

## **APPENDIX C – FEBRUARY 2015 MONITORING REPORT**



February 25, 2015

File No. 0015 008 00

**Mr. Kendall Thiessen, P.Eng.**

Riverbank Management Engineer  
City of Winnipeg, Planning, Property and Development Department  
Waterways Section  
15 – 30 Fort Street  
Winnipeg, MB R3C 4X5

**RE Lyndale Drive –Ave. Taché to Gauvin St.  
2014 Riverbank Monitoring Results**

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Please find enclosed monitoring results for instrumentation installed along riverbank and retaining wall along Lyndale Drive from Avenue Taché to Gauvin Street. The instrumentation was installed in 2013 as part of a riverbank stabilization project from Monck Avenue to Avenue Taché to evaluate the riverbank condition for possible future stabilization works along the stretch of riverbank upstream of the 2013 stabilized zone. Monitoring instrumentation included slope inclinometer casings (SI's) and vibrating-wire piezometers (VW's) along the lower, mid and upper bank areas at three cross-sections within the upstream stretch of bank. Additional instrumentation was installed within the 2013 stabilized zone to monitor movements during construction. Results of monitoring in the 2013 stabilized zone were reported separately in our letter dated February 4, 2015 and will not be repeated herein.

The test hole locations and types of instrumentation installed are shown on the attached site plan (Figure 1) as well as in cross-section in Figures 02, 03 and 04. Figure 1 also shows the limits and types of retaining walls present, including a timber pile wall constructed in 1976 that extends upstream of the 2013 stabilized zone, ending near the intersection of Lyndale Drive and Gauvin Street. Evidence of lower to mid bank movements is apparent at various locations along this stretch of bank, based on visual site inspections and aerial photo review. The current letter summarizes monitoring results to date, while a final monitoring report will be submitted in December 2015 at the conclusion of the 2-year monitoring period. The results of instrumentation monitoring are attached along with test hole logs.

A total of seven slope inclinometers and four vibrating wire piezometers were installed along three cross-sections (XS-B to XS-D) as follows:

- SI-3 and SI-4 in the mid and lower bank in TH's 13-03 and 13-04 along XS-B
- SI-5, SI-6 and SI-7 in the upper, mid and lower bank in TH's 13-05, 13-06 and 13-07 along XS-C
- VW 5A/5B in the clay and till units in the upper bank in TH's 13-05 along XS-C
- VW 7A/7B in the clay and till units in the lower bank in TH's 13-05 along XS-C
- SI-8 and SI-9 in the mid and lower bank TH's 13-08 and 13-09 along XS-D

The upper-bank test hole (TH13-05) was drilled within the boulevard just upslope of the existing timber pile retaining wall, while mid-bank test holes were drilled just downslope of the wall and lower-bank test holes were drilled along the shoreline at the time of drilling. All drilling and instrumentation installation was completed between October 15<sup>th</sup> and 16<sup>th</sup>, 2013. Baseline readings on inclinometers were taken in late October with up to four to five subsequent monitoring events (pre and post 2014 spring flood, pre and post 2014 fall drawdown). Vibrating-wire piezometer monitoring was also completed during each monitoring event.

## Groundwater Monitoring Results

The groundwater monitoring results to date are attached for piezometers VW-5A/5B and VW-7A/7B located in the upper and lower bank areas, respectively. Vibrating wire piezometers installed in the lacustrine clay maintained relatively constant piezometric levels ranging from about Elev. 226.0 m to 226.8 m in the upper bank (VW-5A) or from about Elev. 224 m. to 225.3 m in the lower bank (VW-7A). These levels ranged from about 2 to 4 m above river level in the upper bank, and from about 1 to 2 m above river level in the lower bank with the exception of flood stages when they are lower than the river level.

Piezometric levels in the till ranged from about Elev. 223.2 m to 224.7 m in the upper bank (VW-5B) and from about Elev. 221.5 m to 223.7 in the lower bank (VW-7B). Levels at the top of bank (VW-5B) were typically about 0.8 m to 1.2 m above the river level. At the lower bank area (VW-7B), levels tended to more closely match the river level. The exception to both of these observations is during flood events when river levels are higher than piezometric levels in the till.

All clay and till piezometers showed higher levels following the spring and summer flooding and lower levels during the winter months. Critical groundwater conditions typically occur during the fall and winter months where the groundwater levels in the bank exceeded the river elevation by up to 1.5 m (till) and 4 m (lacustrine clay).

## Inclinometer Monitoring Results

Slope inclinometer cumulative displacement profiles as well as displacement rate plots are attached for all seven SI's. The most recent cumulative displacement profile is also shown in the stratigraphic cross-section to aid in visualization of slope movements.

**Cross Section B:** About 20 mm of horizontal displacement was observed at the lower bank area in SI-4 and at about 1.7 m above till contact (Elev.217.0 m) between October 2013 and December 2014. In the mid-bank area, about 2 to 3 mm of horizontal displacement was observed in SI-3 over the same time period about 1.2 m above the till contact (Elev. 216.8 m). The 20 mm of horizontal displacement observed within the upper 0.5 m of SI-3 is believed to be from environmental effects and not slope movement. Both SI-3 and SI-4 cumulative movement profiles are indicative of shear displacement within the clay just above the till contact. Visual observations and a review of aerial photography indicate active instabilities of the mid-bank area where SI-3 is situated are substantiated by the monitoring results. The relative displacements at SI-4 indicate retrogression of movements towards the retaining wall are occurring although these movements are not likely associated with a well defined failure surface at this time; they may be more indicative of creep movements.

**Cross Section C:** About 14 mm of horizontal displacement was observed at the lower bank area in SI-7 and at about 3.2 m above the till contact (Elev. 217.3 m) between October 2013 and December 2014. From August to December 2014, about 3 mm of horizontal displacement also occurred in SI-7 at Elev. 217.5 (0.3 m above till). In the mid-bank area, about 2 mm of horizontal displacement was observed in SI-6 between October 2013 and December 2014 at about Elev. 218 m (about 0.2 m above till). The 20 mm of horizontal displacement observed within the upper 0.5 m of SI-6 is believed to be from environmental effects and not slope movement. The upper bank inclinometer (SI-5) showed negligible displacement below about Elev. 227 m (approx. 3 m below existing ground downslope of wall), but about 4 to 5 mm of horizontal displacement occurring gradually (i.e. tilting) above this point.



The monitoring suggests active movement along two slip surfaces near the toe of the slope (SI-7) is occurring. Creep movements in the mid-bank area (SI-6) indicate this portion of the bank has been impacted by the lower bank movements although there is no evidence of a well defined failure surface at this location. The upper-bank movements (SI-5) can likely be attributed to deterioration and leaning of the timber pile retaining wall rather than deep-seated riverbank movements.

**Cross Section D:** About 15 mm of horizontal displacement was observed in the upper 4 m of SI-9 between October 2013 and December 2014. This is not considered indicative of a differential (shear) displacement associated with a deep-seated failure surface but rather may be attributed to shallow translational movement of a layer of fill at this location. In the mid-bank area, about 2 mm of horizontal displacement was observed in SI-8 over the same time period at about Elev. 218.5 m (about 1.2 m above till) along with about 5mm of near surface displacement attributable to environmental effects. The movements at SI-8 are close to the resolution of the monitoring probe and do not indicate any active riverbank instabilities at this location.

### Summary and Discussion

Prior to the construction of the retaining wall and off-loading of the riverbank in 1976, upper bank head scarps accompanied by mid and lower bank instabilities were observed along this stretch of Lyndale Drive. Based on the assumption that the bank downslope of the wall was uniformly graded for off-loading, the uneven slope geometry indicates continued riverbank movements have occurred after this work was done, at least along some stretches. Slope inclinometer monitoring confirms that these movements are ongoing as evidenced by up to 20 mm of lower-bank displacements and up to 5 mm of mid-slope displacement over a period of one year. While the rate of mid-bank displacement is relatively small, retrogression of active instabilities towards the retaining wall and roadway remains a possibility, however the time frame for this to occur is uncertain. Horizontal displacement upslope of the retaining wall could possibly be attributed to deterioration of the timber piles and leaning of the wall. Significant deterioration of the timber piles was confirmed within the 2013 stabilized zone downstream of the project area.

Please don't hesitate to contact me if have you any questions or require further clarification.

Kind Regards,

**TREK Geotechnical**

**Per:**

**Michael Van Helden, P.Eng.**

Geotechnical Engineer, Tel: 204.975.9433 ext 102

MVH/kms

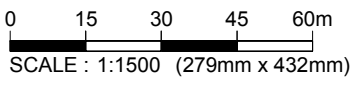
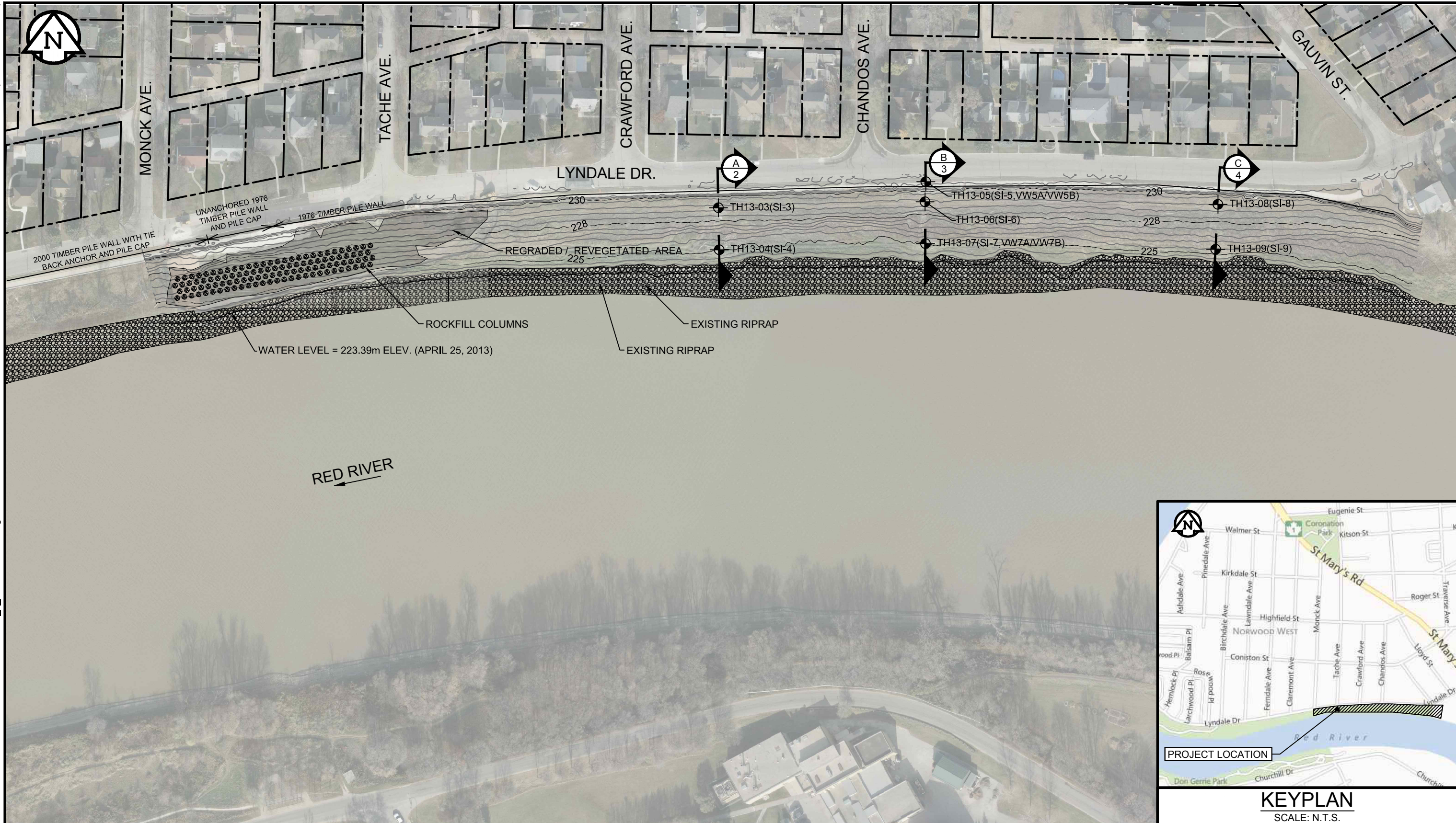
cc. Brad Neirinck, P.Eng., City of Winnipeg Public Works  
Ken Skaftfeld, P.Eng., TREK Geotechnical Inc.



