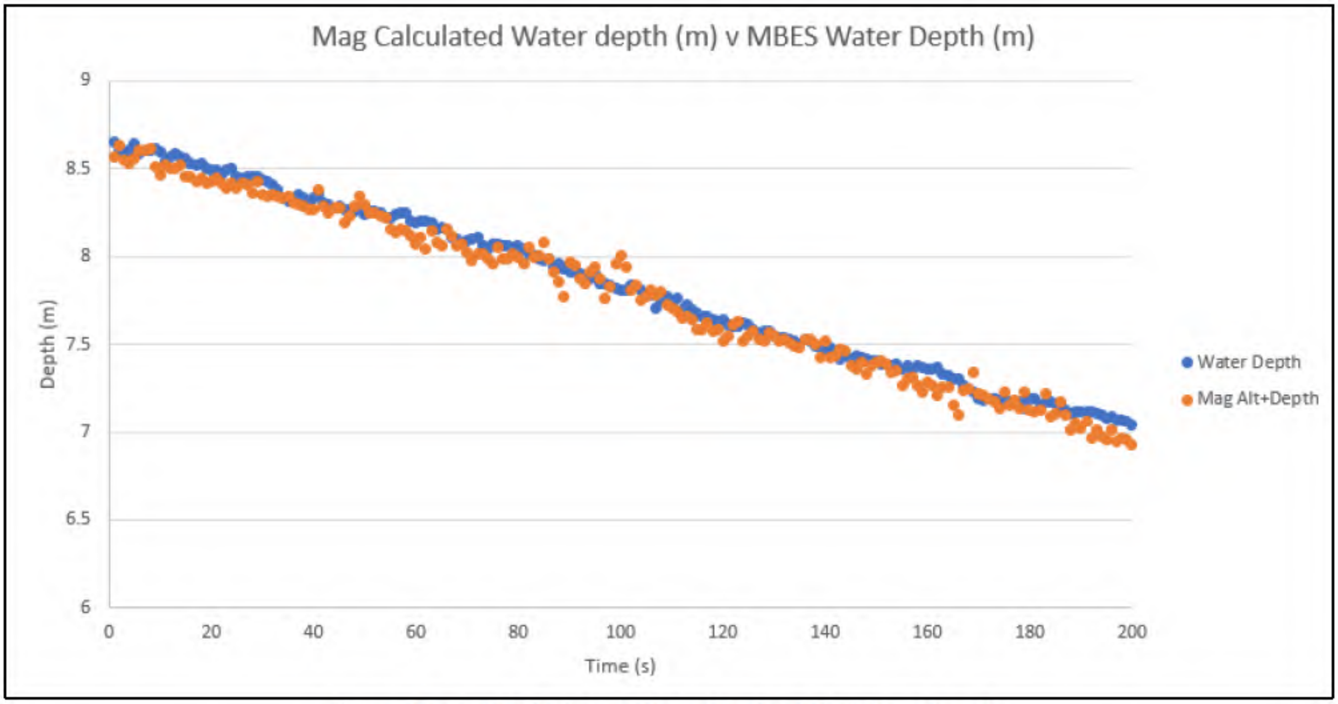

Figure 12. MAG Calculated Water Depth v MBE Water Depth

4.3.2 Position Test and Wet Test

At the calibration site near the survey area, the TVG was deployed, and a wet test completed while underway. Several reciprocal passes were made with the TVG over a strong linear anomaly. Data were logged while underway for five minutes prior to starting position check lines. Comparison of the anomaly center point positions are shown in Table 12. Anomaly alignment was offset due to the physical magnetometer offset during the trial.

Table 12. MAG Position Check

MAG Position Check						
Target	**Line 0006 X**	**Line 0006 Y**	**Line 0007 X**	**Line 0007 Y**	**Delta X (m)**	**Delta Y (m)**
1	580918.26	4497126.57	580922.81	4497128.01	-4.55	-1.43

