SHRIMPTON & LIPINSKI

THE LAKES DEVELOPMENT
STAGE 1E
PYES PA, TAURANGA

Report on Subdivision Earthworks
And Recommendations for Building

Our ref: 17726
April 2007

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

1.0 Introduction

The earthworks, roading construction and services installation have been completed for Stage 1E of the Lakes Subdivision in Pyes Pa.

8 residential lots have been formed and serviced within the Stage 1E area. The locations and sizes of the 8 lots are shown on DP 387811 which has been prepared by E Survey. This document should be consulted for lot dimensions and areas.

The lot positions are also shown on the drawings in Appendix 1 of this report. Lower lots 15, 16 and 17 are accessed directly from Tarn Close, a cul de sac constructed during the Stage 1D development at the Lakes. Upper lots 34 to 36, 38 and 39 are served by access lots that extend from Gyle Place also constructed during the stage 1D development at the Lakes.

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

Conditions (24) to (27) inclusive of that approval related to the geotechnical issues to be addressed during and at the completion of the subdivision or at the completion of specific stages. These conditions are listed on table 1 on page 4 of this report. Since this approval a variation was lodged particularly for the Stage 1E area by S&L Consultants Ltd in February 2007 in which three of the original lots as approved were eliminated. Approval for this variation was granted by the Tauranga City Council on 3 April 2007.

No changes to original conditions (24) to (27) inclusive of 24 May 2004 were required in the granting of this later variation. The scheme plan that was subsequently approved and current at the time of completion of Stage 1E was 17726-V01 (2 sheets) prepared by S&L Consultants Ltd. A copy of the scheme plan is included in Appendix 1.

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

During the report reference is made to drawing 17726-AB28 which is included in Appendix 1.

This drawing shows the road and lot locations, the positions of post construction boreholes, the extent of earthworks and building restriction lines

Table 1: Geotechnical Related Conditions of Subdivision Approval – 24 May 2004

Condition (24) *The Consent Holder shall undertake earthworks and/or works, as necessary, so that each lot contains a building platform suitable for the intended purpose of the District Plan zone.*

The suitable building platforms shall possess a minimum factor of safety against slope failure of 1.5 and shall comply with minimum settlement criteria stated in Appendix B of Section B1/VM4 of the New Zealand Building Code.

At the completion of the earthworks the Soils Engineer shall provide Council with an Opinion of Suitability for Building for the building platforms in the "geotechnical completion report" required by Condition (25).

Condition (25) *The Consent Holder shall, prior to the release of the 224 certificate for the subdivision, provide to Council a "geotechnical completion report" compiled by a Category 1 Registered Engineer.*

This report shall:

- *Comply with the requirements of and supply the information set down in Section 2.F of the Code of Practice.*
- *Display the position of all designated building platforms and building restriction lines (where applicable).*
- *Provide recommendations for the ongoing development of the properties (i.e advice on maximum cut/fill heights, how to manage steep slopes, methods of earthfill that should be adopted for basement style homes etc).*
- *Confirm that any earthfills and/or building platforms that have been constructed, comply in all respects with the requirements set down in Section B1 of the New Zealand Building Code and*
- *The building platforms shall possess a minimum factor of safety against slope failure of 1.5 and comply with minimum settlement criteria stated in Appendix B of Section B1/VM4 of the New Zealand Building Code.*

Condition (26) *Pursuant to Section 128 of the Resource Management Act 1991, the Council may review the conditions of this consent following receipt of the geotechnical completion report and/or Statement of Professional Opinion recommends Conditions, requiring that any application for building consent and or ongoing development on the lot be in accordance with the Conditions given in the geotechnical completion report and/ or Statement of Professional Opinion.*

Condition (27) *All building line restrictions or designated building platforms shall be clearly identified and dimensioned on the subdivision survey plan.*

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 is described as:

(i) On the upper plateau to the east and within the elevated gullies and on slopes facing west.
- 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 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 at the southern end of the development site in old quarry faces.

(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 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.

No specific presubdivision test positions were in the Stage 1E area but the boreholes put down on the elevated ground similar in aspect to the Stage 1E area displayed the subsoils that would be present. This was later confirmed by deep post construction boreholes in the stage 1E area.

The 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.
- Where inorganic alluvial soils or peat may be present the areas should be preloaded to accelerate the consolidation of these soils before residential development or the arterial road into the subdivision can become serviceable.

4.0 Scope of Subdivision Earthworks

The earthworks undertaken in the Stage 1E area and as shown on 17726-AB28 comprised.

(a) At the lower level within lots 15 to 17 the removal of unsuitable surface soils comprising alluvial silts and peat, the installation of subsoil drains and the placement of structural filling up to 1.5m deep. The filling mostly comprised pumiceous sands obtained from borrow areas situated within later stages to the south. The outfalls from the subsoil drains were directed to the stormwater attenuation pond to the north west.

(b) At the upper level by the lowering of an elevated ridge that ran through lots 38, 39 and 40 (in Stage 1D) in cut. The maximum depth of cut was 4.0m at the common boundary of lots 39 and 40.

(c) The formation in cut of the routes of stormwater and wastewater pipes and the surface water overland flow path contained in the easement between lots 15 and 16 and 35 and 36.

