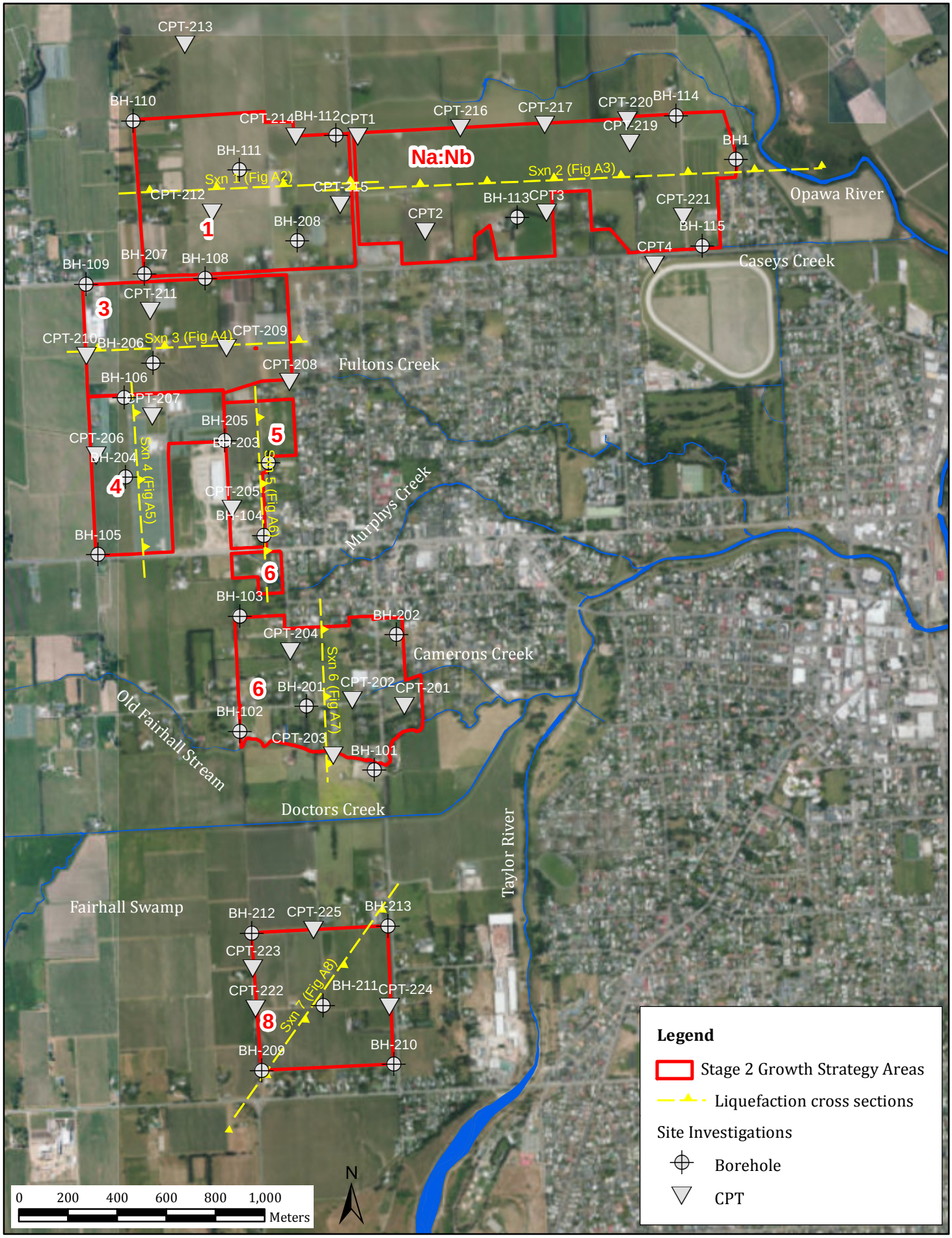
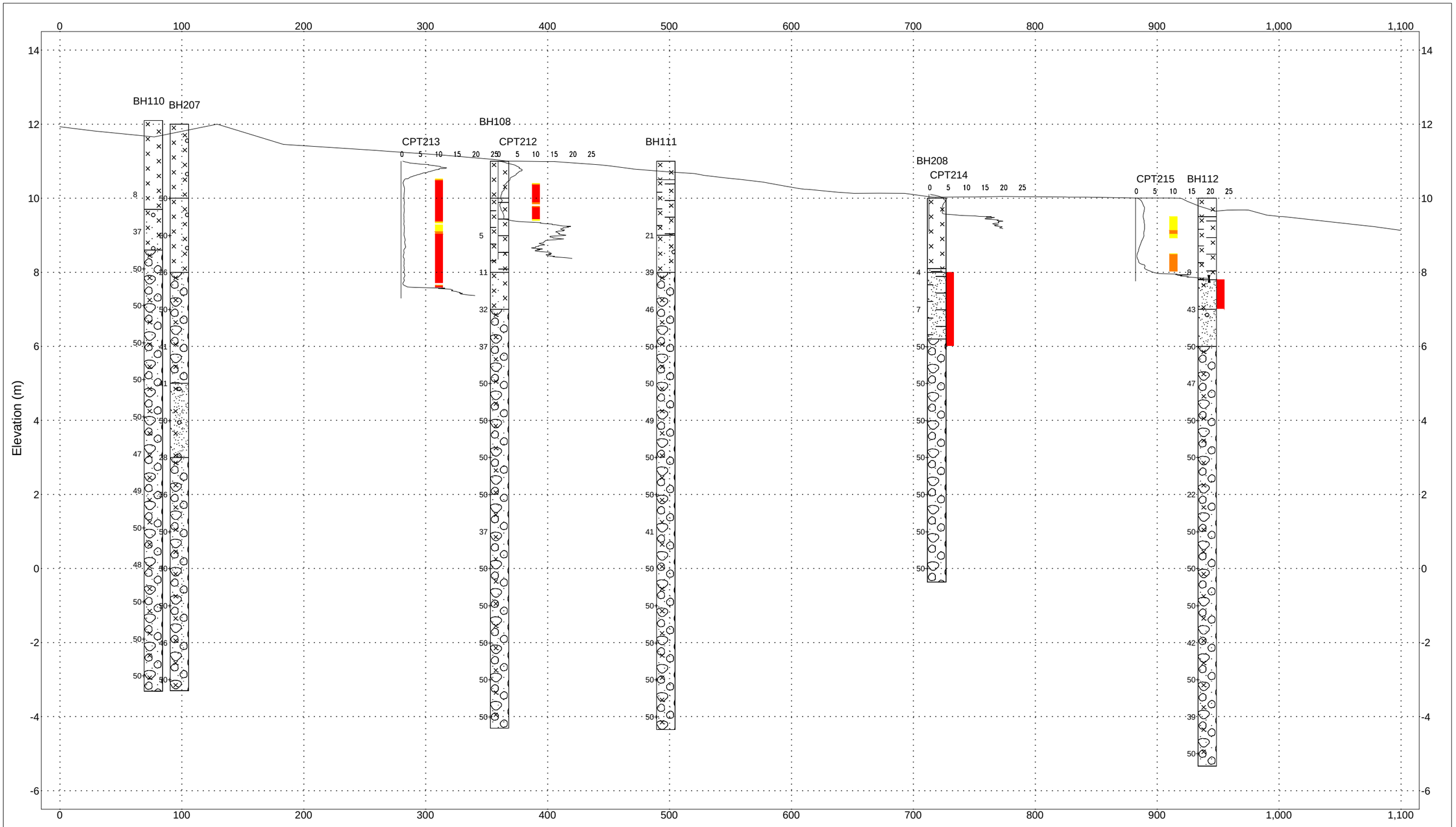
Appendix A

Liquefaction susceptibility cross sections



Prepared For: MARLBOROUGH DISTRICT COUNCIL	*Prepared By:* OPUS	*Title:* Liquefaction cross section locations	
		Project: Blenheim Urban Growth Study Stage 2	
		Scale: 1:20,000	*Date:* Feb 2013
		Project No: 5C2128.01	*Figure:* A1



Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- SILT
- Clayey SILT
- Sandy SILT
- Sandy Silty GRAVEL
- Sandy SILT some Gravel rounded/subrounded gravel
- Gravelly sandy SILT angular/subangular
- Silty SAND
- Gravelly SAND
- Silt with some Gravel. Rounded / subrounded gravel
- Gravelly SAND. Rounded / subrounded gravel
- Sandy CLAY
- Clayey SAND

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 1

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
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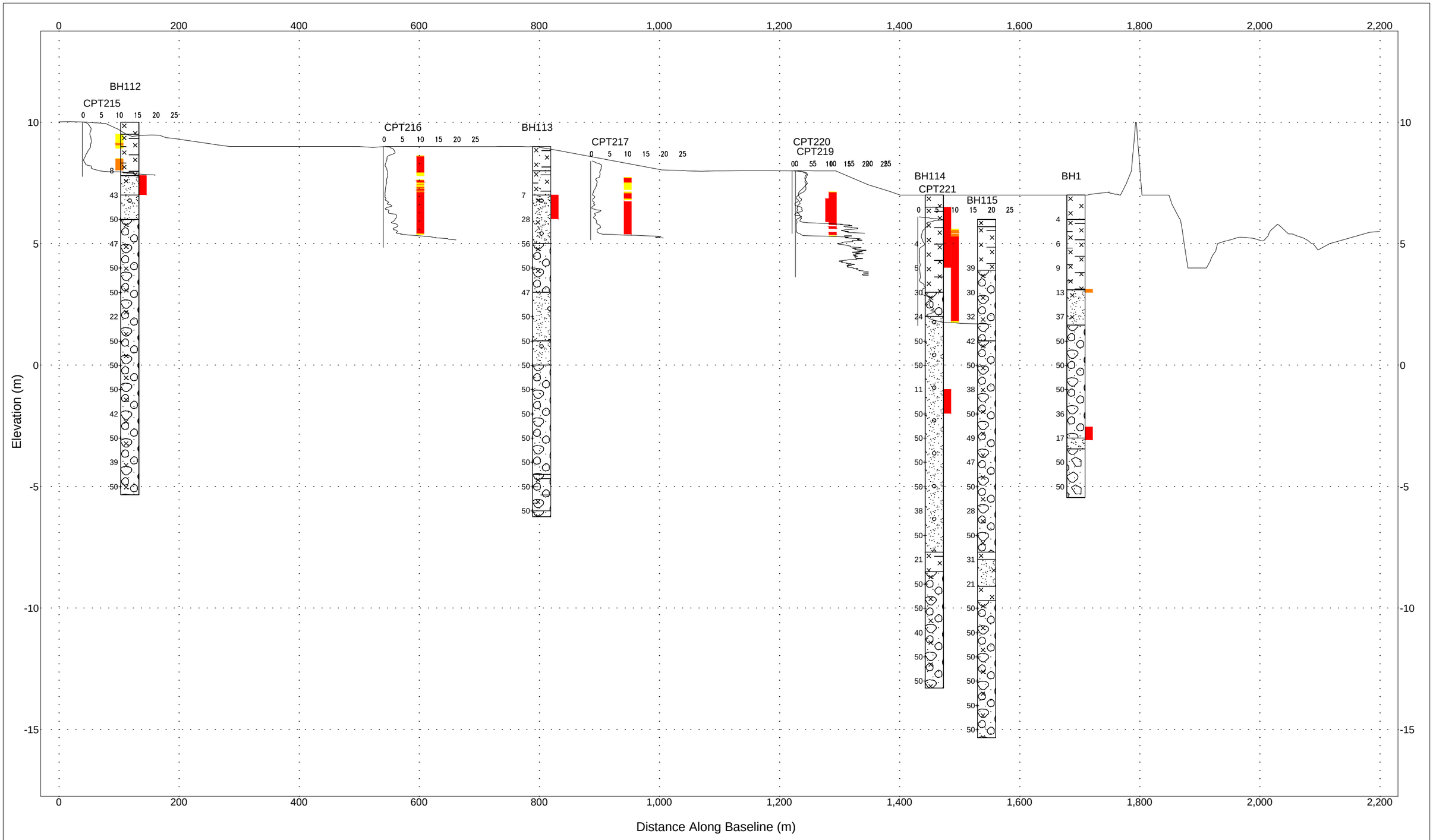

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

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- Clayey SILT
- Silty SAND
- Sandy GRAVEL
- SAND
- Sandy GRAVEL
- Gravelly SAND
- Sandy Silty GRAVEL
- Silt with some Clay
- Clayey sandy Silt
- Silty SAND some gravel rounded / subrounded gravel
- SAND with some Gravel. Rounded / subrounded gravel

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 2

Project: Blenheim Urban Growth Study Stage 2

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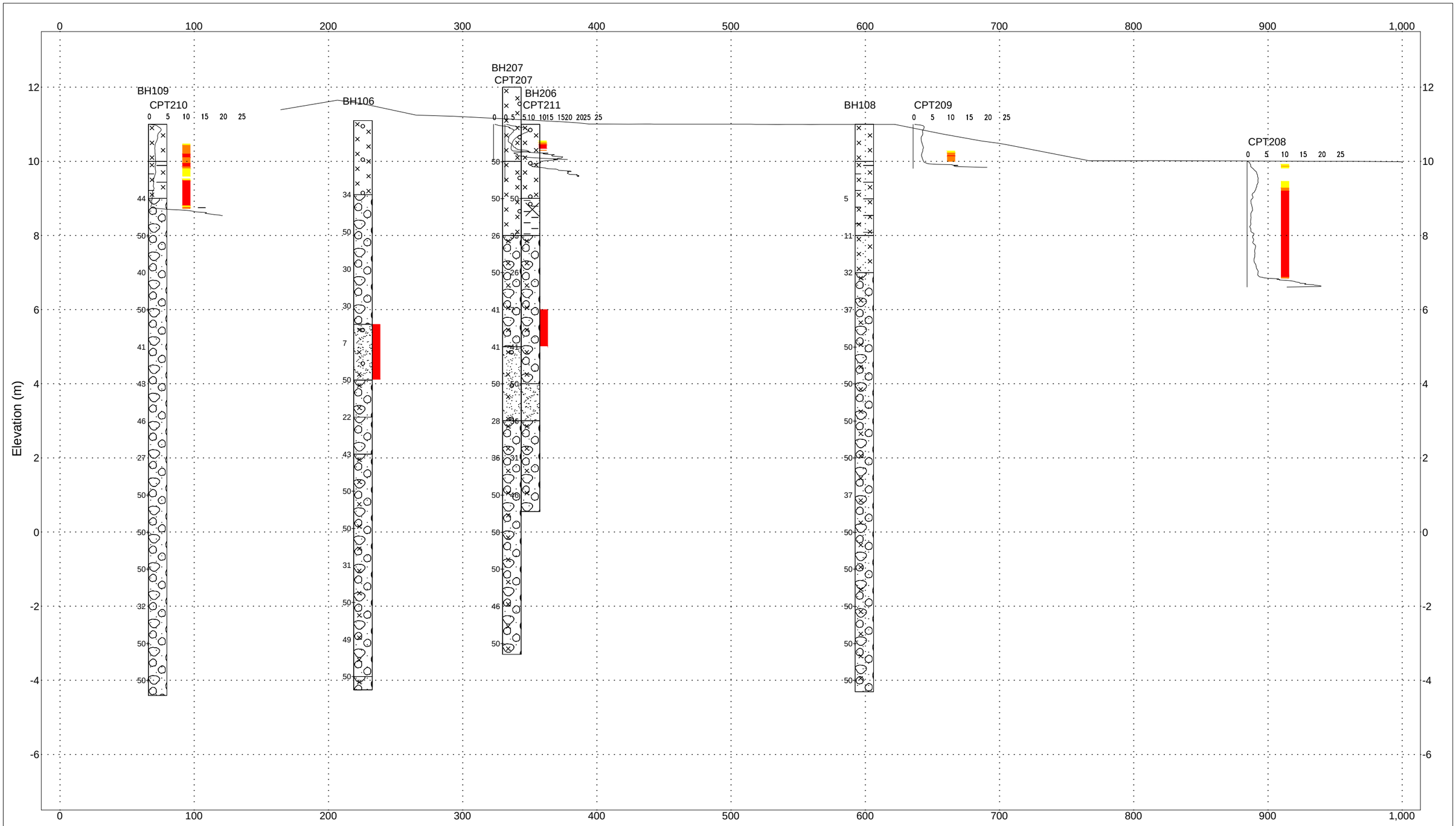

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- Gravelly SILT
- SILT
- Clayey Gravelly Silt. Rounded / subrounded gravel
- Sandy GRAVEL
- Clayey SILT
- SAND
- Silty SAND some gravel rounded/subrounded gravel
- Sandy SILT
- Silt with some Gravel. Rounded / subrounded gravel
- Sandy Silty GRAVEL
- Gravelly Silt
- Gravelly SAND. Rounded / subrounded gravel

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 3

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
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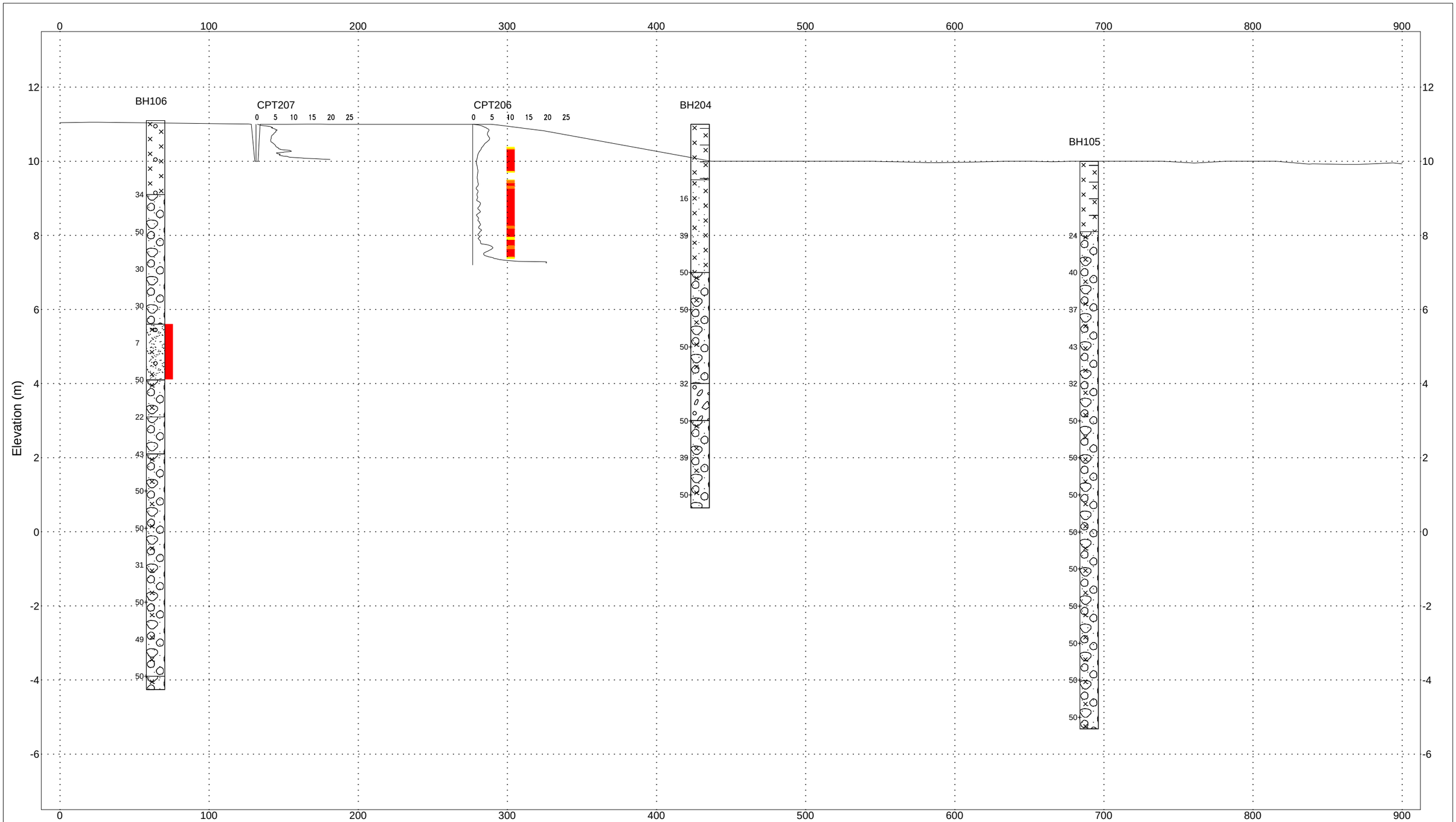

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- Silt with some Clay
- Sandy Silty GRAVEL
- Gravelly SILT
- Sandy GRAVEL
- Silty SAND some gravel rounded / subrounded gravel
- Sandy SILT
- Gravel

