Appendix 7-F: Immediate Post-Installation Inspection Plan

CHPE - Immediate Post Installation Inspection Plan

Champlain Hudson Power Express

Doc. ID.:	1AA0650624	Classification:	Project plan	Prepared by:	
Revision:		Language:	eng	Prepared date:	
Status:	Draft	Function:		Approved by:	
Security level:	Confidential	Project ID:	G22002	Approval date:	

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List of Terms and Abbreviations

Term	Definition
CHPE	Champlain Hudson Power Express
DoL	Depth of Lowering
HDD	Horizontally Drilled Duct
MBES	Multi-Beam Echo Sounder
MP	Mile Post
MSBL	Mean Seabed Level
RBT	Remedial Burial Tool
ROV	Remotely Operated Vehicle

1 Scope and Purpose

This document details the means and methodologies to be used for the post-installation inspection of the Champlain Hudson Power Express (CHPE) submarine cables following the installation campaigns. The criteria for a successful burial (depth of lowering) will be herein discussed as well as remedial actions for insufficiently buried cable and details of remedial actions should damage to third party assets inadvertently occur.

2 Introduction

The CHPE project contains a significant mileage of submarine cables installed over what can be recognised as four distinct on-water campaigns. For the purposes of this EM&CP, the focus is on Lake Champlain.:

Following the installation activities of the cables, verification will be made to the as-built locations. This verification will measure the depth of lowering (DoL) of the cable and whether this achieved DoL meets the criteria required at the specific location. An overview of the specific requirements per the installation campaign is depicted below:

Campaign	Less than 150' water depth	Maintained Channels	Greater than 150' water depth
Lake Champlain	4 feet	8	No burial required

Table 1 Submarine Cable Burial Requirements for Lake Champlain

3 Overview

As part of the cable installation process, the cable bundle will be lowered or buried into the lakebed to the required depth. An indicative sketch of the cable in a buried state is shown in the figure below:

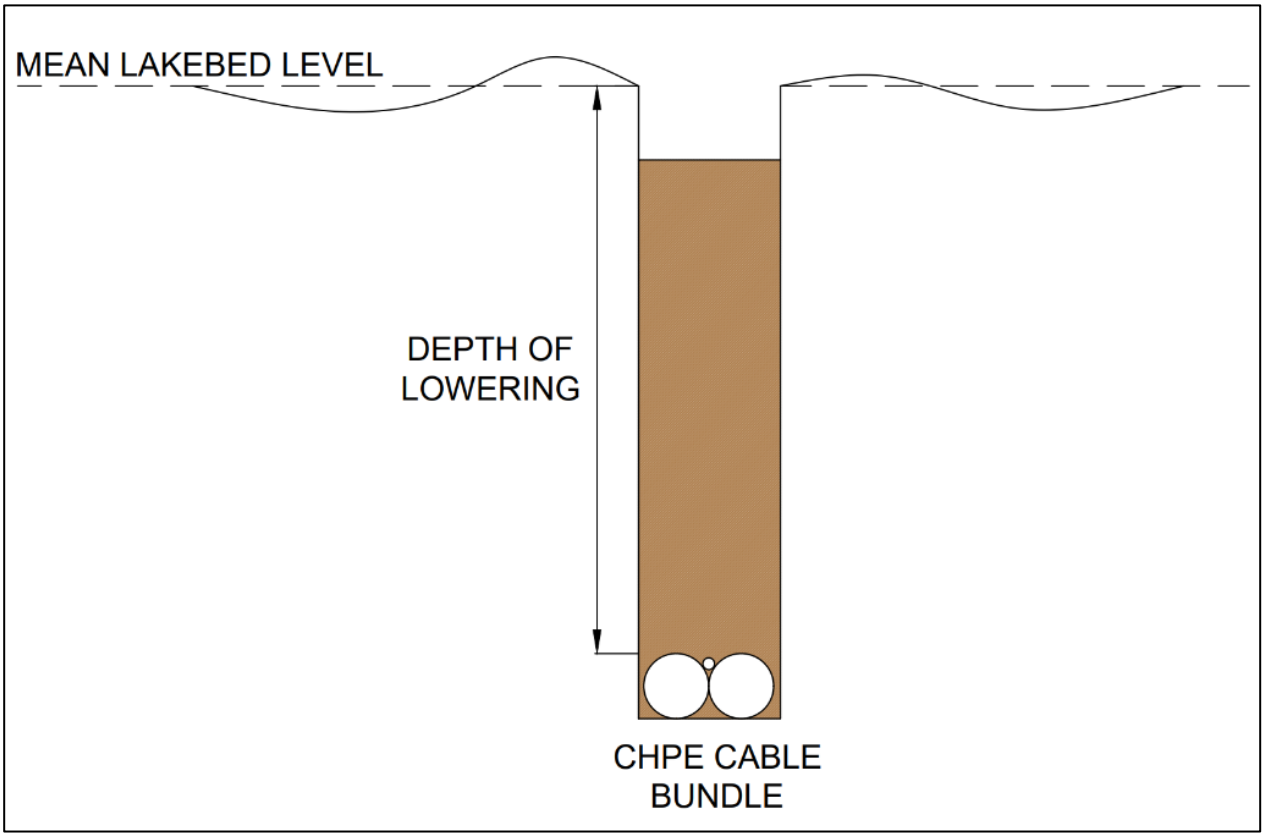

Figure 1 Section of Cable Depth of Lowering (Burial)

Following cable installation, the trench will naturally backfill over time and restore the lakebed bottom.

In reference to compliance with the burial requirements as detailed in Table 1, the DoL will be used as the value of assessment.

Cable installation surveys will occur following the cable installation works as detailed in "*Methodology Statement Submarine Cable Installation Lake Champlain Segment CHPE DC Cable System"*. Survey works may not be performed immediately following installation, but should in general be performed less than 4 days following the installation works.

Data gathered from the post-installation survey works will allow planning for the installation of post-lay mattresses (in terms of alignment) and remedial mattressing works, as detailed in "*Methodology Statement Champlain Hudson Power Express EM&CP Submission Post-Lay and Remedial Mattress Placement (<150ft Water Depth) (Lake Champlain Segment)".*

4 Methodology

Cable installation depth verification methodology will involve the use of a submarine vehicle equipped with cable tracking technology and with a multi-beam echosounder (MBES). The cable tracking operation and MBES operation can either be run simultaneously or separately depending on set-up, requirements and availability.

The cable tracking package can locate the cable by either inducing a current on the ferrous cable armouring, the return signal of which can then be accurately sensed or by detecting an applied signal on the cable armouring of known magnitude which can then be detected and an offset from the cable accurately determined. The distance of the cable from the submarine vehicle in combination with the known position of the vehicle from its onboard navigation and survey package will provide the accurate position of the cable in reference to the project datum.

The cross profiling system is used to verify the lateral lakebed level along the installed cable route. The cross profiling system will provide an accurate section profile of the lakebed and by referencing this to the known position of the vehicle, the data can be compiled to produce an accurate bathymetric model of the river bed over the locations which have been surveyed and thereby provide the mean lakebed level.

By using the outputs of the cable tracker and the cross profiling system the cable depth at any given location can be accurately referenced to the nominal lakebed level.

Prior to the cable tracking and cross profiling system works, various calibrations need to be undertaken in order to ensure accuracy. Although the cable tracker systems are proprietary technology and can therefore require bespoke calibrations depending upon the system chosen, generally the calibration works will involve using a test sample of cable to determine the feedback signals in a controlled environment and at known depth. This testing is then used to create the model specific to the cables being tracked thereby ensuring accuracy. Typically for cross profiling system, the calibration will involve a patch test on a known point and adjustment for the sound velocity in the specific water conditions encountered.

In addition to the ability to track the cable below the lakebed, this methodology can also be used for as-laid cable survey to track the position of the cable on the lakebed after cable lay but before burial operations. This application will be used for scenarios including; final position determination of cable joints, verification of cable alignment over crossings and mattresses, visual inspections and recording of any micro-deviations, and for installation close to cultural heritage locations. During this as-laid survey, visual data from the ROV cameras will be monitored and recorded as far as sub-surface visibility allows.