(d) The formation of compacted earth bunds with reinforcement mesh supporting the grass cover within lot 15 to direct any overland surface water flows from higher ground through the easement that is present on lot 15, and on the lower part of lot 36 to direct any landslip debris away from the residential areas if the existing slip area on lot 36 should be reactivated.

The depths of cut and filling shown on 17726-AB28 were derived from surveyed contours of the finished surface taken on completion of the earthworks compared with a topographical survey undertaken by S&L Consultants Ltd prior to the subdivision construction.

The earthworks for this stage were undertaken during the 2005-2006 and 2006-2007 earthworks seasons in compliance with consent 62387 issued by Environment Bay of Plenty.

5.0 Earthworks Standards

The performance specification required of the Contractor 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

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.

The quality of the filling placed on lots 15, 16 and 17 was described in the summary geotechnical report for the Stage 1D development (S&L Consultants Ltd reference 17726 and dated 15 January 2007). The filling placed extended within lots on each side of Tarn Close, the carriageway of Lakes Boulevard and also the lower areas within Caldera Crescent and Caldera Close.

Of the 69 compaction tests undertaken during the placement of the filling, 4 were located within or immediately adjacent to lots 15, 16 and 17.

These test results are summarised as:

Test No.	Date	Location	% Air Voids	Undrained Shear Strength (kPa)
166	28/09/06	ROW	6.6	180+
167	28/09/06	Lot 15	8.8	161+
168	28/09/06	Lot 16	8.3	165+
169	28/09/06	Lot 18	6.1	159+

6.0 Post Construction Testing

Post construction machine drilled boreholes were put down on lots 15, 17, 35, lot 36 (on the higher and lower ground) and 38 to show the soil types and continuity and to confirm ground bearing conditions for new buildings.

The borehole on lot 35 was drilled to 15.5m to identify the soil types present in the sloping ground on and below this lot and typically on adjacent sloping ground within adjacent lots 34 and 36. The other borehole depths varied from 2 to 4.5m.

As the boreholes were being drilled undrained shear strengths were recorded with a hand held shear vane pushed in advance of the auger. At greater depths in the borehole on lot 35 SPT tests were undertaken.

Summary logs of the soils found in the boreholes are in Appendix 3. The insitu test results are tabulated on the borelogs.

The boreholes on lots 15 and 17 showed that well compacted subdivision filling exists on the flat ground on which building is likely.

The boreholes on higher ground on lots 35, 36 and 38 found the usual volcanic ash derivative stratigraphy described in section 2.0 of this report. These soils were uniformly of high shear strength throughout the depth that further excavation may take place to develop level building sites on the sloping natural ground.

7.0 Summary and Recommendations

7.1 Subdivision Construction Filling

Supervised structural filling as shown on drawing 17726-AB28 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.

A statement in support of the suitability of the filled areas for the erection of buildings in terms of NZS 3604 is appended 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 should therefore be undertaken. If for any reason areas of low soil strength are found professional geotechnical advice should be sought.

7.2 Areas of Cut

The areas of cut within lots 38 and 39 have exposed varying soil types within the parallel bedded volcanic ash stratigraphy. The borehole on lot 35 on relatively flat ground formed during the subdivision earthworks indicates that sufficient strength is present so that 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 NZS 3604.

However the possibility of variation of soil type and strength may exist away from observation or post construction borehole locations. It the subsoils at foundation excavation levels are found to be of lower strength or have been disturbed by earthworks machinery during further site development, foundations detailed in accordance with NZS 3604 may have to be deepened or widened under engineering advice. This may require additional on site testing specific to the building that is to be erected and the calculation of actual ground contact pressures under foundations by a structural engineer.

On lot 39 the depths of cut of up to 3m may have intersected pumiceous sandy soils of possible lower strength. These soils are described on the log of the borehole on lot 35 in Appendix 3. Options for future development on lot 39 are described in Section 7.4 below. It is likely that the development design will require additional investigations to be undertaken.

7.3 Areas of Undisturbed Ground

Areas of undisturbed ground exist on the likely building sites on lots 34, 35 and 38. The surface soils identified in the boreholes on lots 35 and 36 (upper) are of sufficient strength to be considered as "good ground" as described in NZS 3604.

7.4 Land Stability

Past instability has occurred on the lower steeper slopes within **Lot 36**. Slope angles in the headscarp of the relic slip near the northern boundary on lot 36 are in the range of 35 to 40 degrees. Future instability in and to the flanks of the relic scarp may occur. Accordingly, no residential development should take place directly above or below the scarp and within any runout direction for possible future slip debris flow.

A building restriction line is recommended on **Lot 36** to limit building to a generous flatter area back from the relic slip area and also comparatively steep land at 20 to 24 degrees above the slip and to the south west. In both of these steeper areas the existing slope stability could be lowered by building development which would probably require site earthworks to create a vehicle access or levelled areas for building and recreational purposes.

At the lower level of **Lot 36** a bund has been constructed in the area shown as C on DP 387811 and also on reference plan 17726-AB28 in Appendix 1.

The purpose of this bund is to direct any possible future landslip debris into the reserve area to the west and away from any residential development on adjacent lot 15. It shall be incumbent on the owner of lot 36 to ensure that the bund is maintained in its original shape and that any captured material behind the bund shall be removed immediately. No filling shall be placed on the northern side of the bund to reduce the capacity to capture or divert any slip runout material.