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 4

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
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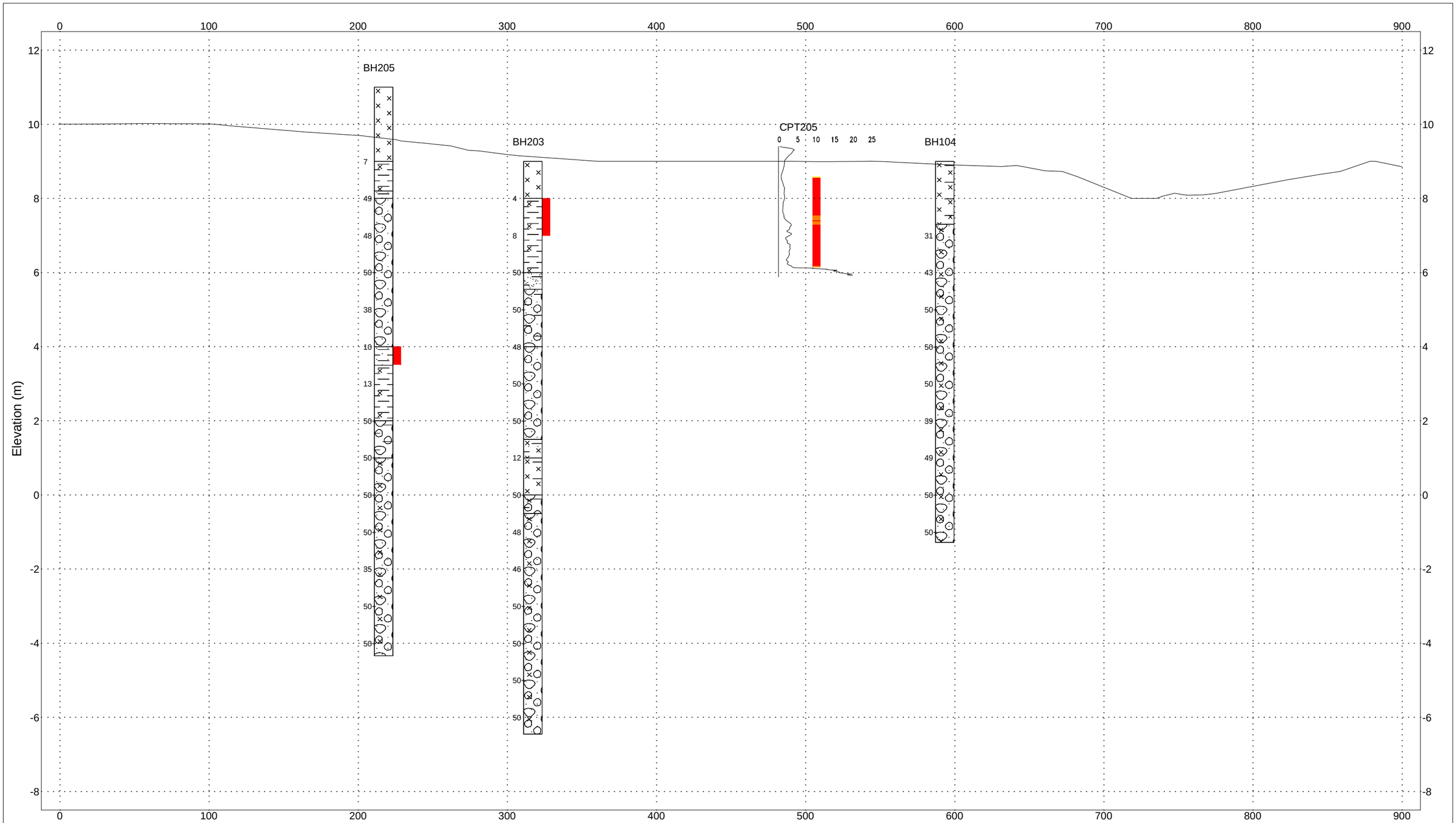

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- Silt with some Clay
- Clayey SAND
- Silty Clayey GRAVEL. Rounded / subrounded gravel
- Sandy Silty GRAVEL
- Clayey Sandy GRAVEL. Rounded / subrounded gravel
- Sandy CLAY
- SILT
- Sandy GRAVEL
- Clayey GRAVEL
- Silty CLAY
- Clayey Silt with some sand

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 5

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
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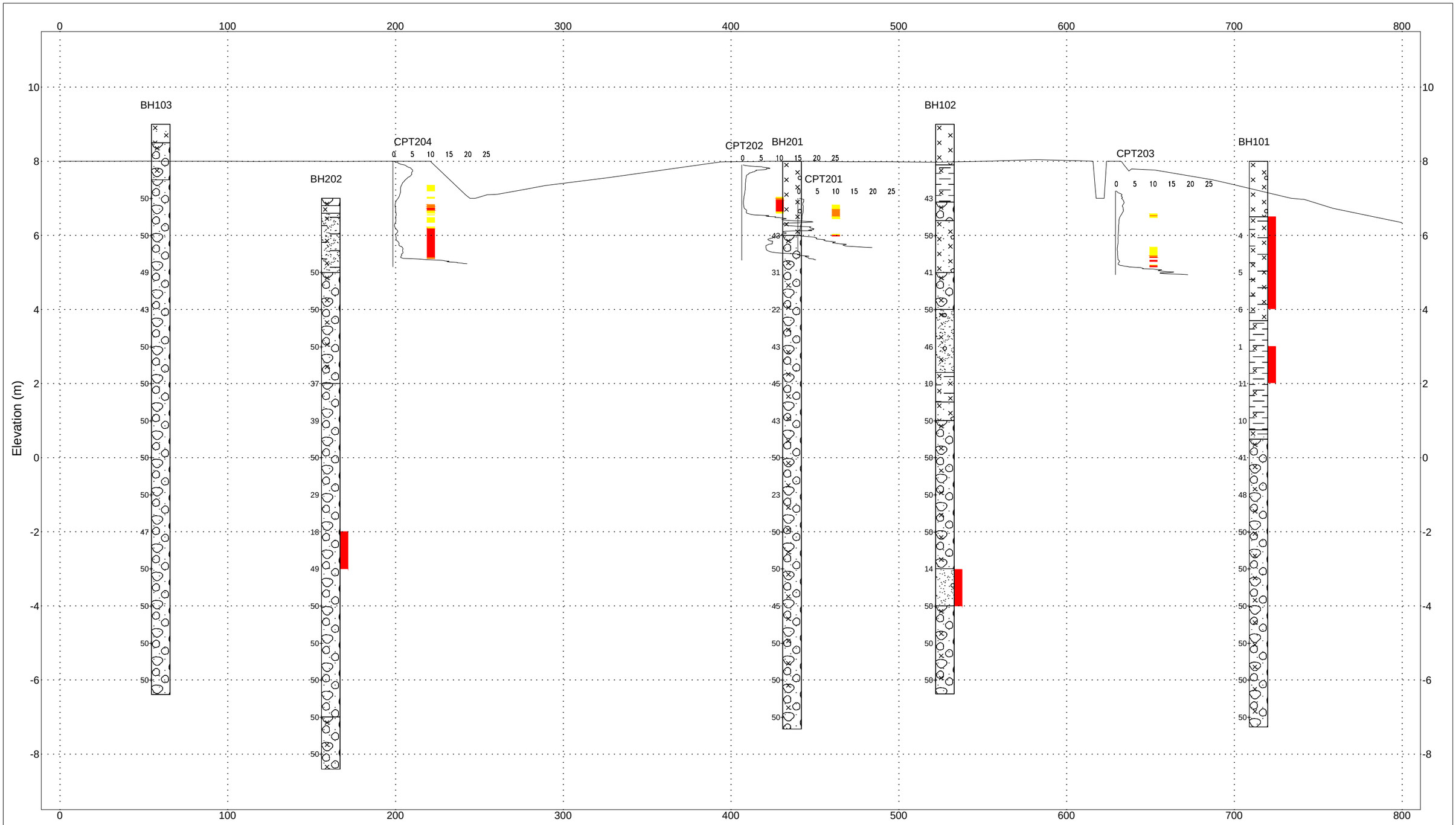

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- Silt with some Gravel. Rounded / subrounded gravel
- Sandy Silty GRAVEL
- Silty SAND some gravel rounded / subrounded gravel
- Clayey SILT
- Silt
- Clayey Silt with some sand
- Silty CLAY
- Silty GRAVEL
- SAND with some Gravel. Rounded / subrounded gravel
- Clayey SILT some gravel some sand angular/subangular
- Gravelly sandy SILT angular/subangular
- Silt with some Sand

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 6

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
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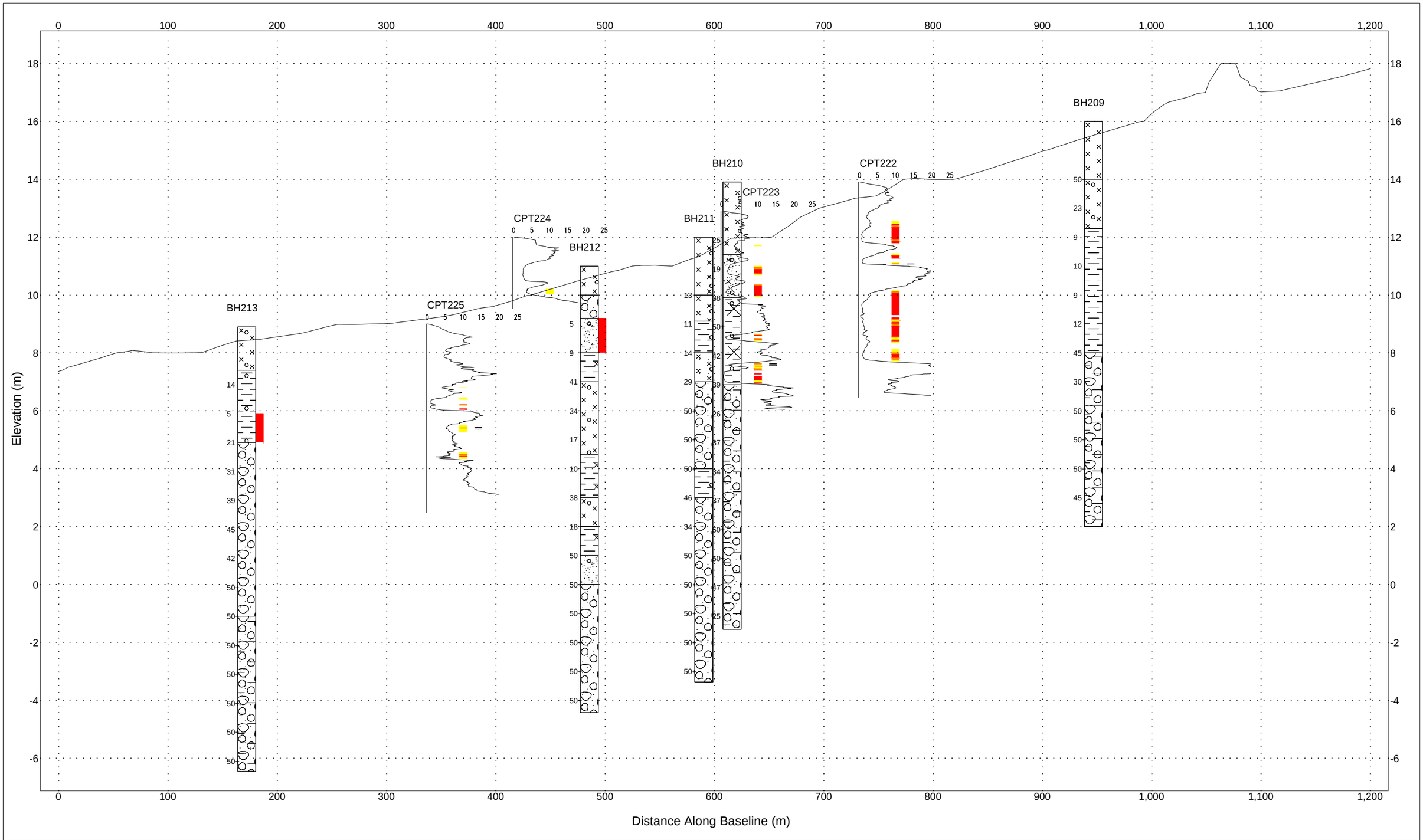

Prepared for:

MARLBOROUGH DISTRICT COUNCIL

Prepared by:

OPUS

Legend:

Lithological Graphics

- SILT
- Silt with some Gravel. Rounded / subrounded gravel
- Clay with some Gravel. Rounded / subrounded gravel
- Gravelly SILT
- Gravelly Silty SAND. (Angular / subangular gravel)
- SILT some gravel some sand angular / subangular
- CLAY
- Clayey Gravelly Silt. Rounded / subrounded gravel
- Sandy GRAVEL
- Clayey GRAVEL
- Clayey Sandy GRAVEL. Rounded / subrounded gravel
- Gravelly SAND

Return Period Event Liquefaction

- 1500 yr
- 1/1000 yr
- 1/2500 yr

Title: Liquefaction Susceptibility Cross Section 7

Project: Blenheim Urban Growth Study Stage 2

Vertical Scale:	Date:	Project:	Figure:
1:125	24/02/2013	5C2128.01	A8

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Marlborough District Council

Blenheim Urban Growth Study Stage 2

Site Investigations

Factual Report

Marlborough District Council

Blenheim Urban Growth Study

Stage 2

Site Investigations

Factual Report

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Approved for Release By
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Date: February 2013
Reference: GER 2013-04
Status: Final

Project No: 5C2128.01

Contents

1 Introduction

Marlborough District Council is developing a strategy for the urban growth and development. The Council has identified a number of potential urban growth areas for Blenheim, that lie on the periphery of the city. Opus International Consultants Ltd (Opus) has been commissioned by the Council to carry out a geotechnical evaluation of the proposed growth areas.

Geotechnical investigations and assessment of proposed growth areas to the north, east and southeast of the city were previously carried out in early 2012 (Opus, 2011; 2012a). The investigations showed the areas to the east and southeast are underlain by significant thicknesses (> 15 m) of loose materials which are susceptible to liquefaction. Consequently, these areas would require considerable cost and resources to develop.

The geotechnical appraisal of the ground conditions and suitability of the land for development recommended that land which is more stable to earthquake hazards be developed (Opus, 2012b). The Council therefore identified 5 new areas to the northwest, west and southwest of the city for possible urban growth, and engaged Opus to carry out investigations in the new areas to assess the geotechnical issues there, particularly relating to the hazard posed by liquefaction.

Site investigations have subsequently been carried out in September to December 2012. This report has been prepared as part of the investigation, and provides the factual results of the investigations and testing.

The investigations were scoped and carried out in accordance with the guidelines provided by the former Department of Building and Housing (now the Ministry of Business, Innovation and Employment) for geotechnical investigations of land in Canterbury (MBIE, 2012).

2 The Site

2.1 Geomorphology

The proposed urban growth areas are located on the outskirts of Blenheim's urban area, to the north (areas Na:Nb), northwest (areas 1, 3 to 6) and southwest (area 8). The sites are situated on predominantly flat to gently undulating alluvial plains, with several streams and drains. The land is predominantly under agricultural use with few existing dwellings.

2.2 Geology

The geology of the Marlborough Area has been mapped at 1:25,000 scale by the New Zealand Geological Survey (NZGS, 1981) and at 1:250,000 scale by the Institute of Geological and Nuclear Sciences (IGNS, 2000).

The mapping shows the Blenheim area is underlain by Holocene age marine/estuarine silts and sands of the Dillons Point Formation and alluvial gravels and sands of the Rapaura Formation. These strata are underlain by older, clay-bound alluvial gravels of the Speargrass Formation (NZGS, 1981; Landcare Research, 1995; MCRWB, 1987; Davidson and Wilson, 2011).

2.3 Groundwater

A study by Marlborough District Council (Davidson and Wilson, 2011) provides a thorough description of the groundwater regime of the lower Wairau Valley. As part of this study, a series of boreholes in the Blenheim area show the static groundwater levels in this area. This analysis shows that shallow groundwater generally lies between 2 m and 5 m below ground level in the vicinity of the study areas, and flows from west to east.

Groundwater in the south Marist-Clifford area suggests a deeper aquifer where groundwater was encountered below 6.0 m in the most southern boreholes.

3 Site Investigations

3.1 Boreholes

Twenty seven boreholes were drilled in two phases, between October and December 2012. The boreholes were drilled by CW Drilling and Investigation Ltd, and all were 125 mm diameter, drilled by rotary percussive (concentrix) drilling. The locations and depths of the boreholes are given in Table 1; their locations are shown on Figure 1.

The boreholes were carried out to provide information to characterise the geology and hydrogeology of the development areas. Undisturbed push tubes and bulk samples were collected from the boreholes to provide information on the physical properties of the soils.

The boreholes were drilled to depths between 10 m and 25 m. Standard Penetration Tests (SPTs) were carried out in the boreholes at 1 m intervals.

Engineering geologists from Opus logged the samples recovered from the boreholes. All samples were logged in accordance with the New Zealand Geotechnical Society (2005) Guidelines.

The borehole logs are presented in Appendix A and the driller's logs are provided in Appendix B. Standpipe piezometers were installed in boreholes BH 101, 105, 109, 110 and 210, to allow measurement of the groundwater levels.

Table 1 Borehole summary table

No.	Location	Easting[1]	Northing[1]	Depth (m)	Groundwater (m)[2]
BH 101	Battys Road	1677842	5403363	15.27	1.5
BH 102	59 Davids Road	1677291	5403528	15.375	1.2
BH 103	Severne Street	1677296	5403996	15.395	1.5
BH 104	3 Rose Street	1677387	5404341	10.28	1.5
BH 105	Middle Renwick Road	1676723	5404249	15.32	1.3
BH 106	Cherryland, off Rene Road	1676821	5404883	15.36	2.0
BH 108	Old Renwick Road	1677174	5405365	15.31	2.0
BH 109	244 Old Renwick Road	1676648	5405338	15.41	2.0
BH 110	Blicks Lane	1676862	5405990	15.415	3.0
BH 111	190 Old Renwick Road	1677291	5405804	15.35	2.0
BH 112	Thomsons Ford Road	1677729	5405953	15.335	2.0
BH 113	78 Old Renwick Road	1678431	5405608	15.24	1.8
BH 114	38 Old Renwick Road	1679067	5406028	20.295	1.2
BH 115	26 Old Renwick Road	1679178	5405490	21.335	1.0
BH 201	David Street	1677565	5403629	15.325	2.0
BH 202	25 Battys Road	1677930	5403920	15.41	2.0
BH 203	Rose Street	1677410	5404619	15.45	3.0
BH 204	Between Rene St & Middle Renwick Rd	1676829	5404561	10.355	3.0
BH 205	Off Westward Avenue	1677233	5404709	15.34	3.0
BH 206	Rene Street	1676940	5405024	10.45	3.0
BH 207	Blicks Lane	1676905	5405386	15.3	3.0
BH 208	Off Old Renwick Road	1677526	5405521	10.365	2.5
BH 209	125 New Renwick Road	1677382	5402149	14.0	7.1
BH 210	Battys Road	1677919	5402149	15.45	6.0
BH 211	125 New Renwick Road	1677632	5402413	15.37	5.0
BH212	125 New Renwick Road	1677342	5402708	15.42	3.0
BH213	Battys Road	1677896	5402736	15.355	2.0

[1] *Coordinates are in metres to NZ Transverse Mercator*

[2] *Depth groundwater encountered following completion of drilling (metres below ground level)*

3.2 Cone Penetration Tests

Eighteen Static Cone Penetration Tests (CPTs) were carried out across the project area between the 11th and 13th of December 2012. The CPTs were carried out to provide geotechnical data on the strength and thickness of the strata, for use in assessing the liquefaction susceptibility of the soils. Water levels were not recorded in the tests.

The locations and depths of the CPTs are summarised in Table 2. The test results are provided in Appendix C.

Table 2 Cone penetration test summary table

No.	Location	Easting[1]	Northing[1]	Depth (m)
CPT 201	89 Battys Road	1677964	5403628	1.43
CPT 202	David Street	1677752	5403653	2.57
CPT 203	Battys Road	1677675	5403427	2.26
CPT 204	102 Battys Road	1677500	5403851	2.85
CPT 205	3 Rose Street	1677263	5404429	3.52
CPT 206	Between Rene St & Middle Renwick Rd	1676711	5404646	3.8
CPT 207	Cherryland of Rene Street	1676940	5404807	0.99
CPT 208	Roseneath Lane	1677496	5404945	3.39
CPT 209	183 Old Renwick Road	1677241	5405081	1.19
CPT 210	Rene Street	1676672	5405052	2.52
CPT 211	Rene Street	1676930	5405232	1.54
CPT 212	190 Old Renwick Road	1677181	5405634	2.65
CPT 213	190 Old Renwick Road	1677071	5406317	3.7
CPT 214	45 Thomsons Ford Road	1677521	5405944	1.01
CPT 215	19 Thomsons Ford Road	1677703	5405665	2.24
CPT 216	56 Thomsons Ford Road	1678191	5405976	4.16
CPT 217	44 Old Renwick Road	1678536	5405990	3.25
CPT 218	Lansdowne Park	1679980	5405464	5.27
CPT 219	Old Renwick Road	1678881	5405915	4.37
CPT 220	Old Renwick Road	1678871	5406010	2.59
CPT 221	Old Renwick Road	1679098	5405617	4.48
CPT 222	125 New Renwick Road	1677360	5402400	7.44
CPT 223	125 New Renwick Road	1677347	5402563	6.85
CPT 224	Battys Road	1677902	5402406	2.47
CPT 225	125 New Renwick Road	1677594	5402719	6.52

[1] *Coordinates are in metres to NZ Transverse Mercator*

3.3 Shear Wave Velocity Testing

Down-hole shear wave velocity testing was carried out in two 15 m deep boreholes (BH 201 and BH 207), on 27 December 2012. The testing was carried out by AJ Sutherland Consulting Ltd, to measure shear wave and compression wave velocities for the stratigraphic layers within the boreholes. The results of the testing are presented in Appendix D.

