Appendix B: Investigation Data

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 1**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT. Silt is non-plastic. Moist.			
0.7	LOESS		Brown, sandy SILT. Sand is fine to medium. Silt is non-plastic. Firm. Moist.			
0.9	COLLUVIUM		Brown, silty GRAVEL. Gravel is fine to coarse. Silt is non-plastic. Loose. Moist.			
1.4	OUTWASH GRAVEL		Grey, sandy GRAVEL. Gravel is fine to coarse. Sand is fine to coarse. Medium dense. Moist.			
2.1	OUTWASH GRAVEL		Grey, bouldery sandy GRAVEL. Boulders up to 500mm. Medium dense. Moist.			
2.9	GLACIAL TILL		Grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.			
3.2	OUTWASH GRAVEL		Grey, gravelly SAND and sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Moist.			
3.3	OUTWASH SAND		Grey, SAND and silty SAND. Sand is fine to coarse. Silt is non-plastic. Medium dense. Wet.		Minor seepage	

Total Depth = 3.3 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 2**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.4	TOPSOIL		Dark brown, organic SILT with rootlets and sandy SILT. Silt is nonplastic. Moist.		NO SEEPAGE	
1.8	OUTWASH GRAVEL		Grey, cobbly sandy GRAVEL. Cobbles to 150mm. Sand is predominantly medium to coarse. Gravel is fine to coarse. Medium dense. Moist.			
2.7	GLACIAL TILL		Grey/brown, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.			
3.5	GLACIAL TILL		Grey, gravelly silty SAND with minor boulders. Gravel is fine to coarse. Sand is fine to medium. Boulders to 250mm. Silt is non-plastic. Medium dense. Moist.			

Total Depth = 3.5 m

COMMENT:

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Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 3**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.4	UNCONTROLLED FILL		Brownish grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Loose. Moist.			
1.5	OUTWASH GRAVEL		Grey, cobbly sandy GRAVEL with minor boulders. Sand is predominantly medium to coarse. Gravel is fine to coarse. Boulders to 500mm. Medium dense. Moist.			
3.5	GLACIAL TILL		Brownish grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.			
4.0	GLACIAL TILL		Grey, silty gravelly SAND. Sand is fine to medium. Gravel is fine to coarse. Silt is non-plastic. Medium dense. Moist.		NO SEEPAGE	

Total Depth = 4 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with roots. Silt is non-plastic. Moist.			
0.7	COLLUVIUM		Brown, gravelly SILT with some sand. Gravel is fine to coarse. Silt is non-plastic. Firm. Moist.			
3.8	GLACIAL TILL		Grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.		NO SEEPAGE	

Total Depth = 3.8 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with roots. Silt is non-plastic. Moist.			
0.7	COLLUVIUM		Brown, gravelly SILT with some sand. Gravel is fine to coarse. Silt is non-plastic. Firm. Moist.			
3.0	GLACIAL TILL		Grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.			
3.4	GLACIAL TILL		Grey, gravelly silty SAND. Gravel is fine to coarse. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.		NO SEEPAGE	

Total Depth = 3.4 m

COMMENT:

Logged By: MDP

Checked Date:

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 6**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan — INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		organic SILT. Silt is non-plastic. Moist.			
0.7	COLLUVIUM		Brown, sandy SILT with some gravel. Sand is fine to coarse. Silt is non-plastic. Firm. Moist.			
3.3	GLACIAL TILL		Grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.		NO SEEPAGE	

Total Depth = 3.3 m

COMMENT:

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: TP 7

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	See Site Plan INCLINATION: VERTICAL		

EASTING:		mE	EQUIPMENT:	8 T Excavator	OPERATOR:	Ethan
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-17
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-17

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT. Silt is non-plastic. Moist.			
1.1	COLLUVIUM		Brown, sandy SILT with some gravel and schist clasts. Sand is fine to coarse. Schist to 700mm. Silt is non-plastic. Firm. Moist.			
3.0	GLACIAL TILL		Grey, silty SAND with some gravel. Sand is fine to medium. Silt is non-plastic. Medium dense. Moist.		NO SEEPAGE	
			Total Depth = 3 m			

COMMENT:

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GeoSolve Ltd

EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT: Northbrook Village		Job Number: 200490
LOCATION: See Site Plan	Inclination: VERTICAL	Direction:

EASTING:	mE	EQUIPMENT: 20 tonne digger		OPERATOR: Sandy	
NORTHING:	mN	INFOMAP NO.		COMPANY: Civil Construction	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 19-Jan-17	
METHOD:		EXCAV. DATUM:		HOLE FINISHED: 19-Jan-17	

SCALA PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.6		Dark brown, organic SILT with roots.		TOPSOIL
		1.4		Brown to grey, SILT with rootlet voids. Non-plastic. Stiff. Massive.	Moist	LOESS
		3.0		Brownish grey, sandy GRAVEL with minor cobbles & rare boulders. Gravel is fine to coarse. Sand is medium to coarse. Boulders maximum size 300mm. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
	Seepage @ 3.9 m →	3.9		Brownish grey, sandy GRAVEL with minor cobbles & a trace of silt. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		5.0		Brown to grey, sandy SILT with minor gravel. Sand is fine. Gravel is fine to medium. Non-plastic. Stiff. Massive to bedded.	Moist	GLACIAL TILL
				Total Depth = 5 m		

COMMENT: Minor collapse in upper outwash gravel unit. Ground water - minor perched seepage at 3.9m along top of till (northern end of pit).

Logged By: GSH/JH

Checked Date:

Sheet: 1 of 1

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EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT: Northbrook Village			Job Number: 200490
LOCATION: See Site Plan	Inclination:	VERTICAL	Direction:

EASTING:	mE	EQUIPMENT: 20 tonne digger		OPERATOR: Sandy	
NORTHING:	mN	INFOMAP NO.		COMPANY: Civil Construction	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 19-Jan-17	
METHOD:		EXCAV. DATUM:		HOLE FINISHED: 19-Jan-17	

SCALA PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Black, organic SILT.		TOPSOIL
	Seepage @ 1.3 m	0.9		Brown, silty SAND. Medium dense. Massive.	Wet	LOESS
		1.2		Brownish grey, SAND with some silt. Sand is fine to medium. Medium dense. Massive.	Saturated	LOESS
	→	1.9		Grey, SILT. Non-plastic. Very stiff. Weakly laminated.	Moist	POND SEDIMENT
		3.4		Brown to grey, sandy GRAVEL. Gravel is fine to medium. Sand is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		3.6		Brown to grey, SAND. Sand is fine to medium. Medium dense. Bedded.	Moist	OUTWASH SAND
		4.2		Brown to grey, interbedded SAND & sandy GRAVEL. Sand is fine to medium. Gravel is fine to medium. Medium dense. Bedded.	Moist	OUTWASH SAND/GRAVEL
		4.8		Brown to grey, sandy GRAVEL with minor cobbles. Sand is medium to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL

Total Depth = 4.8 m

COMMENT: Test pit walls collapsing. Minor seepage at 1.3m.

Logged By: GSH/JH
Checked Date:
Sheet: 1 of 1

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EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT: Northbrook Village			Job Number: 200490
LOCATION: See Site Plan	Inclination:	VERTICAL	Direction:

EASTING:	mE	EQUIPMENT: 20 tonne digger		OPERATOR: Sandy	
NORTHING:	mN	INFOMAP NO.		COMPANY: Civil Construction	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 1-Feb-17	
METHOD:		EXCAV. DATUM:		HOLE FINISHED: 1-Feb-17	

SCALA PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Dark brown, organic SILT with roots.	Moist	TOPSOIL
		0.9		Brown, silty GRAVEL with some boulders. Gravel is fine to coarse. Boulders max. size 700mm. Medium dense. Massive.	Moist	GLACIAL TILL
		1.4		Grey, SAND. Sand is fine. Medium dense. Bedded.	Moist	OUTWASH SAND
		2.0		Grey, SAND with minor boulders. Sand is medium to coarse. Boulders max. size 300mm. Medium dense. Bedded.	Moist	OUTWASH SAND
		3.8		Brown, sandy GRAVEL with minor silt. Sand is medium to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		4.1		Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		5.0		Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to medium. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		5.2		Grey, gravelly SAND. Sand is fine to medium. Gravel is fine. Medium dense. Bedded.	Moist	OUTWASH SAND
	NO SEEPAGE	6.2		Grey, sandy GRAVEL. Sand is fine to medium. Gravel is fine to medium. Medium dense. Bedded.	Moist	OUTWASH GRAVEL

Total Depth = 6.2 m

COMMENT:

Logged By: GSH/JH

Checked Date:

Sheet: 1 of 1

GeoSolve Ltd

EXCAVATION LOG

EXCAVATION NUMBER: **TP 11**

PROJECT: Northbrook Village			Job Number: 200490
LOCATION: See Site Plan	Inclination:	VERTICAL	Direction:

EASTING:	mE	EQUIPMENT: 20 tonne digger		OPERATOR: Sandy	
NORTHING:	mN	INFOMAP NO.		COMPANY: Civil Construction	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 1-Feb-17	
METHOD:		EXCAV. DATUM:		HOLE FINISHED: 1-Feb-17	

SCALA PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Brown, organic SILT with rootlets.	Moist	TOPSOIL
		1.1		Brown, GRAVEL. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		3.1		Grey/brown, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		3.5		Grey, gravelly SAND. Sand is fine. Gravel is fine to medium. Medium dense. Bedded.	Moist	OUTWASH SAND
		4.3		Grey, sandy GRAVEL. Sand is medium to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
	NO SEEPAGE	6.4		Brown, gravelly silty SAND. Gravel is fine to medium. Sand is fine to coarse. Medium dense. Massive.	Moist	GLACIAL TILL

Total Depth = 6.4 m

COMMENT:

Logged By: GSH/JH

Checked Date:

Sheet: 1 of 1

GeoSolve Ltd
EXCAVATION LOG

EXCAVATION NUMBER: **TP 12**

PROJECT: Northbrook Village		Job Number: 200490
LOCATION: See Site Plan	Inclination: VERTICAL	Direction:

EASTING: mE	EQUIPMENT: 20 tonne digger	OPERATOR: Sandy	
NORTHING: mN	INFOMAP NO.	COMPANY: Civil Construction	
ELEVATION: m	DIMENSIONS:	HOLE STARTED: 1-Feb-17	
METHOD:	EXCAV. DATUM:	HOLE FINISHED: 1-Feb-17	

SCALA PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Dark brown, organic SILT with rootlets.	Moist	TOPSOIL
		0.6		Brown, SILT with rootlet voids. Non-plastic. Stiff. Massive.	Moist	LOESS
		1.4		Brown, sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		1.5		Grey, SAND. Sand is fine. Medium dense. Bedded.		OUTWASH SAND
		4.2		Grey, sandy GRAVEL with minor boulders. Sand is fine to coarse. Gravel is fine to coarse. Boulders max. size 300mm. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		4.4		Grey, SAND. Sand is fine to medium. Medium dense. Bedded.	Moist	OUTWASH SAND
		4.9		Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
		5.5		Brown to grey, SILT with thin silty sand & sand beds. Sand is fine. Non-plastic. Firm. Laminated.	Moist	OUTWASH SILT
		6.3		Grey, sandy GRAVEL. Sand is medium to coarse. Gravel is fine to coarse. Medium dense. Bedded.	Moist	OUTWASH GRAVEL
	NO SEEPAGE	7.0		Grey, SAND. Sand is fine to medium. Medium dense. Bedded.	Moist	OUTWASH SAND

Total Depth = 7 m

COMMENT:	Logged By: GSH/JH
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 13**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	INCLINATION:		

EASTING:		mE	EQUIPMENT:	35 T Excavator	OPERATOR:	Matiu
NORTHING:		mN	INFOMAP NO.		COMPANY:	Civil Construction
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	8-Apr-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	8-Apr-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Dry to moist.			
0.7	COLLUVIUM		Light brown, silty SAND with minor gravel and trace rootlets. Sand is fine to medium. Silt is non-plastic. Loose to medium dense. Massive. Dry to moist.			
3.0	GLACIAL TILL		Light grey, silty SAND with some to minor gravel and trace cobbles and boulders. Sand is fine to medium. Boulders up to 200 mm. Silt is non-plastic. Medium dense. Massive. Dry to moist.			
4.0	GLACIAL TILL		Light grey, silty gravelly SAND. Sand is fine to medium. Gravel is fine to coarse and sub-rounded to sub-angular. Silt is non-plastic. Medium dense. Massive. Dry to moist.		NO SEEPAGE	

Total Depth = 4 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 14**

PROJECT:	Northbrook Village	JOB NUMBER:	200490
LOCATION:	INCLINATION:		

EASTING:		mE	EQUIPMENT:	35 T Excavator	OPERATOR:	Matiu
NORTHING:		mN	INFOMAP NO.		COMPANY:	Civil Construction
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	8-Apr-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	8-Apr-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.3	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.			
0.7	COLLUVIUM		Light brown, silty gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse and sub-rounded to sub-angular. Loose to medium dense. Massive. Dry to moist.			
4.4	GLACIAL TILL		Grey, silty SAND with minor gravel and trace cobbles and boulders. Sand is fine to medium. Silt is non-plastic. Medium dense. Massive. Dry to moist.		NO SEEPAGE	

Total Depth = 4.4 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

RILEY CONSULTANTS
Engineers and Geologists
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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Northlake Devolpment	Wanaka, Otago	Refer to site plan.	TP01

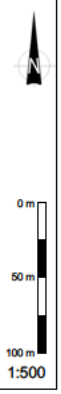
Job No.:	Start Date: 01-12-15 Finish Date: 01-12-15	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
15832		328.30	E 375,644 N 806,938

Client:	Hole Depth:	Sheet:
Northlake Investments Ltd	3.10 m	1 of 1

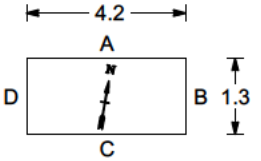
Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering	Field Strength (Soil / Rock)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+328.30									
+328.15	0.15	SILT with some sand and minor rootlets <1mm; brown. Dry; non-plastic; sand, fine. (TOPSOIL)							
+327.97	0.33	SILT with some sand and trace gravel; light yellowish brown. Dry; slightly plastic (when wet); hard; sand, fine; gravel, fine; subrounded to subangular; schist and quartz. (LOESS/LOESS-COLLUVIUM)							P= UTP kPa
	1	Silty fine to coarse GRAVEL with some sand; light brown. Gravel, subrounded to subangular, schist and quartz; sand, fine to medium. (GLACIAL OUTWASH) 1.10m - 1.80m Grades to cobbley GRAVEL with some sand; grey. Sand, medium to coarse.							
+326.50	1.80								
	2	SILT with some gravel and sand; greyish brown. Moist; slightly plastic; dilatant; sand, fine to medium; gravel, fine to coarse, sub rounded to subangular, schist and quartz. (GLACIAL TILL)							
+325.20	3.10								
		EOH @ 3.10 m							

SKETCH:

MAP



Shoring/Support:
Stability: Stable



- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Permeability Test
- Clegg Hammer; test repetitions (IV)
- Insitu Vane Shear Strength (kPa) P=Peak, R=Residual, UTP=Unable to penetrate
- Scala Penetrometer - blows/50mm

GROUNDWATER [X] None
[ ] Slow Seep (depth)
[ ] Rapid Inflow (depth)

PIT TERMINATED DUE TO:
[X] Target depth [ ] Collapse
[ ] Refusal [ ] Machine limit

Remarks

All dimensions in metres Scale 1:30	Contractor:	Rig/Plant Used: Machine Excavator (20 tonne)	Logged by: SJB	Checked by:

RILEY CONSULTANTS
Engineers and Geologists
Riley Consultants Ltd
395 Madras Street
Christchurch
Tel: +643 379 4402
Fax: +643 379 4403

INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Northlake Devolpment	Wanaka, Otago	Refer to site plan.	TP02

Job No.:	Start Date: 01-12-15 Finish Date: 01-12-15	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
15832		328.70	E 375,692 N 806,907

Client:	Hole Depth:	Sheet:
Northlake Investments Ltd	3.00 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering	Field Strength (Soil / Rock)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+328.70									
+328.47	0.23	SILT with some sand and minor rootlets <1mm; brown. Dry; non-plastic; sand, fine. (TOPSOIL)							
+328.05	0.65	SILT with some sand and trace gravel; light yellowish brown. Dry; slightly plastic (when wet); very stiff; sand, fine, gravel, fine; subrounded to subangular; schist and quartz; sand, fine. (LOESS/LOESS-COLLUVIUM)							P= 137 kPa R= 22 kPa
+326.00	0.70	Silty sandy fine to coarse GRAVEL; light brown. Dry; gravel, subrounded to subangular, schist and quartz; sand, fine to coarse. (GLACIAL OUTWASH)							
	1								
+327.30	1.40	Silty fine to medium SAND with trace to minor gravel; greyish brown mottled orange. Moist; slightly plastic; dilatant; sand, fine to medium, gravel, fine to medium, subrounded to subangular, schist and quartz. (GLACIAL OUTWASH)							
		Silty/ sandy fine to coarse GRAVEL with trace cobbles; light greyish brown. Gravel, fine to coarse, subrounded to subangular, schist and quartz, sand, fine to coarse. Includes thin lenses of fine to medium SAND; light grey. (GLACIAL OUTWASH)							
+326.60	2.10								
		SILT with some sand and trace gravel; greyish brown. Moist; slightly plastic; dilatant; sand, fine, gravel , fine to medium, subrounded to subangular, schist and quartz. (GLACIAL TILL)							
+325.70	3.00								P= UTP kPa
		EOH @ 3.00 m							