On **Lots 34 and 35** slope angles near the access lot are at 11 to 14 degrees but steepen to 1 in 2 (26 degrees) near the common boundaries with lots 16 and 17 below. A building restriction line is recommended to lots 34 and 35 which will limit the locations of any buildings to the flatter areas of these lots, to the east. With the observance of the building restriction line global instability arising from the construction of buildings in the upper levels of these lots is considered unlikely. However, care will be required in the planning and implementation of building construction and landscaping or site development to ensure that local instability does not occur or that properties downslope are not put at any unacceptable risk. It is likely that further development earthworks will be undertaken on lots 34 and 35 to create levelled building sites and vehicle accessways that will require the formation of cut faces and possibly the placement of the cut material as filling over the slope faces to extend the levelled area. It is recommended that any building or landscaping development involving earthworks, cutting, filling and retaining structures on the lower western sections of Lots 34 and 35 be reviewed by a geotechnical engineer or geologist prequalified with the Council as category 2. The review should consider any adverse effects on the stability of the slopes as they lead down in to the adjacent downslope lots.

On **Lot 38** slope angles are less than 14 degrees and no global stability issues are likely. Care would be required in the development of this lot to retain support to the accessway on Lot 375 if site development earthworks are undertaken.

Future building development on **Lot 39** should be reviewed by a geotechnical engineer or geologist prequalified with the Council as category 1. It is likely that a building would be multileveled possibly constructed on benches or "steps" excavated into the sloping ground of 1 in 2. Specifically designed retaining walls will be required to stabilise lateral cut faces at the rear of the benches with particular attention paid to their returns along side boundaries especially during construction so that the stability of adjacent properties is not compromised. It is probable that the geotechnical reviewer will require specific site investigation data to be obtained to determine the soil types that will be present in cut faces and at support levels for foundations. Rear wall drains reticulated to the site stormwater service connection will be required.

On **Lots 15 and 16** it is not generally recommended that the levelled building area adjacent to the road boundary is extended by excavation into the sloping ground to the east. However, should such an excavation be required any cut face should be supported by a retaining wall. The wall designer shall take into account any surcharges imposed by the sloping ground that would be present above the wall. It is also recommended that the ground bearing capacity and conditions at the base of the slope or in any excavation be checked by the wall designer.

7.5 Retaining Walls

On any cut faces higher than 1.5m retaining walls should be erected. Such walls are to be specifically designed and a building consent issued.

The covenants for individual site development set by the developer titled "The Lakes – House Design Guidelines Part 2: Design Standards Conventional Housing" require that:

- Retaining walls shall be incorporated into the house structure if possible and feasible.
- Where retaining will be required outside the building platform and where level changes are forced to be greater than 2.0m high stepped retaining walls shall be utilised.
- Retaining wall lifts are to be limited to not more than 1.0m in height and be separated by an intermediate berm width of not less than 0.7m.

Owners of all lots in Stage 1E and especially of lots 34, 35, 36 and 39 should be aware of the contents of the covenants and also be advised that while walls less than 1.5m high are exempt from requiring a building consent under Schedule 1 of the Building Act 2004, the construction of the wall is still required to comply with the requirements of New Zealand Building Code with regard to materials and construction standards. For the configuration described in the covenants the loading from an upper wall located 0.7m behind a lower wall would provide a surcharge to the lower wall and the exemption described in Schedule 1 of the Building Act 2004 would not apply. A building consent will therefore be required for the wall configuration shown on the diagrams in the House Design Guidelines.

In the placement of any cut material the filling should be placed in accordance with NZS 4431 and the Council Code of Practice for Development under engineering supervision. The filling would be placed on horizontal cut lateral benches after the surface topsoil has been removed. Retaining walls should be erected to resist lateral earth pressures from the filling present. With the stepped retaining wall configuration shown on the diagrams in the House Design Guidelines each lift of retaining wall should be founded on the original ground and not on any filling placed on the slope face behind the lower wall. It follows therefore that with wall lifts limited to a height of 1.0m on sloping ground of 1 in 3 the wall lifts would be 3.0m apart. A building consent should not be required because no surcharge would be present but the construction of the wall would still be required to comply with the requirements of the New Zealand Building Code.

7.6 Surface Water Control – Lot 15

Earthfill bunds have been erected on lot 15 to ensure that surface water runoff in extreme rainfall events from the higher ground to the east is contained within the easement shown as A on DP 387811. This bund shall be maintained in its original shape and under no circumstances should it be breached. It shall be incumbent on the Tauranga City Council to undertake regular inspections of the bund and undertake any maintenance work including repair or replacement of the grass reinforcing mesh on the surface of the bund. The owner of lot 15 should take care when mowing or cutting the grass on the bund to ensure that the mesh is not damaged.

7.7 Topsoil Thickness

During the subdivision earthworks areas of cut or fill were initially stripped of topsoil and this was then replaced to target depths of up to 300mm. Close to road berms it is possible that topsoil depths may be deeper than 300mm where the topsoil depth was deepened when slopes were eased from the road berm levels. No guarantee is implied or given that the topsoil on any part of any lot is 300mm deep or less and it is recommended that future owners or builders check topsoil depths when preparing site development plans and cost schedules.