Tabloid (279mm x 432mm)

PLOT: 2/12/2015 10:41:19 AM

FILE NAME: FIG 001 2015-02-12 Site Plan 0\_J\_HA 0015 008.dwg



- LEGEND :**
- TEST HOLE (TREK, 2013)
  - APPROXIMATE PROPERTY LINE

- NOTES :**
1. GROUND SURFACE TOPOGRAPHY BASED ON LIDAR SURVEYS PROVIDED BY CITY OF WINNIPEG.
  2. AERIAL IMAGE TAKEN IN 2013 PROVIDED BY CITY OF WINNIPEG
  3. SI-1 IN TH13-01 ABANDONED ON OCTOBER 25, 2013
  4. SI-2 IN TH13-02 ABANDONED ON NOVEMBER 11, 2013

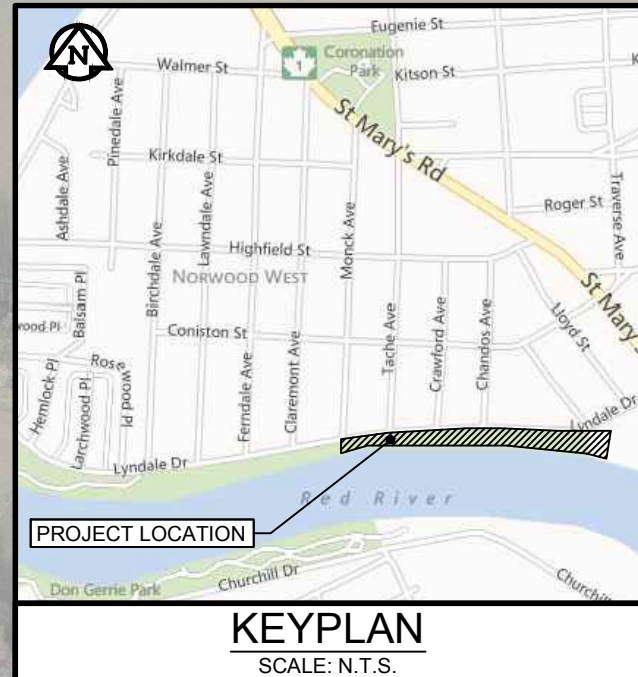


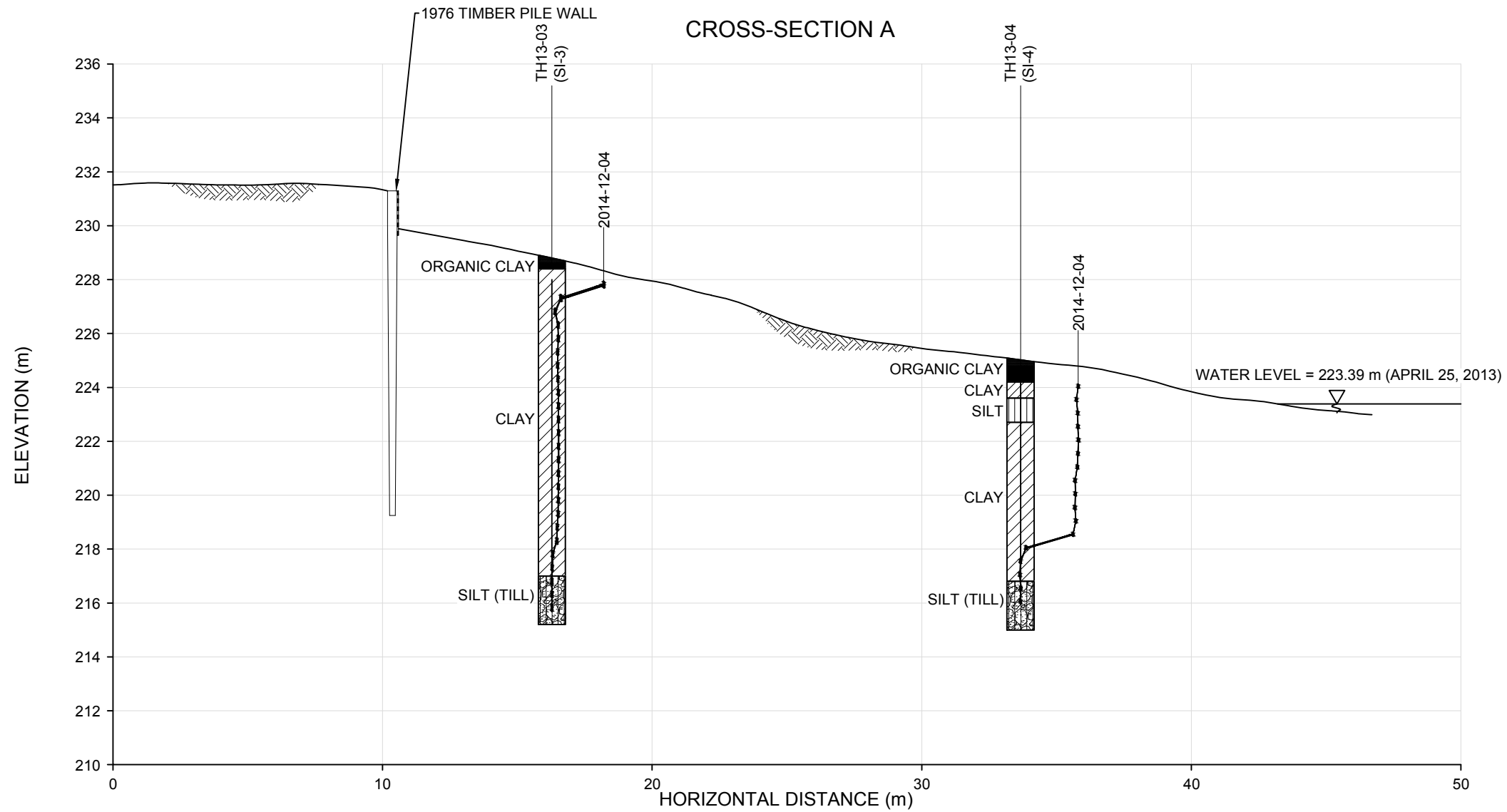
Figure 01  
Site Plan



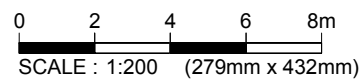
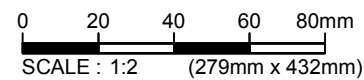
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FILE NAME: FIG 001 2015-02-12 Site Plan 0\_J\_HA 0015 008.dwg



(HORIZONTAL SCALE FOR SI DISPLACEMENT PLOTS)

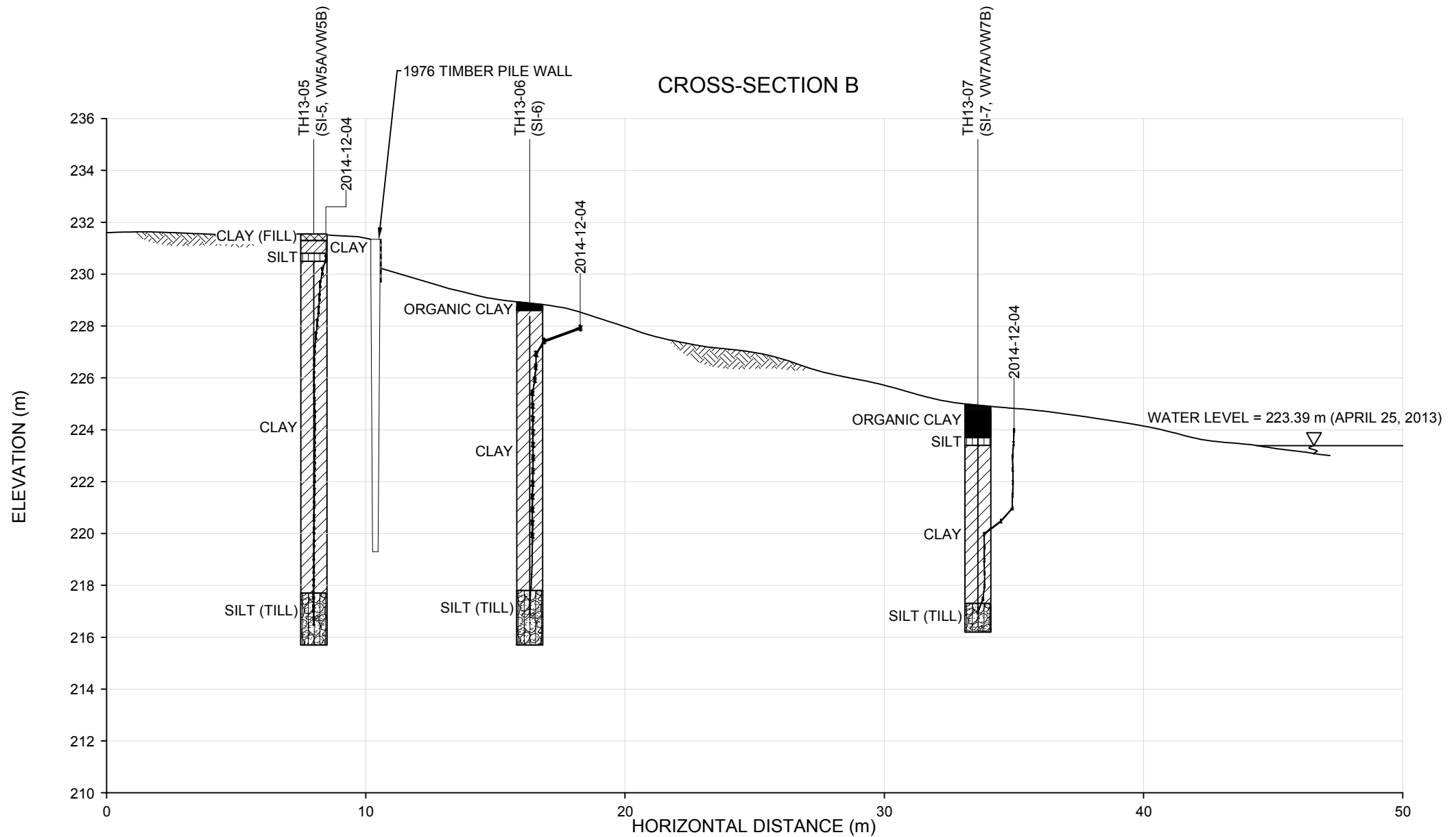


**Figure 02**  
Cross Section A

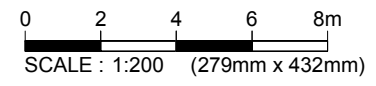
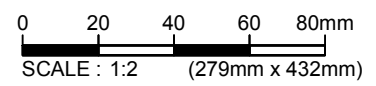
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(HORIZONTAL SCALE FOR SI DISPLACEMENT PLOTS)

