P. AND A. BAGRIE

30 March 2012

BAGRIE OHOKA PRIVATE PLAN CHANGE
Engineering Servicing Report

e2 environmental
CONSULTING ENGINEERS

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Engineering Servicing Report

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1 Executive Summary

Peter and Ann Bagrie wish to re-zone 49ha of their 86ha farm to enable development of a rural-residential subdivision.This report assesses the feasibility of providing the required engineering services to develop the Bagries proposed plan change area as a rural residential subdivision in accordance with the ODP.

The site is flat to slightly rolling, sloping down at a grade of 0.5% from west to east. Soils consists of shallow silt overlying gravels. Groundwater levels typically vary between 0.3m (winter) and 1.3m (summer), with the highest recorded level being close to 0.15m below ground level. Further information on the specific site geology and geotechnical aspects are available in the Geotechnical Report (Geoscience Ltd).

Access to the proposed rural-residential subdivision would be from two intersections off Bradleys Road. Further information on roading and traffic aspects is available in ViaStrada Ltd's report.

Due to a lack of capacity from the existing Ohoka water supply, the most likely option to service the proposed development area is to extend a 100mm diameter principal water main from the existing Rangiora network. This would be adequate to service the development area with potable water on a restricted supply basis. Fire fighting water will be provided by a requirement for on-site storage.

Wastewater servicing will be provided by reticulating low pressure wastewater mains to a community pump station on the Mandeville – Rangiora wastewater rising main route. The pump station would most likely be located in public land at a location that enables efficient servicing of the Bagrie development area and the existing Ohoka settlement.

Stormwater servicing is proposed to be provided by a network of roadside swales and other (mostly) open channels, which will provide treatment as well as conveyance of stormwater. The site is entirely within the catchment area of the Armstrong Drain, which flows into the Cust River at the eastern corner of the proposed plan change area. The proposed development will increase the impervious area of the 98.4ha catchment from 3.9% to 13.5%. To mitigate the effects of increased runoff from the development, detention storage is proposed to reduce the peak flows for the 10-year and 50-year storm events to the pre-development peak flows. Two options have been considered for providing detention storage:

- Option 1: Detention basin by the Armstrong Drain outfall, and widening of the Armstrong Drain to provide detention storage and increased amenity value.
- Option 2: Detention basin by the Armstrong Drain outfall, and a second detention basin central to the development.

The preferred option is Option 1, as it is more efficient with land area within the proposed development and is perceived to provide increased amenity value to Armstrong Drain.

Power and Telecommunications providers have both indicated that the proposed plan change area is able to be serviced by their networks.

Given the information available and the investigations conducted to date we recommend that the Bagries proposed development land as identified in the ODP can be effectively serviced to the requirements of WDC and the applicable national standards.

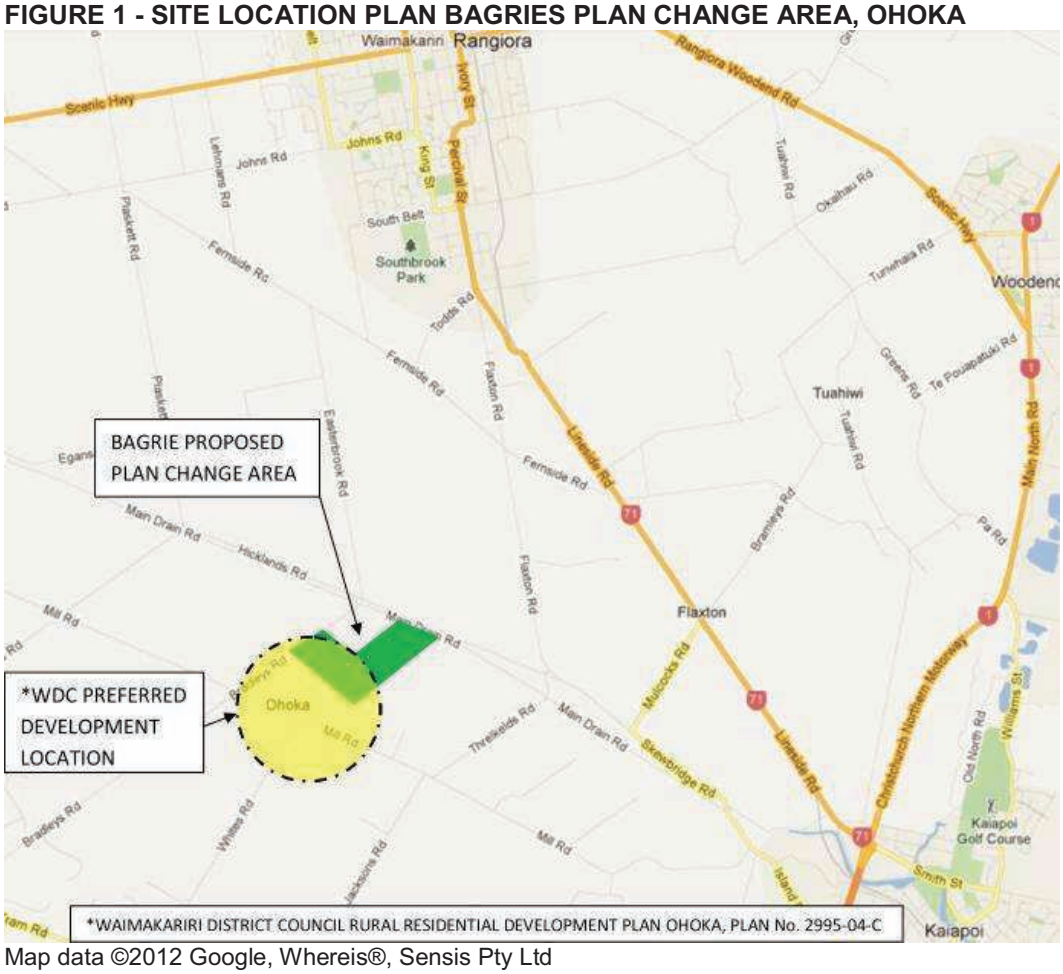
2 Introduction

Peter and Ann Bagrie have engaged e2 Environmental Limited as their engineering consultants to provide this engineering servicing report. This report assesses the feasibility of providing the required engineering services to develop the Bagrie land as a rural residential subdivision in accordance with the Outline Development Plan[1] (ODP). This land is being promoted for development under the Waimakariri District Council (WDC) Rural Residential Development Plan, Plan Change 12 (PC12) which provides for development of up to 150 rural residential lots at Ohoka.

The Bagries own 86ha of land at Bradleys Road, Ohoka. The land adjoins the existing rural residential Ohoka settlement and is within the area initially identified by Council as preferred for further rural residential development at Ohoka.

It is proposed that approximately 54ha of land will be developed for rural residential use. A decision is sought in favour of re-zoning the land Living 4A. Proposed lots are likely to be a mix of sizes with an average lot area greater than the required 5,000m². A total of up to 66 rural-residential lots is being applied for.

FIGURE 1 - SITE LOCATION PLAN BAGRIES PLAN CHANGE AREA, OHOKA



Map data ©2012 Google, Whereis®, Sensis Pty Ltd

2.1 Background

The Bagries own all of the land within the proposed plan change area. They have farmed the land since 1966 (46 years), and currently operate their existing home, a

[1] Outline Development Plan provided on behalf of P. and A. Bagrie by Survus Limited

65,000 bird poultry farm, horse training track and stables with the balance land used for grazing and cropping. Due to earthquake damage, three of the four existing poultry sheds are to be replaced with a single "state of the art" new shed.

Most of the farmland is surplus to their requirements, so the Bagries wish to develop the balance land to the west, south and east of the horse training track for rural residential purposes as shown on the proposed ODP.

3 Site description

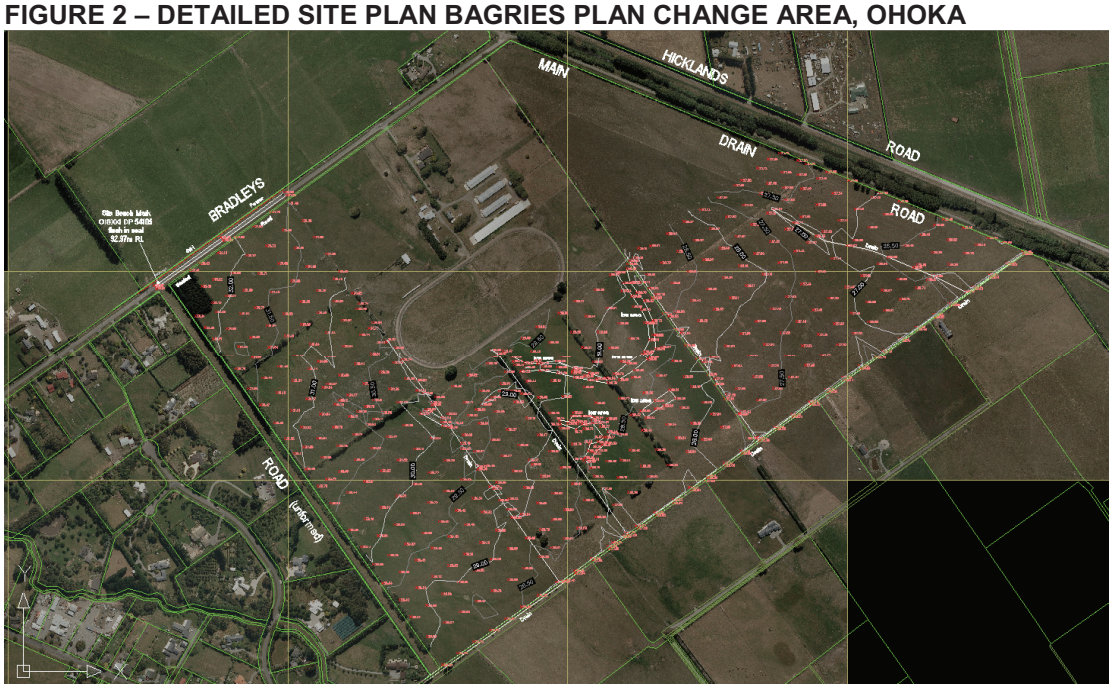
The proposed plan change area incorporates 54ha across parts of two land parcels, legally described as Pt RS 2561 (53.99ha) and RS 2010 (24.28ha), located off Bradleys Road and to the northeast of Keetly Place. The site also borders Main Drain Road (flood protection stop-bank) to the north and a WDC Drain (Armstrong Drain) to the south east.

