Appendix A
Soil Investigation and Railway Crossing

May 25, 2022

CONFIDENTIAL – ISSUED FOR USE
FILE: 734 -2200120200-PAL-G0001-01
Via Email: Utilities_RequestsCanada@cpr.ca

Canadian Pacific Railway
Suite 500 Gulf Canada Square
401 9th Avenue SW
Calgary, AB T2P 4Z4

Attention: Mr. Jack Carello

Subject: Request for Railway Crossing Permit
Midland Street near Saskatchewan Avenue, Winnipeg, Manitoba

We are requesting a permit for a buried watermain pipeline crossing a CPR spur line on Midland Street near Saskatchewan Avenue in Winnipeg, Manitoba. The work is part of the City of Winnipeg 2022 Watermain Renewals (Contract 10) and involves the installation of a 300mm diameter watermain to replace the existing older watermain that is being abandoned. It is anticipated the construction to install the watermain crossing at the CPR spur line will occur in the fall of 2022, pending permit. The spur line runs in a west-east direction crossing Midland Street in the area under review for permit.

Applicant Information:

Tetra Tech Canada Inc.
Indira Maharaj, P.Eng.
400-161 Portage Avenue East
Winnipeg, MB R3B 0Y4
Phone: 204-954-6844
indira.maharaj@tetratech.com

Utility Owner:

City of Winnipeg
Ryan Lucky, P.Eng.
110-1199 Pacific Avenue
Winnipeg, MB R3E 3S8
112-1199 Pacific Avenue
Winnipeg, MB R3E 3S8 (invoicing)
Phone: 204-986-2538
ryanlucky@winipeg.ca

Information requested for invoicing or otherwise, should reference the City of Winnipeg 362-2022 Bid Opportunity, 2022 Watermain Renewals Contract No 10. The agreement should be sent to the applicant (which is also the contract administrator).

Emergency phone number (utility break or damage): 204-986-2626

The City of Winnipeg also has a 311 service.

The watermain crossing uses a casing pipe that has been designed to the guidelines specified in the AREMA Manual of Railway Engineering, Chapter 1, Part 5, Pipelines. An information table for the crossing (based on AREMA Table 1-5-6) is attached within the attached sketch along with the construction drawing.

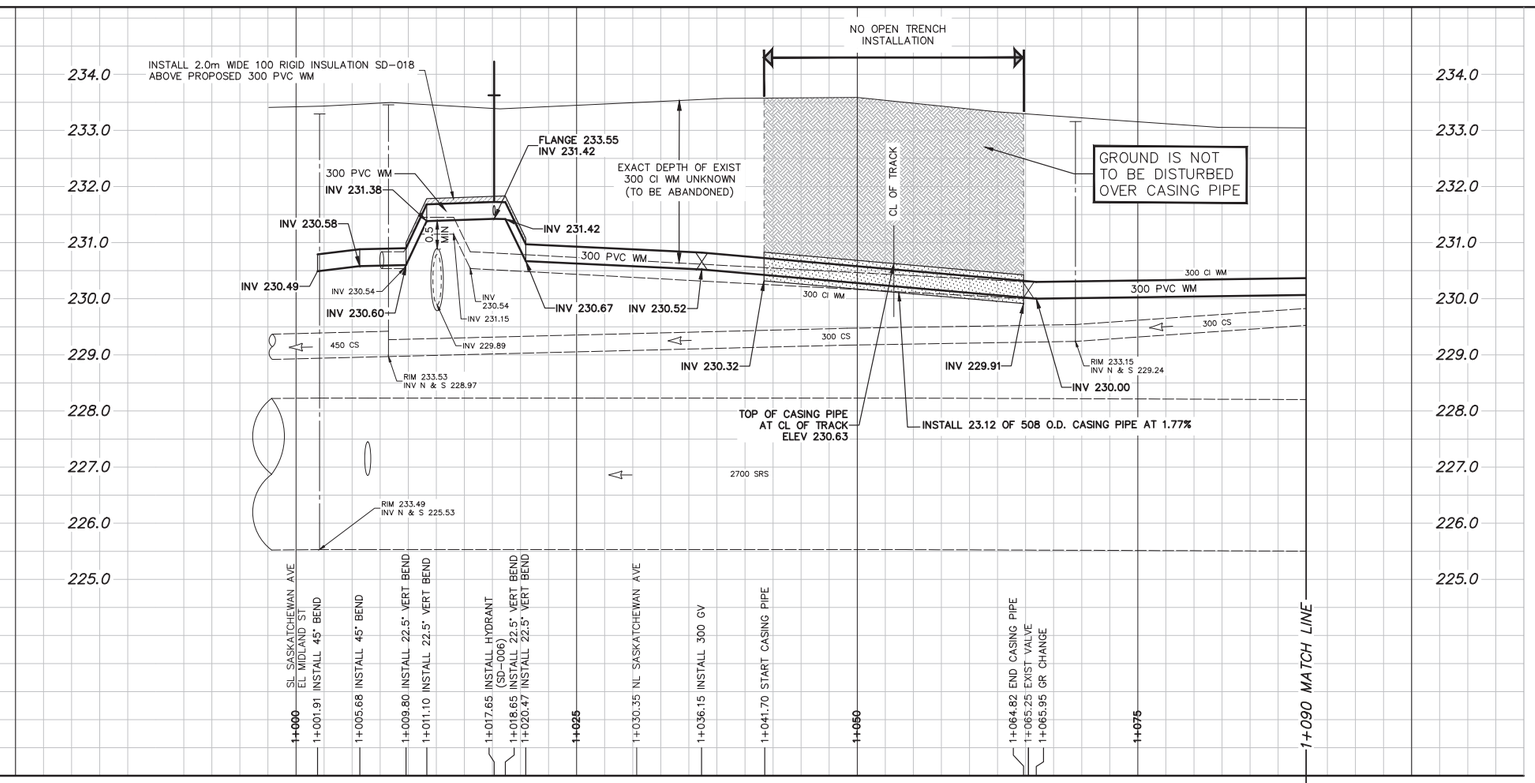
If you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Prepared by:
Indira Maharaj, P.Eng.
Senior Project Engineer
indira.maharaj@tetratech.com

IM/km

Attachments: WM Crossing on Midland Street for CPR Approval (2200120200-SKT-C0001)
Drawing No 2200120200- DWG-C0006 (City Drawing No D-16338)

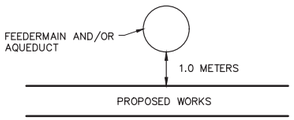


INSTALLATION EQUIPMENT FOR THE PROPOSED WORKS SHALL NOT CROSS OR TRAVEL ALONG EITHER SIDE OF THE AQUEDUCT WITHIN A LATERAL DISTANCE OF 5.0 METERS FROM THE CENTERLINE OF THE AQUEDUCT AND/OR FEEDERMAIN.

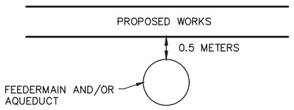
CONCRETE DEMOLITION AND REMOVAL WITHIN 3 METERS HORIZONTALLY OF THE AQUEDUCT AND/OR FEEDERMAIN SHALL BE COMPLETED BY SAWCUTTING AND REMOVAL, OR BY THE USE OF HAND HELD JACKHAMMERS. USE OF MACHINE MOUNTED CONCRETE BREAKERS ABOVE THE AQUEDUCT AND/OR FEEDERMAIN SHALL NOT BE PERMITTED.

DO NOT OPERATE VIBRATORY EQUIPMENT OVER OR WITHIN 3.0 METERS OF THE AQUEDUCT AND/OR FEEDERMAIN.

