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To: Ministry of Transportation	Date: October 16, 2024
Attn: Matthew Leavitt, P.Eng.	File: 48719
From: Michael Eastman, P.Eng.	
Reviewer: P.K. Chatterji, P.Eng.	

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**HIGHWAY 72 NON-STRUCTURAL HIGH FILL CULVERT AT STATION 25+608  
PICKEREL TOWNSHIP, ONTARIO  
AGREEMENT # 6022-E-0038, ASSIGNMENT # 7  
GEOCRES NO. 52F16-010**

Dear Mr. Leavitt,

Thurber Engineering Ltd. (Thurber) was retained by the Ontario Ministry of Transportation (MTO) to provide Foundation Engineering services under Retainer Agreement No. 6022-E-0038 for Assignment No. 7 for the replacement of a non-structural high fill culvert on Highway 72 at Sta. 25+608 in Pickerel Township, Ontario.

This technical memorandum focuses on a slope stability analysis for the proposed temporary detour embankment staging including temporary cut slopes and embankment widening.

*It is a condition of this memorandum that the performance of Thurber's professional services is subject to the attached Statement of Limitations and Conditions.*

### **1. BACKGROUND**

This assessment was based on the following Draft Foundation Investigation Report (FIR) provided by MTO:

- Draft Preliminary Foundation Investigation Report, Culvert 15, 44.3 km North of the Corner of Hwy 17 and 72, Township of Pickerel, Station 25+608, by TBT Engineering Limited, dated February 2, 2024.

The investigation included two boreholes, one through the shoulder of the northbound lane and one through the centre of the southbound land. The borehole locations and strata drawing and borehole logs are attached to this technical memorandum.

The accuracy and quality of the data in the above report remains the responsibility of TBTE.

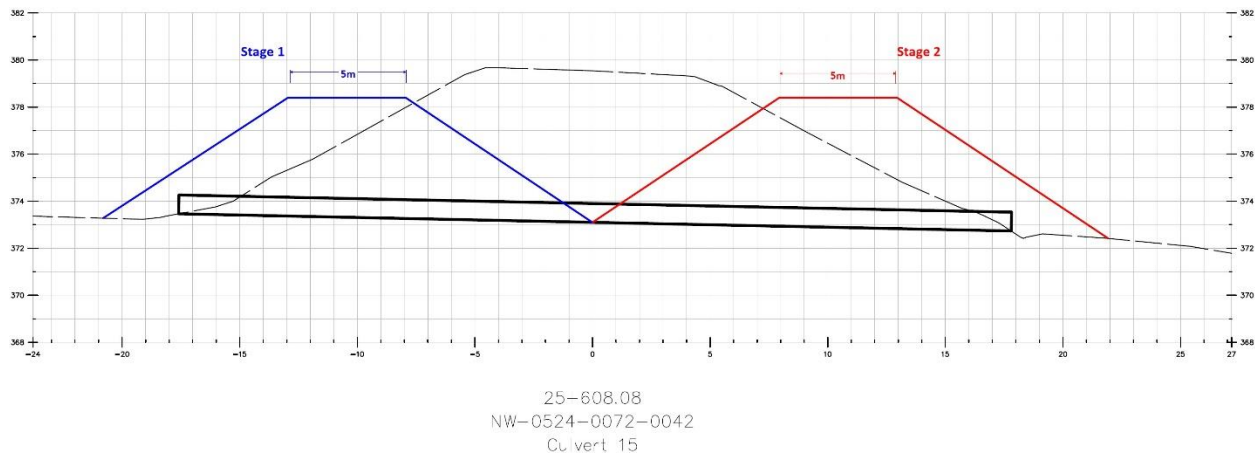
## 2. SUBSURFACE CONDITIONS

The subsurface conditions encountered in Boreholes BH 1 and BH 2 advanced by TBTE generally consisted of embankment fill material comprising very loose to compact sand and gravel with rock fill overlying native very soft to stiff clay and sand underlain by very loose to compact silt. Both boreholes were noted to be dry upon completion and no monitoring wells or standpipe piezometers were installed.

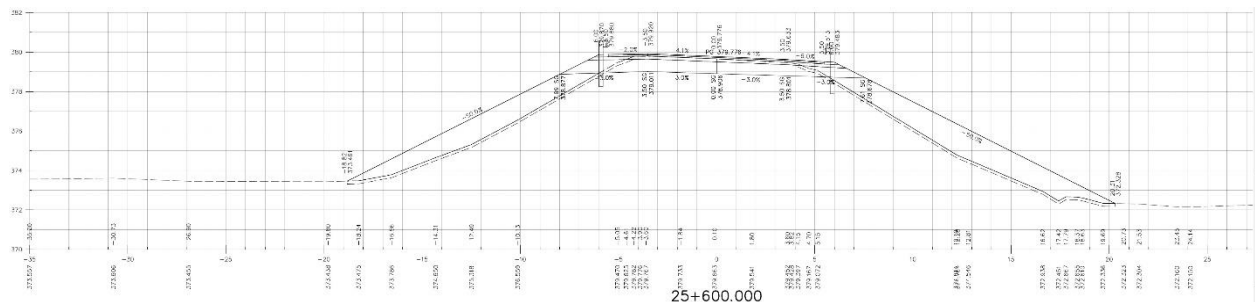
## 3. TEMPORARY DETOUR EMBANKMENTS

### 3.1 Construction Staging

The following culvert construction staging sequence has been provided by MTO in an email dated February 7, 2024.



**Figure 3.1: Culvert construction staging sequence at Station 25+608 (provided by MTO).**



**Figure 3.2: Final embankment configuration at Station 25+608 (provided by MTO).**

- Stage 1: Construct temporary embankment widening to the west of the existing highway alignment to facilitate one lane of traffic flow (i.e., platform width of 5 m) around the excavation for the construction of the new culvert east of the centreline. The temporary embankment will have a temporary cut slope at 1.5H:1V or flatter to the east (inside) and a widened slope to the west (outside) at 1.25H:1V or flatter. The temporary embankment will be widened to the west using OPSS Granular B Type II or rock fill. The maximum height of the new fill is on the order of 3 m.
- Stage 2: Construct temporary embankment to the east of the existing highway alignment to facilitate one lane of traffic flow (i.e., platform width of 5 m) around the excavation for the construction of the new culvert west of the centreline. The temporary embankment will have 1.25H:1V or flatter side slopes to the east (outside) and west (inside). The temporary embankment will be constructed using OPSS Granular B Type II or rock fill. The height of the temporary embankment is approximately 6 m.
- Stage 3 (Final): Construct final embankment along the existing highway alignment using existing fill material or OPSS Granular B Type II. The final embankment will have 2H:1V or flatter side slopes.

### 3.2 Slope Stability Analysis

Stability analyses were carried out for the temporary detour embankments and final embankment configuration utilizing the commercially available computer program SLOPE/W of the GeoStudio software package with the option of Morgenstern-Price method of slices for limit equilibrium.

The input parameters used in the stability analyses, including soil stratigraphy, material properties, groundwater conditions and modeled geometry are shown in the figures attached to this technical memorandum. The material properties used in the analyses were determined from in-situ and laboratory testing as well as soil index correlations.

The stability analysis plots are attached to this technical memorandum. The results of the stability analyses are summarized in the table below.

**Table 3-1 Summary of Slope Stability Analyses**

Location	Cut or Fill	Side	Side Slope	Embank. Fill	Condition	Factor of Safety	Figure
Stage 1 West Temp. Embank.	Cut	East	1.5H:1V	Gran. B Type II	Drained	1.00	1
	Fill	West			Drained	1.13	2
	Cut	East	1.75H:1V	Gran. B Type II	Drained	1.16	3
	Fill	West			Drained	1.30	4
	Cut	East	2H:1V	Gran. B Type II	Drained	1.32	5
	Fill	West			Drained	1.47	6
	Cut	East	2H:1V	Rock Fill	Drained	1.33	7
	Fill	West	1.25H:1V		Drained	1.24	8
Stage 2 East Temp. Embank.	Fill	East	2H:1V	Gran. B Type II	Drained	1.42	9
	Fill	West			Drained	1.47	10
	Fill	East	1.25H:1V	Rock Fill	Drained	1.21	11
	Fill	West			Drained	1.23	12
Stage 3 Final Config.	Fill	East	2H:1V	Existing Fill	Drained	1.29	13
	Fill	West			Drained	1.28	14
	Fill	East	2H:1V	Gran. B Type II	Drained	1.43	15
	Fill	West			Drained	1.43	16

For the Stage 1 temporary embankment to the west, a factor of safety of greater than 1.3 is achieved for a temporary cut slope at 2H:1V (Figure 5) and embankment widening with Granular B Type II at 2H:1V (Figure 6).