5 Results

The results of the cable tracker and cross profiler system survey are referred to as the “as-built” survey data as they jointly represent the final position of the cable below lakebed following the installation works. The data collected is referenced to the distance and position along the route as Mile Posts (MPs) which is correlated to the project MPs. The results can then be graphically depicted both as sections at any given location and longitudinally along the surveyed route.

6 Presentation of Results

As described in Section 5, the collected data can be represented in two ways. The first way being a section as indicatively shown in the below figure:

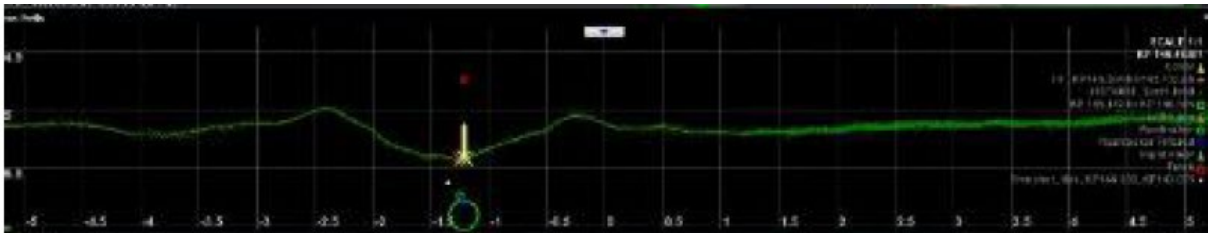

Figure 2 Indicative Section Post-Burial Survey Result

In this figure, the cross profiler system can be seen as the continuous line across the sectional figure and the cable can be seen as the small circle. The difference between the depth of the MSBL and the top of the cable therefore being the DoL.

The second way that the data will be presented is as a longitudinal graph indicatively shown in the below figure:

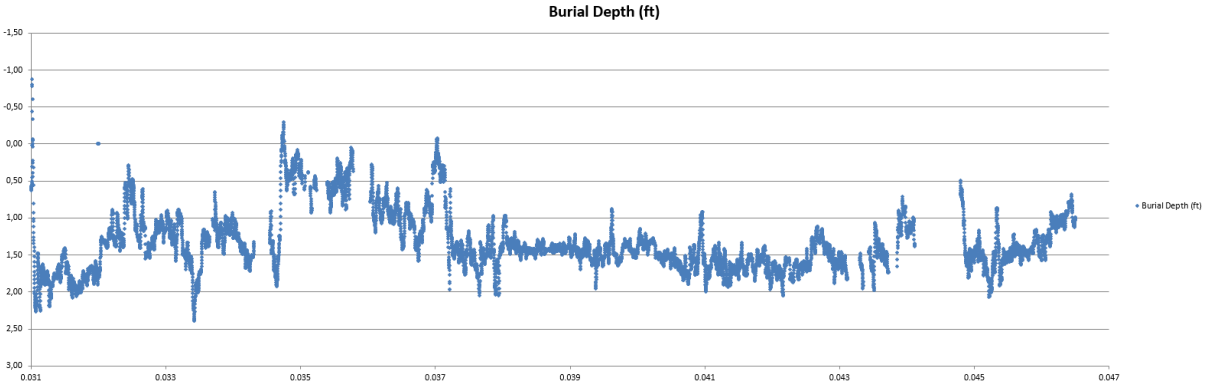

Figure 3 Indicative Longitudinal Depth Profile

In the above figure, the depth of lowering can be seen at different locations along the route, with the y-axis representing DoL and the x-axis representing MP. This graph is then used for the

determination of the requirement for remedial works. For example, if the required DoL in the above data set was 0.5m, then locations requiring remedial efforts can be quickly identified:

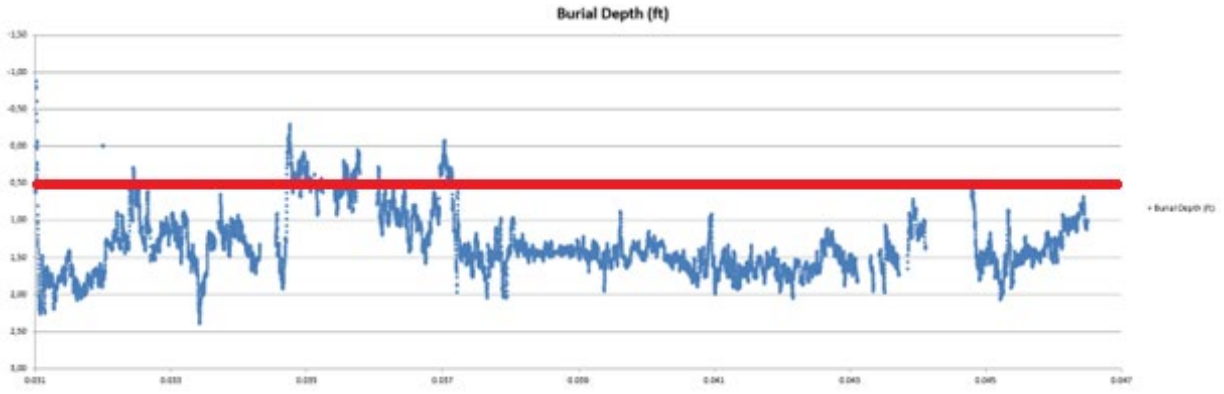

Figure 4 Indicative Burial Results - Remedial Work Determination

From Figure 4 above, if the required DoL is 0.5 feet (red line), then anything above this can be immediately seen as not having achieved the target depth of lowering, thus requiring remedial burial or protection. The appropriate method (remedial burial, mattressing, etc.) for addressing these situations will be determined based upon the site conditions (presence of/proximity of CI; presence of bedrock or other geological constraints; etc.), as described in Section 7 below. All locations are to be considered candidates for remedial burial operations unless there are specific reasons such as tool trafficability, underlying rock inhibiting lowering or proximity to co-located infrastructure that cause remedial burial passes to be un-viable. In this instance, or after successive remedial burial attempts, remedial mattressing will be utilized.

Following completion of all works, as-built documentation inclusive of the cable final (and intermediate) survey results will be compiled for agency submittal. Compilation of data will be made in accordance with all permit conditions and submitted within the windows prescribed by each agency.

7 Remedial Burial / Protection

Once the need for remedial burial or protection has been identified as detailed in Section 6, there are two options which can be used depending on the conditions and equipment availability:

7.1 Remedial Burial

Remedial burial operations can be performed using divers or a Remedial Burial Tool (RBT). An RBT will be deployed at locations at which full burial has not been achieved, but it is evaluated that remedial burial passes will likely result in sufficient further lowering so as to reach the target depth of lowering (burial depth).

Partially buried cable will be sensed by the onboard tool cable tracked to allow the RBT to properly line up on the cable route. Over the course of a set distance, the RBT will grade down to depth and continue at depth along the high spot. The tool is then recovered and a subsequent as-built survey performed to determine the success of remedial efforts.

If the cable has not achieved the required depth of lowering (burial), subsequent remedial burial passes may be attempted or remedial mattressing will be utilized as described below.

7.2 Remedial Mattressing

At locations at which it is either impractical to use the RBT (due to issues of access) or it is evaluated that additional passes with the RBT will not enhance burial (known rocky locations), remedial mattresses will be placed on top of the high spots to provide additional protection at those locations. Surveys will then be performed of the mattresses to ensure their correct positioning with the positions being logged to be used as part of the as-built package.

8 Remediation of Third Party Asset Damage

Due to the extensive survey work performed in the location of third party assets, as well as the engineering and crossing agreements made, it is unlikely that any third party asset should be impacted by the cable installation process.

However, in the unlikely event of impact with a known utility crossing, or an impact with an unknown and undocumented utility, immediate notification of such event will be made to the utility owner and relevant authorities. In order to mitigate risk to the cable installation assets and cable integrity, cable installation operations will continue. Additional spreads can be mobilised to conduct an assessment of the damage to the third party asset, and undertake remedial repairs in parallel with ongoing cable installation efforts. Necessary repairs and requirements shall be developed in coordination with the third party asset owner.