A MINIMUM CLEARANCE OF 1.0 METER MUST BE PROVIDED BETWEEN THE UNDERSIDE OF ANY EXISTING AQUEDUCT OR FEEDERMAIN AND THE TOP OF THE PROPOSED WORKS.
THIS INSTALLATION BY TRENCHLESS METHOD ONLY



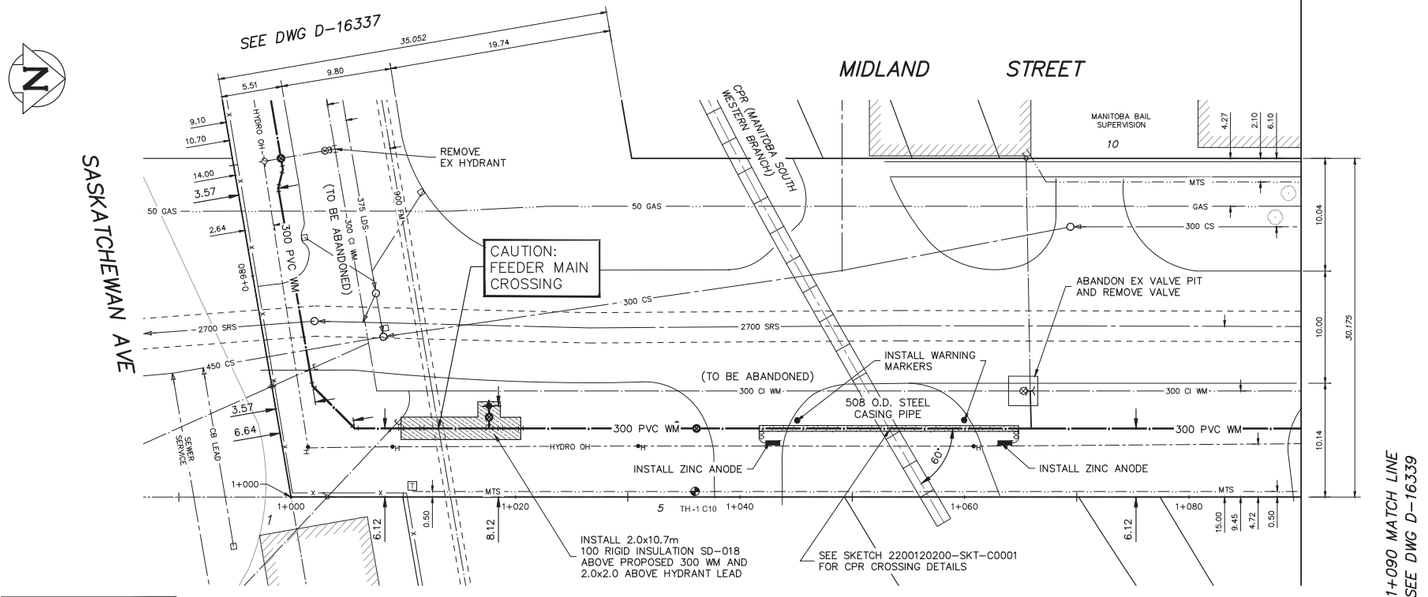
A MINIMUM CLEARANCE OF 0.5 METER MUST BE PROVIDED BETWEEN THE UNDERSIDE OF THE PROPOSED WORKS AND THE TOP OF ANY EXISTING AQUEDUCT OR FEEDERMAIN BY TRENCHLESS OR OPEN TRENCH.



A SHAFT MUST BE EXCAVATED BY SOFT DIG METHODS 4.0 METERS FROM THE CENTERLINE OF THE AQUEDUCT AND/OR FEEDERMAIN TO CONFIRM THE ALIGNMENT AND ELEVATION OF THE DRILLING ROD BEFORE IT CROSSES OVER OR UNDER THE AQUEDUCT AND/OR FEEDERMAIN.
THE CONFIRMATION MUST BE WITNESSED BY A CITY REPRESENTATIVE.

NOTE:

NOTIFY CONSTRUCTION SERVICES COORDINATION (CITY OF WINNIPEG) AT 986-4289, 48 HOURS PRIOR TO EXCAVATION NEAR FEEDERMAIN.



REFER TO D-16334 FOR CONSTRUCTION NOTES

NOTE: CHAINAGES SHOWN ARE ALONG E. ℄ OF MIDLAND STREET

FOR INDEX SEE D-16334

WATER SERVICE INFORMATION

ADDRESS	SIZE (mm) MATERIAL (STREET)	SIZE (mm) MATERIAL (PROP.)	SHORT & LONG MEASUREMENT	CORP. LOCATION	REMARKS
1 MIDLAND STREET CIVIC	38 CU	38 CU	3.2 N OF SL SASKATCHEWAN AVE 6.7 S OF NLL	7.3 N OF S/C	NORTH BUILDING
1 MIDLAND STREET CIVIC	38 CU	38 CU	10 W OF EL MIDLAND STREET 20.6 E OF WLL	2.3 W OF S/C	SOUTH BUILDING
10 MIDLAND STREET PROVINCIAL	38 CU	38 CU	12.2 N OF SL BLDG 35.1 N OF NL SASKATCHEWAN AVE	.36 N OF S/C	

• SERVICES TO BE RENEWED TO ℄. ALL OTHERS TO BE RECONNECTED

NOTE: ALL VALVES TO BE INSTALLED COUNTERCLOCKWISE TO CLOSE (RED OPERATING NUT)

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
Tetra Tech Canada Inc.
No. 6499

METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES
0.0 5.0 10.0 15.0 20.0 25.0

WARNING

IF POWER EQUIPMENT OR EXPLOSIVES ARE TO BE USED FOR EXCAVATION ON THIS PROJECT THE CONTRACTOR MUST:

1) NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.

2) TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.

SEE PROVINCIAL REGULATION 210/72 FOR DETAILS

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE _____ DATE _____

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

CONSTRUCTION COMPLETION DATE:

NO.	REVISIONS	DATE	BY
0	ISSUED FOR TENDER	22/05/25	IJM

TETRA TECH

DESIGNED BY	SR	CHECKED BY	IJM
DRAWN BY	NL	APPROVED BY	IJM
SCALE: HORIZONTAL	1:250	RELEASED FOR CONSTRUCTION	
VERTICAL	1:50		
DATE	2022 05 25	DATE	

