REPORT

Irongate Industrial Plan Change Preliminary Geotechnical Assessment

Prepared for Hastings District Council

JUNE 2009

QUALITY ASSURANCE STATEMENT

PROJECT MANAGER	REVIEWED BY
Tim Grace	Grant Maxwell, Paul Wopereis, , Rebecca Whillans
PREPARED BY	**APPROVED FOR ISSUE BY**
Phil Landmark	Tim Grace

PALMERSTON NORTH
118 Fitzherbert Avenue, PO Box 2033, Palmerston North 4440, New Zealand
P + 64-6-357 4034, F + 64-6-356 1164

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HASTINGS DISTRICT COUNCIL

Irongate Industrial Plan Change
Preliminary Geotechnical Assessment

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1 Introduction

1.1 Background

The Strategic Development Group of the Hastings District Council (HDC) is currently preparing a plan change to rezone land in the area known as the "Irongate Cluster" for industrial purposes. In order to support the proposed plan change the Council requires an assessment of the constraints to future subdivision and industrial development that may be associated with the geology of the area. The proposed plan change stems from the Council's broader industrial review which commenced early in 2000.

In September 2003 the Council adopted the recommendations of the *Site Selection Report* and endorsed the associated strategy. The areas identified as being most suitable for industrial rezoning were the Omahu Road Strip (for high profile dry industry uses), the Irongate Cluster (for larger scale dry industry uses) and the Tomoana Extension (for wet industry uses that require access to the trade waste sewer).

As part of the 2006 Long Term Council Community Plan (LTCCP) process the Council decided to defer any infrastructure construction and hence the rezoning of the Tomoana Extension area until after 2016 due to the existing capacity for wet industry in the current Whakatu industrial zone. The subsequent investigations have therefore focused on the Omahu Road Strip and Irongate Cluster areas (refer to the *Location Plan* in Appendix A).

The Council has now decided to move forward with the notification of a plan change for the Irongate Cluster area and requires detailed area specific assessments to be completed on the basis of the most recent decisions in relation to the extent of the proposed new industrial area.

1.2 Broad Scope of Works

An assessment is required on the extent of the possible geotechnical constraints to future subdivision and development of the land situated within the area proposed to be rezoned for industrial purposes in the vicinity of Maraekakaho Road and Irongate Road in Hastings. The assessment needs to establish from a broad perspective whether the land situated within the area to be rezoned is suitable for subdivision and subsequent development for industrial purposes.

The assessment effectively needs to identify and examine any geotechnical constraints that would render the rezoning of the land or any part of the land for industrial purposes inappropriate. It is envisaged that the assessment will indicate geological features that will require more detailed assessment at the resource consent or building consent stage to ensure that any potential for adverse effects at the time of subdivision and development can be appropriately avoided, remedied or mitigated.

The costs and benefits of the options available to avoid, remedy or mitigate any potential for adverse effects to future subdivision and development for industrial purposes, including the financial implications for any construction standards recommended for the proposed new industrial area, also need to be evaluated in the assessment.

1.3 Detailed Scope of the Assessment

The scope of the Preliminary Geotechnical Assessment consisted of the following:

- Desk-top study of available geological, soil, resource consent and borehole information relating to the proposed industrial area.
- Site walkover by a senior engineer.
- Carrying out of five soakage tests.
- Assessment of investigation results and preparation of this report providing recommendations.

2 Desk Top Study

2.1 Regional Geology

The regional geological map[1] describes the soils underlying the proposed industrial subdivision as: *"Heretaunga Alluvium: Fossiliferous marine sands and greywacke; intercalated in fluvialtile sands and silts".*

The map also indicates that most settlements on the Heretaunga Plain are supplied with artesian bores.

The regional map shows a number of active faults in the vicinity of the area proposed to be rezoned. This information has, however, been largely superseded by updated information which is contained on the website of the Institute of Geological and Nuclear Sciences (GNS). This is discussed further below.

2.2 Earthquake Hazards

2.2.1 Faulting and Ground Shaking

Section 12.3 of the Hastings District Plan[2] deals with natural hazards and states the following with respect to earthquake hazard: *"…The Hawke's Bay Region is one of the most earthquake-prone regions in New Zealand. Within the Hastings District there are a large number of active earthquake faults that are capable of producing very strong earthquake shaking in the future. Some mitigation measures against the effects of earthquakes already exist, most notably a comprehensive building code that requires a high level of earthquake resistant design. Areas close to fault lines and areas underlain by materials capable of amplifying earthquake ground shaking may require additional methods to mitigate the effects of earthquakes…"*

The Hawke's Bay Regional Council Coastal Hazard Assessment[3] states: *"…The Hawke's Bay region lies in the most active seismic region of New Zealand (Hull 1990). Geologic evidence indicates that over the last 6,500 years the Heretaunga Plains have subsided 11m near Hastings at a net rate of 1.7m / 1,000 years (Gibb 1980)…".*

In February 1931 the Hawke's Bay region was struck by one of the three largest earthquakes ever recorded in New Zealand. The earthquake had a magnitude of M7.8 and caused extensive damage in the region, including uplifting an area of about 1,500km^2 a maximum of 2.7m and causing ground subsidence of about 1m in Hastings. Table 2[4] in Appendix B lists historical earthquakes with magnitude greater than 6 and felt Modified Mercalli (MM) intensities of 7 or greater in the Hawke's Bay.

Appendix 12.3-2 of the Hastings District Plan (see Appendix C) provides a relative scale for earthquake ground shaking amplification in the district. The scale varies from 1 to 4, with 1 relating to the *"least likely"* shaking response associated with bedrock / regolith (unconsolidated rock material resting on bedrock) and 4 being the *"greatest"* shaking response associated with unconsolidated swamp, estuarine and lagoon deposits and reclaimed land. The area proposed to be rezoned and the whole area around Hastings City have been assigned a relative earthquake amplification rating of 3 which relates to the amplification response from alluvial sand, silt and gravel.

[1] Kingma J.T.; 1962 Sheet 11 Dannevirke; (1st Edition) *"Geological Map of New Zealand 1:250,000"*; Department of Scientific and Industrial Research, Wellington, New Zealand.
[2] Natural Hazards Resource Management Unit, Hastings District Plan
[3] Hawke's Bay Regional Council Coastal Hazard Assessment; Reference No. 20514; February 2004, Report by Tonkin & Taylor Ltd.
[4] Johnston D.M. & Pearse L.J. (eds), 2007; *Hazards in Hawke's Bay.* Hawke's Bay Regional Council Plan No. 3892.

The Active Faults Database[5] on the GNS website indicates that the closest active fault to the proposed new industrial area will be the Poukawa Fault Zone, which is located approximately 7.5km south-west of the proposed new industrial area. It is a reverse fault with a recurrence interval of 3,500 – 5,000 years. The last event was less than 160 years ago. It has a medium slip rate (1 – 10 mm/year) and a moderate single event displacement (1 – 5m). It is reported that the Poukawa Fault Zone is capable of producing an earthquake of magnitude 7.5.

Regionally there are a number of major faults that could potentially impact on the site area. The Mohaka and Ruahine Faults lie some 34km and 38km respectively north-west of the site area and the Wellington Fault lies about 115km to the south-west, whilst the Wairarapa Fault lies some 130km to the south-south-west

The Ruahine Fault is described as a dextral fault. It has a recurrence interval of between 2,000 and 3,500 years and a medium slip rate (1 – 10mm/year). The single event displacement has not been established and the last fault rupture event occurred between 1,000 and 10,000 years ago.

The Mohaka Fault is also described as a dextral fault. It has a recurrence interval of less than 2,000 years and a medium slip rate (1 – 10mm/year). It has a major single event displacement (equal to or greater than 5m). The last fault rupture event also occurred in the last millennium (160 to 1,000 years ago).

The Wellington Fault is a dextral fault aligned approximately south-west to north-east. It has a recurrence interval of less than 1,000 years, a medium slip rate (1 – 10mm/year) and single event displacement of between 4m and 5m (moderate). The last fault rupture event occurred between 160 and 1,000 years ago.

The Wairarapa Fault is a dextral fault, also aligned approximately south-west to north-east. It has a recurrence interval of less than 2,000 years, a high slip rate (> 10mm/year) and single event displacement that is greater than or equal to 5m (major). The last known fault rupture event occurred in 1955 having a magnitude of 8.

The Wairarapa, Wellington and Mohaka Faults are all classed as major faults [6] requiring near-fault factors > 1.0 in terms of *NZS 1170.5: 2004 Structural Design Actions Part 5: Earthquake Actions – New Zealand*.

Figure 6[7] in Appendix B shows a map of ground shaking intensities in the event of an earthquake on the Mohaka Fault. Shaking is shown in terms of peak ground acceleration (PGA) shown as a fraction of the gravitational acceleration (g). The Hastings area, including the area proposed to be rezoned has an indicative PGA of 0.3g.

2.2.2 Hastings District Earthquake Fault Trace Survey

An earthquake fault trace survey report[8] has recently been prepared by the Institute of Geological and Nuclear Sciences Ltd (GNS) for the Hawke's Bay Regional Council. Parts of the Poukawa Fault Zone, Tukituki Thrust Fault Zone, and Hawke's Bay extensional Domain were mapped in Hastings District and Fault Avoidance Zones were defined around those faults that encompass the area of possible ground deformation associated with active fault traces.

For the Heretaunga Plains efforts were focussed on the northern continuation of the Tukituki Thrust Fault Zone and the Poukawa Fault Zone and 1931 earthquake ruptures.

[5] http://maps.gns.cri.nz/website/af/
[6] Table 3.6 – *NZS 1170.5: 2004*
[7] Johnston D.M. & Pearse L.J. (eds), 2007; *Hazards in Hawke's Bay.* Hawke's Bay Regional Council Plan No. 3892.
[8] Langridge R. & Villamor P., GNS Science, Avalon, *Hastings District: Earthquake Fault Trace Survey*; GNS Science Consultancy Report 2007/145; September 2007; Reference AM 07/15, HBRC Plan 3968.

Fault zones were mapped using a Geographic Information System (GIS) in conjunction with LiDAR (Light Detection and Ranging) imagery and rectified aerial photographs. Using various techniques within the GIS software package a long (about 8km) wavelength, broad pattern of warping with a NE-trending linear bulge of about 1m in height was identified between Bridge Pa and Awatoto (on the coast south of Napier). A parallel trough of about 0.5m depth was discerned through the Hastings area. These observations are consistent with deformation that was re-surveyed after the 1931 earthquake.

The report goes on to comment: *"It is clear that the 1931 Hawke's Bay earthquake caused a broad NE-trending pattern of warping across the plains with an axis about the line of neutral (zero) uplift. However, there is no clear rupture trace and it would be difficult to zone for a feature that we cannot clearly observe on the ground surface. Such a broad warp probably does not pose a life safety risk (from rupture) and accordingly should not require zonation. Therefore, while we recognise the presence of an earthquake source between Bridge Pa and Awatoto, we cannot map it with sufficient accuracy and certainty to be of use in terms of planning purposes".*

The report indicates that the 1931 earthquake on the "Napier" Fault was probably a Recurrence Interval (RI) Class IV event (between 5,000 and 10,000 years). Table 8 in the report (see Appendix D) indicates that for the Hawke's Bay Extentional Domain and northern Poukawa Fault Zone, which has the same fault RI, developed buildings with importance category 1, 2a, 2b and 3 (and already subdivided sites) should be *permitted* where the fault complexity is uncertain or constrained. For greenfield sites buildings with importance category 1, 2a and 2b should be *permitted*, whilst those having a building importance of 3 should either be *discretionary* or possibly *controlled*. It is understood that risks from natural hazards are being reviewed in the Hastings District Plan and that the GNS report will form the basis for the review of this section of the District Plan.

Table 4[9] (also included in Appendix D) shows the building importance categories and lists examples of buildings in each category. Typically it is expected that existing and proposed buildings within the area proposed to be rezoned will fall within categories 1, 2a or 2b; i.e. they should be *permitted*. Category 3 buildings are described as *"…Important structures that may contain people in crowds or contents of high value to the community or pose risks to people in crowds..."* They include service stations and chemical storage facilities greater than 500m^2 – presumably because of the risk associated with hazardous substances stored in large quantities. Whilst both types of facilities may also occur within the area proposed to be rezoned they are currently controlled through separate legislation and the relevant district wide hazardous substances provisions of the District Plan.

2.2.3 Liquefaction

The *Hazards in Hawke's Bay* report describes liquefaction as follows: *"…Liquefaction is the term used to describe when a solid (in this case soil) begins to act as a fluid. Ground shaking causes the pore pressure of water in a saturated sediment to increase until the sediment loses its cohesion and behaves like a liquid. When the sediment is liquefied, it can flow upwards and escape at the surface generating sand boils and sand volcanoes. On gentle slopes, liquefied sediment can cause overlying material to move horizontally and crack into large blocks, while on steeper slopes, liquefaction can cause large landslides, or flow failures. Liquefaction of a soil can cause the ground surface to fail, shifting or damaging any buildings, roads, pipes or other structures built on or within it…"*

The report also states that: *"…following the 1931 Hawke's Bay earthquake there were numerous reports of liquefaction on the Heretaunga Plains…"*

Appendix 12.3-1 of the District Plan provides a map showing zones of relative liquefaction susceptibility throughout the district (refer to Appendix C). The scale of susceptibility ranges from *"very low/negligible"* through to *"very high"*. The map shows that the area proposed to be rezoned has "*moderate"* liquefaction susceptibility. A similar map has been produced by GNS. It also shows the same degree of susceptibility

[9] Source: *Hastings District: Earthquake Fault Trace Survey* report, extracted from *MfE Active Fault Guidelines* report.

for the area proposed to be rezoned but it provides a descriptive measure of the physical effects relating to liquefaction. These are given in Table 1 below.

