THURBER ENGINEERING LTD.

July 13, 2023 File No.: 32079

Associated Engineering
#500 – 2889 East 12th Avenue
Vancouver, BC
V5M 4T5

Attention: Priscilla Tsang, P.Eng.

HIGHWAY 1 WIDENING – 264TH STREET TO WHATCOM ROAD – SEGMENT 1
272nd STREET AND ROSS ROAD UTILITY CORRIDOR PRELOAD RECOMMENDATIONS

Dear Priscilla Tsang,

We have been requested by ISL Engineering and Land Services Ltd. to provide geotechnical input for the preload design required for the 272nd Street utility corridor and Ross Road utility corridor. Specifically, ISL has how to construct the preload and how far the preload and new utility locations should be from the existing utilities. It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

The 272nd Street utility corridor crosses beneath Highway 1 between approximately Sta. 1055+00 and Sta. 1055+80. The Ross Road utility corridors cross beneath Highway 1 between approximately Sta. 1102+00 and Sta. 1102+80. Both utility corridors will require cut through the existing median and ditch infilling for preload. The ditch infilling is up to about 1.5 m for the 272nd Street utility corridor and about 2 m thick at the Ross Road utility corridor.

We understand that Type D material from median excavation is the preferred material to use for the preloading of the 272nd Street and Ross Road utility corridors because it can be sourced from the median removal project. We understand that future utilities will be constructed using cut and cover methods.

2. SETTLEMENT ANALYSIS

We completed settlement analyses using the software Settle3D. The soil profile at the 272nd Street utility corridor was based on TH21-15, TH22-Seg1-01 and TH22-Seg1-76 which encountered stiff to very stiff silty clay to the depths of the test holes (drilled between 6 m and 9 m depth). The soil

profile at Ross Road utility corridor was based on TH22-Seg1-77 and Th22-Seg1-46 which encountered stiff to very stiff silty clay to the depth of the test holes (9 m and 6 m, respectively). Test hole logs can be founded in the FVCIP Factual Report Segment 1 dated May 19, 2023. A summary of the soil profile and the consolidation parameters used is provided in the tables below.

Table 1: Geotechnical Units and Compressibility Parameters at 272nd Street Utility Corridor

Soil Unit / Description	Cc	Cr	(Cα/Cc)	Cv (mm^2/s)	Cvr (mm^2/s)	Initial Void Ratio	OCD (kPa)	Young's Modulus, E (MPa)
Glaciomarine Silt / Clay (FLc) (to 15 m depth)	0.21	0.04	0.035	0.3	0.8	0.8	160	-
Sand (15 m to 16 m depth)	-	-	-	-	-	-	-	20
Glaciomarine Silt / Clay (FLc) (16 m to 30 m depth	0.21	0.04	0.035	0.3	0.8	0.8	20	-
Glaciofluvial Sand and Gravel (Sa,j) (below 30 m depth)	-	-	-	-	-	-	-	50

We included a near normally consolidated layer of clay below 16 m (the clay crust) at the 272nd Street utility corridor to assess the sensitivity if there is softer clay at depth. We included a sand layer between the clay crust and the deeper clay as water well recorded close by encountered the occasional thin sand layer.

Table 2: Geotechnical Units and Compressibility Parameters at Ross Road Utility Corridor

Soil Unit / Description	Cc	Cr	(Cα/Cc)	Cv (mm^2/s)	Cvr (mm^2/s)	Initial Void Ratio	OCD (kPa)	Young's Modulus, E (MPa)
Glaciomarine Silt / Clay (FLc) (0 m to 18 m depth)	0.21	0.04	0.035	0.3	0.8	0.8	160	-
Glaciofluvial Sand and Gravel (Sa,j) (below 18 m depth)	-	-	-	-	-	-	-	50

We have included settlement plots (total settlement and settlement following preload) from Sta. 1055+40, representative of the 272nd Street Utility Corridor and from Sta. 1112+00, representative of the Ross Road Utility Corridor. Both locations estimate that the ditch infilling will result in about 50 mm of settlement over 25 years, with the majority of settlement occurring soon after fill placement. Notably, the ditch preload is sufficiently small that it does not cause settlement of deeper, potentially softer soils at the 272nd Street utility corridor.