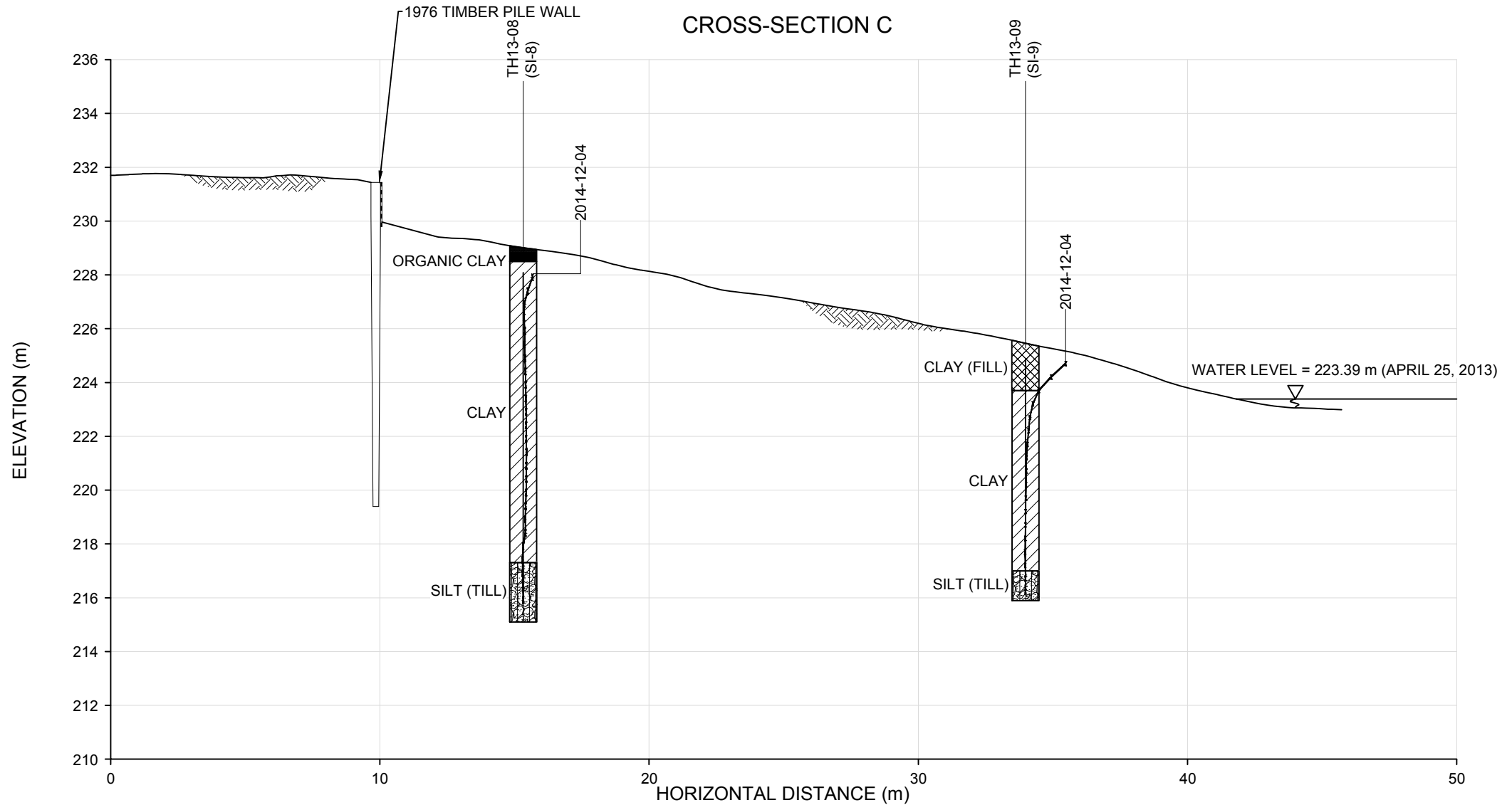


**Figure 03**  
Cross Section B

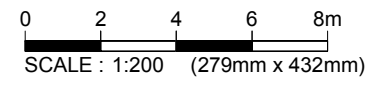
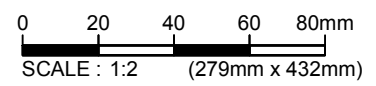
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FILE NAME: FIG 001 2015-02-12 Site Plan 0\_J\_HA 0015 008.dwg



(HORIZONTAL SCALE FOR SI DISPLACEMENT PLOTS)



**Figure 04**  
Cross Section C





# Sub-Surface Log

Test Hole TH13-03

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )		Undrained Shear Strength (kPa)	
							16	17	18	19
217.0	12			SILT (TILL) - some clay, some gravel, trace oxidation - light grey and grey - moist to wet - loose to compact - low plasticity	▲	G11	Particle Size (%)		Test Type	
215.2	13			- trace gravel (subrounded <35mm diameter), trace oxidation, and cobbles (<80mm diameter) below 12.8 m		G12	PL	MC	LL	△ Torvane △

END OF HOLE AT 13.4 m IN SILT TILL

Notes:

- 1) Power auger refusal (PAR) on suspected boulder at 13.4 m.
- 2) Seepage observed below 11.9 m.
- 3) No sloughing observed.
- 4) Water level at 12.2 m upon completion of drilling.
- 5) Slope inclinometer SI-03 installed in test hole.

SUB-SURFACE LOG 0015 008 00 LYNDALD DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15





# Sub-Surface Log

Test Hole TH13-04

1 of 1

**Client:** City of Winnipeg - Public Works **Project Number:** 0015 008 00  
**Project Name:** Lyndale Drive Retaining Wall Assessment **Location:** Lyndale Dr. between Monck Ave. and Gauvin St.  
**Contractor:** Paddock Drilling Ltd. **Ground Elevation:** 224.80 m  
**Method:** 125 mm Solid Stem Auger, Acker MP5-T Track Mount **Date Drilled:** 15 October 2013

**Sample Type:**  Grab (G)  Shelby Tube (T)  Split Spoon (SS)  Split Barrel (SB)  Core (C)  
**Particle Size Legend:**  Fines  Clay  Silt  Sand  Gravel  Cobbles  Boulders  
**Backfill Legend:**  Bentonite  Cement  Drill Cuttings  Filter Pack Sand  Grout  Slough

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )					Undrained Shear Strength (kPa)						
							16	17	18	19	20	21	Test Type					
							Particle Size (%)											
							0	20	40	60	80	100						
							PL _____ MC _____ LL _____ 0 20 40 60 80 100											
							0	20	40	60	80	100	0	50	100	150	200	250
224.2				ORGANIC CLAY - silty, dark brown - moist, friable														
223.6	1			CLAY - silty - brown - moist, firm, high plasticity	▲	G21												
				SILT - trace clay, trace organics - light grey - moist, soft - low plasticity	▲	G22												
222.7	2			CLAY - silty, trace oxidations, trace organics - brown, moist, - stiff, high plasticity	▲	G23												
	3				▲	G24												
	4			- firm below 3,4 m														
	5				▲	G25												
	6																	
	7				⊗	SS26												
	8			SILT (TILL) - trace sand, trace gravel - light grey - moist - compact to dense	⊗	SS27A												
					⊗	SS27B												
	9				⊗	SS28												
216.8																		
215.0																		

END OF HOLE AT 9.8 m IN SILT TILL  
 Notes:  
 1) Power auger refusal (PAR) at 9.8 m  
 2) Solid stem augers were used to 4.6 m depths then switched to hollow stem augers due to sloughing.  
 3) Seepage observed below 15,8 m  
 4) Sloughing was observed below 1.2 m  
 5) Slope inclinometer SI-04 installed in test hole, flush mounted.

**Logged By:** Michael Van Helden **Reviewed By:** Ken Skaffeld **Project Engineer:** Ken Skaffeld

SUB-SURFACE LOG 0015 008 00 LYNDAL DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15





# Sub-Surface Log

Test Hole TH13-05

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	VW Piezo	VW Piezo	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )	Undrained Shear Strength (kPa)	
									16 17 18 19 20 21	Test Type	
									△ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○		
									Particle Size (%) 0 20 40 60 80 100 PL MC LL		
									0 20 40 60 80 100	0 50 100 150 200 250	
217.7	12							G132	●	⊕△	
217.7	13.4					- till inclusions (<20mm diameter) below 13.4 m		G133	●	△	
215.7	14					SILT (TILL) - trace clay - light grey - moist - low to no plasticity		G134	●		

END OF HOLE AT 15.7 m IN SILT TILL

Notes:

- 1) Power auger refusal (PAR) at 15.7 m
- 2) No seepage observed
- 3) No sloughing observed.
- 4) Slope inclinometer SI-05 installed in test hole.
- 5) Vibrating wire piezometers VW-5A and VW-5B installed on tremie line next to slope inclinometer at depths of 9.1 m and 14.5 m.

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15





# Sub-Surface Log

Test Hole TH13-06

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )		Undrained Shear Strength (kPa)
							16 17 18 19 20 21	0 20 40 60 80 100	
							Particle Size (%)		Test Type
							PL MC LL		△ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○
							0 20 40 60 80 100	0 50 100 150 200 250	
215.7	13			- moist - compact - low to non-plastic		G50			
						G51			

END OF HOLE AT 13.4 m IN TILL

Notes:

- 1) Power auger refusal (PAR) on suspected boulder at 13.4 m.
- 2) Test hole open to 12.8 m due to sloughing in silt till.
- 3) No seepage observed.
- 4) Slope inclinometer SI-06 installed in test hole.



# Sub-Surface Log

Test Hole TH13-07

1 of 1

Client: City of Winnipeg - Public Works Project Number: 0015 008 00  
 Project Name: Lyndale Drive Retaining Wall Assessment Location: Lyndale Dr. between Monck Ave. and Gauvin St.  
 Contractor: Paddock Drilling Ltd. Ground Elevation: 224.81 m  
 Method: 108 mm Solid Stem Auger / Yanmar C25R Rubber Track Mount Date Drilled: 16 October 2013

Sample Type:  Grab (G)  Shelby Tube (T)  Split Spoon (SS)  Split Barrel (SB)  Core (C)  
 Particle Size Legend:  Fines  Clay  Silt  Sand  Gravel  Cobbles  Boulders  
 Backfill Legend:  Bentonite  Cement  Drill Cuttings  Filter Pack Sand  Grout  Slough

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinerometer	VW Piezo	VW Piezo	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )		Undrained Shear Strength (kPa)
									16	17	
223.7	1					ORGANIC CLAY - silty, trace silt inclusions (<10mm dia.), trace rootlets, trace organics - dark brown and grey - moist, soft to firm - intermediate to high plasticity		G61			
223.4						SILT - trace clay, trace organics - light grey, moist, soft, low plasticity		G62			
						CLAY - silty, trace silt inclusions (<5 mm dia.), trace precipitates (<10 mm dia.), trace organics, trace oxidation - mottled grey and brown - moist, stiff - high plasticity - silt layer (10 mm thick) light brown, and moist below 2.4 m		G63			
	2							G64			
	3							G65			
	4							G66			
	5							G67			
	6							G69			
217.3	7							G70			
216.2	8					SILT (TILL) - trace to some clay, trace sand, trace gravel (<20 mm dia.) - light grey, - moist, compact to dense - low plasticity					

END OF HOLE AT 8.5 m IN SILT TILL  
 Notes:  
 1) Power auger refusal (PAR) at 8.5 m depth.  
 2) No seepage or sloughing observed.  
 3) Open to 7.0 m depth due to squeezing in CLAY.  
 4) Water level at 6.1 m depth, water from SILT (TILL).  
 5) Test hole was backfilled with auger cuttings to the surface.  
 6) TH13-07 lithology based on TH14-07A located 1.2 m at 290 degrees N.

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15

Logged By: Martial Lemoine Reviewed By: Ken Skafffeld Project Engineer: Ken Skafffeld







# Sub-Surface Log

Test Hole TH13-08

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )		Undrained Shear Strength (kPa)									
							16	17	18	19	20	21						
217.3							Particle Size (%)		Test Type									
							0	20	40	60	80	100	△ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○					
							PL MC LL											
							0	20	40	60	80	100	0	50	100	150	200	250
215.1				SILT (TILL) - trace clay, trace gravel, trace sand - light grey - moist - compact - low to non-plastic		G89												
						G90												

END OF HOLE AT 13.7 m IN SILT TILL

Notes:

- 1) Power auger refusal (PAR) at 13.7 m depth.
- 2) Test hole open to 13.1 m depth due to sloughing.
- 3) No seepage observed.
- 4) Slope inclinometer SI-08 installed in test hole.

