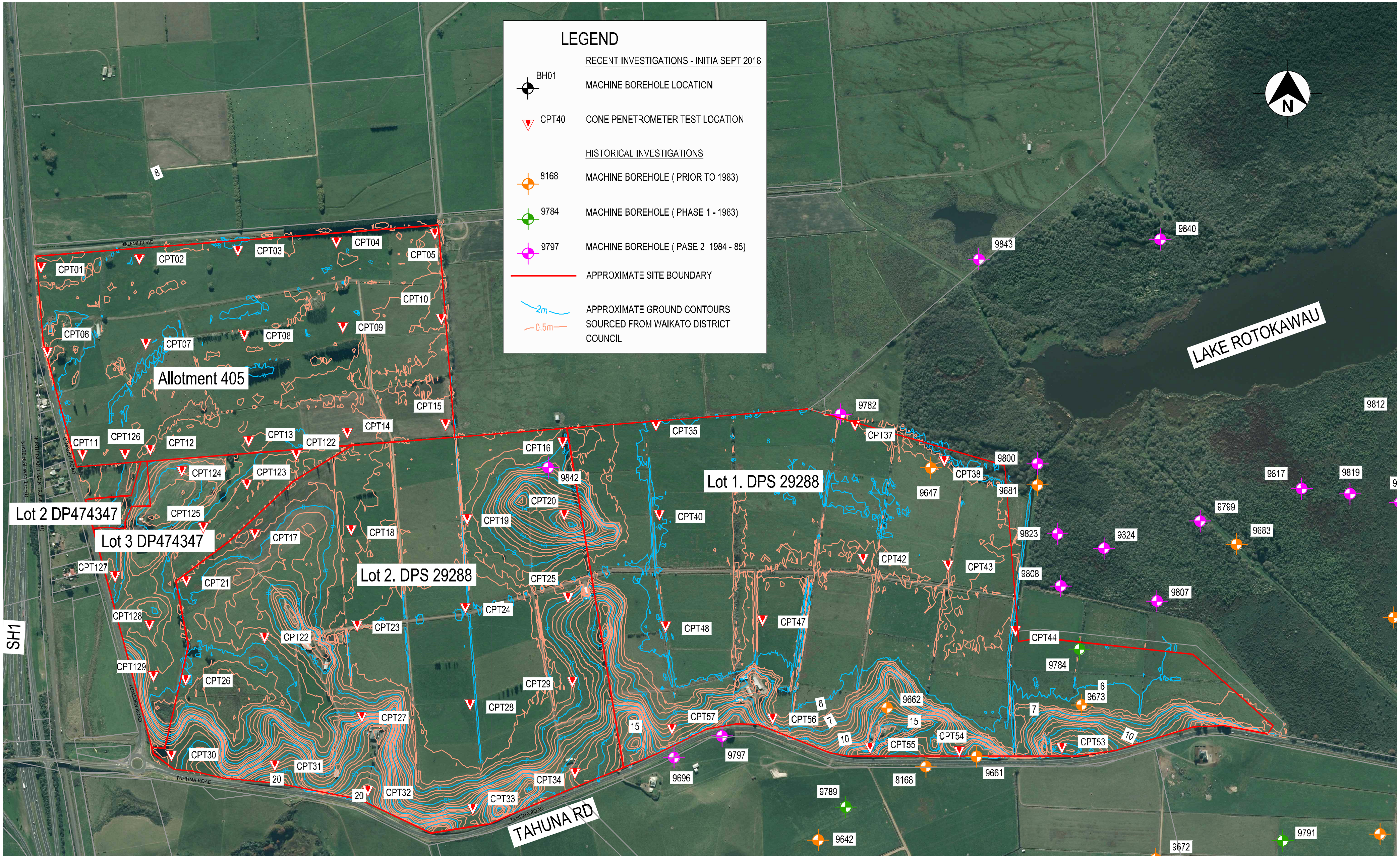
IN THE MATTER	of the Resource Management Act 1991 ("RMA" or "the Act")
AND	
IN THE MATTER	of a submission in respect of the **PROPOSED WAIKATO DISTRICT PLAN** by **AMBURY PROPERTIES LIMITED** pursuant to Clause 6 of Schedule 1 of the Act

EVIDENCE OF NICHOLAS IAN SPEIGHT
ATTACHMENTS

ATTACHMENT A

FIGURES



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SCALE 1 : 7,500m

FOR INFORMATION

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Rev	Revision Description	Designed	Drawn	Checked
B	Lots 2 & 3 DP474347 added	AW	GA	AW
A	First Issue	NS	LN	NS