S. T. HUDSON ENGINEERS, INC.
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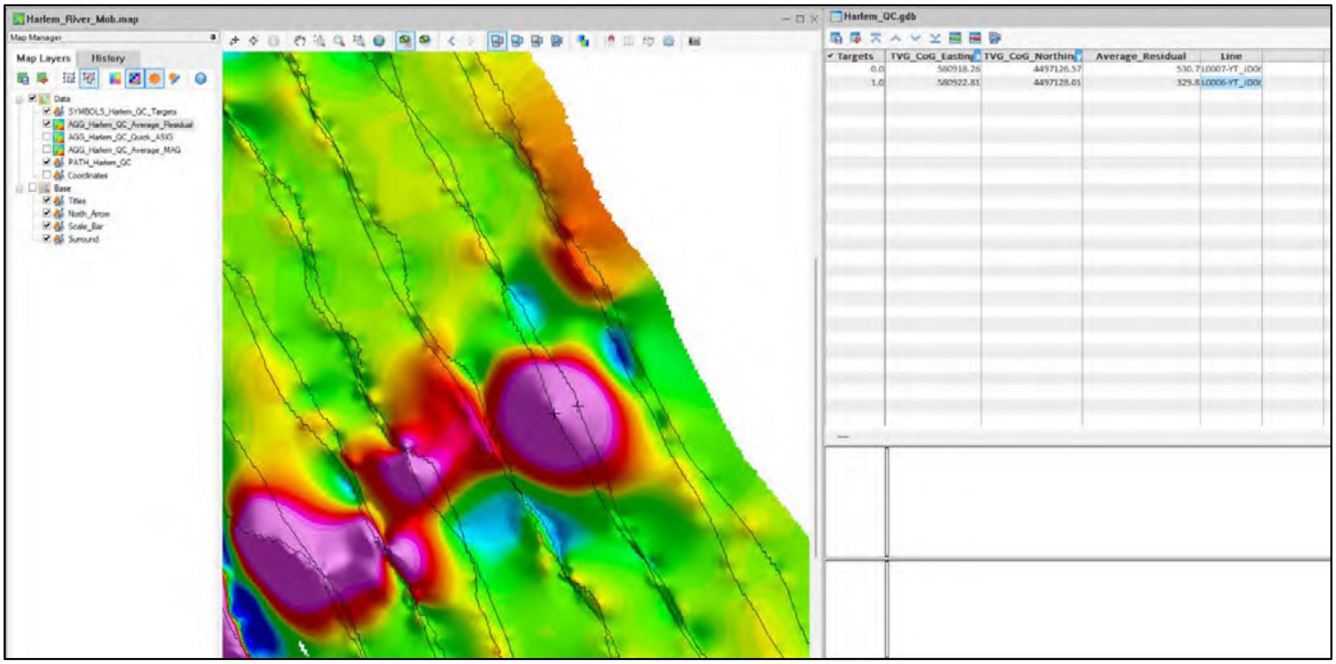