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. This statement is accompanied by form G2A which summarizes the information and recommendations within this report.

9.0 Applicability

Recommendations contained in this document are based on data from boreholes, observations of soil exposures, and test results. 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 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 development at Stage 1E of the Lakes Subdivision 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

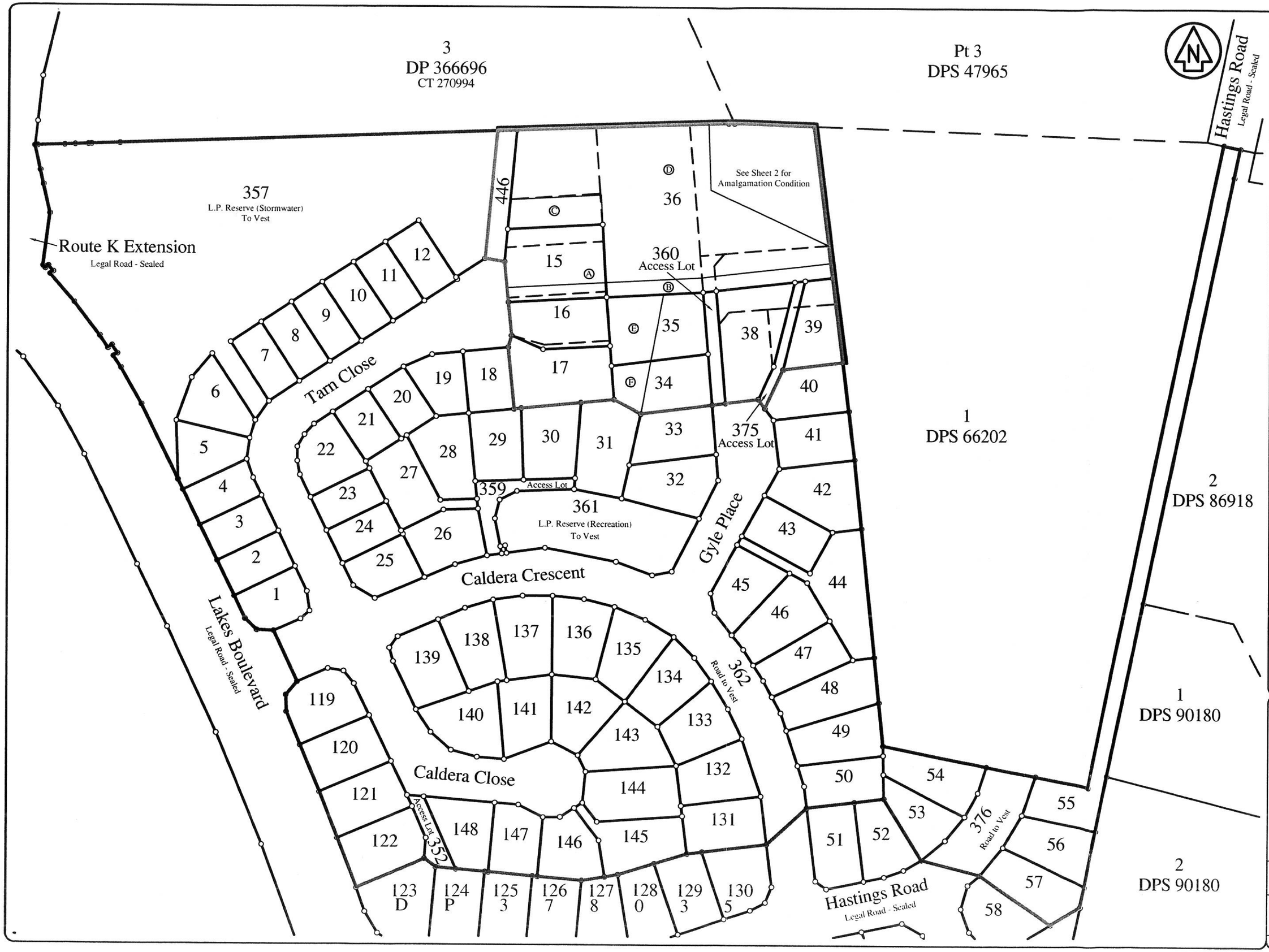
M W Hughes CPEng
Geotechnical Engineer

16 April 2007

Appendix One

Drawings

Subdivision Scheme Plan - 17726-V01 (2 sheets)
Reference Plan - 17726-AB28



Notes:

1) Areas and dimensions are approxiamte only and subject to final survey

2) See Sheet 17726 - V01 Sheet 2 for amalgamation conditions and easements

3) Lots 13, 14 & 37 have been deleted

4) Lot 375 (Access Lot) has been added

5) Lots 15-17, 34-36, 38-40, 360, 375 & 446 have been amended

Key

- Original Approved Boundary Location
- Proposed Boundary Location
- Extent of Subdivision Variation
- Extent of Title

Chk By	Rev. No.	Description	DATE
	2	Easements Added	02/07
	1	Issued to Client	01/07

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	01/07	
Checked			
Approved			

REFERENCES

SHRIMPTON & LIPINSKI

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Email: slconsultants@sltga.co.nz