Scale AS SHOWN | Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS

Unit 13, 114 St Georges Bay Rd
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AMBURY PROPERTIES

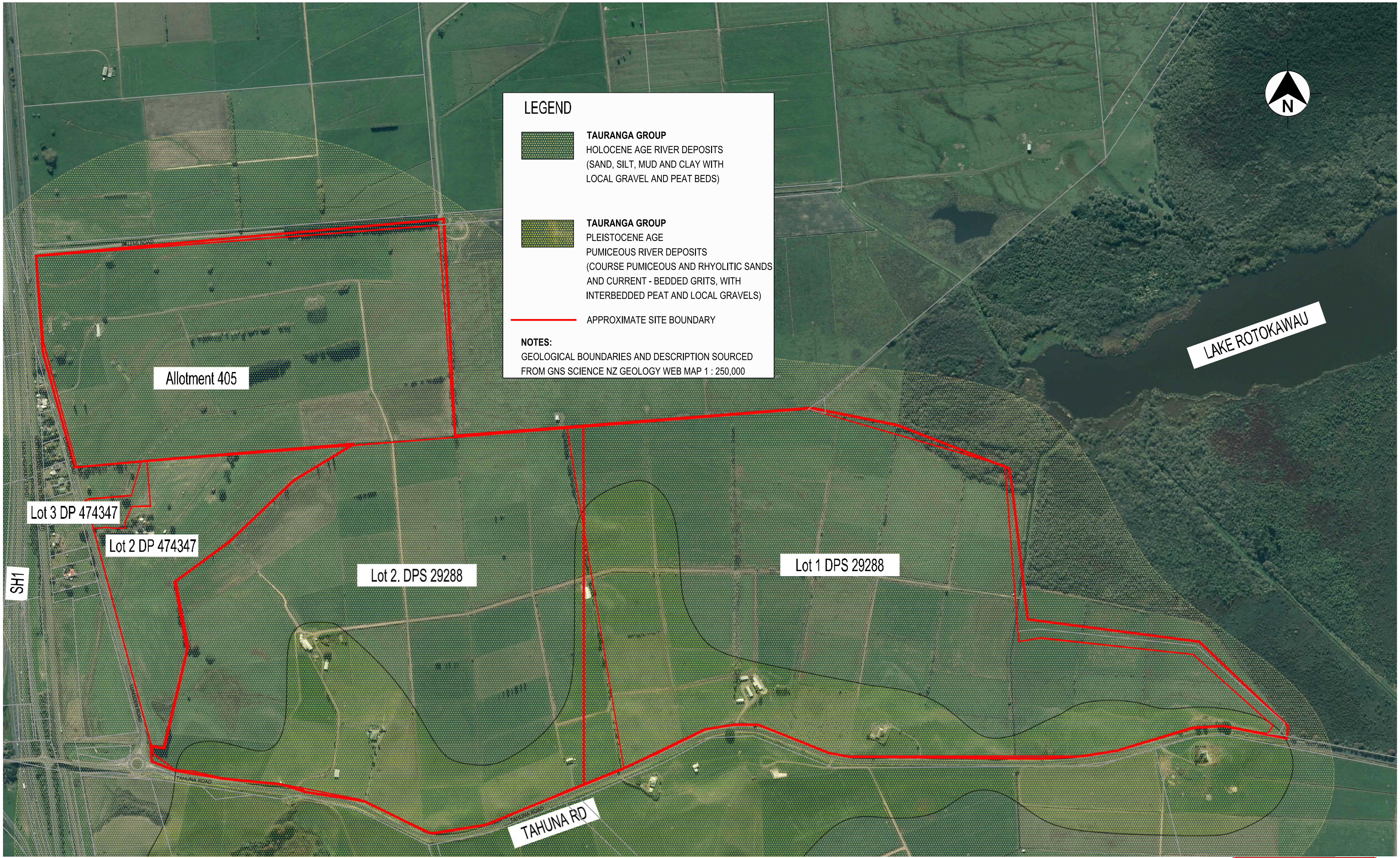
PROPOSED MIXED USE COMMERCIAL AND LIGHT INDUSTRIAL DEVELOPMENT

GEOTECHNICAL INVESTIGATION
TEST LOCATION PLAN
AT 231 TAHUNA ROAD, OHINEWAI

Initia Project ref: P000529

Figure Number: 529-001

Revision: B



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SCALE 1 : 7,500m

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AMBURY PROPERTIES

PROPOSED MIXED USE COMMERCIAL & LIGHT INDUSTRIAL DEVELOPMENT

GEOLOGICAL MAP

Initia Project ref: P000529

Figure Number 529-002

Revision B

Document No.