Table 1: Liquefaction Susceptibility Scale and Description of Physical Effects

Relative Liquefaction Susceptibility	Description of Physical Effects
2 – Low	A few sand boils and minor fissures. Estimate up to 10% of area affected.
3 – Moderate	Sand boils and moderate fissuring (more extensive near basin edges and in waterlogged areas), river banks broken up and embankments slumped; settlements of up to 0.2m. Estimate 10-20% of area affected.
4 – High	Lateral spreading common, with many fissures in alluvium (some large), slumping and fissuring of stopbanks, common sand boils, settlements of up to 0.5m. Estimate 20-50% of area affected.
5 – Very high	Lateral spreading widespread, with extensive fissures; lateral spreads with displacements of up to 10m common especially near channel edges; settlement of fills by up to 1m. Estimate more than 50% of area affected.

Both maps show that most of Hastings City has *"moderate"* susceptibility with the area north-east of the city up to the coast having *"high"* susceptibility. The coastal strip north of the Tutaekuri River through to Onehunga Road north of Napier has *"very high"* liquefaction susceptibility, as does the low-lying area around Lake Poukawa.

2.3 Soils

The soils of the Heretaunga Plains have been extensively documented. A general description of the history of deposition is contained in a reference guide by E. Griffiths [10]:

"Hawke's Bay Heretaunga Plains have been built up over 250,000 years from sediments deposited in a marine basin. Most sediment comes from the Kaweka and Ruahine Ranges, carried by the Ngaruroro, Tutaekuri and Tukituki rivers. These along with some additions from minor rivers and local streams, gradually filled the basin, pushing the coastline to the east.

Greywacke and sandstone, along with small amounts of limestone, volcanic ash and pumice have been eroded from the Kaweka and Ruahine Ranges. The water-borne alluvium carried by the rivers forms most of the Heretaunga Plains"

Griffiths provides typical sections through parts of the Plain, as shown in Figure 5 on the following page.

[10] *Soils of the Heretaunga Plains. A Guide to their Management.* E. Griffiths.

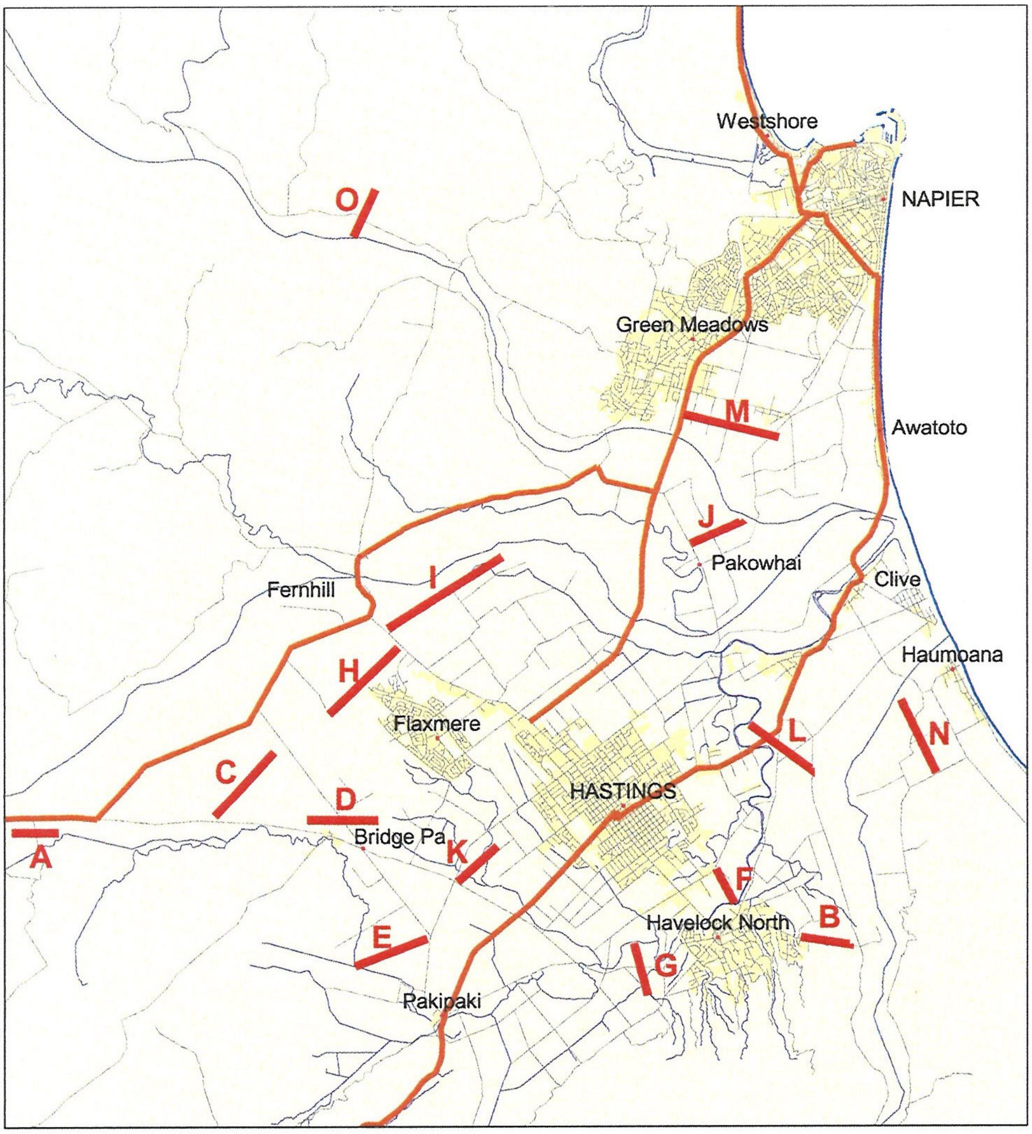
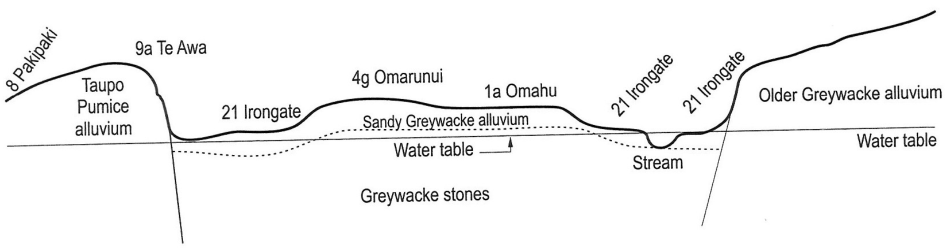


Figure 5: Locality of Soil Landscape Profiles

Section K, below, shows the typical soil profile in the vicinity of the proposed new industrial area.



Irongate soils (21) typically occur on low terraces adjacent to flood channels which have cut into the older plain. Omahu soils (1 and 1a) occur within the flood channel of the Ngaruroro River after the 1867 flood event and Omaranui (4s and 4g) soils form the flood plain remnant which escaped erosion by floods.

The soil map [11] attached in Appendix E shows the soil types encountered in the area proposed to be rezoned for industrial purposes. Table 2 below summarises the soil types and their characteristics[12].

Table 2: Description of Soils found in the Proposed Plan Change Area

Soil Type & percentage ofplan change area	Parent Material	Characteristic site and soil features	Natural drainage and depth to WT after wet periods	Infiltration Rate (1)	Permeability Rate (2)	Susceptibility to wind erosion when dry
Irongate (21) Approx. 17%	Alluvial deposits of Ngaruroro from greywacke and/or sandstone.	Mostly shallow sandy/silt deposits over stones adjacent to the Irongate Stream.	Poor < 30cm	Rapid if sand topsoil	Very rapid	High if sand topsoil
Omahu (1 & 1a) Approx. 56%	Alluvial deposits from greywacke and/or sandstone.	Main channel and active flood plain of Ngaruroro until 1867; gravely and stony soils with less than 30cm of sand to loamy fine sand on top with sand lenses at depth in gravels.	Good > 60cm	1 – very rapid 1a - rapid	Stony gravels – very rapid Sand lenses – moderate or rapid	Very high
Omaranui (4s & 4g) Approx. 19%	Alluvial deposits from greywacke and/or sandstone.	Low terrace adjacent to recent channels; sandy loams overlying permeable older deposits, often stones but maybe heavier textures.	Good > 60cm	Moderate	Moderate, but slow if old topsoil.	High where sand topsoil.
Pakowhai (17) Approx. 8%	Alluvial deposits from greywacke and/or sandstone and limestone.	Active flood plain which is protected from flooding by the stopbanks; sandy or silty sediment overlying buried topsoil. Often with lime deposits.	Imperfect 30 – 60cm	Moderate	Slow	Very high

(1) Infiltration rate – the rate of water movement <u>into</u> the soil.
(2) Permeability – the rate of flow of water <u>through</u> the soil.

Infiltration / Permeability Class	Rate (mm/hour)
Very slow	< 1
Slow	1 – 4
Moderate	4 – 71
Rapid	72 – 288
Very rapid	> 288

[11] Source: Hawke's Bay Regional Council Plan No. 2683 Sheet 4 of 5.
[12] Source: Hawke's Bay Regional Council website: http://www.hbrc.govt.nz/WhatWeDo/Land/SoilsoftheHeretaungaPlains/

2.4 Boreholes

There are a considerable number of boreholes that have been developed within the area proposed to be rezoned. Drawing Z1462302/C01/A (see Appendix F) shows an aerial photograph which indicates the location of bores that the Hawke's Bay Regional Council (HBRC) has on record. The HBRC has drilling logs for most of these bores and whilst the descriptions given for the various soil layers are somewhat generic, they provide a useful indication of the sub-soil conditions. The spreadsheet attached in Appendix F summarises the bore information that has been reviewed to date.

Drawings Z1462302/C02/A and C03/A attached in Appendix F show three sections (A-A', B-B' & C-C') that have been taken through the area proposed to be rezoned based on information derived from available borehole logs. Note that the borehole information is provided with respect to local ground level and so no account can be made for variations in elevation between bores. Since the area is practically flat this does not adversely affect the interpretation of the borehole information.

The borehole logs show that the underlying soils vary quite considerably across the area proposed to be rezoned. However, the following trends are evident:

- Topsoil layer underlain by gravel/sand sometimes with ash/pumice to a depth of between 5m and 20m.
- Underlying soils consist of clay, frequently described as *"blue"*.
- Layers of *"peat/vegetation/wood"* are recorded within the clay layer.
- The clay layer terminates between approximately 30m and 39m where *"blue/brown"* gravel is encountered.

Most of the bores extend to between 30m and 45m, with several only extending to around 10m and a couple going to about 22m. Many of the bores have artesian conditions (up to 3.0m above ground level). The lowest static water level is recorded as 5.5m below ground.

2.5 Resource Consents Information

Information was obtained from the Regional Council for a number of discharges that are permitted in the area. The following summarises pertinent comments drawn from the permits, applications, supporting reports and Regional Council field staff notes.

DP 000634L – Discharge of Truck Wash Effluent to Land (Lot 1, DP 12192) – from the Officer's Report. The date is uncertain but surmised to be in 2001.

- There is a very deep water table at that location (6 – 9m). Groundwater at this confined aquifer area is unlikely to be contaminated by nitrogen or other contaminants.
- Soils are described as *"…mainly shingle and sand…"*
- Soil drainage is described as *"…very good…"*
- Memorandum of 4 August 1995 notes – *"development, groundworks, and excavations were observed to the south of the truck operations centre and photos were taken by …When questioned about the excavation … stated that it was an existing depression, but that he had removed approximately 1m of shingle for on site work. It is his intention to fill the depression/evacuation with hardfill, asphalt etc.…"*

DP050350W – Discharge of Stormwater to Land and Water – Jara Family Trust (property of John Roil). From the Officer's Report:

- Assumed soakage rate of 50mm/hour for clean stormwater to be discharged to soakage in underground trenches.
- *"…details contained in the HBRC groundwater database of bore 3044 (100 - 150m south of the land application area) indicate that the groundwater resource is flowing confined and that the potable water drawn from this aquifer is located at a depth of 33.2m. The bore log of well 3044*

also indicates that a 6.7m thick layer of blue clay is located at a depth of 6.1m below ground level and that there are five additional layers of clay between the surface and the water yielding gravels…"

Design report by Oasis Clearwater for a domestic effluent disposal system (letter to Jara family Trust (property of John Roil) – 14 September 2005):

- *Soil type is Category 1 consisting of a Topsoil layer varying in depth up to 600mm deep with river bed gravels interspersed with loamy type soils consistent with old riverbed flow paths. A design loading rate of 35mm/day has been selected…"*

Report by Beca on Proposed Stock Sales Yards and Subdivision – Maraekakaho Road, Hastings; 23 August 2005 (this is for Lot 3, DP 372375 – property owned by John Roil):

- *"Treated effluent will be disposed of on land in the existing recently planted forest block on the opposite side of the Irongate Stream…The soils are generally a deep sand / shingle layer overlain by a sandy topsoil layer of between 100 and 200 mm in depth. Investigation has shown that the water table is > 2.0m below ground level…"*

Stormwater System Design – Consent DP070601L.

- The swale drain design shows the swale 500mm below existing ground level.

2.6 LiDAR Imagery

LiDAR (Light Detection and Ranging) images are given in Appendix G. For reference purposes the alignment of Sections A-A', B-B' and C-C' and the locations of the soakage tests are shown on the LiDAR images.

The images show clearly the location of the Irongate Stream as well as old stream meanders across the Plain. Comparing the topographic information with the soil map shows a good correlation between the Irongate soils (type 21) and the location of the existing stream and old stream meanders. The location of the Pakowhai soils (type 17) in the north-western corner of the area proposed to be rezoned also correlates well with the increase in elevation in that part of the site.

3 Site Walkover

3.1 Site Features

A site walkover of the proposed industrial area was undertaken on the 16th October 2008. During the course of the site walkover the opportunity was taken to meet with and talk to a number of the property owners. Five soakage tests were also carried out to determine the potential for disposal of stormwater to ground.

Photographic Plates 1 – 12 attached in Appendix H show the site features and topography. The locations of the various photographs are shown in the *Aerial Photograph*, also attached in Appendix H.

The area proposed to be rezoned is practically flat with minor undulations associated with old stream beds. The Irongate Stream and the Sisson Drain are the most significant drainage features.