TITLE

THE LAKES

Stage 1E

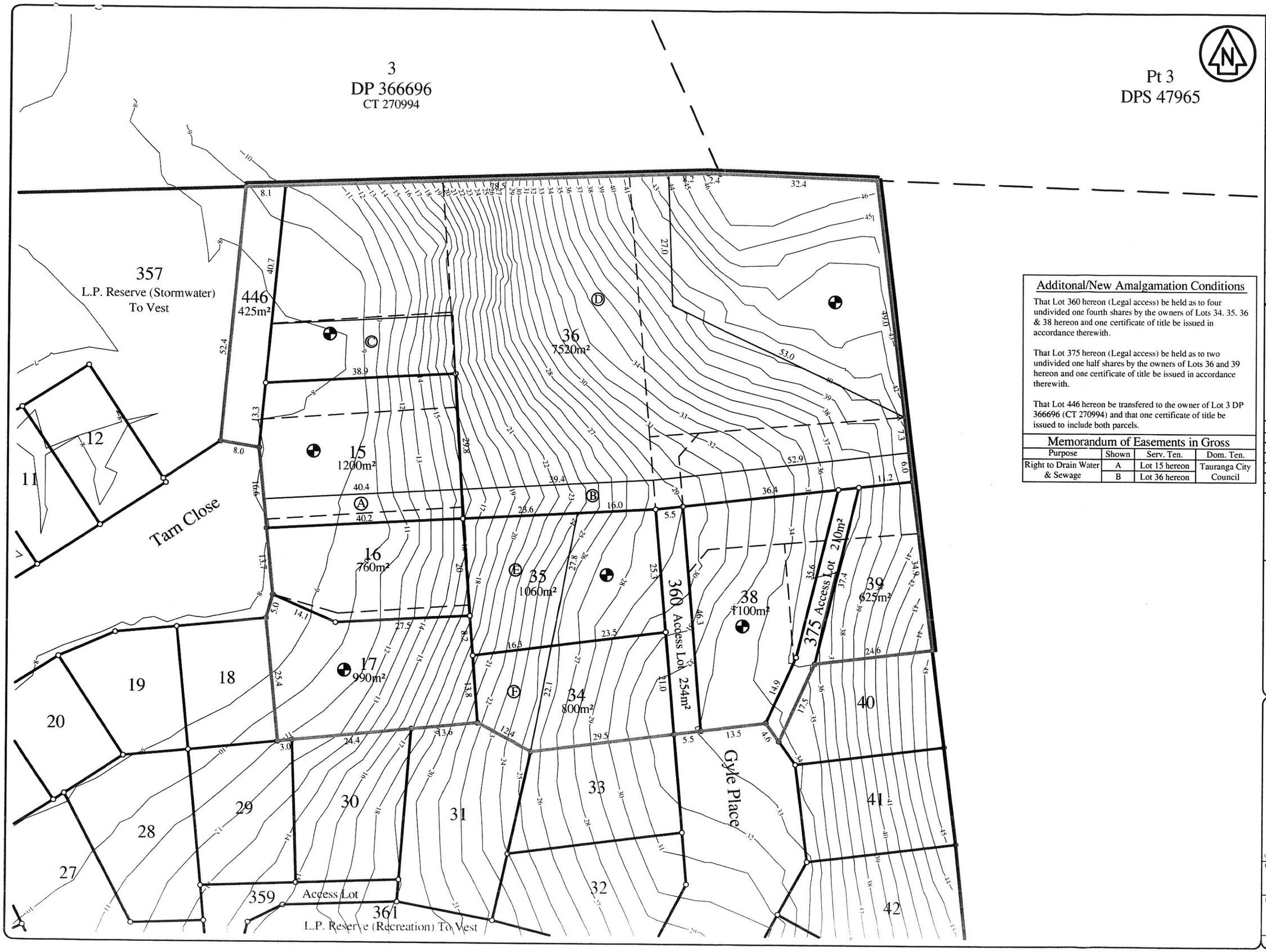
Proposed
Subdivsion Variation
of Lot 1 DP 378035

Regd. Owner : Grasshopper Farms Ltd
Total Area: 8.8198ha
C.T. : 313636

ORIGINAL SCALES	DATE
1:1000 @ A2	01/07

DRAWING No
17726 - V01
Sheet 1 of 2

METRIC DESIGN



Notes:

1) Areas and Dimensions are approximate only and subject to final survey

2) Contours are existing and are in terms of Moturiki Datum

3) Lots 15-17, 34-36 & 38-39 will be subject to specific geotechnical conditions

4) Areas A, B, C, D, E & F will be subject to specific geotechnical constraints

Key

- Original Approved Boundary Location
- Proposed Boundary Location
- Extent of Subdivision Variation
- Extent of Title (Refer Also Sheet 1 of 2)
- Investigation Borehole

Additonal/New Amalgamation Conditions

That Lot 360 hereon (Legal access) be held as to four undivided one fourth shares by the owners of Lots 34, 35, 36 & 38 hereon and one certificate of title be issued in accordance therewith.

That Lot 375 hereon (Legal access) be held as to two undivided one half shares by the owners of Lots 36 and 39 hereon and one certificate of title be issued in accordance therewith.

That Lot 446 hereon be transfered to the owner of Lot 3 DP 366696 (CT 270994) and that one certificate of title be issued to include both parcels.

