THE LAKES DEVELOPMENT
VARIATION TO STAGE 2A
PYES PA, TAURANGA

Geotechnical Assessment

Our ref: 18264
June 2007

S&L CONSULTANTS LTD - SURVEYORS - ENGINEERS - PLANNERS
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Appendices

1.0 Introduction

Approval for the Lakes Development was initially granted jointly by the Tauranga City Council and Western Bay of Plenty District Council on 24 May 2004 based on subdivision plan 16916 dated 20 April 2004 prepared by S&L Consultants Ltd.

A variation is to be submitted to the Tauranga City Council for the proposed development on the area known as Stage 2A at The Lakes. The subdivision scheme plan is shown on drawing 124825-2A-SC01 prepared by Harrison Grierson. A copy of the plan is included in Appendix 1 of this report. Twenty seven residential lots are proposed. Access to these lots is to be by the extension of the subdivision link road, Landing Quay and two short cul de sacs off Landing Quay.

The Stage 2A area is bounded to the north by a steeply sided local hill, to the west by the residential development of Stage 1C of The Lakes with frontage to Landing Drive and to the south west and east by the subdivision roads currently under construction of Landing Quay and Lakes Boulevard respectively.

This report describes the earthworks undertaken in the formation of this stage of the subdivision including the relevant standards adopted for the placement of filling to support residential buildings and recommendations for developing building sites.

During the report reference is made to drawings 18264-AB1 and 18264-AB2.

At the time of preparation of this report the earthworks within the Stage 2A area had been completed. Appended drawing AB1 shows the finished ground contours as the result of the completed earthworks. Drawing AB2 shows the depths of the filling that was placed, the locations of subsoil drains and the positions of compaction tests undertaken during the earthworks.

2.0 Original Landform and Geology

The landform prior to the commencement of the subdivision construction comprised:

- Elevated areas along the eastern side as a central plateau described locally as the Te Ranga Tablelands. These areas have been variously used for farming and horticultural cropping. The existing Pyes Pa residential area further to the east has been established on similar level areas of the same elevation.
- Lower lying areas mainly along and adjacent to the Kopurererua Stream to the west and extending eastwards.
- Transitional slopes of varying steepness between the lower lying areas and the elevated central plateau. Re entrant erosion gullies were present on some of these slopes but most were uniform in slope gradient, albeit steep in some locations.

The geological setting for the development area can be derived from the publication:

Occasional Report 22 – Department of Earth Sciences University of Waikato "Geology of the Tauranga Area" by Briggs et al – 1996

The geology within the Stage 2A area can be described as:

(i) On the steep sided hill to the north.
- Taupo volcanic zone tephras comprising Rotoehu ash (light grey sand) overlaid by brown or yellow post Rotoehu ash being coarse grained silts, sandy silts and sands. These are collectively referred to as "younger ashes" and overlay.
- "Older" ash derivative strongly weathered clay textured tephra beds and palaesols (Hamilton ash) overlaying.
- Older terrestrial and estuarine sediments deposits of the Matua subgroup of the Tauranga formation. These may comprise a wide variety of lithologies.
- Te Ranga ignimbrite being white-grey pumiceous sands and coarse silts. Out crops of this material could be seen in the cut faces within the earthworks areas recently completed in Stages 1 and 2.

(ii) At the lower areas to the west below the transition slopes and adjacent to the Kopurererua Stream:
- Alluvial silts, sands and gravels transported by the stream.
- Organic peat at the existing ground surfaces or overlaid by alluvial soils at depth.
- Eroded sections of the more elevated Taupo volcanic zone tephra that have been reduced to the levels of the stream plain or rise above these levels as mounds or ridges that extend in to the stream plain area.

3.0 Presubdivision Investigations

Prior to obtaining subdivision approval on 24 May 2004 a comprehensive geotechnical assessment was undertaken by S&L Consultants Ltd. The subsequent report that accompanied the consent application was titled "Pyes Pa West Urbanisation Development, Geotechnical Assessment Report, reference 16944" and was dated October 2003.

Fifty two machine drilled boreholes and 26 excavated pits were used to identify the subsoils that are present on the development area. Machine drilled boreholes 9, 10 and 12 were located within or to the south of the Stage 2A area, at locations shown on 18264-AB2. Each of these boreholes showed the presence of similar subsoils being:
- Peat (organic silt) to depths of up to 2.0m
- Grey sandy silts and sands underlying the surface peat. These inorganic soils were found to be of varying densities and strengths with uncorrected SPT N values in the range of 1 to 6. Borehole 9 was drilled to 9.5m. No further organic soils were encountered in that depth apart from the surface cover of peat.

Machine drilled borehole 52, located on higher ground within the Stage 1B area showed the ash stratigraphy that may be present in the slope profiles to the north of Stage 2A. Subsequent test drilling within Stage 1B and as described in S&L Consultants Ltd report 17726 and dated December 2006 identified in more detail the presence of the Te Ranga ignimbrite which is the base constituent for the hill to the north of Stage 2A. Outcrops of the

ignimbrite can also be seen in an old quarry face formed by the farmer to the rear of proposed lots 416 and 417 in the Stage 2A area.

The presubdivision investigations concluded that:

- The soils to be obtained in areas or cut would be suitable for placement as filling to support future houses although some conditioning may be required so that placement would be near optimum moisture contents.
- Areas of ground not to be disturbed by construction earthworks would be suitable for the support of future houses in accordance with NZS 3604.
- As the volcanic ash stratigraphy varies in type and relative strength foundation bearing conditions may vary across building sites formed in areas of cut.
- Similar variations in soil type may be encountered in road subgrades and in situ testing would be required to determine pavement depths applicable to the subgrade conditions present.
- The peat soils can be removed to depths governed by the capability of the earthmoving machinery on the site and the cost effectiveness of removing the peat and undertaking its replacement with filling obtained from elsewhere within the subdivision development area.

4.0 Scope of Subdivision Earthworks

The earthworks undertaken in the Stage 2A area and as shown on 18264-AB2 comprised.

(a) The removal of the surface peats and the replacement of the peat with filling obtained from borrow areas within the subdivision. Prior to placement of the filling over the stripped areas an extensive subsoil drainage system was constructed. The positions of these drains and their outfalls are shown on 18264-AB2. The drains mainly originated at the bases of shallow gullies that extended southwards into the peat areas from the steep hillside to the north. The points of seepage that are serviced by the drains were identified when removal of the peat commenced.