For the Stage 2 temporary embankment to the east, embankment construction with Granular B Type II at 2H:1V achieves a factor of safety of greater than 1.3 (Figures 9 and 10).

For the final embankment configuration (i.e., Stage 3), the factor of safety is less than 1.5 for both sides when constructed using the existing fill or Granular B Type II at 2H:1V under permanent condition (Figures 13 to 16).

#### 4. CLOSURE

Engineering analysis and preparation of this technical memorandum were carried out by Mr. M. Eastman, P.Eng. The technical memorandum was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundation Projects.

Thurber Engineering Ltd.  
Report Prepared By:



Michael Eastman, P.Eng.  
Associate  
Geotechnical Engineer



P.K. Chatterji, Ph.D., P.Eng.  
Designated Principal Contact  
Senior Geotechnical Engineer

#### Attachments

- Borehole Locations and Strata Drawing and Borehole Logs (prepared by TBTE)
- Slope Stability Analysis

## 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. 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. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any 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.

Pickereil TWP 25+608 Culvert 15										RECORD OF BOREHOLE No 1					1 OF 1		METRIC	
W.P. 6417-13-00			LOCATION Station 25+602 o/s 2.6m Lt of C/L N:5535750; E:561229 MTM Zone:16					ORIGINATED BY IB/SL/BA										
DIST NWR HWY 72			BOREHOLE TYPE Hollow Stem Auger					COMPILED BY ZA/TG										
DATUM Geodetic			DATE 2023.11.22 - 2023.11.22		LATITUDE 49.9709486		LONGITUDE -92.1461557		CHECKED BY DV									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
379.7							20	40	60	80	100							
379.4	ASPHALT - 300 mm																	
0.3	FILL - SAND & GRAVEL - trace silt, brown, compact to loose			SS	26													
				SS	8											39 52 (9)		
				SS	7													
				SS	6													
	----- - some sand, some silt, numerous rockfill			SS	8													
				SS	13											72 17 (11)		
372.6																		
7.1	CLAY & SAND - varved, brown, soft to firm			SS	15													
				SS	5											0 38 (62)		
				SS	6													
				SS	1													
366.5																		
13.2	SILT - Sandy, brown, loose to compact			SS	2											0 28 (72) Non-Plastic.		
				SS	11													
363.8																		
15.9	End of Borehole @ 15.9 m.																	

-DRAFT-

ONTARIO MTO MOD DRAFT 12 - PICKEREL 25+608 CULVERT 15-1.GPJ ONTARIO MTO.GDT 2-2-24

RECORD OF BOREHOLE No 2										1 OF 1		METRIC					
W.P. <u>6417-13-00</u> LOCATION <u>Station 25+611 o/s 3.7m Rt of C/L N:5535751; E:561240 MTM Zone:16</u>										ORIGINATED BY <u>IB/SL/BA</u>							
DIST <u>NWR</u> HWY <u>72</u> BOREHOLE TYPE <u>Hollow Stem Auger</u>										COMPILED BY <u>ZA/TG</u>							
DATUM <u>Geodetic</u> DATE <u>2023.11.24 - 2023.11.24</u> LATITUDE <u>49.9709565</u> LONGITUDE <u>-92.1460022</u>										CHECKED BY <u>DV</u>							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
379.3																	
0.0	FILL - SAND - Gravelly, some silt to Silty, occasional cobbles, brown, very loose to compact																
	----- - ROCK FILL - some sand, trace silt																
			SS	28													
			SS	12													
			SS	10													
			SS	8													
			SS	3													
			SS	15													
372.0																	
7.3	CLAY & SAND - varved, trace gravel, trace silt, brown, stiff																
			SS	9													
			TW														
368.7																	
10.6	SILT - some sand, grey, very loose to compact																
			SS	5													
			SS	2													
			SS	17													
365.3																	
14.0	End of Borehole @ 14.0 m. Case Advanced to 15.0 m.																

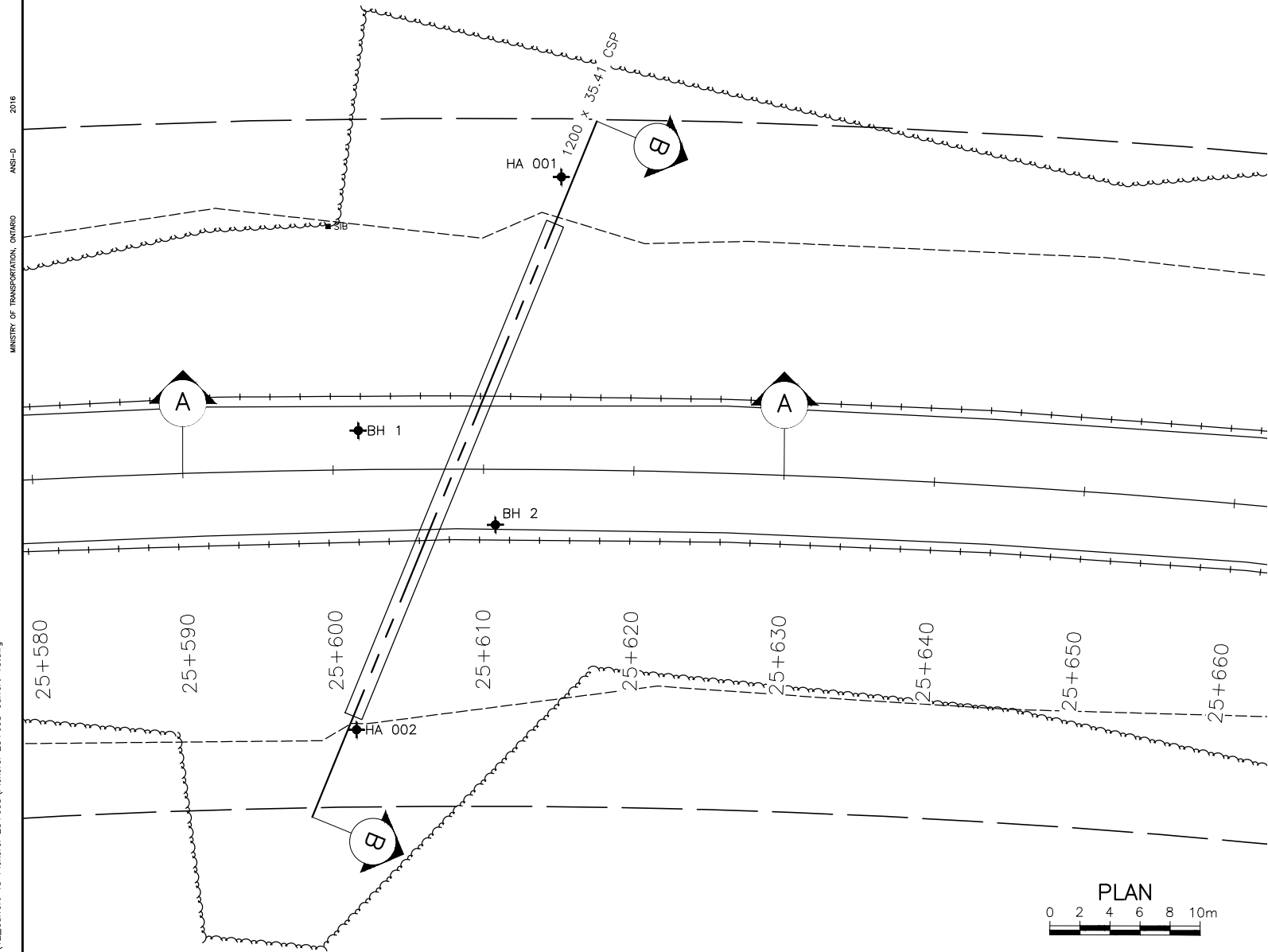
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ONTARIO MTO MOD DRAFT 12 - PICKEREL 25+608 CULVERT 15-1.GPJ ONTARIO MTO.GDT 2-2-24