ENGINEER'S SEAL
PROVINCE OF MANITOBA
2022-05-25
I. J.
MAHARAJ
Member
20797
REGISTERED PROFESSIONAL ENGINEER

CONSULTANT DRAWING NUMBER
2200120200-DWG-C0006

Winnipeg

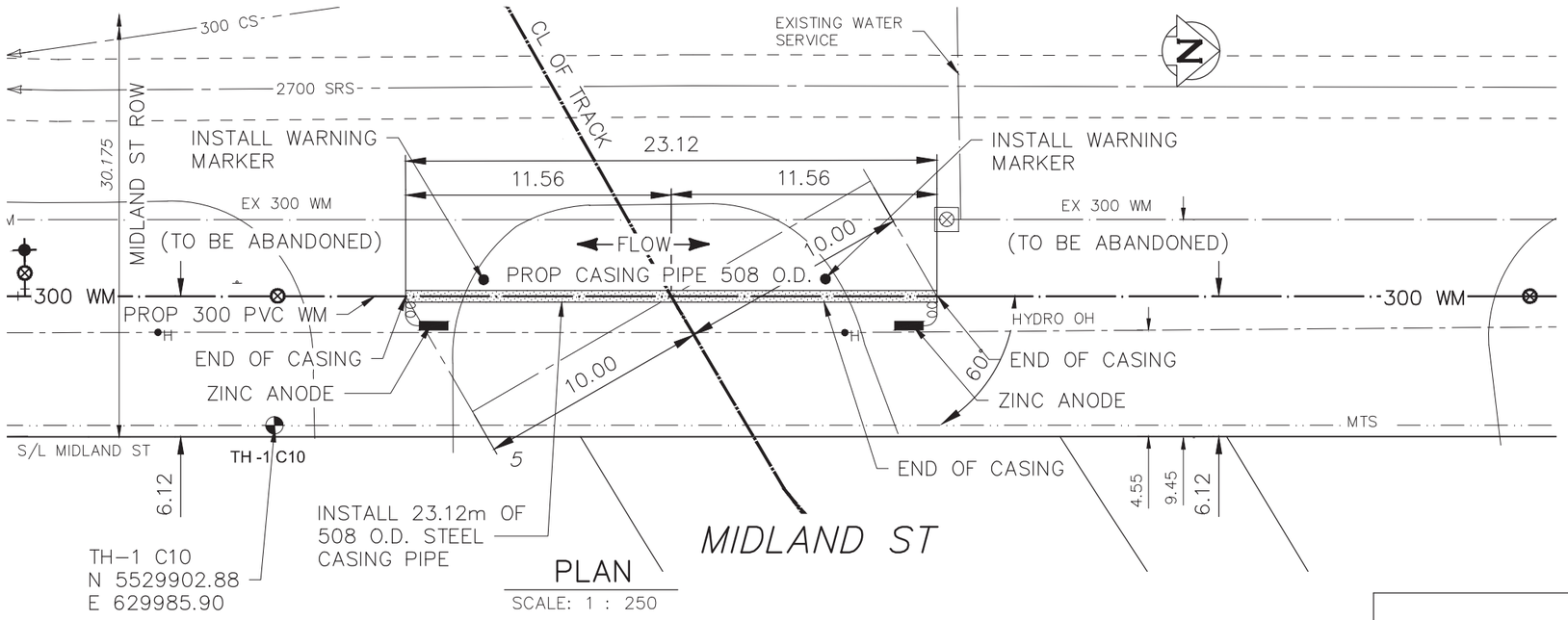
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT
ENGINEERING DIVISION

2022 WATERMAIN RENEWALS
CONTRACT 10
MIDLAND STREET
SAKATCHEWAN AVE TO 60m NORTH

SHEET 6 OF 12
CITY DRAWING NUMBER
D-16338

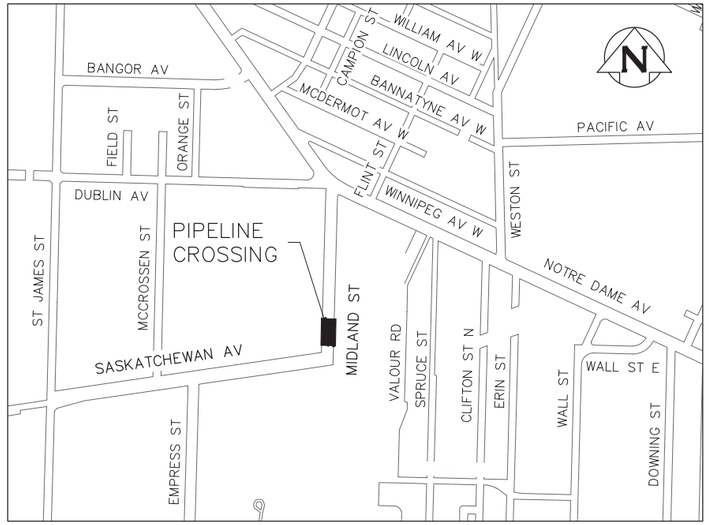
TENDER: 362-2022
CONTRACT NUMBER: 10

FILE PATH: \\TTS2SKFS2.TT.LOCAL\Projects\A-G\City of Winnipeg-Water&Waste Department-0012\734-20001204.00-2020 Water Main Renewals - C3\CAD\Civil\Production Drawings\
FILE NAME: C1003-C1007 2200120200-DWG-C0003-7 Saskatchewan_Midland.dwg



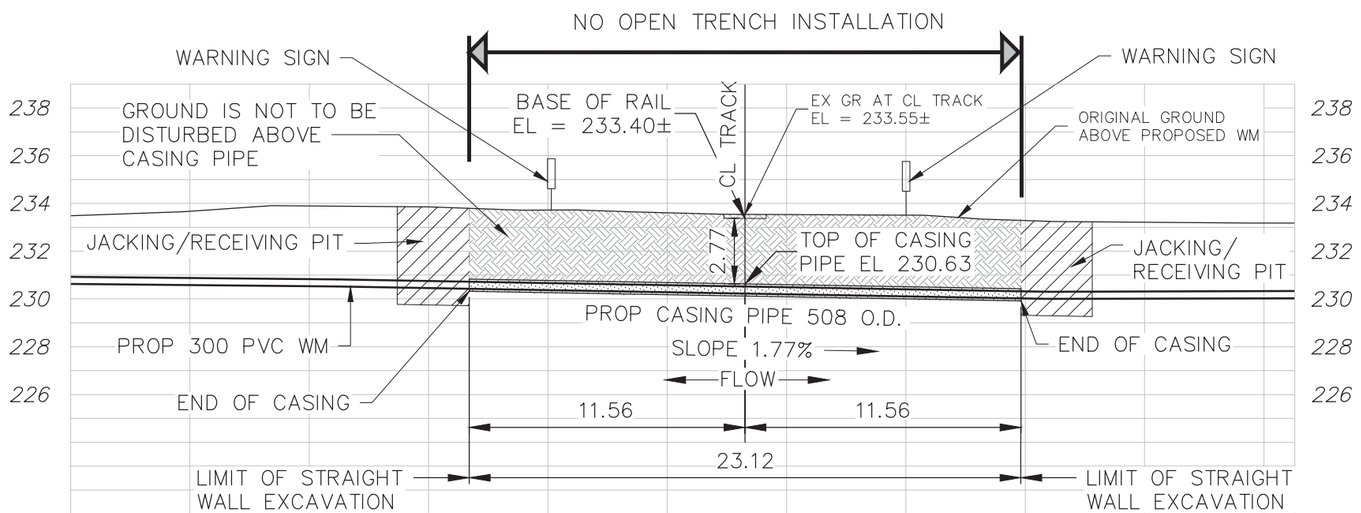
PLAN

SCALE: 1 : 250



LOCATION PLAN

SCALE: 1 : 15000



PROFILE

HOR & VERT SCALE: 1 : 250

PIPE SPECIFICATIONS				
PIPE	OUTSIDE DIAMETER	WALL THICKNESS	SPECIFICATION	COMMENTS
CARRIER PIPE	335MM	19MM	PVC DR 18 BELL & SPIGOT (WATERMAIN)	WORKING PRESSURE – 450 kPa/ TESTED AT 1034 kPa
CASING PIPE	508MM	15MM	CARBON STEEL ASTM A53 SCHEDULE 40 – JOINT WELD	TRENCHLESS INSTALLATION
SPACERS			SS BANDS, POLYMER RUNNERS (APS MODEL SSI)	YES SEE NOTES: MATERIAL 3.
END SEALS			RUBBER (APS MODEL AW)	YES SEE NOTES: MATERIAL 4.
CATHODIC PROTECTION			10.9 kg ZINC ANODES	YES SEE NOTES: MATERIAL 5.