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FOR INFORMATION

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Rev	Revision Description	Designed	Drawn	Checked
B	LOTS 2 & 3 DP 474347 ADDED	AW	GA	AW
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AMBURY PROPERTIES

PROPOSED MIXED USE COMMERCIAL & LIGHT INDUSTRIAL DEVELOPMENT

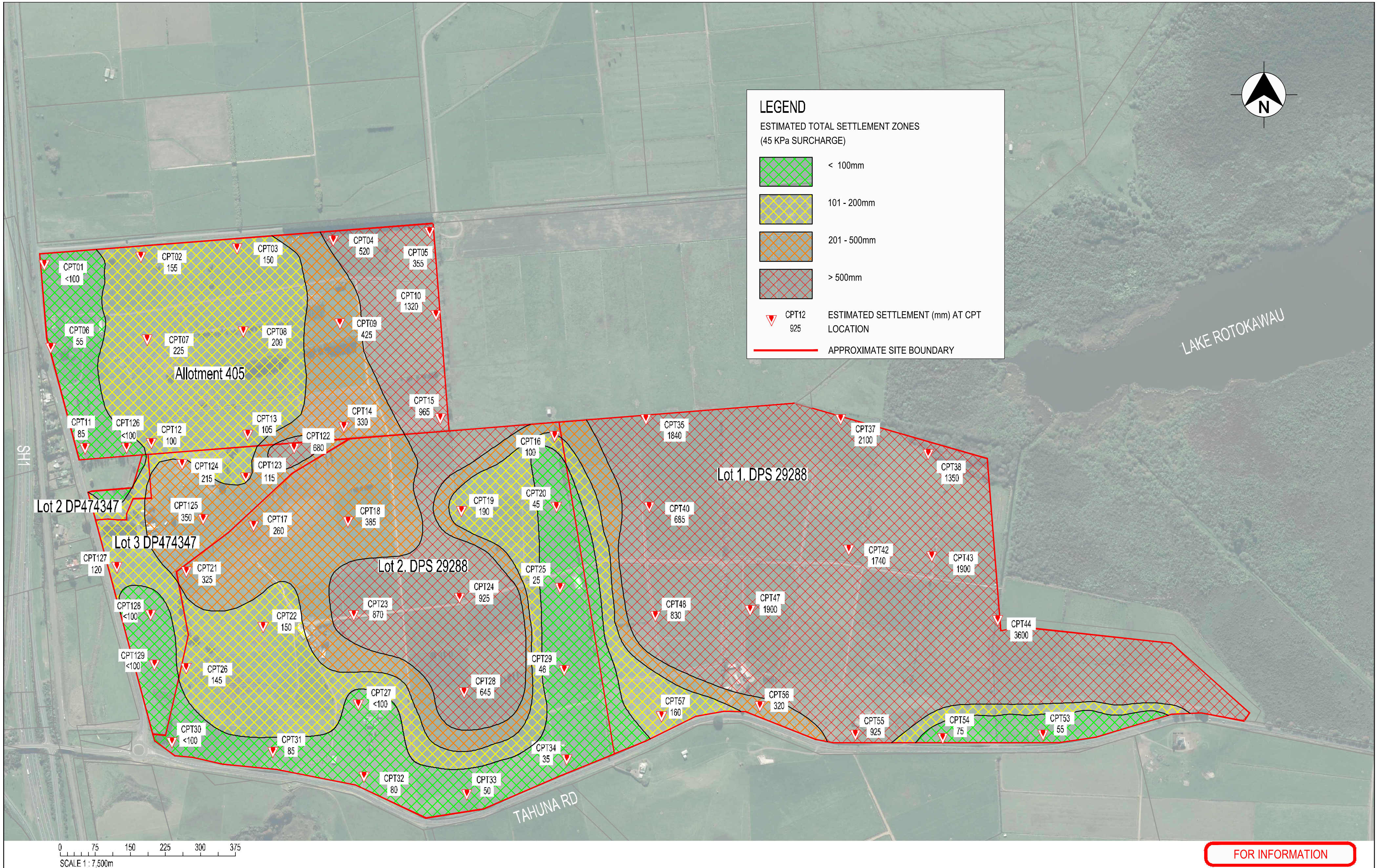
LIQUEFACTION SEVERITY
FOR ULS EARTHQUAKE
(PGA = 0.22g MW = 5.8)

Initia Project ref: P000529

Figure Number 529-003

Revision B

Document No.