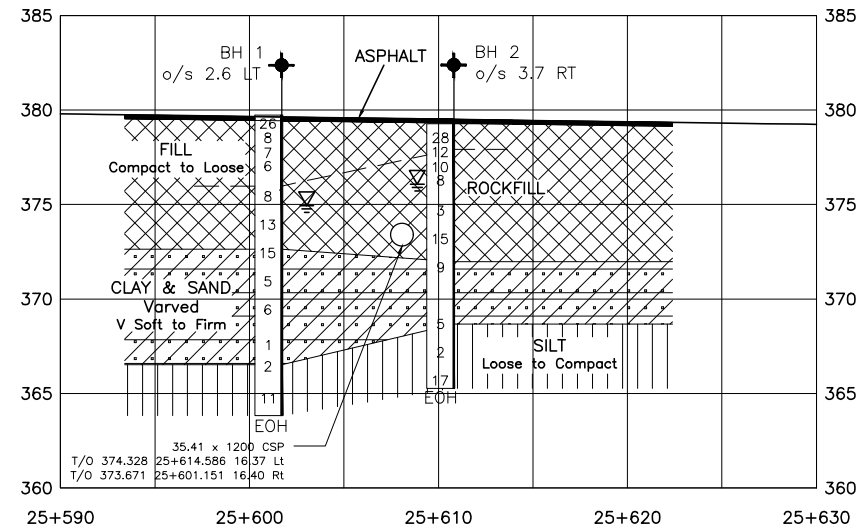


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MINISTRY OF TRANSPORTATION, ONTARIO

FILE NAME: Y:\Projects\2022\22-146 MTO, NMR Geotechnical Retainer\22-146-10 - Hwy 72 & 664 FND\Drawings\12\_Culvert 15 Pickrel 25+608\Pickrel 25+608 Culvert 15.dwg  
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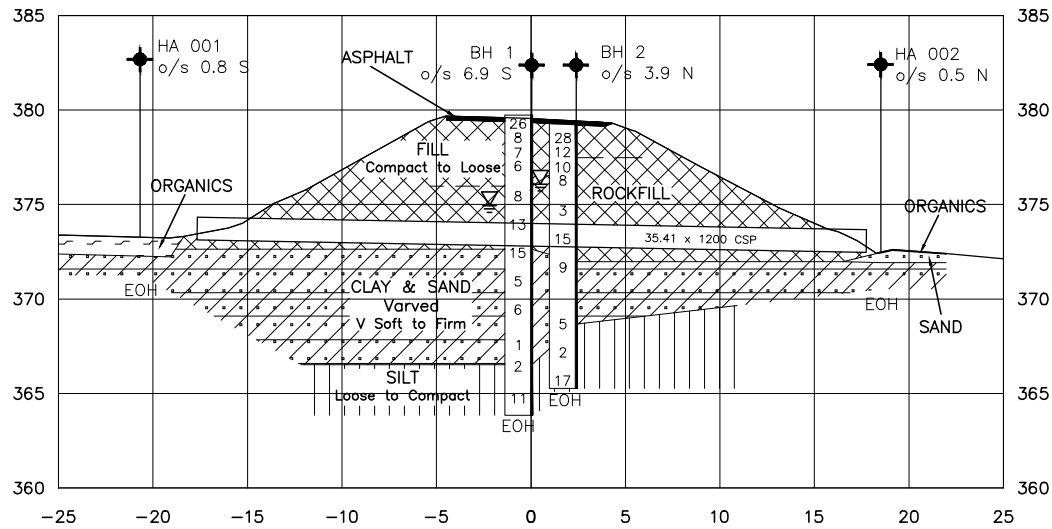


PLAN  
0 2 4 6 8 10m



PROFILE A-A

0 2 4 6 8 10m



SECTION B-B

0 2 4 6 8 10m

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN

Ontario Ministry of Transportation

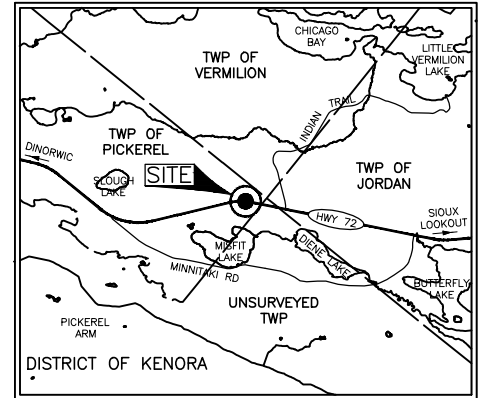
GEOCRES  
CONT  
WP 6417-13-00

SOIL STRATA  
CULVERT 15 HIGHWAY 72 STA 25+608  
PICKEREL TOWNSHIP



SHEET  
1

TBT ENGINEERING  
CONSULTING GROUP



KEY PLAN

2.0 km 0 2.0 km

SOIL STRATA SYMBOLS

	TOPSOIL		SILT & SAND
	FILL		SAND - Silty
	SAND & CLAY		

LEGEND

	Borehole
	Hand Auger
	Std Pen Test (Blows/0.3m)
	Water Level on Completion
	EOH
	AR

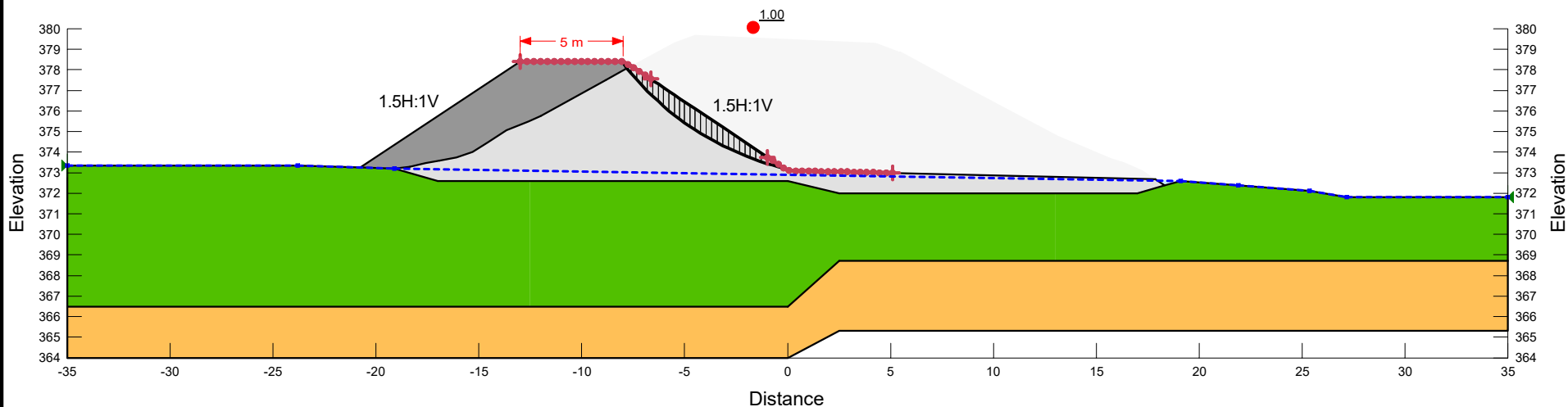
No	ELEVATION	CO-ORDINATES (MTM 16)	
		NORTH	EAST
BH 1	379.7	16 5 537 411	366 047
BH 2	379.3	16 5 537 412	366 058
HA 001	373.3	16 5 537 433	366 047
HA 002	372.5	16 5 537 396	366 060

NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS				
	1	SS	ISSUED FOR REVIEW	
DESIGN	XX	CHK	XX	CODE XXXXXX
DRAWN	TG	CHK	SS	SITE XXXXX
			LOAD XXXX	DATE 02/02/24
			DWG 1	