CONSTRUCTION NOTES:

1. CONSTRUCTION IN ACCORDANCE WITH TRANSPORT CANADA STANDARD (TCE–10)
2. CASING PIPE WILL BE INSTALLED USING TRENCHLESS METHODS BY HORIZONTAL EARTH CORING.
3. THE WATERMAIN PIPE WILL BE INSERTED INTO THE CASING PIPE COMPLETE WITH SPACERS AND END SEALS.
4. EMERGENCY VALVE LOCATIONS FOR THE 300mm WATERMAIN (25.8 M NORTH & 5.6 M SOUTH – FROM CASING PIPE END POINTS).

DESIGN NOTES:

1. CROSSING TO BE DESIGNED, CONSTRUCTED, MAINTAINED AND OPERATED IN ACCORDANCE WITH TRANSPORT CANADA STANDARD (TCE – 10), STANDARDS RESPECTING PIPELINE CROSSING UNDER RAILWAYS
2. THE WATERMAIN CROSSINGS UTILIZE CASING PIPES DESIGNED TO THE GUIDELINES SPECIFIED IN THE AREMA MANUAL OF RAILWAY ENGINEERING CHAPTER 1 PART 5 "PIPELINES".

MATERIALS:

1. CARRIER PIPE – POTABLE WATER PIPE PVC AWWA C–900 CLASS 150 (DR18)
2. ENCASEMENT PIPE – SHALL CONFORM TO ASTM A53 STEEL PIPE, ASTM SPECIFICATIONS A134 MILD CARBON STEEL, A139, GRADE B. BUTT WELD JOINTS SHALL HAVE A MINIMUM THICKNESS OF 13mm REGARDLESS OF DIAMETER. NO COATING
3. ENCASEMENT PIPE SPACERS – SHALL BE 200MM WIDE, HEAVY DUTY TWO PIECE STAINLESS STEEL BANDS WITH 25mm WIDE BY 75mm SPACERS, EQUAL TO ADVANCE PRODUCTS AND SYSTEMS INC. (APS) MODEL SS18.
4. ENCASEMENT PIPE SEALS – SHALL BE WRAPAROUND RUBBER WITH STAINLESS STEEL BAND CLAMPS AND WATERPROOF MASTIC SEALS SPACERS EQUAL TO ADVANCE PRODUCTS AND SYSTEMS INC. (APS) MODEL AW OR AZ.
5. SACRIFICIAL ANODE – 10.9 kg ZINC ANODES AT EACH END OF CASING PIPE.

PROVINCE OF MANITOBA
2022-05-25
I. J. MAHARAJ
Member
20797
REGISTERED PROFESSIONAL ENGINEER

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

TETRA TECH

DRAWING DESCRIPTION

WM CROSSING ON MIDLAND STREET FOR CPR APPROVAL

AUTHORIZED BY: IJM	CLIENT DRAWING NO.			
DATE: 22/05/11				
DESIGNED BY: SJR	DRAWN BY: NL/SJR	DRAWING NO.	REV.	
REVIEWED BY: IJM	SCALE: 1 : 250	2200120200-SKT-C0001	0	

GEOTECHNICAL
ENGINEERS

DYREGROV ROBINSON INC.
1692 Dublin Ave #1, Winnipeg, MB, Canada R3H 1A8
204.632.7252
DRIGEOTECHNICAL.CA

May 19, 2022 File No. 224594

Tetra Tech Canada Inc.
400 - 161 Portage Avenue East
Winnipeg, MB R3B 0Y4

Attn: Indira Maharaj, P. Eng.

RE: City of Winnipeg – Watermain Renewals - Contract 10
Geotechnical Investigation

As requested, Dyregrov Robinson Inc. (DRI) has undertaken a geotechnical investigation near the Canadian Pacific Railway (CPR) crossing on Midland Street in Winnipeg, MB where a new watermain will be installed below the CPR Right-of-Way for the City of Winnipeg Watermain Renewals (Contract 10) project. The purpose of the investigation was to explore the subsurface conditions in the area of the proposed watermain crossing on Midland Street. The work was authorized by Indira Maharaj of Tetra Tech Canada Inc. on March 30, 2022.

1) Proposed Development and Site Conditions

Based on the attached drawing from Tetra Tech, titled “WM Crossing On Midland Street For CPR Approval”, we understand that a 508 mm OD casing pipe for the watermain crossing will be installed across the CPR Right-of-Way on the east side of Midland Street using trenchless methods by horizontal earth coring. A 335 mm diameter watermain carrier pipe will be inserted into the casing pipe complete with spacers and end seals. The crown of the casing pipe is at elevation 230.63 m which corresponds to a depth of about 2.8 m below the center line of the railway tracks. The total length of trenchless pipe installation will be about 23 m, with a jacking/receiving pit at each end of the casing pipe.

The project site is located in the boulevard on the east side of Midland Street and starts approximately 25 to 30 m north of Saskatchewan Avenue. The test hole was drilled on the boulevard area directly west of the property at 5 Midland Street and approximately 16 m away from the CPR railway tracks. The area around the test hole and railway is generally flat lying. In the area of the proposed watermain renewal project there are overhead power lines and the existing watermain is located along the east side of Midland Street.

2) Field Investigation

On April 19, 2022, one test hole was drilled at the approximate location illustrated on Figure 1. The test hole was drilled by Paddock Drilling Ltd. using a truck mounted Acker MP8 drill rig equipped with 125 mm solid stem augers. The test hole was drilled to a depth of 6.1 m (20 feet) below grade.

The subsurface conditions were visually logged during drilling by DRI. Disturbed (auger cuttings) and undisturbed (Shelby tube) soil samples were recovered at regular depth intervals. The test hole was backfilled to grade with auger cuttings and bentonite chips. All samples were taken to DRI’s Soils Testing Laboratory for additional visual classification and testing. The testing included determining the moisture contents of all samples and measuring bulk unit weights and undrained shear strengths on the Shelby tube samples. The test hole log in Appendix A summarizes the subsurface conditions encountered, results of

the laboratory testing and notes on the observations made during drilling. The UTM coordinates and ground elevation shown on the test hole log were surveyed by Tetra Tech.

3) Subsurface Conditions

The soil stratigraphy encountered in the test hole consists of clay fill, silt and silty clay. A general description of the main stratigraphic units is described below and is based on the test hole log in Appendix A. Refer to the test hole log for detailed information.

Clay Fill

A layer of clay fill was encountered at grade in the test hole. The clay fill is about 1.2 m thick and it contains trace to some sand and trace gravel. It is brown in color and wet with a soft to firm consistency. The moisture content of the clay fill is around 56 percent.

Silt

A silt layer was encountered at a depth of 2.1 m below grade. The silt layer is about 1.2 m thick and contains trace clay. It is light brown in color and is moist to wet with a loose compactness condition. The moisture content of the silt layer is around 27 percent.

Silty Clay

Lake Agassiz lacustrine silty clay was encountered beneath the clay fill layer at a depth of 1.2 m and beneath the silt layer at a depth of 3.3 m below grade. The upper layer of clay (above the silt layer) is approximately 0.9 m thick and it is brown in color, moist to wet with a stiff consistency and has high plasticity. The moisture content of the upper clay layer is around 40 percent.

The main deposit of silty clay below the silt layer is mottled brown and grey in color, moist with a firm to stiff consistency and it has high plasticity. The moisture content of the clay ranges from about 50 to 60 percent. The undrained shear strength of the clay was measured from the Shelby tube sample (T15), which was recovered at a depth of 4.6 m, using Torvane, penetrometer and unconfined compressive strength tests. The clay has undrained shear strengths ranging from about 30 to 60 kPa. The average bulk unit weight of the clay is around 16 kN/m^3.