3.4 Laboratory Testing

Laboratory soil classification tests were performed on samples collected from the boreholes, in accordance with NZS 4402 : 1986, to determine the following properties:

- Particle size distribution (NZS 4402, tests 2.8.1 and 2.8.4);
- Atterberg limits (NZS4402, tests 2.1, 2.2, 2.3, and 2.4).

The tests were carried out to provide data to characterise the soils and provide information for use in the liquefaction assessment. The tests were completed by Opus Central Laboratories in Lower Hutt. The tests are summarised in Table 3 and the analytical results are included in Appendix E.

Table 3 Soil classification test results summary

BH No.	Sample Depth (m)	Plasticy Index	Particle Size Distribution (%)			
			Clay	Silt	Sand	Gravel
BH 101	5.0 – 5.45	13 ± 2	25	63	12	0
BH 102	12.45 – 13.0		0	2	77	21
BH108	2.0 - 2.45	non plastic				
BH 112	2.5 – 2.8		5	28	66	1
BH 115	0.5 – 1.0		18	66	16	0
BH 116	2.45 – 3.0		17	78	5	0
BH 117	12.0 – 12.45		17	65	17	1
BH 203	8.0 – 8.45		19	52	29	0
BH 205	8.0 – 8.45	14 ± 2	29	69	2	0
BH 208	2.0 – 2.45	non plastic				
BH 209	7.0 – 7.45	4 ± 2				
BH 211	3.0 – 3.45	6 ± 2				
BH 212	7.0 – 7.45	11 ± 2	18	36	30	16
BH 213	3.0 – 3.45	7 ± 1				

4 References

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Appendix 5

MARLBOROUGH DISTRICT COUNCIL

urbanism +

BLENHEIM RESIDENTIAL GROWTH AREAS

ESSENTIAL STREET CONNECTIONS

PREPARED FOR MARLBOROUGH DISTRICT COUNCIL

JUNE 2013

PREPARED BY

URBANISMPLUS LTD

delivering sustainable communities

1.1 Introduction

BACKGROUND AND INTENTION

The Marlborough District Council ('MDC' or 'the Council') is in the process of rezoning land on the periphery of Blenheim to enable residential growth and development. The land is divided into seven areas, numbered according to their expected staging. This process is the result of a growth strategy process, including the identification of the preferred growth areas as part of the Southern Marlborough Growth and Development Strategy ('SMUGS') in May 2010, a Revision of Blenheim's urban growth areas in response to further geotechnical information ('the Revision') in November 2012, and the finalisation of the District-wide Growth and Development Strategy ('District-wide Strategy') in March 2013.

Urbanismplus has assisted the Council during the processes that led to the above strategies. Upon request, Urbanismplus has now provided proposals for the street connections within the Council's proposed residential growth areas that are critical for an efficient, coherent and balanced development of these areas. These network proposals are outlined in this report and are accompanied by a brief rationale. For Areas 2 (west), 3, 4, 6 and 7 these proposed connections are based upon conceptual layouts for the growth areas that were developed to test the capacity of the areas as part of the Revision process. This process included visits to all proposed areas, but was not based on extensive technical investigations.

The proposed network for Areas 1, 5 and the eastern part of Area 2 (together forming the former Blenheim-North area) is derived from a design exercise undertaken by Urbanismplus for MDC. This exercise sought to establish a Comprehensive Development Plan (CDP) for this area in consultation with the landowners and Council staff representing all relevant technical disciplines. The extent of the area has subsequently changed slightly and the Council has decided not to continue with the CDP approach. The outcomes of the design exercise for the movement network are however still valid and useful.

As outlined above, this report presents the street connections that are essential for development within the Plan Change areas. A large number of additional residential streets, connecting between the essential streets shown are expected and required for development of these areas. Also, a small number of additional connections to existing streets and roads would be possible and required. An exception to this is that the only connections onto Old Renwick and Middle Renwick Roads are those that are shown.

REPORT STRUCTURE

The proposed networks for neighbouring areas cannot be seen in isolation and have been developed in conjunction with each other. Several of these are presented together in order to demonstrate coherence between neighbouring areas.

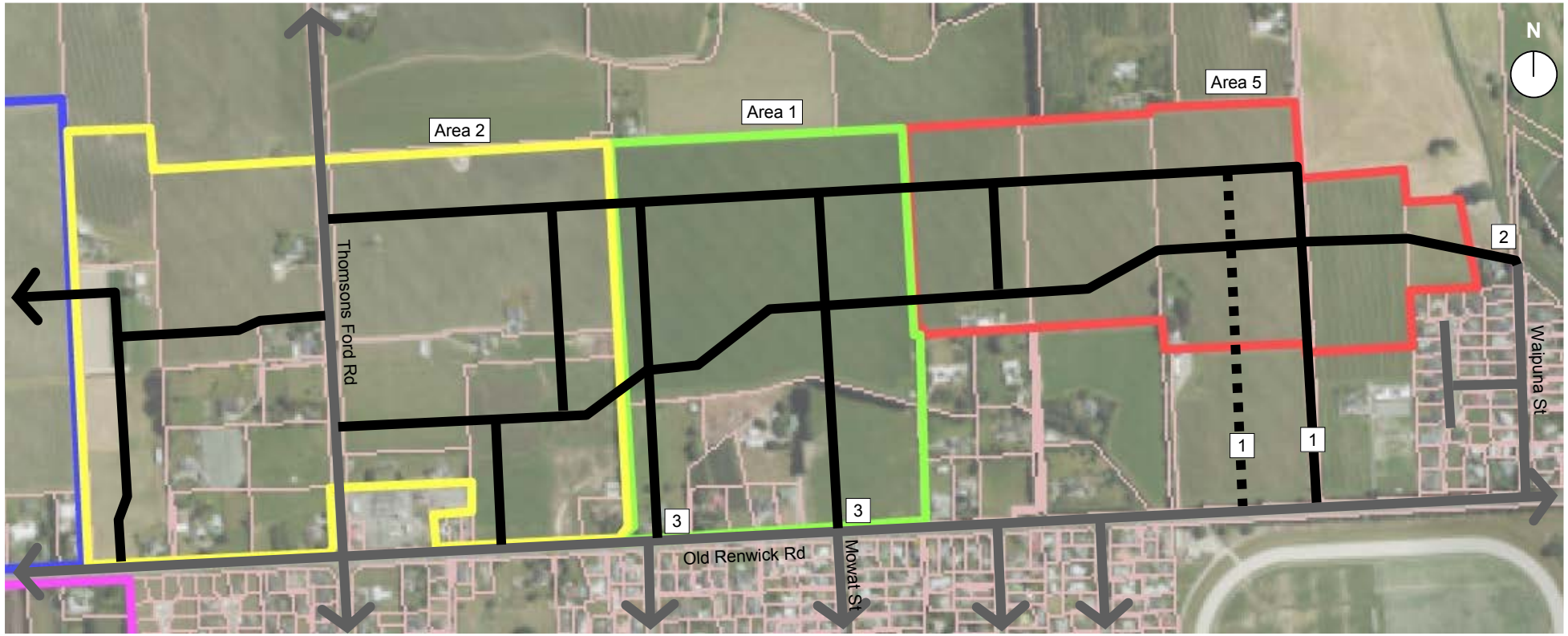
This report is structured as follows:

- → Page 3: Areas 1, 2 and 4;
- → Page 4: Areas 2 and 4;
- → Page 5: Areas 3 and 6; and
- → Page 6: Area 7.

PRINCIPLES

The principles behind the proposed essential street networks for the different growth areas include the following:

- → Maximise connectivity for all transport modes.
- → Create layouts that are legible and easy to understand for all users.
- → Create networks that encourage walking and cycling.
- → Create networks that are able to facilitate (future) public transport services.
- → Avoid conflicting right-turns between T-intersections in close proximity to each other.
- → Favour cross intersections over T-intersections. Apply small off-sets of the carriageways within the road reserves to force the traffic that has to give way to stop or slow down.
- → Avoid roundabouts in areas with high pedestrian and cycling traffic.
- → Minimise dependencies between landowners and maximise opportunities for independent and efficient development by individual landowners, while maximising connectivity and coherence. Practically this means that where possible each property should be connected to an existing public street via as few other properties as possible. It also means that connections are projected at the distance of the depth of a residential lot from the property boundary in order to use development to enable the connection.
- → Create layouts whereby fronts of properties / dwellings face other fronts across a public street and backs face backs, while avoiding rear lots.
- → Create layouts that set up as many north-south blocks (and hence east-west lots) for optimum solar access to all properties.
- → Assume the retention of existing dwellings and the areas immediately surrounding those.



2.1 Areas 1, 2 and 5

RATIONALE

The main objective is to create at least two east-west connections deep into the site with multiple connections to Old Renwick Road. This is to maximise connectivity within the growth areas independent from Old Renwick Road (and to a lesser extent independent of Thomsons Ford Road). A situation in which individual properties are developed as separate pockets only connected to Old Renwick or Thomsons Ford Road should be avoided.

Specific areas of attention include the following (refer to numbers on the map):

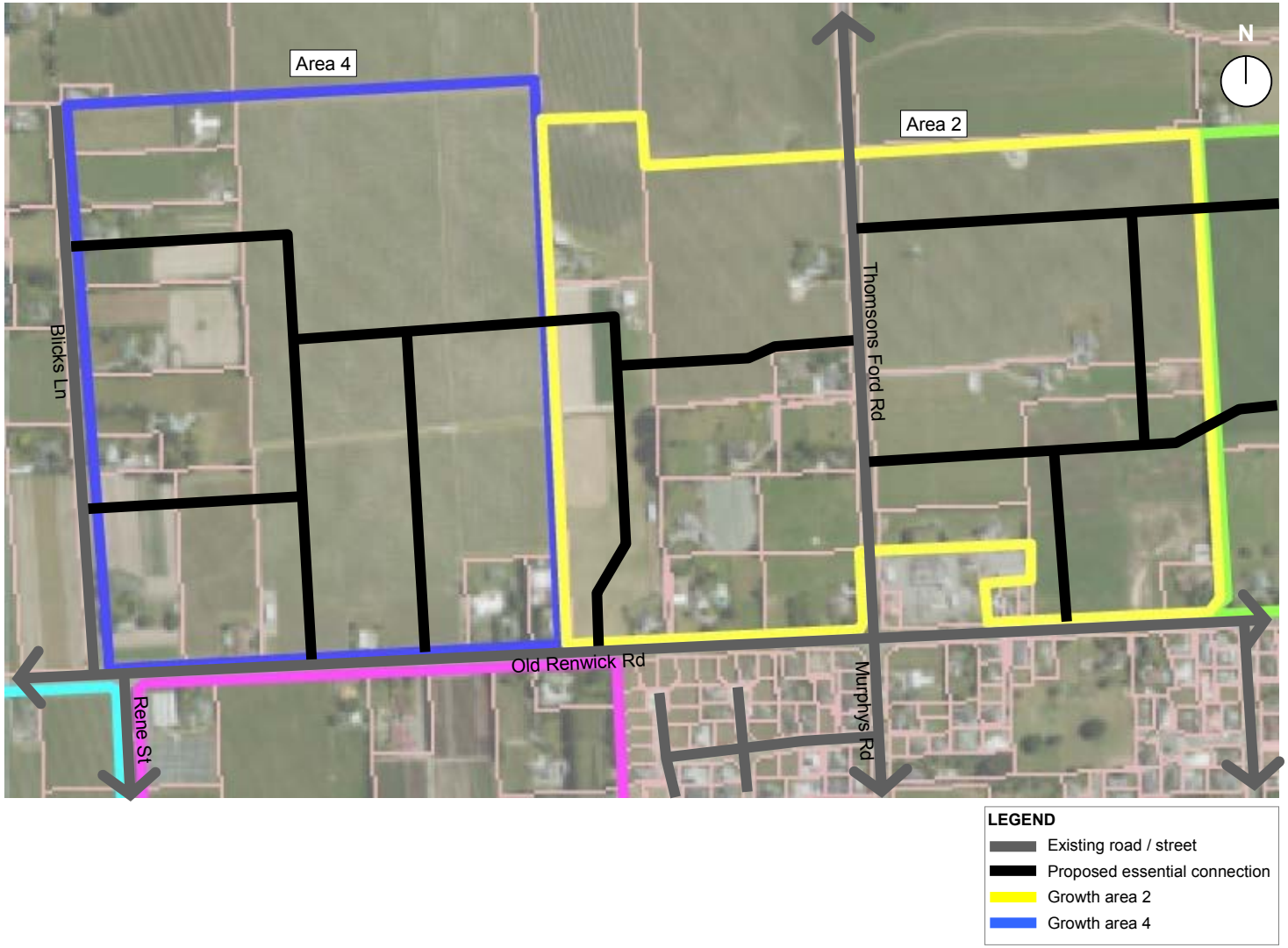
1. This proposed connection is located over multiple parallel private driveways through land within a Rural zone. At least one of the driveways provides access to land located outside of any growth area and is in ownership of a landowner not benefitting from the proposed plan changes. The dotted line provides an alternative and is solely located on the land of which a portion is proposed to be rezoned.
2. A connection with Waipuna Street would vastly improve connectivity in the north-eastern part of Area 5. It should be noted that a small part of this connection is located outside the proposed plan change area.
3. Off-set T-intersections that visually function as cross intersections should be considered for these points.

2.2 Areas 2 and 4

RATIONALE

The main objective is to create an east-west connection between Blicks Lane and Thomsons Ford Road deep into the site with multiple connections to Old Renwick Road. This is to maximise connectivity within the growth areas independent from the existing roads. A situation in which individual properties are developed as separate pockets only connected to Old Renwick Road, Blicks Lane or Thomsons Ford Road should be avoided.

It is assumed that fragmented ownership and existing large lot development in the south-western part of Area 2 and in the western part of Area 4 limit opportunities for new connections. It would be beneficial for the overall connectivity if additional connections were provided as part of the development of some of these properties.



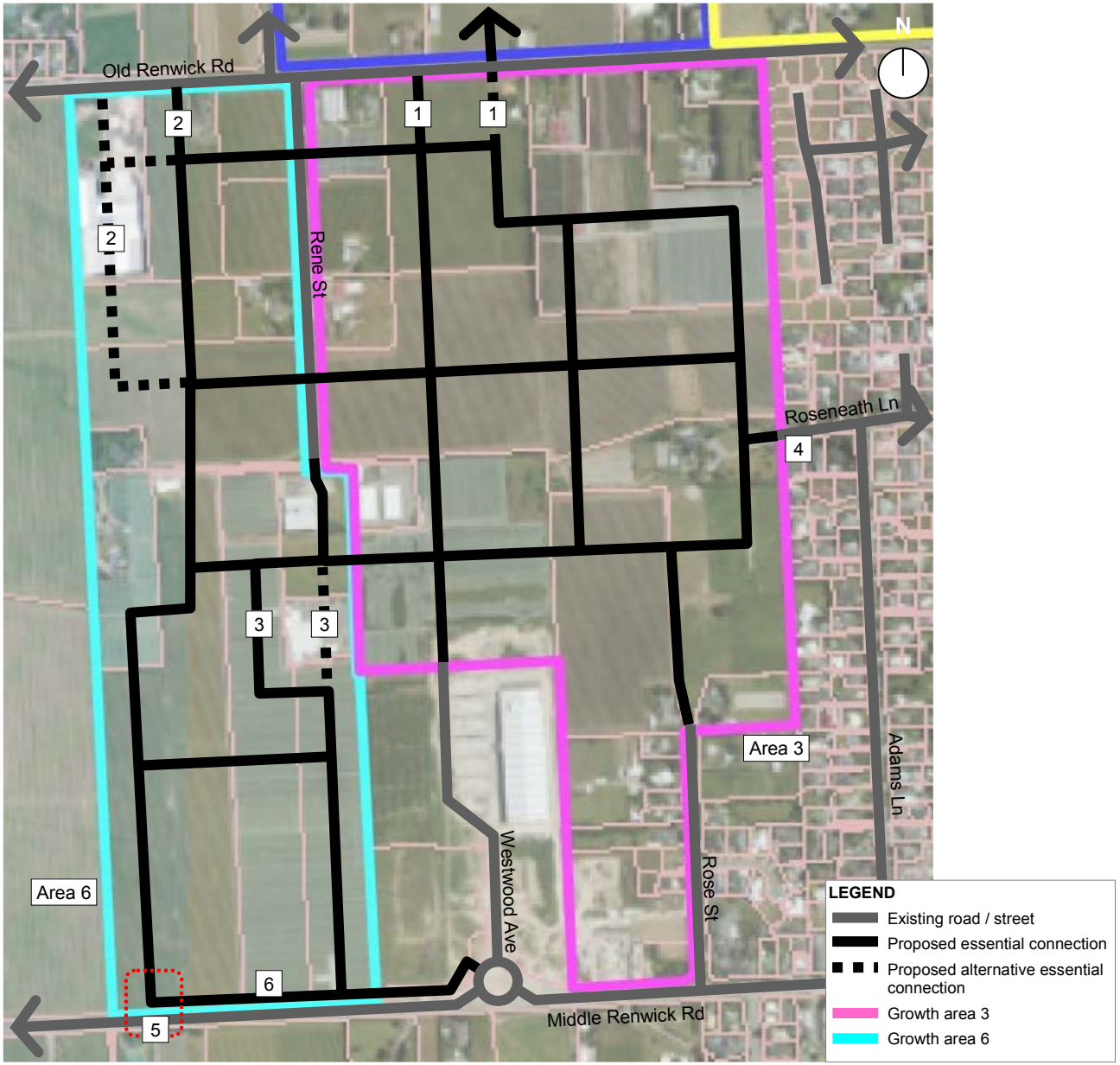
2.3 Areas 3 and 6

RATIONALE

The main objective is to create multiple connections between Old Renwick and Middle Renwick Roads, partly using the existing connections via Rene Street, Rose Street and Westwood Avenue. It is assumed that fragmented ownership and existing large-lot development in the northern part of Area 3 limit opportunities for feasible connections to Old Renwick Road. It would be beneficial for the overall connectivity if additional connections were provided as part of the development of some of these properties.

Specific areas of attention include the following (refer to numbers on the map):

1. It is assumed that only one of these two connections onto Old Renwick Road would be feasible. The alternative connection indicated would be aligned with a proposed connection through Area 4 (indicated with blue outline) located to the north of Area 3. This connection would be appropriate if the combination of the two proposed connections onto Old Renwick Road were preferred over two separate T-intersections.
2. Ideally both connections onto Old Renwick Road would be constructed, but it is assumed that only one of these two would be feasible. The proposed alignment is based on the situation whereby the PCL Cold Store Centre is retained. The westernmost connection is based on the assumption that by the time Area 6 is developed this facility will have been relocated. The alternative could be constructed in the form of a crescent if the Cold Store Centre site were available and only one connection were feasible.
3. The indicated proposed connection is based on the assumption that the PGG Wrightson facility at the end of Rene Street will have to be retained. An alternative is indicated for a situation whereby this building is relocated by the time Area 6 is developed.
4. Good connectivity with Roseneath Lane from all parts of the plan change areas would help provide access to



several schools located in the Springlands areas without using Middle and Old Renwick Roads.

5. The design of this area should be future-proofed to allow a connection to Middle Renwick Road / SH6 which may become feasible in the future.
6. A slip lane is proposed in order to provide a connection with the Westwood Avenue roundabout while encouraging residential development to front onto Middle Renwick Road across the slip lane (and possibly associated landscaping), as opposed to turning its back to it. It should be noted that Middle Renwick Road is one of the key entrances into town.