As is seen in the *Aerial Photograph* much of the area is taken up with agricultural activities (grazing, orcharding and some cropping) and there are also a number of industries at the southern end of Irongate Road (fire wood, cottage construction, warehousing) and along Maraekakaho Road (stock transport, fertiliser warehouse, salvage yard, timber yards, building materials sales, vegetable processing).

To the south of the proposed new industrial area there is a quarry (Fulton Hogan Gun Club Quarry) where shingle extraction is occurring. This is seen in *Photographic Plate 10*. Concurrently, the excavations are being filled largely with builders' rubble as well as minor amounts of other material that would not be classed as being cleanfill (greenwaste, old furniture, cardboard).

Within the areas used for stock the yellowing of grass in areas provides valuable clues regarding the underlying soils. *Photographic Plate 4* shows extensive areas where grass die-off is already occurring. The underlying soils are stony gravels associated with the old stream bed.

3.2 Anecdotal information

The following is a summary of the information provided by land owners in discussions during the course of the site walkover.

Tony and Jo Rasmussen – owners of Pt Lots 1 and 2, DP 2589 and Lot 9, DP 2975.

- The soils are very free draining – in summer the grass tends to "burn off" and they are poor for cropping.
- The soils are stony through the old creek bed (which runs parallel to Maraekakaho Road).

Peter Northe – owner of Lot 1, DP 12192.

- He has owned the property since 1993.
- The ground is mostly free draining. It does get a bit wet in winter but it does not last long.
- If the irrigator is not moved for a week then the soils in the irrigation area become soggy.
- Large parts of the property were used for shingle extraction. Areas have been filled up with rubble and bark/sawdust.
- Bricks and other rubble were encountered in constructing the shed foundations but there have been no problems with settlement.
- Stormwater from the buildings on site is soaked to ground with no problems of ponding on the surface.
- A 10m deep bore located at the north-eastern boundary of the property flows under artesian conditions.

John Roil – owner of a number of properties within the south-eastern boundary of the area proposed to be rezoned.

- John recently constructed an oxidation pond for effluent that will come from a truck wash, still to be constructed on his property.
- He has obtained resource consent for stock yards to be constructed on Lot 3, DP 372375.
- John confirmed that large areas of his property have been used for shingle extraction. A portion of Lot 1, DP 372375 (outside of the proposed new industrial area but adjacent to it) has been identified on the Certificate of Title as having been filled (see area "M" on the Certificate of Title attached in Appendix I).
- As far as he is aware, no geotechnical issues were identified with the construction of the large fertiliser storage facility on Lot 2, DP 372375, though a separate geotechnical investigation was carried out for it.
- Stormwater soaks freely into the ground on his property. He showed me a recently constructed artesian bore (depth of 38m) that has been allowed to run for four days to purge the bore. The ground is not water-logged.
- Close by a cable trench has recently been dug – the trench spoil consists predominantly of stony gravel (medium to coarse greywacke gravel - see *Photographic Plate 18*).
- John estimates the groundwater to be between 2.5m and 3m below the ground level.

3.3 Soakage Tests

Five soakage tests were carried out within the area proposed to be rezoned. The approximate location of the tests is shown on the *Aerial Photograph* as well as one of the LIDAR images. Test locations were chosen to provide coverage of the various soil types encountered in the area.

Tests were carried out in accordance with *Verification Test Method E1/VM1* described in *Section 9.02* of the *New Zealand Building Code*.

Soakage holes were excavated by hand with a 100mm diameter auger to depths between 1.2m and 1.3m, except for Test Hole # 4 which contained very coarse gravel that prevented excavation beyond 0.7m. The groundwater table was not reached in any of the test holes.

The soils excavated from the test holes were logged in accordance with New Zealand Geotechnical Society Guidelines (December 2005). *Photographic Plates 13* to *17* show the various soil types encountered and provide a description of the soils.

Soakage of the test holes prior to carrying out soakage measurements proved futile (for all holes except for Test Hole # 5) on account of the free-draining sands and gravels encountered at depth. Test results are attached in Appendix J. Table 3 below summarises the soakage test results.

Table 3: Summary of Soil Soakage Tests

Soakage Test No.	Location	Property Owner	General Description of Predominant Soil Type	Results (mm/hour)
1	8 Irongate Rd.; Lot 1, DP12192	P Northe	Sandy fine to coarse GRAVEL	600 - very rapid
2	1195 Maraekakaho Rd.; Pt Lots 1 & 2, DP 2589	JN Campbell & PJ Rasmussen	Fine SAND with occasional medium gravel	1,800 – very rapid
3	1195 Maraekakaho Rd.; Pt Lots 1 & 2, DP 2589	JN Campbell & PJ Rasmussen	Gravely (fine to v. coarse) fine SAND	1,050 – very rapid
4	58 Irongate Rd.; Lot 2, DP 3067	GR & AM Sudfelt	Gravely (fine to coarse) fine to medium SAND	600 – very rapid
5	70 Irongate Rd.; Lot 5, DP 2975	TG Heard	SILT	240 - rapid

Drainage proved to be very rapid in all the test holes which contained sand/gravel. Soakage Test # 5 was distinctly slower, as would be expected since the soils consisted of silt, yet the result is still classed as *"rapid"*.

It should be noted that the topsoil in all cases consisted of a silty material. In all likelihood the soakage rate of water <u>into</u> the topsoil (infiltration) will be significantly less than the movement of water <u>through</u> the soil layers below the topsoil (permeability). In fact, this was verified on site for Test Hole # 4. Water was poured into that hole when it was only 100mm deep to try to bind up the very dry soil fines so that they could be removed with the hand auger. The water level drained extremely slowly initially and only drained away when the gravely sand was encountered lower down the test hole.

4 Summary of Desk Top Study and Site Investigations

The following summarises the findings of the desk-top study and site investigations:

- The proposed new industrial area is underlain by extensive alluvial sediments consisting predominantly of greywacke-derived gravels, sands and silts, with minor amounts of ash, pumice and limestone.
- Borehole logs provide a generic description of the underlying sediments but indications are that there are layers of clayey material of varying thickness (in places up to almost 30m) across most of the proposed new industrial area. Some borelogs describe deposits of peat, vegetation and wood mixed in with the clayey soils.
- The near-surface soils generally drain rapidly to very rapidly though infiltration may be slow to moderate if the topsoil has high silt content.
- Only the Pakowhai soils which constitute about 8% of the area appear to be less than free-draining.
- Current stormwater disposal practices are to ground soakage.
- Soil quality is generally poor due to moisture deficiencies, except for the Pakowhai soils.
- Many bores extend through to the unconfined aquifer and experience artesian conditions. The groundwater level usually lies approximately 2.5m to 3m below the surface.
- The Hawke's Bay region as a whole is considered one of the most seismically active regions in New Zealand. The proposed new industrial area is approximately 7.5km from the closest active fault (Poukawa Fault Zone). Other faults that need to be considered for design purposes include the Wairarapa, Wellington and Mohaka Faults.
- A comprehensive report by GNS shows that the 1931 Hawke's Bay earthquake caused a broad NE-trending pattern of warping across the plains with an axis about the line of zero uplift extending approximately between Bridge Pa and Awatoto. It is considered that the 1931 earthquake on the "Napier" Fault was probably a Recurrence Interval (RI) Class IV event and the resultant broad warp probably does not pose a life safety risk (from rupture) and accordingly should not require zonation.
- This report indicates that buildings having building importance categories 1, 2a and 2b (i.e. the type of buildings likely to be constructed within the area proposed to be rezoned) can be permitted for similar Class IV event faults where the fault complexity is uncertain or constrained.
- The proposed new industrial area is regarded as having a *"moderate"* susceptibility to liquefaction and a relative earthquake amplification rating of 3 on account of the underlying alluvial sand, silt and gravel. The proposed new industrial area does not have a higher risk or susceptibility to liquefaction or ground shaking when compared to most of the areas around Hastings.
- Past activities have included shingle extraction, particularly within the vicinity of the Irongate Stream. South of the area proposed to be rezoned such activities are ongoing. Backfilling of holes has been done with rubble and (anecdotally) sawdust and bark. Confirmation of ground conditions is required to ensure that founding conditions are adequate.

5 Engineering Considerations

5.1 Introduction

The proposed new industrial area is to cater for larger scale dry industries. The final layout and extent of the plan change area will be confirmed as the statutory process proceeds. Presently, there are not any specific details of the type of industrial buildings that will be constructed within the proposed new industrial area. However, it is expected that they will likely be buildings having building importance categories of 1, 2a and 2b. The proposed new industrial area will be provided with reticulated wastewater and water supply services. The stormwater management regime to be adopted for the proposed new industrial area is a combination of reticulation via swales and attenuation with discharge to the Sisson drain, stormwater runoff from roof areas to ground soakage within individual sites and onsite treatment and soakage to ground or direct discharge to the Irongate Stream.

It has been assumed for the purposes of this report that the potential for impacts from flooding on the proposed new industrial area will be assessed separately as part of the stormwater assessments.

The geotechnical assessment carried out to date is of a preliminary nature. No tests has been carried out that would enable accurate assessments of potential soil settlements or bearing capacities to be done. At this stage broad assumptions may be made based on the information at hand.

The important geotechnical engineering aspects to be considered in carrying out future industrial development are as follows:

- Site class for seismicity
- Site liquefaction potential
- Site drainage
- Potential settlement of building sites
- Foundation options for buildings.

5.2 Site Class for Seismicity

The site is underlain by alluvial deposits to a considerable depth below the surface.

In considering earthquake ground shaking amplification on a scale from 1 to 4 (*"least likely"* to *"greatest"*), the area proposed to be rezoned is considered to have a shaking response of 3 which relates to the amplification response from alluvial sand, silt and gravel (see *Appendix 12.3-2* of the Hastings District Plan). This is same as the area around Hastings City.

It is likely that the area will be categorised as *Class D – Deep* or *Soft Soil* site in terms of *clause 3.1.3.5* of *NZS 1170.5: 2004 Structural Design Actions Part 5: Earthquake Actions – New Zealand.* However, standard penetration tests should be carried out as part of detailed investigations for developments to confirm this.

Both the Mohaka and Wellington Faults are classed as major faults requiring near-fault factors > 1.0 in terms of the above standard.

5.3 Site Liquefaction Potential

Appendix 12.3-1 of the District Plan indicates that the proposed subdivision area has "*moderate"* liquefaction susceptibility. Physical effects are projected to encompass: *"…Sand boils and moderate fissuring (more extensive near basin edges and in waterlogged areas), river banks broken up and embankments slumped; settlements of up to 0.2m…"* It is estimated that between 10% and 20% of the area may be affected.

The following factors are generally considered to trigger liquefaction in any site:

- Strong ground motion; and
- Saturated or submerged loose, coarse grained soils (sands / gravels).

It appears that the groundwater table is approximately at the same depth across the area proposed to be rezoned (between 2m and 3m below ground level). There are extensive layers of saturated, coarse grained soils underlying the site though bore logs indicate that the nature and depth of the materials varies considerably across the site.

If settlement is considered an issue for particular industrial activities then it is recommended that more extensive investigations be carried out on a site-specific basis to more accurately determine the possible extent of settlement. Mitigation measures may be designed that would allow for even settlement or could densify soils to limit potential settlement.

5.4 Site Drainage

Anecdotal information intimates that the soils are well drained and indications are that the existing developments get rid of stormwater by ground soakage. A recent resource consent decision indicates that a soakage rate of 50mm/hour was adopted for the design of a stormwater trench soakage system on the property of John Roil. A value of 35mm/day was used for the disposal of primary-treated effluent on site. This is the maximum loading rate permitted by standard *AS/NZS 1547: 2000 On-site domestic-wastewater management*. On-site soil soakage tests have confirmed that subsurface soils (below 0.5m deep) are rapidly to very rapidly drained. It does appear, however, that the surface soils, especially where they have high silt content, have a moderate to poor infiltration rate.

The issue of stormwater disposal is being addressed separately but it appears that soakage to ground is likely to be a viable option. The following aspects, however, will require consideration:

- The groundwater table appears to be between 2m and 3m below the existing ground level. Most of the area is served by a confined aquifer as shown in *Schedule Va – Heretaunga Plains Unconfined Aquifer* of the Regional Resource Management Plan. Where groundwater soakage is proposed on site it will need to be sufficiently remote from buildings to not induce settlement of foundations.
- It is reported that there are areas within the area proposed to be rezoned (particularly in close vicinity to the Irongate Stream) that were used for shingle extraction and which have subsequently been backfilled with a variety of materials including cleanfill and possibly bark and sawdust. Such areas are unlikely to be suitable for on-site disposal of stormwater and they will need to be identified through a more detailed study of aerial photographs and further ground investigations.

5.5 Potential Settlement of Building Sites

Borehole logs indicate that the near surface soils consist mostly of silts, sands and gravels to a minimum depth of approximately 4.5m. In some places the depth of gravels extends to over 30m. However, many of the boreholes record layers of clayey material, including peat, vegetation and wood. Such layers vary in thickness but in some borehole logs they are shown to be over 30m in depth. The load from the proposed industrial buildings could cause some settlement in the clay layers.

As noted in section 5.4, there are areas within the area proposed to be rezoned where excavations (for shingle) have been backfilled with a variety of materials. Settlement of such areas is a distinct possibility, particularly if the backfilled material was not well compacted and/or contained organic material.

It is not possible to assess the magnitude of the settlement at this stage since it depends on a number of factors such as the type of the proposed buildings and loads, and the thickness of the clay layers (or backfilled layers). Therefore the actual settlement and bearing capacity assessment should be carried out at the design stage of the proposed buildings. This will require borings to obtain quantitative information such as standard penetration tests (SPTs).

5.6 Foundation Options for Buildings

The types of foundations will depend on the types of building structures and loads. Without quantitative information, such as SPT data, it is not possible to provide parameters for the design of foundations. However, there is some anecdotal evidence to suggest that at least some of the existing industrial type buildings (Balance Agri-Nutrients and large portal frame structures on Peter Northe's property) are founded on reasonably shallow footings, i.e. they have not required piled foundations. There has been no suggestion that the soils are poor from a founding perspective.