3. PRELOAD RECOMMENDATIONS

We recommend constructing the preload so that it covers at least 10 m on each side of the proposed utilities. The preload should be constructed to underside of asphalt. Where a temporary culvert is required for conveyance of water, we recommend overbuilding the preload by a thickness equal to the culvert diameter. The preload can be constructed with suitable Type D material that is free of organics (i.e. mineral fill). Note the contractor will likely have to be selective in the material they re-use from median excavation and a ministry representative should confirm the material is suitable before placement. The preload should be compacted to 95% standard Proctor maximum dry density. The preload should be constructed with 2H:1V side slopes.

The preload should be setback at least 20 m from existing utilities. We understand that this is not possible at Ross Road as a preload that extends 10 m on each side of the proposed utility will result in the preload toe being about 8 m away from the existing utilities. We recommend that the preload is constructed as described above, and that the existing utility is monitored for settlement rather than reduce the preload width. If settlements come within the settlement threshold of the utility, the Ministry should be prepared to remove a portion of the preload.

The soil that is being removed within the median should only be excavated to the underside of asphalt (i.e. to match grade with the preload) above the proposed utility and 10 m to each side.

We recommend preloading for a minimum of 6 months before utility installation. It is preferable for the preload to be in place for longer. We recommend settlement pins be placed to monitor settlement after preload construction. Settlement pins comprise a 600 mm piece of rebar hammered into the finished preload grade. The settlement pins should be installed upon completion of preload construction to confirm settlement rates have sufficiently slowed prior to utility installation. We recommend one settlement pin placed above utilities adjacent to each side of highway (2 pins) and 2 settlement pins on the preload adjacent to each side of the highway (4 pins). The settlement pins should be placed in the centre of the preload where it is thickest.

Survey control should be established to allow the pins to be surveyed with an accuracy of +/- 5 mm. The top of pin, pin stickup, and notes on potential damage and disturbance should be collected. Settlement pins should be surveyed weekly during preload construction and every two weeks following construction. The survey interval may be increased following review of the settlement data. We anticipate that the survey will not be required beyond 6 months, even if the preload will be in place for longer.

Thurber Engineering Ltd.
Permit to Practice #1001319

Yours truly,
Thurber Engineering Ltd.
Paul Evans, P.Eng.
Review Principal

Christopher Clarke, P.Eng.
Geotechnical Engineer

Attachment
- Statement of Limitations and Conditions
- Settlement Plots

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client, the BC Ministry of Transportation and Infrastructure (MoTI) and Authorized Users as defined in the MoTI Special Conditions Form H0461d. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Any use which an unauthorized third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any unauthorized third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