Glacial till was not encountered in the test hole however, local experience indicates that glacial till is present in the local area at a depth of approximately 10 m.

Test Hole Stability and Groundwater Conditions

In Winnipeg, groundwater usually occurs in shallow perched water tables within fill layers and silt deposits that are quite permeable and underlain by the relatively impermeable Agassiz clays. A groundwater table is not apparent during drilling within the clay soil due to its low permeability.

Trace groundwater seepage was observed from the clay fill layer below a depth of 0.6 m and from the silt layer. Sloughing of the silt layer was observed during drilling. Upon completion of drilling to a depth of 6.1 m, the test hole was open to 2.6 m and no water had accumulated above this depth. The groundwater conditions should be expected to vary seasonally, from year to year and possibly as a result of construction activities.

4) Discussion and Recommendations

Based on the attached test hole log and watermain crossing drawing prepared by Tetra Tech, which shows the top of casing pipe at elevation 230.63 m, the casing pipe will be located towards the bottom of the silt layer and the pipe invert should be a short distance into the underlying clay deposit. The silt layer encountered in the test hole is moist to wet and is susceptible to seepage and sloughing conditions. The extent of the silt layer (e.g. thickness and contact elevation) should be expected to vary along the length of the proposed trenchless pipe installation. The condition of the silt (e.g. moisture content) can vary along the length of the proposed casing pipe installation and seasonally, which will impact the groundwater seepage and sloughing potential of the layer.

Contractor bidding the casement pipe and carrier pipe installation work will need to select a trenchless excavation method that best suits the subsurface conditions expected in the work area and understanding that the subsurface conditions described on the test hole log in Appendix A can vary.

The potential for sulphate attack is considered to be severe (Exposure Class S-2). All concrete in contact with soil should be made with sulphate resistance cement (Type HS) in accordance with the current Manitoba Building Code and relevant CSA standards.

All excavation work should be completed by the Contractor in accordance with the current Manitoba Workplace Health and Safety Regulations to suit the planned and expected construction activities and schedule. Local excavations in fill materials may need to be flatter than allowed in the Manitoba Workplace Health and Safety Regulations. The earth pressure distribution shown on Figure 2 can be used for temporary braced shoring design.

5) Closure

This report and its findings were prepared based on the subsurface conditions encountered in the random representative test hole drilled on April 19, 2022 for the sole purpose of this geotechnical investigation and our understanding of the proposed watermain renewal project crossing the CPR Right-of-Way on Midland Street in Winnipeg, MB at the time of this report. Subsurface conditions are inherently variable and should be expected to vary across the site.

This report was prepared for the sole and exclusive use of Tetra Tech Canada Ltd. for the proposed watermain renewal project across the CPR Right-of-Way on Midland Street in Winnipeg, MB. The information and recommendations contained in this report are for the benefit of Tetra Tech Canada Ltd. only and no other party or entity shall have any claim against Dyregrov Robinson Inc., or the author, nor may this report be used for any other projects, including but not limited to changes in the proposed watermain renewal project without the consent of Dyregrov Robinson Inc. The findings and recommendations in this report have been prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, expressed or implied, is provided.

Please contact the undersigned if we can be of further assistance.

Sincerely,

DYREGROV ROBINSON INC.

Report Prepared By:

for Gil Robinson

Alessandro Augellone, EIT
Geotechnical Engineering Intern

Report Reviewed By:

per Gil Robinson

Gil Robinson, M.Sc., P.Eng.
Senior Geotechnical Engineer

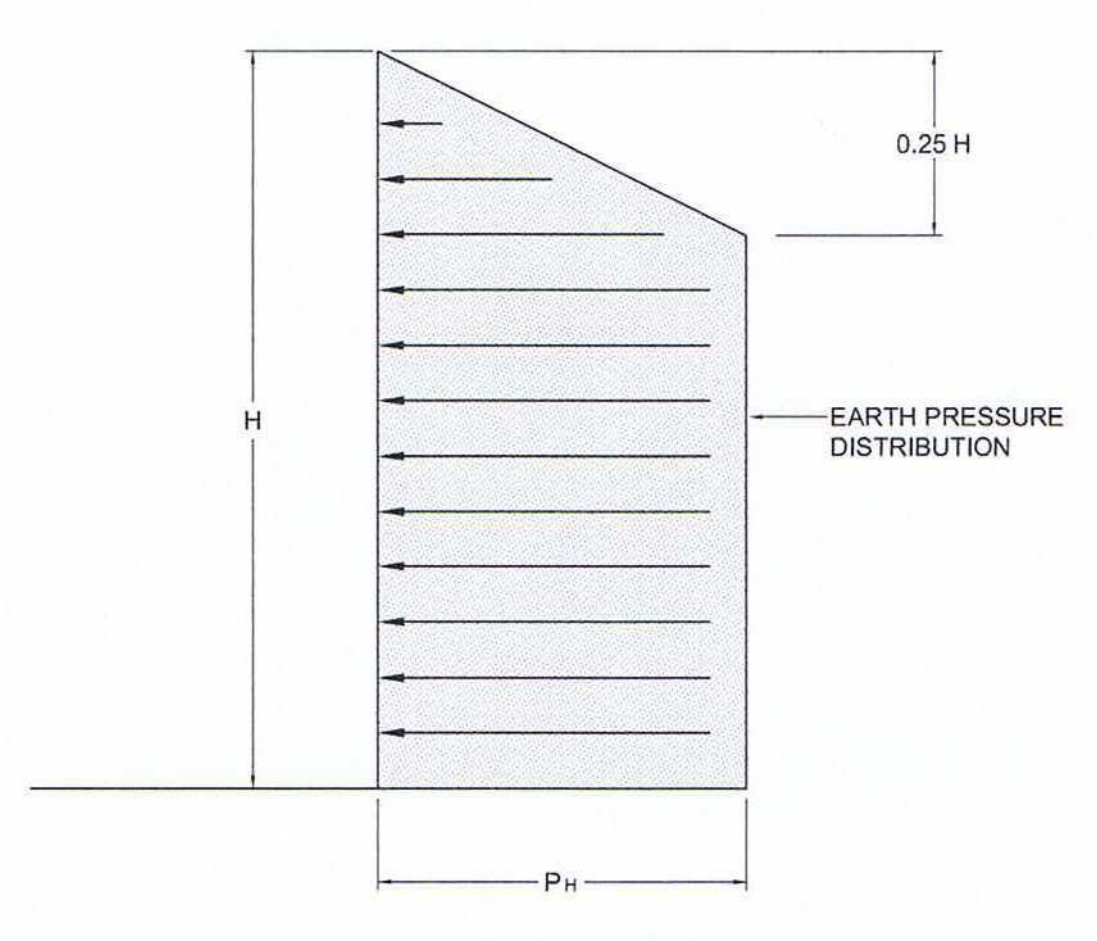
APEGM
Certificate of Authorization
Dyregrov Robinson Inc.
No. 86 Date: 19 May 2022

PROVINCE OF MANITOBA
GR
G.G.B.
ROBINSON
19 May 2022
REGISTERED PROFESSIONAL ENGINEER

DYREGROV ROBINSON INC.