(b) The minor trimming at the base of hill to the north to establish flatter areas at the rear of proposed lots 406, 409, 410, 411, 415 and 416. The soils removed were mostly topsoil and colluvium from past erosion of the steeper slopes above.

(c) The formation of an earthfilled bund at the rear of lots 406, 409, 410, 411, 415 and 416. The purpose of this bund is described in Section 6.3 of this report.

The depths of cut and filling shown on 18264-AB2 were derived from surveyed contours of the finished surface taken on completion of the earthworks compared with topographical surveys undertaken by S&L Consultants Ltd prior to the subdivision construction and also after the removal of the unsuitable surface soils and prior to the placement of the replacement filling.

The earthworks for the Stage 2A area were undertaken by RPL Services Ltd contracted to the developer during the 2005-2006 earthworks season and by Hick Bros Earthmoving during the 2006-2007 earthworks season.

The area of filling undertaken by RPL Services in 2005-2006 was within proposed lots 400 to 408 inclusive. At the same time the peat was removed from the remainder of the Stage 2A area. Hick Bros completed the filling including the placement of additional filling to lift ground levels in the area previously filled by RPL Services.
The earthworks were undertaken in compliance with consent 62387 issued by Environment Bay of Plenty.

5.0 Earthworks Standards

The performance specification required of the Contractors for the earthworks was based on the guidelines contained in NZS 4431:1989 "Code of Practice for Earthfill for Residential Development". Compliance with the compaction requirements listed below satisfies the standards listed in Section 7 of the NZS 4431.

Air voids percentage (as defined in NZS 4402: Part 1:1980)
Structural Fill - Average value less than 10% (any 10 tests)
- Maximum single value 12%

Undrained shear strength (measured by in situ vane)
Structural Fill - average value not less than 150kPa (any 10 tests)
- Minimum single value 100kPa

Where the filling placed was clearly pumiceous sand obtained from borrow pits in the Te Ranga ignimbrite Scala penetrometer tests were specified with blow counts of 5 or more per 100mm of penetration being required.

The calculation of air voids percentages is dependant on the determination of the solid densities of the soils used in the filling. These soils mainly comprised mixed silts, clayey silts, sandy silts and sands depending on the depths below the original ground surfaces that the cuts were made for obtaining fill materials. For cohesive silt/clay soil mixtures a value of solid density of 2.65t/m^3 was used in the calculation of air voids. Where the sample taken for laboratory determination of insitu water content comprised pumiceous sands and was indicative of the soils in which the nuclear densometer test was undertaken a lower value of solid density was used in the calculation based on specific tests for solid density.

The earthworks were supervised by site engineering technicians employed by the developer and observed by engineering staff from S&L Consultants Ltd during specific site inspections.

Compaction and strength control testing was undertaken by IANZ accredited Opus International Consultants Ltd both on site and in their Tauranga Laboratory.

63 compaction tests were undertaken within the areas of filling within the Stage 2A area at locations shown on 18264-AB2. The results of these tests are summarised in Appendix 3.

The test results meet the specification criteria.

6.0 Summary and Recommendations

6.1 Subdivision Construction Filling

Supervised structural filling as shown on drawing 18264-AB2 was placed in accordance with the methods and standards quoted in NZS 4431 under the management of S & L Consultants Ltd. Compaction testing on site confirmed that a high and uniform degree of compaction has been achieved suitable for the support of buildings.
For all of the lots which are located in the areas of fill the ultimate ground bearing capacity in the limit state may be taken at 300kPa and this capacity meets the definition of "good ground" as defined in NZS3604.

A statement in support of the suitability of the filled areas for the erection of future buildings in terms of NZS 3604 is contained in Appendix 2 of this report. Within areas of structural filling on which buildings may be erected, however, the possibility of variation of soil type and strength may exist away from observation or compaction tests locations. The normal inspection of foundation conditions during construction of buildings by competent tradesmen as described in NZS 3604 and by building inspectors would still be undertaken. If for any reason areas of low soil strength are found professional geotechnical advice should then be sought.

6.2 Areas of Cut or Undisturbed Ground

All areas within Stage 2A were earthworked initially in cut and then were subsequently filled. No areas of the original topography apart from the hill to the north were left unmodified by the subdivision earthworks.

6.3 Land Stability

Steep but uniform slopes rise beyond the rear boundaries of proposed lots 405, 406, 409, 410, 411, 415, 416 and 417. These slopes are up to 29m in height and stand at 30 to 35 degrees. The original gorse and other weed cover and some large trees have been removed from the slope faces and geomorphic features can now be seen.

The only apparent evidence of past instability that has occurred is present as shallow erosion scarps immediately above the end of the western most of the two short cul de sacs, above the reserve accessway between lots 410 and 411 and behind lots 411 and 415.

Soil exposures seen on the slope faces under the grass cover and in minor recontouring excavations at the base of the slopes are of Matua subgroup as described in Section 2.0 of this report being cream coloured sandy silts and silts. Presubdivision boreholes and post construction boreholes in the adjacent stage 1B area to the east on the eastern side of Lakes Boulevard and also in the exposures on the old quarry face behind lots 416 and 417 showed that the Matua subgroup soils overlay dense pumiceous sands being Te Ranga ignimbrite.

The ability of the slopes to stand at relatively steep angles is due to be angular pumiceous soil particles present on the matrix of the Te Ranga ignimbrite. The largely shallow and superficial erosion scarps have occurred

where the ash cover has moved off the underlying ignimbrite. Any future slope movement is therefore likely to be in a similar mode where the ash (Matua subgroup) cover could be mobilised. To reduce the risk of such erosion occurring the slope surfaces are to be stabilised by the replanting of trees and the maintenance of the existing grass cover. The future erosion, if any, would only be mobilised by rainfall arriving at and running down the slope face to the base of the slope. There are no upslope catchments from where surface water runoff may originate. The development at the crest of the hill as a reserve and lookout has created an overland flow path down the access steps on the northern side of the hill.