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

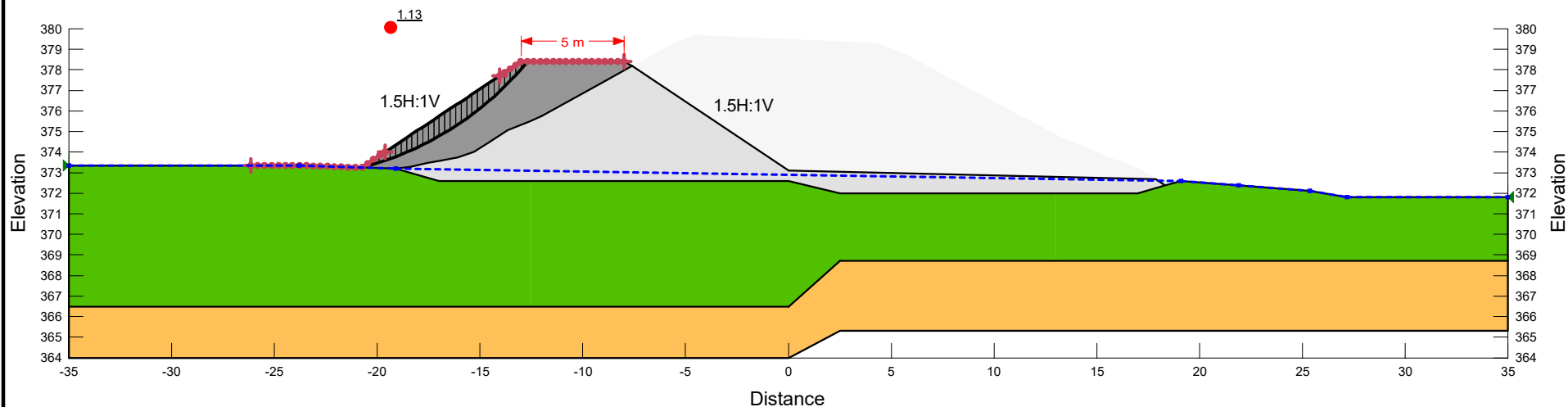


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 East Side Temp. Cut Slope at 1.5H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:21 PM	1:301

Additional Details	
Name: Stage 1 East Side Temp. Cut Slope at 1.5H:1V with Gran. B Type II	
Comments: Sta. 25+608	
Method: Morgenstern-Price, Half-Sine	
Minimum Slip Surface Depth: 1 m	
Entry: (-8.0489803, 378.4) m, Exit: (-0.19480243, 373.23039) m	
Center: (3.0835684, 386.76243) m, Radius: 13.9235 m	

**Figure 1**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

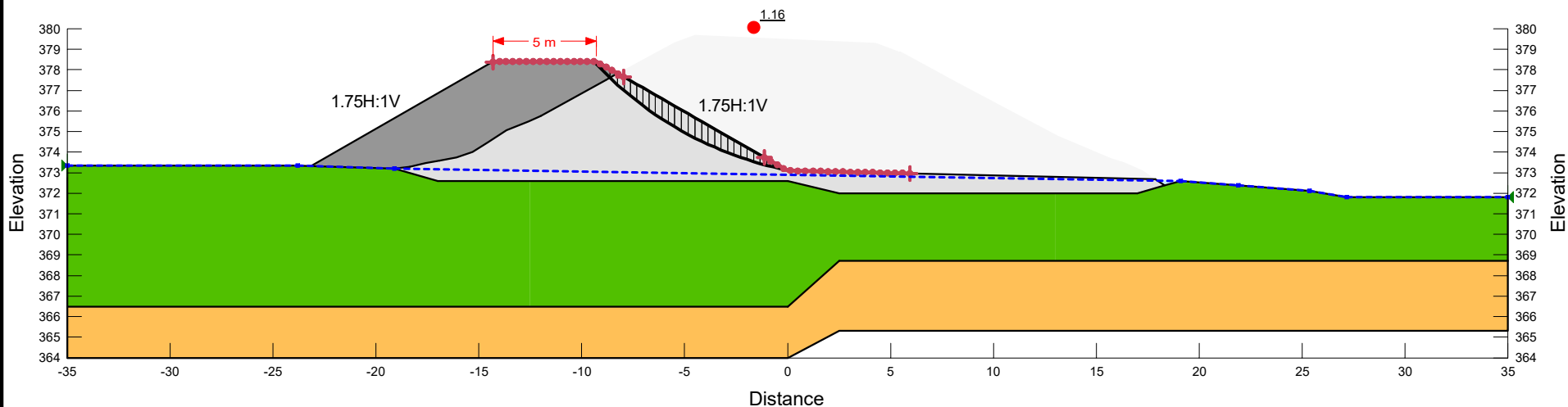


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 West Side Embank. Widening at 1.5H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:31 PM	1:301

Additional Details  
Name: Stage 1 West Side Embank. Widening at 1.5H:1V with Gran. B Type II  
Comments: Sta. 25+608  
Method: Morgenstern-Price, Half-Sine  
Minimum Slip Surface Depth: 1 m  
Entry: (-20.735157, 373.26252) m, Exit: (-12.69534, 378.4) m  
Center: (-24.597168, 388.16594) m, Radius: 15.395682 m

**Figure 2**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

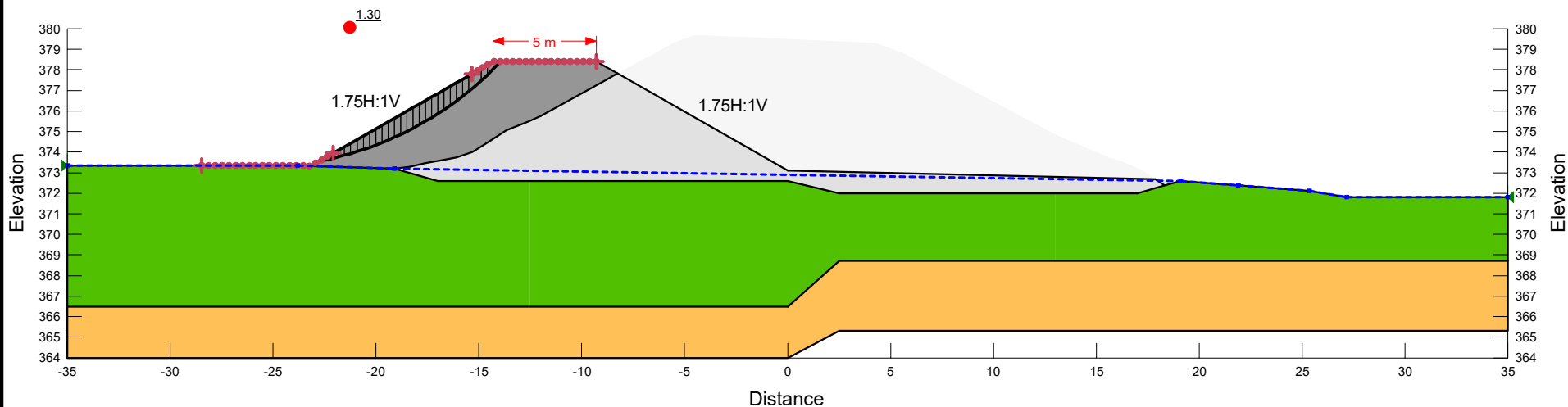


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 East Side Temp. Cut Slope at 1.75H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:19 PM	1:301

Additional Details  
 Name: Stage 1 East Side Temp. Cut Slope at 1.75H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum SD Surface Depth: 1 m  
 Entry: (-9.3995551, 378.4) m, Exit: (-0.064782281, 373.13712) m  
 Center: (3.429854, 390.24554) m, Radius: 17.461686 m