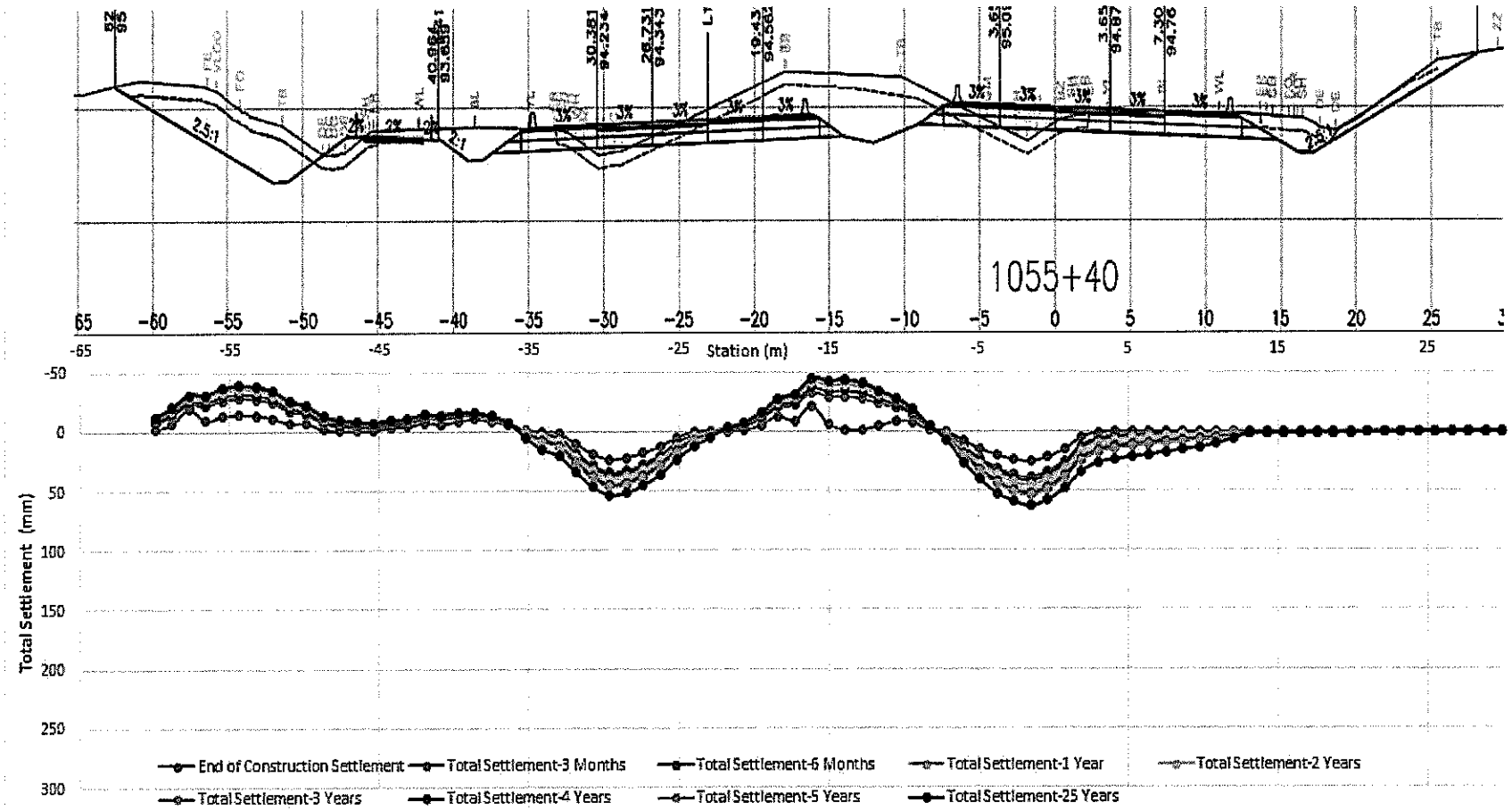
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