5.7 Cost Considerations

It is apparent that shingle extraction and backfilling of excavated holes with diverse materials has occurred in some areas, particularly alongside the Irongate Stream where deposits of coarse gravels are found. These areas also tend to be close to or within properties that are being used for industrial purposes.

A possible limitation to development may be the extent of clayey deposits that have been described in the borehole logs and which appear to occur at depth over most of the proposed new industrial area. It would appear that the clayey layer has not limited development to date but it is considered that site specific geotechnical investigations which include borings be carried out for large industrial buildings to determine the strength parameters and nature of the underlying sediments so that the potential for settlement and liquefaction may be quantified and the soil bearing capacity verified. It is considered that such investigations would be considered a normal part of the investigation and design process for any large industrial building (i.e. would form part of the building consent process) and are not unique to the area proposed to be rezoned. The availability of information on the underlying soils has simply highlighted an aspect that should not be ignored.

The cost to carry out a detailed geotechnical site investigation clearly depends on the scope of the investigation, for example, the number of borings and soil laboratory tests undertaken. The following example[13] illustrates the level of cost and how increasing the site investigation costs reduces the construction risks: *"…Note that with the traditional levels of expenditure on ground investigation (typically less than 1%), 13 cost overruns on highway projects were found to be as much as 100%, while expenditure on site investigation of 6% of construction cost appeared to be necessary to guarantee an overspend of less than 10%..."* For a $200,000 development costs of about $12,000 would appear merited for ground investigations.

[13] Simons N., Menzies B. & Matthews M.; *A Short Course in Geotechnical Site Investigation*; Thomas Telford, 2002.

6 Conclusions

The information derived from this assessment has not highlighted any geotechnical constraints that would render the rezoning of the land or any part of the land for industrial purposes inappropriate. The one possible exception has been noted in Section 5.5 above, which is that the effect of clayey material, including peat, vegetation and wood on building settlement is unknown and should be investigated at the design stage for each building, the extent of investigation being commensurate with the size of the proposed development. It is expected that such requirements would be addressed by developers at the building design stage and managed through any subsequent building consent process.

Indeed, the proposed location appears to be one of the more suitable areas within the vicinity of Hastings City. The area to the north-east of Hastings City has a *"high"* liquefaction susceptibility compared to the Irongate area's *"moderate"* susceptibility.

Areas close to the northern extension of the Tukutuki Thrust Fault Zone are classed as having a Recurrence Interval Class III whereas the lack of clear rupture traces across the Heretaunga Plains (there is a broad warp discernible between Bridge Pa and Awatoto) indicates that zonation is not justified in this area. Conservatively, a Recurrence Interval Class IV could be applied. This would permit all existing and new buildings with importance category 1, 2a and 2b. The only new buildings having a building importance of 3 likely to establish in a industrial area would be either service stations or large chemical storage facilities. It is understood that these types of buildings are controlled through other legislation (HAZNO requirements) and the district wide provisions contained in the hazardous substances section of the District Plan. Typically it is expected that existing and proposed buildings within the proposed industrial subdivision will all fall within categories 1, 2a or 2b.

The Irongate area is characterised by near surface soils (below 0.5m) which drain rapidly to very rapidly. Ground soakage is currently used for disposing of stormwater on the existing industrial properties with no apparent negative effects to building foundations. The in-situ soakage tests confirmed that the soils below topsoil level are generally extremely well drained.

7 Limitations

This report has been prepared for Hastings District Council in accordance with the generally accepted practices and standards in use at the time it was prepared. MWH accepts no liability to any third party who relies on this report.

The information contained in this report is to the best of our knowledge accurate at the time of issue. MWH has made no independent verification of this information beyond the agreed scope set out in the report.

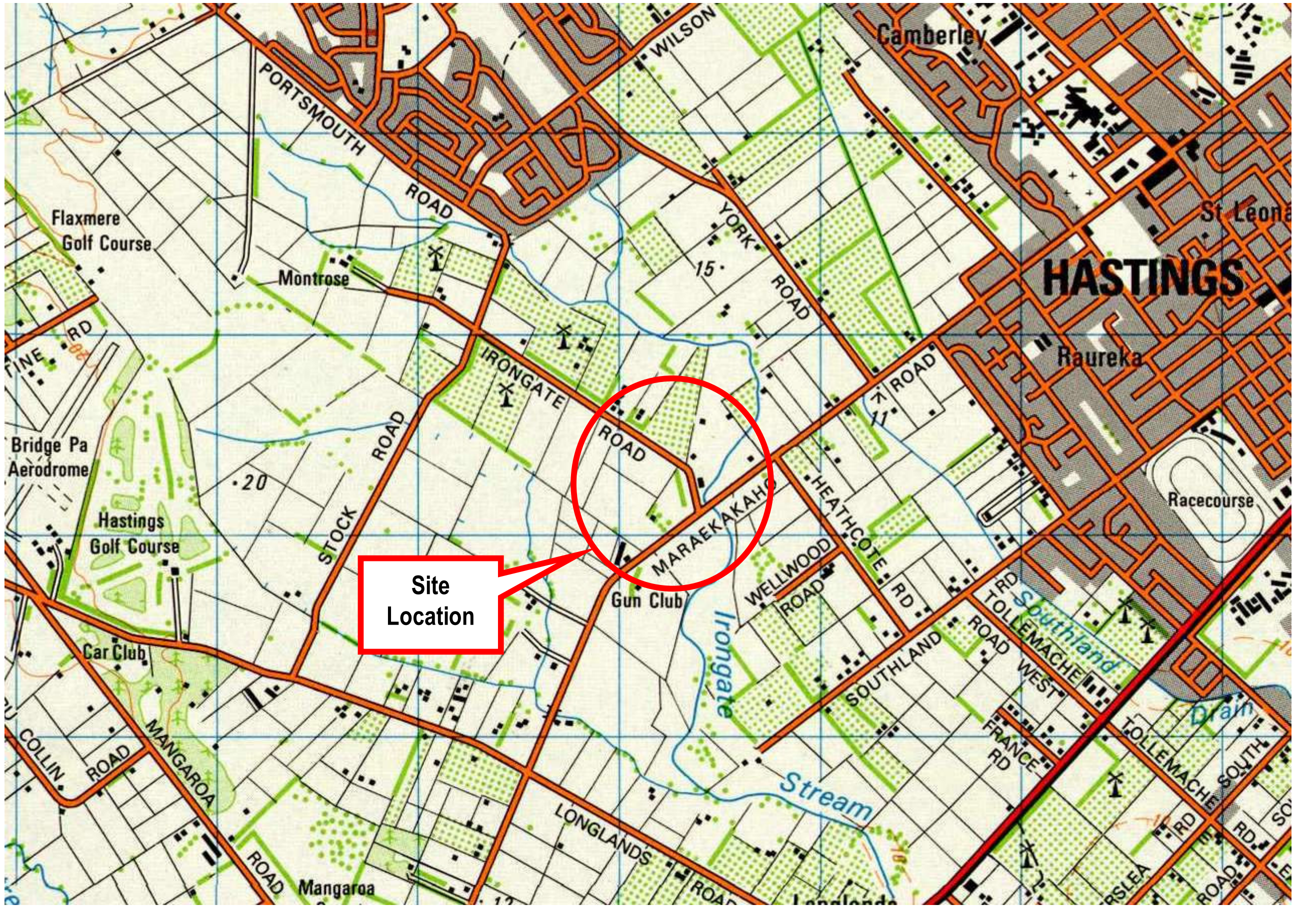
The interpretations as to likely subsurface conditions contained in this report are based on the site observations and field investigations at discrete locations as described in this report. The type, spacing and frequency of the investigations and sampling were selected to meet the technical, financial and time requirements agreed by the client and no further investigations have been undertaken. MWH accepts no liability for unknown adverse ground conditions that would have been identified had further testing been undertaken.

Actual ground conditions encountered may vary from the predicted subsurface conditions. For example, subsurface groundwater conditions often change seasonally and over time. No warranty is expressed or implied that the actual conditions encountered will conform exactly to the conditions described herein.

Where conditions encountered at the site differ from those inferred in this report MWH NZ Ltd must be notified of such changes and provided an opportunity to review the report recommendations in light of this further information. MWH accepts no liability for damage or loss incurred where the Client does not comply with this requirement.

This report does not purport to describe all the site characteristics and properties. Subsurface conditions and testing relevant to construction works must be undertaken and assessed by contractors as necessary for their own purposes.

Appendix A: Location Plan



SCALES : Each blue square is 1 km x 1 km			Hastings District Council Irongate Industrial Plan Change Preliminary Geotechnical Assessment Report	MWH	Status: Final		
	INIT	DATE			Date: October 2008		
DESIGNED	N/A	N/A					
DRAWN	N/A	N/A					
CHECKED	GM	10/2008	Location Plan (source: MapToaster 260p-V21)		Job No. Z1462302	Sheet No. 01	Rev. A
APPROVED	PSL	10/2008					

Appendix B: Extracts from *"Hazards in Hawke's Bay"*

Table 2. Historical earthquakes with magnitude > 6 and felt MM intensities of 7 or greater in Hawke's Bay.

Date	Magnitude	MM Intensity in Hawke's Bay	Distance from Napier (km)
8 Jul 1843	7.5?	7-8?	?
16 Oct 1848	7.5	5-6	>200
23 Jan 1855	8.0-8.2	6-8	>200
23 Feb 1863	7.5	8-9	70
11 Oct 1892	6.0-6.3	7	120
4 Dec 1898	6-6.2	7	90
1 Aug 1903	6.0	7	20
9 Aug 1904	7-7.2	6-8	120
22 Nov 1914	>7.0	6-7	225
28 Jun 1921	7.0	7	60
7 May 1929	6.0	5-7	140
12 Feb 1930	6.2	6-8	120
2 Feb 1931	7.8	7-9	30
8 Feb 1931	6.3	6-7	50
13 Feb 1931	7.3	6-7	40
16 Sep 1932	6.9	5-10	80
5 Mar 1934	7.4	5-7	170
10 Mar 1934	6.0	7	120
31 Jan 1958	6.1	4-7	80
13 May 1990	6.2	5-8	110

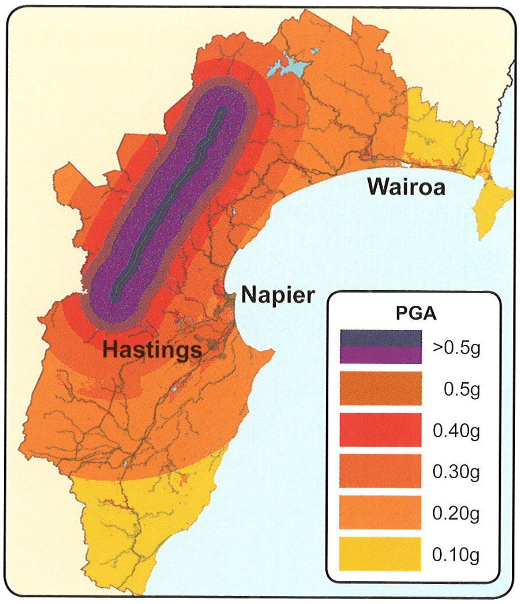
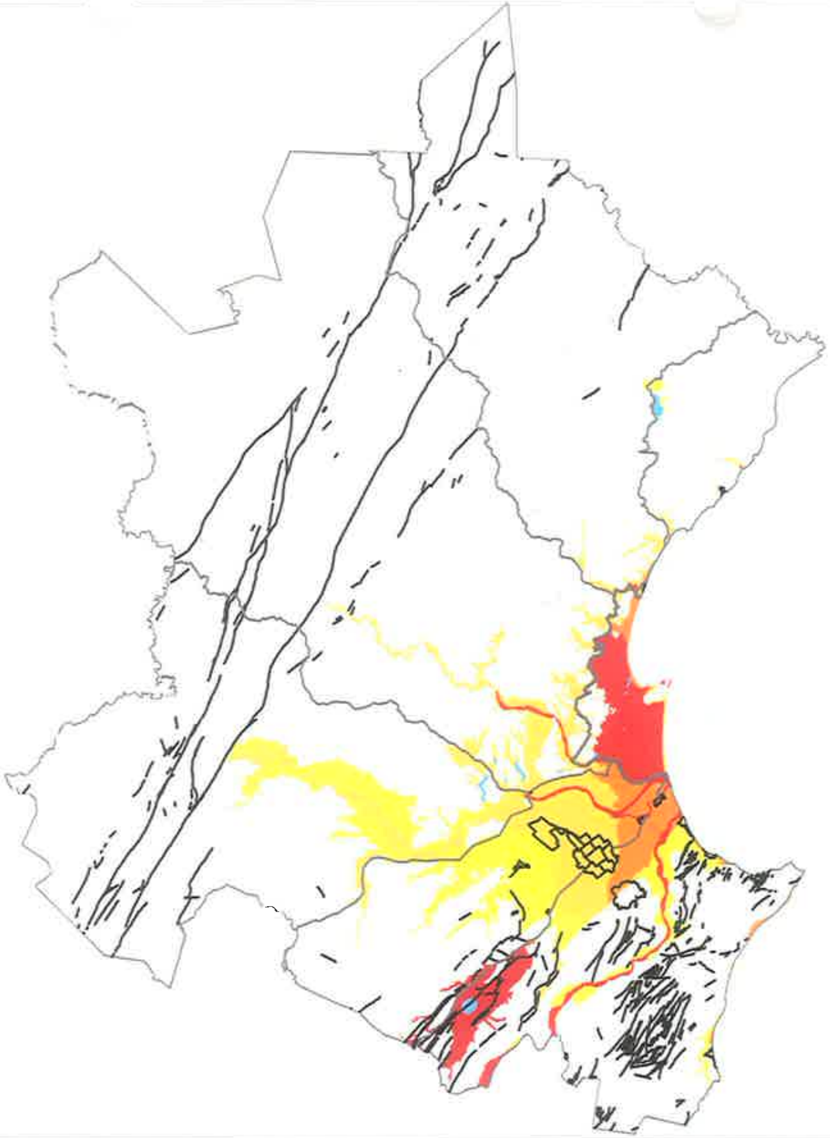


Fig 6. *Map of ground shaking intensities in the event of an earthquake on the Mohaka Fault, one of the larger faults in the Hawke's Bay region. Ruptures on other faults could produce similar patterns of shaking. Shaking is shown in terms of peak ground acceleration (PGA), shown as a fraction of g, gravitational acceleration.*

Appendix C: Extracts from Hastings District Plan



Liquefaction Susceptibility

Legend

RELATIVE LIQUEFACTION SUSCEPTIBILITY

- Very Low / Negligible
- Low
- Moderate
- High
- Very High
- Active Faultlines
- Main Roads

The presence of a hazard zone on the map does not guarantee the existence of such a hazard, nor does the lack of a hazard on the map preclude the existence of a hazard. Site-specific investigations should be conducted to determine actual soil properties and ground shaking amplification potential. The information will be used by the user at their own risk. The Institute of Geological and Nuclear Sciences Limited, while providing the information in good faith, accepts no responsibility for any loss, damage, injury, or loss in value of any person, property, service or otherwise resulting from earthquake hazards or knowledge of earthquake hazards in the Hawke's Bay Region.