3.1.1 Geology and Topography

The specific site geology and geotechnical aspects are being assessed by Geoscience Limited and we refer the reader to their report for discussions of the site suitability for building.

Generally the proposed development area is in pasture and gently slopes from a top level in the west of 32.4m ASL to a low point in the east along the top of the Armstrong drain at 26.0m ASL. The average slope from west to east is approximately 0.5% or 1:200. The site is located entirely within the Cust River catchment due to the slope towards Armstrong Drain along the south east boundary. Stormwater discharge to the Cust River occurs at the east corner of the site and is controlled by a flap gate.

FIGURE 2 – DETAILED SITE PLAN BAGRIES PLAN CHANGE AREA, OHOKA



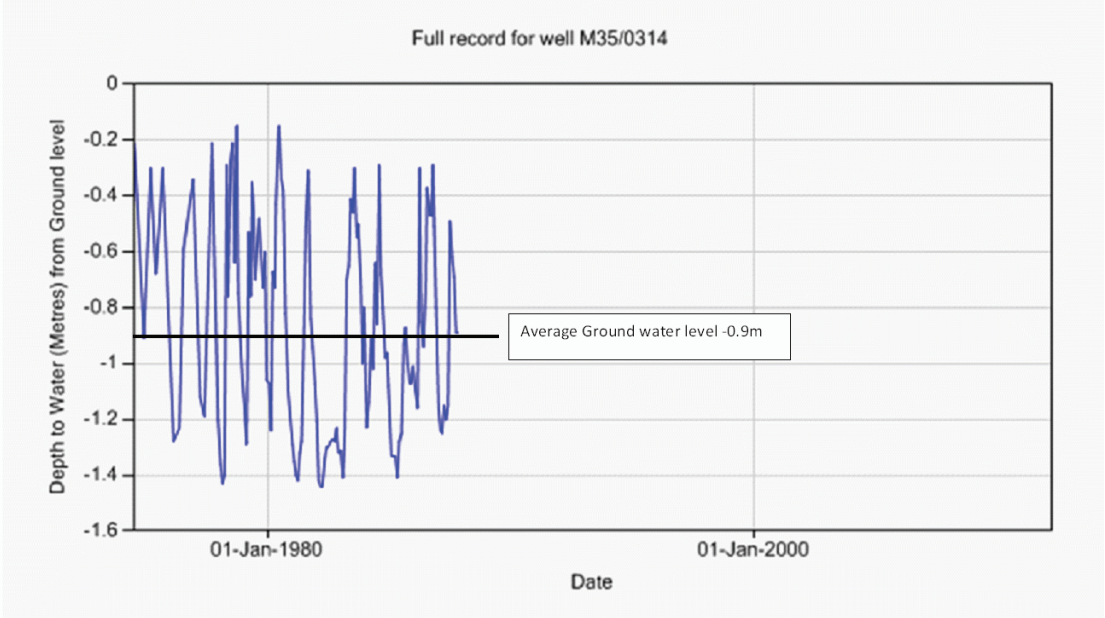
Map data LINZ Crown copyright reserved

A preliminary review of soil types from ECan well cards both on-site and within 500m indicates the site may be underlain by topsoil and clay layers to shallow depth (<1m), then various sized gravels bound in sand or slit/ clay layers to depth exceeding 15m.

An extract from ECan bore log records is included in Appendix A. A detailed sub-surface site investigation report has been prepared by Geoscience Limited.

The ECan water level record at well reference M35/0314 indicates groundwater levels vary between 1.4m and 0.2m depth and average 0.9m depth. ECan GIS records show the site is located above a semi or unconfined aquifer and that the coastal confined aquifer is located approximately 4.5km to the east.

FIGURE 3– ECAN WELL RECORD FOR M35/0314 (NEAR BAGRIE DEVELOPMENT AREA)



Due to the combined effect of relatively high ground water (average 0.9m depth and as shallow as 0.2m) and the silt/ clay bound gravel sub soil layers, it is likely that infiltration will be limited and that the majority of stormwater will run-off the site. These effects have been a key consideration in deciding the optimum location for stormwater management areas.

As part of the initial Geotechnical Investigation, up to five groundwater monitoring piezometers will be installed at key locations across the site. It is expected that data collected over the wet months will confirm the average and shallowest depth to ground water and enable a stormwater management plan to be developed with a high level of confidence.

Given the above information, the ODP has been designed to enable successful servicing of the site utilising existing land features. We note this site is situated at a similar elevation to the existing Ohoka settlement.

4 Access

A comprehensive road access strategy has been prepared by others (ViaStrada Ltd) and we refer the reader to that report for a detailed assessment of the existing and proposed road networks and traffic. The section below presents a brief overview of the issues from an engineering design and construction perspective only.

The subdivision access will be from Bradleys Road in accordance with the proposed ODP. Two entry points from Bradleys Road are proposed in order to provide an alternative emergency access.

Internal access to lots will be provided by constructing a network of local roads to comply with WDC requirements for rural residential developments. These roads will be vested with Council. Where lots are not served with direct access to a proposed public road a private right-of-way will be provided. In developing the ODP, preliminary lot layouts have sought to minimise the number of private right-of-ways required. The site topography, anticipated soils and depth to ground water do not pose any known limitations on internal road layout.

The proposed ODP acknowledges that some development may occur in the proposed Plan Change 17 (PC17) land to the south east. In light of this, road linkages are proposed at two locations on the south east boundary to provide future access links to this land if required.

The road network and subsequent preliminary lot layouts have been designed to incorporate a number of planning features which are covered in other parts of the plan change submission.

5 Water Supply

5.1 Existing Ohoka water supply

The existing Ohoka settlement is supplied from a local community ground water source owned and maintained by WDC (ECan consent reference NCY880236.1). This water source and associated reticulation has been established on a rural residential restricted supply basis. Although technically possible to expand this water source and reticulation to supply the proposed development area this is not a recommended option.

Council have indicated[2] they consider further development of the Ohoka community water source is undesirable for a number of reasons including:

- Lack of existing capacity
- Economic and health implications for upgrading an increased supply to comply with the New Zealand Drinking Water Standards 2005;
- Economics of maintaining additional satellite water sources;
- A lack of significant benefits over extending supply from existing large water sources (Rangiora or Kaiapoi).

5.2 Alternative water supply

An alternative to the existing Ohoka community water source is to extend the existing supply from either Rangiora or Kaiapoi. Upon review of previous studies undertaken by others[3], it is apparent that extending supply from Rangiora is the most economic option, subject to approval from Council. A schematic showing the likely internal and external water reticulation is included at Appendix B.

Recent discussions with Council suggest:

- the water supply option most likely to gain Council support will be to extend the existing public water reticulation from Rangiora via a new water main;
- A rural residential restricted supply servicing arrangement for new lots would be the most appropriate supply option and is consistent with current Ohoka supply levels of service;
- Supply volumes for rural residential restricted supply in line with the WDC Engineering Code of Practice;
- On-site fire fighting storage appropriate to the dwelling built upon the site;
- Council would consider a cost share arrangement to increase the pipe capacity to service the remaining Ohoka settlement.

5.3 Levels of service

The WDC Engineering Code of Practice states rural residential restricted water supply is to be capable of delivering volumes of 2m³/day/lot for domestic purposes. WDC indicate that residential developments are to be designed with additional capacity available so residents have the ability to purchase additional units. Any water reticulation system must be capable in terms of flow and pressure of meeting this minimum level of service. For concept design we have based our calculations on a minimum of 3 units (3m³/day/lot), as recommended by WDC.

[2] Meeting with Council representatives K. Simpson & G. Boot, 7 February 2012
[3] Davis Ogilvie and Partners, Ohoka Plan Change Group, November 2011

Fire fighting water will be supplied by on-site storage tanks located on each property. Storage tank construction, location and volume are recommended to be in line with SNZ PAS 4509.

5.4 External and internal water reticulation

Upon review of previous studies undertaken by others[4], initial hydraulic calculations and recent discussions with Council, the most economic external water supply strategy is likely to involve extending the existing Rangiora water supply to the development. A brief summary of requirements follow:

- Connection to the public supply from the existing water main outside 284 Flaxton Road (Southbrook Resource Recovery Park);
- Install 100mm water main south along Flaxton Road (2.9km);
- Install 100mm water main south along Threlkelds Road crossing the Cust River bridge (0.3km);
- Install 100mm water main north-west along Main Drain Road to the property boundary (1.2km).

Once the site boundary has been reached it is likely that internal reticulation would be via reduced diameter water main (80mm/ 63mm/ 32mm OD PE80B) subject to detailed design, with a restricted water connection to each lot. On-site water storage for domestic purposes and separate on-site fire fighting storage would need to be installed at the building consent stage.

At this stage there has not been a detailed discussion of potential cost sharing arrangements should Council wish to increase the capacity of, or extend, the principal water supply mains in order to supply the remaining Ohoka settlement from Rangiora. It is expected these arrangements would be formalised at the detailed design stage.

The internal and external reticulation would be designed in accordance with WDC Engineering Code of Practice Section 7 – Water Supplies, and the applicable national standards.

[4] Davis Ogilvie and Partners, Ohoka Plan Change Group, November 2011

6 Wastewater

6.1 Existing wastewater disposal at Ohoka

Currently there is no public wastewater collection and treatment system within the Ohoka settlement and existing wastewater is dealt with primarily by on-site collection and/ or treatment disposal systems.

6.2 Regulatory controls on development

It is noted that the ECan Regional Policy Statement 1998 as amended including Chapter 12A restricts rural residential development by requiring developments be serviced by a reticulated wastewater disposal system.

6.3 Proposed Ohoka public wastewater system

Discussions with Council confirm that a pumped wastewater rising main serving the settlements of Ohoka and Mandeville is currently being tendered for construction. And that it is likely construction will commence in financial year 2012/13. This new public asset is a result of studies dating back to 2009 when MWH Ltd prepared a report[5] for WDC to assess wastewater servicing options for Ohoka and Mandeville. As a result of this study, WDC have adopted a solution that involves connecting the existing community schemes around Mandeville and pumping the effluent to the Rangiora wastewater treatment plant, for eventual disposal through the Eastern Districts Sewer Scheme (EDSS). The report recommends the pipe route pass through Ohoka along Mill Road and Threlkelds Road, which will enable it to service the existing Ohoka township and 100 (since increased to 150) additional properties in the Ohoka area. The rising main route as tendered for construction is shown in Appendix C.