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AMBURY PROPERTIES

PROPOSED MIXED USE COMMERCIAL & LIGHT INDUSTRIAL DEVELOPMENT

SETTLEMENT ZONING PLAN
45 KPa SURCHARGE

Initia Project ref: P000529

Figure Number 529-004

Revision B

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Document No.

ATTACHMENT B

GROUND IMPROVEMENT OPTIONS TABLE

Table 4-4: Ground Improvement Options

Ground improvement		Addresses risks from				Cost appraisal
		Liquefaction	Settlement			
Preloading	All building platforms and some pavements (those with medium to long term sustained heavy loading, e.g. yard storage areas, rail corridor, areas of fill embankment) could be preloaded with soil/rock (locally sourced or imported) and held for a period of 12-18 months. Regular monitoring of instrumentation required throughout preload period.	No	Yes	Usually the most cost-effective form of ground improvement for settlement where there is a readily available supply of preload material (on site or offsite). Preload material can be re-used for other buildings once initial preload is complete. Provides a uniformly improved platform which should be suitable for a shallow foundation/slab on grade solution for future buildings. Preload pressure can be designed to the equivalent long-term building surcharge pressure. Large open site, with limited space constraints, well suited to earthworks type operations.	Not a complete improvement option in isolation – ground will still require treatment to mitigate liquefaction effects. Preload timeframes are uncertain. May require importation of significant volume of preload material if no suitable on-site source is available (e.g. Soft Pit Run or GAP65). Secondary settlement (creep) likely to continue even after preloading and will need to be designed for.	Low
Stone columns/ rammed aggregate piers	The ground beneath building platforms is improved by installation of columns of hardfill at a regular grid spacing. The columns are usually 600 mm to 1,000 mm in diameter and spaced in a triangular arrangement of 2D to 3.5D (D=column diameter), depending on the nature of the soils (a typical spacing of 2.5D should be assumed for this site). The columns are installed either by 'vibro-replacement' where aggregate is fed into the ground and vibrated by a probe that both densifies the natural ground (depending on the properties of the ground) and compacts the aggregate in the column. Alternatively, 'piers' can be installed by "ramming" aggregate in thin lifts from the base of the pier to ground surface level. In both cases, the result of this stabilisation method is the formation of a thick 'raft' that acts as a composite soil mass that fully translates and distributes building loads to the toe level of the piers/columns. Column/pier depths at this site could vary between 8 and 15 m depth. Stone columns and rammed aggregate piers are often used in combination with a reinforced gravel raft beneath building footprints to reduce the centre to centre spacing of the columns/piers and to help ensure the ground below the buildings behaves a uniform, composite founding material.	Yes (in the upper soils)	Partly	Provides a uniformly improved raft of ground suitable for supporting buildings on shallow foundation/slab on grade. Cost-effective when compared against traditional piled foundation options. Usually very effective method of ground improvement for sites which are largely dominated by sandy material. Large number of quarries located within 20 km of site.	There is no continuous and reliable end-bearing stratum for columns/piers to bear on. Therefore, settlement may still occur in the deeper soils, below the column/pier toe level. This could be mitigated by preloading. Requires significant volume of imported aggregate to construct columns/piers. Ground conditions are highly variable (peats, sands, clays etc) which could make installation problematic. The effectiveness of the stone columns will be variable due to the interlayering of sandy and silty deposits (meaning a relatively high density of columns is likely to be required) Some areas of the site may be too soft and compressible to confine stone columns when they are axially loaded. Soils at and below the toe level of the columns may be liquefiable under a ULS event which would could result in loss of end bearing.	Medium
Deep soil mixed (DSM) columns	Similar concept to Stone Columns and Rammed Aggregate Piers; building loads are effectively supported by bearing on ground at a greater depth (8-15 m) by installation of regularly spaced soil/cement mixed columns, typically 600 mm to 1,000 mm in diameter. The difference between stone column/RAPs and DSMs is that DSMs involve in situ stabilisation of the natural soils by injection of cement (and/or other suitable binders) and mixing by auger to form a column of relatively high material (typically around 1 MPa compressive strength).	Yes (in the upper soils)	Partly	Provides a uniformly improved raft of ground for supporting building on shallow foundation/slab on grade. Cost effective when compared against traditional piled solutions Avoids requirement to import large volume of granular material, as with stone columns/RAPs.	No continuous and reliable end bearing stratum for DSMs to bear on. Therefore, settlement may still occur in the deeper soils below the DSM toe level. This could be mitigated by preloading. Requires significant volume of cement for binding the soils. May be difficult to achieve a uniform/consistent column strength due to variable soil types (sands/clays/peats). Peat may not bind with cement. Soils at and below the toe level of the columns may be liquefiable under a ULS event which would could result in loss of end bearing.	Medium
Reinforced gravel raft	The upper soils are excavated and removed and replaced with high strength structural fill (using quarry graded hardfill such as GAP65), often reinforced with multiple layers of geogrid, to form a structural raft to support building structures and floor slabs. The minimum thickness of the raft (which can be a combination of new hardfill associated with ground raising and below ground hardfill replacement) would need to be approximately 3 m for buildings. This option is unlikely to be cost effective for external pavements/yards.	Yes	No (only partially)	Provides a uniform and stiff bearing layer to support buildings on shallow foundations and slabs on grade. Simple operation that could be easily conducted as part of 'normal' earthworks operations.	Not a complete solution in isolation, i.e. the ground would also require treatment for settlement (e.g. by preloading). Requires significant volume of structural fill imported from off site and disposal of the excavated material – either on site or off site. Excavation below groundwater level may be problematic	Medium