Figure 13. MAG Position Check – Grid Overview

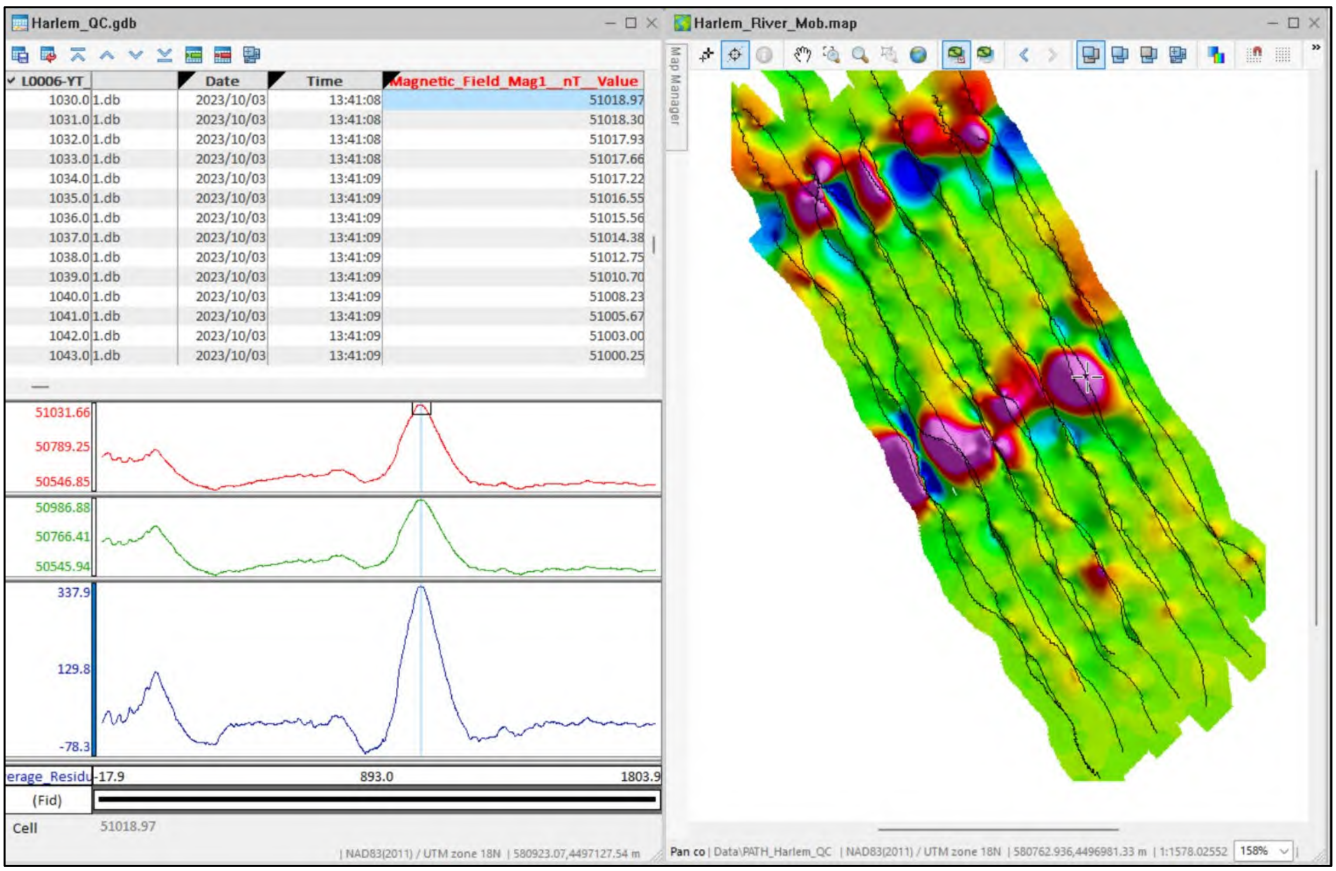


Figure 14. MAG Position Check – Line 0006

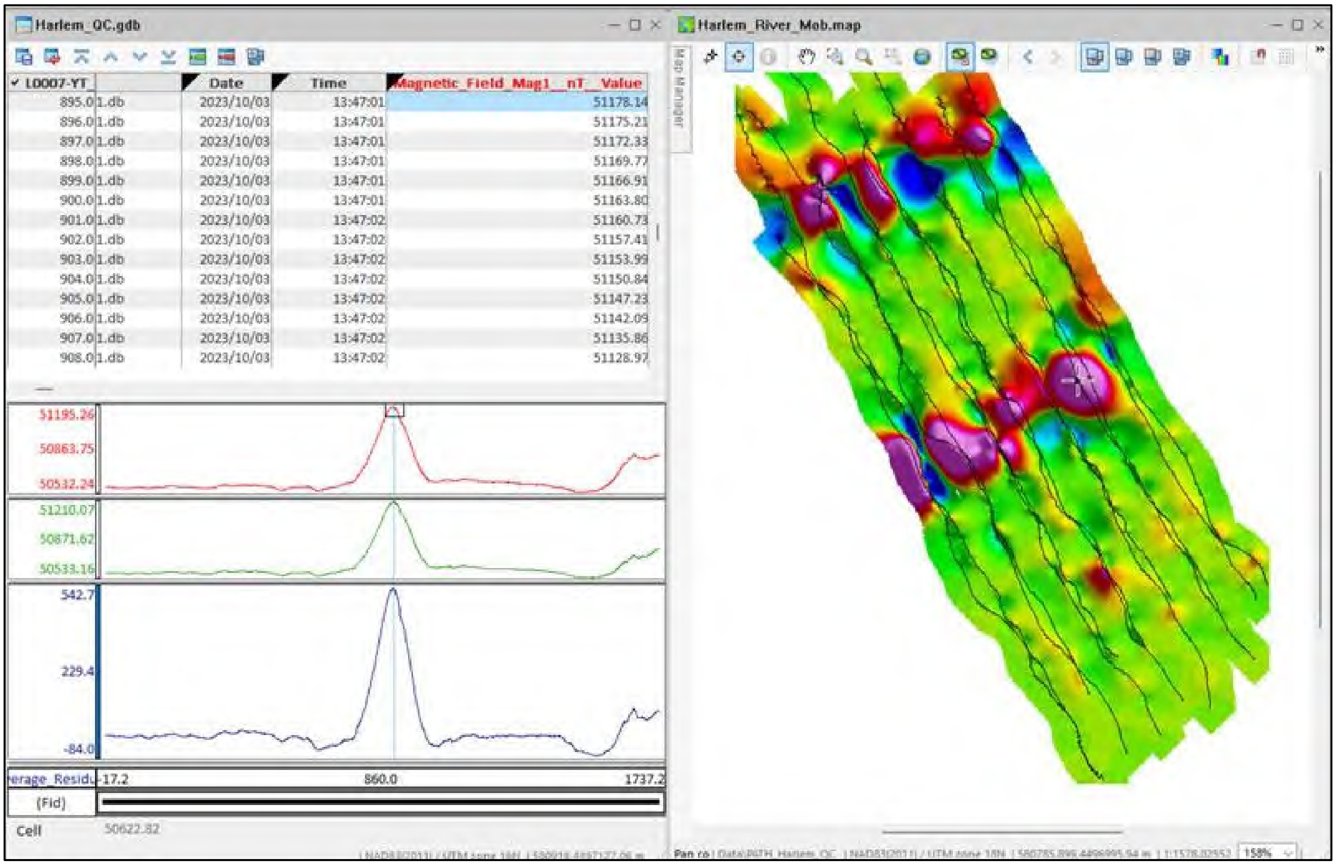


Figure 15. MAG Position Check – Line 0007

4.4 Sub-bottom Profiler

An Innomar Medium was utilized on the project as the sub-bottom profiler and was pole mounted to the port side gunwale of the vessel.

4.4.1 Wet Test

Data were acquired at survey specifications to ensure that data, time, heave, and navigation were received and logged properly (Figure 16).