SUB-SURFACE LOG 0015 008 00 LYNDAL DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15



# Sub-Surface Log

Test Hole TH13-09

1 of 1

**Client:** City of Winnipeg - Public Works      **Project Number:** 0015 008 00  
**Project Name:** Lyndale Drive Retaining Wall Assessment      **Location:** Lyndale Dr. between Monck Ave. and Gauvin St.  
**Contractor:** Paddock Drilling Ltd.      **Ground Elevation:** 225.39 m  
**Method:** 108 mm Solid Stem Auger / Yanmar C25R Rubber Track Mount      **Date Drilled:** 16 October 2013

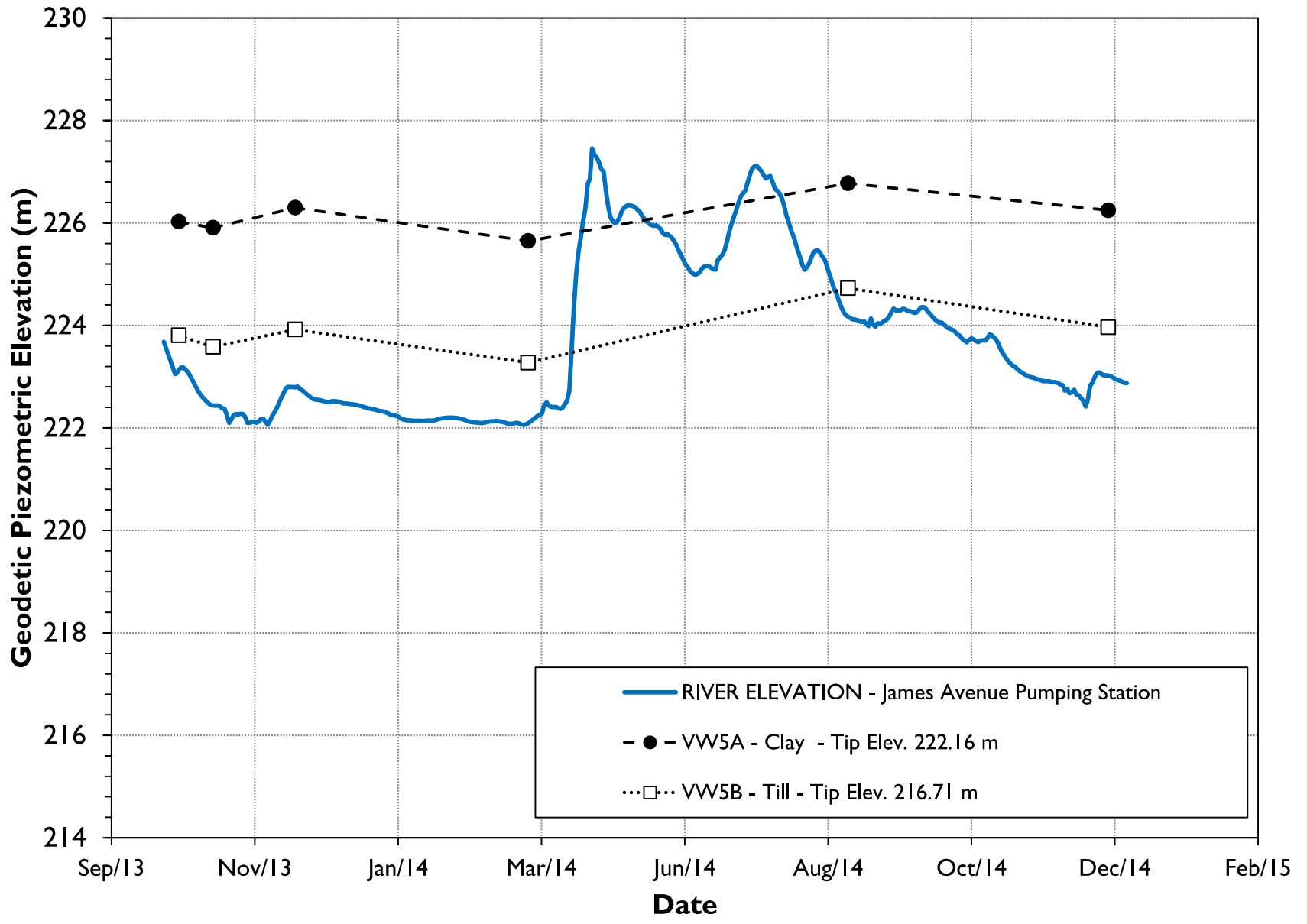
**Sample Type:**  Grab (G)     Shelby Tube (T)     Split Spoon (SS)     Split Barrel (SB)     Core (C)  
**Particle Size Legend:**  Fines     Clay     Silt     Sand     Gravel     Cobbles     Boulders  
**Backfill Legend:**  Bentonite     Cement     Drill Cuttings     Filter Pack Sand     Grout     Slough

Elevation (m)	Depth (m)	Soil Symbol	Slope Inclinator	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m <sup>3</sup> )					Undrained Shear Strength (kPa)
							16	17	18	19	20	
223.7	0			CLAY (FILL) - silty, trace silt inclusions (<10mm dia.), trace rootlets, trace roots, trace organics, trace oxidation - grey - moist, firm - intermediate to high plasticity - black and grey, high plasticity below 0.6 m - sand and gravel layer (300 mm thick), trace boulders, moist, very dense below 1.4 m		G101						
	1					G102						
	2					G103						
	3			CLAY - silty, trace silt inclusions (<5 mm dia.), trace precipitates (<10 mm dia.), trace organics, trace oxidation - mottled grey and brown - moist, stiff - high plasticity - trace silt inclusions (<15 mm dia.) below 3.3 m		G104						
	4					G105						
	5			- grey and firm below 4.6 m		T106						△
	6					G107						
	7			- soft to firm below 6.9 m		T108						△
	8			- soft, trace till inclusions (<20mm dia.) below 7.8 m		G109						
217.0	9			SILT (TILL) - trace clay, trace sand, trace gravel (<19 mm dia.) - light grey, - moist, compact to dense - low plasticity		G110						
215.9	9.5			END OF HOLE AT 9.5 m IN SILT TILL		G111						

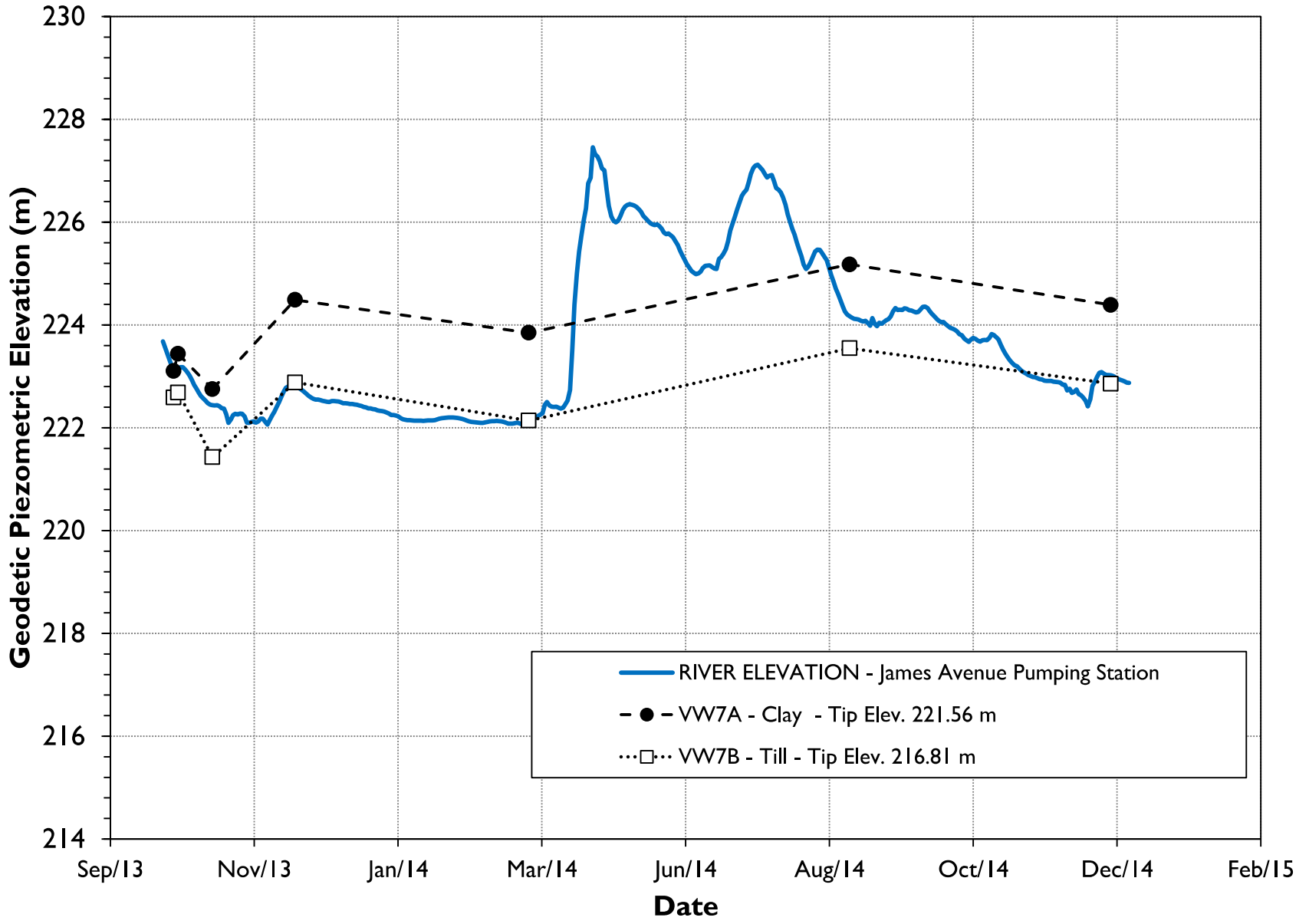
**Notes:**  
 1) Power auger refusal (PAR) at 9.5 m  
 2) No sloughing observed, open to 9.5 m depth.  
 3) Seepage observed from silt till layer.  
 4) Water level at 8.4 m depth, water from SILT (TILL).  
 5) Test hole was backfilled with auger cuttings to the surface.  
 6) TH13-09 lithology based on TH14-09A located 2.1 m at 300 degrees N.