Hastings District Council

Grid: New Zealand Map Grid
Height Datum: Mean Sea Level
Coordinates in Metres
Geodetic Datum 1949

Scale 1 : 770000

7.7 0 7.7 15.4 23.1 30.8

Kilometres

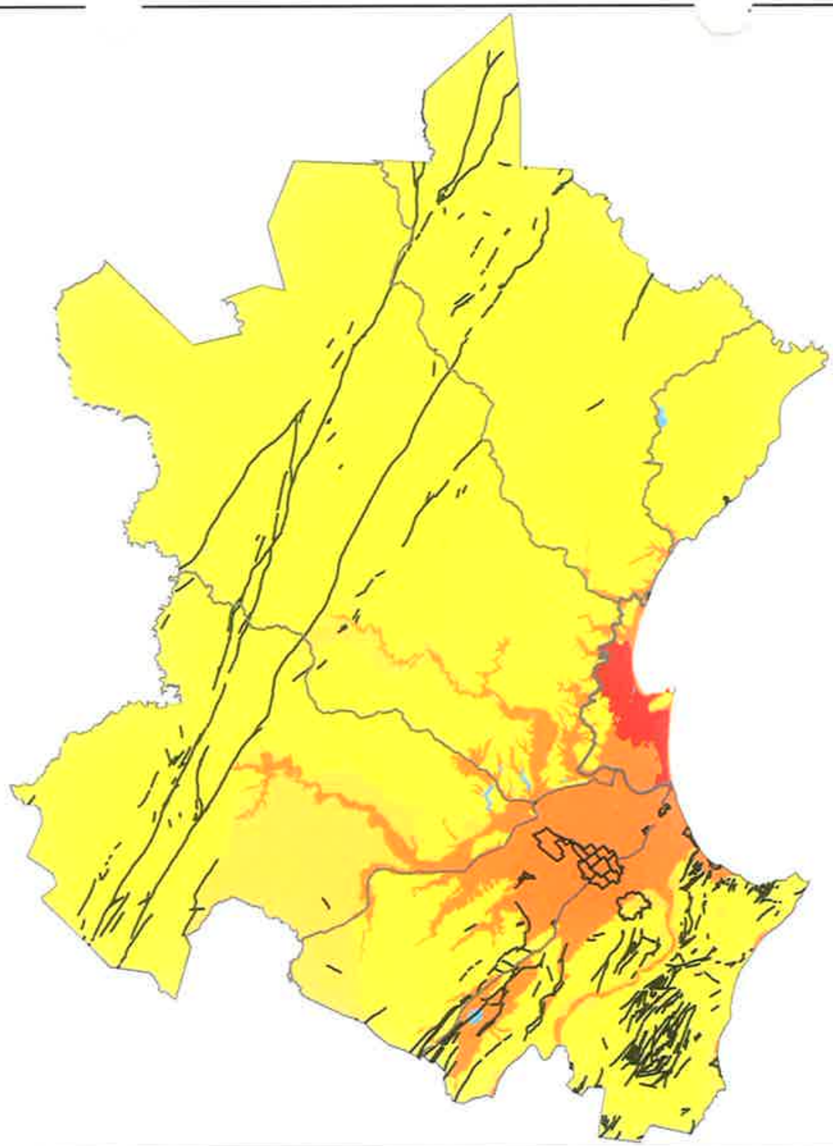
Date : June 2003

N

DATA SOURCE
Cadastral information derived from the Land Information New Zealand's Digital Cadastral Database (DCDB).

DISCLAIMER
The Hastings District Council cannot guarantee that the data shown on this map is 100% accurate.

Earthquake Ground Shaking Amplification



Legend

RELATIVE EARTHQUAKE AMPLIFICATION

4 Unconsolidated swamp, estuarine and lagoonal deposits and reclaimed land

3 Alluvial sand, silt and gravel

2 Compact alluvial sand, silt and gravel

1 Bedrock / Regolith

Active Faultlines

Main Roads

The presence of a hazard zone on the map does not guarantee the existence of such a hazard, nor does the lack of a hazard on the map preclude the existence of a hazard. Site-specific investigations should be conducted to determine actual soil properties and ground shaking amplification potential. The information will be used by the user at their own risk. The Institute of Geological and Nuclear Sciences Limited, while providing the information in good faith, accepts no responsibility for any loss, damage, injury, or loss in value of any person, property, service or otherwise resulting from earthquake hazards or knowledge of earthquake hazards in the Hawke's Bay Region.

Hastings District Council

Grid: New Zealand Map Grid
Height Datum: Mean Sea Level
Coordinates in Metres
Geodetic Datum 1949

Scale 1 : 770000

7.7 0 7.7 15.4 23.1 30.8

Kilometres

Date : June 2003

N

Appendix D: Extracts from GNS Fault Trace Report

Table 8. Examples, based on the MfE Active Fault Guidelines, of Resource Consent Category for both developed and/or already subdivided sites, and Greenfield sites along the Hawke's Bay Extensional Domain and northern Poukawa Fault Zone, accounting for various combinations of Building Importance Category, and Fault Complexity.

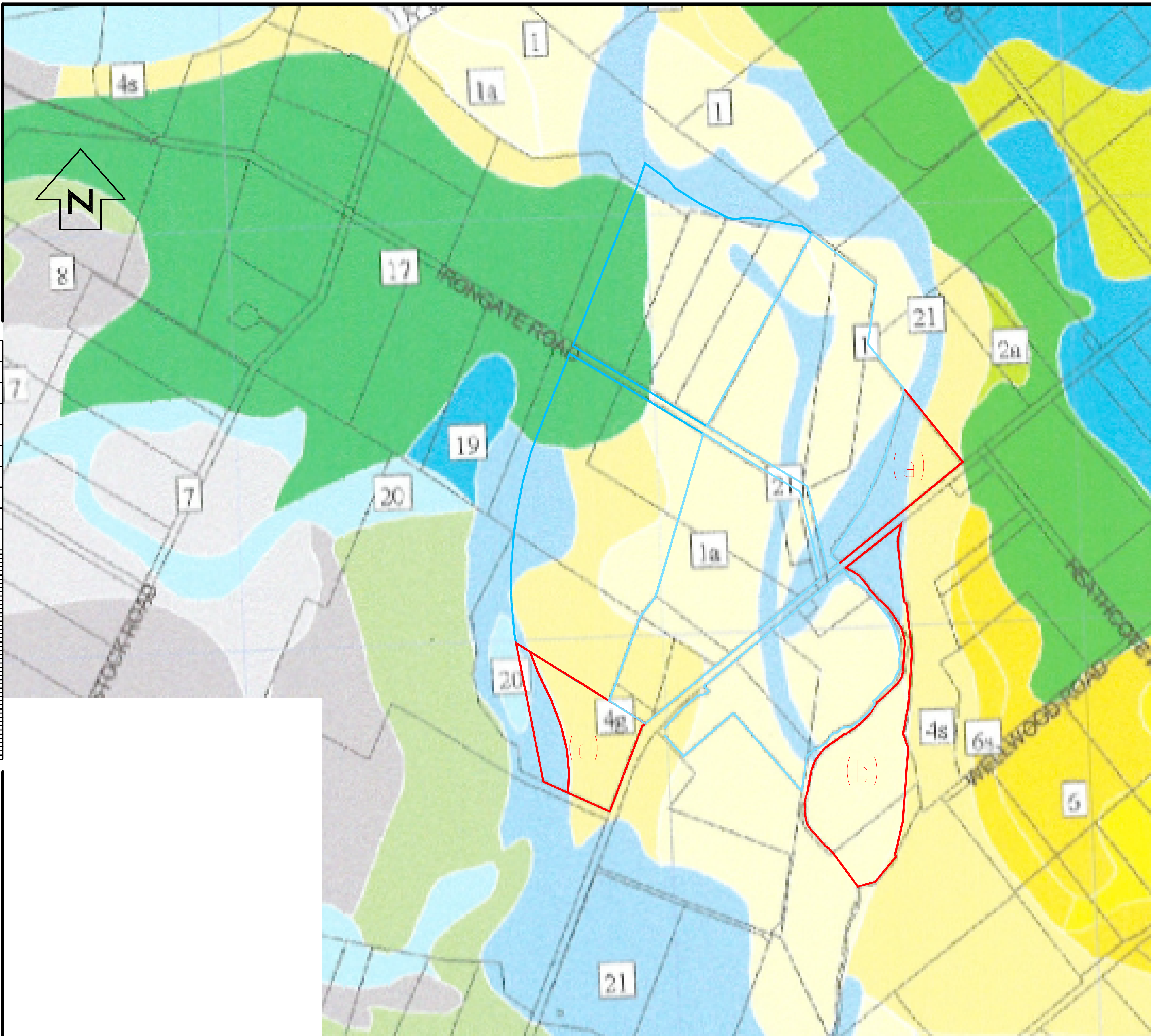
Hawke's Bay Extensional Domain & northern Poukawa Fault Zone (based on Fault Recurrence Interval Class IV, >5000 to ≤10,000 years)					
Developed and/or Already Subdivided Sites					
Building Importance Category	**1**	**2a**	**2b**	**3**	**4**
Fault Complexity	**Resource Consent Category**				
Well Defined	Permitted	Permitted*	Permitted*	Permitted*	Non-Complying
Distributed	Permitted	Permitted	Permitted	Permitted	Non-Complying
Uncertain - constrained	Permitted	Permitted	Permitted	Permitted	Non-Complying
Greenfield Sites					
Building Importance Category	**1**	**2a**	**2b**	**3**	**4**
Fault Complexity	**Resource Consent Category**				
Well Defined	Permitted	Permitted*	Permitted*	*Non-Complying*	Non-Complying
Distributed	Permitted	Permitted	Permitted	*Discretionary*	Non-Complying
Uncertain - constrained	Permitted	Permitted	Permitted	*Discretionary*	Non-Complying

Notes:
* Indicates that the Resource Consent Category is permitted, but could be Controlled or Discretionary given that the fault location is well defined.
Italics: The use of italics indicates that the Resource Consent Category – activity status of these categories is more flexible. For example, where *Discretionary* is indicated, *Controlled* may be considered more suitable by Council, or vice versa.

Table 4. Building Importance Categories and representative examples. For more detail see Kerr et al. (2003), and King et al. (2003).

Building Importance Category	Description	Examples
1	**Temporary structures** with low hazard to life and other property	• Structures with a floor area of <$30m^2$ • Farm buildings, fences • Towers in rural situations
2a	**Timber-framed** residential construction	• Timber framed single-story dwellings
2b	**Normal structures** and structures not in other categories	• Timber framed houses with area >300 m^2 • Houses outside the scope of NZS 3604 "Timber Framed Buildings" • Multi-occupancy residential, commercial, and industrial buildings accommodating <5000 people and <10,000 m^2 • Public assembly buildings, theatres and cinemas <1000 m^2 • Car parking buildings
3	**Important structures** that may contain people in crowds or contents of high value to the community or pose risks to people in crowds	• Emergency medical and other emergency facilities not designated as critical post disaster facilities • Airport terminals, principal railway stations, schools • Structures accommodating >5000 people • Public assembly buildings >1000 m^2 • Covered malls >10,000 m^2 • Museums and art galleries >1000 m^2 • Municipal buildings • Grandstands >10,000 people • Service stations • Chemical storage facilities >$500m^2$
4	**Critical structures** with special post disaster functions	• Major infrastructure facilities • Air traffic control installations • Designated civilian emergency centres, medical emergency facilities, emergency vehicle garages, fire and police stations

Appendix E: Soil Map



SOIL MAP EXTRACT FROM HAWKES BAY REGIONAL COUNCIL
PLAN NO. 2683 SHEET 4 OF 5

LEGEND

SOIL TYPE 1 & 1a OMAHU
AREA = 62 ha approx.

SOIL TYPE 4g & 4s OMARANUI
AREA = 21 ha approx.

SOIL TYPE 17 PAKOWHAI
AREA = 8.3 ha approx.

SOIL TYPE 21 IRONGATE
AREA = 19 ha approx.