**Figure 3**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

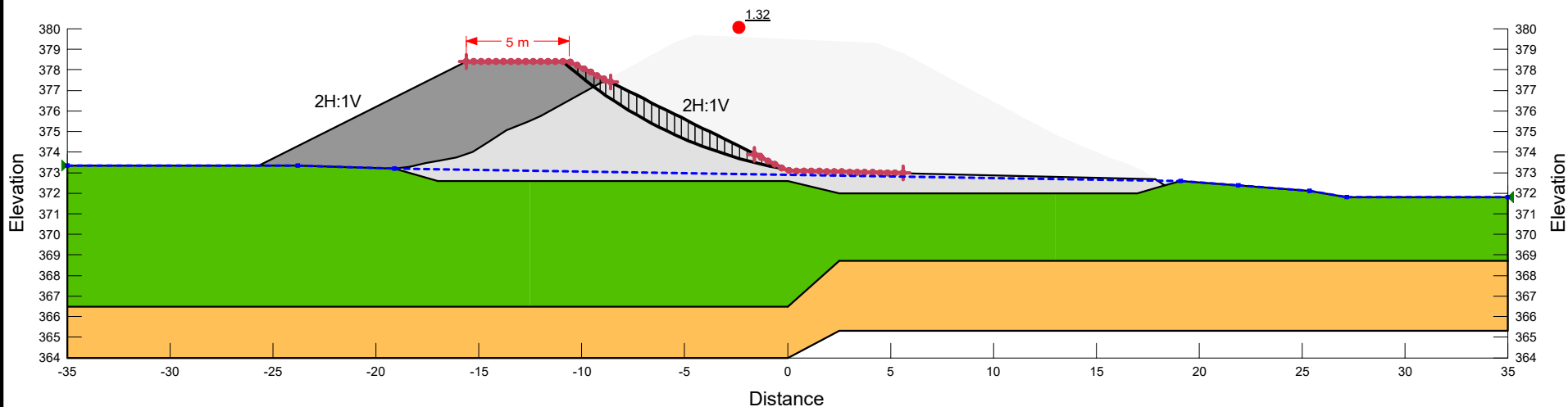


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 West Side Embank. Widening at 1.75H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	
H: 0g, V: 0g	2024-03-19, 03:31:34 PM	
Scale		1:301

Additional Details  
 Name: Stage 1 West Side Embank. Widening at 1.75H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (-22.73912, 373.56468) m, Exit: (-13.957901, 378.4) m  
 Center: (-25.850381, 389.60617) m, Radius: 16.340417 m

**Figure 4**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	OPSS Gran. B Type II	22	0	35
■	Silt	20	0	29

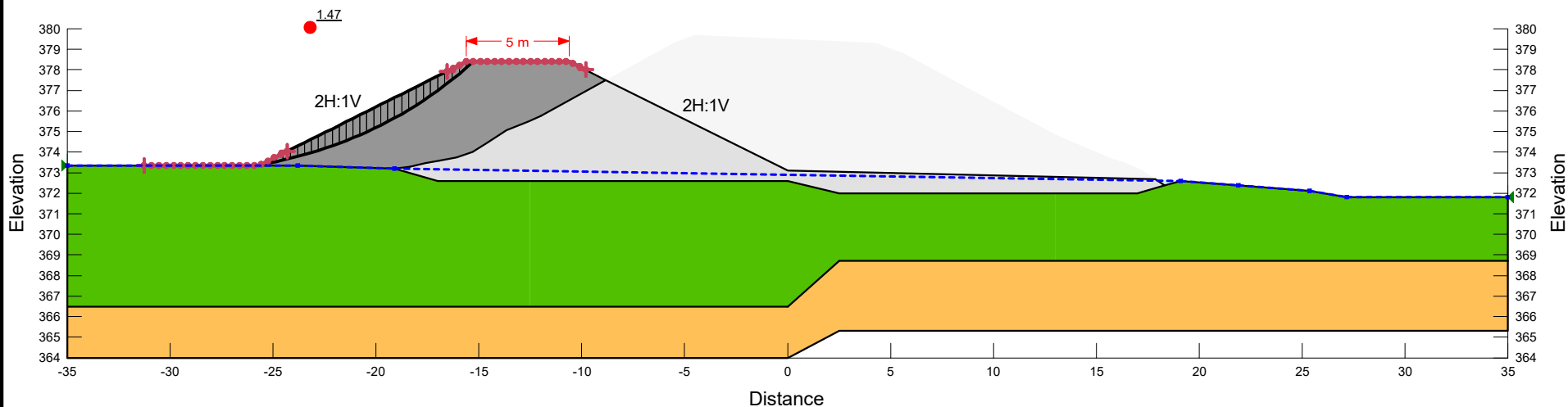


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 East Side Temp. Cut Slope at 2H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:24 PM	1:301

Additional Details  
 Name: Stage 1 East Side Temp. Cut Slope at 2H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (-10.901008, 378.4) m, Exit: (-0.1793575, 373.18968) m  
 Center: (3.6479836, 394.70199) m, Radius: 21.850127 m

**Figure 5**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

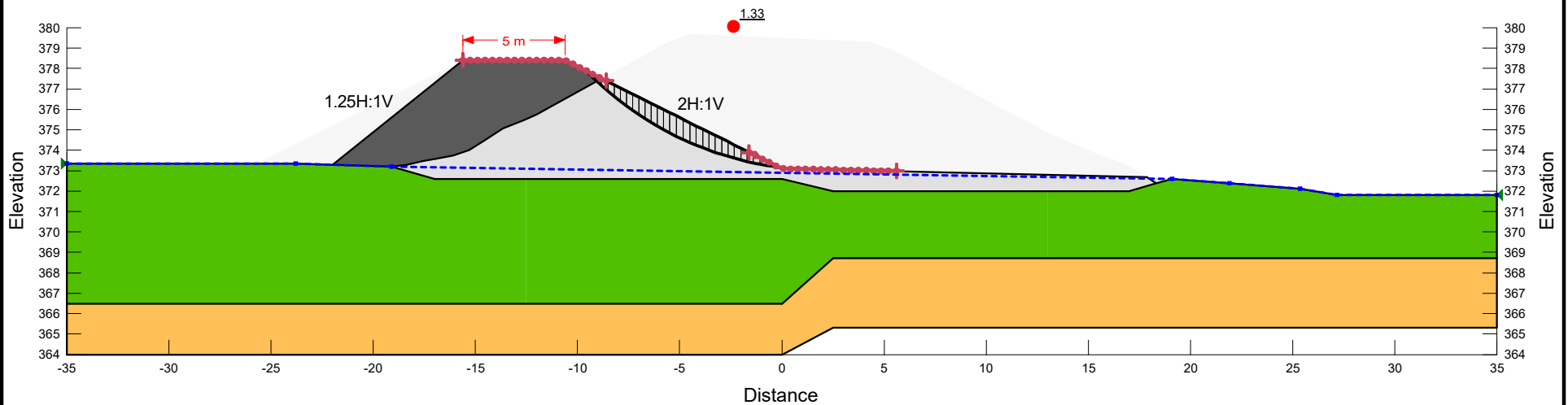


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 1 West Side Embank. Widening at 2H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:36 PM	1:301

Additional Details  
 Name: Stage 1 West Side Embank. Widening at 2H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Embedment Depth: 1 m  
 Entry: (-25.572814, 373.41359) m, Exit: (-15.270812, 378.4) m  
 Center: (-28.886987, 393.39599) m, Radius: 20.255367 m

**Figure 6**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	Rock Fill	19	0	42
<span style="color: orange;">■</span>	Silt	20	0	29



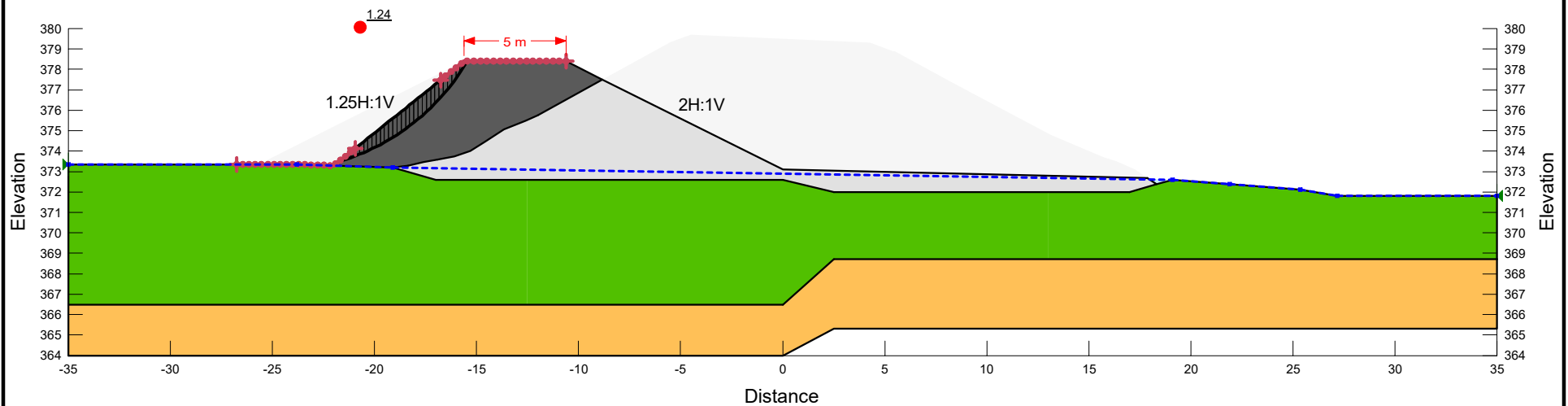
Project		
Hwy 72 Non-Structural High Fill Culvert (Pickere)		
Analysis		
Stage 1 East Side Temp. Cut Slope at 2H:1V with Rock Fill (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:27 PM	1:301