**Logged By:** Martial Lemoine      **Reviewed By:** Ken Skafffeld      **Project Engineer:** Ken Skafffeld

SUB-SURFACE LOG 0015 008 00 LYNDALE DRIVE LOGS - 1-9 - DRAFT.GPJ TREK GEOTECHNICAL.GDT 25/2/15



**GROUNDWATER MONITORING REPORT**  
**Lyndale Drive Retaining Wall Assessment**  
**Piezometer Summary Plot (TH13-07)**

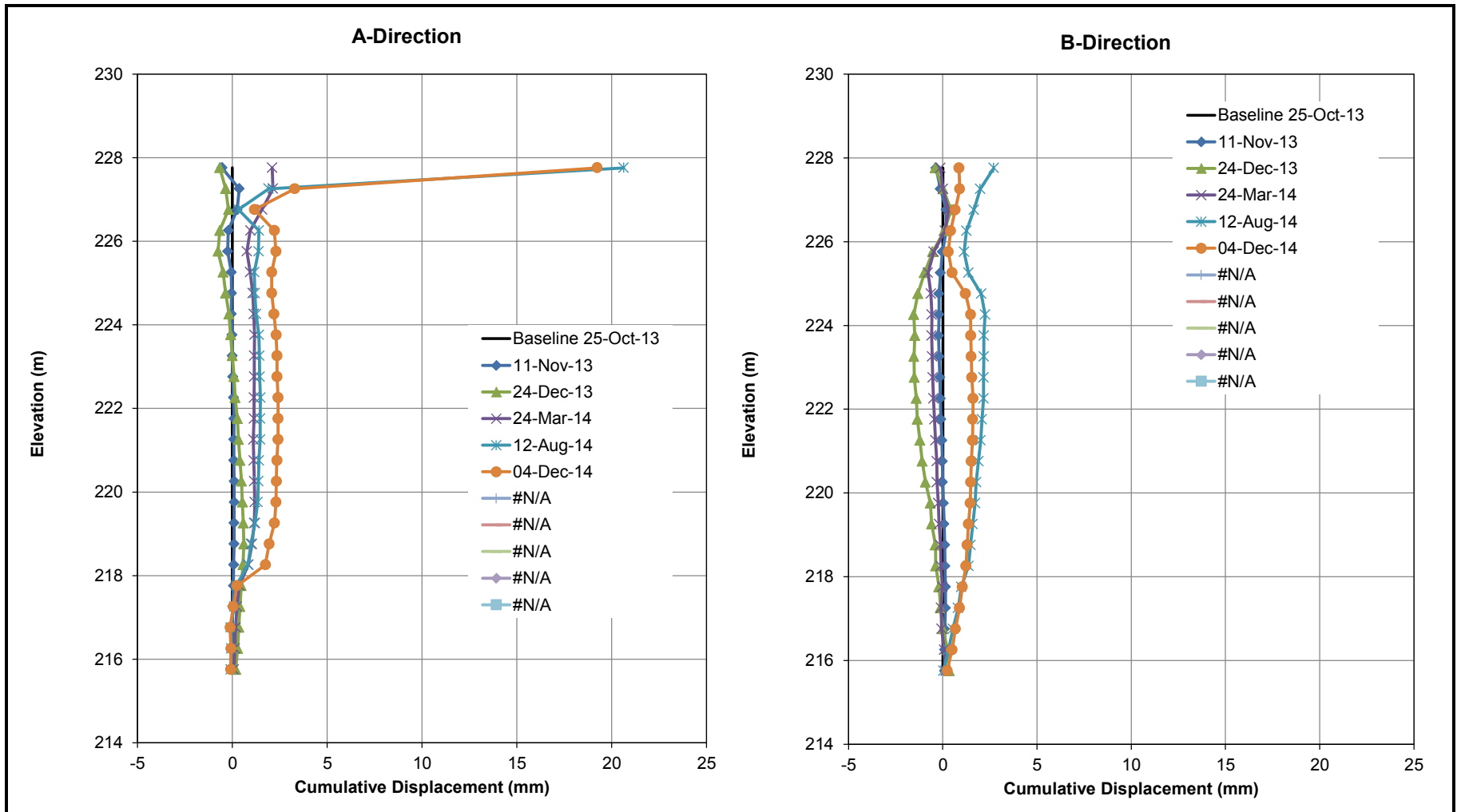




**SLOPE INCLINOMETER WORKSHEET**  
Cumulative Displacement in A and B Directions (Movement)

**INSTALLATION DATA**

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-3





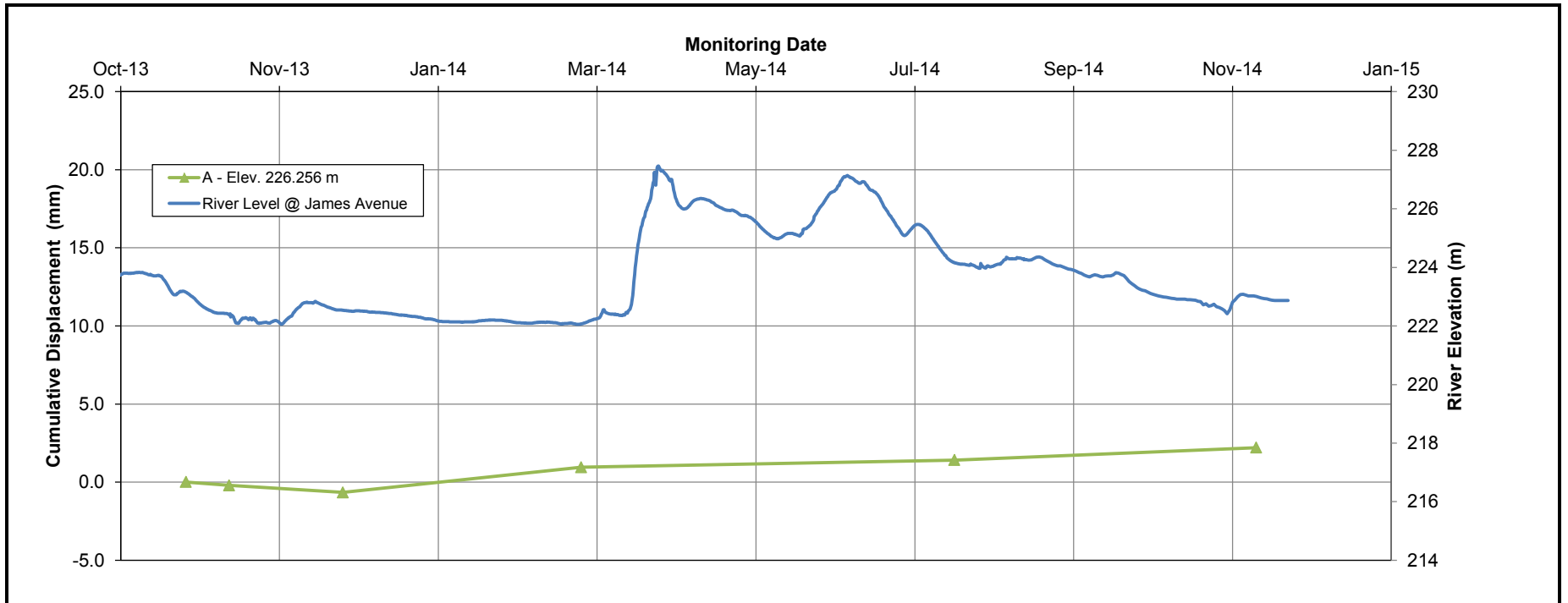


**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-3

Elevation Range (m)		Axis	Cumulative Displacement (mm) vs. Monitoring Date							
Bot	226.3	A	25-Oct-13	11-Nov-13	24-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14		
		B	0.0	-0.2	-0.7	1.0	1.4	2.2		
		Resultant	0.0	0.2	0.1	0.1	1.3	0.4		
			0.0	0.3	0.7	1.0	1.9	2.2		