SKETCH:

MAP

0 m
50 m
100 m
1:500

Shoring/Support:
Stability: Stable

4.1
A
D
B
C
1.2

- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Permeability Test
- Clegg Hammer; test repetitions (IV)
- Insitu Vane Shear Strength (kPa) P=Peak, R=Residual, UTP=Unable to penetrate
- Scala Penetrometer - blows/50mm

GROUNDWATER [X] None
[ ] Slow Seep (depth)
[ ] Rapid Inflow (depth)

PIT TERMINATED DUE TO:
[X] Target depth [ ] Collapse
[ ] Refusal [ ] Machine limit

Remarks

All dimensions in metres Scale 1:30	Contractor:	Rig/Plant Used: Machine Excavator (20 tonne)	Logged by: SJB	Checked by:

RILEY AGS 3_1 NZLIB 13.GLB Log RILEY CHCH TP 15832 NORTHLAKE DEVELOPMENT TP.GPJ <<DrawingFile>> 23/12/2015 11:32 Produced by gINT Professional

RILEY CONSULTANTS
Engineers and Geologists
Riley Consultants Limited
395 Madras Street, Christchurch
Christchurch 8013
Tel: 03 3794402
Fax: 03 3794403

BORE HOLE LOG

Project:	Location:	Hole position:	No.:
Northlake Development	Wanaka, Otago	Refer to Site Plan.	BH1

Job No.:	Start Date: 01-12-15 Finish Date: 01-12-15	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
15832		327.26	E 375,808.3 N 806,845.6

Client:	Hole Depth:	Direction:	Sheet:
Northlake Investments Ltd	10.64 m		1 of 2

Geological Interpretation

Rock Description (where applicable): Weathering; ROCK NAME; colour; texture; fabric and orientation; strength (GEOLOGICAL UNIT). Defect description
Soil description (where applicable): Fraction (MAJOR / minor); colour; bedding. Strength, moisture; plasticity; additional (GEOLOGICAL UNIT)

Geological Description (recovered as):

Soil description (where applicable): Fraction (MAJOR / minor); colour; bedding. Strength, moisture; plasticity; additional

(refer to separate Geotechnical and Geological Information sheet for further information)

Run	Elevation (m LINZ)	Depth (m)	Description	Tests	Samples / Sample Description / Lab testing
0.00	+327.11	0	**SILT with minor sand and trace rootlets <1mm; dark brown. "Very soft"; wet; slightly plastic; dilatant; sand, fine.** (TOPSOIL)		
	+326.96		**SILT with some gravel and sand; light yellowish brown. "Very soft"; dry; friable; slightly plastic when wet; gravel; fine to medium, subrounded to subangular, schist and quartz; sand, fine to medium.** (LOESS)		
		1	**Gravelly SILT with some sand; brownish grey. "Firm"; dry; slightly plastic (when wet); gravel; fine to medium (rare coarse), subrounded to subangular, schist and quartz; sand, fine to medium.** (GLACIAL OUTWASH)		
1.52	+325.76			SPT 1.52 m 4, 5, 4, 5, 6, 6; Nc = 21	
		2	**Interbedded SILT, SAND and GRAVEL mixtures with thick bedded GRAVEL from 9.12m bgl.** (GLACIAL TILL) 1.50m - 2.90m Silty fine to medium SAND with trace gravel; dark yellowish brown. Medium dense; gravel, fine to medium, angular, schist. 1.82m - 2.90m Grades to light yellowish brown; sand, fine.		
3.04		3	2.90m - 3.04m SILT with minor sand and trace clay; dark yellowish brown with dark brown mottling. "Soft"; moist; low plasticity; sand, fine. 3.04m - 6.00m Sandy SILT with some gravel; dark greyish brown. "Soft to firm"; wet; sand fine to medium; gravel, fine to medium (rare coarse), subrounded to subangular schist and quartz	SPT 3.04 m 10, 11, 10, 9, 10, 11; N = 40	SPT - Rec: 390mm; Sandy SILT with some gravel.
		4			
4.56		5	4.56m - 4.80m Sand lense (medium to coarse). Medium dense.	SPT 4.56 m 4, 5, 5, 5, 7, 6; N = 23	SPT - Rec: 380mm; Medium to coarse SAND.
6.08		6	6.00m - 6.08m SILT with minor clay, trace gravel and sand; dark greyish brown. "Firm"; moist to wet; low plasticity; dilatant; gravel, fine to medium, subrounded to subangular, schist and quartz; sand, fine. 6.08m - 6.10m CORE LOSS. 6.10m - 7.00m Sandy SILT with some gravel; dark greyish brown with slight orange brown weathering. "Firm"; non-plastic; dilatant; sand, fine to medium; gravel, fine to medium (rare coarse), subrounded to subangular, schist and quartz.	SPT 6.08 m 5, 10, 8, 7, 7, 7; N = 29	SPT - Rec: 340mm; Sandy SILT with some gravel.
		7	7.00m - 9.34m Silty sandy fine to medium GRAVEL; dark greyish brown with slight orange brown weathering. Gravel, fine to medium, subrounded to subangular, schist and quartz; sand, fine to coarse.		
7.60		8	7.60m - 9.12m Fine to medium (rare coarse) Gravel, predominately subrounded, quartz. Very dense.	SPT 7.60 m 10, 19, 16, 15, 15, 14; Nc = 60	

Fluid & Water: 1 Slow Seep

Backfill / Piezometer

SONIC1 114mm GEOPROBE 8140LC

Explanations:

- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)
- Small Disturbed Sample (SDS)
- Large Disturbed Sample (LDS)
- Standard Penetration Test (SPT)

Soil Types: CLAY, SILT, SAND, GRAVEL, TOPSOIL, PEAT, FILL, NO RECOVERY *

Backfill: Bentonite, Grout, Drill arisings or collapsed hole, Filter material

Remarks

1. PQ sized core; 95mm diameter casing; flushed with potable water.
2. Heave (up-flow of material into casing) minimal (<100mm) unless stated.
3. Cohesive soil strength terms based on field description of drill arisings and indicated in quotation marks.
4. Sample moisture contents: soil moisture levels affected by drill method (500L added); not recorded for non-cohesive soils; based on field description of drill arisings for cohesive soils.
5. Core loss attributed to one or combination of compression or soil or outflow of material during extraction (suction).
6. SPT tests: commenced approx. 70mm below end-of-run depths; hammer energy ratio 90.8%; undertaken with split spoon unless stated as solid cone (Nc); "Rec"= recovered sample length (max 450mm).
7. Piezometer measured on 2/12/2015, no water level recorded (dry). Possible perched zone where seepage indicated.