Council's preference is for a single community pumping station to be built capable of serving the proposed development and the existing Ohoka settlement. With this in mind, three alternative community pump station locations have been shown on the Wastewater Concept drawing in Appendix B. Options 1 and 2 are indicatively shown within Council land along Mill Road near the Bradleys Road intersection, while Option 3 is shown within the Bagrie's development area. These options are discussed further in the following sections.

The Bagries proposed development area is conveniently located to economically connect to the wastewater rising main via a community pump station in any of the proposed locations.

6.4 Internal and external wastewater servicing options

Given that a public wastewater rising main is currently being tendered for construction and the proposed alignment is unlikely to be changed, we have based our preliminary servicing concepts on the proposed route as designed and tendered.

The proposed wastewater reticulation will include:

- A low pressure on-site pumped wastewater system from individual lots via low pressure sewer reticulation to a public pumping station.
- Construction of a pumping station to pump into the proposed public Mandeville – Rangiora wastewater rising main.

[5] Mandeville and Ohoka Wastewater Options, Options Evaluation Report, Nov 2009

6.4.1 Internal wastewater servicing from individual lots

Within the development area, all wastewater reticulation from individual lots is likely to be by a low pressure pumped system. Due to groundwater being generally within one metre of the ground surface, construction of a gravity network may be prohibitively expensive and be susceptible to stormwater ingress resulting in increased disposal and treatment costs.

Wastewater disposal from individual lots by small diameter pumping mains to a large community pumping station could be achieved by a range of proprietary systems:

- Low Pressure Sewer – a small chamber located at each dwelling incorporates a small grinder pump, wet well and control system, and discharges wastewater to the public main via small diameter pipework. The main advantage of this type of system is that all wastewater including solids are discharged from site, removing the need for a large septic tank and the periodic removal of accumulated solids;
- Septic Tank Effluent Pumping (STEP) – located at each dwelling, the STEP system requires a septic tank with a pump chamber to be installed and only the liquid effluent is pumped offsite. This system requires periodic removal of accumulated solids (5- 10 yearly) depending upon the installed system. As bio-solid wastes are effectively stored on site, the septic tank could be a source of groundwater contamination if it was damaged prior to installation or damage from earthquakes in-situ. This is the system that Council requires for the rural-residential developments in the Mandeville area. An advantage of this system is that the effluent is less likely to become septic in the pipelines due to long residence times, however Ohoka is located close enough to the downstream end of the rising main that this is unlikely to be a problem.

6.4.2 Pump station discharging to external public rising main

A community pumping station discharging from the proposed development area to the public Mandeville – Rangiora wastewater rising main could be located either within public land such as the parcel of WDC land at the corner of Bradleys Road – Mill Road (Option 1) or the Ohoka Domain Mill Road site (Option 2). If required, a location within the Bagries proposed development area could also be made available (Option 3). Plans showing these indicative community pump station locations are included at Appendix B.

Option 1: Corner Bradleys Road, Mill Road (Preferred Location)
On the northern corner of the intersection between Bradleys Road and Mill Road the Council own a small parcel of land approximately 10m x 20m in size. This land, combined with the adjacent road reserve, may be just large enough to construct the proposed public pump station. If the pump station was sited here, a low pressure sewer main would be laid from the proposed plan change area along Bradleys Rd. This would also provide a pressure sewer main for the properties along Bradleys Road to connect into.

Option 2: Ohoka domain, Mill Road
Ohoka Domain lies on the MWH proposed rising main alignment[6] and is naturally situated near the geographic centre of the Ohoka settlement. Wastewater could be directed from the Bagries development to the pump station by small diameter low pressure mains. Possible alignments may be either through Council land at the south corner of the development area (via Armstrongs Drain, the Ohoka River reserve and

[6] Mandeville and Ohoka Wastewater Options Assessment of Optimum Pipe Route, Nov 2009

Keetley Place) or from the west corner of the development area along Bradleys and Mill Roads.

Option 3: On-site development alternative
If required a community pump station could be located within the development area. This would require the Mandeville – Rangiora rising main to either deviate from Mill Road along the alternative alignment as shown in Appendix B, or enter the development area by deviating along Bradleys Road. This alternative location is still relatively central allowing an efficient low pressure pumping network to be established from the existing Ohoka settlement.

For either public pump station location, the land required would need to be sufficiently large to accommodate the physical pumping station, wet wells and electrical control structures, hardstand parking for maintenance and provide access for heavy vehicles. Depending upon the pump station configuration and adjacent facilities a typical land area up to 400m² may be required.

7 Stormwater

7.1 Existing site stormwater management

The Bagrie block is relatively flat and slopes from east to west at a grade of around 0.5%. It is entirely within the catchment area of the Armstrong Drain, which runs along the southeast boundary of the site and discharges into the Cust River via a 1200mm culvert and flap gate. The block is bounded by drains to the northwest (north side of Bradleys Road), southwest (west side of the paper road), and by the Cust River (also known as Main Drain) along its northeast boundary. The drains effectively isolate the block from surface runoff from outside the block, though there has been some isolated surface flows into the block from overflows of Bradley Road drain (covered in more detail below). There are several drains running through the Bagrie property perpendicular to and discharging into Armstrong Drain that control surface runoff within the block.

The drain running along the west side of the paper road bounding the southeast of the site is a relatively shallow drain that discharges into Armstrong Drain near the upstream end. Though no ground levels were available, it is expected that this drain would intercept surface runoff from approximately half to two-thirds of the land between this drain and the Ohoka Stream, a catchment area of around 17-18ha of rural-residential land.

Armstrong Drain runs the full length of the south-eastern site boundary and is approximately 1.2m deep for most of its length. It appears to have been constructed for control of groundwater levels as well as surface runoff management. The total catchment area of the Armstrong Drain is estimated at 98.4ha (including the catchment of the paper road drain).

The Bradleys Road drain runs from the Ohoka Stream crossing (west of the site) to the Cust River, where it discharges into the river via a small diameter culvert through the stopbank. This culvert does not have any trash screen on the inlet, or flap gate on the outlet. The drain intercepts surface runoff from the land northwest of Bradleys Road, as well as collecting road runoff from the northern half of the road carriageway and berm. Where the Ohoka Stream crosses under Bradleys Road, there is a high level weir that allows the stream to overflow into the drain during high flows in the stream. The drain also appears to have been constructed for control of ground water levels, being around 1.2m deep.

The Cust River has stopbanks constructed both sides along this stretch, which define the northeast boundary of the catchment. Environment Canterbury has stated that these have been constructed based on the estimated 50-year flood level (184 cumecs) plus 0.6m freeboard.

7.2 Historical flooding

Discussions held with Mr Bagrie indicate that there has not been any major surface flooding problems on the property while their family has been farming the land (since 1966). He stated that surface water tends to concentrate in surface depressions after several days of rain (usually during the winter months, when the groundwater table is high), but the natural overland flow paths and man-made drains carry this water down to the Armstrong Drain before it causes any significant problems. In addition to this, the Bradley Road drain has overflowed onto the Bagrie property in the past, due to gorse trimmings from the hedge next to the drain being washed down and partially

blocking the inlet to the culvert. When this occurs, this water flows along a very shallow depression in the ground, roughly parallel to and 100m away from the Cust River. This surface flow runs into an existing drain and then into the Armstrong Drain near its discharge point into the Cust River.

As part of the investigations, a flood risk assessment by Environment Canterbury was commissioned for the site (refer Appendix F). This brief report appears to agree with the anecdotal evidence provided by Mr Bagrie. Aerial photographs included in the Ecan report taken following rainfall events in March and August 1986 (estimated at less than 5-year events) clearly show where the low points are on part of the site near the Cust River. They also show the Armstrong Drain breaking out approximately 125m upstream from its outfall culvert and flowing overland through the property to the south, before ponding adjacent to the Cust River stopbank. This must occur when either the river levels cause the drain to back up, or the culvert capacity is exceeded. The assessment also states that there is a risk of flood breakout from the Cust River should the design standard for the stopbank be exceeded.

A further potential flood risk may come from the Bradleys Road drain outlet culvert. During extreme events it may also be possible for the Cust River to backflow through the culvert (no flap gate) and potentially cause the drain to overflow. Levels have not yet been taken of the culvert and riverbed that may enable this to be confirmed. We understand from Council that they are currently investigating this potential issue.

7.3 Groundwater

When the site was visited in February 2012, Armstrong Drain was dry, though discussions with Mr Bagrie indicate it carries a small baseflow (50-100mm deep) throughout the winter months. The Bradley Road drain was holding water (approximately 1m below ground level) and flowing at the culvert into the Cust River (approximately 30mm deep in the culvert). In stark comparison, the Threlkelds Road drain was flowing significantly more at its outlet into the Cust River, and the water level in the drain was typically around 0.3-0.4m below ground level. The highest water level recorded in the well located on the property is approximately 150-200mm below ground surface. It appears from the well data and discussions with Mr Bagrie that there has not been an issue with groundwater resurgence (i.e. groundwater levels locally exceeding the ground surface) on the property. This is likely to be helped by the relatively deep Armstrong Drain limiting the rise of groundwater levels in the southeastern part of the property, where there is a higher risk of this occurring due to lower ground levels.

It appears that ground levels in the proposed plan change area are generally around 0.2-0.6m higher above the water table than the land to the southeast of the site (between Armstrong Drain and Threlkelds Road drain).

7.4 Stormwater concept design

Due to the high winter groundwater levels in the proposed plan change area, discharge to ground is not considered a viable option. Therefore, discharge to surface water is the proposed means of stormwater disposal, via the Armstrong Drain. The stormwater concept is to use roadside swales for collection of road runoff, with individual lots discharging roof and pavement stormwater to the roadside swales (or other swales) via pipes or swales within the lots. This system, as well as providing treatment of stormwater runoff, should replicate reasonably well the pre-development hydrological regime.

The existing catchment area of the Armstrong Drain is 98.4ha, with a total impervious area estimated at 3.9%. The development of the proposed plan change area will not modify the catchment boundaries, but the total impervious area will increase to an estimated 13.5% when fully developed. This assumes 500m² of roof area and 500m² of paved area per rural-residential lot (based on an assessment from aerial photographs of Keetly Place, Ohoka) and new roads in accordance with the proposed ODP with 6m carriageways and 1.5m footpath. This increase in impervious area will result in a higher volume of stormwater runoff, and would result in significantly higher peak flows if no peak flow attenuation is provided.