STAGE 1

STAGE 2

AREAS SUBJECT TO
FURTHER CONSIDERATION

ORIGINAL SIZE A3 0 10 20 30 40 50 60 70 80 90 100 DO NOT SCALE - IF IN DOUBT, ASK

NOT FOR CONSTRUCTION

REV	REVISIONS	APP	DATE
A	FINAL REVISED - JUNE 2009	TG	06/09

SCALES (A3) Not to Scale

	NAME	DATE
DESIGNED		
DESIGN CHECK		
DRAWN	PAC	06/09
DRAWING CHECK		
APPROVED	TG	06/09

MWH

HASTINGS DISTRICT COUNCIL

HASTINGS DISTRICT COUNCIL
IRONGATE INDUSTRIAL PLAN CHANGE

SOIL MAP

Status Stamp **PRELIMINARY**

Date Stamp **16/06/2009**

Drawing No.	Sheet No.	Rev.
Z1462302	C03	A

 XRefs : cadastral, cadastLC

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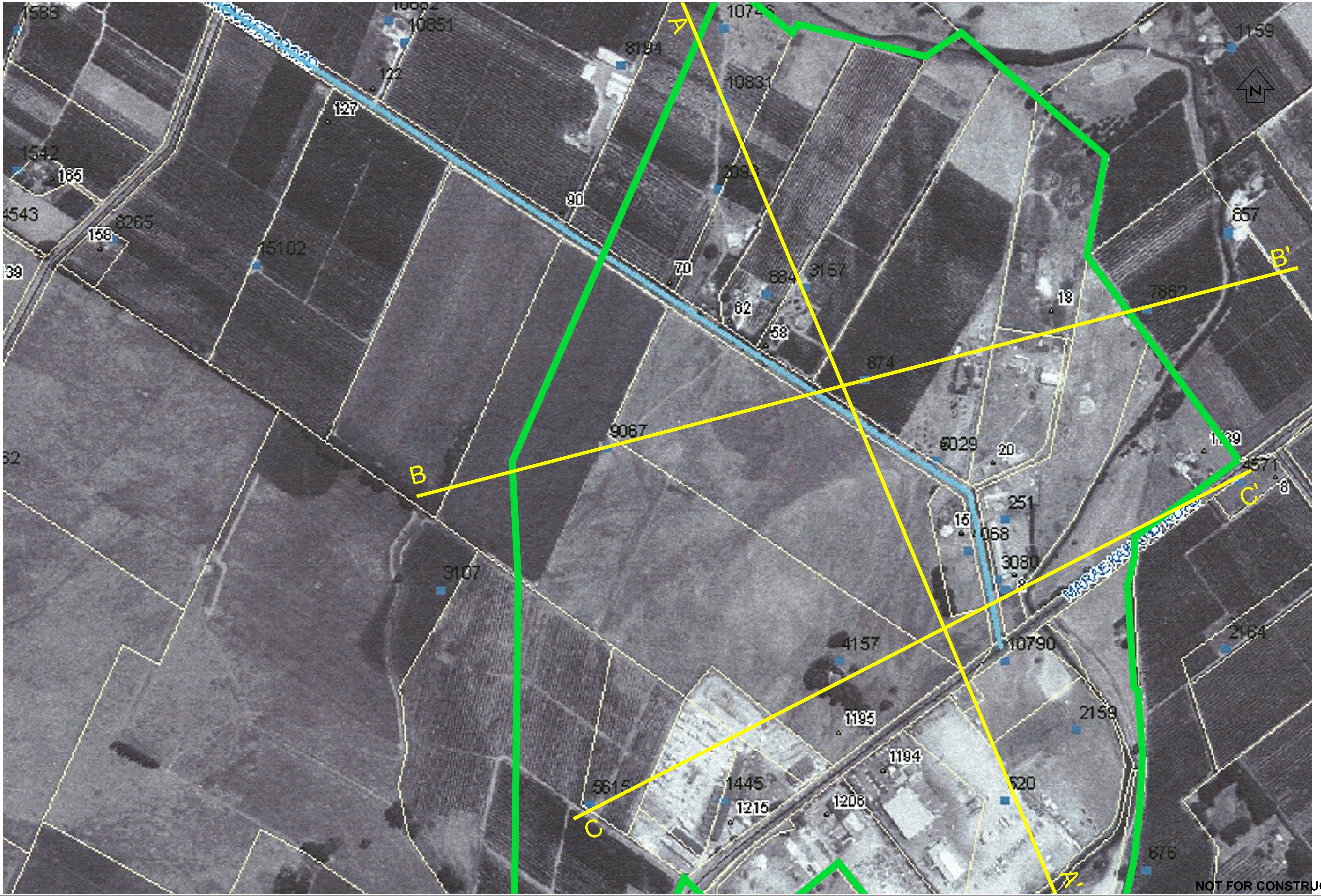
Appendix F: Borehole Information

BoreNo	Owner (at time of drilling)	Easting	Northing	Bore Depth	Static Water Level	Distance	Diameter	Drill Date	Top of Screen	Bottom of Screen
9067	CAMPBELL C W	2835835	6166402	40.8	5.5	163	100	2-Dec-68	40.8	0.0
3107	THELWELL G.A.	2835600	6166200	36.6	?	343	100	25-May-92	35.0	36.6
884	HEARD C J	2836061	6166622	40.5	0.8	353	100	15-Oct-79	40.5	0.0
2093	HEARD T.G.	2835992	6166773	41.7	0.0	369	100	17-Jul-86	41.7	43.7
3167	SOUTHFIELD ORCHARD (SUDFELT C R & A M)	2836116	6166631	40.8	0.1	408	150	27-Oct-92	39.0	40.8
8194	WILSON J	2835855	6166948	45.7	1.2	448	100	8-Feb-64	45.7	0.0
10831	BOYD & DUNLOP	2836000	6166900	9.8	1.5	470	100	7-Jun-66	8.3	9.8
874	WEBB W R	2836200	6166500	12.2	0.0	477	100	1-Nov-79	0.0	0.0
10746	ANDERSON	2836000	6167000	13.7	-1.1	554	?	28-Jan-59	0.0	0.0
4157	CAMPBELL C W & J N	2836164	6166099	38.0	?	610	80	29-May-98	35.4	36.7
5615	TUMU TIMBERS LTD	2835811	6165896	35.7	?	630	200	11-Jan-07	34.4	35.7
1445	TUMU TIMBERS	2836000	6165900	36.8	1.2	679	100	2-May-84	36.8	0.0
3080	REEVES TRANSPORT LTD	2836389	6166214	43.9	2.7	733	100	31-Mar-92	42.4	43.9
10790	H.B.ELECTRIC POWER PLANTS	2836400	6166100	21.6	0.0	797	50	4-Sep-62	0.0	0.0
7862	REEVES TRANSPORT LTD	2836600	6166600	32.9	4.3	881	50	8-Oct-62	32.9	0.0
520	HB TRANSPORT HOLDINGS LTD	2836400	6165900	39.3	3.7	918	100	14-Mar-75	39.3	0.0
2159	HB TRANSPORT HOLDINGS LTD	2836500	6166000	43.9	2.6	935	150	3-Nov-86	37.9	43.9
2164	RUSTWELL THIRTY SIX LTD	2836712	6166117	49.0	-3.0	1068	250	17-Dec-86	49.0	51.5
676	RICHMOND W LTD	2836600	6165800	33.8	0.0	1135	50	25-May-77	33.8	0.0



NOT FOR CONSTRUCTION

A	FOR INFORMATION	PRS	PSL	PSL	28/08/08
REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE

	Name	Date
SURVEYED		
DESIGNED		
DESIGN CHECK		
DRAWN	P SHARPE	08/08
DRAWING CHECK	P LANDMARK	08/08
APPROVED	P LANDMARK	28/08/08

MWH

HASTINGS DISTRICT COUNCIL

IRONGATE INDUSTRIAL PLAN CHANGE
PRELIMINARY GEOTECHINAL ASSESSMENT

PLAN OF EXISTING BORES

Status Stamp: FOR INFORMATION

Date Stamp: 28/10/2008

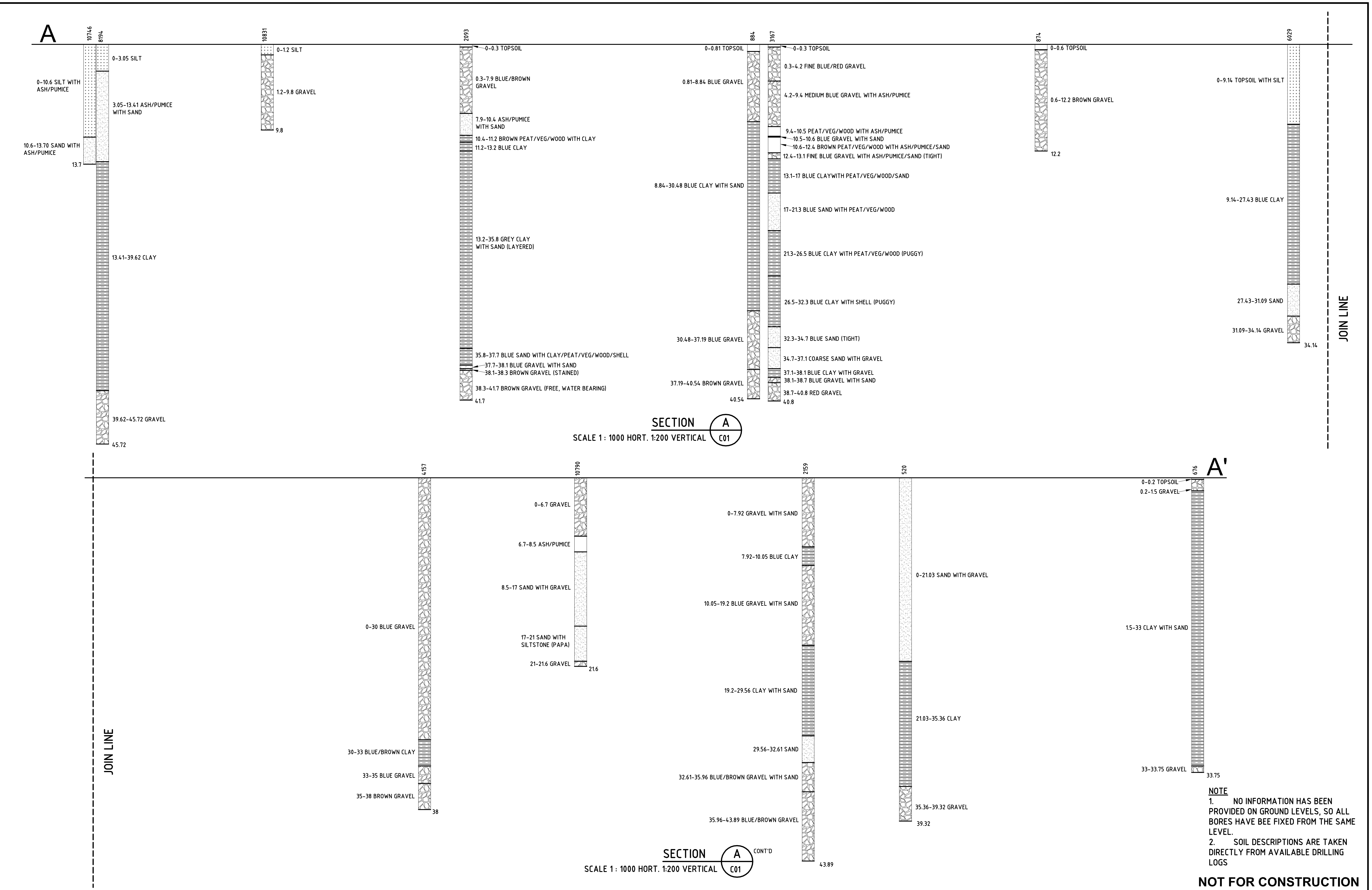
SCALES (A1) 1:2500

Drawing No.	Sheet No.	Rev.
Z1462302	C01	A

XREFS :

\\nzpmn1s01\projects\Z14500+\Z14623 Irongate Industrial Plan Change\Z1462302 Geotechnical Assessment\Z1462302 C01.dwg

ORIGINAL SIZE A1 — DO NOT SCALE - IF IN DOUBT, ASK



ORIGINAL SIZE A1 — DO NOT SCALE - IF IN DOUBT, ASK

NOTE
1. NO INFORMATION HAS BEEN PROVIDED ON GROUND LEVELS, SO ALL BORES HAVE BEE FIXED FROM THE SAME LEVEL.
2. SOIL DESCRIPTIONS ARE TAKEN DIRECTLY FROM AVAILABLE DRILLING LOGS

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR INFORMATION	PRS	PSL	PSL	28/08/08

	Name	Date
SURVEYED		
DESIGNED		
DESIGN CHECK		
DRAWN	P SHARPE	08/08
DRAWING CHECK	P LANDMARK	08/08
APPROVED	P LANDMARK	28/08/08

MWH

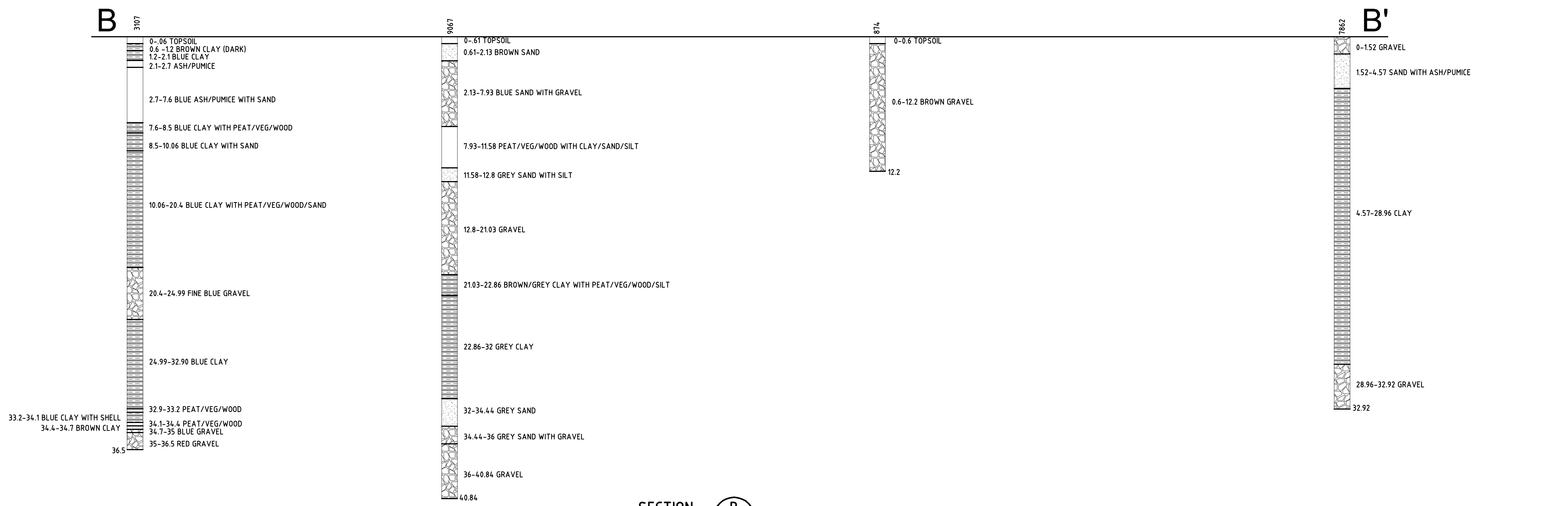
HASTINGS DISTRICT COUNCIL

IRONGATE INDUSTRIAL PLAN CHANGE
PRELIMINARY GEOTECHINAL ASSESSMENT

BORE LOG PROFILES - SECTIONS A-A'