COW Watermain Renewals – Contract 10
Test Hole Location Plan

SCALE:	MADE BY:	CHKD BY:	PROJECT NO.	DATE:	
NTS	AA	GR	224594	May 2022	**Figure 1**



Ph = 0.4 (γH + q)

Where:

Ph = Lateral Earth Pressure (kPa)

γ = Soil Unit Weight (17.3 kN/m^3)

H = Depth of Excavation (m)

q = surface surcharge load (kPa)

DYREGROV ROBINSON INC.			**EARTH PRESSURE DISTRIBUTION TEMPORARY BRACED SHORING**		
SCALE: NTS	MADE BY: GR	CHKD BY: AA	PROJECT NO. 224594	DATE: May 2022	**FIGURE 2**

APPENDIX A

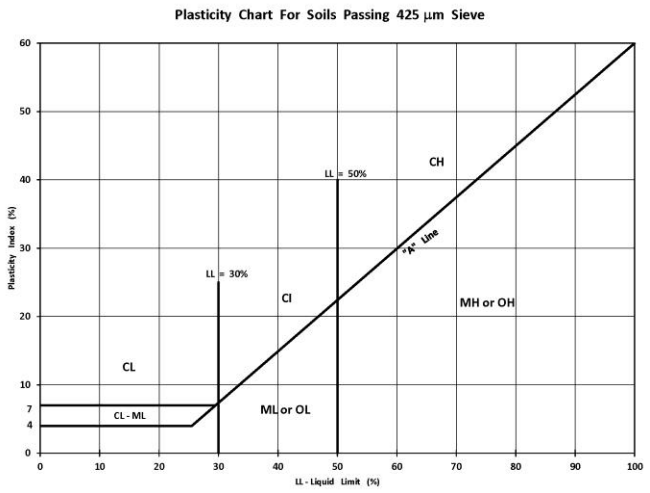
Test Hole Log
&
Tetra Tech Drawing: WM Crossing On Midland Street For CPR Approval

EXPLANATION OF TERMS & SYMBOLS

Description				TH Log Symbols	USCS Classification	Laboratory Classification Criteria			
						Fines (%)	Grading	Plasticity	Notes
COARSE GRAINED SOILS	GRAVELS (More than 50% of coarse fraction of gravel size)	CLEAN GRAVELS (Little or no fines)	Well graded gravels, sandy gravels, with little or no fines		GW	0-5	$C_U > 4$ $1 < C_C < 3$		Dual symbols if 5-12% fines. Dual symbols if above "A" line and $4<W_P<7$ $C_U = \frac{D_{60}}{D_{10}}$ $C_C = \frac{(D_{30})^2}{D_{10} x D_{60}}$
			Poorly graded gravels, sandy gravels, with little or no fines		GP	0-5	Not satisfying GW requirements		
		DIRTY GRAVELS (With some fines)	Silty gravels, silty sandy gravels		GM	> 12		Atterberg limits below "A" line or $W_P<4$	
			Clayey gravels, clayey sandy gravels		GC	> 12		Atterberg limits above "A" line or $W_P<7$	
	SANDS (More than 50% of coarse fraction of sand size)	CLEAN SANDS (Little or no fines)	Well graded sands, gravelly sands, with little or no fines		SW	0-5	$C_U > 6$ $1 < C_C < 3$		
			Poorly graded sands, gravelly sands, with little or no fines		SP	0-5	Not satisfying SW requirements		
		DIRTY SANDS (With some fines)	Silty sands, sand-silt mixtures		SM	> 12		Atterberg limits below "A" line or $W_P<4$	
			Clayey sands, sand-clay mixtures		SC	> 12		Atterberg limits above "A" line or $W_P<7$	
FINE GRAINED SOILS	SILTS (Below 'A' line negligible organic content)	$W_L<50$	Inorganic silts, silty or clayey fine sands, with slight plasticity		ML			Classification is Based upon Plasticity Chart	
		$W_L>50$	Inorganic silts of high plasticity		MH				
	CLAYS (Above 'A' line negligible organic content)	$W_L<30$	Inorganic clays, silty clays, sandy clays of low plasticity, lean clays		CL				
		$30<W_L<50$	Inorganic clays and silty clays of medium plasticity		CI				
		$W_L>50$	Inorganic clays of high plasticity, fat clays		CH				
	ORGANIC SILTS & CLAYS (Below 'A' line)	$W_L<50$	Organic silts and organic silty clays of low plasticity		OL				
		$W_L>50$	Organic clays of high plasticity		OH				
HIGHLY ORGANIC SOILS			Peat and other highly organic soils		Pt	Von Post Classification Limit		Strong colour or odour, and often fibrous texture	

	Asphalt		Glacial Till		Bedrock (Igneous)
	Concrete		Clay Shale		Bedrock (Limestone)
	Fill				Bedrock (Undifferentiated)

DYREGROV ROBINSON INC.
CONSULTING GEOTECHNICAL ENGINEERS



FRACTION		PARTICLE SIZE (mm) Min.	Max.	RELATIVE PROPORTIONS (by weight) Percent	Descriptor
Boulders		>300			
Cobbles		75	300	>35%	main fraction
Gravel	Coarse	19	75	35 - 50	"and"
	Fine	4.75	19		
Sand	Coarse	2.0	4.75	20 – 35	Adjective e.g. silty, clayey
	Medium	0.425	2.0		
	Fine	0.075	0.425	10 – 20	"some"
Silt (non-plastic) or Clay (plastic)		< 0.075 mm		1 - 10	"trace"

Soil Classification Example

Clay 50% (main fraction), Silt 25%, Sand 17%, Gravel 8%

Clay – silty, some sand, trace gravel

TERMS and SYMBOLS

Laboratory and field tests are identified as follows:

Unconfined Comp.: undrained shear strength (kPa or psf) derived from unconfined compression testing.

Torvane: undrained shear strength (kPa or psf) measured using a Torvane

Pocket Pen.: undrained shear strength (kPa or psf) measured using a pocket penetrometer.

Unit Weight bulk unit weight of soil or rock (kN/m^3 or pcf).

SPT – N Standard Penetration Test: The number of blows (N) required to drive a 51 mm O.D. split barrel sampler 300 mm into the soil using a 63.5 kg hammer with a free fall drop height of 760 mm.

DCPT Dynamic Cone Penetration Test. The number of blows (N) required to drive a 50 mm diameter cone 300 mm into the soil using a 63.5 kg hammer with a free fall drop height of 760 mm.

M/C insitu soil moisture content in percent

PL Plastic limit, moisture content in percent

LL Liquid limit, moisture content in percent

The undrained shear strength (Su) of cohesive soil is related to its consistency as follows:

Su (kPa)	Su (psf)	CONSISTENCY
<12	250	very soft
12 – 25	250 – 525	soft
25 – 50	525 – 1050	firm
50 – 100	1050 – 2100	stiff
100 – 200	2100 – 4200	very stiff
200	4200	hard

The SPT - N of non-cohesive soil is related to compactness condition as follows:

N – Blows / 300 mm	COMPACTNESS
0 - 4	very loose
4 - 10	loose
10 - 30	compact
30 - 50	dense
50 +	very dense

References:

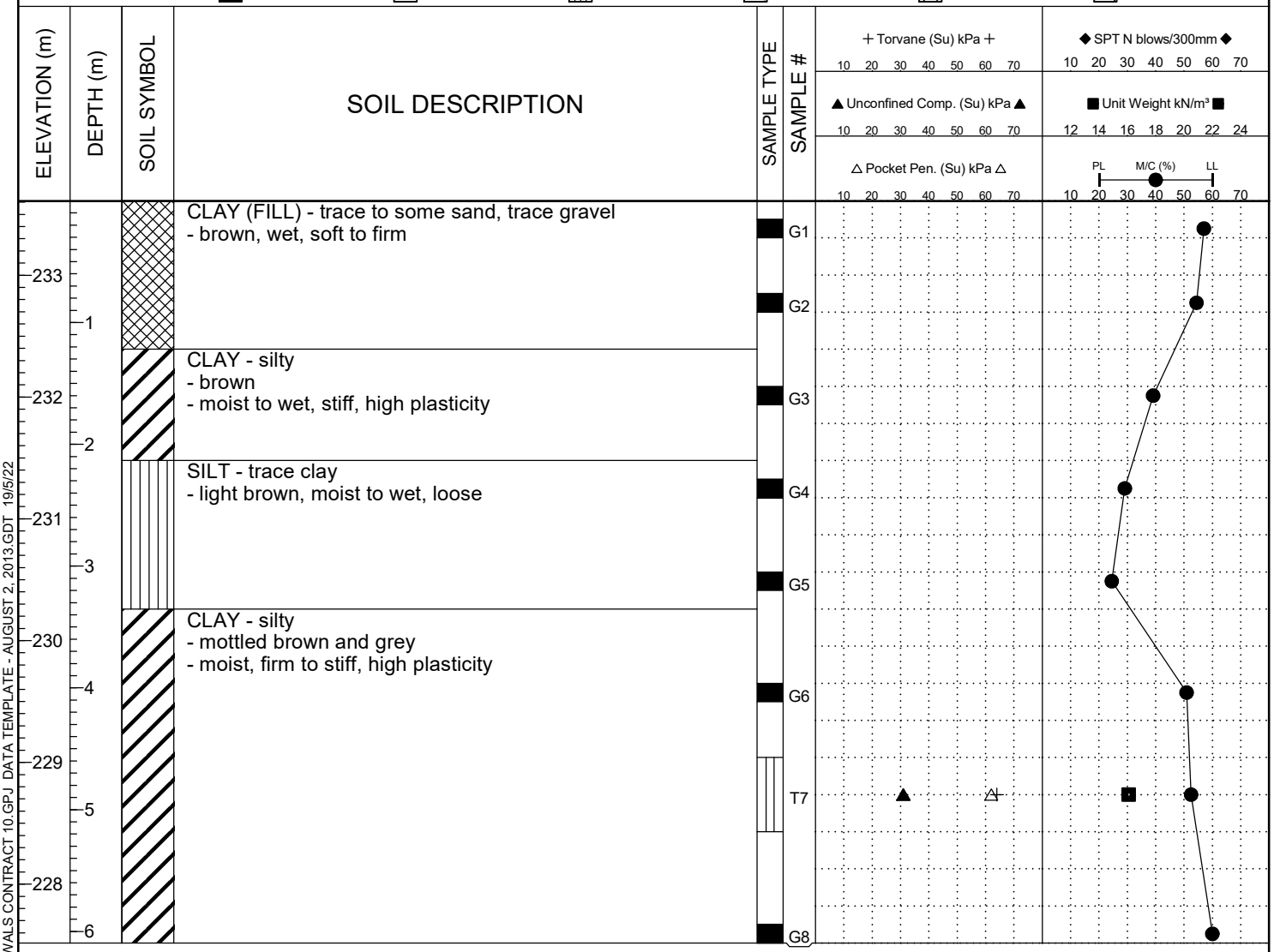
ASTM D2487 – Classification of Soils For Engineering Purposes (Unified Soil Classification System)

Canadian Foundation Engineering Manual, 4th Edition, Canadian Geotechnical Society, 2006

PROJECT: COW Watermain Renewals - Contract 10	CLIENT: Tetra Tech Canada Inc.	TEST HOLE NO: **1**
LOCATION: UTM 14U: 629,985.9 m E, 5,529,902.9 m N		PROJECT NO.: 224594
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Acker MP8 Drill Rig w/ 125mm SS augers	ELEVATION (m): 233.623

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND



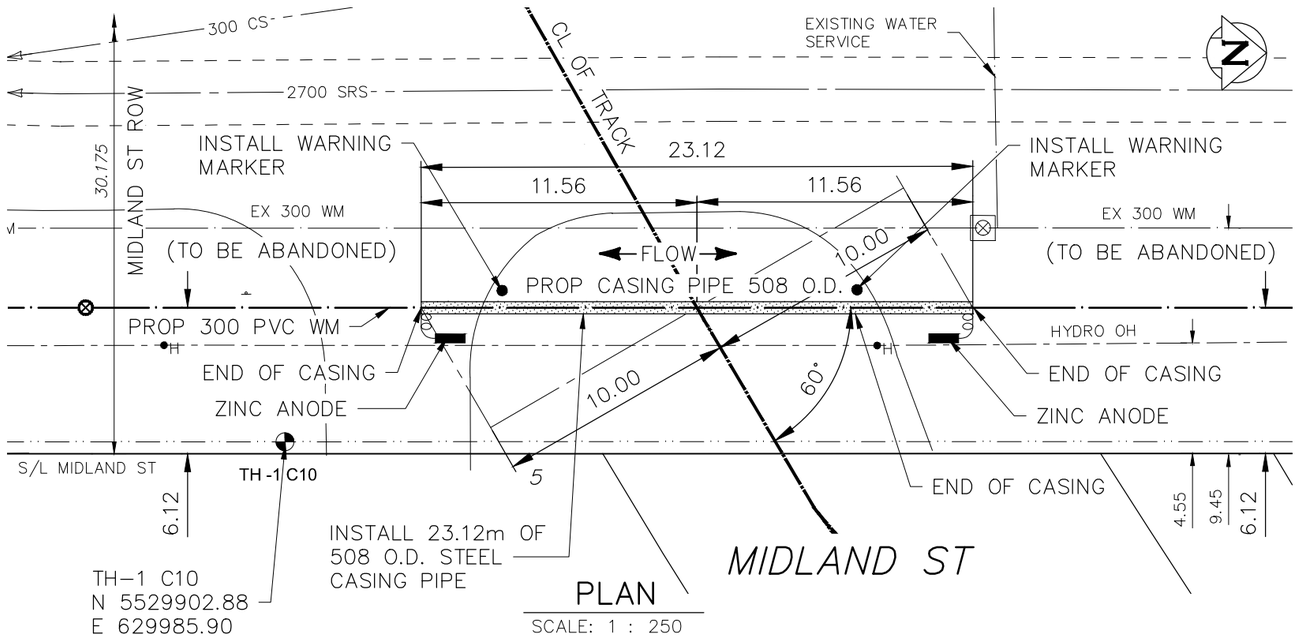
END OF TEST HOLE AT 6.1 m IN CLAY

Notes:
1. Trace seepage observed below 0.6 m from clay fill and silt layers.
2. Sloughing of silt layer observed during drilling.
3. Upon completion of drilling, test hole open to 2.6 m & no water accumulation.
4. Test hole backfilled with auger cuttings and bentonite chips.