All dimensions in metres Scale 1:50	Contractor: McMillan Specialist Drilling Services	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: PS	Logged by: CFC	Checked by: LK

RILEY CONSULTANTS
Engineers and Geologists
Riley Consultants Limited
395 Madras Street, Christchurch
Christchurch 8013
Tel: 03 3794402
Fax: 03 3794403

BORE HOLE LOG

Project:	Location:	Hole position:	No.:
Northlake Development	Wanaka, Otago	Refer to Site Plan.	BH1

Job No.:	Start Date: 01-12-15 Finish Date: 01-12-15	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
15832		327.26	E 375,808.3 N 806,845.6

Client:	Hole Depth:	Direction:	Sheet:
Northlake Investments Ltd	10.64 m		2 of 2

Type	Run	Fluid & Water	Legend	Geological Interpretation / Geological Description (recovered as):	Elevation (m LINZ)	Depth (m)	Tests	Samples / Sample Description / Lab testing	Backfill / Piezometer
SONIC 114mm GEOPROBE 8140LC	7.60			**Interbedded SILT, SAND and GRAVEL mixtures with thick bedded GRAVEL from 9.12m bgl.** (GLACIAL TILL) *(continued)*		9			
	9.12			9.12m - 9.34m CORE LOSS; very dense.			SPT 9.12 m 8, 12, 13, 19, 20, 10 (430mm); Nc = 62		
				9.34m - 10.64m Fine to medium (rare coarse) GRAVEL with minor silt/sand; brown. Gravel predominately subrounded, quartz with rare subangular, schist; sand, fine to coarse.		10			
				EOH @ 10.64 m		11	SPT 10.64 m 7, 10, 10, 10, 10, 13 (410mm); N = 43	SPT - Rec: 450mm; Fine to medium (rare coarse) GRAVEL with minor silt and sand.	
						12			
						13			
						14			
						15			
						16			

Geological Interpretation
Rock Description (where applicable): Weathering; ROCK NAME; colour; texture; fabric and orientation; strength (GEOLOGICAL UNIT). Defect description
Soil description (where applicable): Fraction (MAJOR / minor); colour; bedding. Strength, moisture; plasticity; additional (GEOLOGICAL UNIT)

Geological Description (recovered as):
Soil description (where applicable): Fraction (MAJOR / minor); colour; bedding. Strength, moisture; plasticity; additional

(refer to separate Geotechnical and Geological Information sheet for further information)

Explanations:

- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)
- Small Disturbed Sample (SDS)
- Large Disturbed Sample (LDS)
- Standard Penetration Test (SPT)

Soil Types:

CLAY, SILT, SAND, GRAVEL, TOPSOIL, PEAT, FILL, NO RECOVERY *

Backfill:

Bentonite, Grout, Drill arisings or collapsed hole, Filter material

Remarks

1. PQ sized core; 95mm diameter casing; flushed with potable water.
2. Heave (up-flow of material into casing) minimal (<100mm) unless stated.
3. Cohesive soil strength terms based on field description of drill arisings and indicated in quotation marks.
4. Sample moisture contents: soil moisture levels affected by drill method (500L added); not recorded for non-cohesive soils; based on field description of drill arisings for cohesive soils.
5. Core loss attributed to one or combination of compression or soil or outflow of material during extraction (suction).
6. SPT tests: commenced approx. 70mm below end-of-run depths; hammer energy ratio 90.8%; undertaken with split spoon unless stated as solid cone (Nc); "Rec"= recovered sample length (max 450mm).
7. Piezometer measured on 2/12/2015, no water level recorded (dry). Possible perched zone where seepage indicated.

All dimensions in metres Scale 1:50	Contractor:	Rig/Plant Used:	Driller:	Logged by:	Checked by:
	McMillan Specialist Drilling Services	Geoprobe Sonic (McMillan)	PS	CFC	LK

Appendix C: B F Whitham - Stage 15 Geotechnical Completion Report

BF WHITHAM LTD
Civil and Structural Engineer

1 Hawkdun Place
ALEXANDRA 9320
Tel 64 3 448 8503 Mobile s 9(2)(a)
Email : s 9(2)(a)

GEOTECHNICAL COMPLETION REPORT

NORTHLAKE SUBDIVISION
STAGE 15

AUBREY / OUTLET ROAD, WANAKA

for

NORTHLAKE INVESTMENTS LTD

Date: 7 February 2020
Reference : B 66212-11

1. Introduction

B F Whitham Ltd has been engaged by Civil Construction Ltd to oversee the construction on stages 1-15 of the Northlake Subdivision at Aubrey and Outlet Roads in Wanaka.

This report relates to stage 15 of the subdivision (excluding the carriageways).

This report includes:

a) A review of all previous geotechnical reports prepared for this site and their recommendations,

b) An overview of the earthworks completed on site including
   i. excavations and fill operations
   ii. fill certification in accordance with NZS4431 for the reinstatement of the temporary storm water retention pond affecting lots 5001 – 5009.

c) Recommendations regarding suitability for foundation design within stage 15 as required by Section 2.6.1 of the Queenstown Lakes District Council Land Development and Subdivision Code of Practice (LDSCOP)

2. Site description

Stage 15 – is described as 175 lots being numbered 5001 – 5175.

Stage 15 is formed in excavation and fill. Some of the Lots had cut and fill operations.

- The excavated lots were Lots 5038 – 5047, 5053 – 5098, 5100, 5101, 5110 – 5114, 5166 – 5172) with cuts up to 9.5m deep. The excavated material was utilised in the fill areas in Stage 15 and elsewhere within the subdivision.
- The filled lots were Lots 5001 – 5037, 5049 – 5052, 5127 – 5143, 5161 – 5164.
- Lots 5001 – 5009 were utilised as a temporary stormwater retention pond area for the subdivision. This area was subsequently undercut and backfilled as per NZS 4431. The maximum backfilled depth of 5.0m was within this retention pond area.
- Lots 5001 – 5020 along the Outlet Road boundary has a 1.0m high timber post and board retaining wall – designed and checked by others.
- Lots 5021 – 5032 have been tested and certified by Ground Consulting Ltd to be have an ultimate bearing capacity of 300kPa from finished ground level.

Refer to Appendix B for

- Stage 15 As built cut-fill plan RM 171190 (Paterson Pitts Group ref W5431-014-100a 4 dated 17 January 2020). With NDM test locations
- Stage 15 As built cut-fill plan SDP B & C RM 171190 (Paterson Pitts Group ref W5431-014-100b 4 dated 17 January 2020). With NDM test location.
- Stage 15 NDM Testing results sheet (Paterson Pitts Group ref W5431-014-101 rev 1 dated 17 January 2020)
- Stage 15 As built contours RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)
- Stage 15 Scala test locations RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)
- Stage 15 Scala test results

From the as built contour plan it can be observed stage 15

- Generally has a gentle topography of approximately 1 in 50 from east to west.
- Lots 5001 – 5020 along outlet Road have a batter slope to the boundary of 3H:1V with an overall height differential of some 2.0 metres. These lots are subject to a separate contract subsequent to the earthworks contract that included a 990mm high retaining wall and backfill slope of 3H:1V.

There is no sign of slope instability.

There is no trace of water table.

3. Scope of works

This report included a desk top study of previous geotechnical reports, site inspections during construction, and review of the testing regime and test results.

The issue of a Schedule 2A certificate with conditions as required, is attached as Appendix A

4. Previous reports

Previous reports relevant to this area of stage 15 are listed below and are on the Queenstown Lakes District files and attached to previous Geotechnical Completion Reports for this subdivision.

1. Riley Consultants - geotechnical assessment report 15832-B dated 17 February 2016

2. Geosolve Ltd – Geotechnical Report Northlake Subdivision – subzone area B2, B3 and C1, Outlet Road, Wanaka dated August 2017.

Riley Consultants Ltd (Riley) report 15832-B dated 17 February 2016 was a geotechnical assessment prepared in support of the ODP application approved by the Queenstown Lakes District Council in RM160152.

As part of their assessment Riley carried out shallow subsurface geotechnical investigations including 32 hand auger boreholes to 3.0 metres deep and 42 shallow test pit investigations including in-situ strength testing with shear vane and scala penetrometer testing where appropriate. Also deep ground investigations including four rotary-sonic machine boreholes (two at 10m depth and two at 15m depth) with in-situ soil strength tests by standard penetration test (SPT).

The shallow subsurface geotechnical investigations relevant to stage 15 are listed below with the geotechnical ultimate bearing capacity listed. This table below is from page 8 of the report and the inspection logs in Appendix A of that report.

	Investigation ID	200kPa (m below topsoil)	300kPa (m bgl)
Lot 5017 approx	HA2	0.0	0.6
Lot 5144 approx	HA3	0.0	0.2
Lot 5010 approx	TP1	These test pits TP1 and TP2 were excavated to 3.0 metre deep into sandy silt gravel (glacial till)	
Lot 5014 approx	TP2		

Riley stated in their executive summary "the site was found to be generally suitable for lightweight structures with shallow foundation types, such as residential housing. An ultimate bearing capacity of 200kPa consistently available across the site from below the topsoil, an ultimate bearing capacity of 300kPa was available below 1.0m across most of the site" This statement was for the whole site but the local test results for Stage 15 indicate an ultimate bearing capacity of 300kPa at 0.2 metres to 0.6 metres from the finished level.

The Geosolve Ltd report dated August 2017 reports on some of the area in stage 15. Test pits relevant to stage 15 are TP3, TP22, TP23 and TP25.

The results from these test pits are consistent with the Riley report and what was encountered on site. Namely the area had some 0.2 metres of topsoil overlaying a 0.3-0.6 metre layer of colluvium on top of glacial till.

From these reports it can be generally accepted the subgrade over stage 15 will achieve the ultimate bearing capacity of 300kPa.