To protect future development on lots 406, 409, 410, 411 and 415 from surface water runoff down the slope faces and also transported soil from any future surface erosion an earthfill bund has been erected along the rear boundaries of lots 406, 409, 410, 411, 415 and 416. The bund has been shaped to divert surface water into an overland flow path within the access to the future reserve from Landing Quay between lots 410 and 411. Sufficient room and storage has also been created between the base of the slope and the bund to capture and hold any future transported soil from erosion on the upper slopes and allow the accumulated soil to be removed by earthmoving equipment that would gain access from Landing Quay, either up the western cul de sac or up the reserve accessway between lots 410 and 411 or from Lakes Boulevard.

No bunds have been erected at the rear of lots 405 and 417 because natural ridges extend towards those lots. Surface water would shed to the lower ground and pass behind the bunds.

The long term security of lots 406, 409, 410, 411, 415 and 416 will depend on the maintenance of the earthfill bunds in their present form with a dense grass cover. No excavations should be made into the bunds from any of the lots that would reduce their mass or height. Furthermore any accumulated material in the reserve behind the bunds should be removed. Regular inspections will be required to identify the presence of such accumulated material and to also ensure that the stormwater runoff routes remain in place. A consent notice that would refer to this recommendation should be placed on the Certificates of Title for lots 406, 409, 410, 411, 414, 415 and 416.

7.0 Conditions for Approval

It is expected that the original conditions of subdivision approval first issued on 24 May 2004 will be carried forward for the approval of the variation shown on the Harrison Grierson scheme plan in Appendix 1 of this report.

8.0 Professional Opinion

A statement in the format of Council's Code of Practice for Development (Form G2) that all lots are suitable for building is contained in Appendix 2.

9.0 Applicability

Recommendations contained in this document are based on data from presubdivision boreholes, observations of soil exposures during earthworks, and test results of filling placed. Inferences about the nature and continuity of subsoils away from these locations are made but cannot be guaranteed.

In all circumstances, if variations in the subsoils do occur which differ from those described or are assumed to exist the site should be inspected by an engineer suitably qualified to make an informed judgment and provide advice on appropriate improvement measures.

This report has been prepared specifically for the proposed subdivision development at Stage 2A of the Lakes Development and no responsibility is accepted by S & L Consultants Ltd for the use of any part of this report for other development sites without their written approval.

S & L Consultants Ltd
Consulting Engineers, Surveyors, Planners

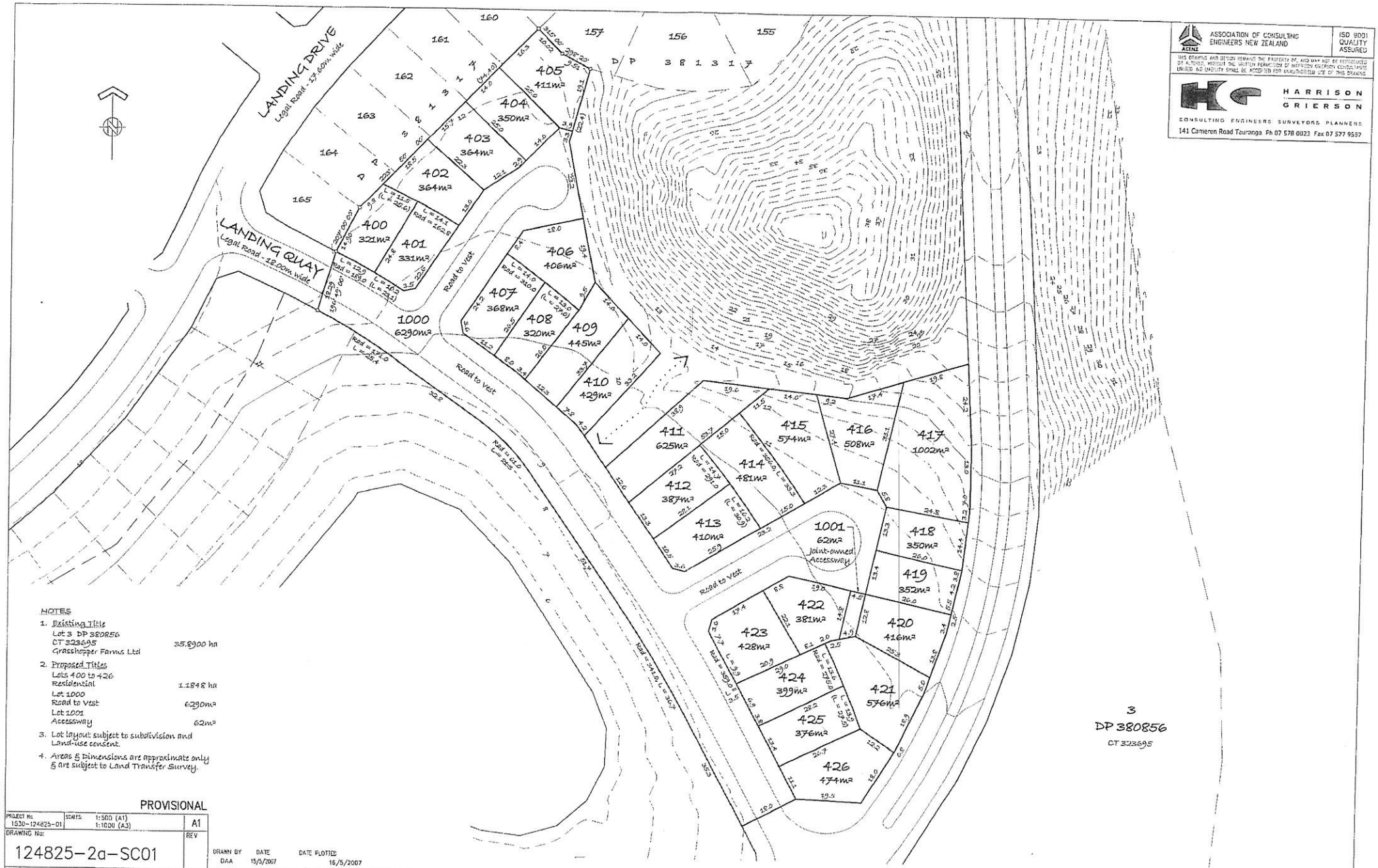
M W Hughes CPEng
Geotechnical Engineer

13 June 2007

Appendix One

Drawings

Subdivision Scheme Plan by Harrison Grierson
Reference Plan - 18264-AB1
- 18264-AB2



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

HARRISON GRIERSON
CONSULTING ENGINEERS SURVEYORS PLANNERS
141 Cameron Road Tauranga Ph 07 578 0023 Fax 07 577 9557

NOTES

1. Existing Title
   Lot 3 DP 380856
   CT 323695 — 35.8900 ha
   Grasshopper Farms Ltd
2. Proposed Titles
   Lots 400 to 426
   Residential — 1.1848 ha
   Lot 1000
   Road to Vest — 6290m²
   Lot 1001
   Accessway — 62m²
3. Lot layout subject to subdivision and Land-use consent.
4. Areas & Dimensions are approximate only & are subject to Land Transfer Survey.