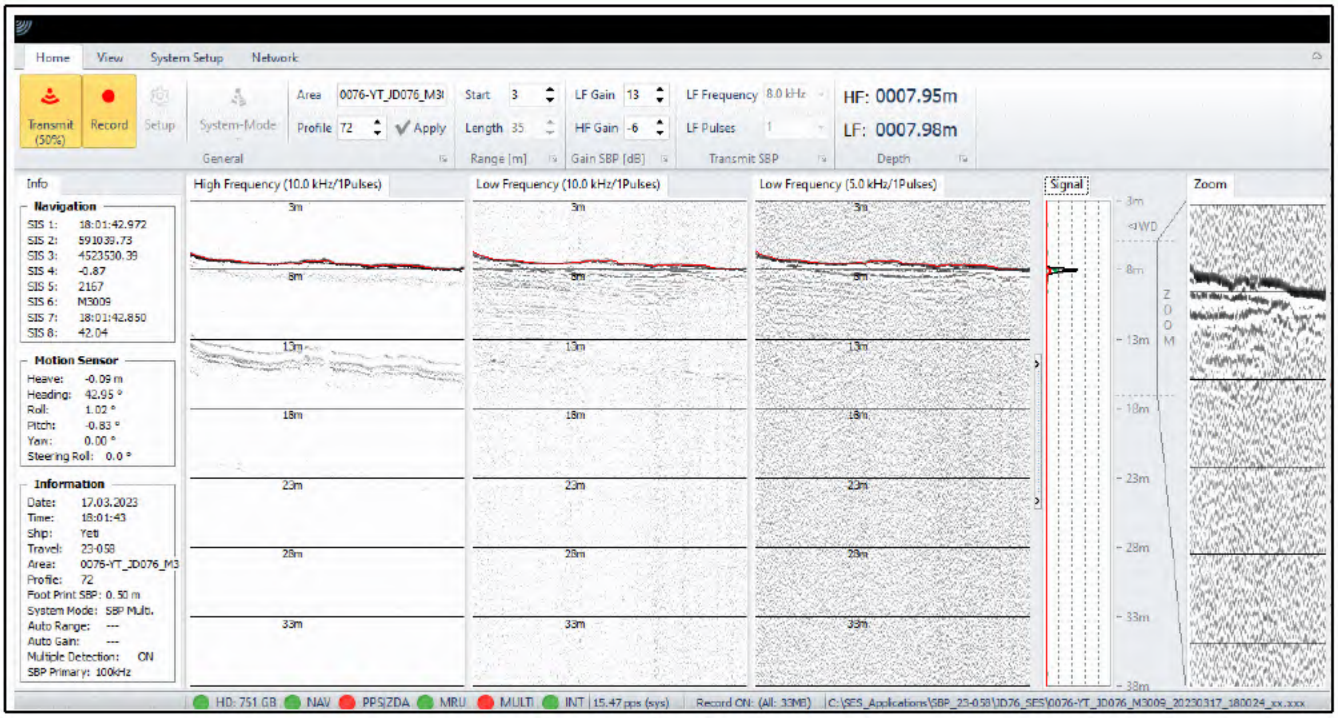


Figure 16. SBP Wet Test

4.4.2 Positional Verification

Reciprocal lines were run over a known linear target within the Hudson River while the system operated fully with all data being recorded (sonar, time, heave, navigation, and fix). The contact was picked on the SBP lines and compared against the magnetometer data (Table 13).

Table 13. SBP Position Check

MAG Position Check						
Target	**SBP X**	**SBP Y**	**MAG X**	**MAG Y**	**Delta X (m)**	**Delta Y (m)**
1	580829.28	4497204.64	580828.90	4497204.76	0.38	-0.12