Memorandum of Easements in Gross

Purpose	Shown	Serv. Ten.	Dom. Ten.
Right to Drain Water & Sewage	A	Lot 15 hereon	Tauranga City Council
	B	Lot 36 hereon	

Chk By.	Rev. No.	Description	DATE
	2	Easements Added	02/07
	1	Issued to Client	01/07

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	01/07	
Checked			
Approved			

REFERENCES

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TITLE

THE LAKES

Stage 1E

Proposed
Subdivsion Variation
of Lot 1 DP 378035

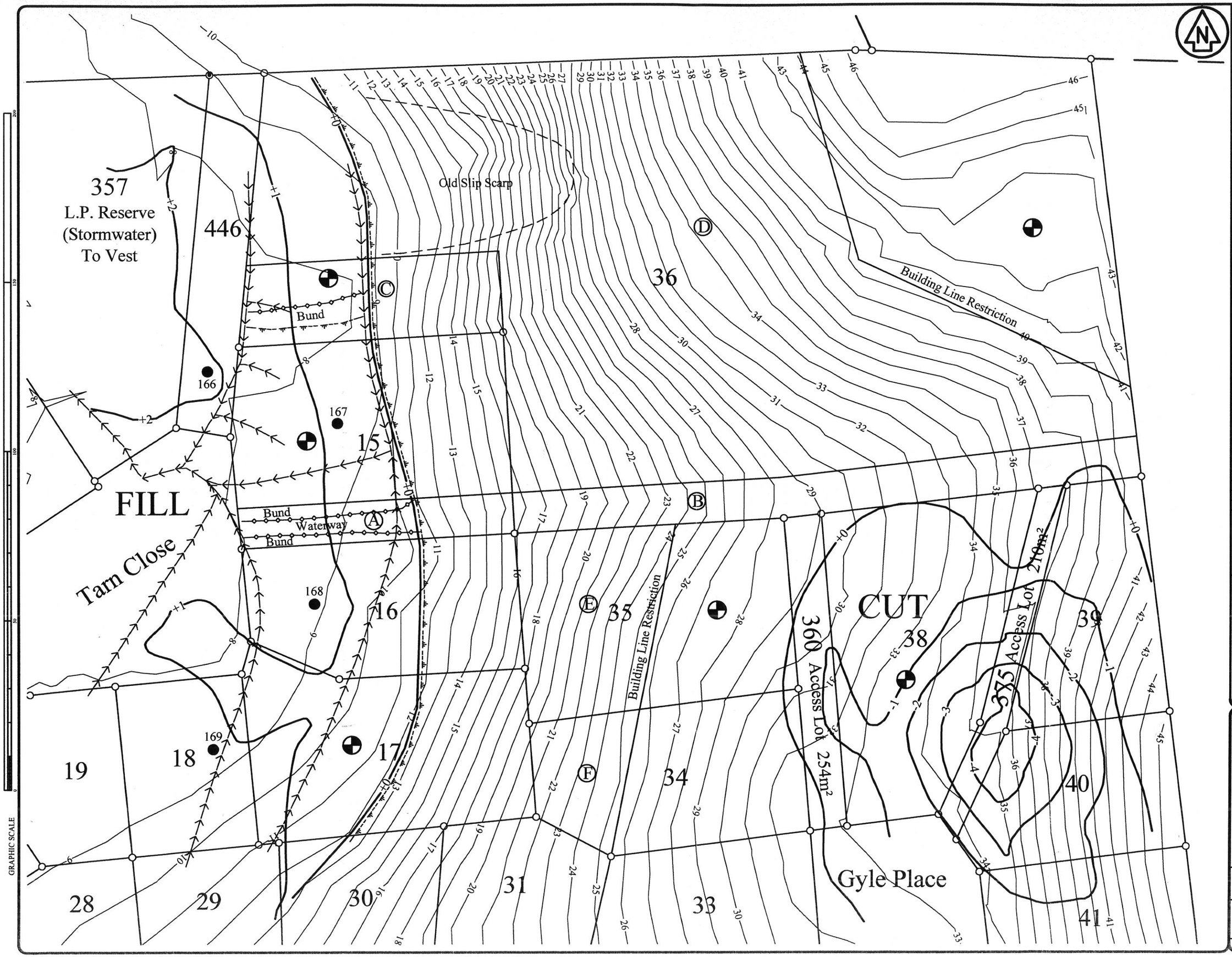
Regd. Owner : Grasshopper Farms Ltd
Total Area: 8.8198ha
C.T. : 313636

ORIGINAL SCALES	DATE
1:500 @ A2	01/07

DRAWING No
17726 - V01
Sheet 2 of 2

Revision 1 2

METRIC DESIGN



GRAPHIC SCALE

Notes:

1) Contours are in terms of Moturiki Datum

Key

- Post Construction Borehole
- Depth of Fill
- Depth of Cut
- Subsoil drain
- Compaction test

Easements and building restriction lines detailed on DP 387073

REV No.	DESCRIPTION	DATE
1	Issued for 224	04/07

CKD BY

	NAME	DATE	SIGNED
Surveyed			
Designed			
Drawn	GR	04/07	
Checked			
Approved			

REFERENCES

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TITLE

THE LAKES

Stage 1E

Geotechnical Report
Reference Plan

ORIGINAL SCALES	DATE
1:500 @ A3	04/07

DRAWING No
17726 - AB28

REVISION: 1

METRIC DESIGN

Appendix Two

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

Lot Summary Report

SECTION 2

To: The Director of Environmental Services

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

DEVELOPMENT: The Lakes Subdivision Stage 1E

OWNER: Grasshopper Farms Ltd

LOCATION: Tarn Close, Gyle Place, Pyes Pa

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 16 April 2007

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

(a) Areas shown in my report dated 16 April 2007 of each new allotment are 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 with including care in the development of some lots with significant slopes and the observance of building restriction lines.