PROVISIONAL

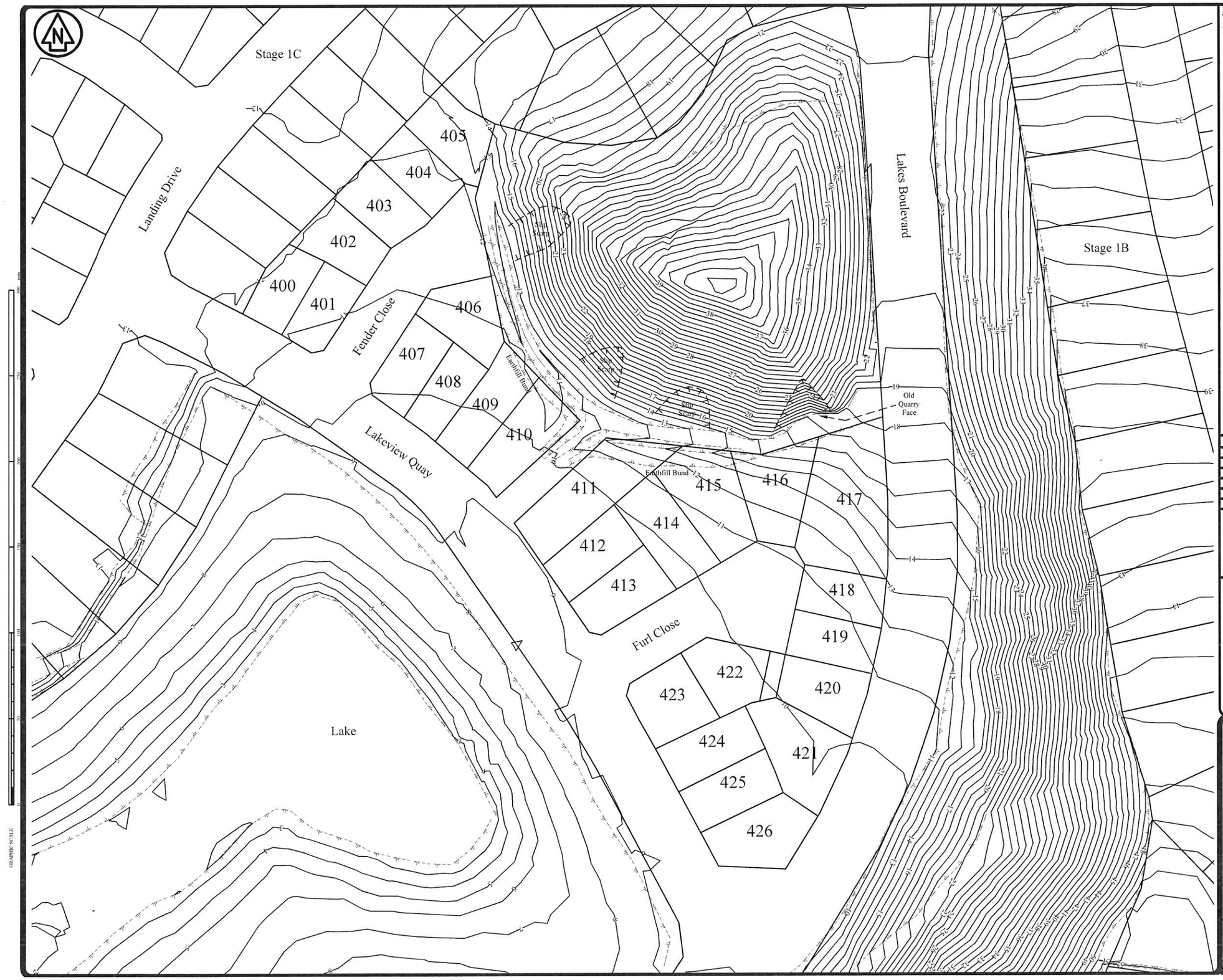
PROJECT No:	SCALES:	
1530-124825-01	1:500 (A1) 1:1000 (A3)	A1

DRAWING No: 124825-2a-SC01 REV

DRAWN BY: DAA DATE: 15/5/2007 DATE PLOTTED: 16/5/2007

TITLE: THE LAKES STAGE 2A

PROJECT: PROPOSED SUBDIVISION OF PART LOT 3 DP 380856



Notes:
1) Contours are in terms of Moturiki Datum

Rev No	Description	DATE
4	Bund realignment	07/08
3	Issued for 224 Certificate	03/08
2	Earthwork Bund Amended	25/01/08
1	Issued for Subdivision Consent	06/07