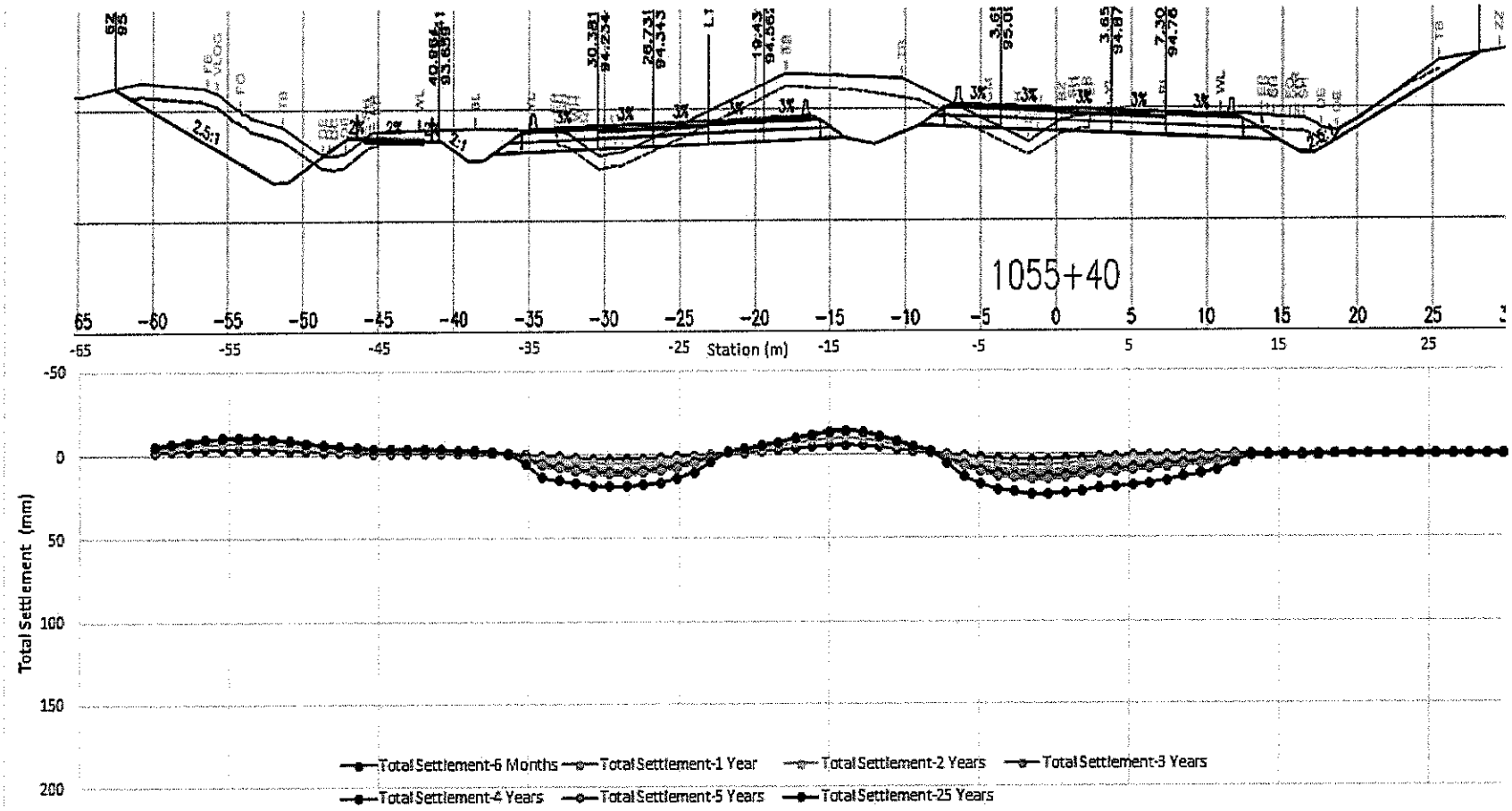
Station vs. Total Settlement (Sta 1055+40)



REV	DATE	REVISION	BY
1	YYYY-MM-DD	-	-

LEGEND / NOTES	SEAL	CLIENT NAME: Associated Engineering / ISL Engineering and Land Services Ltd.	DRAWN BY: SY; DATE: 2023-05-24
	PERMIT TO PRACTICE	DRAWING TITLE: Settlement Analysis Sta. 1055+40 - Total Settlement	DESIGNED BY: CJC; SCALE: NTS
THURBER		PROJECT NAME AND LOCATION: Highway 1 Widening - 264th Street to Whatcom Road (Segment 1) Abbotsford, BC	APPROVED BY: -; PROJECT No.: 32079
			DRAWING / FIGURE No.: Figure D45; REV.: -