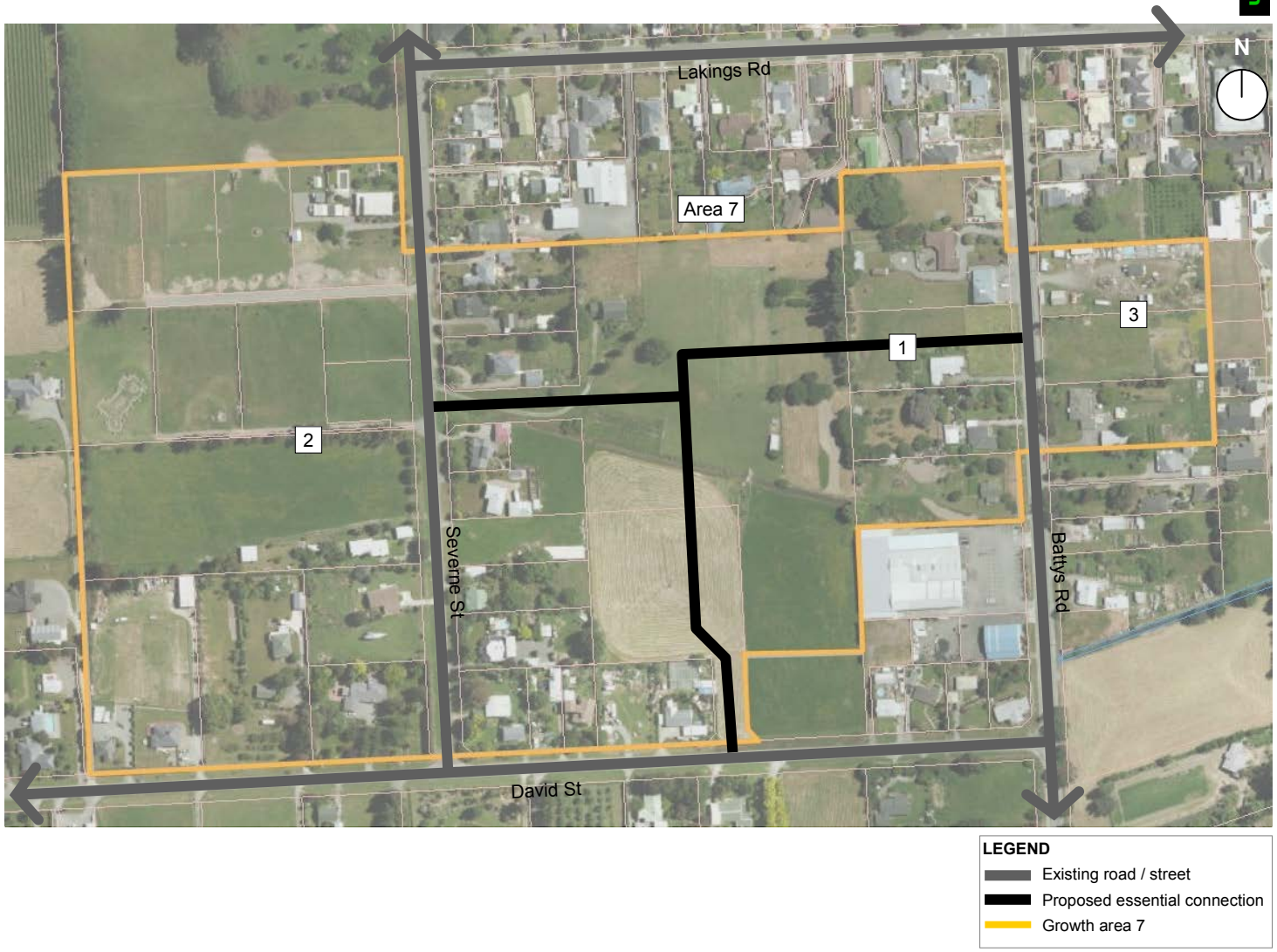
2.4 Area 7

RATIONALE

The main objective is to provide a connection between the two largest development sites, which each have road access to Severne and David Streets respectively. This is to ensure that the development would be connected to both of these key roads. An additional connection to Battys Road is indicated (refer to more information under (1) below).

Specific areas of attention include the following (refer to numbers on the map):

1. This is assumed to be the most likely property on Battys Road that is to be redeveloped with incorporation of an east-west street. This is however dependent on the minimum lot size that the proposed zone for this property will allow.
2. It is assumed that these properties will be developed independently and in a similar way as the recent subdivision on Severne Street, whereby each property will have a shared right of way connecting onto Severne Street or David Street that provides access to individual residential lots.
3. It is assumed that these properties will be developed independently whereby each will have a separate connection onto Battys Road.



Appendix 6

05 June 2013

Record No. 13120342

Appendix 6

Blenheim Urban Growth Provision of Infrastructure Proposed Plan Changes 64-71

Report prepared by: **Brett Walker (NZCE, REA) Infrastructure Engineer, Marlborough District Council and Mark Wheeler (B.Com) Manager, Assets & Services, Marlborough District Council**

Purpose

This report provides an overview of work undertaken by Council's Assets & Services Department to establish concepts for the water, sewer and stormwater servicing of the proposed Plan Change areas, management of the sequencing of development and its funding.

Roads

Transportation effects of the Proposed Plan Changes on roading network are separately considered by GHD New Zealand.

"Accepted Services Plan"

Work to date has established initial infrastructure concept plans which can now be subject to more detailed survey and engineering design to finalise an "Accepted Services Plan". This Plan will be prepared by Council and include:

(a) "Essential Connections" – the road network and road widths.

(b) Routes for reticulation – piped and open channel – utilising the road corridor where feasible.

(c) Reticulation capacity requirements – pipe sizes, channel profiles, stormwater storage pond capacities, pump station capacities.

(d) Land to be acquired or easements to be created outside the road corridor.

Maps of the proposed Plan Change areas showing summarised concepts plan for infrastructure are attached. These will be the basis for the detailed "Accepted Services Plan", which will be finalised as the Plan Change areas are developed.

Design standards/levels of service

The Accepted Services Plan is consistent with Council infrastructure design standards as described in the following Council documents:

- Long Term Plan 2012-22
- Asset Management Plans
  - Water
  - Sewer
  - Stormwater

- Wairau/Awatere Resource Management Plan
- Code of Practice for Subdivision and Land Development and NZS 4404:2004.

Hydraulic modelling has been extensively used to ensure future sewer and water upgrades are identified and levels of service and funding requirements can be met.

The road network standards are generally consistent with the above but also the recommendations of the 'Growing Marlborough Strategy" and the further work of Urbanismplus Limited for Council "Essential Street Connections – Blenheim Residential Growth Areas" and the principles described therein which are:

- Maximise connectivity for all transport modes.
- Create layouts that are legible and easy to understand for all users.
- Create networks that encourage walking and cycling.
- Create networks that are able to facilitate (future) public transport services.
- Avoid conflicting right-turns between T-intersections in close proximity to each other.
- Favour cross intersections over T-intersections. Apply small off-sets of the carriageways within the road reserves to force the traffic that has to give way to stop or slow down.
- Avoid roundabouts in areas with high pedestrian and cycling traffic.
- Minimise dependencies between landowners and maximise opportunities for independent and efficient development by individual landowners, while maximising connectivity and coherence. Practically this means that where possible each property should be connected to an existing public street via as few other properties as possible. It also means that connections are projected at the distance of the depth of a residential lot from the property boundary in order to use development to enable the connection.
- Create layouts whereby fronts of properties/dwellings face other fronts across a public street and backs face backs, while avoiding rear lots.
- Create layouts that set up as many north-south blocks (and hence east-west lots) for optimum solar access to all properties.
- Assume the retention of existing dwellings and the areas immediately surround those.

Funding Infrastructure required for development

Funding is required to enable the new development areas to be serviced according to the "Accepted Services Plan" and to undertake upgrades to "downstream" infrastructure to cope with the extra demands created.

Council has policies and provisions in place under both the Resource Management and Local Government Acts to ensure developers fund the required services and upgrades.

There are several ways the developer will do so:

(a) Developer construction of infrastructure according to the "Accepted Services Plan" within their own development area and adjacent to that to connect to Council's existing infrastructure.

(b) Payment of contributions levied under the Council's "Financial and Development Contributions" policy from its Long Term Plan 2012-22.

Development contributions ensure that upgrades to Council infrastructure, normally "downstream" of the development area but attributable to the extra demands of the development, are funded equitably.

(c) Payment of "Zone Levies", where appropriate.

The "Accepted Services Plan" will ensure that across new development areas the most efficient and effective infrastructure is installed. Design should consider the wider area and not necessarily just the particular developer owned area. This approach will mean pipelines may have different capacities within a particular area than they would if that area was simply servicing its own area alone. Similarly roads will vary in width and design depending on their role for the wider area rather than what would be built just for a smaller area on its own.

Ultimately the construction of services in this way will provide higher standard developments with much better connectivity and at reduced cost than the alternative. That alternative would be a collective of smaller areas built to minimum specifications with no thought to connectivity or any ability to accept traffic or reticulate the three waters to service other areas.

Another way of looking at this is to consider the situation if one developer owned the whole development area. That developer would design to Council standards but bear all zone costs. Levies would not be necessary.

An overall plan, similar to the "Accepted Services Plan" to Council approval would still be required, but the one developer would construct it.

The "Zone Levy" ensures that the additional cost imposed on a developer if they are required to construct an infrastructure component above the normal standard for just their development, is shared by all new lots in the wider area eg; Developer A must construct a 12 m wide road to enable connection in future to other development areas (B). His 20 lot development would if standalone only require an 8 m wide road.

The cost of the extra width is spread across the whole wider area.

Thus (A) will receive a credit for that extra cost. (A) and (B) areas will pay for that through a Zone Levy.

The "Zone Levy" system has been successfully used in the northwest of Blenheim for over 10 years.

Council acts as "banker" for this system.

Sequence of development

Council is seeking eight Plan Changes for seven (7) areas.

Some but not all are contiguous.

There are upgrades required to either existing Council infrastructure or within other proposed development areas downstream of the area being developed before some areas can be further developed.

Council's downstream upgrades need to be managed carefully to endeavour to avoid delays to upstream developments. Development contributions and Zone Levies will fund the development share of the upgrades – payable as lots are available for sale.

The market is the best determinant of the timing for new areas development ie; demand for sections in that area.

Council will endeavour to enable that market demand to drive the sequence of development where that is practically and economically feasible. It may not be practically or economically feasible in the following circumstances:

(a) Several areas wish to commence development over a short timeframe forcing expensive downstream upgrades of Council infrastructure in a short timeframe.

(b) Downstream development areas required for services or road connections have not installed those necessary connections and the developer will not fund the downstream work required.

It is expected that the market will control the number of developments occurring over a short timeframe and the above delays would be unlikely.

Summary

Council engineers and planners have considered the infrastructure requirements of the proposed Plan Change areas. Concept designs have been prepared which can now be subject to more detailed survey and design.

Levels of service and standards will meet Council's Long Term Plan, Resource Management Plan, Asset Management Plans, Code of Practice and "Growing Marlborough Strategy" aspirations.

Funding will be equitably provided by developer construction, development contributions and zone levies which have been applied successfully to previous Blenheim developments.

Sequencing can be largely determined by market requirements but Council does have the ability to control its upgrade expenditure demands.

In summary infrastructure for the new zones is manageable and will be effective.

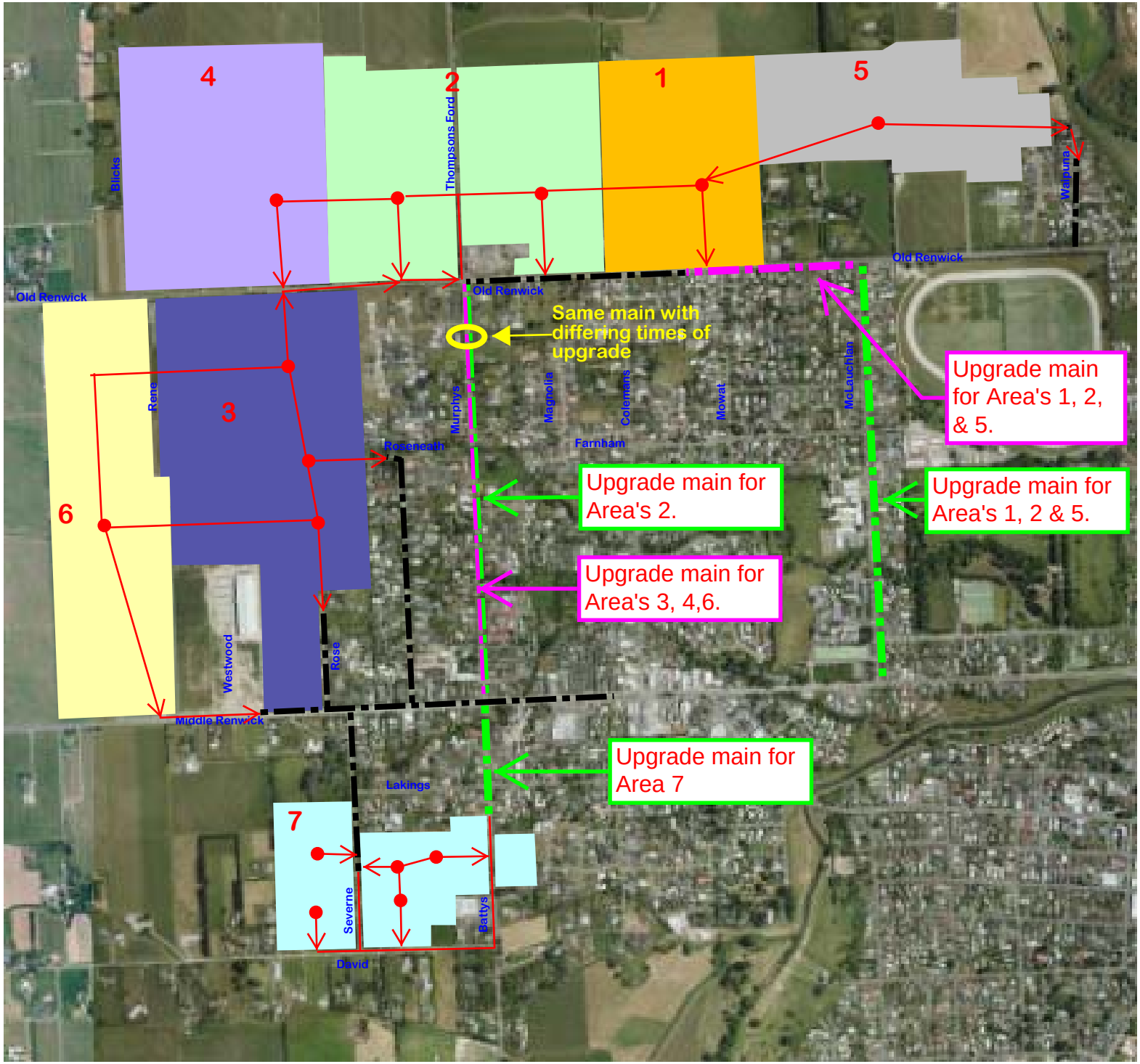
BRETT WALKER
MARLBOROUGH DISTRICT COUNCIL – INFRASTRUCTURE ENGINEER

MARK WHEELER
MARLBOROUGH DISTRICT COUNCIL – MANAGER ASSETS AND SERVICES

Dated: 5 June 2013

24/05/13

WATER DIAGRAM



Legend

Upgrade required prior to start of Development

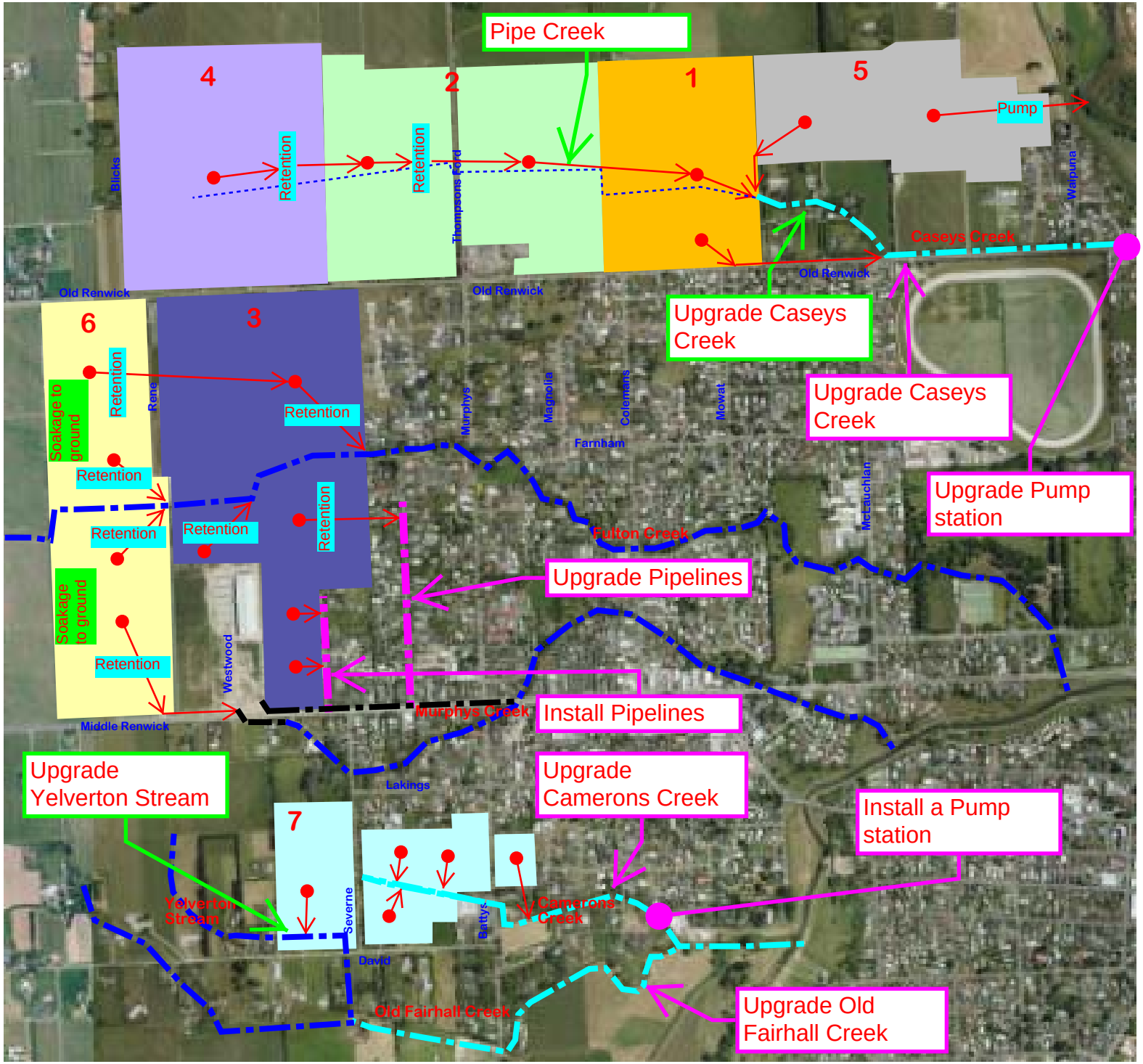
Upgrade required as Development progresses

Point of supply for each Area from existing infrastructure

Indication of where existing infrastructure runs

24/05/13

STORMWATER DIAGRAM



Legend

Upgrade required prior to start of Development — Pipe lines / Waterway

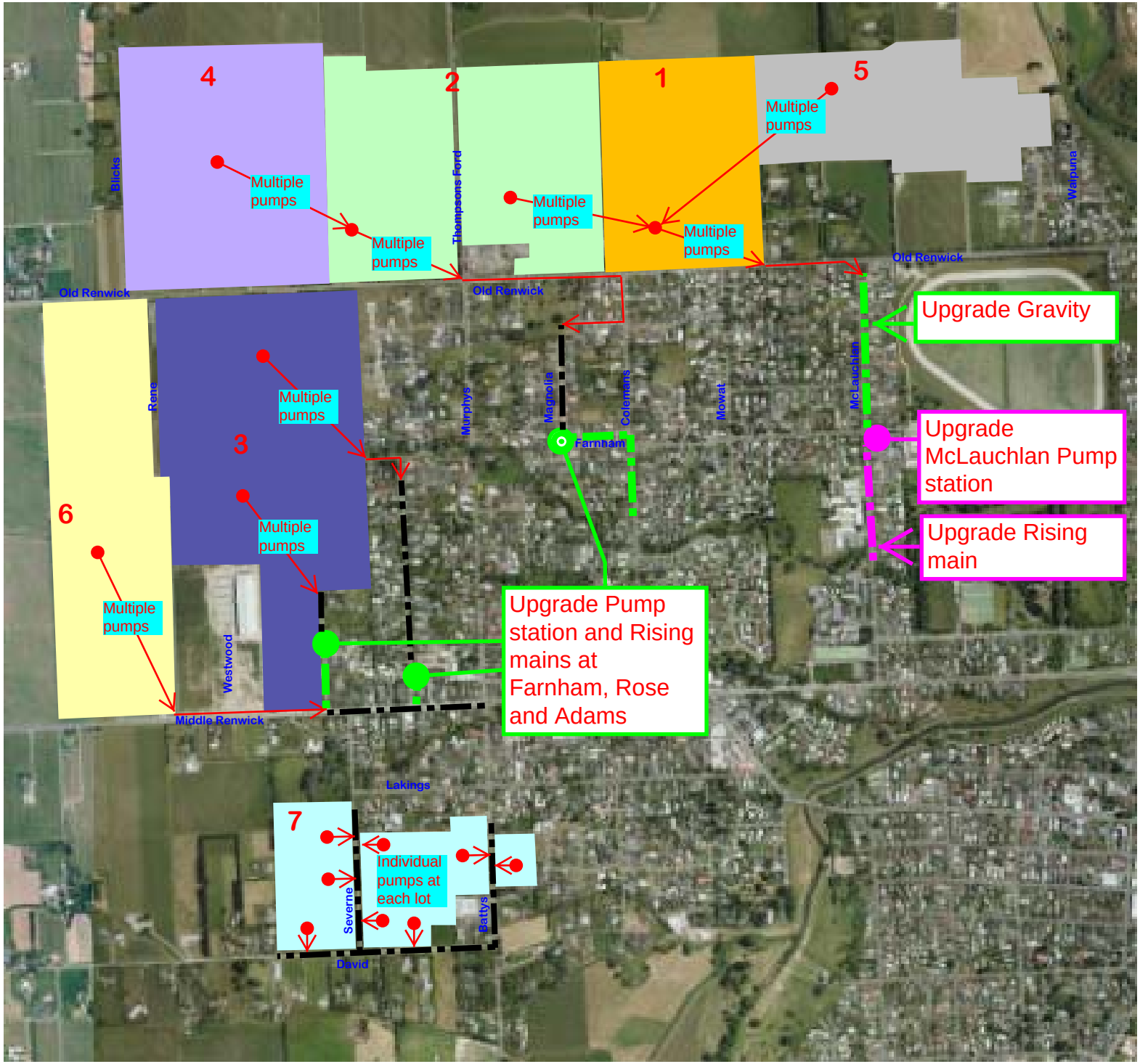
Upgrade required as Development progresses

Direction of where Stormwater from each Area is to discharge to existing infrastructure

Indication of where existing infrastructure runs — Pipe lines / Waterway

23/05/13

SEWER DIAGRAM



Legend

Upgrade required prior to start of Development

Upgrade required as Development progresses

Direction of where Sewer from each Area is to discharge to existing

Indication of where existing infrastructure runs

Appendix 7

Marlborough District Council

Residential Plan Changes

Transportation Effects

June 2013

Executive summary

Marlborough District Council has engaged GHD to undertake an assessment of the transportation effects of the proposed Plan Changes 65 to 71 to rezone rural land to residential land.