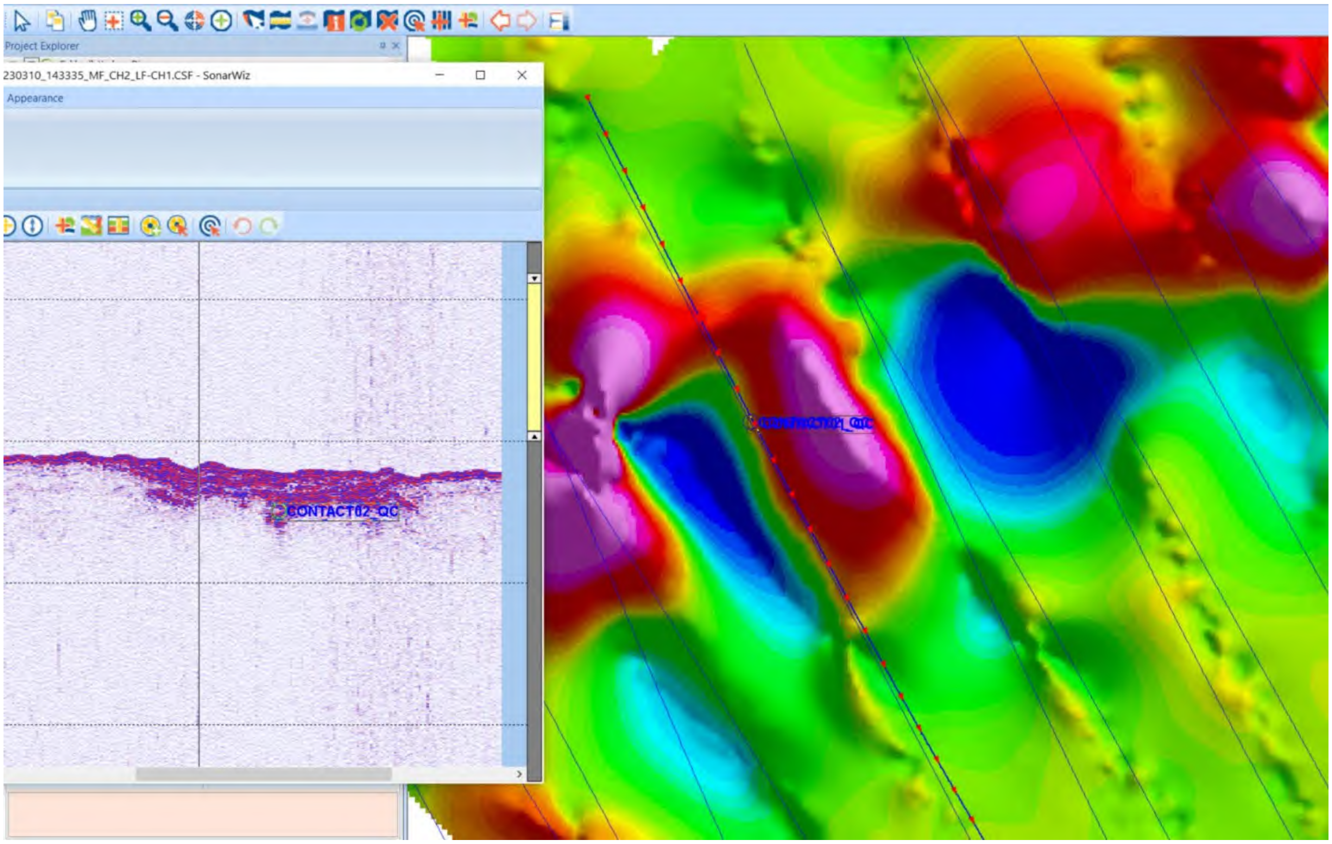


Figure 17. SBP Position Check against Magnetometer

4.4.3 Geological Assessment Test

SBP data were reviewed to assess interpretability to 10ft BSB (where acoustic penetration was achieved based on substrate conditions). Data quality demonstrated interpretability well below the 10ft requirement. (Figure 18).

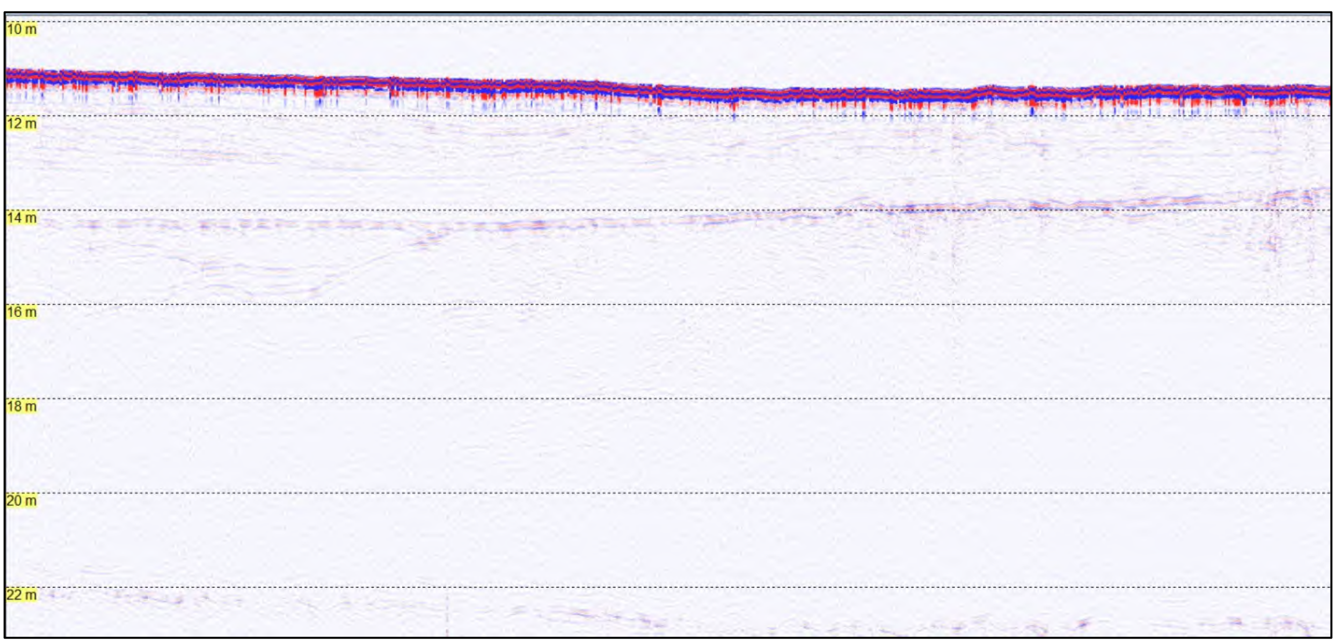


Figure 18. SBP Geological Assessment

4.4.4 Noise Test

No noise or interference was observed in the SBP from the other survey systems. The image below shows the wiggle trace of a subset of returns from the SBP (Figure 19). The seafloor return was observed as a thick black line due to the amplitude. The water column can be seen above and is acoustically quiet. No regular or chaotic noise was observed within the WC or after the seafloor return.