In order to maintain peak runoff flows to pre-development levels and not exacerbate off-site flooding issues (i.e. when the Armstrong Drain breaks out and flows through the property to the southeast of the site), it is proposed that stormwater detention storage will be provided on-site. Two options are being considered for providing detention storage:

- **Option 1** involves widening of the Armstrong Drain within the site and construction of check dams to provide detention storage, as well as a basin at the lowest (eastern corner) of the site.
- **Option 2** involves constructing stormwater basins in two locations within the proposed plan change area. Refer to the Concept Stormwater Layout in Appendix B for a plan showing the proposed stormwater options.

Widening of the drain would involve excavating it out to a top width of approximately 20-25m, but maintaining its existing depth. The sides would be gently sloped, in effect turning it into a large swale. A low flow channel would be maintained in the bottom of the drain, and the slopes could incorporate a path and planting where desired.
Any basin constructed is likely to be 0.6-1.0m below ground level. This would potentially place the invert of the basin below the groundwater table during winter, however in reality it would act in a similar manner to the existing Armstrong drain, and locally lower the groundwater table to the base of the drain. Groundwater resurgence in the base of the basins could be controlled using either shallow subsurface drains, or gravelled “low flow” channels in the base of the basin that would direct any seepage to the basin outlets and into Armstrong Drain.

7.5 Stormwater Modelling

In order to make an assessment of the effects of development of the proposed plan change area, a stormwater model for the Armstrong Drain catchment was developed, using USEPA’s SWMM modelling software.

7.5.1 Modelling Parameters

The input parameters for the model have been determined from the following resources:

- Site topographical survey with 0.5m contours and spot heights in drains, with property boundaries including neighbouring areas.
- 10cm resolution orthophotos from 24 February 2011.
- HIRDS Version 3 rainfall data, factored for climate change of 2°C increase, plus std error (approximately 10% higher values than in WDC CoP Rainfall Tables).
- Waterways, Wetlands & Drainage Guide (WWDG), Part B: Design (CCC, February 2003).

Rainfall Hyetographs were developed in accordance with Figure 21-6, WWDG.

Roughness values of 0.01 for impervious surfaces, 0.25 for rural-residential and 0.35 for rural pasture were used (refer Table 21-1, WWDG).

Soil infiltration rates were set at 7 mm/hr constant rate, at it has been conservatively assumed that the ground will be saturated prior to the design storm event, so a higher initial infiltration rate has not been used.

The time of concentration for the pre-development catchment has been determined as 60-90 minutes. This is unlikely to change significantly post-development, as the current network of drains in the undeveloped block will be replaced with roadside swales once developed. We have not allowed for further development in the paper road drain catchment area as part of the modelling exercise.

7.5.2 Modelling Results

Initial modelling was carried out for various storm events for the pre-development and post-development scenarios with no flow attenuation or detention storage. The results are presented in the table below:

TABLE 1 – INITIAL MODELLING RESULTS

Rain Event	Pre-development		Post-development (No Attenuation)	
	Peak Flow (m^3/s)	Total Runoff (m^3)	Peak Flow (m^3/s)	Total Runoff (m^3)
10 Year				
1 Hour	0.43	1800	0.77	3400
2 Hour	0.48	2800	0.92	5200
6 Hour	0.41	4700	0.78	9300
12 Hour	0.26	4900	0.52	11000
24 Hour	0.10	4300	0.30	12900
50 Year				
1 Hour	1.01	5500	1.60	8200
2 Hour	1.17	8900	1.88	12900
6 Hour	1.32	17500	1.91	24800
12 Hour	1.11	21400	1.51	31000
24 Hour	0.63	18700	0.87	30300
48 Hour	0.08	7300	0.27	22600

The modelling was carried out using normal outfalls, i.e. not restricted by the Cust River levels. During a coarse calibration process, some model runs were carried out using historical rainfall and river stage data (there is a stage recorder near the Threlkelds Rd bridge), along with a cross section of the river at the outfall. It was found that although the river level restricted flows when it started to rise significantly, this tended to occur well after the peak flow had occurred, due to the significantly longer time of concentration of the Cust River (around 24 hours) compared with the Armstrong Drain. For the purposes of determining peak flows and detention storage volumes, it was found that modelling the outfall with river levels did not affect the detention volume required to reduce peak flows to pre-development levels.
The pre-development modelling scenario showed the drain and culvert being able to pass flow flows without any break out into the neighbouring property to the southeast. The level of the low point in the top of bank at the breakout point has been assessed at approximately 1m above the drain invert at the point determined from the flooding

photographs, so the post-development options are modelled with the basins sized such that no break out will occur for any storm event up to 50 year duration.
Due to the peak river levels tending to be around 24 hours after commencement of the rain event, and the critical storm events for the post-development catchment (Allowing for flow attenuation) being 6-12 hours, it will be important to design any detention storage to release as much stormwater as possible early on. As such, the primary outlets from storage basins have been modelled as rectangular orifices, simulating a stoplog arrangement with chocks under the lowest board. The orifice is sized to restrict flows to not exceed the pre-development peak flow for the 10-year critical storm event. Secondary outlets from storage basins have been sized to not exceed the pre-development peak flow for the 50-year critical storm event.
The results of the two post-development options modelled are presented in the table below:

Rain Event	Post Development Option 1 (drain widening) Peak Flow (m^3/s)	Post Development Option 2 (second basin) Peak Flow (m^3/s)
10 Year		
1 Hour	0.41	0.40
2 Hour	0.44	0.43
6 Hour	0.46	0.46
12 Hour	0.43	0.43
24 Hour	0.31	0.32
50 Year		
1 Hour	0.50	0.50
2 Hour	0.95	0.71
6 Hour	1.30	1.32
12 Hour	1.29	1.29
24 Hour	0.91	0.85
48 Hour	0.27	0.27

Option 1 requires a basin approximately 0.5m deep (from the existing top of bank level of the drain), with a storage volume of around 5500m^3 to achieve the results as shown in the table above, with no flooding.

Option 2 requires the basin at the eastern end of the site to be approximately 0.6m deep with a storage volume of around 6600m^3, and the second basin to be 0.75m deep (adjacent to the outlet – up to 1.2m deep as the ground rises to the northwest) with a storage volume of around 6500m^3.

7.5.3 Modelling Conclusions

The modelling indicates that both options considered can attenuate flows in the Armstrong Drain catchment to not exceed pre-development peak flows for the critical 10-year and 50-year storms.

Both options will require a similar amount of earthworks (when the drain widening is taken into account for Option 1). Option 1 has the advantage of being able to use the drain corridor for both amenity and stormwater purposes. With a wide corridor, a more naturalised look can be achieved, with gentle side slopes and a meandering channel in the base to carry groundwater base flows and runoff from smaller storm events. It is also a relatively “natural” option, more closely replicating the current drainage regime. It also provides more land within the plan change area for other purposes, as most of the second detention basin area is not required for stormwater purposes.

8 Power and Telecommunications

Mainpower Limited has confirmed that the proposed development area can be serviced for reticulated power from the existing network. A copy of Mainpowers letter is included at Appendix D.

Chorus Limited has confirmed that the proposed development area can be serviced for reticulated telecommunications from the existing network. A copy of Chorus' letter is included at Appendix E.

9 Construction

9.1 Staging

Generally, it is expected the development would be staged over three to four stages with new stages being released to the market in line with demand.

Though a formal staging plan would only be prepared for the subdivision consent the initial stage of development would likely include:

- Access from Bradleys Road;
- Construction of roads and right-of-ways along the south west side of the development area;
- Construction of roadside swales, secondary flow paths including widening of the existing Armstrong Drain and installation of stormwater control measures along the full length of the south east boundary to the outlet with the Cust River (Main Drain);
- Construction of reticulated water both internally and externally to service the development, this would likely be by extending the existing Rangiora supply;
- Construction of wastewater reticulation both internally and with an external connection to the proposed public wastewater rising main at a publicly sited pumping station;
- Reticulation of utilities services.

9.2 Earthworks

As the site has relatively constant grade from west to east a minimal earthworks strategy would be adopted to achieve the requirements of the road access and stormwater networks. The majority of cut earthworks volumes would likely originate from:-

- Excavation to road subgrade and to form stormwater treatment swales within the proposed legal road reserve. Swales would also form secondary flow paths to stormwater detention basins;
- Widening of the existing Armstrong Drain and development of shallow stormwater detention basins as shown in the ODP.

The fill volumes resulting from excavation would be used elsewhere on the site for landscape shaping of reserves and lots to ensure minimum site gradients for stormwater are achieved and to prevent ponding.

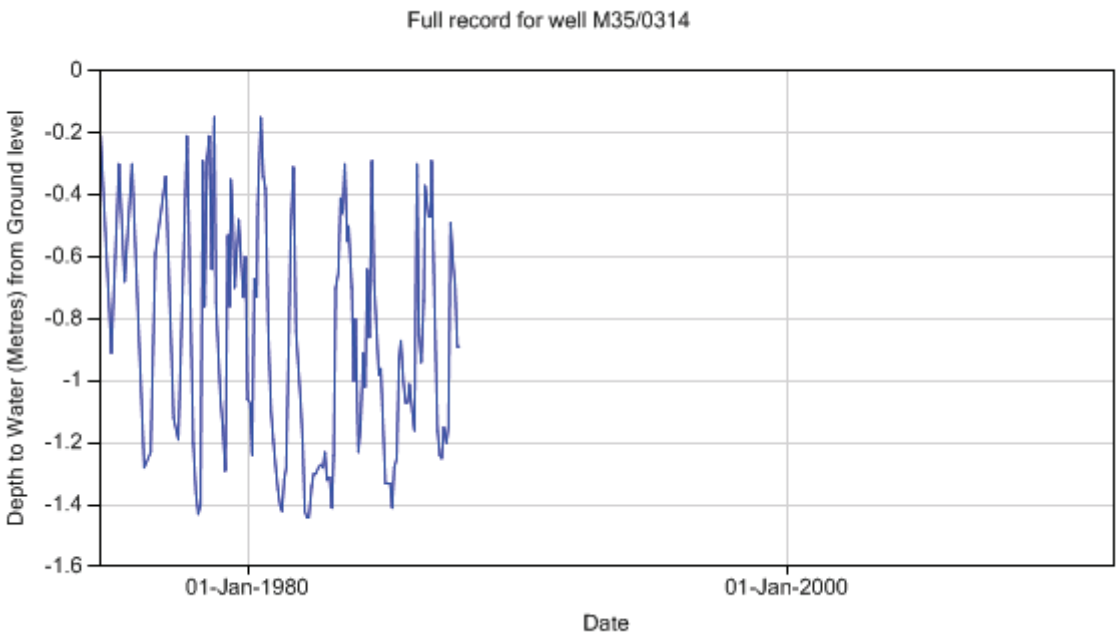
All earthworks will be undertaken in accordance with NZS4431 – Earth fill for residential development, and compliance with this standard for certification would be achieved by appropriate site inspections.