5. Site works

5.1 Site works

The extent of the construction works area in the stage 15 area was the excavation down to the required design levels, with the depth varying from original ground level to 9.5 metres in depth and the backfilling to grade design levels with a maximum fill depth of 5.5m. Refer to appendix A - Stage 15 As built cut-fill plan.

The underlying fill subgrade was a silty/sand/gravel colluvium which is consistent with the findings contained in the Riley report.

The area required for filling was prepared as per Civil Construction Ltd method of construction. The subgrade was cleared, compacted and tested by scala penetrometer, as per standard practice, to confirm an allowable bearing capacity of 100kPa prior to any fill being placed. The temporary pond area (Lots 5001 – 5009) was stripped out of the pond sealing layer to a subgrade of alluvial gravels.

No indication of ground water was observed during the pre-fill subgrade inspections or during the earthworks filling operations. Accordingly, it was assessed that there was no requirement for under-fill drainage

The backfill was placed and constructed in terms of NZS4431:1989. The fill was placed in 200 – 300mm layers and compacted with a 16 ton vibrating drum compactor. The fill was also further compacted with construction traffic of fully laden rubber tyred 50 ton dump trucks.

The fill material used was clean sandy silt and silty gravelly material sourced from within the stage 15. This material as reported by:

1. Riley "is unlikely to be subject to seasonal wetting/shrink-swell effects and can be categorised as non-expansive Class A soils in terms of AS2870".
2. Geosolve in section 5.3 Site preparation / earthworks this material "colluvium can be used as engineered fill on site".

The lots adjacent to Outlet Road (5001 – 5032) have a fill batter sloping down at 3H:1V to the boundary. For lots 5001 – 5020, a contract subsequent to the earthworks contract, constructed a retaining wall some 0.9 metres high. It is recommended any foundation within 10 metres of this Outlet Road boundary of these Lots 5001 – 5032 be assessed by a CPEng professional.

5.2 Testing regime

As stated above the fill subgrade area was tested prior to filling and thereafter testing was carried out for compaction compliance with relative compaction testing. This was undertaken at or in excess of the frequency recommended in NZS4431:1989 "Code of practice for earth fill for residential development" as recommended by the Riley report (section 9.1).

Refer to Appendix B for

1. Stage 15 As built cut-fill plan RM 171190 (Paterson Pitts Group ref W5431-014-100a and 100b 4 dated 17 January 2020). With NDM test locations
2. Stage 15 NDM Testing results sheet (Paterson Pitts Group ref W5431-014-101 rev 1 dated 17 January 2020)
3. Stage 15 Scala test locations ref W5431-014-102a and 102b rev 2 dated 20 January 2020". The scala penetrometer testing showed a subgrade with a working bearing capacity of 100kPa or an ultimate bearing capacity of 300kPa.
4. Scala test results

The NDM Relative Compaction tests were carried out by Central Testing Ltd. Of the 152 test results 6 were at 94% and 3 at 93%. These 9 tests results below 95% are considered to be within the range allowed by NZS4431. The 143 other tests results exceed the 95% minimum allowable in terms of NZS4431:1989.

As stated above, the completed surface of stage 15 was tested by scala penetrometer. Each Lot had two locations tested and the results proved an allowable bearing capacity of 100kPa which equates to an ultimate bearing capacity of 300kPa.

6. Conclusion and recommendation

NZS 3604:2011 clause 3.3.8 prescribes that for "good ground" each lot shall have a minimum four penetrometer tests to confirm the bearing capacity. This testing programme is for an individual lot in isolation and was not carried out.

However, from the NDM testing regime carried out, and two scala penetrometer tests per lot, it can be concluded that all the sites within Stage 15 satisfy the definition of "good ground" within NZS3604:2011.

As stated above Lots 5001 – 5032 adjacent to Outlet Road have a sloping fill batter and any foundation in this area shall be assessed by a CPEng professional.

On the basis of:

1. The construction method undertaken, machinery and plant used,
2. The material used in the construction
3. All fill compaction testing being undertaken at or in excess of the frequency recommended in NZS4431:1989 and satisfying the 95% requirement.

4. The scala penetrometer testing regime upon completion proving all tests exceeded 100kPa allowable bearing capacity

I believe on reasonable grounds that Stage 15 can be classified as "good ground" as having an allowable bearing capacity of 100kPa or greater.

As per clause 21(l) of the Resource Consent RM160509, a Schedule 2A certificate as per NZS4404:2010 "Land Development and Subdivision Infrastructure" is attached as Appendix A.

Please also note the standard clause 4 of the Schedule 2A certificate.

Yours faithfully

Bernard Whitham
MIPENZ (Civil), CPEng IntPE, Regn no. 58201, MBA (Tech Mgt.)

7. Appendices

Appendix A – Schedule 2A certificate

Appendix B –

- Stage 15 As built cut-fill plan RM 171190 (Paterson Pitts Group ref W5431-014-100a 4 dated 17 January 2020). With NDM test locations
- Stage 15 NDM Testing results sheet (Paterson Pitts Group ref W5431-014-101 rev 1 dated 17 January 2020)
- Stage 15 As built cut-fill plan SDP B & C RM 171190 (Paterson Pitts Group ref W5431-014-100b 4 dated 17 January 2020). With NDM test location.
- Stage 15 As built contours RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)
- Stage 15 Scala test locations RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)
- Stage 15 Scala test results

SCHEDULE 2A

STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

Development Northlake Subdivision, Wanaka - Stage 15

Developer Northlake Investments Ltd

Location Aubrey Road / Outlet Road, Wanaka

I Bernard Francis Whitham of B F Whitham Ltd, 22 CIty Road, Dunedin

(Full name) *(Name and address of firm)*

Hereby confirm that:

1. I am a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the developer as the geo-professional on the above development.

2. The extent of my preliminary investigations are described in my Report(s) number N/A, dated ....., and the conclusions and recommendations of that/those document(s) have been re-evaluated in the preparation of this report. The extent of my inspections during construction, and the results of all tests and/or re-evaluations carried out are as described in my geotechnical completion report dated 7 february 2020 ref: 66212/11 and attached to this certificate

3. In my professional opinion, not to be construed as a guarantee, I consider that (delete as appropriate):

   (a) The earth fills shown on the attached Plan No. W5431-014-100a and 100b have been placed in compliance with the requirements of the NZS4431:1989 Council and my specification.

   (b) The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, (which should be read in conjunction with the appended final site contour plan).

   (c) Subject to 3(a) and 3(b) of this Schedule, the original ground not affected by filling is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i) see report 66212 / 11 - all lots satisfy requirements for "good ground" as per NZS3604 Section 1....

   (ii) .....

   (d) Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i) see report 66212 / 11 - all lots satisfy requirements for "good ground" as per NZS3604 Section 1... with Lots 5001 - 5030 requiring foundation design within 10m of the Outlet Road boundary

   (ii) .....

   (e) The original ground not affected by filling and the filled ground are not subject to erosion, subsidence, or slippage in accordance with the provisions of section 106 of the Resource Management Act 1991 provided that:

   (i) not applicable

   (ii) .....

NOTE – These subclauses may be deleted or added to as appropriate, to include such considerations as expansive soils where excluded from NZS 3604, and site seismic characteristics as covered in clause 3.1.3 of NZS 1170.5.

4. This professional opinion is furnished to the TA and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.

5. This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

Signed .....

Date .....7 February 2020.....