Additional Details  
 Name: Stage 1 East Side Temp. Cut Slope at 2H:1V with Rock Fill  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Entry: (-9.5724335, 377.88625) m, Exit: (-0.1490065, 373.1745) m  
 Center: (1.8730034, 388.99774) m, Radius: 15.951909 m

**Figure 7**



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	Rock Fill	19	0	42
■	Silt	20	0	29

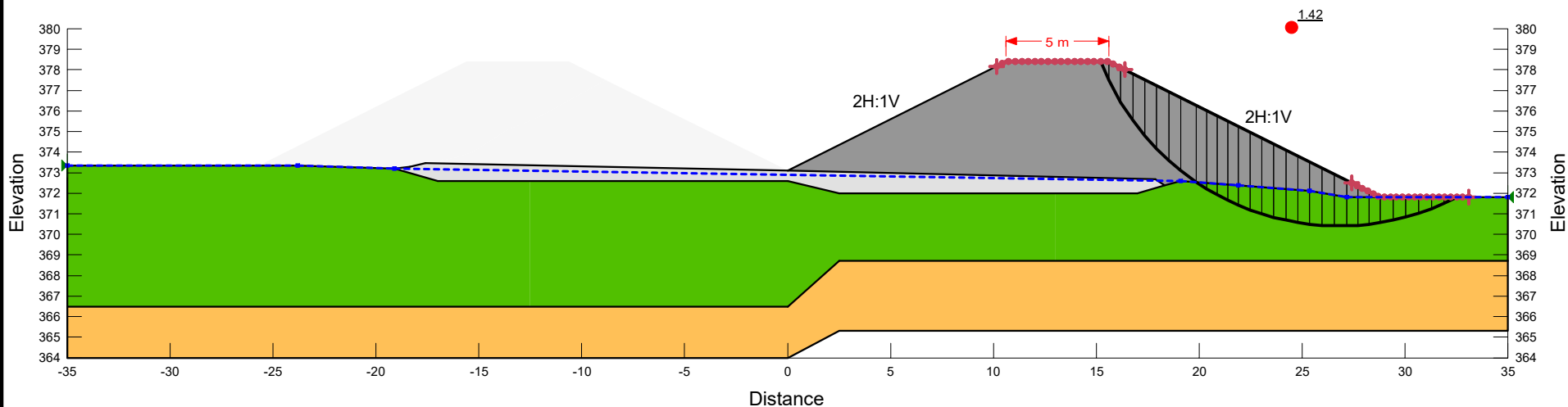


Project	
Hwy 72 Non-Structural High Fill Culvert (Pickerel)	
Analysis	
Stage 1 West Side Embank. Widening at 1.25H:1V with Rock Fill (Drained)	
Seismic Coefficient	Last Run
H: 0g, V: 0g	2024-03-19, 03:31:29 PM
Scale	1:301

Additional Details  
 Name: Stage 1 West Side Embank. Widening at 1.25H:1V with Rock Fill  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (-21.7452, 373.49589) m, Exit: (-15.455906, 378.4) m  
 Center: (-24.787476, 383.88239) m, Radius: 10.822882 m

**Figure 8**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29

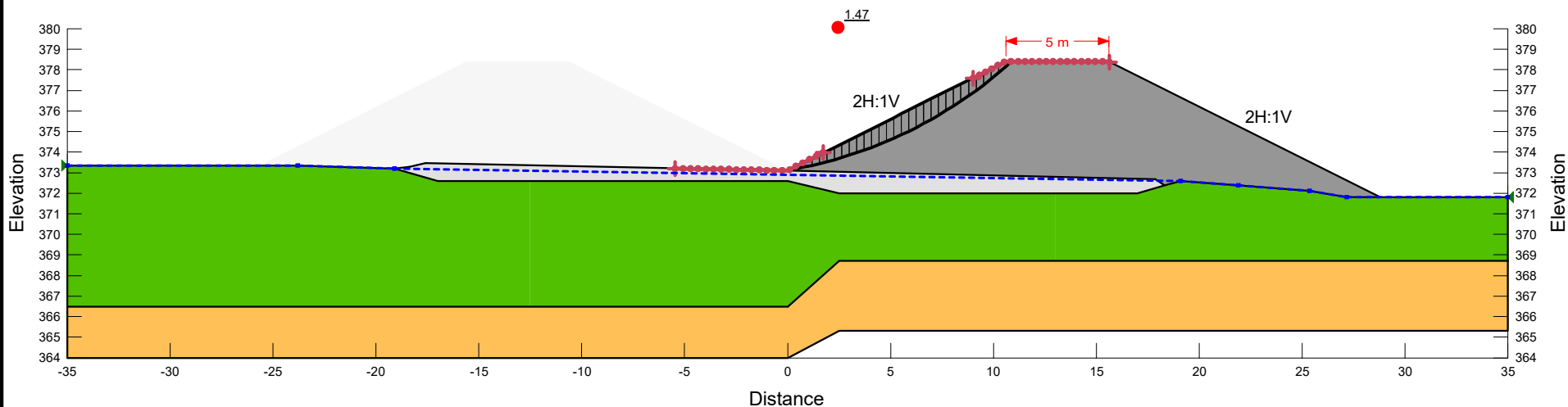


Project	
Hwy 72 Non-Structural High Fill Culvert (Pickerel)	
Analysis	
Stage 2 East Side New Embank. at 2H:1V with Gran. B Type II (Drained)	
Seismic Coefficient	Last Run
H: 0g, V: 0g	2024-03-19, 03:31:42 PM
Scale	1:301

Additional Details  
Name: Stage 2 East Side New Embank. at 2H:1V with Gran. B Type II  
Comments: Sta. 25+608  
Method: Morgenstern-Price, Half-Sine  
Minimum Slip Surface Depth: 1 m  
Entry: (15.214919, 378.4) m, Exit: (32.513475, 371.8) m  
Center: (26.810941, 382.8234) m, Radius: 12.411051 m

**Figure 9**

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	OPSS Gran. B Type II	22	0	35
■	Silt	20	0	29

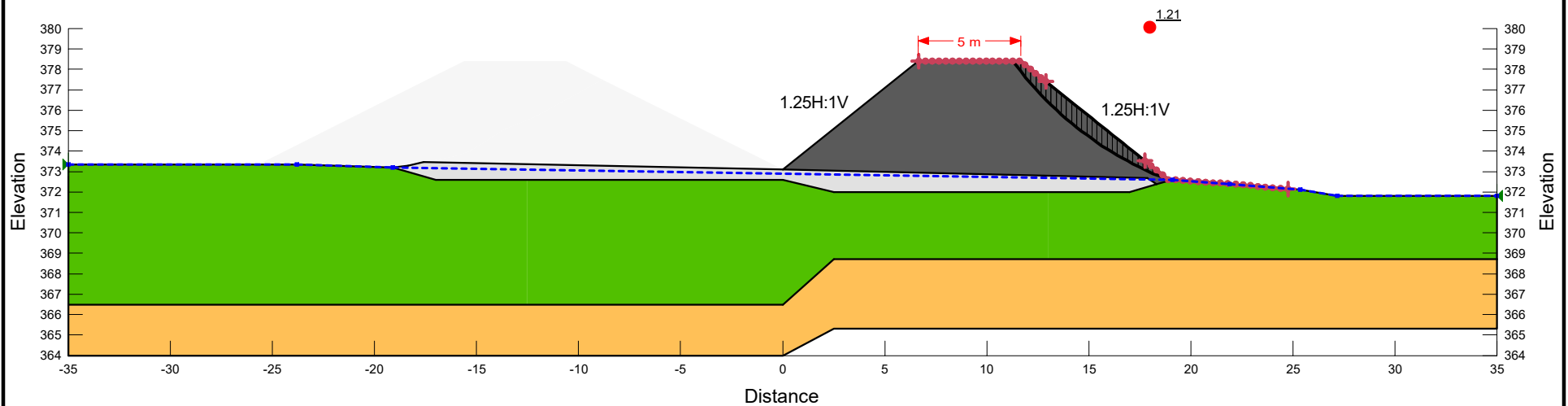


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 2 West Side New Embank. at 2H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:46 PM	1:301