An erosion and sediment control plan would be prepared in accordance with ECan guidance documents[7] with the engineering drawings. This will define earthworks staging and the types of controls to be put in place to minimise the discharge of contaminants to the environment during construction.

[7] Environment Canterbury Erosion and Sediment Control Guidelines 2007, with updates 2008

Appendix A

Environment Canterbury (ECan) well card data



[Printable Bore Log]

How to use this map

The location is indicated by a red square. You can hover over the square to view more information.

Use the Imagery, Topo and Street buttons on the right of the map to change the imagery of the map.

StreetMap
Topo
Aerials

1:1000000

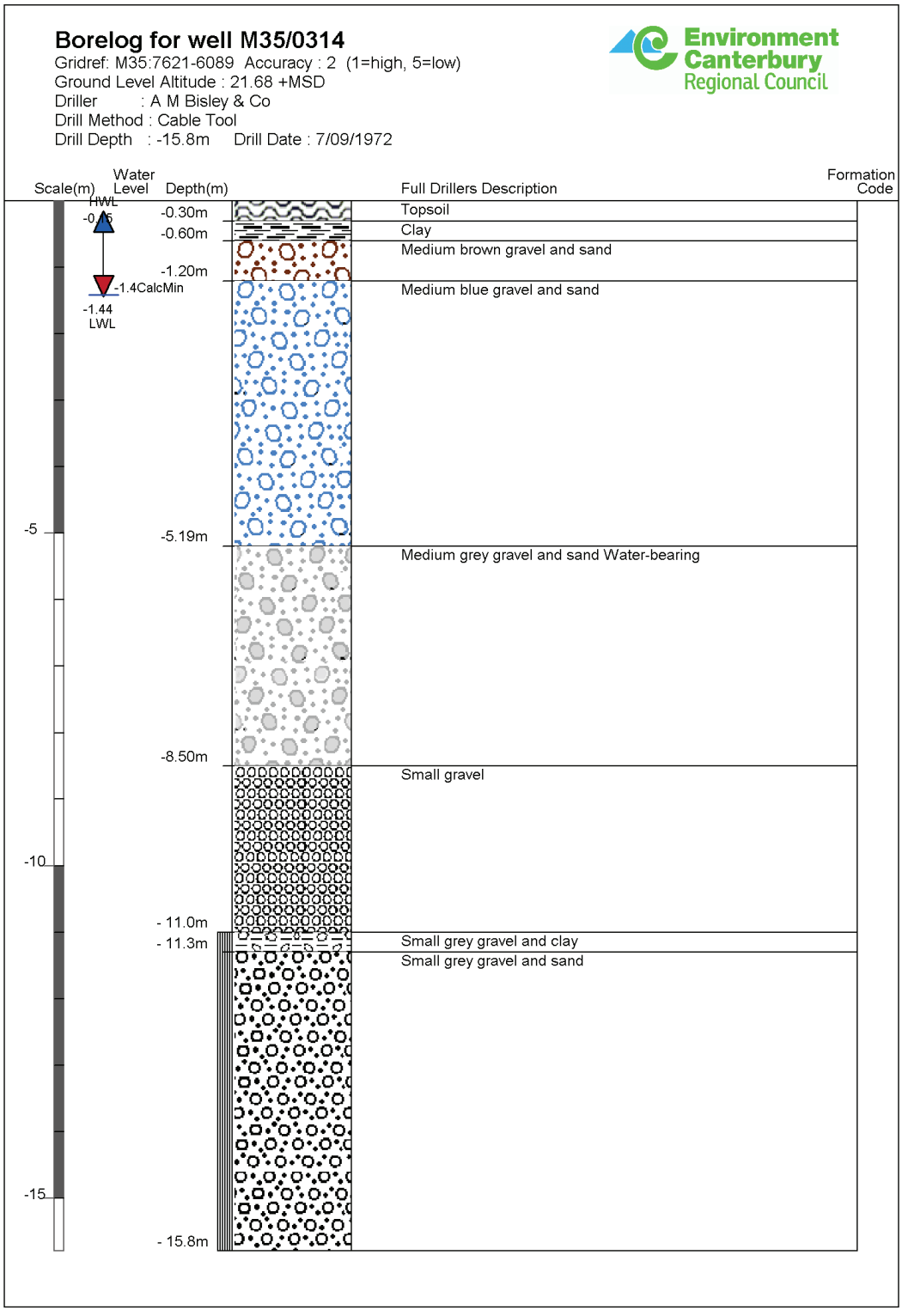
LOADING

This well currently has no aquifer tests.

- Home
- Contact Us
- Copyright Information
- NewZealand.govt.nz
- Accessibility
- Privacy
- Sitemap
- Advanced Search

Search the ECan website [Search]

- News RSS
- Events RSS



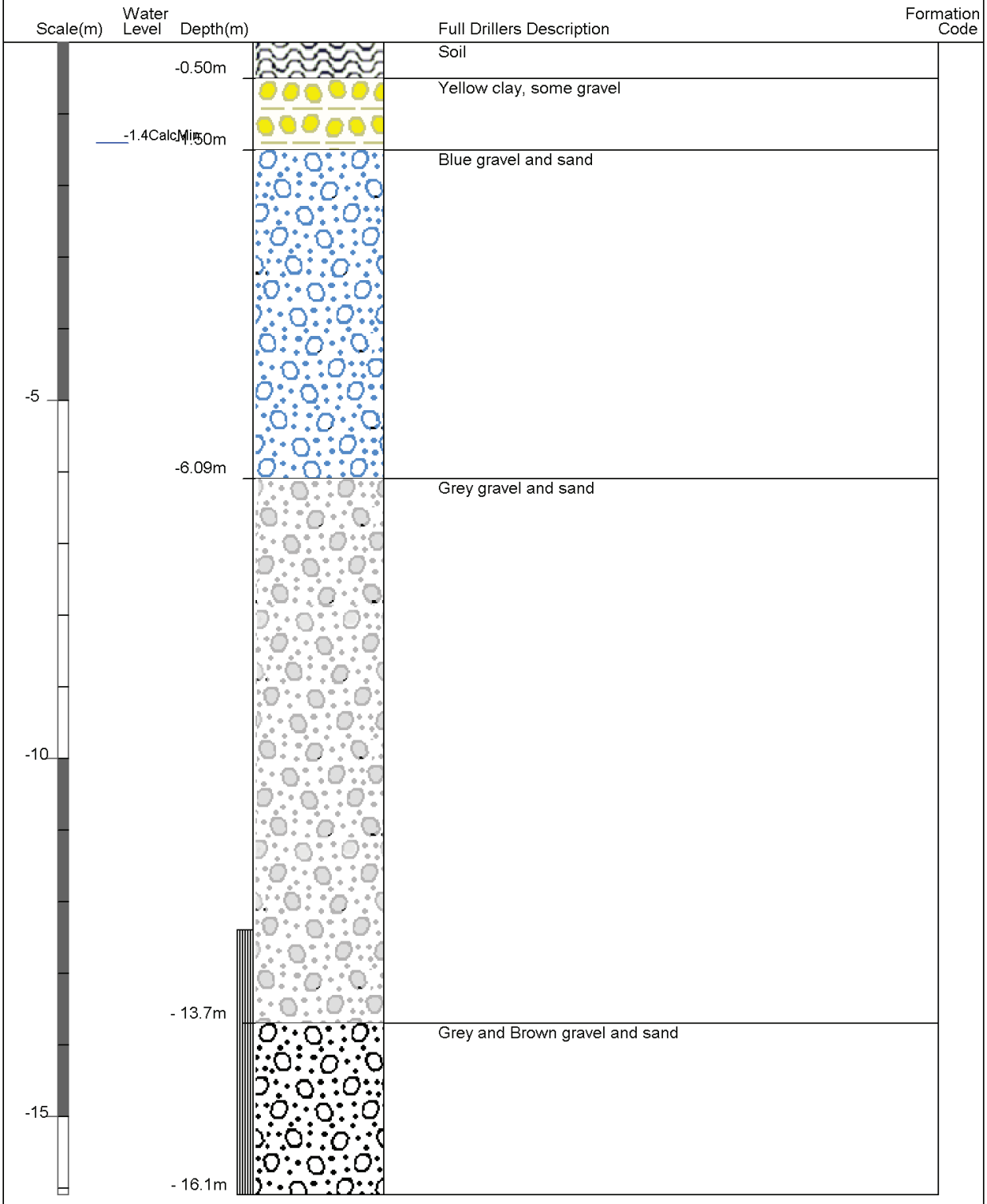
How to use this map

The location is indicated by a red square. You can hover over the square to view more information.