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	06/07	
Checked			
Approved			

REFERENCES

S&L
SHRIMPTON & LIPINSKI

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TITLE

Stage 2A

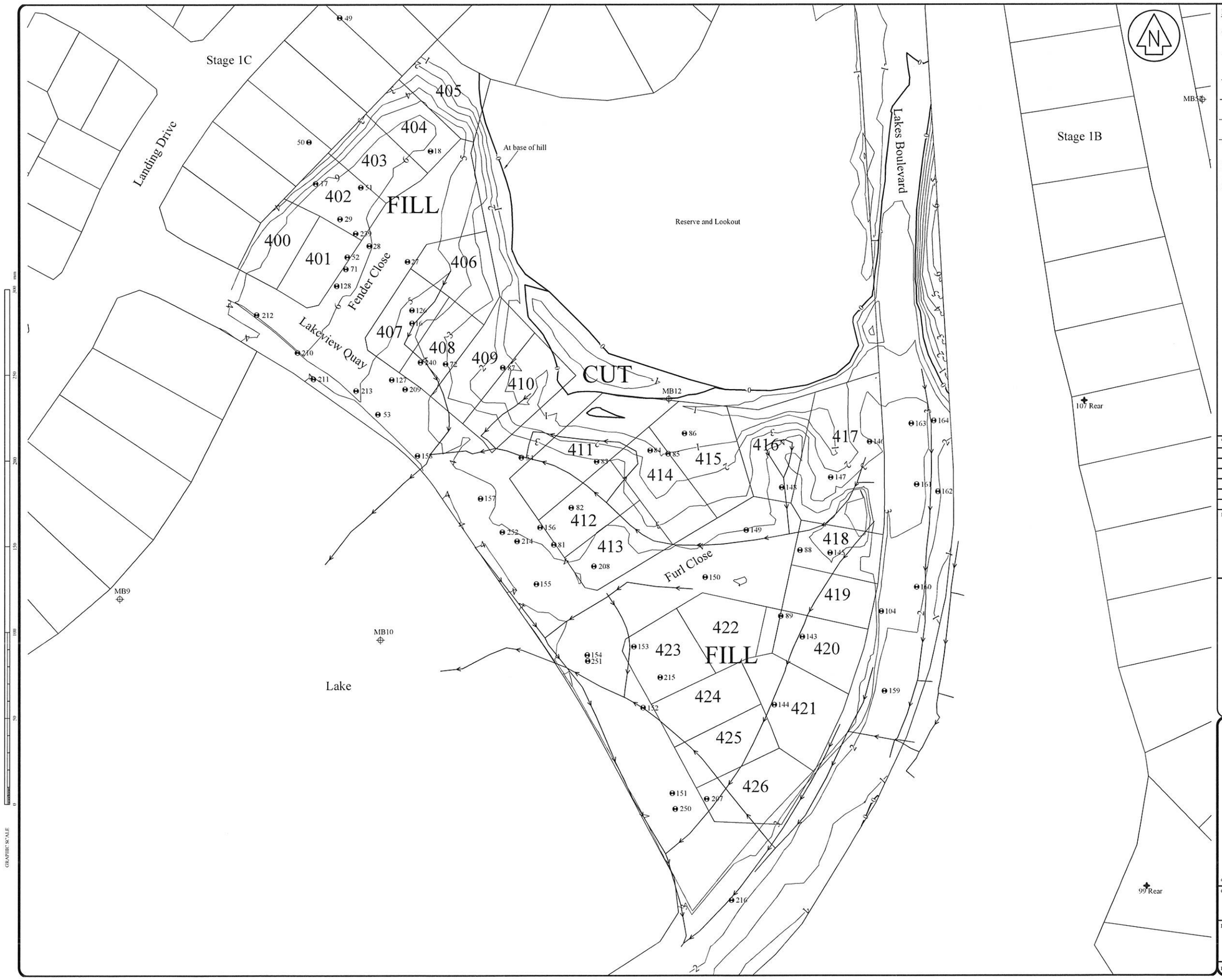
Earthworks Asbuilts
Final Contours

ORIGINAL SCALES	DATE
1:500 @ A1	06/07

DRAWING No
18264 - AB1

Revision: 1 2 3 4

METRIC DESIGN



Key

- Fill Compaction Test
- Post-subdivision construction borehole Stage 1B
- Pre-subdivision Construction borehole
- Subsoil Drain
- −2− Depth of fill contour
- ~2~ Depth of cut contour

Notes:
1) Refer to 18264-AB1 for finished ground contours

checked by:	Rev No	Description	DATE
	2	Issue for 224 certificate	03/08
	1	Issue for Sudivsion Consent	06/07

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	06/07	
Checked			
Approved			

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TITLE

Stage 2A

Earthworks Asbuilts
Depth of Cut/Fill

ORIGINAL SCALES	DATE
1:500 @ A1	06/07

DRAWING No
18264 - AB2

Revision: 1 2

METRIC DESIGN

Appendix Two

Statement of Professional Opinion as to the Suitability of Land for Building Development

SECTION 3

To: The Manager: City Development

STATEMENT OF PROFESSIONAL OPINION AS TO THE GEOTECHNICAL SUITABILITY OF LAND FOR BUILDING

DEVELOPMENT: The Lakes Subdivision Stage 2A

OWNER: Grasshopper Farms Ltd

LOCATION: Lakes Boulevard, Lakeview Quay

I Michael William Hughes (Full Name) of S&L Consultants Ltd

PO Box 231, Tauranga (Name and Address of Firm)

Hereby confirm that;

1) I am a professional person appropriately qualified with experience in geotechnical engineering to ascertain the suitability of the land for building development and was retained as the Soils Engineer to the above development.

2) An appropriate level of site investigation and construction supervision has been carried out under my direction and is described in my development evaluation dated 13 June 2007

3) In my professional opinion, not to be construed as a guarantee, I consider that;

(a) Every part / the area shown in my report dated 13 June 2007 of each proposed allotment as shown on Harrison Grierson scheme plan 124825-2A-SC01 is suitable for the erection thereon of the building types appropriate to the zoning of the land, provided that;

Recommendations contained in my report are complied within including

The maintenance of the earth bunds behind some of the lots.

(b) The earth fills shown on the attached Plan No. 18264-AB2 have been placed in accordance with the Code of Practice for Development of the Tauranga City Council.

(c) The completed works give due regard to all land slope and foundation stability considerations.

(d) The filled ground is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZS 3604:1999 and related documents providing that:

Recommendations contained in my report, section 6 are complied with.

(e) No original ground is present that has not been affected by filling.

4. This professional opinion is furnished to the Council and the owner for their purpose 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 for any dwelling.