Bernard Whitham

CPEng IntPE, MBA (Tech Mgt)

(Name, title, and professional qualifications)

APPENDIX B

Paterson Pitts Group drawings

- Stage 15 As built cut-fill plan RM 171190 (Paterson Pitts Group ref W5431-014-100a 4 dated 17 January 2020). With NDM test locations

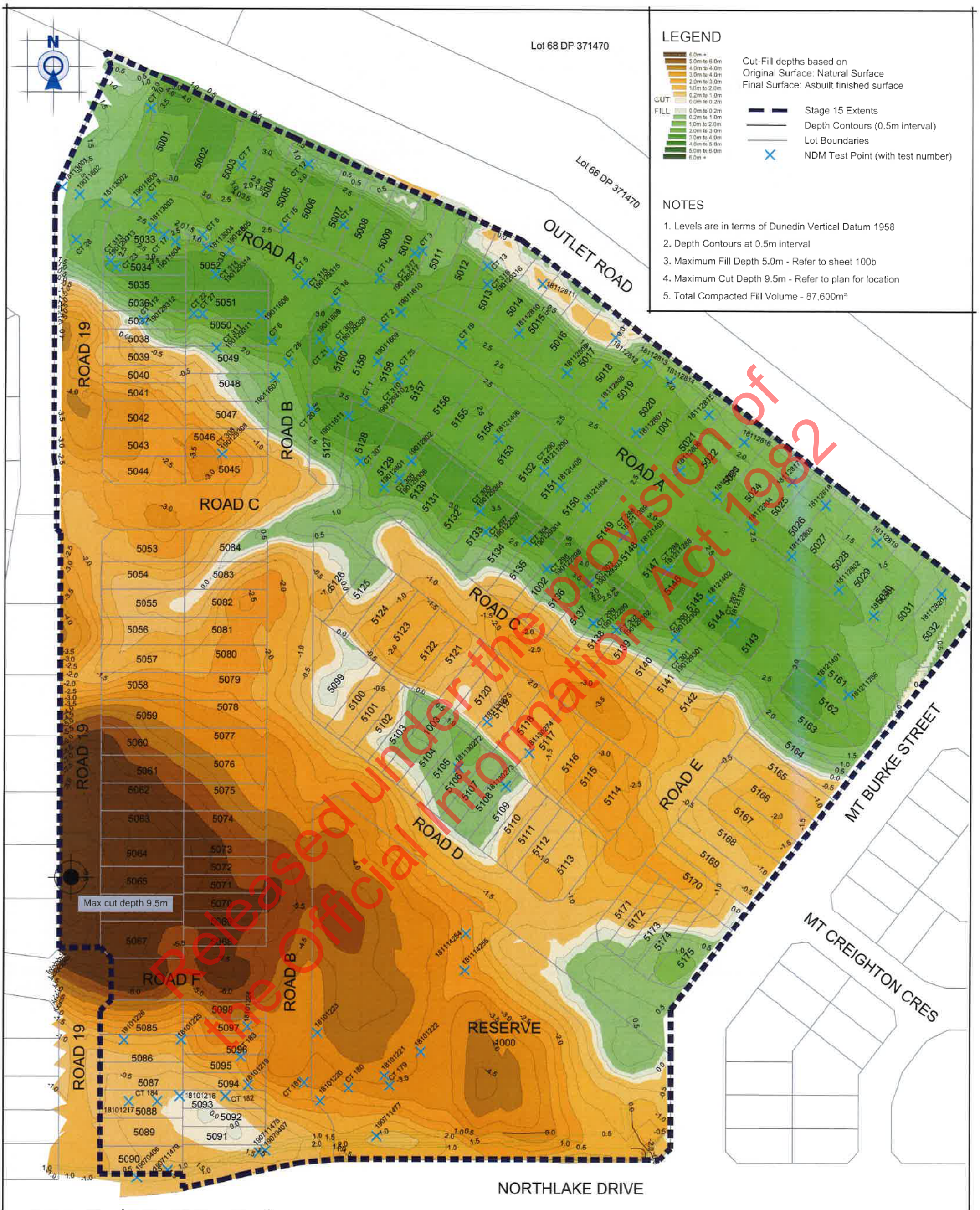
- Stage 15 As built cut-fill plan SDP B & C RM 171190 (Paterson Pitts Group ref W5431-014-100b 4 dated 17 January 2020). With NDM test location.

- Stage 15 NDM Testing results sheet (Paterson Pitts Group ref W5431-014-101 rev 1 dated 17 January 2020)

- Stage 15 As built contours RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)

- Stage 15 Scala test locations RM 171190 (Paterson Pitts Group ref W5431-014-102a and 102b rev 2 dated 20 January 2020)

- Stage 15 Scala test results



LEGEND

CUT
6.0m +
5.0m to 6.0m
4.0m to 4.0m
3.0m to 4.0m
2.0m to 3.0m
1.0m to 2.0m
0.2m to 1.0m
0.0m to 0.2m

FILL
0.0m to 0.2m
0.2m to 1.0m
1.0m to 2.0m
2.0m to 3.0m
3.0m to 4.0m
4.0m to 5.0m
5.0m to 6.0m
6.0m +

Cut-Fill depths based on
Original Surface: Natural Surface
Final Surface: Asbuilt finished surface

- Stage 15 Extents
- Depth Contours (0.5m interval)
- Lot Boundaries
- NDM Test Point (with test number)

NOTES

1. Levels are in terms of Dunedin Vertical Datum 1958
2. Depth Contours at 0.5m interval
3. Maximum Fill Depth 5.0m - Refer to sheet 100b
4. Maximum Cut Depth 9.5m - Refer to plan for location
5. Total Compacted Fill Volume - 87,600m³

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Client & Location:
NORTHLAKE
wanaka

Purpose & Drawing Title:
Stage 15 Asbuilt Cut-Fill Plan
RM 171190

Surveyed by:	PPG	Original Size:	Scale:	
Designed by:	-	A3	1:1500 @ A3	
Drawn by:	AGM		DO NOT SCALE	
Checked by:	DA			
Approved by:	AGT			
Job No:	Drawing No:	Sheet No:	Revision No:	Date Created:
W5431	014	100a	1	17/01/2020

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LEGEND

CUT: 6.0m + / 5.0m to 6.0m / 4.0m to 4.0m / 3.0m to 4.0m / 2.0m to 3.0m / 1.0m to 2.0m / 0.2m to 1.0m / 0.0m to 0.2m

FILL: 0.0m to 0.2m / 0.2m to 1.0m / 1.0m to 2.0m / 2.0m to 3.0m / 3.0m to 4.0m / 4.0m to 5.0m / 5.0m to 6.0m / 6.0m +

Cut-Fill depths based on
Original Surface: Pond B & Pond C surfaces
Final Surface: Asbuilt finished surface

- Stage 15 Extents
- Depth Contours (0.5m interval)
- Lot Boundaries
- NDM Test Point (with test number)

NOTES

1. Levels are in terms of Dunedin Vertical Datum 1958
2. Depth Contours at 0.5m interval
3. Maximum Fill Depth 5.0m - Refer to plan for location
4. Maximum Cut Depth 9.5m - Refer to sheet 100a
5. Total Compacted Fill Volume - Refer to sheet 100a

Max fill depth 5.0m

Lot 68 DP 371470

Lot 66 DP 371470

OUTLET ROAD

ROAD A

ROAD B

ROAD C

ROAD D

ROAD E

ROAD F

ROAD 19

MT BURKE STREET

MT CREIGHTON CRES

NORTHLAKE DRIVE

RESERVE 1000

5053	5084
5054	5083
5055	5082
5056	5081
5057	5080
5058	5079
5059	5078
5060	5077
5061	5076
5062	5075
5063	5074
5064	5073
	5072
5065	5071
5066	5070
	5069
5067	5068

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Client & Location:
NORTHLAKE
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Purpose & Drawing Title:
Stage 15 Cut-Fill Plan
SDP B & C Backfill
RM 171190

Surveyed by:	PPG	Original Size:	Scale:
Designed by:	-	A3	1:1500 @ A3
Drawn by:	AGM		
Checked by:	DA		DO NOT SCALE
Approved by:	AGT		
Job No: W5431	Drawing No: 014	Sheet No: 100b	Revision No: 1
			Date Created: 17/01/2020