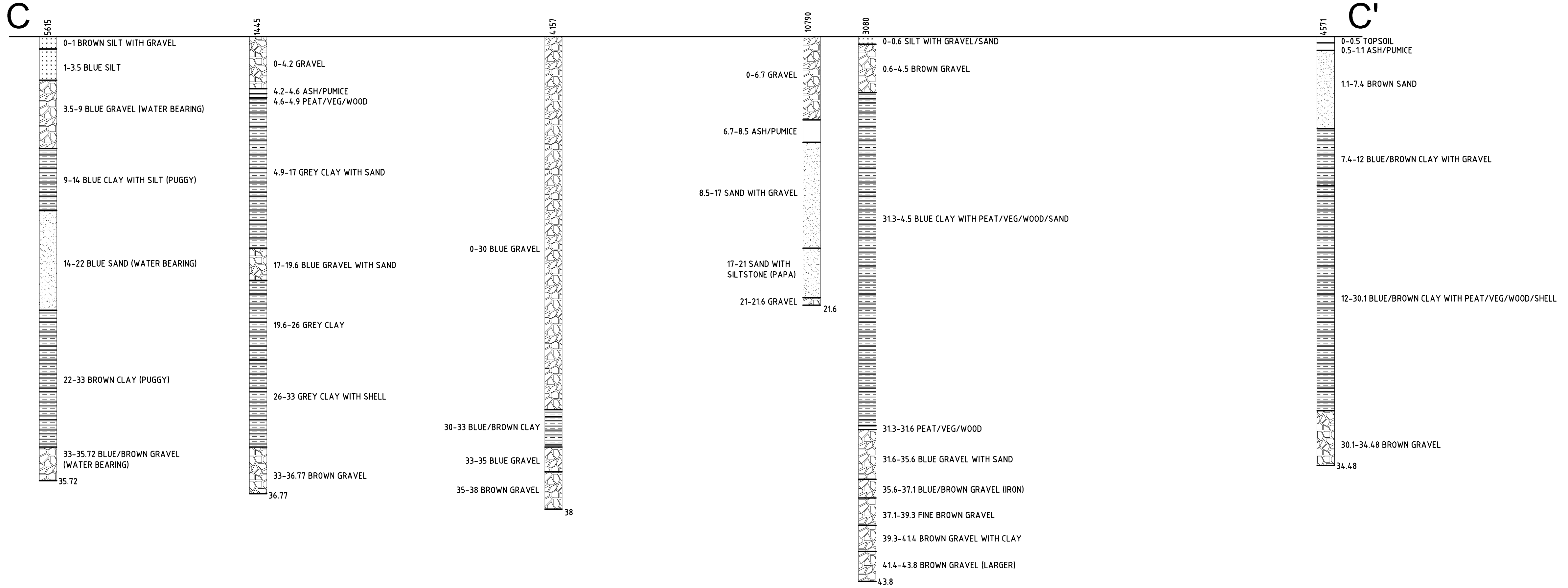
Status Stamp: **FOR INFORMATION**
Date Stamp: 28/10/2008
SCALES (A1) AS SHOWN
Drawing No. Z1462302 | Sheet No. C02 | Rev. A

XREFS :
\\nzpmn1s01\projects\Z14500+\Z14623 Irongate Industrial Plan Change\Z1462302 Geotechnical Assessment\CAD\Z1462302 C02.dwg



SECTION B / C01

SCALE 1 : 2000 HORT. 1:200 VERTICAL



SECTION C / C01

SCALE 1 : 2000 HORT. 1:200 VERTICAL

NOTE

1. NO INFORMATION HAS BEEN PROVIDED ON GROUND LEVELS, SO ALL BORES HAVE BEE FIXED FROM THE SAME LEVEL.

2. SOIL DESCRIPTIONS ARE TAKEN DIRECTLY FROM AVAILABLE DRILLING LOGS

ORIGINAL SIZE A1 — 0 10 20 30 40 50 60 70 80 90 100 150 200 mm — DO NOT SCALE - IF IN DOUBT, ASK

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR INFORMATION	PRS	PSL	PSL	28/08/08

	Name	Date
SURVEYED		
DESIGNED		
DESIGN CHECK		
DRAWN	P SHARPE	08/08
DRAWING CHECK	P LANDMARK	08/08
APPROVED	P LANDMARK	28/08/08

MWH

HASTINGS DISTRICT COUNCIL

IRONGATE INDUSTRIAL PLAN CHANGE
PRELIMINARY GEOTECHINAL ASSESSMENT

BORE LOG PROFILES - SECTIONS B-B' & C-C'

Status Stamp: **FOR INFORMATION**

Date Stamp: **28/10/2008**

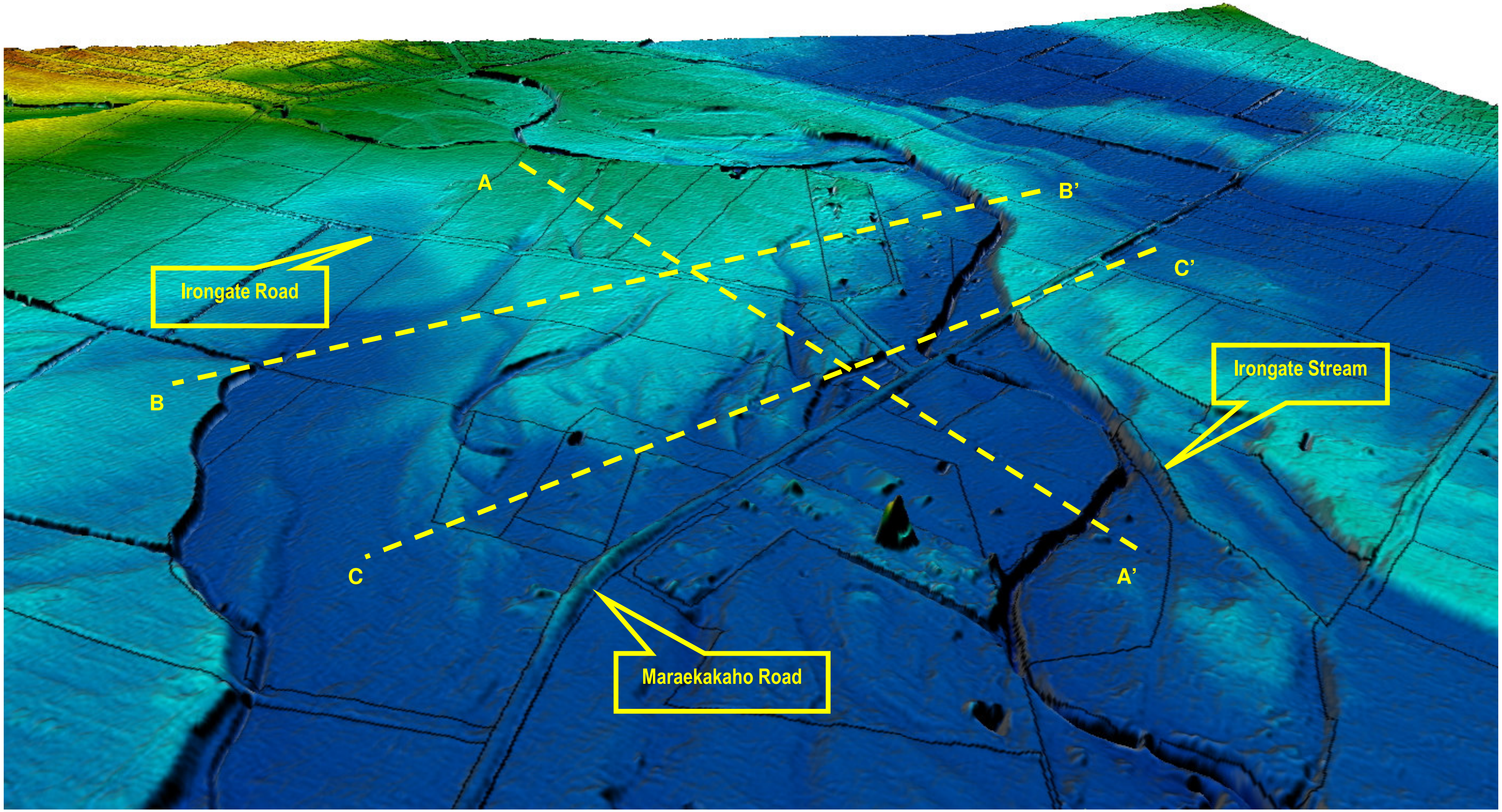
SCALES (A1) AS SHOWN

Drawing No.	Sheet No.	Rev.
Z1462302	C03	A

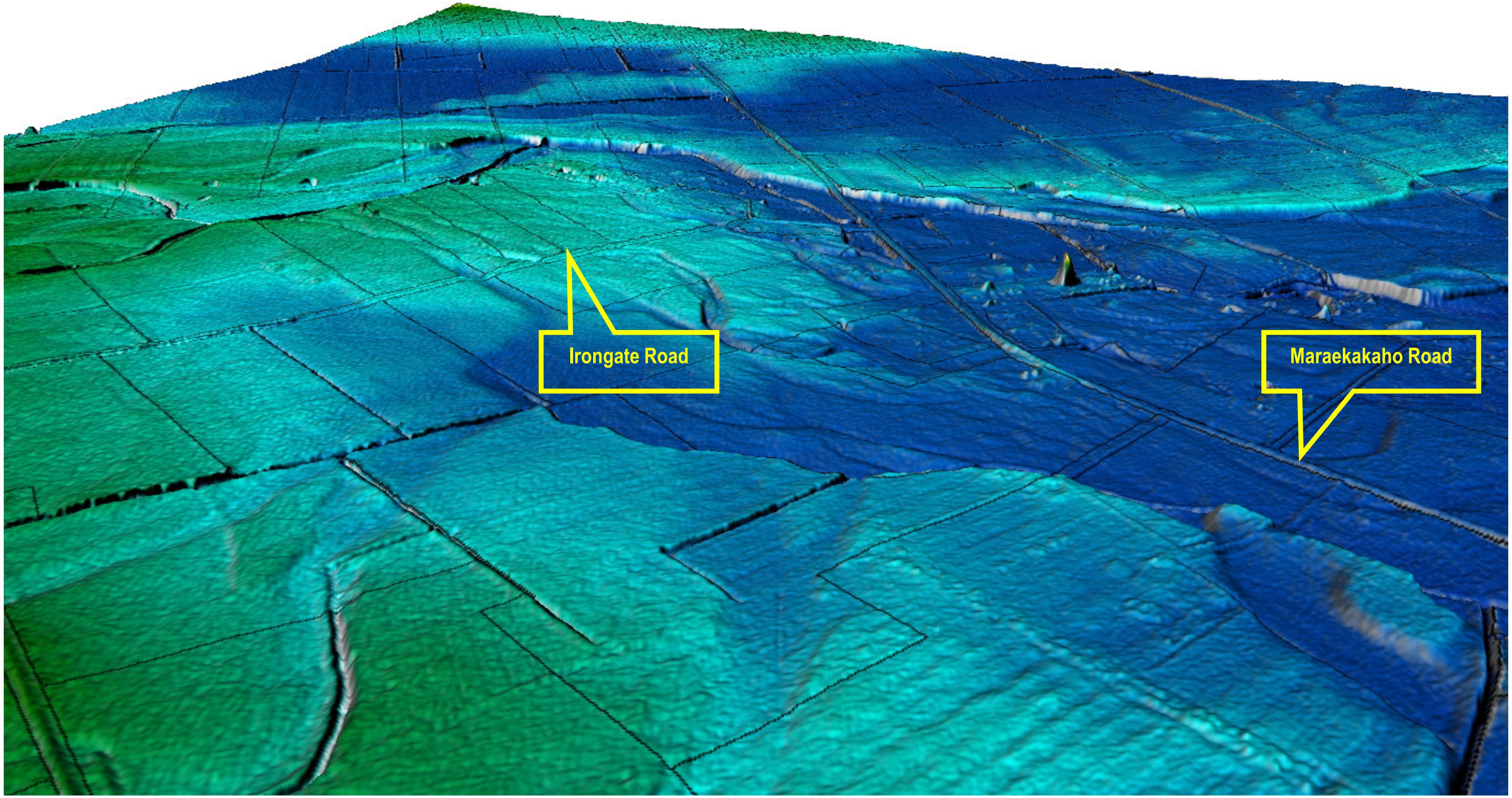
XREFS :

\\nzpmn1s01\projects\Z14500+\Z14623 Irongate Industrial Plan Change\Z1462302 Geotechnical Assessment\CAD\Z1462302 C03.dwg