Signed ..... Date 13 June 2007

Tauranga City

SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

TAURANGA CITY COUNCIL

Jan 07

G 2 Δ

Appendix Three

Compaction Test Results

Summary of Compaction Test Results
Stage 2A

Test No.	Date	Soil Type	Percentage Air Voids	Undrained Shear Strength (kPa)	Scala penetrometer blows per 100mm
16	28/10/05	Silt/Clay	6.8	UTP	
17	28/10/05	Silt/Clay	9.2	UTP	
18	28/10/05	Silt/Clay	7.8	UTP	
27	07/11/05	Silt/Clay	6.6	199+	
28	07/11/05	Silt/Clay	9.4	217+	
29	07/11/05	Silt/Clay	3.9	211+	
71	03/12/05	Sand			3-6
72	03/12/05	Sand			4-5
126	22/02/06	Silt/Clay	9.3	216+	
127	22/02/06	Silt/Clay	12.6	172+	
128	22/02/06	Silt/Clay	10.3	190+	
49	31/10/06	Sand	12.8*	UTP	
50	31/10/06	Sand	14.7*	UTP	
51	31/10/06	Silt/Clay	3.8	UTP	
52	31/10/06	Silt/Clay	1.1	UTP	
53	31/10/06	Silt/Clay	5.8	UTP	
54	31/10/06	Silt/Clay	7.4	150	
81	06/12/06	Silt/Clay	0.6	UTP	
82	06/12/06	Silt/Clay	10.6	UTP	
83	06/12/06	Silt/Clay	8.4	172+	
84	06/12/06	Silt/Clay	5.8	170+	
85	06/12/06	Silt/Clay	5.5	183+	
86	06/12/06	Silt/Clay	7.5	UTP	
87	06/12/06	Silt/Clay	0.0	179+	
88	06/12/06	Silt/Clay	7.9	162+	
89	06/12/06	Sand/Ash	14.2*	179+	
104	06/12/06	Sand			5-11
143	08/01/07	Silt	9.5	UTP	
144	08/01/07	Sand			4-6
145	08/01/07	Sand			4-7
144	08/01/07	Sand	6.9*	UTP	
145	08/01/07	Sand	6.3*	UTP	
146	08/01/07	Sand	11.3*	UTP	
147	08/01/07	Silt	5.4	UTP	
148	08/01/07	Silt	9.5	UTP	
149	08/01/07	Silt	3.2	UTP	
150	08/01/07	Silt	1.7	UTP	
151	09/01/07	Sand/Silt	7.6*	UTP	
152	09/01/07	Sand/Silt	2.4*	157	
153	09/01/07	Silt	4.7	186+	
154	09/01/07	Silt	2.2	182+	
155	09/01/07	Silt	4.7	188+	
156	09/01/07	Silt	3.8	UTP	

157	09/01/07	Silt	0.5	157	
158	09/01/07	Silt	2.8	188+	
159	19/01/07	Silt	0.0	UTP	
160	19/01/07	Silt	0.0	UTP	
161	19/01/07	Silt	2.1	UTP	
162	19/01/07	Silt	0.2	UTP	
163	19/01/07	Silt	0.0	UTP	
164	19/01/07	Silt	2.5	UTP	
207	20/02/07	Silt	4.3	UTP	
208	20/02/07	Silt	4.8	UTP	
209	20/02/07	Silt	0.0	UTP	
210	20/02/07	Silt	6.0	150	
211	20/02/07	Silt	8.3	180+	
212	27/02/07	Silt	5.7	UTP	
213	27/02/07	Silt	8.2	UTP	
214	27/02/07	Silt	2.0	188+	
215	27/02/07	Silt	1.1	UTP	
216	27/02/07	Silt	9.7	UTP	
239	06/03/07	Silt	9.0	UTP	
240	06/03/07	Silt	1.7	180+	
250	21/03/07	Silt	8.3	UTP	
251	21/03/07		3.8	178+	
252	21/03/07		8.1	UTP	

Notes:

* Specific solid density tests undertaken – samples were lightweight pumiceous sand.

UTP Unable to penetrate with vane head

Appendix Four

Pre Construction Borehole Logs

SHRIMPTON & LIPINSKI

Lot 99
Rear of Lot

Site: Pyes Pa Residential Development: The Lakes Stage 1B

Sheet: 1 Of: 3

Job No. 17726 | Date Excavated: Tu.5/11/06 | RL 51.2m Moturiki Datum | Logged By: MH

DR 2275
CF=1.687

Description of Soil	Soil Symbol	Depth (m)	SPT	SPT N Value	Corrected Shear Strengths	Undrained Shear Strength (kPa) 50 100 150
No Topsoil						
Sand: Fine grained, silty, pale brown, stiff, damp	Natural Insitu Subsoils	1.0	Borehole Dry		84/33	
Rustic brown, uniform, compact damp		2.0				
		3.0			134/37	
		4.0				
		5.0			151/33	
Silt: Clayey, slightly friable, cream brown, stiff, moist sensitive		6.0			118/32	
Becomes dark brown						
Pumice Sand: Silty, pale yellow, stiff, damp		7.0				
Silt: Very clayey, cohesive, dark brown, very stiff slightly moist		8.0				
Becomes brown orange		9.0				

Groundwater Monitoring Results from Standpipe		
Date	Notes	Depth
W.15/11/06	During Drilling	Dry
Tu.5/12/06	Drilling + 20 Days	Dry

EXCAVATION METHOD: Rotary Machine and Raymond SPT (Hollow) Sampler

SHRIMPTON & LIPINSKI

Lot 99
Rear of Lot

Site: Pyes Pa Residential Development: The Lakes Stage 1B

Sheet: 2 Of: 3

Job No. 17726 | Date Excavated: Th.9/11/06 | RL 51.2m Moturiki Datum | Logged By: MH

DR 2275
CF=1.687
Undrained Shear Strength (kPa)
50 100 150

Description of Soil	Soil Symbol	Depth (m)	SPT	SPT N Value	Corrected Shear Strengths
Silt: Very clayey, cohesive, brown orange, very stiff slightly moist	Natural Insitu Subsoils				
Becomes orange		10.0			
SPT: Very clayey, cohesive, orange SILT, very stiff		11..0	2 3 4	N=7	
As per SPT but becoming pale orange		12.0			
		13.0			
Pumiceous Silt: Clayey, some sand, friable, pale grey with black orange streaks and patches stiff, moist, sensitive (Logged from SPT)		15.0	1 1 1	N=2	
Becomes sandy, cream full core recovery		16.0			
Pumice Sand: Fine grained, silty, pale grey, very stiff damp	Weathered Ignimbrite	17.0			
Becoming grey		18.0			
SPT Compact, pale grey Pumice Sand, fluffy texture some gravels up to 5mm diameter	Ignimbrite		2 3 4	N=7	
As per SPT but grey full core recovery		19.0			