In order to continue to grow, more residential land is required to meet the demands for residential housing. Council have undertaken a growth strategy study which has identified that an additional 1434 greenfield dwellings are required.

Council has identified seven growth areas in the north and west of Blenheim which will accommodate up to 1806 households. The residential growth will be complimented by a growth in employment and it has been assumed that the areas adjacent to Omaka and Woodbourne will be developed together with the identified areas for large format retail. Additional commercial employment has been assumed to continue to grow in the existing locations.

An Essential Street Connections report by Urbanismplus Limited has provided an indicative roading layout in each of the proposed growth areas and the Wairau Plains transport model has been used to quantify the associated traffic effects of the residential growth. Twelve scenarios have been developed. The first seven scenarios are for the effects of each development area individually. Scenarios 8, 9 and 10 are for a total of 30% development, but with alternative distributions. Scenario 11 is for 60% development and the final scenario is for full development.

The sensitivity tests for alternative distributions did not show a significant difference in the staging of any required mitigation works.

Road Widening

The following roads or sections of road have been identified as requiring widening and/or other features to accommodate the expected increases in traffic volumes.

- Old Renwick Road will require additional features such as kerb and channel, footpaths and on street parking on both sides of the road while maintaining two 3.5 m wide traffic lanes to create a more urban environment. This work will be able to be accommodated within the 17 m road reserve.
- Due to the narrow width of Colemans Road no stopping restrictions should be installed so that two traffic lanes are available at all times. Alternatively road widening could be undertaken to allow for on street parking. There is sufficient width within the road reserve to accommodate this.
- Nelson Street (SH6) between Battys Road and Boyce Street will require four laning prior to 30% of the residential uptake being undertaken, or by around 2020.
- Boyce Street will require widening to four lanes by around 2027.
- Passing lanes will be required on SH6 between Blenheim and Renwick by around 2027.
- Murphys Road will require monitoring once 60% of the development has occurred as while the flows will be within the capacity of a two lane road driver frustration may occur.
- SH6 in Woodbourne will require right turn bays to be installed at all intersections to allow right turning vehicle a safe position to wait for a gap to turn while not impeding through vehicles.

Intersection Improvements

The following intersections have been identified as requiring reviewing and/or upgrading works as a result of the increased traffic flows.

- The SH6 intersections of Battys Road Colemans Road and Boyce Street are already under investigation and will definitely require improvement within a few years of residential development occurring on the proposed sites. These intersections will require dual lane roundabouts by around 2020 and possible signalisation around 2035.
- The SH6 intersections with Severne Street and Adams Lane will require reviewing around 2020. At this time they should be upgraded to single lane roundabouts, however once the areas are fully developed dual roundabouts will be required.
- The New Renwick / Battys Road intersection will require improvements at around 2027.
- The SH6 / Westwood roundabout will require dual laning around 2035.
- The intersections on Old Renwick Road should be able to remain as priority controlled, however by 2035 the Battys Road, Colemans Road, Mowat Street, McLauchlan Street and Waipuna Street intersections may need reviewing.

Other Management Tools

It is recommended that as the level of development in the area increases the posted speed limit on Old Renwick Road between Waipuna Street and Rene Street and other locations as required should be reviewed periodically to ensure that they are appropriate.

Safety

No specific safety measures have been identified as they are intrinsically linked to the capacity of a road and/or the intersection and driver behaviours. By implementing the works discussed above the level of service will improve and as a consequence any increase in the crash rate as a result of the increased traffic volumes can be expected to be mitigated.

Overall the suggested improvements will adequately mitigate adverse effects in respect of capacity and consequently safety as a result of the increased traffic movements generated by the growth areas.

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Appendices

1. Introduction

1.1 Background

Following the completion of the South Marlborough Urban Growth and Development Strategy and the earthquakes across the Canterbury region, the Marlborough District Council commissioned extensive geotechnical testing of the areas proposed to accommodate Blenheim's urban growth over the next decades. The testing identified that the proposed growth areas east of the town are prone to liquefaction in the event of an earthquake.

A revised Growth Strategy was undertaken in late 2012 and identified land in the northwest and west of Blenheim for preferred residential growth. Land around Omaka Aerodrome and Woodbourne Airport was identified as the preference for employment growth.

1.2 Purpose of this Report

The purpose of this report is to assess the transportation effects of road and intersection capacity and safety on the existing roading network from the proposed residential growth areas. Seven separate residential areas have been identified and each area has been assessed both singularly and collectively. The existing Wairau Plains Transport Model has been used to assess the effects.

1.3 Scope and Limitations

This report assesses the transportation effects of the proposed residential land changes only. It includes an associated growth in infill residential land and the required employment growth to accommodate the residential effects. However no analysis has been undertaken for the specific effects of the proposed employment areas.

1.4 Other Reports

This report has been developed while being cognizant of the Essential Street Connections report by Urbanismplus Limited which has provided an indicative roading layout in each of the proposed growth areas and identified the key connections to the existing arterial roading network.

2. Existing Environment

2.1 District Plan Road Hierarchy

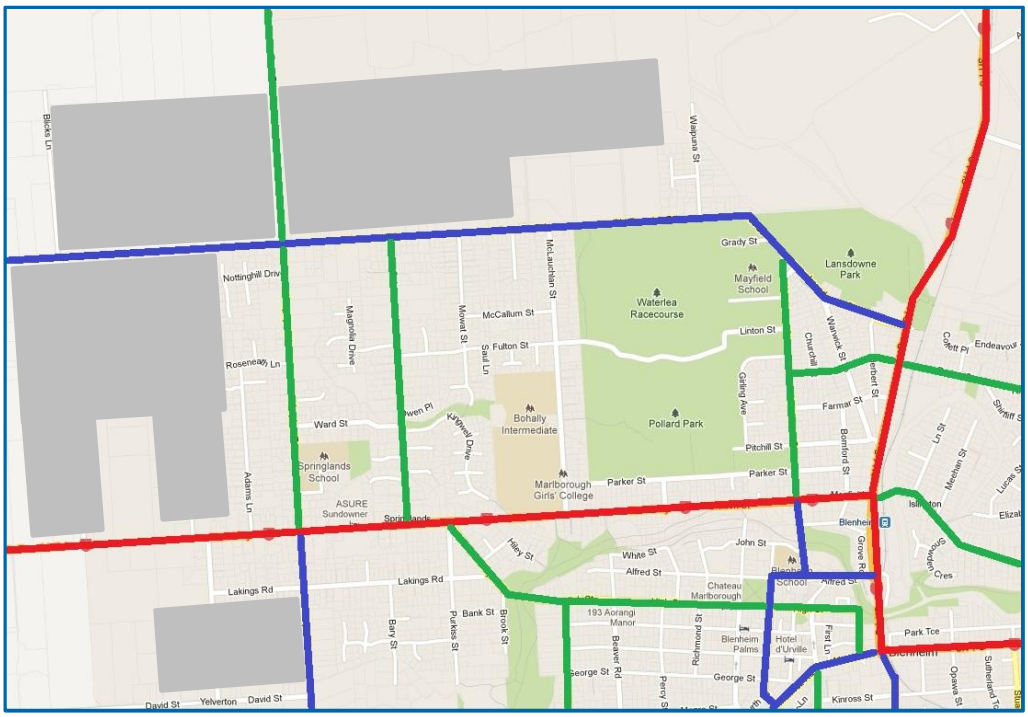
Section 27.2.1 in the District Plan provides the road hierarchy for Blenheim. All roads are classed as local roads unless otherwise specified. Table 1 provides the road classification of roads in the vicinity of the sites under review.

Table 1: Road Classifications within Study Area

Classification	Road Name
National Routes	SH1, SH6, SH63
Primary Arterial Routes	SH62 (Rapaura Road)
Secondary Arterial Routes	Old Renwick Road, Dodson Street, Fell Street, Battys Road
Collector Routes	Thompsons Ford Road, Murphys Road, Colemans Road, Hutcheson Street, Budge Street, Boyce Street

The road hierarchy is shown below.

Figure 1: Road Classifications



National routes are shown in red, arterial routes blue and collector routes green. The residential growth areas are shown in grey.

2.2 Existing Traffic Volumes

The Marlborough Roads traffic count database has been examined for traffic counts in the area.

Regular counts have been assessed to review the daily flow and associated traffic growth. These are tabulated below:

Table 2: Daily traffic Flow and Growth Rates

Traffic Count Location	from	to	2012 ADT	Annual Growth Rate
Boyce Street	Narrowing	Lakings Road	9200	0.1%
Hutcheson Street	S.H.6	Parker Street	5700	1.2%
Old Renwick Road	Lansdowne Street	Waipuna Street	3700	2.0%
Murphys Road			2600	0.8%
Dodson Street	Lansdowne Street	S.H.1	2900	0.0%
Colemans Road	Owen Place	Fulton Street	2800	2.3%
Thomsons Ford Road	Old Renwick Road		1200	1.3%
Hutcheson Street	Auckland Street	S.H.6	6800	0.7%

The average growth rate was 1.1% per annum.

2.3 Existing Road Widths

The road widths of key roads within the study area have been extracted from the Marlborough Roads RAMM database. The road and seal widths are tabulated below:

Table 3: Existing Road Widths

Locatio	from	to	Carriageway	Reserve
Boyce Street	Middle Renwick	Narrowing	21.9	30.4
Boyce Street	Narrowing	Lakings	13.0	
Hutcheson Street	Nelson	Parker	13.1	20.5
McLauchlan	Nelson	Old Renwick	11.6	20.4
Old Renwick Road	McLauchlan	Mowat	7.9	16.9
Murphys Road	At Old Renwick		7.6	14.4
Colemans Road	Ruthken	Fulton	9.4	20.0

Boyce Street widens at Nelson Street to a sealed width of 21.9 m and a road reserve of 30.4 m to accommodate additional turning lanes.

2.4 Existing Road Descriptions

Middle Renwick Road (SH6)

State Highway 6 is a national route that runs in an east-west direction. It connects State Highway 1 to Woodbourne airport, Renwick and beyond. Between SH1 and Boyce Street, SH6 is known as Nelson Street. West of Boyce Street it changes name to Middle Renwick Road.

Between SH1 and Severne Street, SH6 has a posted speed limit of 50 km per hour. West of Severne Street the posted speed limit is 100 km per hour.

Nelson Street and the urban area component of Middle Renwick Road has a 25 m road reserve. Footpaths and berms are located on each side of the road, together with parking and a flush median. A typical profile is shown below:

Figure 2: Nelson Street west of McLauchlan Street

The Nelson Street intersections with SH1 and Hutcheson Street are roundabout controlled. The remaining intersections are priority controlled with priority to SH6. Intersection improvements are planned for the three intersections in Springlands, namely the Boyce, Colemans and Battys Road intersections. It is likely that one or more of these intersections will be altered to roundabout control in the future.

In the rural area, Middle Renwick Road has a road reserve of around 20 m. A typical profile is shown below:

Figure 3: Middle Renwick Road east of St Leonards Road

The recent development known as Westwood has resulted in a large rural roundabout being constructed at entrance to the development.

Old Renwick Road

Old Renwick Road is a secondary arterial route. It runs parallel to and north of Middle Renwick Road. Old Renwick Road connects to SH1 via Fell Street, Lansdowne Street and Dodson Street in the east.

All intersections on this route are priority controlled with the priority on the arterial route.

Old Renwick Road between Fell Street and Waipuna Street has a posted speed limit of 50 km per hour. Between Waipuna Street and Hammerichs Road the posted speed limit increases to 70 km per hour. Along this section, Old Renwick Road has residential properties on the southern and larger rural properties on the northern side. The southern side of the road has kerb and channel and footpath, however the northern side of the road has none of these features. A typical profile is shown below:

Figure 4: Old Renwick Road east of McLauchlan Street

West of Hammerichs Road Old Renwick Road has a posted speed limit of 100 km per hour.

The road reserve of Old Renwick Road varies between 20 m at Lansdowne Street to 17 m between Waipuna Street and Murphys Road and reduces to 15 m west of Murphys Road. The sealed width is approximately 8 m for the entire length of road.

A power station is located on the north east corner of Old Renwick Road and Thomsons Ford Road.

Murphys Road

Murphys Road is a collector road that carries around 2,600 vehicles per day and connects Old Renwick Road to Middle Renwick Road. It changes to Thomsons Ford Road in the north, giving access to Rapaura Road, and to Battys Road in the south, providing access to New Renwick Road. Together these three roads provide a major north-south connector.

All the intersections on this route are priority controlled.

Murphys Road has a posted speed limit of 50 km per hour. The sealed width varies between 7.6 m and 10.6 m. The road reserve north of Roseneath Lane is 18.5 m. South of the lane the road reserve reduces to 14.4 m.

Springlands School is on Murphys Road. South of the school the road has footpaths on both sides, however north of the school there is only a footpath on the eastern side.

Colemans Road

Colemans Road is a collector road that runs parallel to Murphys Road between Middle Renwick Road and Old Renwick Road and carries around 2,800 vehicles per day.

Colemans Road has a posted speed limit of 50 km per hour. It has a legal road reserve of approximately 20 m with a seal width of 5.6m between Fulton Street and Old Renwick Road. South of Fulton Street the sealed width varies between 9.3 m and 12.4 m at Middle Renwick Road.

A typical northern section of Colemans Road is shown below:

Figure 5: Colemans Road north of Farnham Drive

As can be seen above the carriageway is narrow with parking allowed on both sides of the road, however generally vehicles appear to park off street.

Hutcheson Street

Hutcheson Street is a collector road between Lansdowne Street and Alfred Street. The road reserve north of Middle Renwick Road is 20.1 m and the sealed width varies between 12.1 m and 13.4 m. Hutcheson Road has footpaths on each side of the road.

McLauchlan Street

McLauchlan Street is a local road connecting Old Renwick Road to Nelson Street with a sealed width of 11.6 m and a road reserve of 20.4 m. It has footpaths on both sides of the road.

A typical cross section of McLauchlan Street is shown below:

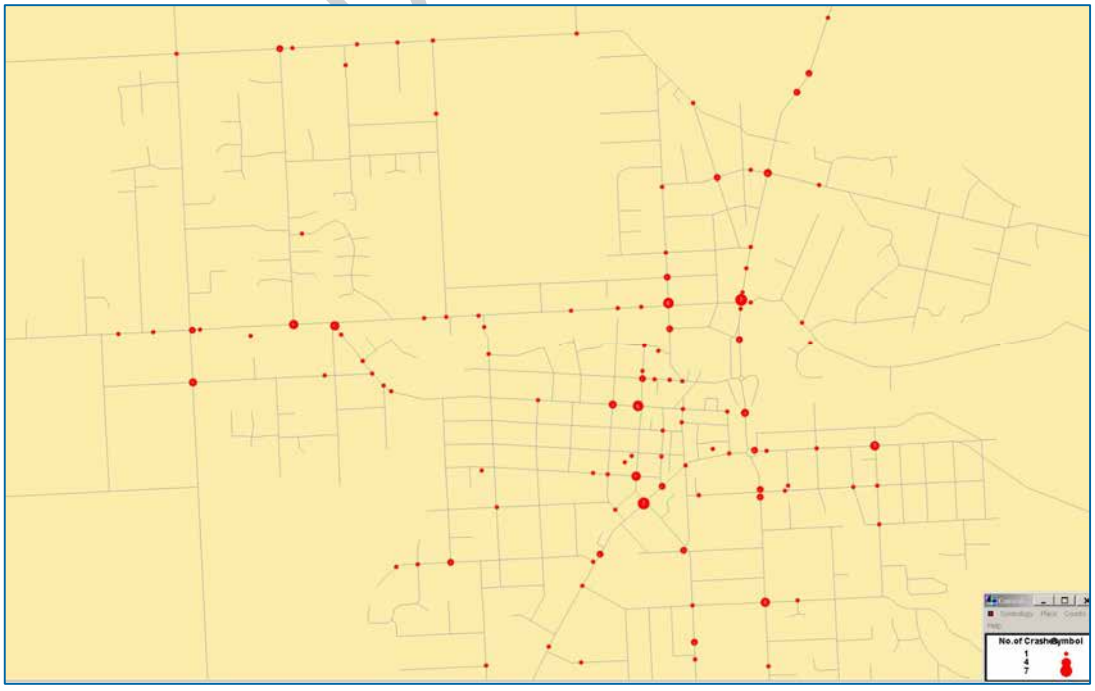
Figure 6: McLauchlan Street north of Fulton Street

2.5 Road Safety

Since 1985 there has been a general downward trend in reported traffic accidents in New Zealand. At the same time that accident numbers have decreased, traffic volumes have increased, indicating that generally accident rates have decreased more than accident numbers.

A search has been made of the NZTA Crash Database for the 5 year period 2008 to 2012 inclusive for crashes within Blenheim. The reported injury accidents within Blenheim are shown diagrammatically below. The larger the red dot, the more injury accidents that have been reported.

Figure 7: Reported Injury Accidents 2008-2012



As can be seen above the intersections with the highest traffic volumes, and conflicting movements, generally have the highest number of reported accidents.

2.6 Recent Traffic Studies

Springlands Intersection Study

Opus Consultants were commissioned by Marlborough Roads to investigate alternative intersection improvements for the Springlands intersections, being:

- Nelson Street (SH6) / Boyce Street
- Nelson Street (SH6) / Colemans Street
- Nelson Street (SH6) / Murphys Road / Battys Road

The assessment showed that roundabouts were justified based on benefits but could not be safely constructed within the existing road reserve and the cost of additional land resulted in low benefit cost ratios.

Council has decided to fund the roundabouts without subsidy from NZTA and the construction of the roundabouts is expected to take place in the 2013/2014 financial year.

SH6 / Bells Road / St Leonards Road

GHD was commissioned by Marlborough Roads to review the safety of the Bells Road / St Leonards Road intersection with SH6.

This high speed intersection has had many crashes, partially due to poor visibility and also the lack of turning bays on SH6.

Five options for addressing safety were considered with one option recommended to be progressed further to the Design and Project Documentation stage.

The recommended option is for head to head right turning bays with the carriageway being widened on the southern side of the State Highway 6 (SH6), and it requires the purchase of 690 m^2 of private land to accommodate the proposed works. It was also recommended to remove the road hump west of the intersection to improve visibility.

There is no indication as to whether this project will proceed or not at the time of writing.

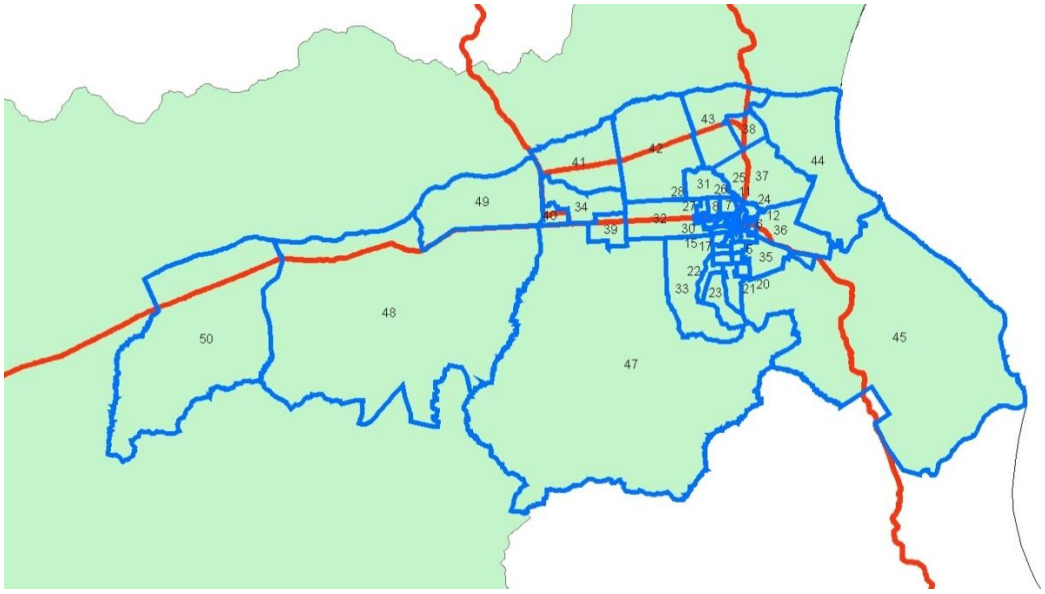
3. Wairau Plains Transport Model

3.1 Background

A transport model was built in 2008 to enable future traffic flows in the Wairau Plains area to be predicted based on future land use assumptions. The model was been validated against a 2006 base year and was been peer reviewed by SKM Ltd. Full details of the procedures and parameters, together with the detailed validation data is reported in a separate Transport Model Report, dated January 2008. The model uses the SATURN suite of software.