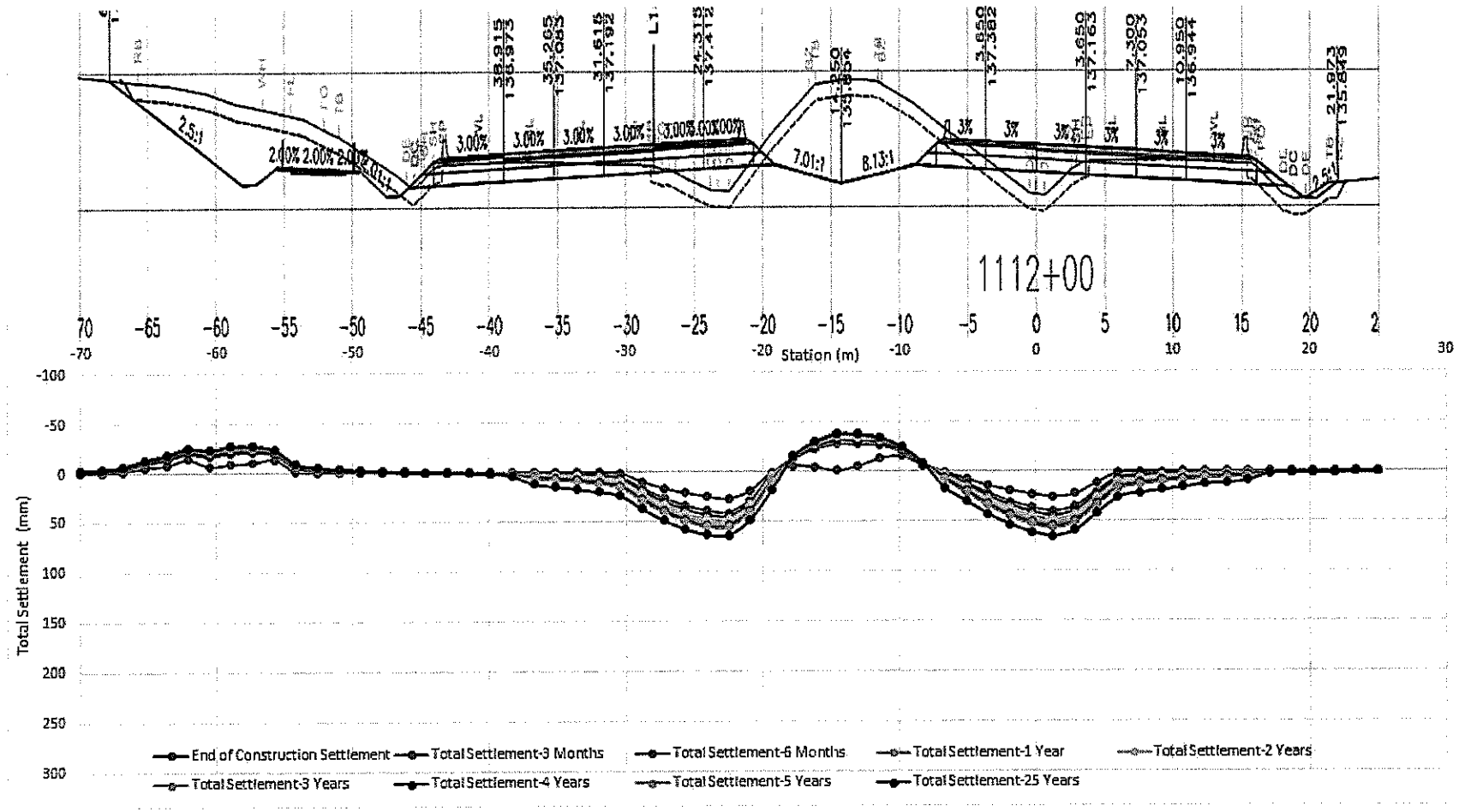
Station vs. Total Settlement (Sta 1055+40)



REV	DATE	REVISION	BY
1	YYYY-MM-DD	-	-

LEGEND / NOTES	SEAL	CLIENT NAME: Associated Engineering / ISL Engineering and Land Services Ltd.	DRAWN BY: SY	DATE: 2023-05-24
	PERMIT TO PRACTICE	DRAWING TITLE: Settlement Analysis Sta. 1055+40 - Settlement Following 3 Month Preload	DESIGNED BY: CJC	SCALE: NTS
THURBER		PROJECT NAME AND LOCATION: Highway 1 Widening - 264th Street to Whatcom Road (Segment 1) Abbotsford, BC	APPROVED BY: -	PROJECT No.: 32079
			DRAWING / FIGURE No.: Figure D46	REV.: -

Station vs. Total Settlement (Sta 1112+00)