Borelog for well M35/1823

Gridref: M35:763-611 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 21.49 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -16.1m Drill Date : 1/02/1981

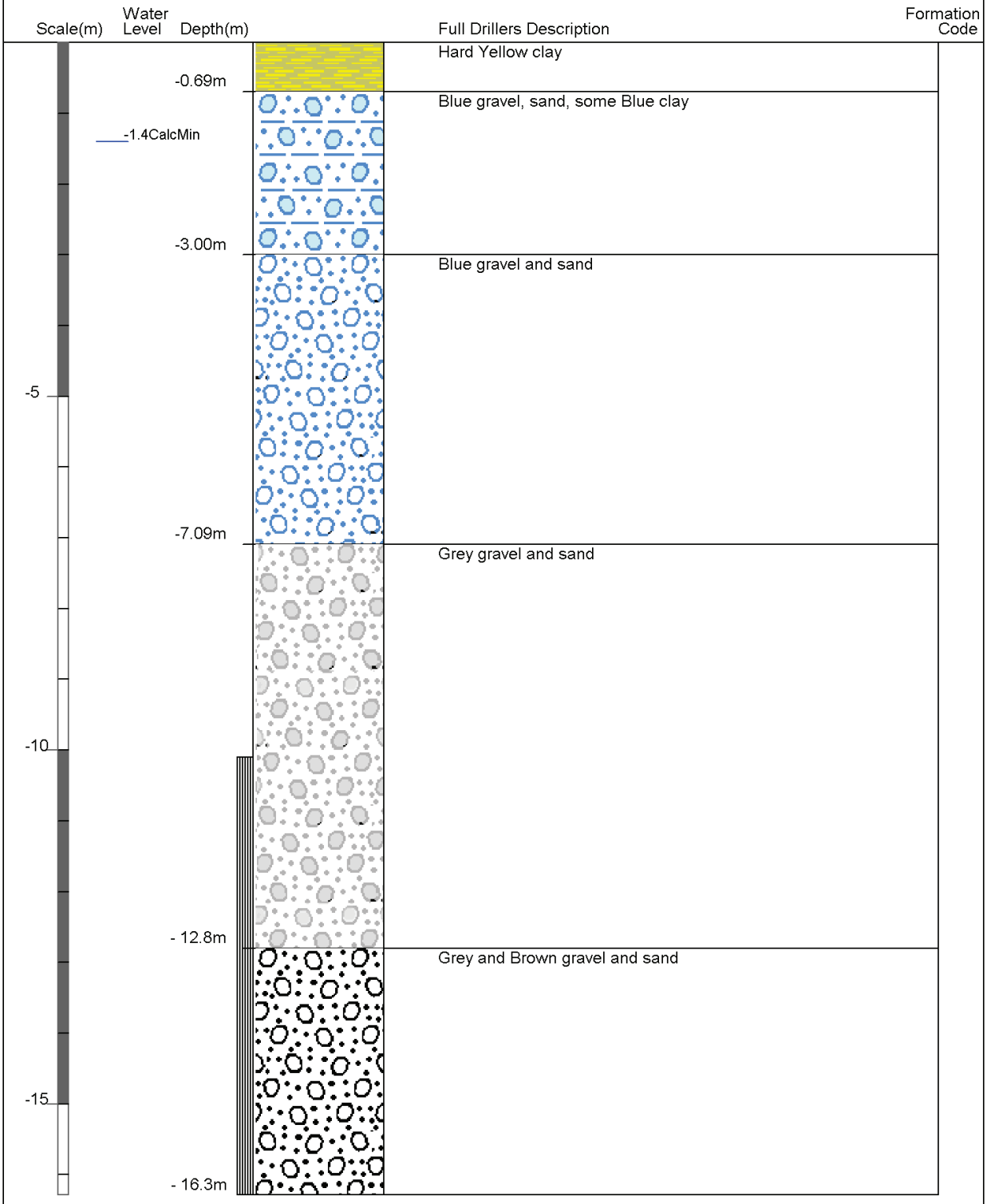
Environment Canterbury Regional Council



Borelog for well M35/1824

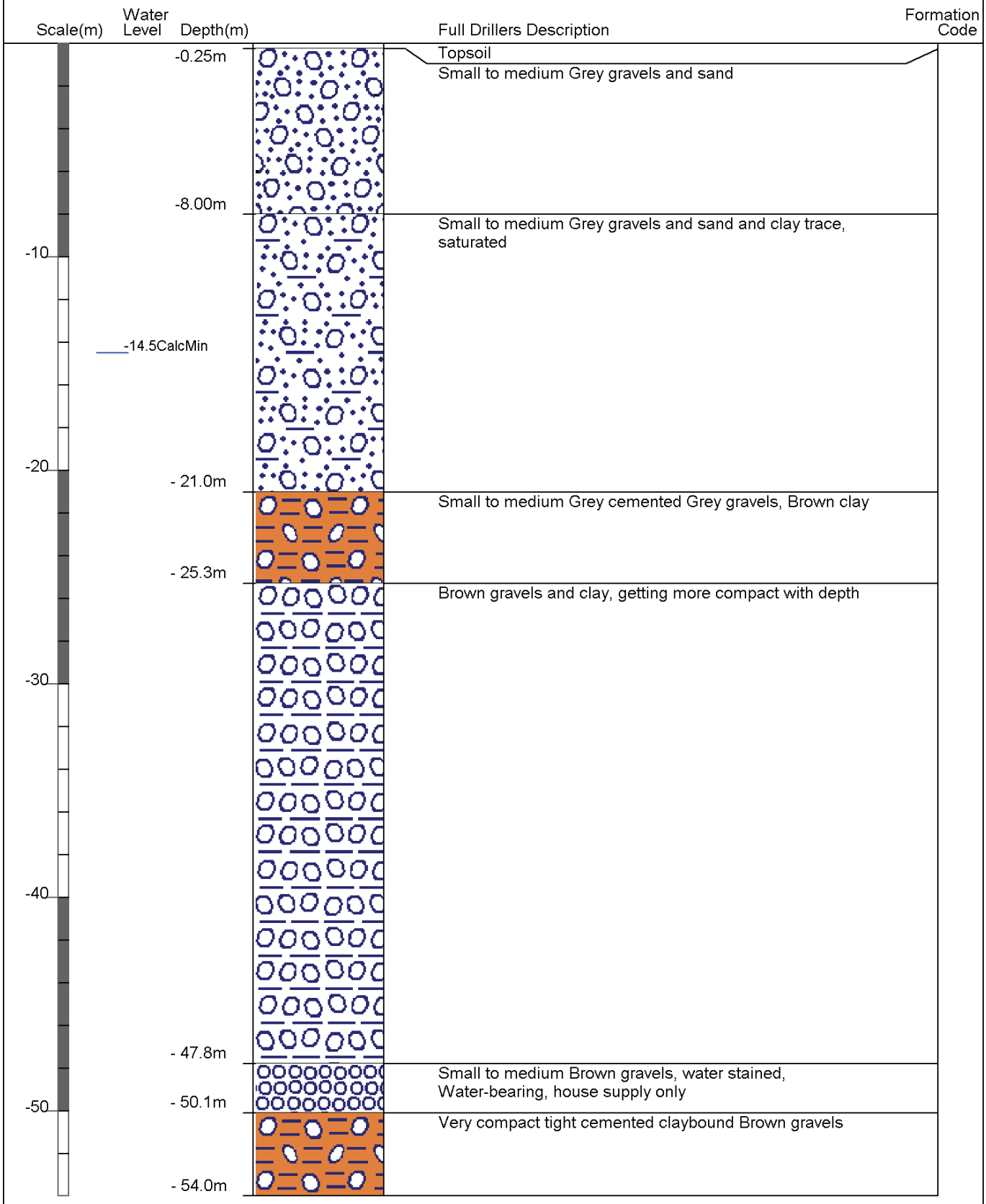
Gridref: M35:764-610 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 20.77 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -16.29m Drill Date : 2/02/1981

Environment Canterbury Regional Council



Borelog for well M35/2622

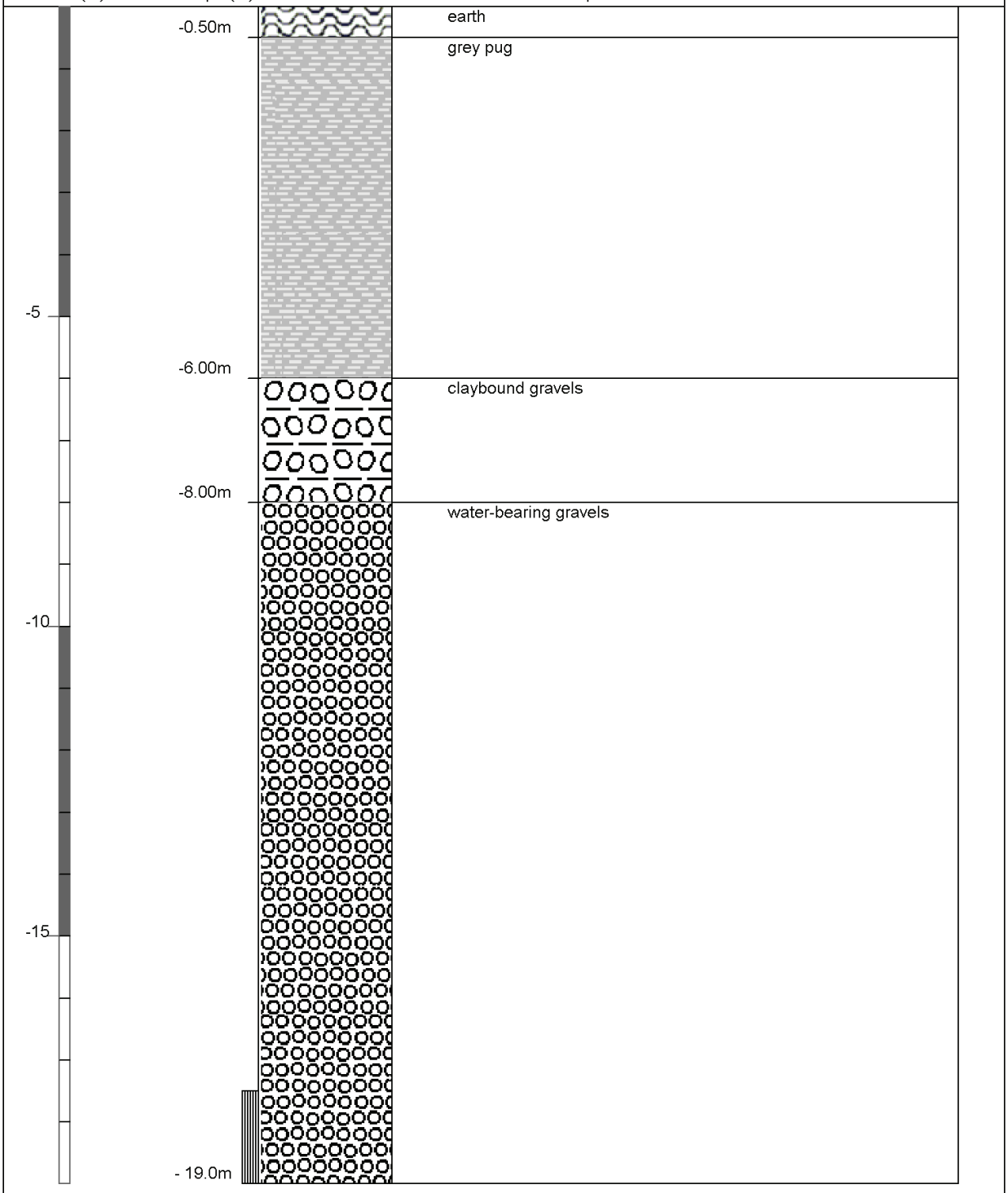
Gridref: M35:764-614 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 20 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -54m Drill Date : 30/09/1982