The model predicts trip generation and attractions within each zone of the model based on land use assumptions and calibrated trip generation rates. The trips are then distributed to the other zones based on the attractiveness between two zones (a combination of the number of trips and the travel cost). The final matrix is then assigned to the network based on an iterative process. The travel times within the network are then updated during each iteration based on the flows and capacities on individual links.

Figure 8: Model Zone Boundaries



The computer model of the Blenheim road network contains all the important roads within the study area that are judged to possess a significant traffic function.

The road network is represented to the computer by “links” or sections of roadway that join the “nodes” which are either locations where trips begin or end (the traffic zones), or actual intersections in the street system. As the computer model is prepared on the basis that all of the traffic originating or destined to a zone appears at a single point (the zone centroid), additional false links are included to represent the many subdivisional streets that connect the zone to the arterial system.

Thus there is not necessarily a one-to-one relationship between the links in the computer model and actual streets on the ground.

The model has two time periods; a morning peak hour (8:00-9:00) and an evening peak hour (4:30-5:30).

The model has been validated based on all available traffic data. The validation results showed that the model is able to perform well within the levels of accuracy that can be practically achieved within the assumptions made. The model is capable of predicting flows on the important arterials as well as the individual turning movements at the significant intersections

within an overall accuracy of approximately ±20%, which readily meets the tolerances necessary for this strategic level assessment.

The transportation model is able to provide an account of the major effects including in particular, the primary influence of alternative land uses within and around Blenheim and the Wairau Plains.

It should also be emphasised that the accuracy of a future prediction will be correspondingly less certain. The precise prediction of the large number of influences that impinge on urban travel demands by motor vehicles relies principally on being able to predict the base land use variables rather than the analysis procedure. Moreover, future predictions are based on the assumption that current habits will persist or that the changes in these habits will be sufficiently small to be ignored. Any estimates of future travel produced by the model must then be interpreted with care.

The land use file to run the Wairau Plains transport model requires the following information:

- Total number of households in each zone;
- Average household occupancy (persons in each household);
- Average car ownership (cars owned per household);
- Total employment in the zone;
- Total retail employment (as a subset);
- Total education jobs (as a subset); and
- Total worked from home.

The 2008 model has a 2006 base year where the land use data is based on the 2006 census land use data.

The travel patterns within the model are based on the land use activities within each zone.

3.2 2013 Update

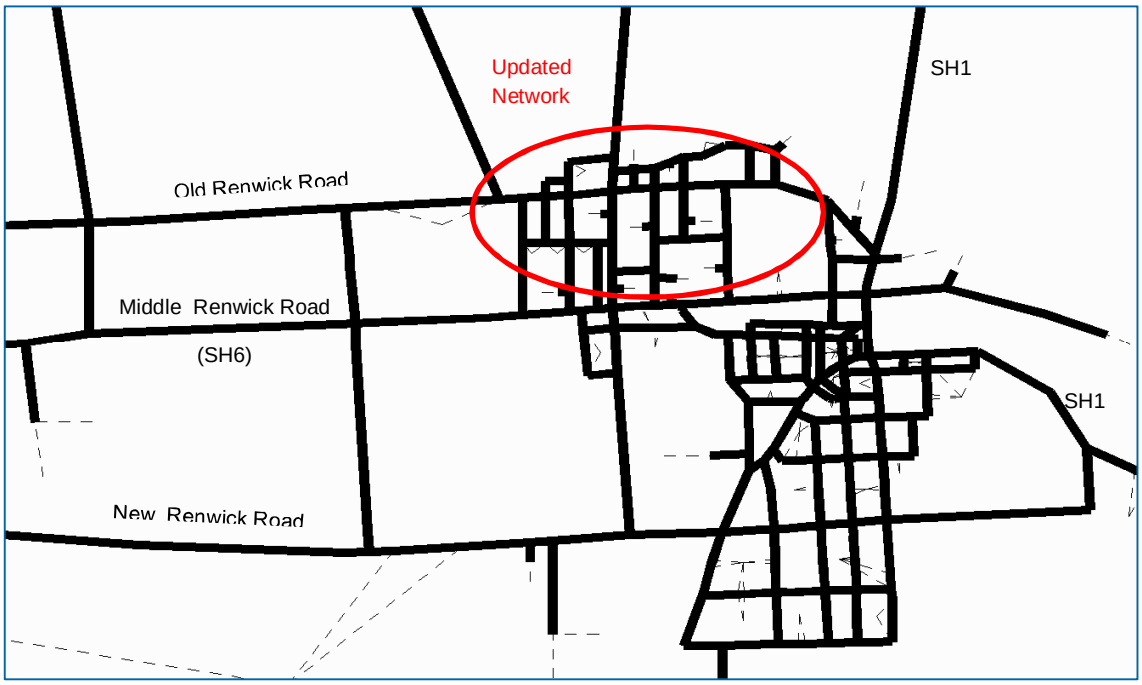
The 2006 validated base model was updated to a 2012 base model as part of this project. The 2012 model includes the following:

- New residential houses based on building consents
- Westwood Retail area
- Refined zone structure around the northern periphery of Blenheim
- Allowance for the future growth areas

The number of zones in the model has increased from 56 to 76 as a result of dividing the larger zones in the north to smaller zones and allowing for the growth areas.

The updated model network is provided below:

Figure 9: Updated Network Layout



3.3 Do-Minimum Network

The base 2006 calibrated network has been used as a basis for a do-minimum network. In accordance with the Land Transport New Zealand Economic Evaluation Manual, the do-minimum network consists of all committed works. It has been assumed for modelling purposes that these "committed", works include:

- Colemans / SH6 – upgraded to roundabout
- Boyce / SH6 – upgraded to roundabout
- Battys / SH6 – upgraded to roundabout
- Kinross / Redwood – upgraded to roundabout

In addition to these works, a certain minimum level of expenditure may be required to maintain a minimum level of service. This minimum level of expenditure is known as the do minimum. It is important not to overstate the scope of the do-minimum and it should only include the work that is absolutely essential to preserve a minimum level of service. .

4. Proposed Growth Areas

4.1 Residential Growth

A revised Growth Strategy was undertaken in late 2012 by Urbanism Plus Ltd and identified land in the northwest and west of Blenheim preferred for residential growth. Land around Omaka Aerodrome and Woodbourne Airport was identified as a preference for employment growth.

Blenheim's Urban Growth Strategy suggests that Blenheim will need an additional 1434 greenfield dwellings by 2031[1]. This amounts to approximately 80 new dwellings per year. Between 1999 and 2005 there was an average of 156 new dwellings built each year, of which 57 were on greenfield sites. The number of available infill sites is reducing, hence the need for additional greenfield sites. Seven residential growth areas have been identified as shown below:

Figure 10: Residential Growth Areas

A summary of the land area and number of households estimated to be accommodated on each area is tabulated below:

[1] Page 15, Revision Strategy for Blenheim's Urban Growth, Urbanismplus Ltd.

Table 4: Residential Growth Areas

Area	Size	Households	Proportion of Total
1	22.20 ha	222	12%
2	39.02 ha	351	19%
3	44.69 ha	389	22%
4	33.82 ha	238	13%
5	20.59 ha	206	11%
6	32.25 ha	270	15%
7	18.26 ha	130	7%

The total number of new greenfield sites provided by these seven areas is 1806.

Between 2006 and 2010, 12 percent of new households within Blenheim were infill and it has been assumed that this will continue for the purpose of this analysis.

There are still 936 existing residential greenfield sites available for development within Blenheim and it has been assumed that these will be developed concurrently with any new greenfield sites from the seven identified areas. Residential development will also continue in Renwick, and it has been assumed that the existing level of uptake will continue.

The development of all infill, existing and proposed greenfield sites is expected to result in the construction of 3431 new dwellings. The 3431 new households will come from the following areas:

Table 5: Future Household Locations

Existing Greenfield	New Greenfield Areas	Renwick	Infill	Total
936	1806	327	362	3431

4.2 Employment Growth

The residential growth requires a similar level of growth in employment to be sustainable.

The 2006 level of employment was 1.01 jobs per household and it has been assumed that this will continue for the purpose of this analysis. 21% of all employment was in retail.

The 2006, 2012 and resulting future land use activities in the model study area are summarised below.

Table 6: Required Employment Levels

	Households	Total Employment	Retail Employment	Education Employment
2006	11903	11997	2504	780
2012	12926	13028	2719	847
Future	16357	16487	3440	893
Difference	3431	3459	722	47

The table above assumes that all greenfield sites are developed (existing and proposed) and the assumed proportion of infill, and Renwick development occurs, together with a level of employment consistent with the residential household uptake.

The growth strategy identified several possible employment areas which are discussed below.

Omaka Employment Areas

The Omaka employment areas (Areas 10, 11 and 12) are considered suitable for industrial employment. Area 11 is subject to an appeal to the Environment Court as the owners of the site would like to re-zone the land to residential. Whether Area 11 will be developed for residential or employment land uses will be dependent on the outcome of that appeal.

Figure 11: Omaka Employment Areas

Woodbourne Employment Area

The Woodbourne employment area (Area 14) provides approximately 15 hectares of land for employment purposes near the airport at Woodbourne. The site has good connection to the state highway, is well serviced and is currently used for rural purposes.

Figure 12: Woodbourne Employment Area

Retail Employment

In addition to the industrial areas identified there are four locations identified as being suitable for large format retail activity in the vicinity of Blenheim. These locations will not be rezoned as part of this plan change however the identification of these locations is important in determining likely destinations for trip distribution for retail purposes from residential areas.

Summary

The following assumptions have been made with respect to employment growth:

- The level of employment will remain constant to that surveyed in 2006
- The new employment zones will accommodate 28 persons per hectare (average employment densities for industrial zoned land)
- While no resource consent applications have been made to enlarge the existing Westwood development, it is considered that the vacant sites will be occupied in the future. For the purpose of this study, an increase of 75% retail employment was used.
- The four large format retail areas identified will each provide 100 jobs once fully developed
- The location of the remaining new employment will be proportional to the existing employment.

The required 3459 new jobs will be in the following areas:

Table 7: Employment Locations

New Industrial zones	New Large Format Retail zones	Westwood	Infill	Total
1876	400	113	1070	3459

In keeping with the existing employment ratios a total of 722 retail and 46 educational jobs are required within the total of 3459 jobs.

4.3 Scenario Land Use Activities

As each growth area is being assessed individually, it has been assumed that with each growth area, a proportion of the existing greenfield, infill and Renwick households will be occupied.

The resulting new land use activities in each of the seven scenarios assessed are tabulated below:

Table 8: New Land Use Activities per Scenario

Scenario	1	2	3	4	5	6	7
Existing Greenfield and infill	156	248	275	168	145	191	92
New Greenfield	222	351	389	238	206	270	130
Renwick	44	68	75	46	40	52	25
Total Employment	426	672	745	455	395	517	249
Retail Employment	89	140	156	95	82	108	52

Each scenario can then be modelled within the transport model to determine the effects of a particular area being fully developed. The effect of all the areas being fully developed can be estimated based on the cumulative effects. It is also possible to determine the effects of each area being partially developed by proportionally adding the effects.

The distribution of the new households by zone, are detailed in Appendix B.

The distribution of the new employment, by zone, is detailed in Appendices C, E and F.

5. Level of Service

The capacity of a roadway varies according to a wide range of influences including the road type, location in the network and the nature of adjoining land uses. Urban roads are limited by the capacity of downstream intersections, whereas the capacity of rural roads is principally determined by alignment and geometries.

The term Level of Service is provided to characterise operational conditions within a traffic stream and their perception by motorists and passengers. Six Levels of Service (LOS) are defined with A representing the highest level, and F the worst. As traffic volumes increase, the level of service decreases. For most design or planning purposes, service flow rates of C are typically used. Investigation for improvement works is typically triggered once service flow rates reach E. The following general statements describe the various Levels of Service.

- LOS A describes primarily free-flow operations. Vehicles are seldom impeded in their ability to manoeuvre in the traffic stream. Delay at intersections is minimal.
- LOS B represents reasonably unimpeded operations at average travel speeds. The ability to manoeuvre in the traffic stream is only slightly restricted and delays are not bothersome.
- LOS C represents stable operations; however, ability to manoeuvre and change lanes in midblock locations may be more restricted than in LOS B, and longer queues, adverse signal coordination, or both may contribute to lower average travel speeds.
- LOS D borders on a range in which small increases in flow may cause substantial increases in approach delay and hence decreases in arterial speed. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or some combination of these.
- LOS E is characterised by significant delays and average travel speeds of one-third the free-flow speed or less. Such operations are caused by some combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.
- LOS F characterises arterial flow at extremely low speeds, from less than one-third to one-quarter of the free-flow speed. Intersection congestion is likely at critical signalised locations, with long delays and extensive queuing.

As traffic volumes increase, the Level of Service decreases, i.e. traffic volumes are highest in LOS F.

5.1 Rural Roads

The capacity of a rural road is dependent not only on the traffic volume in the direction of travel, but also on the traffic volume in the opposite direction, as passing opportunities diminishes. As the directional split moves away from 50/50 'ideal' conditions, the total two-way capacity is reduced. The highest volume attainable under Level of Service C and E is shown below:

Table 9: Rural Road Capacities – Two Way flow

Directional split of traffic	Level of Service C (vph)	Level of Service E (vph)
50/50	1,200	2,800
60/40	1,100	2,650
70/30	1,000	2,500
80/20	900	2,300
90/10	800	2,100
100/0	700	2,000

It should be noted that these values will reduce as carriageway cross sections reduce, horizontal curves became sharper, and vertical alignment become more acute.

5.2 Urban Roads

Urban traffic congestion is primarily a result of intersection delay. The difference in travel time between peak periods and non-peak periods is due to the increased pressure at intersections.

The capacity of an intersection is defined in terms of delay, which is a measure of driver discomfort, frustration, fuel consumption and lost travel time. The assessed level of delay for each level of service for a signalised intersection, as defined by the US Highway Capacity Manual, is tabulated below:

Table 10: Level of Service at Intersections

Level of Service	Description	Maximum Intersection Delay (sec/veh)	
		Signals and Roundabouts	Priority Controlled
A	Free-flowing	<10	<10
B	Reasonably unimpeded	11 – 20	11 - 15
C	Stable flow	21 – 35	16 - 25
D	Unsettled	36 – 55	26 - 35
E	Significant delays	56 – 80	36 - 50
F	Unacceptable	>80	>50

Generally a Level of Service C provides an acceptable level of delay and is what we have assumed for the Blenheim urban network.

The average delay to motorists at an intersection is a key factor in determining whether an intersection control requires upgrading or altering. In some areas, high intersection delays are acceptable, as a means of reducing through traffic, e.g. local roads and parking streets, a tiered level of acceptable delays therefore needs to be established. Furthermore peak delays over a short amount of time does not warrant additional lanes at an intersection if the intersection is going to be well within capacity for the remainder of the day.

Roundabout Controlled Intersections

Roundabouts reduce the relative speeds of conflicting vehicles and when properly designed involve simple and clear 'right-of-way' requirements. The safety performance of roundabouts is well proven and in many situations can be expected to be better than other forms of intersection control. This is due to a reduced approach speed. If an incident does occur, the severity is often much lower with a roundabout control. Roundabouts are appropriate at intersections with a high proportion or right-turning traffic, as traffic signals at such intersections result in high delays to the through movements. They are also appropriate at 'T' or 'Y' intersections where the major traffic flow turns through a right angle, and multi-approach intersections. Roundabouts may not be successful where traffic volumes are unbalanced where one approach has significantly more traffic than the other approaches. Roundabouts are also not successful in areas of high pedestrian activity and care needs to be taken in areas of high cycle activity. During off peak periods, delays are less than traffic signals, as vehicles are never faced with a red light.

A single roundabout has the capacity to cater for approximately 3,000 to 3,500 vehicles per hour.

Priority Controlled intersections

Priority controlled intersections include both give way and stop controls. Priority is for the main flow and the side road traffic needs to find a gap in the main flow. Delays on the side road are based on the volume of traffic in each direction on the main road, together with any effects from downstream intersections. For example traffic signals close to the priority controlled intersection create a platooning effect as the signals change from red to green. During the red phases, vehicles can typically exit onto the roadway.

The practical traffic volumes associated with Level of Service C for intersections controlled by a give way or stop is shown below:

Table 11: Priority Controlled Intersection Capacity

	Two way Maximum Flows (vehicles per hour)		
Two lane through road	400	500	650
Side road	250	200	100

Higher traffic flows on the main road will result in a lower level of service on the side roads.

5.3 Intersection Performance

As the volumes at an intersection increases, so does the resulting delay. The delay is dependent on the intersection control, together with the number of approach lanes and turning volumes. However below is an approximate guide for the relationship between the total traffic volume at an intersection (sum of all approaches) and the control type.

Figure 13: Intersection Speed Flow Curves

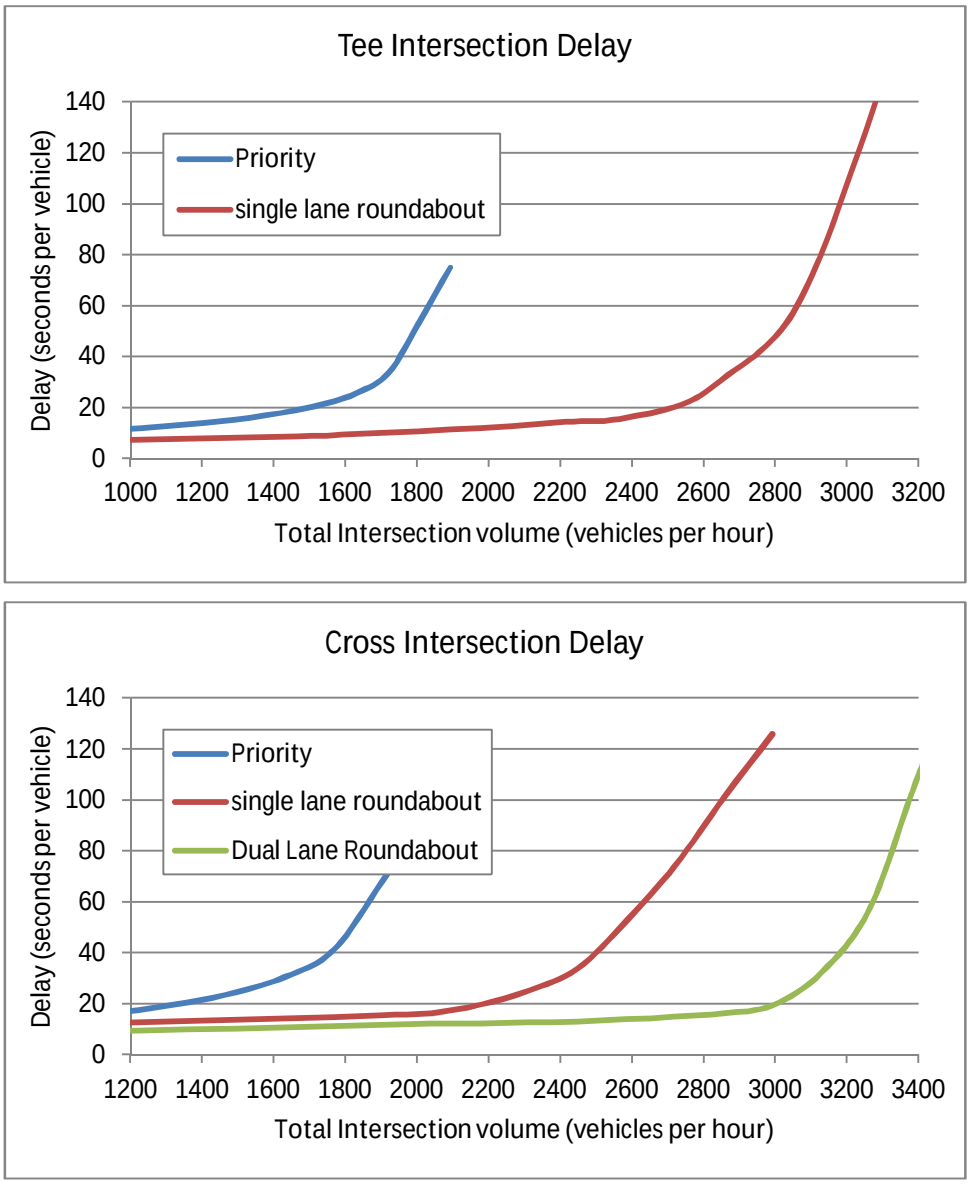


Table 12 provides the approximate intersection flow when Level of Service E is reached and when an intersection will require assessing to undertake improvements to reduce congestion back to a more acceptable level such as Level of Service C.

Table 12: Approximate Intersection Capacity

	Tee Intersection	Cross Intersection
Priority	1750	1720
Single Lane Roundabout	2800	2600
Dual Lane Roundabout		3300

The actual capacity will vary based on individual turning movements and a more detailed analysis should be undertaken on a case by case basis. However this gives a general guidance on when intersection improvement may be needed.