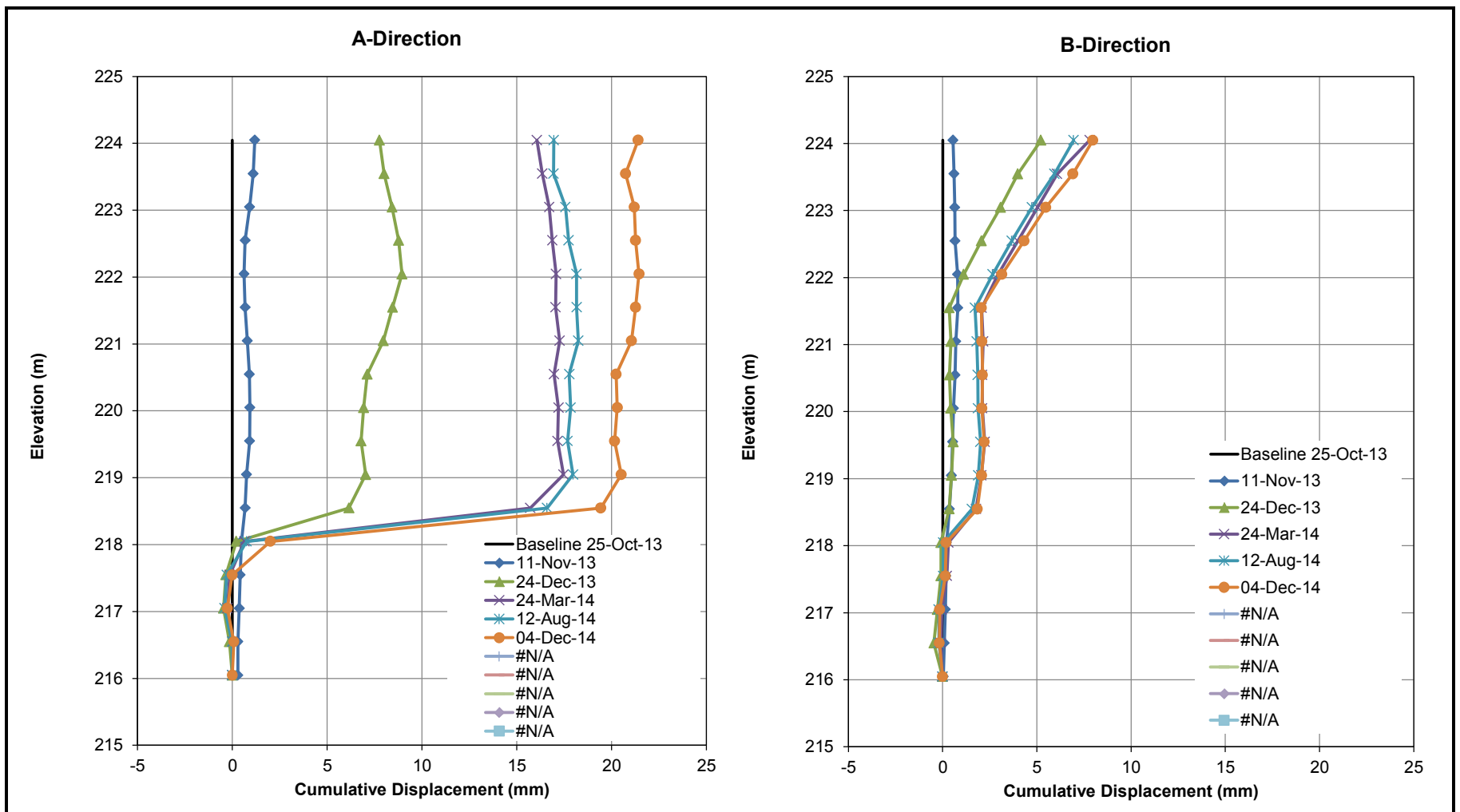




**SLOPE INCLINOMETER WORKSHEET**  
Cumulative Displacement in A and B Directions (Movement)

**INSTALLATION DATA**

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-4



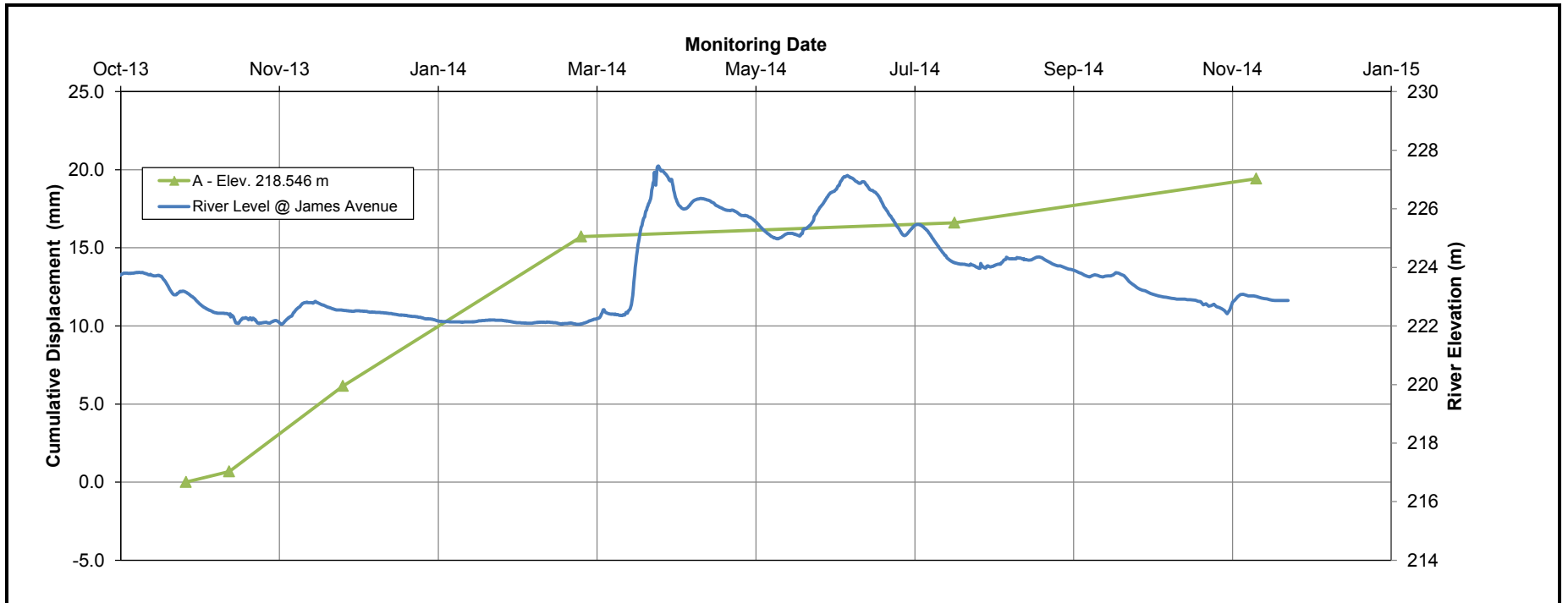


**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-4

Elevation Range (m)		Axis	Cumulative Displacement (mm) vs. Monitoring Date							
218.5			25-Oct-13	11-Nov-13	24-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14		
Mid	218.5	A	0.0	0.7	6.2	15.7	16.6	19.4		
		B	0.0	0.4	0.4	1.8	1.6	1.8		
		Resultant	0.0	0.8	6.2	15.8	16.7	19.5		

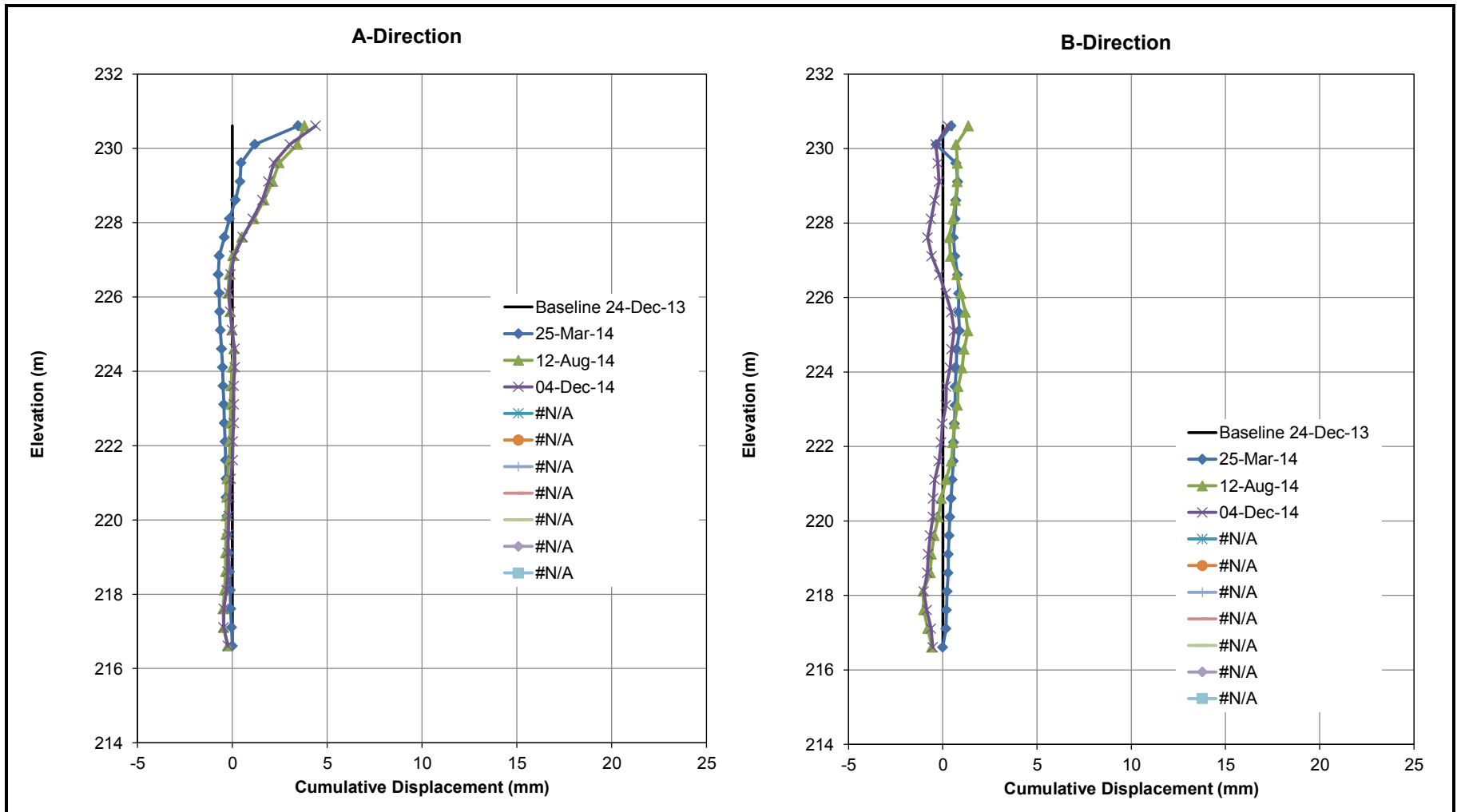




**SLOPE INCLINOMETER WORKSHEET**  
Cumulative Displacement in A and B Directions (Movement)

**INSTALLATION DATA**

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-5



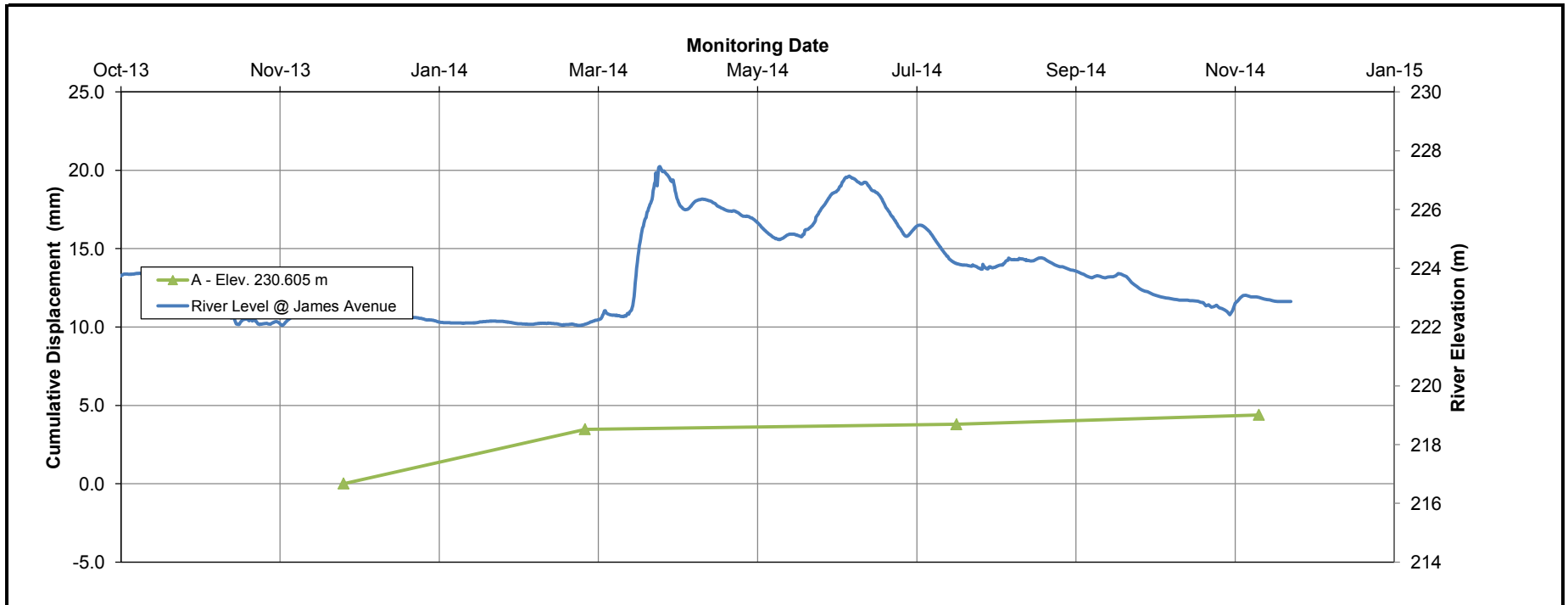


**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-5

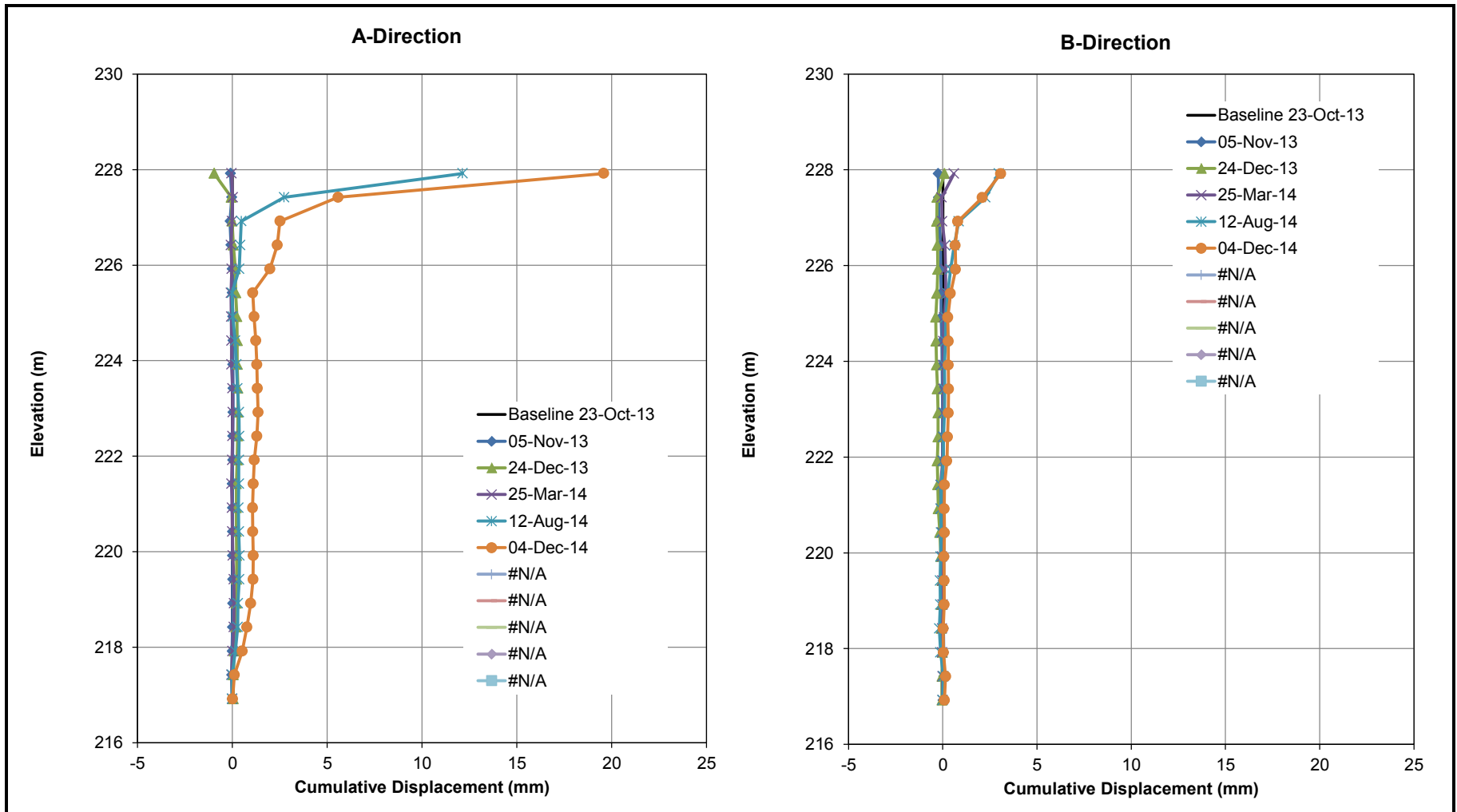
Elevation Range (m)		Axis	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14							
Top	230.6	A	0.0	3.5	3.8	4.4							
		B	0.0	0.4	1.4	0.3							
		Resultant	0.0	3.5	4.0	4.4							