L:\DATA\5400\5431 NIL BULK EARTHWORKS PHASE 2\ACAD\W5431 014 STAGE 15 CUT-FILL PLAN.DWG

Stage 15 NDM Testing

Test ID	Northing (m)	Easting (m)	RL (m)	Relative Compaction
18101217	806665.1	375569.0	336.5	96.4
18101218	806667.0	375587.4	336.3	96.8
18101219	806671.1	375612.2	336.1	94.7
18101220	806665.4	375638.2	335.7	97.3
18101221	806674.5	375661.4	335.6	95.8
18101222	806683.2	375674.5	334.9	95
18101223	806689.9	375637.2	335.9	95.7
18101224	806692.2	375611.9	336.4	96
18101225	806687.3	375587.9	336.5	95.5
18101226	806687.2	375567.2	336.8	98.5
18112801	806841.6	375837.8	329.3	96
18112802	806850.8	375825.2	329.4	95.3
18112803	806862.9	375808.0	329.5	98
18112804	806873.6	375793.3	329.7	97
18112805	806884.4	375780.9	329.7	96.3
18112806	806893.6	375767.5	329.8	98.9
18112807	806907.2	375751.6	329.9	98.9
18112808	806917.5	375739.7	329.9	100.7
18112809	806928.8	375726.5	330.0	95.9
18112810	806943.0	375709.1	330.1	104.3
18112811	806960.8	375717.6	329.5	101.4
18112812	806941.6	375744.1	329.3	101
18112813	806932.3	375755.3	329.3	98.5
18112814	806925.8	375764.0	329.2	99.7
18112815	806913.9	375777.9	329.2	99.8
18112816	806903.9	375790.7	329.1	100.5
18112817	806889.7	375808.2	329.0	96.8
18112818	806881.3	375820.3	328.9	100
18112819	806868.0	375838.7	328.8	100.6
18112820	806849.5	375862.4	328.4	97.8
18113001	806995.2	375543.4	329.7	100
18113002	806989.6	375559.6	329.7	103
18113003	806980.7	375576.5	329.8	100
18113004	806973.7	375596.1	329.8	102
18121401	806817.4	375818.4	329.7	98
18121402	806847.0	375778.7	330.1	98
18121403	806865.3	375754.2	330.2	97
18121404	806880.4	375733.7	330.4	97
18121405	806887.5	375724.3	330.4	98
18121406	806904.7	375701.9	330.5	97
19011602	806992.6	375550.0	330.3	98
19011603	806990.0	375570.4	330.2	102
19011604	806975.6	375584.8	330.1	104
19011605	806972.6	375604.5	330.2	98
19011606	806949.3	375615.8	330.8	96
19011607	806926.7	375621.0	331.8	97
19011608	806940.8	375637.0	330.9	94
19011609	806932.6	375658.0	330.8	93
19011610	806950.4	375666.4	330.4	96
19011611	806912.8	375647.6	331.9	97
19070406	806637.7	375572.0	334.8	104
19070407	806647.6	375618.5	334.4	104
181114254	806725.9	375690.7	334.9	98
181114255	806712.6	375690.3	334.9	95
181130272	806785.9	375687.7	333.5	95
181130273	806779.4	375704.9	333.2	98
181130274	806791.3	375713.4	331.8	100
181130275	806802.5	375698.1	332.0	95
181211286	806812.8	375828.7	329.6	96
181211287	806838.8	375787.4	330.1	96
181211288	806857.7	375763.1	330.2	97
181211289	806869.8	375747.2	330.3	98
181211290	806893.2	375718.5	330.4	98
190122297	806871.2	375697.4	331.0	97
190122298	806857.9	375719.5	330.7	96
190122299	806838.4	375736.4	330.6	95
190122300	806833.4	375766.1	330.5	94
190129301	806827.0	375765.3	331.2	96
190129302	806836.0	375744.6	331.5	94
190129303	806852.8	375734.9	331.6	94
190129304	806868.0	375712.2	331.9	94
190129305	806878.7	375695.1	332.1	97
190129306	806890.5	375666.0	332.4	98
190129308	806899.0	375602.1	332.6	97
190129309	806937.8	375644.9	331.1	95
190129310	806926.4	375665.4	330.8	100
190129311	806937.4	375599.8	331.7	99

Stage 15 NDM Testing

Test ID	Northing (m)	Easting (m)	RL (m)	Relative Compaction
190129312	806947.0	375573.1	332.4	98
190129313	806968.5	375561.1	332.1	94
190129314	806963.8	375599.3	331.2	96
190129315	806960.7	375631.9	330.5	102
190129316	806960.5	375697.8	330.1	93
190129317	806971.7	375671.3	330.2	98
190711477	806652.8	375658.6	335.6	103
190711478	806646.9	375616.1	335.6	104
190711479	806640.5	375583.2	336.0	98
CT1	806918.2	375653.7	329.3	95
CT2	806945.0	375660.3	329.1	98.9
CT3	806972.6	375674.1	328.9	97.1
CT4	806982.0	375645.4	328.8	96.2
CT5	806963.7	375629.2	328.9	95.1
CT6	806939.9	375619.9	329.3	98.3
CT7	807003.4	375608.6	328.1	97.7
CT8	806978.1	375594.6	328.2	98.8
CT9	806991.8	375575.9	328.1	97.8
CT10	807023.8	375575.8	328.0	96.0
CT12	807003.9	375632.9	328.7	98.9
CT13	806967.3	375697.7	328.7	96.7
CT14	806962.8	375658.7	328.9	95.6
CT15	806980.6	375624.3	328.8	95.8
CT17	806978.1	375580.6	329.1	99.1
CT18	806954.4	375642.7	329.1	97.7
CT19	806939.1	375688.5	329.4	97.4
CT20	806915.3	375634.3	330.0	98.7
CT21	806936.0	375641.2	330.0	96.8
CT22	806949.7	375591.6	330.0	96
CT23	806966.4	375563.4	330.0	99.6
CT25	806929.7	375667.0	330.4	101.9
CT26	806932.1	375625.9	330.7	97.6
CT27	806949.5	375594.8	330.6	100.9
CT28	806976.3	375548.8	330.9	93.3
CT179	806670.9	375663.2	335.4	97.8
CT180	806670.0	375648.4	335.5	96.4
CT181	806671.9	375632.4	335.6	100.0
CT182	806667.0	375604.0	336.0	98.6
CT183	806681.3	375609.5	336.1	100.8
CT184	806665.1	375579.3	336.1	95.6
CT254	806725.9	375690.7	334.9	99.1
CT255	806712.6	375690.3	334.9	96.2
CT272	806785.9	375687.7	333.5	98.1
CT273	806779.4	375704.9	333.2	102.8
CT274	806791.3	375713.4	331.8	103.2
CT275	806802.5	375698.1	332.0	100.3
CT286	806812.8	375828.7	329.6	99.7
CT287	806838.8	375787.4	330.1	97.3
CT288	806857.7	375763.1	330.2	101.3
CT289	806869.8	375747.2	330.3	100.7
CT290	806893.2	375718.5	330.4	100.3
CT297	806871.2	375697.4	331.0	98.0
CT298	806857.9	375719.5	330.7	98.8
CT299	806838.4	375736.4	330.6	96.2
CT300	806833.4	375766.1	330.5	97.2
CT301	806827.0	375765.3	331.2	97.2
CT302	806836.0	375744.6	331.5	94.8
CT303	806852.8	375734.9	331.6	96.8
CT304	806868.0	375712.2	331.9	96.4
CT305	806878.7	375695.1	332.1	99.3
CT306	806890.5	375666.0	332.4	100.8
CT307	806896.5	375651.9	332.5	97.0
CT308	806899.0	375602.1	332.6	99.7
CT309	806937.8	375644.9	331.1	97.7
CT310	806926.4	375665.4	330.8	100.4
CT311	806937.4	375599.8	331.7	100.1
CT312	806947.0	375573.1	332.4	99.8
CT313	806968.5	375561.1	332.1	96.8
CT314	806963.8	375599.3	331.2	100.5
CT315	806960.7	375631.9	330.5	99.7
CT316	806960.5	375697.8	330.1	96.7
CT317	806971.7	375671.3	330.2	96.3
CT477	806652.8	375658.6	335.6	96
CT478	806646.9	375616.1	335.6	96
CT479	806640.5	375583.2	336.0	93

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Client & Location:
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Purpose & Drawing Title:
Stage 15 NDM Testing Results Sheet

Surveyed by:	PPG	Original Size:	Scale:		
Designed by:	-				
Drawn by:	AGM	A3	1:1500 @ A3		
Checked by:	DA				
Approved by:	AGT		DO NOT SCALE		
Job No:	Drawing No:	Sheet No:	Revision No:	Date Created:	
W5431	014	101	1	17/01/2020	

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LEGEND

- Stage 15 Extents
- Major Contour (2.0 m interval)
- Minor Contour (0.5 m interval)
- Lot Boundaries
- Scala penetrometer test point

NOTES

1. Levels are in terms of Dunedin Vertical Datum 1958

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Client & Location:

NORTHLAKE
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Purpose & Drawing Title:

Stage 15 Asbuilt Contours
RM 171190

Surveyed by:	PPG	Original Size:	Scale:
Designed by:	-	A3	1:1000 @ A3
Drawn by:	AGM		
Checked by:	DA		DO NOT SCALE
Approved by:	AGT		