Additional Details  
Name: Stage 2 West Side New Embank. at 2H:1V with Gran. B Type II  
Comments: Sta. 25+608  
Method: Morgenstern-Price, Half-Sine  
Minimum Failure Surface Depth: 1 m  
Entry: (0.088586044, 373.14429) m, Exit: (10.857838, 378.4) m  
Center: (-3.4827075, 394.12335) m, Radius: 21.28086 m

**Figure 10**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	Rock Fill	19	0	42
■	Silt	20	0	29

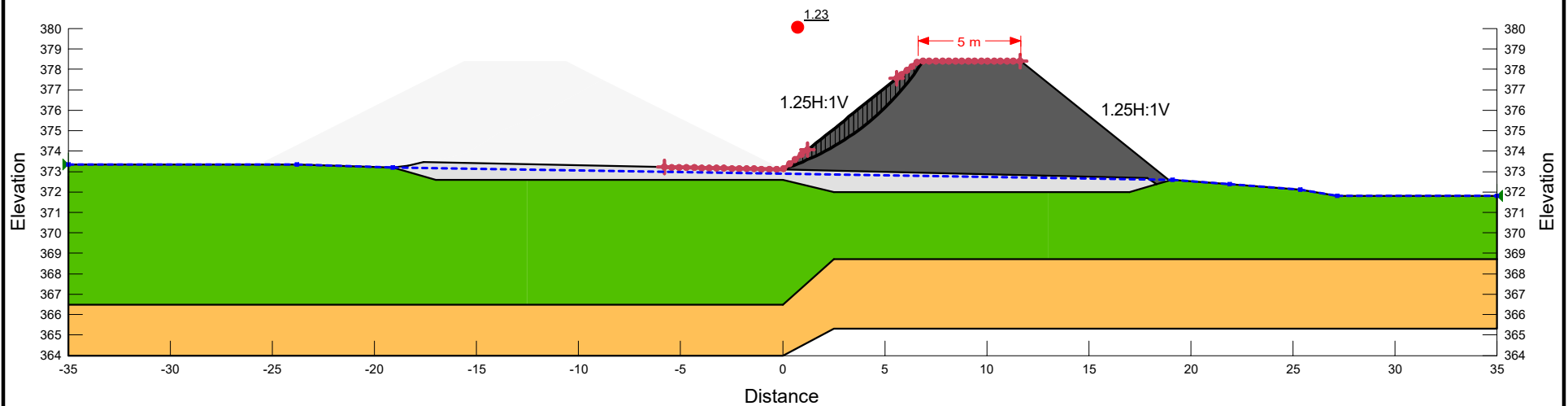


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 2 East Side New Embank. at 1.25H:1V with Rock Fill (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:39 PM	1:301

Additional Details  
 Name: Stage 2 East Side New Embank. at 1.25H:1V with Rock Fill  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (11.278111, 378.4) m, Exit: (18.897382, 372.60458) m  
 Center: (24.956639, 388.47697) m, Radius: 16.989627 m

**Figure 11**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	Rock Fill	19	0	42
■	Silt	20	0	29

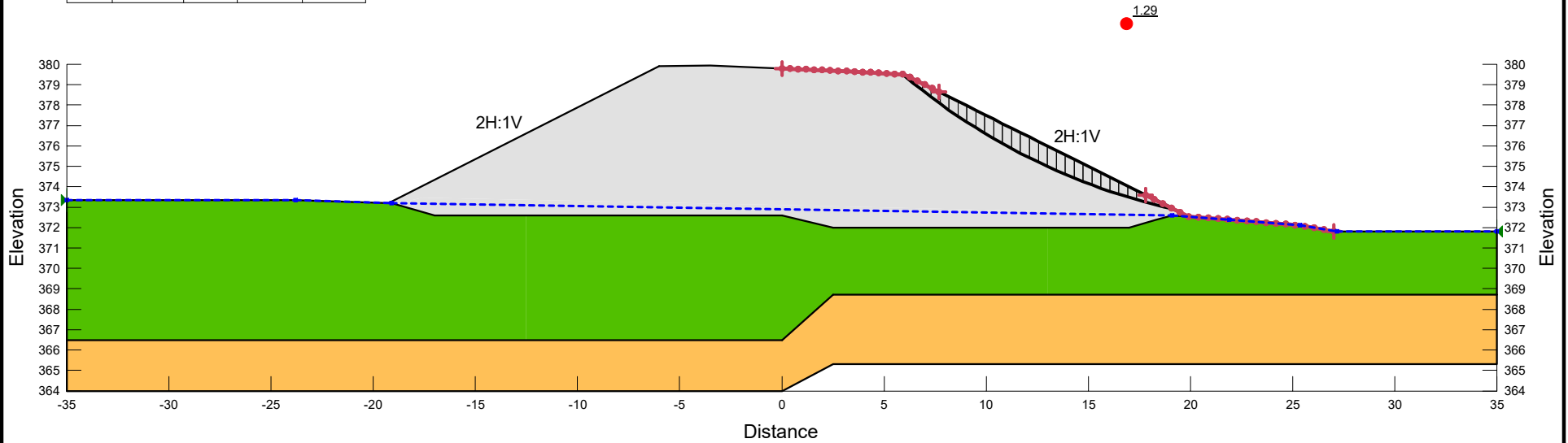


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 2 West Side New Embank. at 1.25H:1V with Rock Fill (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-19, 03:31:44 PM	1:301

Additional Details  
 Name: Stage 2 West Side New Embank. at 1.25H:1V with Rock Fill  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Entry: (0.056240104, 373.14482) m, Exit: (6.8726022, 378.4) m  
 Center: (-3.9431981, 385.38065) m, Radius: 12.872881 m

**Figure 12**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	Silt	20	0	29

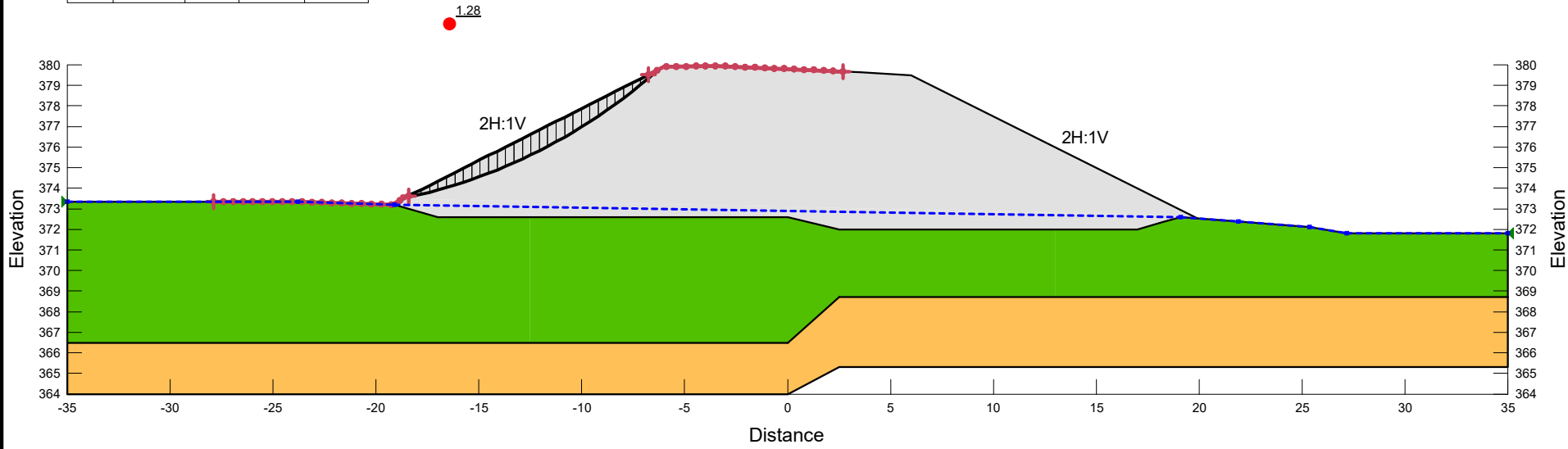


Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 3 East Side Final Config. at 2H:1V with Existing Fill (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-13, 05:05:02 PM	1:301