INSTALLATION DATA

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-6







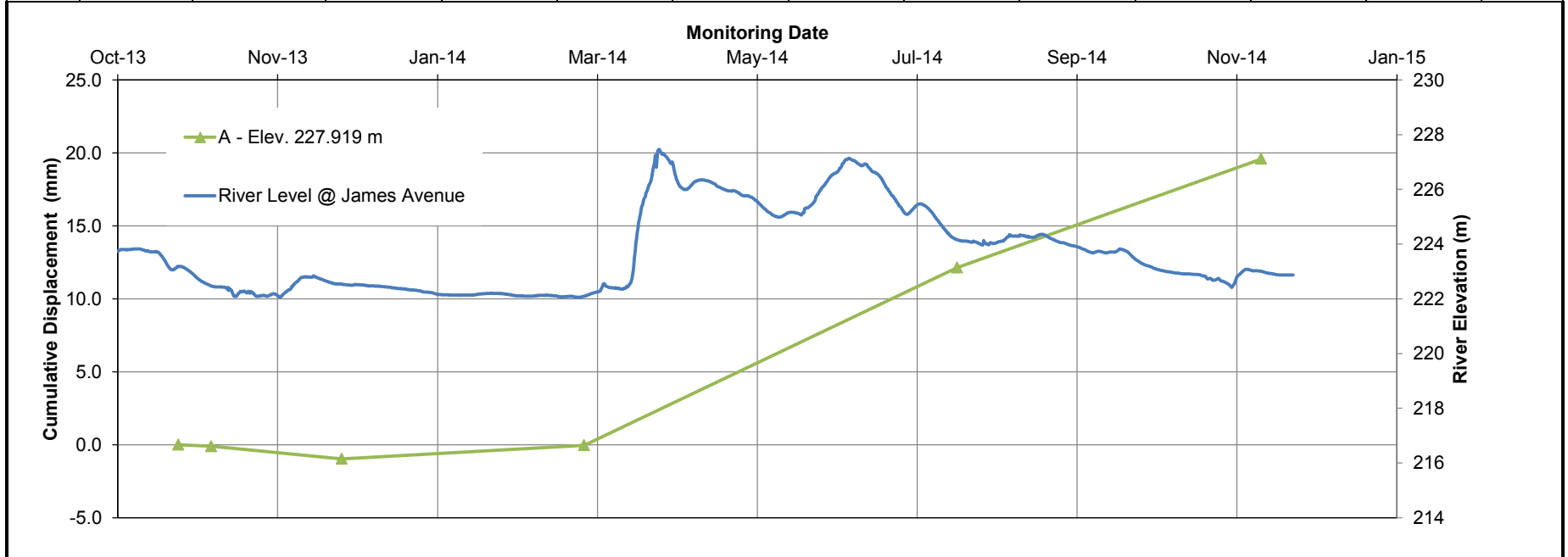
**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-6

**Cumulative Displacement (mm) vs. Monitoring Date**

Elevation Range (m)	Axis	23-Oct-13	5-Nov-13	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14				
Top 227.9	A	0.0000	-0.1000	-0.9600	-0.0400	12.1	19.6				
	B	0.0	-0.2	0.1	0.6	3.0	3.1				
	Resultant	0.0	0.3	1.0	0.6	12.5	19.8				