Job No:	Drawing No:	Sheet No:	Rev No:	Date Created:
W5431	014	102a	2	20/01/2020

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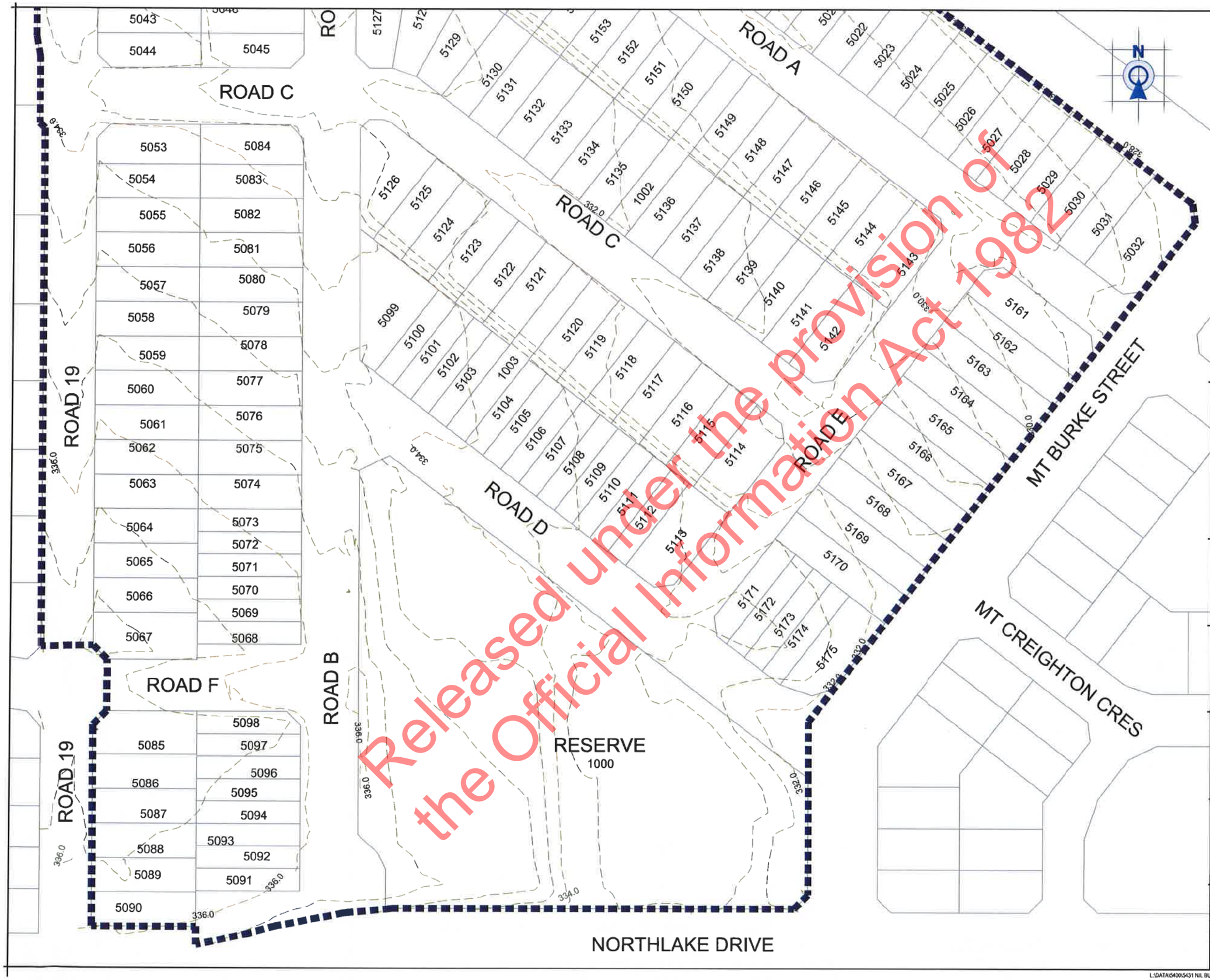

LEGEND

- Stage 15 Extents
- Major Contour (2.0 m interval)
- Minor Contour (0.5 m interval)
- Lot Boundaries
- Scala penetrometer test point

NOTES

1. Levels are in terms of Dunedin Vertical Datum 1958

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Client & Location:

NORTHLAKE
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Purpose & Drawing Title:

Stage 15 Asbuilt Contours RM 171190

Surveyed by:	PPG	Original Size:	Scale:
Designed by:	-	A3	1:1000 @ A3
Drawn by:	AGM		
Checked by:	DA		DO NOT SCALE
Approved by:	AGT		

Job No:	Drawing No:	Sheet No:	Rev No:	Date Created:
W5431	014	102b	2	20/01/2020

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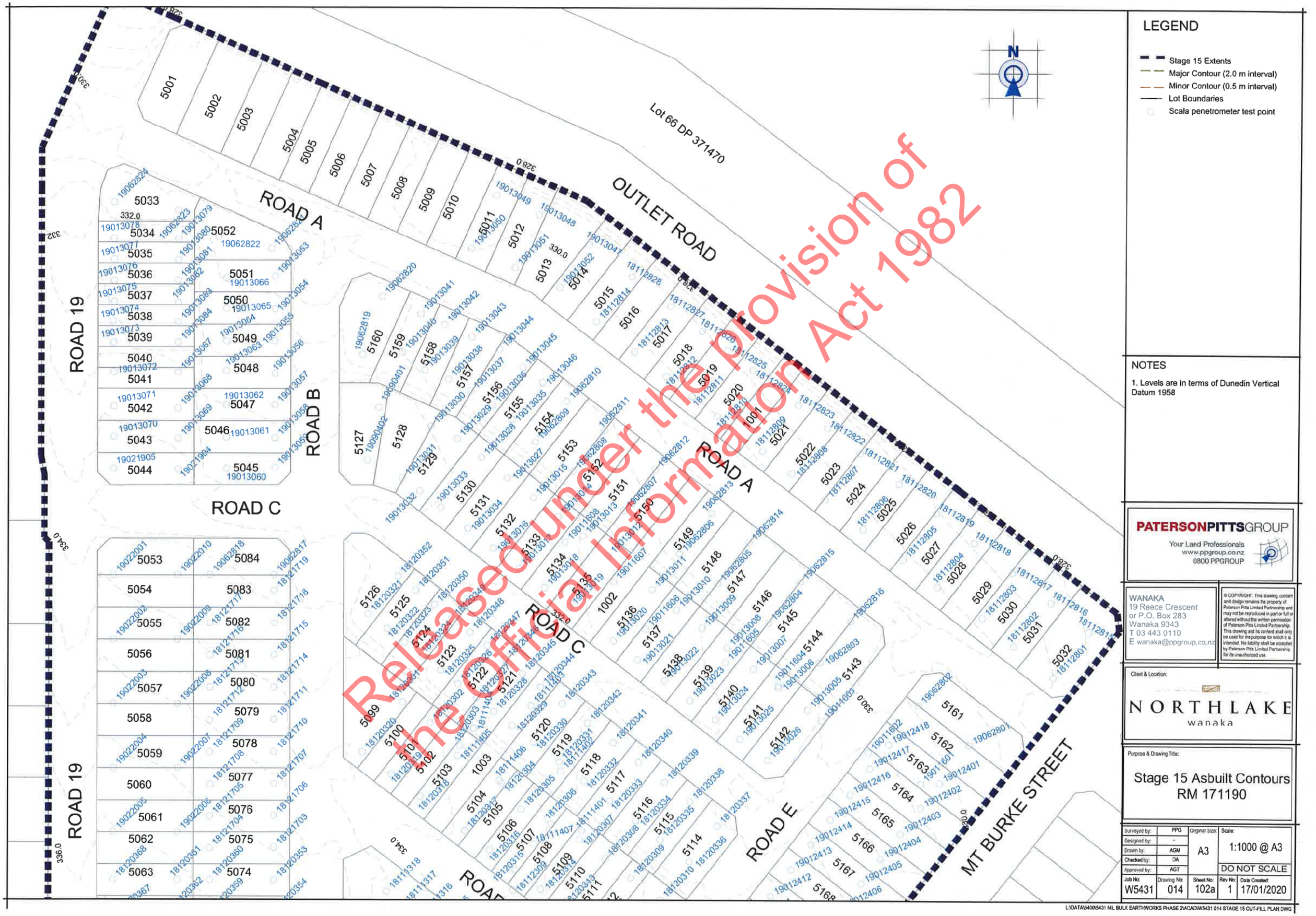

LEGEND

- Stage 15 Extents
- Major Contour (2.0 m interval)
- Minor Contour (0.5 m interval)
- Lot Boundaries
- Scala penetrometer test point

NOTES

1. Levels are in terms of Dunedin Vertical Datum 1958

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Client & Location:
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Purpose & Drawing Title:
Stage 15
Scala Test Points
RM 171190

Surveyed by:	PPG	Original Size:	Scale:
Designed by:	-	A3	1:1000 @ A3
Drawn by:	AGM		DO NOT SCALE
Checked by:	DA		
Approved by:	AGT		
Job No:	Drawing No:	Sheet No:	Rev No: / Date Created:
W5431	014	102b	0 / 20/01/2020

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