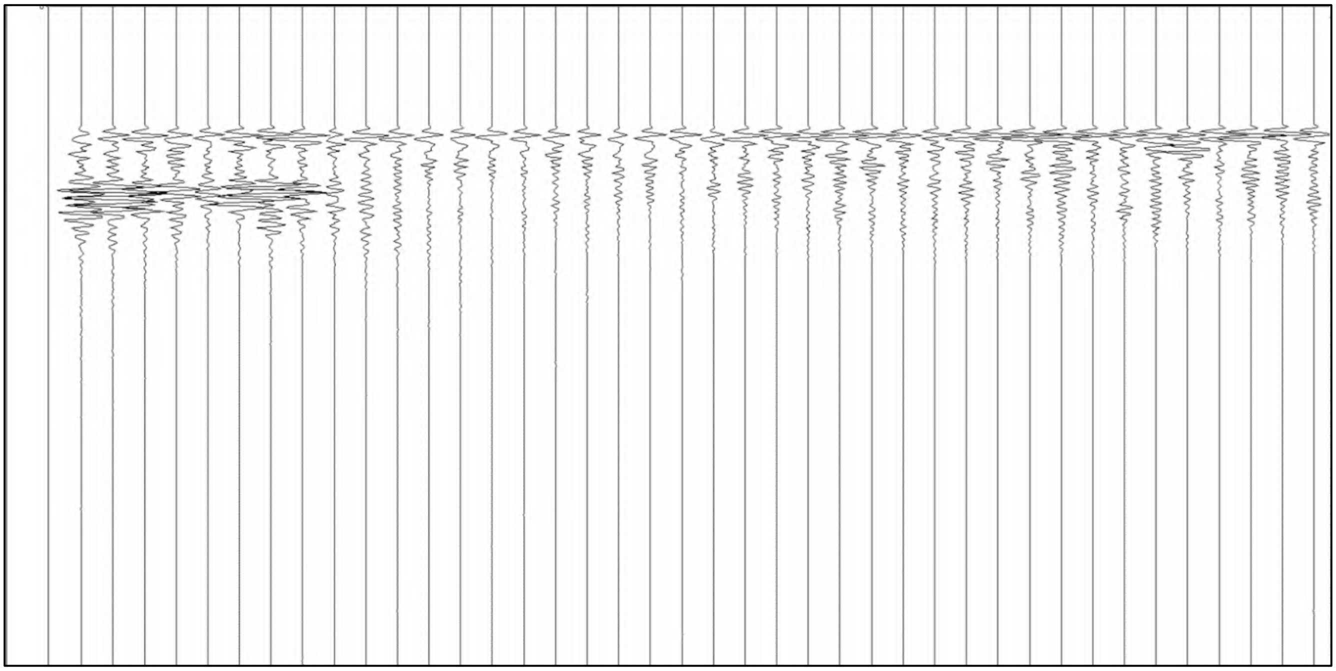


Figure 19. SBP Noise Test

APPENDIX D. CHPE CABLE SPECIFICATION

[6 Pages]