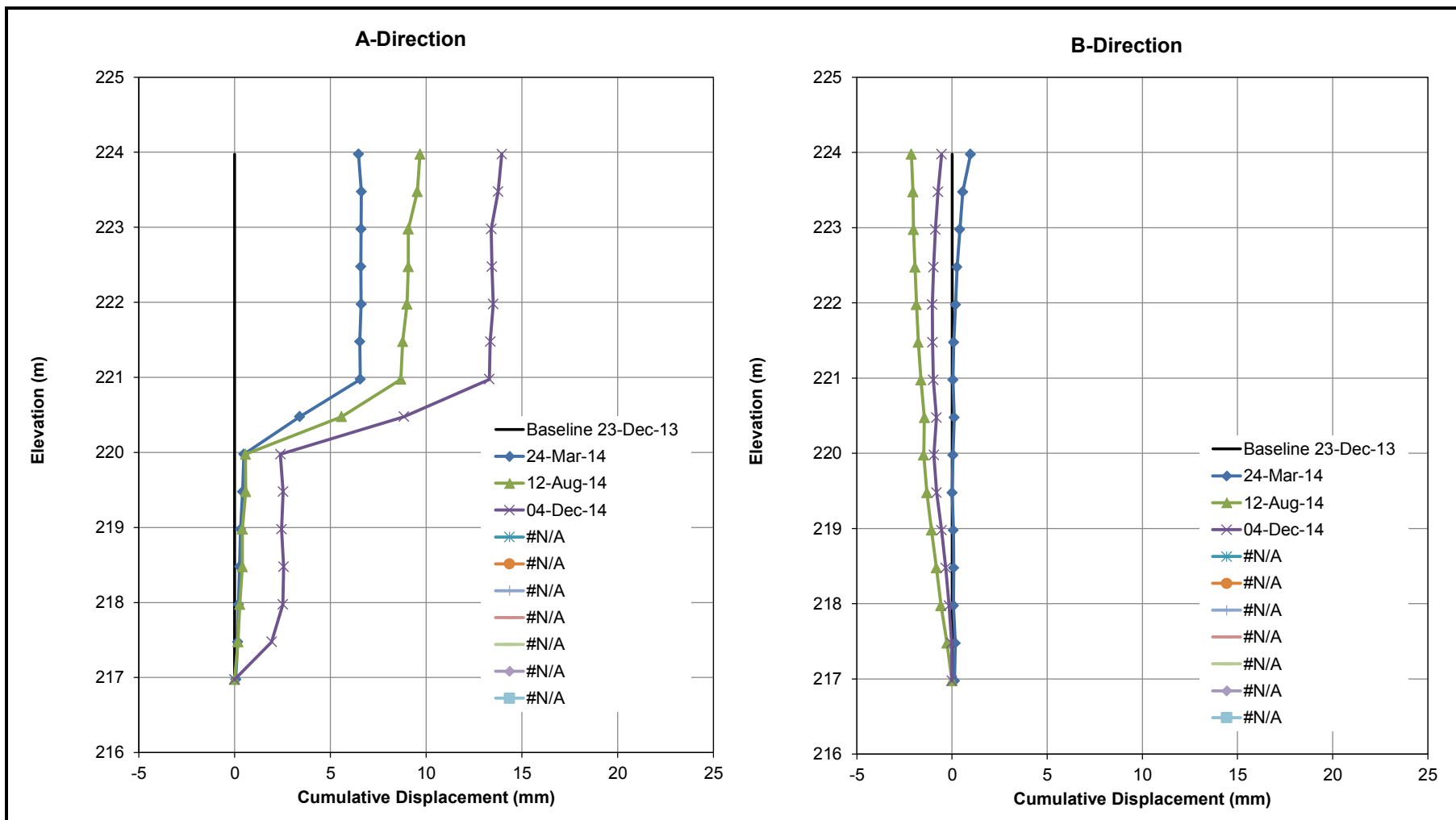




**SLOPE INCLINOMETER WORKSHEET**  
Cumulative Displacement in A and B Directions (Movement)

**INSTALLATION DATA**

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-7



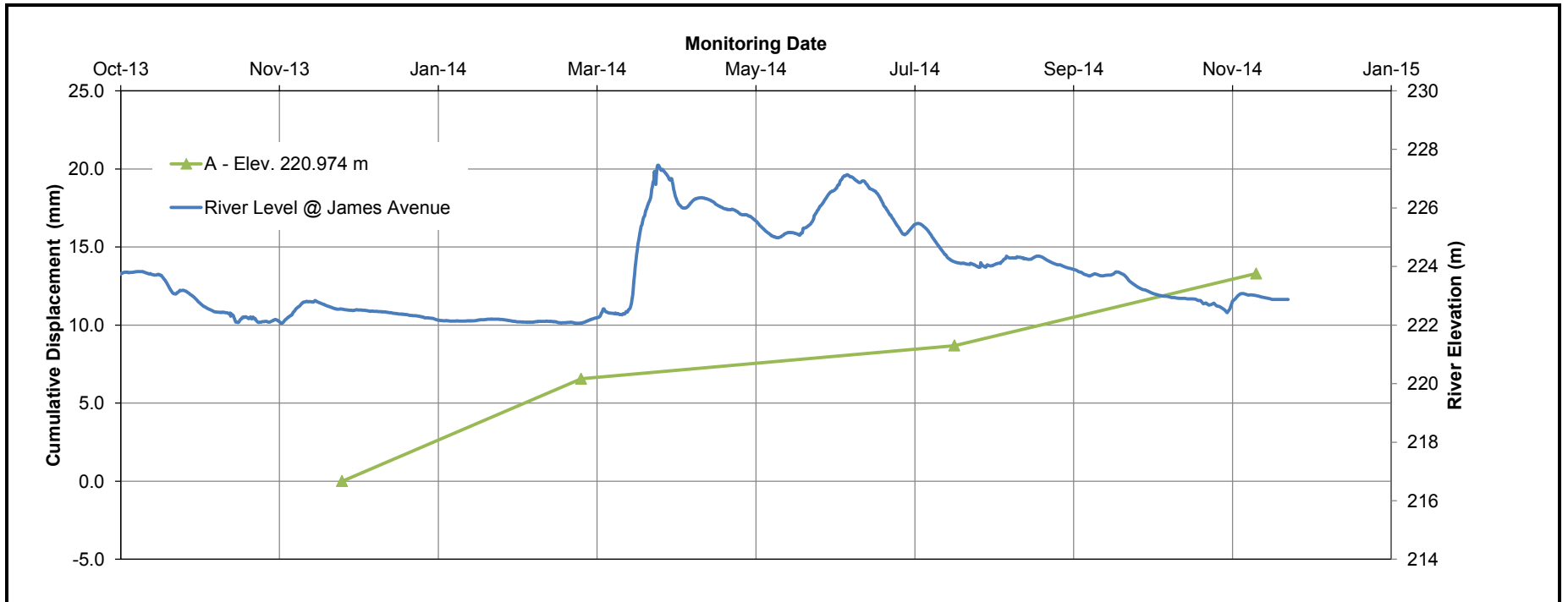


**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-7

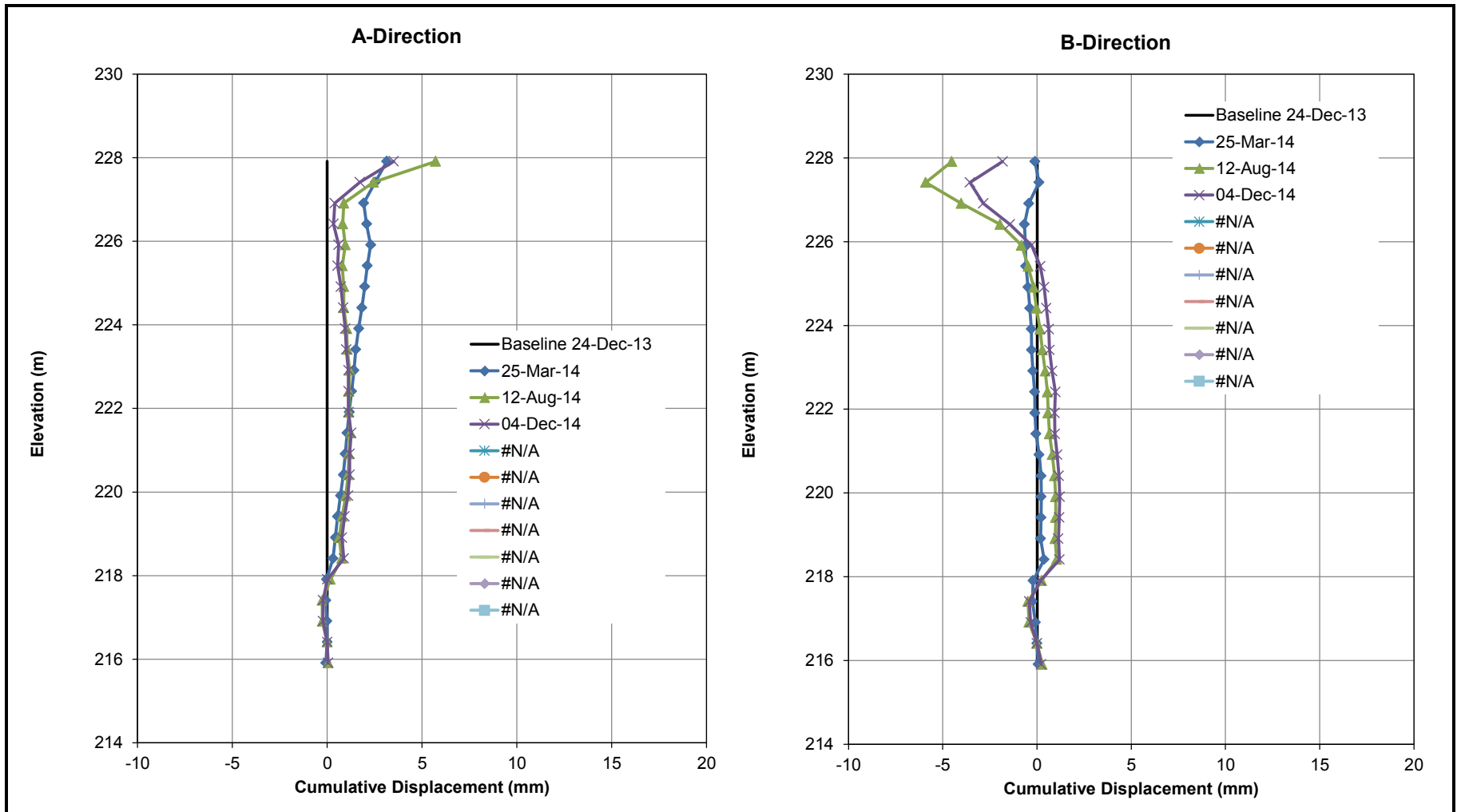
Elevation Range (m)		Cumulative Displacement (mm) vs. Monitoring Date										
221.0	Axis	23-Dec-13	24-Mar-14	12-Aug-14	4-Dec-14							
	A	0.0	6.6	8.7	13.3							
	Resultant	0.0	6.6	8.8	13.3							





INSTALLATION DATA

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-8



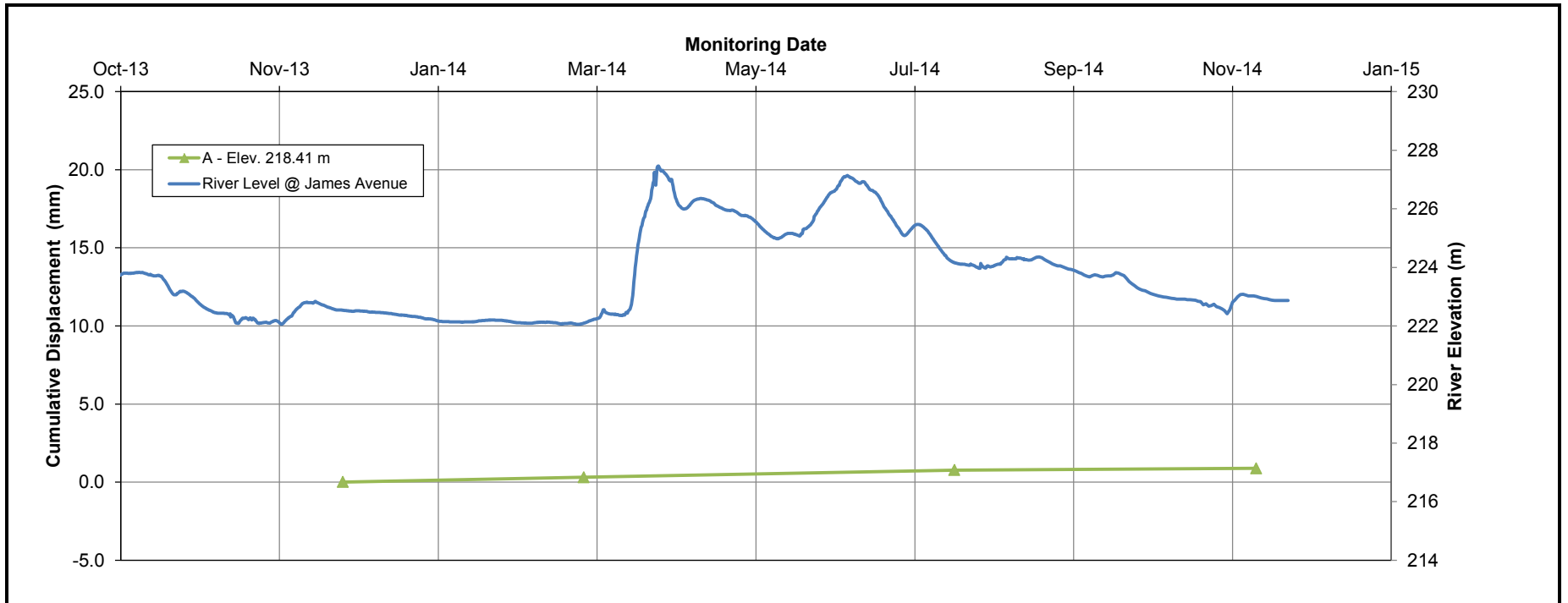


**SLOPE INCLINOMETER WORKSHEET**  
 Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-8

Elevation Range (m)		Axis	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14						
Bot	218.4	A	0.0	0.3	0.8	0.9						
		B	0.0	0.4	1.1	1.2						
		Resultant	0.0	0.5	1.3	1.5						

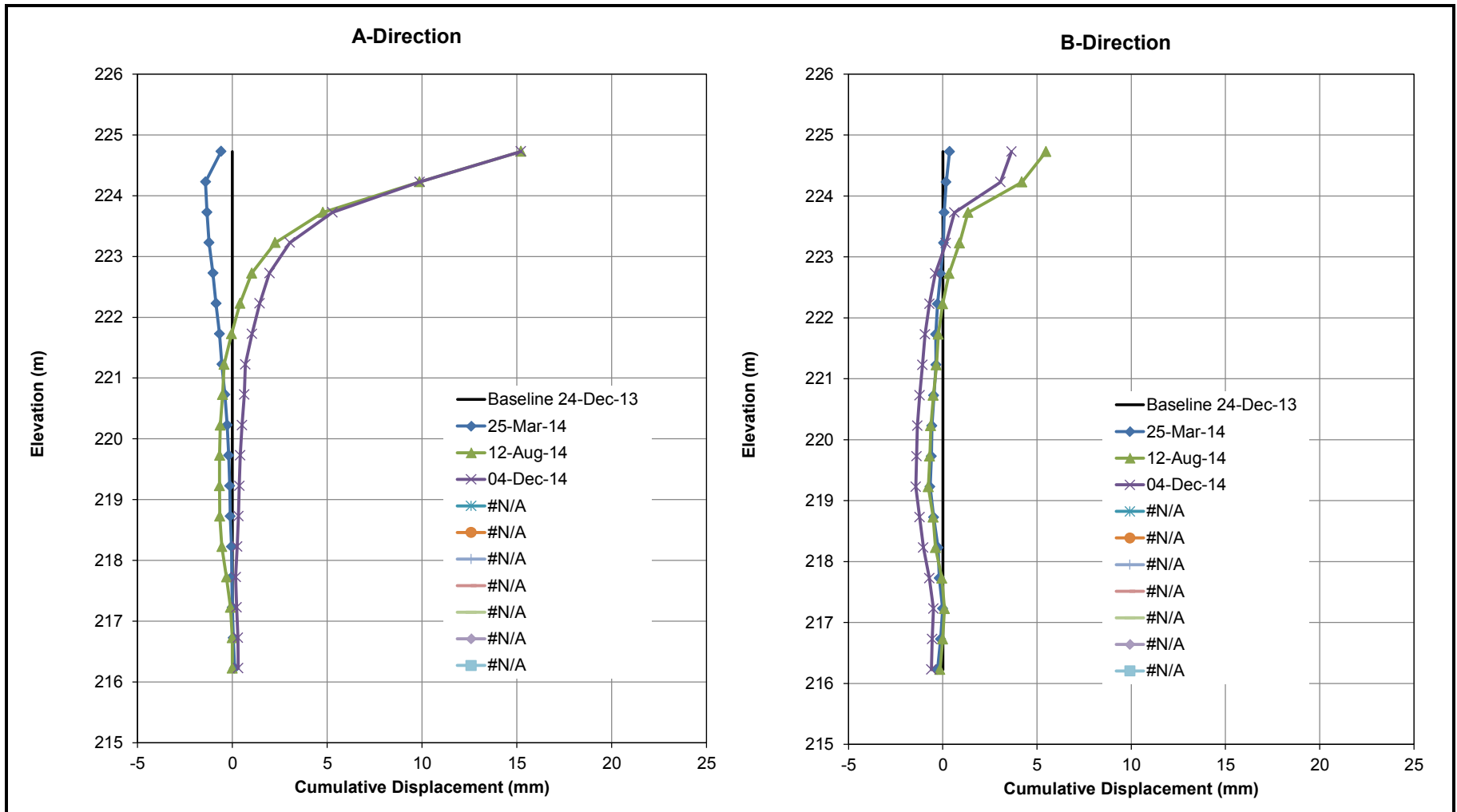




**SLOPE INCLINOMETER WORKSHEET**  
Cumulative Displacement in A and B Directions (Movement)

**INSTALLATION DATA**

Project No. 0015 008 00  
Project Title Lyndale Drive Retaining Wall Assessment  
Client City of Winnipeg  
Slope Inclinator No. SI-9





**SLOPE INCLINOMETER WORKSHEET**  
**Deflection Rate Plots (All Axes Combined, Relative to Casing Bottom)**

**INSTALLATION DATA**

Project No. 0015 008 00  
 Project Title Lyndale Drive Retaining Wall Assessment  
 Client City of Winnipeg  
 Slope Inclinator No. SI-9

Elevation Range (m)		Axis	24-Dec-13	25-Mar-14	12-Aug-14	4-Dec-14						
Top	224.7	A	0.0	-0.6	15.2	15.2						
		B	0.0	0.4	5.5	3.6						
		Resultant	0.0	0.7	16.2	15.7						