(b) The earth fills shown on the attached Plan No. 17726-AB28 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 7 are complied with.

(e) The original ground not affected by filling is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZS 3604:1999 and related documents subject to the recommendations contained in my report including those relating to building restriction lines, topsoil depths and soil variations away from test or observation positions.

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 [signature] Date 16 April 2007

TAURANGA DISTRICT COUNCIL

SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

MAY 98

TAURANGA CITY COUNCIL

G2 Δ

THE LAKES SUBDIVISION STAGE 1(E)
TARN CLOSE & GYLE PLACE, PYES PA

The comments and notations included on this summary sheet are outlined in the support documents. These shall be read in conjunction with this summary.

T.C.C R C 1375

File Ref: 17726

Lot#	Area(m²)	Subsurface Data						Foundations		Building line restriction?	Recommendations/restrictions
		Shear Strength kPa	Subdivision Filling		Natural topography unworked	Natural topography earthworked		Conventional shallow Foundations to NZS 3604:1999	Specific Design		
			Y/N	Depth (m)	Y/N	Y/N	Depth(m)	Y/N/NA	Y/N/NA	Y/N	
15	1200	150	Y	0-1.5	Y	N	-	Y	N	N	Maintenance of bund in easement
16	760	150	Y	0-1.5	Y	N	-	Y	N	N	
17	990	150	Y	0-1.0	Y	N	-	Y	N	N	
34	800	150	N	-	Y	N	-	Y	N	Y	
35	1060	150	N	-	Y	N	-	Y	N	Y	
36	7520	150	N	-	Y	N	-	Y	N	Y	Maintenance of bund at lower level.
38	1100	150	N	-	N	Y	0-3.5	Y	N	N	
39	625	150	N	-	N	Y	0-4.0	Y	Y*	N	A geotechnical review required.

Refer to S&L Consultants Ltd report 17726 dated 16 April 2007

Lots shown on DP 387073

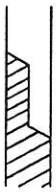
Appendix Three

Post Construction Borehole Logs

ENGINEERING LOG TERMINOLOGY

DRILLING OR EXCAVATION

FLUID LOSS



NO LOSS

PARTIAL LOSS

COMPLETE LOSS

WATER

WATER LEVEL ON DATE SHOWN

WATER INFLOW

WATER OUTFLOW

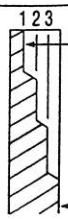
CORE RECOVERY

Core recovered expressed as percentage of the length of the core run.

METHOD/CASING

Shows drilling method and depth of casing.

PENETRATION



SAMPLES AND TESTS

SAMPLE TYPE

- OPEN BARREL
- DOUBLE OR TRIPLE TUBE
- STANDARD PENETRATION TEST
- LARGE DIAMETER THIN WALLED TUBE
- SMALL DIAMETER THIN WALLED TUBE
- BULK SAMPLE

Length of sample indicated by length of symbol.

TESTS

N = 22 SPT. UNCORRECTED BLOW COUNT FOR 300MM

●75kPa UNDRAINED SHEAR STRENGTH AS MEASURED BY FIELD VANE

☒ PRESSUREMETER TEST

✻ LABORATORY TEST(S) CARRIED OUT — UNSPECIFIED OR SPECIFIED AS BELOW

LV	- LABORATORY VANE	AL	- ATTERBERG LIMITS
UU	- UNDRAINED TRIAXIAL	PSD	- PARTICLE SIZE
C'Ø'	- EFFECTIVE STRESS	CONS	- CONSOLIDATION
DS	- DIRECT SHEAR	COMP	- COMPACTION
UC	- UNCONFINED COMPRESSION	IS	- POINT LOAD

GRAPHIC LOG

The Graphic Log shows soil and rock substances, significant defects, and core loss. Soil and rock substances represented by clear contrasting symbols consistent for each project.

TYPICAL SYMBOLS

SOIL DESCRIPTION

CLASSIFICATION SYMBOL

Based on USBR Unified Soil Classification System Visual Method for field identification. Classification symbols based on Laboratory Method may differ.