Table 4-4: Ground Improvement Options (continued)

Ground improvement option	Details	Addresses risks from		Pros	Cons	Relative cost appraisal
		Liquefaction	Settlement			
Excavation and re-compaction – Ground Improved raft	An upper layer of natural ground (where the Taupo Pumice Alluvium is present) is excavated to a depth below design subgrade level and replaced successively in 300 mm thick layers. Heavy compaction (using a 10t roller with vibratory mode capability) is applied to each successive layer to achieve a high degree of compaction. Cement and lime could be added to the materials to improve overall strengths if needed. The improved "raft" of high strength ground is sufficiently dense so as to mitigate the liquefaction susceptibility risk under a ULS seismic event meaning buildings and pavements can be safely supported on grade. The minimum thickness of the raft (which could be a combination of new, compacted bulk fill associated with ground raising and compacted natural soils) would need to be approximately 3 m for buildings and approximately 1 m for pavements. The soils would most economically be stabilised by excavation to a maximum of 2.5 m below ground level. This would be completed by standard earthmoving plant together. The strength of the stabilised raft could be improved using layers of geogrid between layers .	Yes (upper 3 m)	No (only partially)	Provides a uniform and stiff bearing layer to support buildings on shallow foundations and slabs bearing on grade. Cost effective solution - works could be completed as a simple bulk earthworks operation. No need to import or export significant volumes of material to/from the site. The site is very large and has ample space for bulk earthworks operations (eg. laying out and conditioning of soils on site).	Not a complete solution in isolation, i.e. the untreated ground would also require treatment for settlement (e.g. by preloading). Excavation below groundwater level may be problematic, requiring installation of diversion/cut-off drains around the perimeter of the excavation. A stiff layer of soil would be required at the base of the excavation to support trafficking of earthmoving plant. Excavation depths may therefore be limited, or special treatment may be required at the excavation base (e.g. by the use of BIDIM geotextile and/or geogrid).	Low-medium
Dynamic Compaction (DC)	The upper 3 to 5 m is compacted by dropping a heavy weight (approx. 10t) with a diameter of 1 to 2 m from a height of 6 to 10 m using a large crawler crane. The weight is dropped several times in one location until the compaction effectiveness is reduced (the optimum number of drops is usually determined by a trial prior to commencing). Drop locations are usually spaced at 1.5 to 2 x D (D= diameter of the weight). The "pitted" surface requires re-levelling and surface compaction following completion	Yes (upper soils)	No (only partially)	Very effective in sandy and other granular soils such as those present at near surface levels at this site. Simple operation that has been widely used and tested in New Zealand. Effectiveness can be easily assessed by performing tests pre and post DC.	Only suitable in predominantly sandy soils. Is not suitable for areas directly underlain by clayey and peat soils (e.g. Rotokawau Formation). Will require significant filling following compaction to building levels back up to original (pre DC) site elevations.	Low