DYREGROV ROBINSON INC.
Consulting Geotechnical Engineers

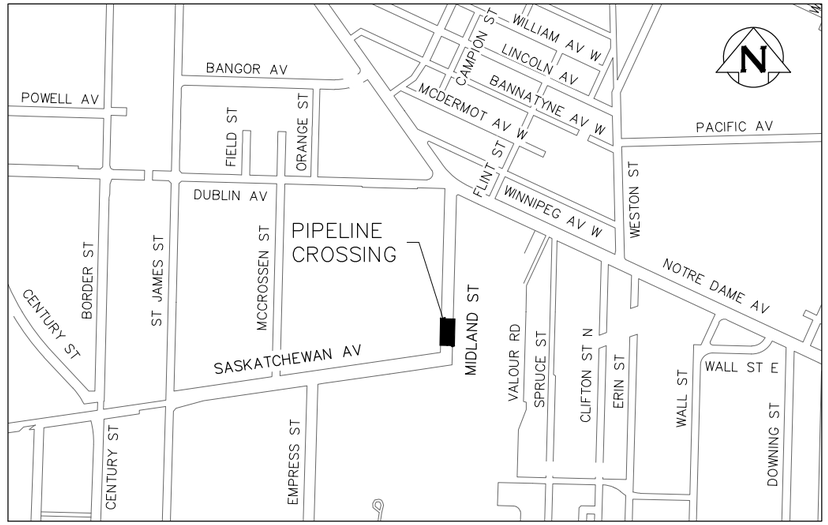
LOGGED BY: AA	COMPLETION DEPTH: 6.10 m
REVIEWED BY: GR	COMPLETION DATE: 19/4/22
PROJECT ENGINEER: Gil Robinson	Page 1 of 1

BH GEOTECH PLOTS-AUGUST 2013 224594_TETRA TECH_COW WATERMAIN RENEWALS CONTRACT 10.GPJ DATA TEMPLATE - AUGUST 2, 2013.GDT 19/5/22



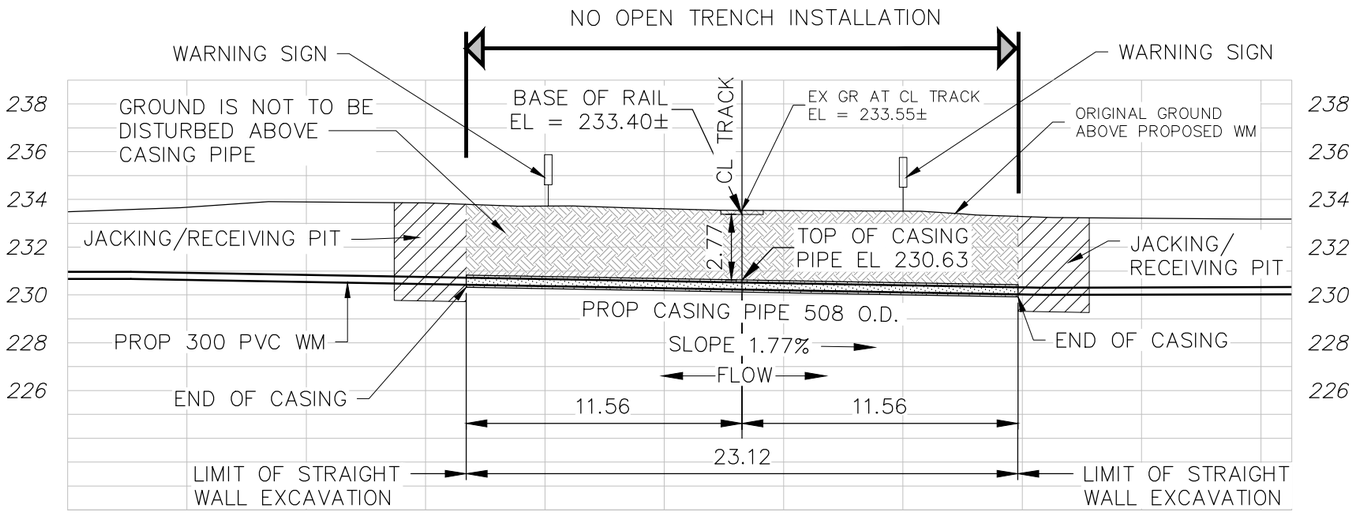
PLAN

SCALE: 1 : 250



LOCATION PLAN

SCALE: 1 : 15000



PROFILE

HOR & VERT SCALE: 1 : 250

PIPE SPECIFICATIONS				
PIPE	OUTSIDE DIAMETER	WALL THICKNESS	SPECIFICATION	COMMENTS
CARRIER PIPE	335MM	19MM	PVC DR 18 BELL & SPIGOT (WATERMAIN)	WORKING PRESSURE – 450 kPa/ TESTED AT 1034 kPa
CASING PIPE	508MM	15MM	CARBON STEEL ASTM A53 SCHEDULE 40 – JOINT WELD	TRENCHLESS INSTALLATION
SPACERS			SS BANDS, POLYMER RUNNERS (APS MODEL SSI)	YES SEE NOTES: MATERIAL 3.
END SEALS			RUBBER (APS MODEL AW)	YES SEE NOTES: MATERIAL 4.
CATHODIC PROTECTION			10.9 kg ZINC ANODES	YES SEE NOTES: MATERIAL 5.

CONSTRUCTION NOTES:

1. CONSTRUCTION IN ACCORDANCE WITH TRANSPORT CANADA STANDARD (TCE–10)
2. CASING PIPE WILL BE INSTALLED USING TRENCHLESS METHODS BY HORIZONTAL EARTH CORING.
3. THE WATERMAIN PIPE WILL BE INSERTED INTO THE CASING PIPE COMPLETE WITH SPACERS AND END SEALS.
4. EMERGENCY VALVE LOCATIONS FOR THE 300mm WATERMAIN (36.8 M NORTH & 14.1 M SOUTH).

DESIGN NOTES:

1. CROSSING TO BE DESIGNED, CONSTRUCTED, MAINTAINED AND OPERATED IN ACCORDANCE WITH TRANSPORT CANADA STANDARD (TCE – 10), STANDARDS RESPECTING PIPELINE CROSSING UNDER RAILWAYS
2. THE WATERMAIN CROSSINGS UTILIZE CASING PIPES DESIGNED TO THE GUIDELINES SPECIFIED IN THE AREMA MANUAL OF RAILWAY ENGINEERING CHAPTER 1 PART 5 "PIPELINES".

MATERIALS:

1. CARRIER PIPE – POTABLE WATER PIPE PVC AWWA C–900 CLASS 150 (DR18)
2. ENCASEMENT PIPE – SHALL CONFORM TO ASTM A53 STEEL PIPE, ASTM SPECIFICATIONS A134 MILD CARBON STEEL, A139, GRADE B. BUTT WELD JOINTS SHALL HAVE A MINIMUM THICKNESS OF 13mm REGARDLESS OF DIAMETER. NO COATING
3. ENCASEMENT PIPE SPACERS – SHALL BE 200MM WIDE, HEAVY DUTY TWO PIECE STAINLESS STEEL BANDS WITH 25mm WIDE BY 75mm SPACERS, EQUAL TO ADVANCE PRODUCTS AND SYSTEMS INC. (APS) MODEL SS18.
4. ENCASEMENT PIPE SEALS – SHALL BE WRAPAROUND RUBBER WITH STAINLESS STEEL BAND CLAMPS AND WATERPROOF MASTIC SEALS SPACERS EQUAL TO ADVANCE PRODUCTS AND SYSTEMS INC. (APS) MODEL AW OR AZ.
5. SACRIFICIAL ANODE – 10.9 kg ZINC ANODES AT EACH END OF CASING PIPE.

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

TETRA TECH

DRAWING DESCRIPTION

WM CROSSING ON MIDLAND STREET FOR CPR APPROVAL

AUTHORIZED BY: IJM	CLIENT DRAWING NO.			
DATE: 22/05/11				
DESIGNED BY: SJR	DRAWN BY: NL/SJR	DRAWING NO.		REV.
REVIEWED BY: IJM	SCALE: 1 : 250	2200120200-SKT-C0001		0