MOISTURE CONTENT

D - DRY, LOOKS AND FEEL DRY

M - MOIST, NO FREE WATER ON HAND WHEN REMOULDING

W - WET, FREE WATER ON HAND WHEN REMOULDING

Moisture content may be compared to the plastic limit (PL) eg M > PL = moist, moisture content greater than the plastic limit

UNDRAINED SHEAR STRENGTH

	Cu (kPa)
VS - VERY SOFT	< 10
S - SOFT	10 to 25
F - FIRM	25 to 50
St - STIFF	50 to 100
VSt - VERY STIFF	100 to 200
H - HARD	> 200
Fb - FRIABLE	

RELATIVE DENSITY

	SPT-UNCORRECTED N VALUE
VL - VERY LOOSE	0 to 4
L - LOOSE	4 to 10
MD - MEDIUM DENSE	10 to 30
D - DENSE	30 to 50
VD - VERY DENSE	> 50

ROCK DESCRIPTION

WEATHERING

Fr - FRESH

SW - SLIGHTLY WEATHERED

HW - HIGHLY WEATHERED

EW - EXTREMELY WEATHERED

ROCK STRENGTH

	UCS (MPa)
EXTREMELY LOW	< 2
VERY LOW	2 to 6
LOW	6 to 20
MODERATE	20 to 60
HIGH	60 to 200
VERY HIGH	> 200

SIGNIFICANT DEFECTS

SIGNIFICANT DEFECTS SHOWN GRAPHICALLY

JOINT

SHEARED ZONE

CRUSHED SEAM

INFILL SEAM

EXTREMELY WEATHERED SEAM

SHRIMPTON & ELFINSKI

Borehole On Lot 15

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 1 Of: 1

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 8.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL 100 deep			
SILT stiff sl friable moist light brown		0.5	45 87
bec v stiff sl-friable moist light brown (natural ground)		1	89 95
		1.5	104
END OF BORE		2	76 101

EXCAVATION METHOD: **Machine auger**

SHRIMPTON & LIPENSKI

Borehole On Lot 17

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 1 Of: 1

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 10.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL 300 deep			
SILT v stiff clayey moist cohesive dark brown – orange		0.5	20 (x) 66 (•)
		1	49 (x) 116 (•)
remain stiff moist cohesive brown – light brown		1.5	
		2	43 (x) 101 (•)
SILT Sandy (f) stiff moist.. friable pumiceous cream coloured		2.5	
END OF BORE		3	26 (x) 90 (•)

EXCAVATION METHOD: **Machine auger**

Shrimpton & Lepinski

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Borehole On Lot 35

Sheet: 1 Of: 2

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 27.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	SPT N	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL 120 deep				
SILT Sandy (f) stiff moist friable light yellow (younger ash)		1.0		17 92
SILT clayey stiff moist cohesive dark brown		2.0		42 104
SAND (f) loose moist pumiceous grey		3.0		13 84
SILT clayey v. stiff moist cohesive dark brown – orange (older ash)		4.0		
SILT Clayey Sandy Sl. friable stiff moist light brown – orange		5.0	3	
SILT Sandy stiff moist light brown		6.0		
SILT Sandy (f) stiff v. moist friable sensitive cream coloured		7.0		
SILT v. clayey stiff moist Sl. cohesive (greasy) sensitive white – cream		8.0	1	
stiff cream coloured sensitive		9.0		

EXCAVATION METHOD: **Machine auger**

S&L
SKRIMPTON & LEPINSKI

Borehole On Lot 35

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 2 Of: 2

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 27.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	SPT N	Undrained Shear Strength (kPa) 50 100 150
Silt clayey sandy stiff pumiceous moist light cream		10.0		
		11.0	4	
Silt clayey stiff - v. stiff pumiceous sensitive cream coloured		12.0		
Rec. friable s/l pink		13.0	4	
		14.0		
Silt clayey stiff moist sensitive pumiceous cream		15.0	2	
END OF BORE				

EXCAVATION METHOD: **Machine auger**

SHRIMPTON & SIPINSKI

Borehole On Lot 36

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 1 Of: 1

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 8.00 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)
TOPSOIL 1.0 m deep (bulk fill in non building area)		0.5
SILT Sandy (f) v. Stiff friable moist light brown		1 1.5
END OF BORE		2

Undrained Shear Strength (kPa)

50 100 150

43 (X) 104 (●)

46 (X) 116 (●)

EXCAVATION METHOD: **Machine auger**

SHRIMPTON & SLIPINSKI

Borehole On Lot 36

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 1 Of: 1

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 42.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL 200 deep			
SILT clayey stiff moist sl. friable light brown		0.5	14 75
		1	17 84
		1.5	20 87
SILT Sandy (lf) firm–stiff moist sensitive light brown		2	12 72
		2.5	12 69
		3	65
SILT clayey stiff sl. friable v. moist dark brown		3.5	
becomes cohesive v. stiff sl. moist brown		4	
borehole dry		4.5	
END OF BORE			

EXCAVATION METHOD: **Machine auger**

SHRIMPTON & SPINSKE

Borehole On Lot 38

Site: **The Lakes Subdivision Stage 1E, Tarn Close, Gyle Place, Pyes Pa**

Sheet: 1 Of: 1

Job No. **17726** | Date Excavated: **13-02-07** | RL Ground: 33.50 | Logged By: **M Hunt**

Description of Soil	Soil Symbol	Depth (m)	Undrained Shear Strength (kPa) 50 100 150
TOPSOIL 100 deep			
SILT clayey stiff cohesive dark orange-brown		0.5	37 87
becomes yellow orange stiff cohesive.		1	36 98
(younger ash) borehole dry		1.5	55 113
END OF BORE		2	69 127

EXCAVATION METHOD: **Machine auger**