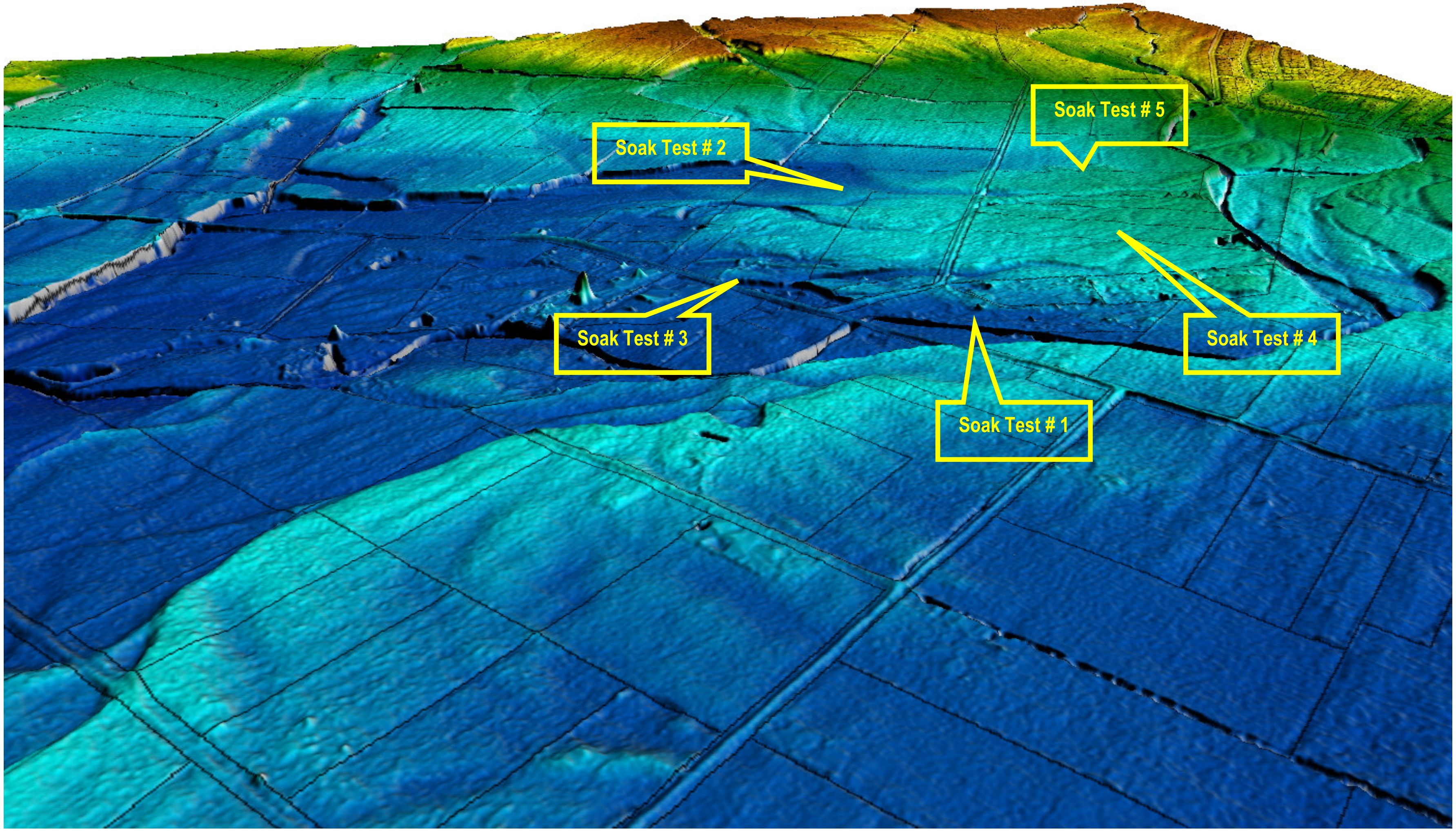
Appendix G: LiDAR Images



LIDAR Image looking from the south.



LIDAR Image looking from the west.

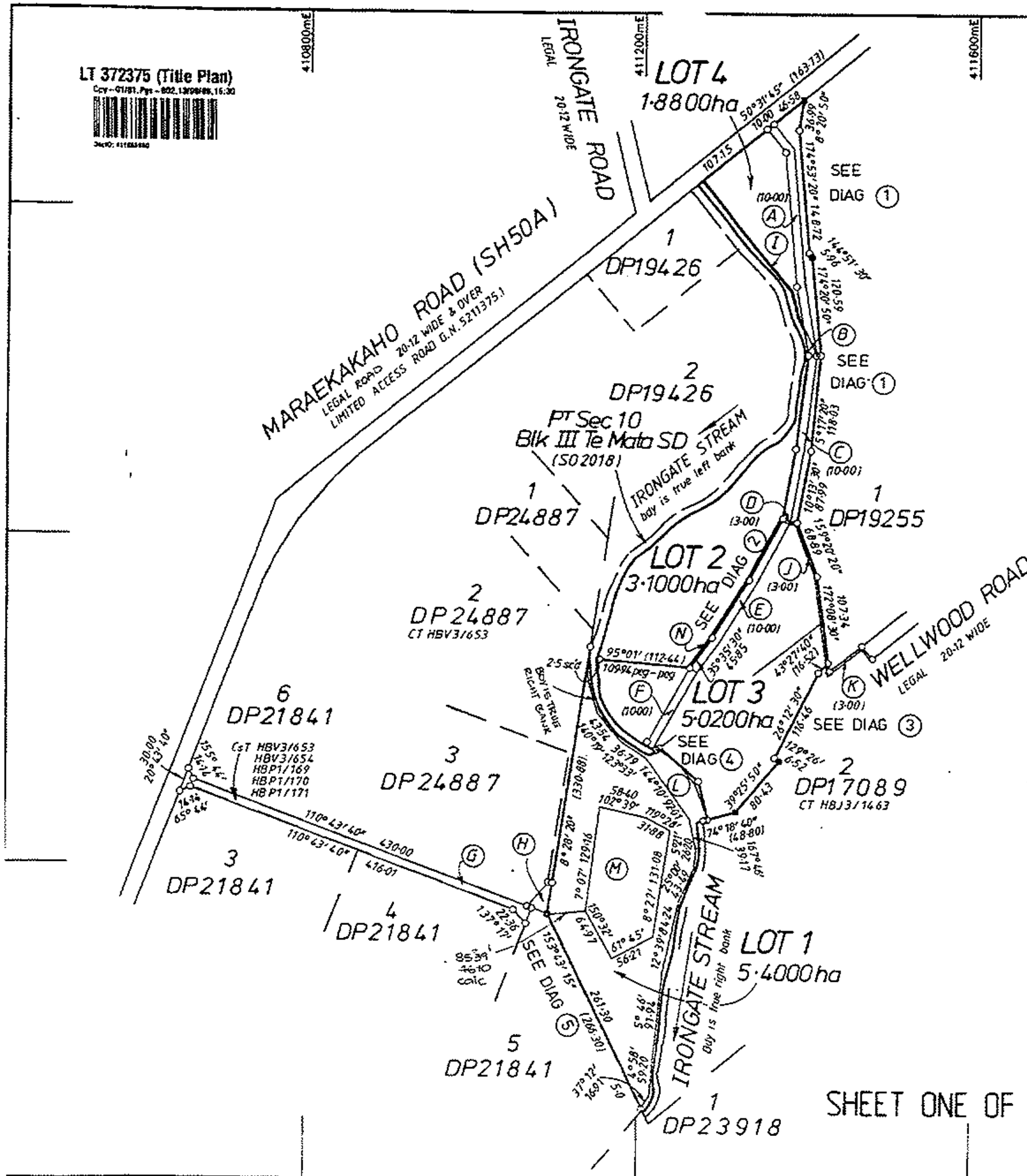


LIDAR Image looking from the east.

Appendix H: Photographic Plates

Appendix I: Certificate of Title

LT 372375 (Title Plan)



SHEET ONE OF TWO SHEETS

MEMORANDUM OF EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
Right of Way	LOT 4 hereon	A, B	LOTS 2 & 3 hereon
	LOT 3 hereon	C, D, E	LOT 2 hereon
	LOT 6 DP21841	G	LOT 1 hereon
	LOT 2 DP24887	H	

PROPOSED EASEMENTS IN GROSS			
PURPOSE	SERVIENT TENEMENT	SHOWN	GRANTEE
Right to convey electricity, telecommunications & electronic data	LOT 2 DP17089	K	Unison Networks Limited
	LOT 3 hereon	D, J	

PROPOSED EASEMENTS			
PURPOSE	SERVIENT TENEMENT	SHOWN	DOMINANT TENEMENT
Right of Way	LOT 4 hereon	A, B	LOT 1 hereon
	LOT 3 hereon	C, D, E, F	LOT 1 hereon
Right to convey telecommunications & computer media	LOT 4 hereon	B, I	LOTS 2 & 3 hereon
	LOT 3 hereon	C, D, E	LOT 2 hereon
Right to convey water	LOT 4 hereon	A, B	LOTS 1-3 hereon
	LOT 3 hereon	C, D, E	LOTS 1 & 2 hereon
		F	LOT 1 hereon
	LOT 2 hereon	N	LOT 3 hereon
Right to convey electricity	LOT 2 hereon	N	LOT 3 hereon
Right to drain sewage	LOT 4 hereon	A, B	LOTS 1-3 hereon
	LOT 3 hereon	C, D, E	LOTS 1 & 2 hereon
		F	LOT 1 hereon

RMA 05/434

I hereby certify that this plan was approved by the Hastings District Council pursuant to section 223 of the Resource Management Act 1991

on the 6th day of JUNE 2006

SUBJECT to the Amalgamation condition set out hereon and SUBJECT to the granting or reserving of the easements set out in the Memorandum hereon

Authorised Officer

AMALGAMATION CONDITION

That Lots 3 and 4 hereon be held in the same certificate of title

LINZ Number: 566915

HDC REF 05/434

NOTE: For Diagrams 1 - 5 See Sheet Two
Areas shown as L and M are to be subject to a Consent Notice

NEW C'sT ALLOCATED

LOT 1 292840
LOT 2 292841
LOTS 3 AND 4 292842

CLASS OF SURVEY: Lots 2 & 4 Class II
Lots 1 & 3 Class III

Total Area: 15·4000 ha

Comprised in: CT HBG2/72

CT's HBJ3/1463, P1/169, P1/170, P1/171, V3/653, V3/654 (ED)

I Colin George Shanley, being a person entitled to practise as a licensed cadastral surveyor, certify that-

(a) The Surveys to which this dataset relates are accurate, and were undertaken by me or under my direction in accordance with the Cadastral Survey Act 2002 and the Surveyor General's Rules for Cadastral Survey 2002/2

(b) This dataset is accurate, and has been created in accordance with that Act and those Rules

Signed Date 22/4/06

Reference Plans

APPROVAL AS TO SURVEY by LAND INFORMATION NZ on 6/7/2006

DEPOSITED by LAND INFORMATION NZ on __/__/__

File 6830
Received 13-6-06
Platform approval WGLM95/6

DP 372375

Land District	Hawkes Bay	PLAN OF LOTS 1 - 4 BEING SUBDIVISION OF LOT 1 DP13951 AND LOT 1 DP14366 AND EASEMENTS OVER LOT 6 DP21841, LOT 2 DP17089 AND LOT 2 DP24887	Territorial Authority: HASTINGS DISTRICT Surveyed by: SHANLEY & CO. Scale: 1:4000 Date: NOV 2005 - MARCH 2006

Appendix J: Soil Soakage Test Results

IRONGATE INDUSTRIAL PLAN CHANGE - SOIL SOAKAGE TESTS - OCTOBER 2008

BH1

Time	Depth	Rate (mm/hr)
0	130	
15	260	31200
30	340	19200
45	410	16800
60	450	9600
75	470	4800
90	495	6000
105	525	7200
120	540	3600
135	560	4800
150	580	4800
180	585	600
210	595	1200
240	605	1200
300	615	600
360	640	1500
480	680	1200

BH2

Time	Depth	Rate (mm/hr)
0	144	
15	310	39840
30	430	28800
45	510	19200
60	580	16800
75	630	12000
90	680	12000
105	725	10800
120	750	6000
135	780	7200
150	810	7200
165	860	12000
180	880	4800
195	925	10800
210	970	10800
225	980	2400
240	990	2400
300	1020	1800
360	1100	4800

BH3

Time	Depth	Rate (mm/hr)
0	180	
15	420	57600
30	530	26400
45	630	24000
60	680	12000
75	725	10800
90	750	6000
105	770	4800
120	805	8400
135	830	6000
150	845	3600
165	865	4800
180	870	1200
240	910	2400
300	940	1800
360	970	1800
480	1015	1350
600	1050	1050

BH4

Time	Depth	Rate (mm/hr)
0	140	
15	500	86400
30	530	7200
45	570	9600
60	590	4800
75	600	2400
90	620	4800
105	640	4800
120	690	12000
135	700	2400
150	710	2400
165	720	2400
180	730	2400
210	765	4200
240	800	4200
270	810	1200
300	815	600
330	840	3000

BH5 After 15m Soak

Time	Depth	Rate (mm/hr)
0	90	
15	140	12000
30	180	9600
45	210	7200
60	245	8400
75	280	8400
90	305	6000
105	325	4800
120	345	4800
150	410	7800
180	440	3600
210	460	2400
240	510	6000
270	560	6000
300	575	1800
360	635	3600
420	690	3300
480	740	3000
600	820	2400
720	915	2850
840	970	1650
960	1030	1800
1080	1075	1350
1200	1110	1050
1320	1170	1800

BH5 After 4hr soak

Time	Depth	Rate (mm/hr)
0	140	
15	150	2400
30	165	3600
45	180	3600
60	190	2400
75	200	2400
90	210	2400
105	220	2400
120	230	2400
150	245	1800
180	260	1800
210	280	2400
240	295	1800
270	310	1800
300	325	1800
330	340	1800
360	350	1200
390	360	1200
420	370	1200
480	390	1200
540	410	1200
600	430	1200
720	460	900
840	500	1200
960	535	1050
1080	570	1050
1200	600	900
1320	630	900
1440	655	750
1560	685	900
1680	715	900
1800	740	750
2100	800	720
2400	850	600
2700	895	540
3000	940	540
3300	985	540
3600	1020	420
3900	1040	240
4200	1075	420

Notes:
BH4 very quick draining, some gravels from the bottom of the bore collapsed on filling
Rain on Friday: steady, light rain overnight until 0930, one small shower at 1220