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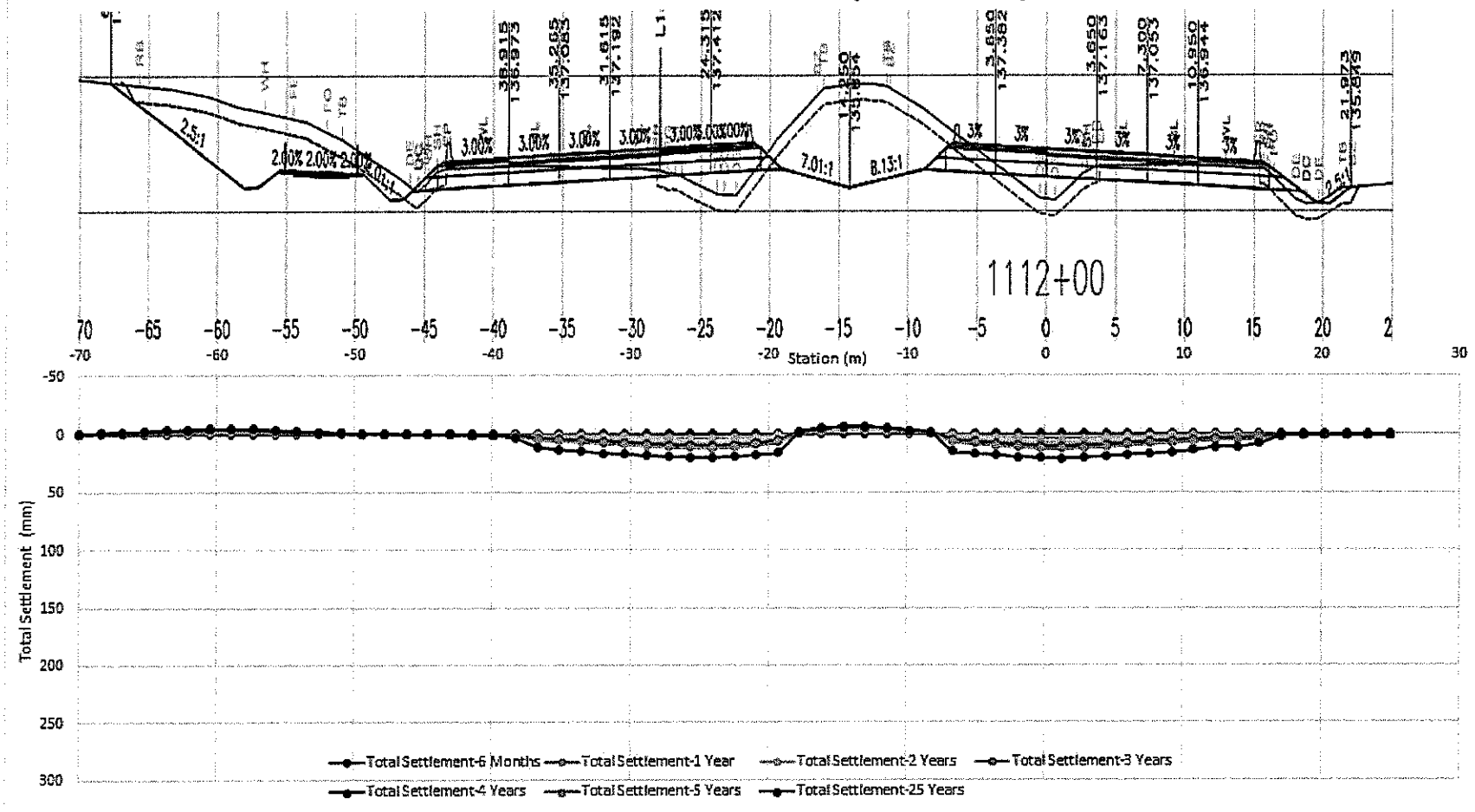
LEGEND / NOTES	SEAL	THURBER	CLIENT NAME: Associated Engineering / ISL Engineering and Land Services Ltd.	DRAWN BY: SY	DATE: 2023-05-24
	PERMIT TO PRACTICE		DRAWING TITLE: Settlement Analysis Sta. 1112+00 - Total Settlement	DESIGNED BY: CJC	SCALE: NTS
			PROJECT NAME AND LOCATION: Highway 1 Widening - 264th Street to Whatcom Road (Segment 1) Abbotsford, BC	APPROVED BY: -	PROJECT No.: 32079
				DRAWING / FIGURE No.: Figure D78	REV.: -

Station vs. Total Settlement (Sta 1112+00)



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LEGEND / NOTES	SEAL	CLIENT NAME: Associated Engineering / ISL Engineering and Land Services Ltd.	DRAWN BY: SY	DATE: 2023-05-24
	PERMIT TO PRACTICE	DRAWING TITLE: Settlement Analysis Sta. 1112+20 - Settlement Following 6 Month Preload	DESIGNED BY: CJC	SCALE: NTS
THURBER		PROJECT NAME AND LOCATION: Highway 1 Widening - 264th Street to Whatcom Road (Segment 1) Abbotsford, BC	APPROVED BY: -	PROJECT No.: 32079
			DRAWING / FIGURE No.: Figure D79	REV.: -