EXCAVATION METHOD: Rotary Machine and Raymond SPT (Hollow) Sampler

SHRIMPTON & LIPINSKI

Lot 99
Rear of Lot

Sheet: 3 Of: 3

Site: Pyes Pa Residential Development: The Lakes Stage 1B

Job No. 17726	Date Excavated: Th.9/11/06	RL 51.2m Moturiki Datum	Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	SPT	SPT N Value	Corrected Shear Strengths
Pumice Sand: Fine grained, silty, grey, compact fluffy texture, damp, full core recovery uniform	Ignimbrite	20.0			
		21.0	3 5 7	N=12	
spt Fine grained silty Pumice Sand, grey, compact fluffy texture, dry					
As per SPT		22.0			
		23.0			
			5 8		
SPT Fine grained silty Pumice Sand, grey, compact		24.0	10	N=18	
EOB @ 24.0m: Too Hard To Drill					

DR 2275
CF=1.687
Undrained Shear Strength (kPa)
50 100 150

EXCAVATION METHOD: Rotary Machine and Raymond SPT (Hollow) Sampler

SHRIMPTON & LIPINSKI

Lot 107
Rear of Lot

Site: Pyes Pa Residential Development: The Lakes Stage 1B

Sheet: 1 Of: 2

Job No. 17726	Date Excavated: W.29/11/06	RL 40.0m Moturiki Datum	Logged By: MH

DR 2275
CF=1.687
Undrained Shear Strength (kPa)
50 100 150

Description of Soil	Soil Symbol	Depth (m)	SPT	SPT N Values	Corrected Shear Strengths
Topsoil		150mm			
Silt: Clayey, cohesive, brown yellow, very stiff, moist full recovery	Natural Insitu Subsoils	1.0			100 kPa to 150 kPa
Becomes friable, cream grey, stiff very moist, sensitive		2.0			
Clayey, friable, cream grey, stiff very moist, sensitive		3.0			
		4.0			75 kPa
SPT: Clayey, cream grey PUMICEOUS SILT, friable stiff, moist, sensitve, full recovery		5.0	0 1 1	N=2	
As per SPT					
Becomes sandy, pale grey very stiff		6.0			100 kPa
SPT: Sandy, cream grey PUMICEOUS SILT, friable very stiff, moist, sensitve, full recovery		7.0	1 2 3	N=5	
		8.0			
Pumice Sand: Fine grained, silty, pale grey, compact damp, fluffy texture (Logged from SPT) full recovery	Ignimbrite	9.0			

Groundwater Monitoring Results		
Date	Notes	Depth
W.15/11/06	During Drilling	Dry
Tu.5/12/06	Drilling + 20 Days	Dry

EXCAVATION METHOD: Rotary Machine and Raymond SPT (Hollow) Sampler

SHRIMPTON & LIPINSKI

Lot 107
Rear of Lot

Site: Pyes Pa Residential Development: The Lakes Stage 1B

Sheet: 2 Of: 2

Job No. 17726	Date Excavated: W.29/11/06	RL 40.0m Moturiki Datum	Logged By: MH

DR 2275
CF=1.687
Undrained Shear Strength (kPa)
50 100 150

Description of Soil	Soil Symbol	Depth (m)	SPT	SPT N Values	Corrected Shear Strengths
Pumice Sand: Fine grained, silty, grey, compact dry, fluffy texture, full recovery (SPT)	Ignimbrite		6 8 14	N=22	
As per SPT Uniform materials Full recovery		10.0			
		11.0			
SPT Fine grained, silty, PUMICE SAND, grey compact, dry, fluffy texture, full recovery			5 10 18	N=28	
As per SPT Uniform materials Full recovery		13.0			
		14.0			
EOB @ 14.0m: Too Dense for Machine Drill					

EXCAVATION METHOD: Rotary Machine and Raymond SPT (Hollow) Sampler

SHRIMPTON & LIPINSKI

Borehole Log. MB 9

Site: Pyes Pa West Urbanisation

Sheet: 1 Of: 3

Job No. 16944 | Date Excavated: 15/4/03 | RL Ground: | Logged By: MA

Description of Soil	Soil Symbol	Depth (m)	SPT	GROUNDWATER	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL	ORGANIC SOILS	0				
SILT : Highly (40-65%) organic brown soft organic content comprises both spongy wood and stringy wood, peaty smell		0.5				
		1.0		▽ DURING DRILLING	100 %	
		1.5				
SILT : Very sandy, non cohesive, pale grey, loose	NON ORGANIC SOILS	2.0			100 %	
		2.5				
SPT 450 : Sandy, pale grey silt RECOVERY loose				SINKS		
				1 N=1		
SPT 300 : Sandy, pale grey silt RECOVERY loose		3.0				
			1			
				N<1		
SILT : Very sandy, pale grey, medium dense		3.5				
		4.0				
Pumiceous, fine grained cream silt non cohesive, medium Dense Sensitive, dilatent					100 %	
		4.5				

EXCAVATION METHOD: 100mm ϕ Machine Auger & HOLLOW SPT

SHRIMPTON & LIPINSKI

Borehole Log. MB 9

Site: Pyes Pa West Urbanisation

Sheet: 2 Of: 3

Job No. 16944 | Date Excavated: 15/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	SPT		CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
450 MM RECOVERY SPT : Very silty sand, pale cream brown, dense		4.5	1 2 5	N=7		
SAND : Silty, non cohesive, pale cream brown, dense		5.0 5.5			100 %	
SPT 450 RECOVERY Sand / Gravel / Sand		6.0	2 4 4	N=8		
SAND : Gravelly, pale grey brown dense		6.5 7.0			100 %	
SPT NO RECOVERY		7.5	1 1	N=1		
SAND : Very silty, pale grey brown Sensitive		8.0 8.5 9.0			20 %	

EXCAVATION METHOD: 100mm ϕ MACHINE AUGER & HOLLOW SPT

SHRIMPTON & LIPINSKI

Borehole Log. MB 9

Site: Pyes Pa West Urbanisation

Sheet: 3 Of: 3

Job No. 6944 | Date Excavated: 15/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)		Undrained Shear Strength (kPa) 50 100 150
No Recovery in SPT		9	SPT SINKS UNDER WEIGHT OF RODS	
EOR @ 9.5m : TARGET DEPTH		9.5		
NOTE : SPT 9.0 - 9.5m : WEIGHT OF RODS DO NOT INCLUDE HAMMER WEIGHT.				