6. Road Design Standards

The requirements for road design are provided for in the Marlborough District Council Code of Practice for Subdivision and Land Development, dated June 2008, which is an addendum to be used in conjunction with NZS4404 Land Development and Subdivision Engineering.

The code is based on NZS4404:2004 with modifications and amendments to suit local conditions. The Standard was updated in 2010. Since its issue NZS4404 has been updated with significant changes to the road design section, however in this instance the Marlborough District Council Code of Practice for Subdivision and Land Development is considered to be the authoritative document.

The Code of Practice requires the Road Design Standards within NZS4404 to be superseded by those within the Council's Resource Management Plan.

Chapter 28 of the Wairau Awatere Resource Management Plan has the Standard Requirements for Subdivision and Development.

The recommended carriageway widths and associated traffic volumes provided in Table 28.1 are repeated in Table 13.

As shown below, urban arterial roads with more than 3,000 vehicles per day require specific design.

Table 13: Subdivision Carriageway Widths

Table 28.1:
Road Classification and Pavement Structure

Classification	Type of Road		Traffic Volume (v.p.d.) or dwelling units (du)	Design Speed (km/hr) (metres)	Recommended Carriageway Width (metres)			Recommended pavement structure. Two layer basecourse construction. Depth (mm) and aggregate type code (See Code of Practice for Subdivision and Land Development D3.2.4, D3.2.5)	
					Parking	Traffic	Total	Lower layer	Upper layer
Local Roads	Urban	Short cul-de-sac (<100 m)	<20	40	1 x 2.0 m	1 x 3.5 m	5.5	100 SBAP60	100 GAP 40
		Long cul-de-sac (> 100 m)	>20		1 x 2.0 m	1 x 4 m	6		
		Minor access	<100		2 x 2.0 m	1 x 3.5 m	7.5		
	Rural		<200		-	1 x 3.5 m	3.5	Use SHPDRM design method	
Collector Roads	Urban		400 - 1000		2 x 2.25 m	1 x 3.5 m	8.0	200 SBAP60	100GAP40
	Rural		200 to	*100	-	2 x 3.0 m	6.0		
	Industrial		1000	50	2 x 2.5 m	1 x 3.5 m	8.5	Use SHPDRM design method	
	Urban		800 to	*100	2 x 2.0 m	2 x 3.5 m	11	200 GAP 40 150 TNZ AP40	
	Rural		3000	50	-	2 x 3.5 m	7.0		
	Industrial		>1000	50	2 x 2.5 m	2 x 3.5 m	12	SHPDRM use design method	
Arterial Routes	Rural		1000 - 4000	*100	-	2 x 3.5 m	7	Use SHPDRM design method	
	Urban		Over 3000	50	Specific design				

* Wherever practicable but not less than 70 km/hr unless topography constrains to a lower speed value. Appropriate controls are then required.

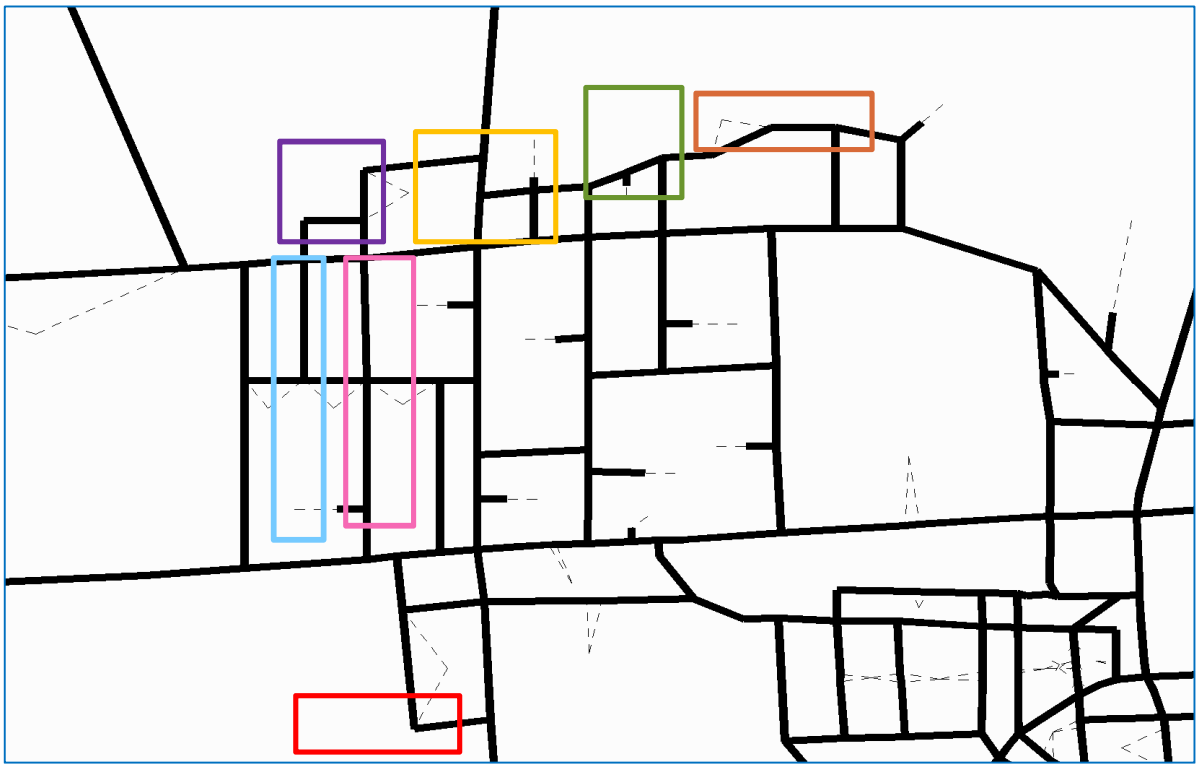
7. Traffic Flows

The Wairau Plains Transport Model has been used to assess the impacts of the plan change on the surrounding roading network. Each of the seven scenarios identified has been assessed individually to assess their individual effects. The effects of a combination of scenarios have also been estimated by using the accumulative effects.

A skeleton network has been prepared in the future residentially zoned land to assess the effects of the trips generated from the proposed residential land on the surrounding network. It should be noted that due to the zone structure and size, internal effects within each area were not able to be fully assessed.

The individual areas are shown below:

Figure 14: Proposed Areas



Where available observed traffic count data exists, the estimated future traffic volume is based on the difference between the 2012 modelled flow and future modelled flow added to the 2012 observed flow.

7.1 Scenarios

Seven different future land use scenarios have been developed within the transport model based on each of the residential areas identified and associated employment growth. These options have then been further developed into five mixed scenarios as it is likely that more than one area will under development at one any time.

Table 14: Scenarios

	1	2	3	4	5	6	7	HH	Description
1	100%	0	0	0	0	0	0	422	Area 1 developed
2	0	100%	0	0	0	0	0	667	Area 2 developed
3	0	0	100%	0	0	0	0	739	Area 3 developed
4	0	0	0	100%	0	0	0	452	Area 4 developed
5	0	0	0	0	100%	0	0	391	Area 5 developed
6	0	0	0	0	0	100%	0	513	Area 6 developed
7	0	0	0	0	0	0	100%	247	Area 7 developed
8	30%	30%	30%	30%	30%	30%	30%	1029	30% of All Areas
9	70%	50%	0	50%	50%	0	0	1050	30 % mainly "north"
10	0	0	70%	0	0	70%	70%	1049	30% mainly "west"
11	70%	50%	70%	50%	50%	70%	70%	2100	60% of All Areas
12	100%	100%	100%	100%	100%	100%	100%	3431	100% of All Areas

The first seven scenarios include each area individually being fully developed, together with associated growth in employment and retail, but none of the other areas being developed.

Scenario 8 assumes that 30% of all available areas will be developed, which will provide enough housing until around 2020. Scenarios 9 and 10 are sensitivities of Scenario 8 with of 30% of the total households developed, but only in the northern areas (ie area 1, 2, 4 and 5) or in the west (areas 3 and 6).

Scenario 11 assumes that 60% of all available areas will be developed, and is a combination of Scenarios 9 and 10. This will provide the required housing until around 2027.

Scenario 12 assumes all areas are fully developed. This will cater for residential growth until around 2035.

7.2 Link Volumes

The two way traffic volumes on the key links in the area have been extracted for 2012 and each of the scenarios.

The resulting traffic volumes on key links for the morning peak hour are provided below:

Table 15: AM Peak Traffic Volumes (vehicles per hour)

Street	Location	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
Old Renwick Road	West of Murphys	352	370	383	398	518	368	388	352	446	471	410	530	667
Old Renwick Road	East of Waipuna	314	390	443	349	399	418	344	318	453	526	363	575	779
SH6	Woodbourne	590	617	627	635	618	614	625	613	656	654	662	726	809
SH6	East of Murphys	1291	1341	1354	1493	1334	1337	1454	1351	1479	1402	1588	1699	1917
SH6	East of Colemans	1316	1370	1403	1495	1376	1354	1442	1364	1493	1446	1563	1693	1907
SH6	East of Boyce	981	997	1001	1067	995	1005	1043	1034	1064	1022	1122	1164	1259
Murphys Road	North of SH6	366	395	432	614	413	397	500	372	534	458	638	730	927
Colemans	North of SH6	462	497	515	443	494	483	462	466	502	540	453	534	596
Boyce Street	South of SH6	803	834	854	894	839	810	867	801	887	872	911	980	1083
McLauchlan Street	North of SH6	389	396	398	390	396	394	386	392	398	404	391	406	420
Hutcheson	South of Lansdown	218	280	319	229	286	304	227	224	321	389	236	407	561
Lansdowne Street	West of Hutcheson	320	347	364	356	349	349	352	329	382	390	374	444	526
Bells Road	South of SH6	115	130	148	156	131	128	135	121	159	157	163	205	262

The resulting traffic volumes on key links for the evening peak hour are provided below:

Table 16: PM Peak Traffic Volumes (vehicles per hour)

Street	Location	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
Old Renwick Road	West of Murphys	259	306	344	368	435	307	344	293	434	446	419	606	844
Old Renwick Road	East of Waipuna	441	563	598	535	567	582	527	482	671	738	595	892	1206
SH6	Woodbourne	745	818	840	839	812	798	816	783	895	906	891	1052	1247
SH6	East of Murphys	1743	1995	2039	2253	1996	1994	2118	1979	2395	2319	2527	3104	3916
SH6	East of Colemans	1767	2098	2164	2335	2120	2088	2196	2071	2578	2534	2678	3445	4470
SH6	East of Boyce	1215	1181	1156	1276	1170	1173	1187	1243	1180	1118	1258	1161	1096
Murphys Road	North of SH6	407	543	547	823	550	536	672	497	803	709	947	1248	1726
Colemans	North of SH6	539	635	662	592	626	615	582	586	700	750	640	856	1076
Boyce Street	South of SH6	1142	1499	1603	1667	1532	1499	1602	1427	1992	1995	2031	2884	3975
McLauchlan Street	North of SH6	387	491	500	485	491	483	484	480	598	616	588	818	1092
Hutcheson	South of Lansdown	254	441	470	410	444	467	402	382	626	695	557	997	1492
Lansdowne Street	West of Hutcheson	327	401	418	398	408	401	399	360	478	501	456	630	829
Bells Road	South of SH6	131	152	162	170	156	149	161	146	185	183	191	243	313

The hourly traffic volumes are highest in the evening peak.

7.3 Intersection Volumes

The total flows through the various intersections in the area have been extracted for 2012 and each of the scenarios.

The resulting traffic volumes on key links for the morning peak hour are provided below:

Table 17: AM Peak Total Intersection Flows (vehicles per hour)

Street	Type	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
Old Renwick / Rene	Tee	316	340	355	340	343	336	334	319	363	376	348	407	471
Old Renwick / New 1	Cross	308	340	355	339	343	336	357	316	377	385	370	447	538
Old Renwick / New 2	Cross	306	349	366	376	511	345	362	321	452	488	405	587	794
Old Renwick / Batty	Cross	416	467	523	469	593	468	456	421	562	620	485	688	901
Old Renwick / New 3	Tee	109	123	415	130	212	120	125	109	250	329	135	355	580
Old Renwick / Colemans	Cross	345	429	546	390	478	409	380	348	515	603	403	661	910
Old Renwick / Mowat	Cross	308	398	462	361	412	310	350	315	444	501	379	572	760
Old Renwick / McLauchlan	Tee	293	382	442	339	395	303	332	298	425	486	356	549	733
Old Renwick / New 4	Tee	278	357	410	316	367	310	311	283	400	460	331	513	686
Old Renwick / Waipuna	Tee	334	413	468	375	423	441	367	340	481	554	390	610	823
SH6 / Rene	Tee	910	935	958	992	937	933	995	942	1007	977	1049	1116	1232
SH6 / Westwood	Tee	1035	1072	1099	1134	1073	1066	1109	1075	1150	1127	1184	1277	1418

Street	Type	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
SH6 / Severne	Tee	1009	1042	1069	1078	1041	1038	1080	1055	1111	1093	1139	1223	1349
SH6 / Adams	Tee	1009	1042	1069	1078	1041	1038	1080	1038	1106	1093	1127	1211	1332
SH6 / Murphys / Battys	Cross	1257	1312	1361	1534	1329	1308	1456	1297	1498	1411	1620	1774	2060
SH6 / Colemans	Tee	1482	1546	1582	1647	1548	1527	1609	1530	1670	1632	1726	1877	2107
SH6 / Boyce	Tee	1600	1652	1681	1780	1656	1632	1728	1648	1773	1720	1849	1970	2176
SH6 / MacLauchlan	Tee	1069	1082	1085	1091	1081	1081	1085	1087	1104	1098	1108	1143	1187
SH6 / Hutcheson	Cross	1199	1228	1243	1241	1223	1249	1219	1251	1277	1278	1279	1358	1460
SH6 / SH1	Cross	2196	2264	2282	2282	2264	2275	2265	2257	2351	2360	2347	2511	2713
New Renwick / Batty	Tee	1214	1362	1425	1445	1381	1356	1401	1314	1570	1578	1577	1940	2400
Coleman / Ward / Kingwell	Cross	447	473	486	451	470	463	447	450	482	504	456	514	565

The resulting traffic volumes on key links for the evening peak hour are provided below:

Table 18: PM Peak Total Intersection Flows (vehicles per hour)

Street	Type	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
Old Renwick / Rene	Tee	347	389	403	422	383	380	392	370	440	439	447	539	657
Old Renwick / New 1	Cross	344	388	402	423	382	380	445	368	458	441	487	584	724
Old Renwick / New 2	Cross	341	415	454	501	650	408	474	390	613	637	580	877	1246
Old Renwick / Batty	Cross	473	605	645	631	758	590	608	539	793	852	724	1104	1538
Old Renwick / New 3	Tee	123	213	505	182	197	211	162	149	350	458	210	545	881
Old Renwick / Colemans	Cross	408	548	704	545	630	520	528	461	732	821	625	1038	1488
Old Renwick / Mowat	Cross	438	627	680	587	633	495	580	505	750	817	689	1068	1479
Old Renwick / McLauchlan	Tee	407	592	643	551	596	464	544	470	710	778	648	1018	1418
Old Renwick / New 4	Tee	395	559	601	516	563	540	512	447	687	769	598	972	1368
Old Renwick / Waipuna	Tee	472	634	676	596	637	651	587	523	772	859	675	1062	1472
SH6 / Rene	Tee	953	1043	1076	1074	1057	1041	1062	1035	1168	1174	1171	1392	1670
SH6 / Westwood	Tee	1093	1324	1365	1367	1336	1318	1324	1308	1600	1625	1597	2129	2784
SH6 / Severne	Tee	1073	1290	1309	1293	1285	1282	1279	1299	1531	1553	1529	2010	2599
SH6 / Adams	Tee	1073	1290	1309	1293	1285	1282	1279	1278	1525	1553	1515	1995	2578
SH6 / Murphys / Battys	Cross	1683	2001	2025	2283	2007	1983	2125	1937	2461	2390	2592	3305	4276

Street	Type	2012	1	2	3	4	5	6	7	8 30% 2020	9 30 N 2020	10 30 W 2020	11 60% 2027	12 100% 2035
SH6 / Colemans	Tee	1897	2231	2294	2462	2242	2216	2320	2193	2701	2661	2796	3561	4577
SH6 / Boyce	Tee	2058	2388	2454	2619	2413	2382	2487	2372	2870	2826	2970	3738	4765
SH6 / MacLauchlan	Tee	1132	1163	1149	1220	1154	1149	1165	1195	1220	1182	1260	1322	1424
SH6 / Hutcheson	Cross	1233	1288	1295	1335	1265	1278	1245	1309	1348	1341	1366	1474	1617
SH6 / SH1	Cross	2393	2410	2411	2451	2399	2402	2409	2424	2440	2421	2467	2495	2548
New Renwick / Batty	Tee	1511	1769	1869	1913	1800	1769	1840	1710	2139	2144	2162	2795	3604
Coleman / Ward / Kingwell	Cross	455	535	555	504	528	517	493	495	589	629	544	720	902

The side road volumes on the key priority controlled intersections are tabulated below. These are the approach volumes only to the intersection.

Table 19: AM Peak Side Road Flows

Side Road Volumes		2012	8 30% 202	11 60% 2027	12 100% 2035
Old Renwick / Rene	northbound	0	5	11	16
Old Renwick / New 1	northbound	0	28	60	92
Old Renwick / New 1	southbound	0	7	12	23
Old Renwick / New 2	northbound	0	14	30	45
Old Renwick / New 2	southbound	0	43	72	143
Old Renwick / Batty	northbound	93	100	105	117
Old Renwick / Batty	southbound	43	45	47	50
Old Renwick / New 3	southbound	0	79	133	263
Old Renwick / Colemans	northbound	64	66	67	71
Old Renwick / Colemans	southbound	0	37	76	124
Old Renwick / Mowat	westbound	158	199	239	294
Old Renwick / Mowat	eastbound	112	183	241	350
Old Renwick / McLauchlan	northbound	6	9	12	16
Old Renwick / New 4	southbound	0	3	5	9
Old Renwick / Waipuna	southbound	58	88	110	157
Old Renwick / Waipuna	southbound	26	29	32	36
SH6 / Rene	southbound	0	13	30	43
SH6 / Westwood	southbound	40	54	70	86
SH6 / Severne	northbound	0	4	9	13
SH6 / Adams	southbound	0	0	0	0
SH6 / Murphys / Battys	northbound	116	134	153	174
SH6 / Murphys / Battys	southbound	168	290	437	576
SH6 / Colemans	southbound	264	296	321	369
SH6 / Boyce	northbound	428	460	495	535
SH6 / MacLauchlan	southbound	210	215	218	226

Table 20: PM Peak Side Road Flows

Side Road Volumes		2012	8 30% 202	11 60% 2027	12 100% 2035
Old Renwick / Rene	northbound	0	2	6	8
Old Renwick / New 1	northbound	0	18	40	61
Old Renwick / New 1	southbound	0	2	4	8
Old Renwick / New 2	northbound	0	65	130	215
Old Renwick / New 2	southbound	0	20	34	68
Old Renwick / Batty	northbound	76	116	148	209
Old Renwick / Batty	southbound	49	64	81	98
Old Renwick / New 3	southbound	0	46	81	153
Old Renwick / Colemans	northbound	44	87	125	186
Old Renwick / Colemans	southbound	0	8	17	26
Old Renwick / Mowat	westbound	306	518	733	1011
Old Renwick / Mowat	eastbound	112	186	257	358
Old Renwick / McLauchlan	northbound	15	43	72	108
Old Renwick / New 4	southbound	0	1	2	3
Old Renwick / Waipuna	southbound	40	54	64	86
Old Renwick / Waipuna	southbound	27	32	37	43
SH6 / Rene	southbound	0	1	3	4
SH6 / Westwood	southbound	42	348	669	1062
SH6 / Severne	northbound	0	2	4	6
SH6 / Adams	southbound	0	0	0	0
SH6 / Murphys / Battys	northbound	134	246	362	506
SH6 / Murphys / Battys	southbound	150	226	319	406
SH6 / Colemans	southbound	205	206	202	206
SH6 / Boyce	northbound	643	999	1376	1830
SH6 / MacLauchlan	southbound	143	295	454	652

8. Traffic Effects

The proposed residential plan change will increase traffic volumes on the roads and intersections within the surrounding network. In order to reduce the effects of these mitigation works will be required.

The link and intersection flows provided in Section 7 have been compared with the approximate maximum capacities provided in Table 9 and Table 12 to provide an indication of if or when mitigation measures may be required as a result of the proposed plan change.

It should be noted that it is likely that more network wide improvements will be required beyond the immediate study area. In addition should the residential development take place in a different location, alternative measures will be required on the corresponding roading network to mitigate the effects of the increased traffic flows.

8.1 Road Widening

The following roads or sections of road have been identified as requiring widening and/or other features to accommodate the expected increases in traffic volumes.