Borelog for well M35/11068

Gridref: M35:76859-60204 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 16.79 +MSD
Driller : East Coast Drilling
Drill Method : Rotary Rig
Drill Depth : -19m Drill Date : 1/01/2006

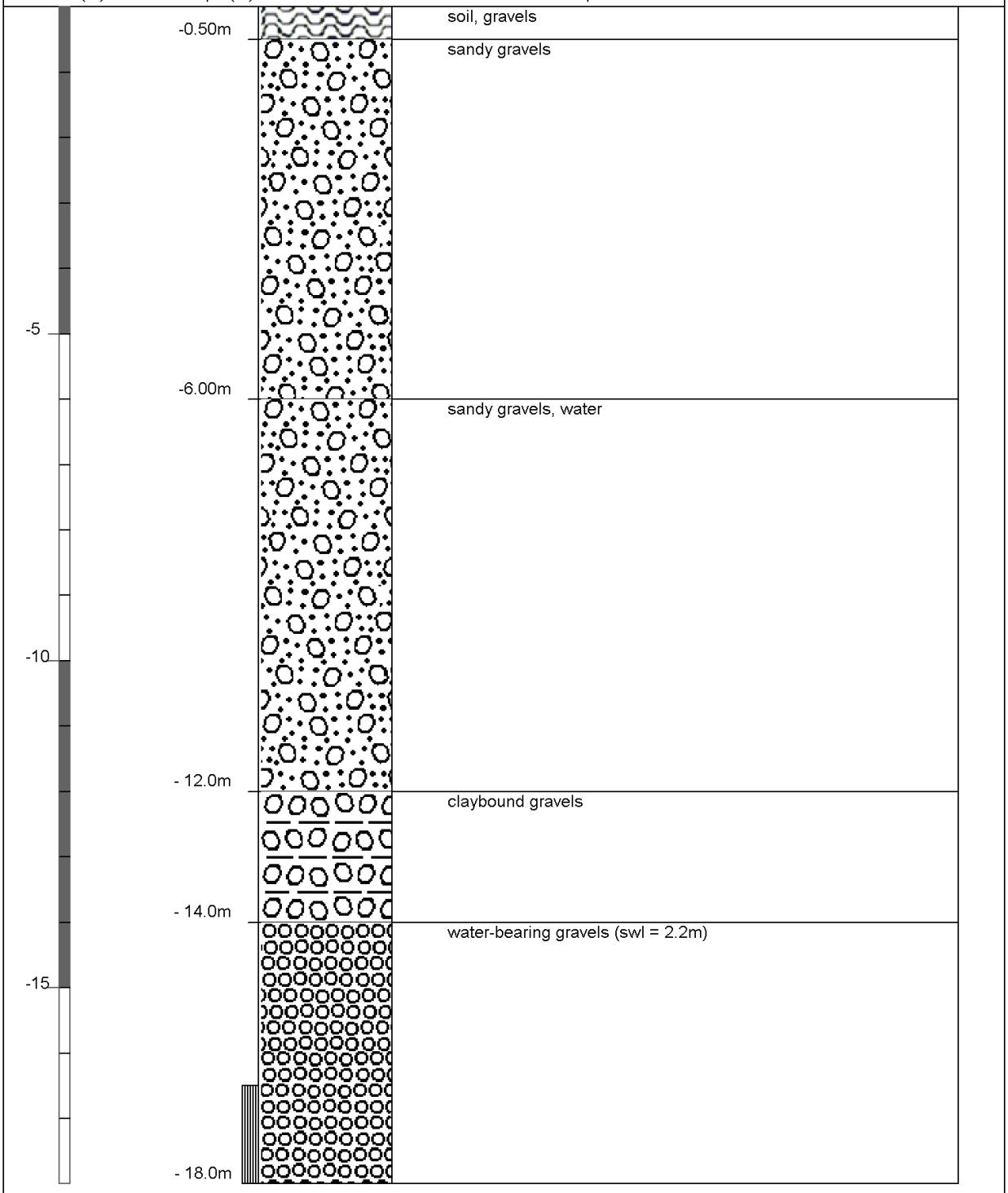
Environment Canterbury Regional Council



Borelog for well M35/11069

Gridref: M35:77175-60881 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 15.35 +MSD
Driller : East Coast Drilling
Drill Method : Rotary Rig
Drill Depth : -18m Drill Date : 28/09/2006

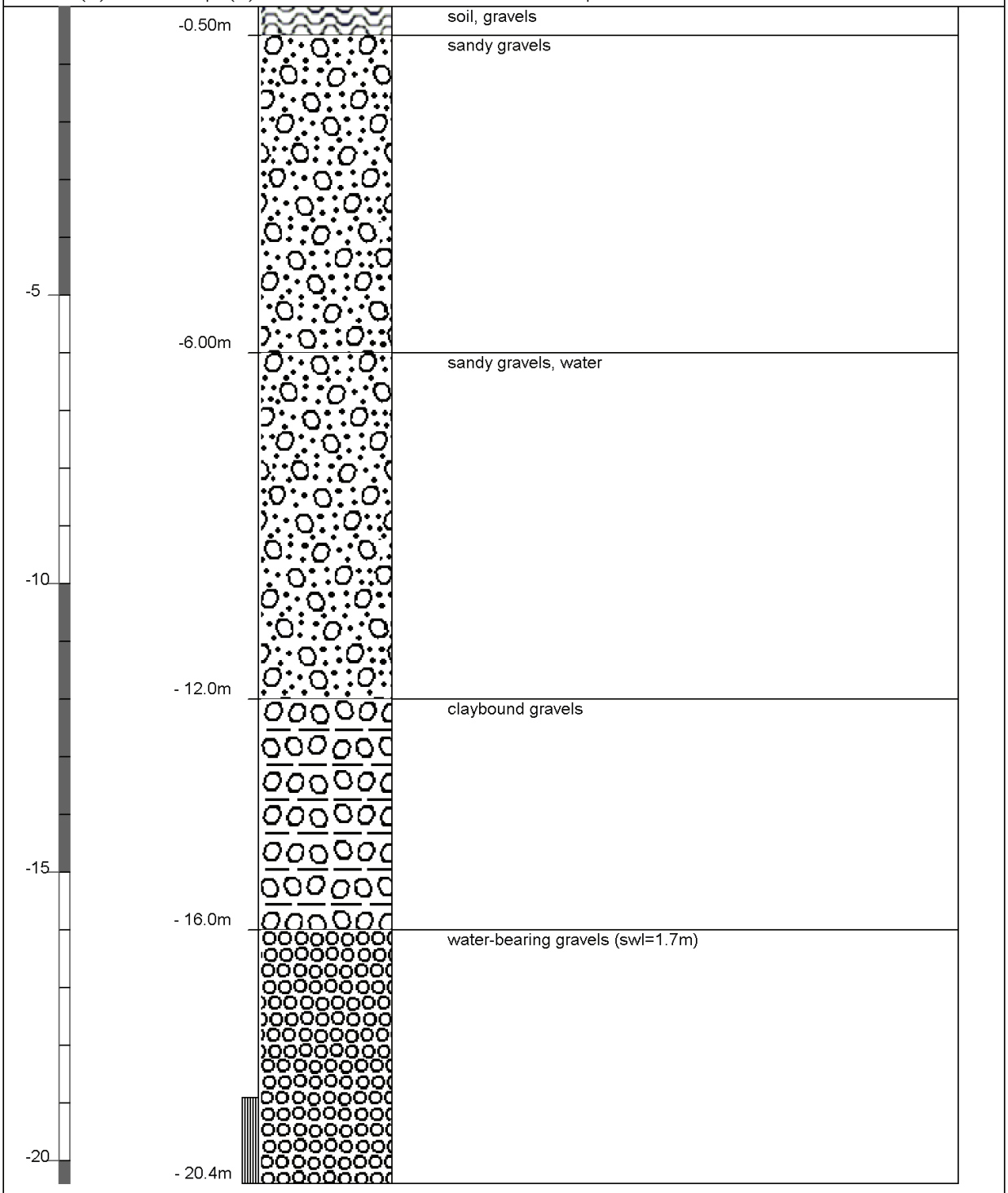
Environment Canterbury Regional Council



Borelog for well M35/11070

Gridref: M35:77005-60771 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 16.09 +MSD
Driller : East Coast Drilling
Drill Method : Rotary Rig
Drill Depth : -20.4m Drill Date : 27/09/2006