2.2 Submarine Cable Design Sheet – 1,250 MW

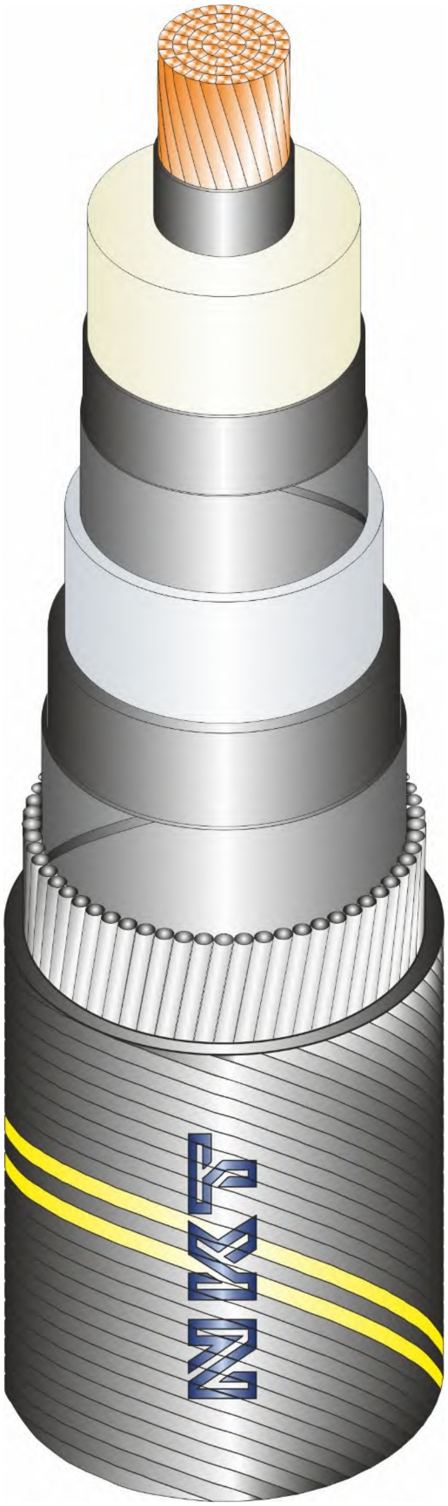


Figure 2: HVDC Submarine Cable Drawing

DC Voltage	±400 kV	
Conductor	Profiled wires	
Type / material	Copper, Compound Water-Blocked	
Cross-section	4935 kcmil	2500 mm2
Water blocking	compound	
Diameter	2.28 in	57.8 mm
Conductor binder		
Material	semi-conductive swelling tape	
Thickness	22 mils	0.6 mm
Conductor shield		
Material	semi-conductive polymer	
Thickness	59 mils	1.5 mm
Insulation		
Material	cross-linked DC polymer	
Thickness	839 mils	21.3 mm
Insulation shield		
Material	semi-conductive polymer	
Thickness	55 mils	1.4 mm
Longitudinal water barrier		
Material	semi-conducting swell-able tape	
Thickness	26 mils	0.7 mm
Metallic sheath		
Type / material	extruded / lead alloy	
Thickness	118 mils	3 mm
Inner sheath		
Material	high-density polyethylene	
Thickness	98 mils	2.5 mm
Tensile armour		
Type / material	wire / steel	
Thickness	197 mils	5 mm
Outer serving		
Material	polypropylene yarn, 2 layers	
Thickness	157 mils	4 mm
Complete cable		
Diameter	5.44 inches	138.1 mm
Weight in air	36.4 lbf./ft.	54.2 kg/m
Weight in water	26.9 lbf./ft.	40.1 kg/m

Note: All data shall be considered nominal

2.3 Electrical Cable Properties

The submarine cable has the following electrical properties:

Table 1: Submarine Cable Electrical Properties

Rated continuous DC voltage, U_0	400 kV
Switching impulse withstand level (SIWL) started from U_0	900 kV
Subtractive SIWL started from U_0 to voltage at opposite polarity	400 kV
Rated continuous current under the installation conditions	1,638 A
Maximum conductor temperature in normal operation	70 °C
Max. Δθ over insulation	15 K
DC resistance at 20 °C	0.0022 ohm/1,000 ft. (0.0072 ohm/km)
DC resistance at maximum conductor temperature	0.0026 ohm/1,000 ft. (0.0086 ohm/km)
Losses at rated current	7.6 W/ft. and cable (25.0 W/m)
Capacitance	0.081 μF/1,000 ft. (0.265 μF/km)
Inductance (between conductor and metallic sheath)	0.040 mH/1,000 ft. (0.132 mH/km)
Surge impedance	22.3 ohm
Max. non-adiabatic short circuit current in conductor (0,1 s) in accordance with IEC 60949	860 kA
Max. non-adiabatic earth fault current in metal screen/sheath (0,1 s) in accordance with IEC 60949	77 kA

2.4 Mechanical Cable Properties

The submarine cable has the following mechanical properties:

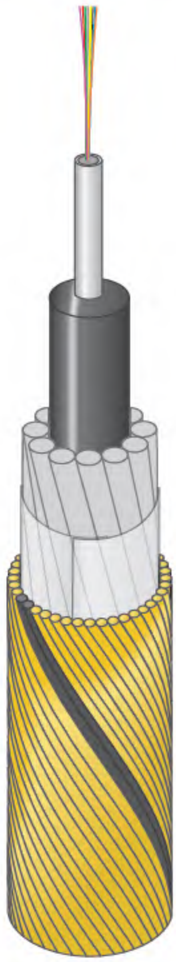
Table 2: Submarine Cable Mechanical Properties

Maximum Water Depth	400 feet (121.92 m)
Minimum bending radius	
- at laying (tension less than or equal 20 kN)	5.9 feet (1.8 m)
- at handling (tension greater than 20 kN)	6.9 feet (2.1 m)
- installed	5.9 feet (1.8 m)
Minimum bending radius for Chute	13.8 feet (4.2 m)
Minimum bending radius for turntable	6.9 feet (2.1 m)
Minimum coiling diameter 200 meters away from factory flexible joint	83 feet (25.3 m)
Minimum coiling diameter within 200 meters of a factory flexible joint	83 feet (25.3 m)
Maximum pulling force in conductor	
Straight Pull with conductor weld	54853lbs. (244kN)
Max permissible tension during bending MBR = 4.2 meters	47210lbs. (210kN)
Maximum side wall pressure $SWP = \frac{PullingForce}{BendingRadius}$	11240 lbs./ft. (50kN/m)

HEXATRONIC
Cables & Interconnect Systems

GJLTM 10-ton SA, 12-192 Fibers

Loose Tube Submarine Fiber Optic Cable



Features

- For unrepeatered systems
- Water depth 3000 m
- Compact design, only 22 mm in diameter
- 12-192 optical fibers
- With or without electroding conductor
- Single layer steel wire reinforcement
- Hydrogen protected
- Outer protection polypropylene yarns or polyethylene sheath

Application

GJLTM, 10-ton SA is a single layer armored, loose tube cable for submarine installation where moderate protection is required.