- Old Renwick Road will require additional features such as kerb and channel, footpaths and on street parking on both sides of the road while maintaining two 3.5 m wide traffic lanes to create a more urban environment. This work will be able to be accommodated within the 17 m road reserve.
- Due to the narrow width of Colemans Road no stopping restrictions should be installed so that two traffic lanes are available at all times. Alternatively road widening could be undertaken to allow for on street parking. There is sufficient width within the road reserve to accommodate this.
- Nelson Street (SH6) between Battys Road and Boyce Street will require four laning prior to 30% of the residential uptake being undertaken, or by around 2020.
- Boyce Street will require widening to four lanes by around 2027
- Passing lanes will be required on SH6 between Blenheim and Renwick by around 2027.
- Murphys Road will require monitoring once 60% of the development has occurred as while the flows will be within the capacity of a two lane road driver frustration may occur.
- SH6 in Woodbourne will require right turn bays to be installed at all intersections to allow right turning vehicle a safe position to wait for a gap to turn while not impeding through vehicles.

No other roads are anticipated to require upgrading.

8.2 Intersection Improvements

The following intersections have been identified as requiring reviewing and/or upgrading works as a result of the increased traffic flows.

- The SH6 intersections of Battys Road Colemans Road and Boyce Street are already under investigation and will definitely require improvement within a few years of residential development occurring on the proposed sites. These intersections will require dual lane roundabouts by around 2020 and possible signalisation around 2035.
- The SH6 intersections with Severne Street and Adams Lane will require reviewing around 2020. At this time they should be upgraded to single lane roundabouts, however once the areas are fully developed dual roundabouts will be required.

- The New Renwick / Battys Road intersection will require improvements at around 2027.
- The SH6 / Westwood roundabout will require dual laning around 2035.
- The intersections on Old Renwick Road should be able to remain as priority controlled, however by 2035 the Battys Road, Colemans Road, Mowat Street, McLauchlan Street and Waipuna Street intersections may need reviewing.

The remaining internal intersections should all be able to remain priority controlled.

The recommended intersection improvements have been shown diagrammatically below by approximate year using the following symbolism.

Sites where single lane roundabouts should be considered

Sites where single lane roundabouts may need to be upgraded to dual lane roundabouts

Sites that require a more detailed design, possibly signalisation

Figure 15: Recommended Intersection Improvements - 2020

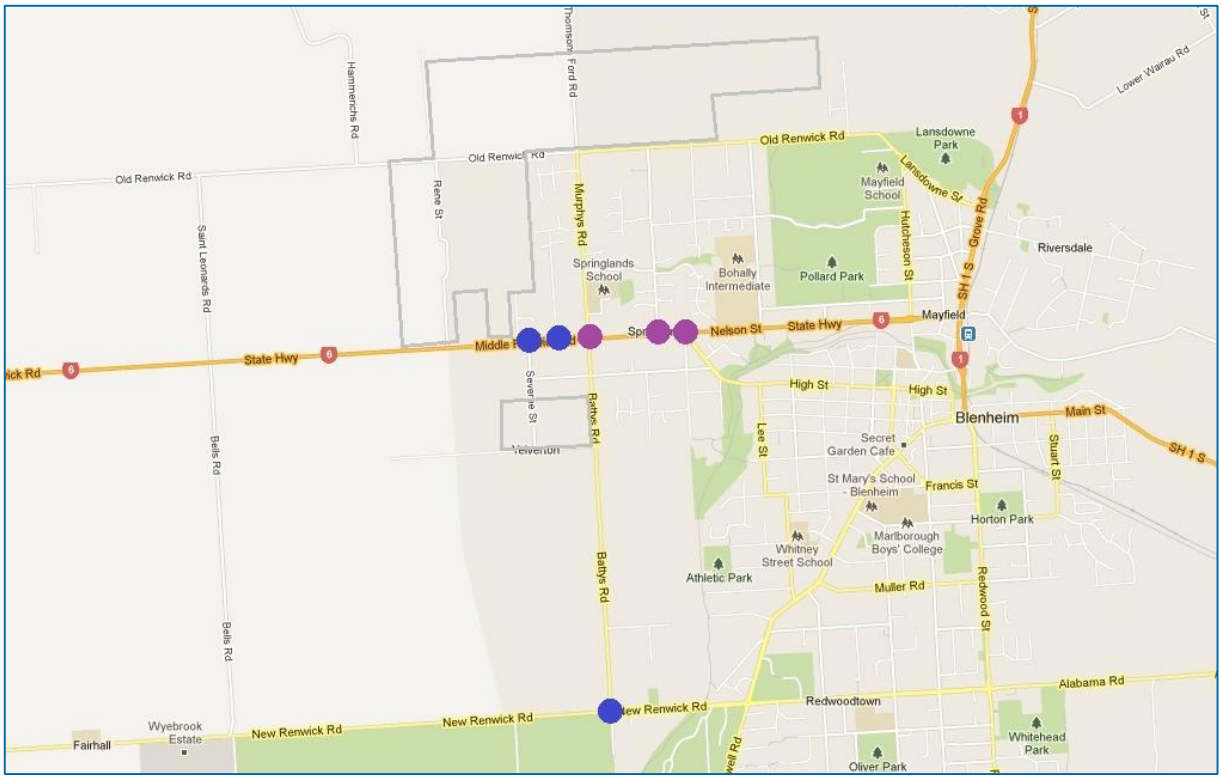
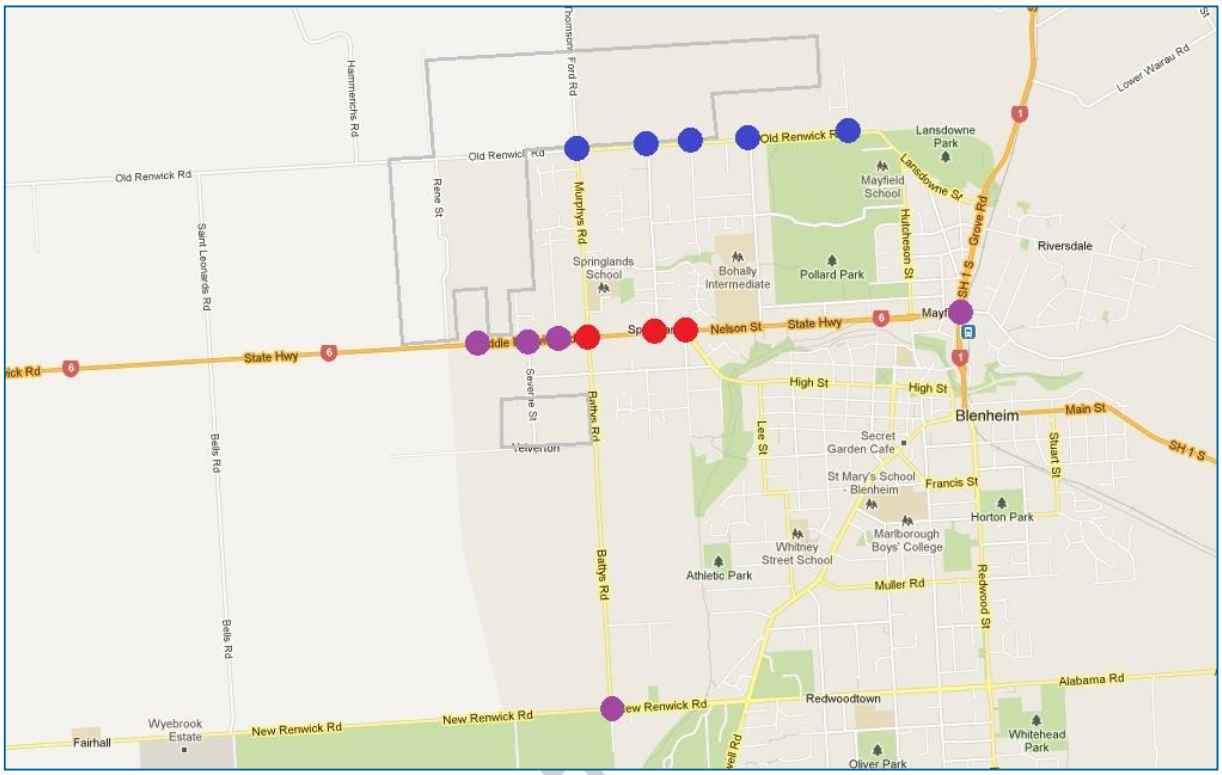


Figure 16: Recommended Intersection Improvements - 2035



The close proximity of these intersections to each other means that if one intersection has been improved there could be a shift in traffic flow so that the adjacent intersection improvements could be deferred. Furthermore the signalisation of a single intersection can often alleviate intersection delays downstream of the traffic signals as the platooning effect of green and red waves often provides gaps in flow for vehicles to enter from the side roads.

8.3 Other Management Tools

Speed limits are another tool that can be used to manage traffic and improve safety.

It is recommended that as the level of development in the area increases, the posted speed limit on Old Renwick Road between Waipuna Street and Rene Street and other locations as required should be reviewed periodically to ensure that they are appropriate.

8.4 Safety

No specific safety measures have been identified as they are intrinsically linked to the capacity of a road and/or the intersection and driver behaviours. Typically as the traffic volumes increase so too does the crash rate as the level of service drops and driver frustration increases. By implementing the works discussed above the level of service will improve and as a consequence any increase in the crash rate as a result of the increased traffic volumes can be expected to be mitigated.

Appendices

Appendix A – 2012 Land Use Data

Zone	HH	Per/HH	Veh/HH	Jobs	Retail	Education	WAH
1	0	0	0	444	208	0	0
2	3	2.44	1.69	683	184	13	0
3	0	0	0	399	105	4	0
4	27	2.04	1.29	586	164	9	1
5	18	2.44	1.2	808	430	16	1
6	296	2.4	1.6	188	60	0	19
7	279	2.44	1.62	194	43	0	19
8	33	1.9	1	637	55	38	2
9	91	2.17	1.07	471	148	16	6
10	302	2.02	1.23	81	0	4	20
11	100	2.28	1.4	458	167	4	6
12	329	2.33	1.49	156	30	0	17
13	249	2.16	1.44	353	37	199	14
14	353	2.22	1.32	92	0	0	20
15	498	2.51	1.52	116	4	36	29
16	389	2.28	1.5	134	59	21	14
17	745	2.26	1.44	217	20	45	29
18	580	2.37	1.53	68	0	0	19
19	538	2.28	1.48	181	30	4	21
20	449	2.47	1.87	55	8	0	19
21	693	2.42	1.65	67	8	0	30
22	328	2.28	1.65	644	8	20	5
23	605	2.59	1.74	54	8	0	23
24	566	2.64	1.68	122	6	55	19
25	71	2.13	1.32	323	187	0	2
26	409	2.53	1.54	125	13	0	14
27	0	2.54	1.69	0	0	0	0
28	0	2.55	1.79	0	0	0	0
29	166	2.5	1.61	436	141	7	10
30	341	2.49	1.86	217	23	0	20
31	0	2.75	2.07	0	0	0	0
32	0	2.91	2.09	0	0	0	0
33	155	2.56	2	524	10	2	31
34	36	2.77	2	138	0	0	7
35	80	3.02	2.22	673	102	36	12
36	107	2.37	1.86	136	9	0	18
37	239	2.51	1.9	178	9	0	40
38	169	2.87	1.95	99	0	0	28
39	150	2.82	1.7	145	6	0	9
40	826	2.69	1.94	487	89	52	41
41	57	2.86	2.28	285	15	0	17
42	150	2.65	2.12	221	12	13	46

Zone	HH	Per/HH	Veh/HH	Jobs	Retail	Education	WAH
43	66	2.81	2.23	88	15	0	20
44	90	2.53	1.82	39	0	0	27
45	96	2.97	2.32	88	3	0	29
46	343	2.29	1.52	69	49	26	104
47	258	2.74	2.25	337	37	20	79
48	126	2.61	2.05	180	6	0	39
49	63	2.52	1.9	157	3	3	19
50	51	2.75	2.17	32	0	0	15
51	0	1.69	2.63	150	150	0	0
52	85	2.75	2.07	31	6	1	10
53	32	2.75	2.07	21	4	1	6
54	407	2.54	1.69	16	2	0	10
55	135	2.54	1.69	16	2	0	10
56	0	2.54	1.69	160	0	162	15
57	0	2.54	1.69	130	18	0	0
58	347	2.55	1.79	24	0	0	11
59	222	2.55	1.79	34	0	0	11
60	0	2.55	1.79	40	0	40	0
61	71	2.91	2.09	0	0	0	0
62	107	2.91	2.09	221	26	0	35
63	0	2.47	1.68	0	0	0	0
64	0	2.47	1.68	0	0	0	0
65	0	2.47	1.68	0	0	0	0
66	0	2.47	1.68	0	0	0	0
67	0	2.47	1.68	0	0	0	0
68	0	2.47	1.68	0	0	0	0
69	0	2.47	1.68	0	0	0	0
70	0	2.47	1.68	0	0	0	0
71	0	2.47	1.68	0	0	0	0
72	0	2.47	1.68	0	0	0	0
TOTAL	**12926**			**13028**	**2719**	**847**	**1068**

Appendix B – Distribution of Future New Households

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	1	1	0	0	0	0	0	0
5	1	0	0	0	0	1	0	0
6	92	11	18	20	12	10	14	7
7	17	2	3	4	2	2	3	1
8	1	1	0	0	0	0	0	0
9	3	1	1	1	0	0	0	0
10	8	1	2	1	1	1	1	1
11	3	0	1	1	0	1	0	0
12	9	1	2	2	1	1	1	1
13	7	1	1	1	1	1	1	1
14	10	1	2	2	1	1	2	1
15	14	2	3	2	2	2	2	1
16	19	2	4	4	3	2	3	1
17	21	3	4	5	3	1	3	2
18	140	18	27	30	18	16	21	10
19	20	2	4	4	4	2	3	1
20	14	1	3	3	2	2	2	1
21	19	2	4	4	3	2	3	1
22	66	8	13	14	9	8	10	4
23	411	51	80	89	53	47	61	30
24	64	8	12	14	8	7	10	5
25	7	1	1	1	1	1	1	1
26	12	1	2	3	2	1	2	1
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	5	1	0	1	1	1	1	0
30	25	3	5	5	3	3	4	2
31	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0
33	8	1	2	2	1	1	0	1
34	1	0	0	0	0	0	1	0
35	8	1	2	2	1	0	1	1
36	3	0	1	1	0	1	0	0
37	7	1	1	2	1	1	1	0
38	5	1	1	1	0	1	1	0
39	4	0	1	1	1	0	1	0
40	350	44	68	75	46	40	52	25

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
41	2	1	0	0	0	0	1	0
42	4	0	1	1	1	0	1	0
43	2	0	0	0	1	1	0	0
44	3	0	1	1	0	0	1	0
45	3	0	1	1	0	0	1	0
46	10	1	2	2	1	2	1	1
47	7	1	0	2	1	1	1	1
48	4	0	1	1	1	0	1	0
49	2	0	0	1	0	0	0	1
50	1	0	1	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	26	3	5	6	3	3	4	2
53	1	0	0	0	1	0	0	0
54	11	2	2	2	1	1	2	1
55	4	0	1	1	1	0	1	0
56	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0
58	137	16	27	30	18	16	20	10
59	28	4	5	6	4	3	4	2
60	0	0	0	0	0	0	0	0
61	2	1	0	0	0	1	0	0
62	3	0	1	1	1	0	0	0
63	222	222	0	0	0	0	0	0
64	351	0	351	0	0	0	0	0
65	389	0	0	389	0	0	0	0
66	238	0	0	0	238	0	0	0
67	206	0	0	0	0	206	0	0
68	270	0	0	0	0	0	270	0
69	130	0	0	0	0	0	0	130
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
TOTAL	**3431**	**422**	**667**	**739**	**452**	**391**	**513**	**247**

Appendix C – Distribution of Future Employment

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
1	37	5	6	8	5	4	6	3
2	57	7	11	12	8	7	9	3
3	33	4	6	7	5	4	5	2
4	49	6	10	10	6	6	7	4
5	67	8	13	14	9	8	10	5
6	116	14	23	25	15	14	17	8
7	16	2	3	3	2	2	3	1
8	53	7	10	11	7	6	8	4
9	39	5	8	8	5	4	6	3
10	7	1	1	1	1	1	1	1
11	38	5	7	8	5	4	6	3
12	13	2	2	3	2	1	2	1
13	29	4	6	6	4	3	4	2
14	8	1	2	2	1	1	1	0
15	10	1	2	2	2	1	1	1
16	11	2	2	2	1	1	2	1
17	18	2	3	5	2	2	3	1
18	106	13	20	23	14	12	16	8
19	15	2	3	3	2	2	2	1
20	5	1	1	0	1	1	1	0
21	6	1	1	1	1	1	1	0
22	54	7	10	12	7	6	8	4
23	4	0	1	1	1	0	1	0
24	10	1	2	2	1	2	1	1
25	27	3	5	6	4	3	4	2
26	10	1	3	2	1	1	1	1
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	36	4	7	8	5	4	5	3
30	18	2	3	4	3	2	3	1
31	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0
33	244	30	47	53	32	28	36	18
34	11	1	2	2	1	1	3	1
35	56	7	11	13	7	6	8	4
36	11	2	2	2	1	1	2	1
37	15	2	3	3	2	2	2	1
38	8	1	1	2	1	1	1	1
39	12	1	2	3	2	1	2	1
40	40	5	8	8	5	5	6	3
41	24	3	5	5	3	3	3	2
42	18	2	4	4	2	2	3	1

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
43	7	1	1	2	0	1	1	1
44	3	0	1	1	0	0	1	0
45	7	0	1	2	1	1	1	1
46	6	1	1	1	1	1	1	0
47	28	3	5	7	4	3	4	2
48	15	2	3	3	2	2	2	1
49	13	2	3	2	2	1	2	1
50	3	0	1	1	1	0	0	0
51	113	14	22	24	15	13	17	8
52	3	0	1	1	0	0	0	1
53	2	0	1	0	0	1	0	0
54	1	0	0	1	0	0	0	0
55	1	1	0	0	0	0	0	0
56	13	2	3	3	2	1	1	1
57	11	1	2	2	1	1	3	1
58	2	0	1	1	0	0	0	0
59	3	0	1	1	1	0	0	0
60	3	0	1	1	0	1	0	0
61	0	0	0	0	0	0	0	0
62	18	3	3	4	2	2	3	1
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0
70	420	52	82	90	55	48	63	30
71	616	76	120	133	81	70	92	44
72	840	103	163	181	111	96	126	60
TOTAL	**3459**	**426**	**672**	**745**	**455**	**395**	**517**	**249**

Appendix D – Distribution of Retail Employment

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
1	17	2	3	4	2	2	3	1
2	15	2	3	3	2	2	2	1
3	9	1	2	2	1	1	1	1
4	14	1	3	3	2	2	2	1
5	35	4	7	8	5	4	4	3
6	105	13	20	23	13	12	16	8
7	4	0	1	1	1	0	1	0
8	5	1	1	1	1	0	1	0
9	12	1	2	3	2	1	2	1
10	0	0	0	0	0	0	0	0
11	14	2	3	3	2	2	2	0
12	2	1	1	0	0	0	0	0
13	3	0	1	1	0	0	1	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	5	1	0	1	1	1	1	0
17	2	1	0	0	0	1	0	0
18	100	12	19	22	13	12	15	7
19	2	0	1	0	0	0	1	0
20	1	0	0	0	0	0	0	1
21	1	1	0	0	0	0	0	0
22	1	0	0	1	0	0	0	0
23	1	0	0	0	0	1	0	0
24	0	0	0	0	0	0	0	0
25	15	2	3	3	2	2	2	1
26	1	0	1	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	12	1	2	3	2	1	2	1
30	2	0	0	0	1	0	1	0
31	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0
33	201	25	40	43	26	23	30	14
34	0	0	0	0	0	0	0	0
35	8	1	1	2	1	1	1	1
36	1	0	0	0	0	0	0	1
37	1	1	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	7	1	1	2	1	0	1	1
41	1	0	0	1	0	0	0	0
42	1	0	0	0	0	1	0	0

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
43	1	1	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0
46	4	0	1	1	1	0	1	0
47	3	0	1	1	1	0	0	0
48	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	113	14	22	24	15	13	17	8
52	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0
57	1	0	1	0	0	0	0	0
58	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0
62	2	0	0	0	0	0	1	1
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
TOTAL	**722**	**89**	**140**	**156**	**95**	**82**	**108**	**52**

Appendix E – Distribution of Education Employment

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
1	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	1	0	0	0	0	1	0	0
5	1	0	0	0	0	0	0	1
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	2	0	1	1	0	0	0	0
9	1	0	0	0	0	1	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	11	2	2	2	1	2	1	1
14	0	0	0	0	0	0	0	0
15	2	0	1	1	0	0	0	0
16	1	0	0	0	0	0	1	0
17	3	1	1	1	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	1	0	0	0	0	0	0	1
23	0	0	0	0	0	0	0	0
24	3	1	0	0	1	0	1	0
25	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0
35	2	0	1	1	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	3	0	0	1	1	0	1	0
41	0	0	0	0	0	0	0	0
42	1	0	0	0	0	1	0	0

Zone	Total	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
43	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0
46	1	0	0	0	1	0	0	0
47	1	0	0	0	0	0	1	0
48	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0
56	9	1	2	2	2	0	2	0
57	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0
60	2	0	1	1	0	0	0	0
61	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
TOTAL	**46**	**6**	**9**	**10**	**6**	**5**	**7**	**3**

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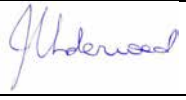
	Laura Skilton	Janette Underwood		Carey Morris		04/06/2013