EXCAVATION METHOD: 100mm ϕ Machine Auger + Hollow SPT

SHRIMPTON & LIPINSKI

Borehole Log: MB 10

Sheet: 1 Of: 2

Site: Pyes Pa West Urbanisation

Job No. 16944 | Date Excavated: 15/4/03 | RL Ground: | Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	SPT	GROUND WATER	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
PEAT: Youthfall, mixture of spongy brown wood and stringy poorly decomposed wood, highly compressible.	ORGANIC SOILS	0.5		▽ DURING DRILLING		
		1.0				
SILT: Sandy, non cohesive, pale grey, medium dense		1.5			100%	
		2.0				
		2.5				
SPT 450 : Sandy Silt RECOVERY pumice Sand, dense			1 3 3 N=6		100%	
SAND: Very silty, pale brown grey dense Some core loss below Groundwater table.	NON ORGANIC SOILS	3.0				
		3.5				
		4.0			60-70%	
SILT: pumiceous, sandy, pale brown grey, sensitive, dilatent		4.5				

EXCAVATION METHOD: 50 mm ϕ Machine Auger & HOLLOW SPT

SHRIMPTON & LIPINSKI

Borehole Log. MB10

Site: Pyes Pa West Urbanisation

Sheet: 2 Of: 2

Job No. 16944 | Date Excavated: 15/4/03 | RL Ground: | Logged By: MH.

Description of Soil	Soil Symbol	Depth (m)			Undrained Shear Strength (kPa) 50 100 150
SILT: pumiceous, sandy, pale brown grey,	X X X	4 5	1	N<1	
EOB @ 5.0m: TARGET DEPTH		5.0			

EXCAVATION METHOD: 100mm ϕ Machine auger & HOLLOW SPT

SHRIMPTON & LIPINSKI

Borehole Log. MB 12

Sheet: 1 Of: 1

Site: Pyes Pa West Urbanisation

Job No. 16944 | Date Excavated: 15/4/03 | RL Ground:

Logged By: MH

Description of Soil	Soil Symbol	Depth (m)	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL		0		
SAND: very silty, cream, medium dense	ALLUVIAL SEDIMENTS	0.5	100%	
rapid groundwater inflow		1.0		
		1.5	100%	
		2.0		
		2.5		
		3.0		
EOB @ 3.0m: TARGET DEPTH				

EXCAVATION METHOD: 100 mm ϕ Machine Auger

SHRIMPTON & LIPINSKI

Borehole No. MB 52

Site: Pyes Pa West Urbanisation

Sheet: 1 Of: 4

Job No. 16944 | Date Excavated: F. 19/9/03 | RL Ground: | Logged By: mt

Description of Soil	Soil Symbol	Depth (m)	SPT	GROUNDWATER	CORE RECOVERY	Undrained Shear Strength (kPa) 50 100 150
SILT: very clayey, cohesive, brown orange, very stiff, slightly moist	YOUNGER ASHES	0.5			100%	
		1.0				
Sandy, non cohesive, cream moist		1.5		BOREHOLE DRY	100%	
		2.0				
		2.5				
		3.0				
clayey, cohesive, brown yellow, very stiff, moist	OLDER ASHES	3.5	1 2 3 N=5		100%	
		4.0				
		4.5			100%	

EXCAVATION METHOD: 75 mm ϕ MACHINE AUGER + HOLLOW SPT.

S&L SHRIMPTON & LIPINSKI

Borehole No. MB 52

Site: Pyes Pa West Urbanisation

Sheet: 2 Of: 4

Job No. 16944 | Date Excavated: F. 19/9/03 | RL Ground: | Logged By: MA

Description of Soil	Soil Symbol	Depth (m)	SPT		Core Recovery	Undrained Shear Strength (kPa) 50 100 150
SPT: CLAY: very silty, cohesive orange, stiff, moist		5.0	2 2 2	N=4	100%	
CLAY: cohesive, homogeneous, orange stiff, moist		5.5			100%	
SPT: CLAY: cohesive, brown yellow stiff, very moist		6.0	1 1 2	N=3	100%	
CLAY: cohesive, brown yellow, stiff very moist, homogeneous.	OLDER ASHES	7.0			100%	
brown orange		7.5				
SPT: CLAY: cohesive, brown orange stiff, very moist			1 1 2	N=3	100%	
CLAY		8.0				
SILT: coarse grained, slightly cohesive grey mottled orange, slightly moist	MATUA	8.5			100%	
		9.0				

EXCAVATION METHOD: 75mm ϕ MACHINE AUGER + HOLLOW SPT.

SHRIMPTON & LIPINSKI

Borehole No. MB 52

Site: Pyes Pa West Urbanisation

Sheet: 3 Of: 4

Job No. 16944 | Date Excavated: F. 19/9/03 | RL Ground: | Logged By: NVH

Description of Soil	Soil Symbol	Depth (m)	SPT		Core Recovery	Undrained Shear Strength (kPa) 50 100 150
SPT: pumiceous SILT: clayey, slightly cohesive, cream, very stiff, slightly moist	P	9	1 2 2		100%	
	P	9.5				
Slightly cohesive / non cohesive	P	10.0			100%	
	P	10.5				
SPT: pumiceous SILT: clayey, non cohesive	P	11.0	1 2 3	N=5	100%	
pumice sand, cream, medium Dense Dry		11.5			100%	
		12.0				
SPT: pumiceous Silt, non cohesive cream, moist, sensitive, stiff	P	12.0	1 1 2	N=3	100%	
pumiceous silt as per SPT ~ homogeneous ~ non cohesive ~ stiff ~ Sensitive ~ moist	P	12.5				
	P	13.0			100%	
	P	13.5				

EXCAVATION METHOD: 75mm ϕ MACHINE AUGER + HOLLOW SPT.

SHRIMPTON & LIPINSKI

Borehole No. MB 52

Site: Pyes Pa West Urbanisation

Sheet: 4 Of: 4

Job No. 16944 | Date Excavated: F. 19/9/03 | RL Ground: | Logged By: MA

Description of Soil	Soil Symbol	Depth (m)	SPT		Core Recovery	Undrained Shear Strength (kPa) 50 100 150
SPT: Pumiceous silt, non cohesive cream grey, medium Dense slightly moist	PP	1.0	1		100%	
			1			
			2			
	P	1.40				
		1.45			100%	
	PP					
	P	1.50				
EOR @ 15.0m: TARGET DEPTH						
NOTE						
BOREHOLE DRY						

EXCAVATION METHOD: 75 mm ϕ MACHINE AUGER + HOLLOW SPT