This submarine cable is based on a hermetically sealed stainless tube. Inside the tube the fibers are free to move in a thixotropic water blocking compound. The steel tube is protected by a polyethylene sheath. Outside the sheath there is one layer of galvanized steel wires. The steel wires are flooded in bitumen.

The complete cable is wrapped with a layer of polypropylene yarns or a polyethylene sheath.

The steel wire reinforcement provides reliable mechanical protection, enabling installation and operation during rough conditions.

High packing density of the fibers is provided by the loose tube technique. This permits a small outer diameter and easy handling of the cable.

The fibers are easy to identify due to color and colored yarns.

info@hexatronic.com
www.hexatronic.com
+46 10 453 02 00

Typical Data

Temperature range
Operation ....-30 till +60°C
Storage.....................................-40 till +70°C
Installation ....-15 till +40°C

Maximum water depths
....3000 m

Bend radius
No tensile load.......................≥ 0.5 m
With tensile load ....≥ 1.5 m
Coiling ....≥ 1.5 m

Dimensions
Diameter..................................22 mm

Weight
In air..1.1 kg/m
In seawater..............................0.8 kg/m

Tensile force
UTS...≥ 130 kN
FBL ....≥ 130 kN
NTTS..100 kN
NOTS ....70 kN
NPTS..50 kN

Crush resistance
....≤ 10 kN/10 cm

Impact resistance
....≤ 200 J

Mechanical and environmental test in accordance with IEC 60794-1-21 and IEC 60794-1-22

Electroding conductor
Electrical resistance ....7 Ω /km

Ordering Information

Upon ordering, specify the following parameters:

- Fiber type
- Number of fibers
- Fiber color coding scheme
- With- or without electroding conductor
- Sheath type (PP yarns or PE Sheath)
- Length

Contact Hexatronic for further assistance.

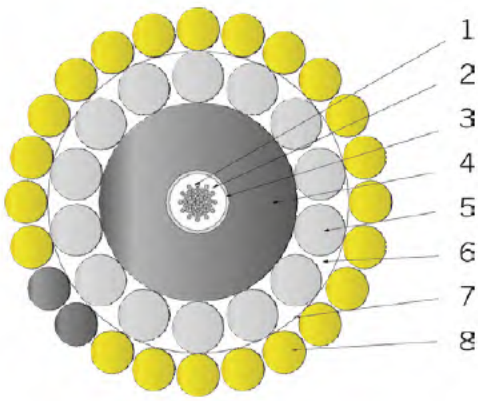
Cable markers
The submarine cable is marked with kilometer markers and factory joint markers.

Delivery information
The cable is supplied in any length in coil

Design

1. Primary coated fiber .... Silica, acrylate
2. Filling compound .... Thixotropic compound
3. Tube .... Stainless steel
4. Sheath .... Polyethylene, black
5. Armoring............................ Galvanized steel wires, single layer 14 x ø3.0 mm

6 Filling compound............. Bitumen
7 Wrapping .... Polyester tape
8 Wrapping .... Polypropylene yarns or HDPE sheath



Produktansvarig	Nr – No.		
HCI/T Tobias Borg	1301-25887-002		
Godkänd	Datum	Rev	File
HCI/T Thomas Ericsson	2022-02-03	A	

Characteristics of Submarine G.654.C single-mode optical fiber and cable

1 Transmission

Attenuation 1550 nm (dB/km)	≤ 0.17

Chromatic dispersion 1550 nm (ps/nm.km) ≤ 18

PMD coefficient	M	20 cables
	Q	0.01%
	Maximum PMD_Q	0.20 ps/√km

Cable cut-off, λ_{cc} (nm)	≤ 1520
Effective area (typical) (μm^2)	83

2 Geometry

Core concentricity error (µm)	≤ 0.5
Cladding diameter (µm)	125.0 ± 1.0
Cladding non-circularity (%)	≤ 2
Coating diameter (µm)	245 ± 10
Fiber	

3 Mechanical performance

Proof test (%) ≥ 1.0

4 Reference

ITU-T Rec. G.654.C	Characteristics of a cut-off shifted single-mode optical fiber and cable

All values are nominal unless otherwise specified.

APPENDIX E. CHPE CABLE SPLICE

[2 Pages]

Doc. ID.:	1AA0548863	Classification:	Technical report	Prepared date:	2023-03-22
Revision:	B	Project ID:	G22002	Approved date:	2023-03-22
Status:	Approved	Function:	Engineering	Security level:	Confidential
Customer:	CHPE LLC (9988)	Submittal ID:	NKT-SUB-0115	Customer Rev:	02

Datasheet - HVDC Rigid Submarine Joint

Champlain Hudson Power Express

CHPE

Rev.	Purpose	Date	Description	Prepared	Reviewed	Approved
01	IFR	2023-02-10	Issued For Review	Sverker Nyberg	Henrik Warngren	Arne Abrahamsson
02	IFR	2023-03-22	Issued For Review	Sverker Nyberg	Henrik Warngren	Arne Abrahamsson