Additional Details	
Name: Stage 3 East Side Final Config. at 2H:1V with Existing Fill	
Comments: Sta. 25+608	
Method: Morgenstern-Price, Half-Sine	
Minimum Slip Surface Depth: 1 m	
Entry: (5.9239921, 379.50456) m, Exit: (19.175842, 372.90531) m	
Center: (25.88145, 402.97578) m, Radius: 30.809061 m	

**Figure 13**

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Clay and Sand (Drained)	18.5	2	28
■	Existing Fill	21	0	32
■	Silt	20	0	29




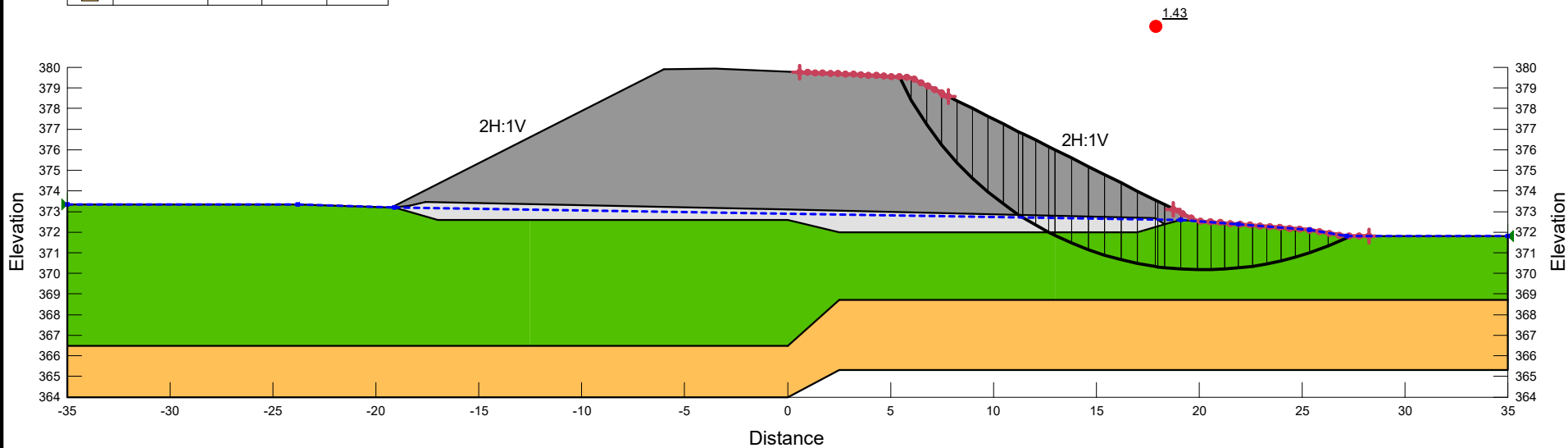
	Project		Additional Details	
	Hwy 72 Non-Structural High Fill Culvert (Pickerel)		Name: Stage 3 West Side Final Config. at 2H:1V with Existing Fill	
	Analysis		Comments: Sta. 25+608	
	Stage 3 West Side Final Config. at 2H:1V with Existing Fill (Drained)		Method: Morgenstern-Price, Half-Sine	
	Seismic Coefficient		Entry: (-18.623346, 373.52144) m, Exit: (-6.3239682, 379.7363) m	
H: 0g, V: 0g		Center: (-24.140145, 399.71716) m, Radius: 26.770337 m		
Last Run		Scale		
2024-03-13, 05:05:05 PM		1:301		

Figure 14

Figure 14

Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29



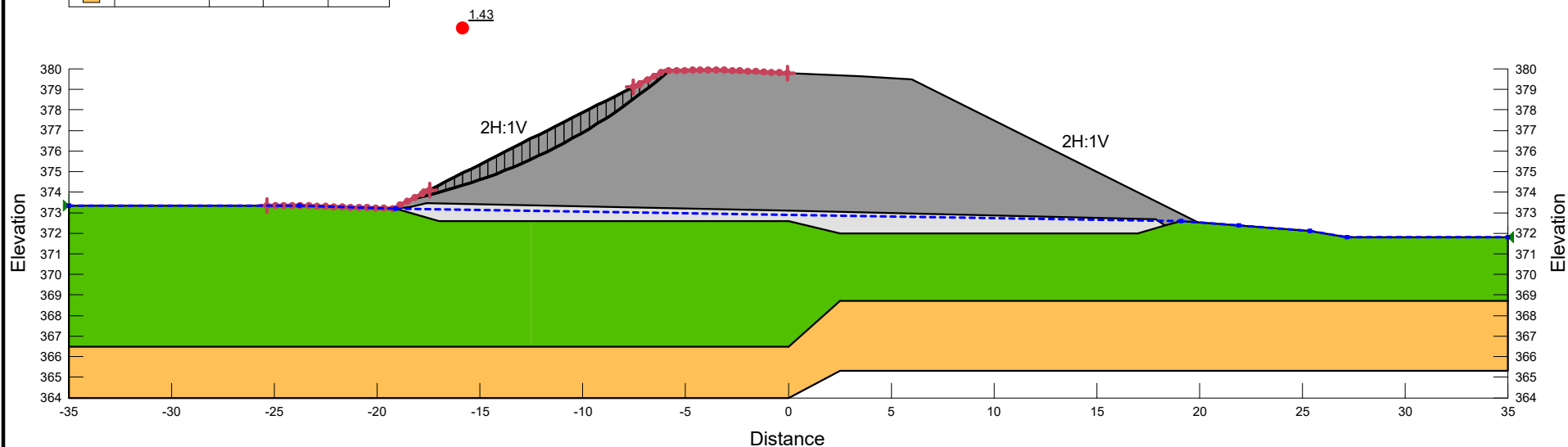
Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 3 East Side Final Config. at 2H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-13, 05:13:54 PM	1:301

Additional Details  
 Name: Stage 3 East Side Final Config. at 2H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (5.4169065, 379.53499) m, Exit: (27.282105, 371.8) m  
 Center: (20.178946, 386.49252) m, Radius: 16.319471 m

**Figure 15**



Color	Name	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
<span style="color: green;">■</span>	Clay and Sand (Drained)	18.5	2	28
<span style="color: lightgray;">■</span>	Existing Fill	21	0	32
<span style="color: gray;">■</span>	OPSS Gran. B Type II	22	0	35
<span style="color: orange;">■</span>	Silt	20	0	29



Project		
Hwy 72 Non-Structural High Fill Culvert (Pickerel)		
Analysis		
Stage 3 West Side Final Config. at 2H:1V with Gran. B Type II (Drained)		
Seismic Coefficient	Last Run	Scale
H: 0g, V: 0g	2024-03-13, 05:15:11 PM	1:301

Additional Details  
 Name: Stage 3 West Side Final Config. at 2H:1V with Gran. B Type II  
 Comments: Sta. 25+608  
 Method: Morgenstern-Price, Half-Sine  
 Minimum Slip Surface Depth: 1 m  
 Entry: (-18.296215, 373.68674) m, Exit: (-5.814099, 379.90372) m  
 Center: (-24.18302, 401.14489) m, Radius: 28.082105 m

**Figure 16**