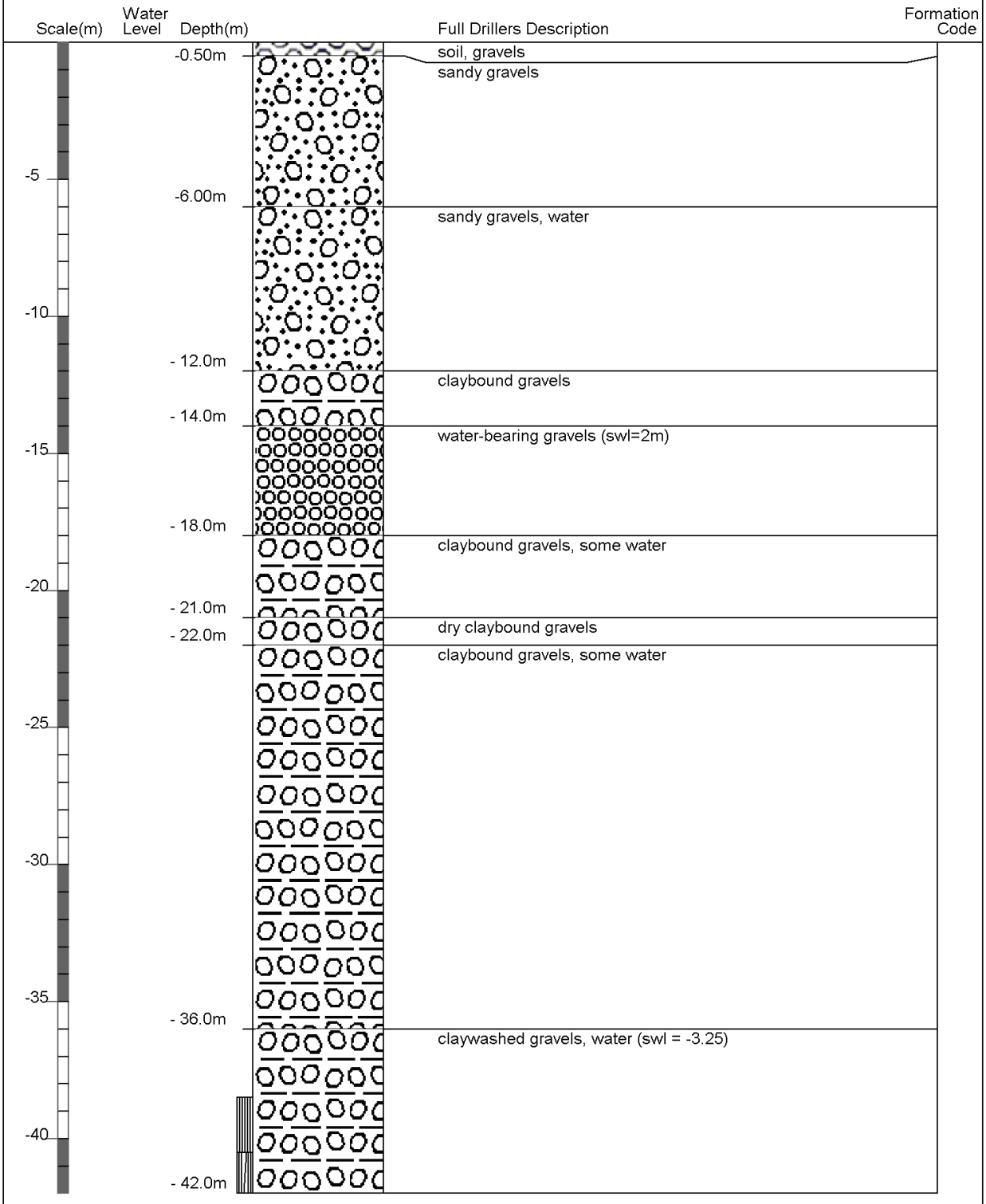
Environment Canterbury Regional Council



Borelog for well M35/11071

Gridref: M35:76956-60747 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 16.59 +MSD
Driller : East Coast Drilling
Drill Method : Rotary Rig
Drill Depth : -42m Drill Date : 14/11/2006

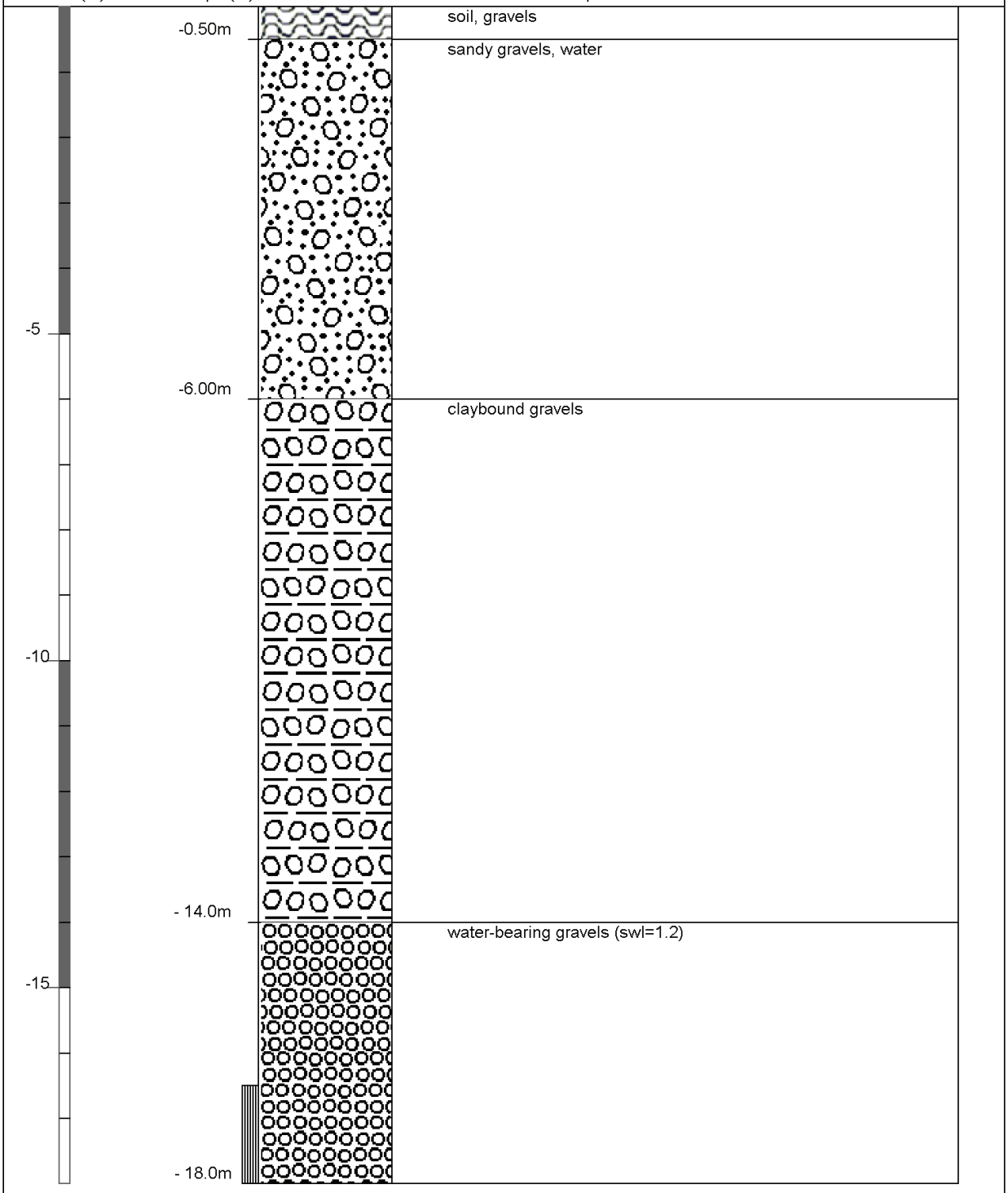
Environment Canterbury Regional Council



Borelog for well M35/11072

Gridref: M35:76664-60507 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 18.03 +MSD
Driller : East Coast Drilling
Drill Method : Rotary Rig
Drill Depth : -18m Drill Date : 25/09/2006

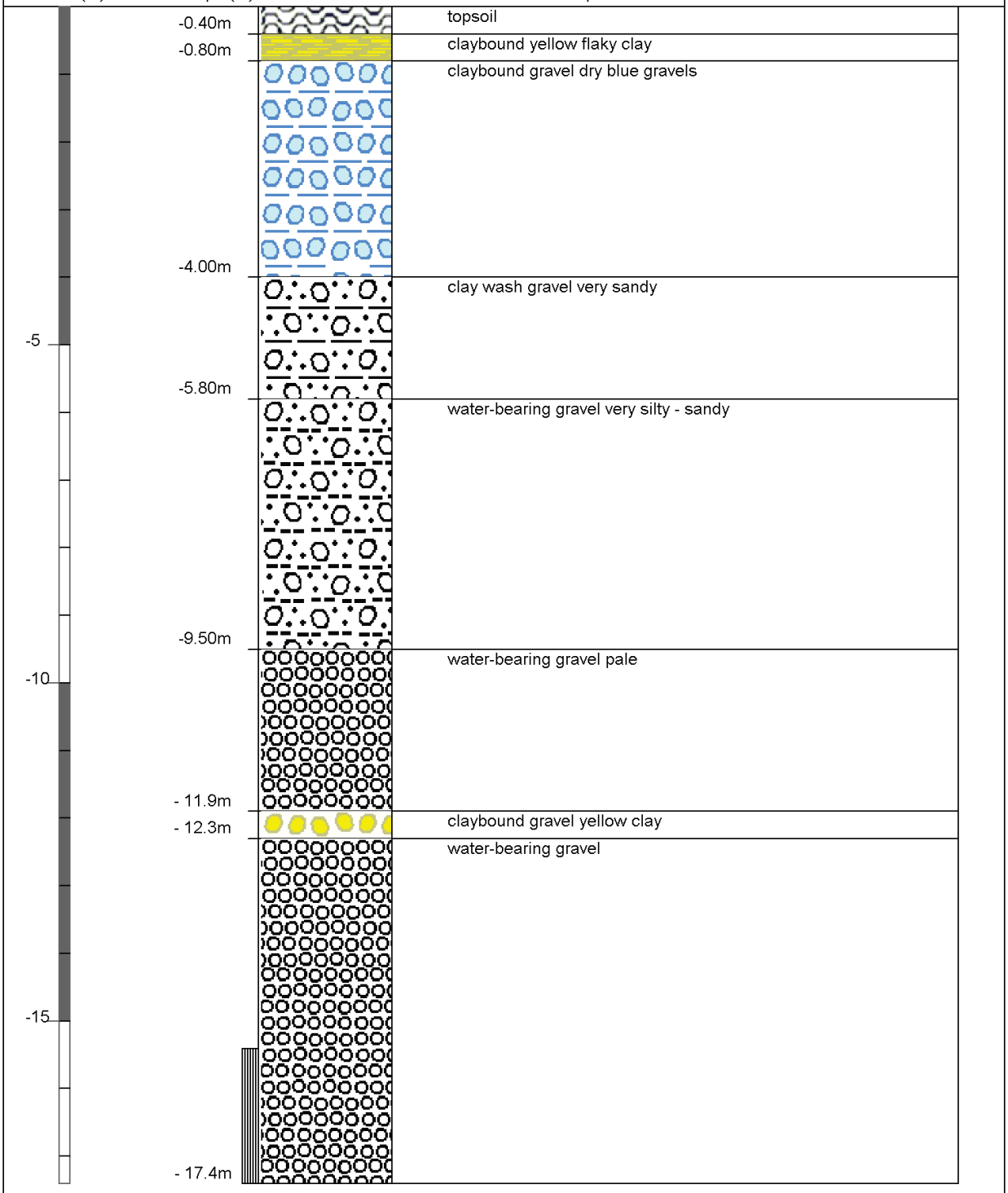
Environment Canterbury Regional Council



Borelog for well M35/11711

Gridref: M35:77190-60679 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 15.19 +MSD
Driller : Clemence Drilling Contractors
Drill Method : Rotary Rig
Drill Depth : -17.41m Drill Date : 18/07/2006

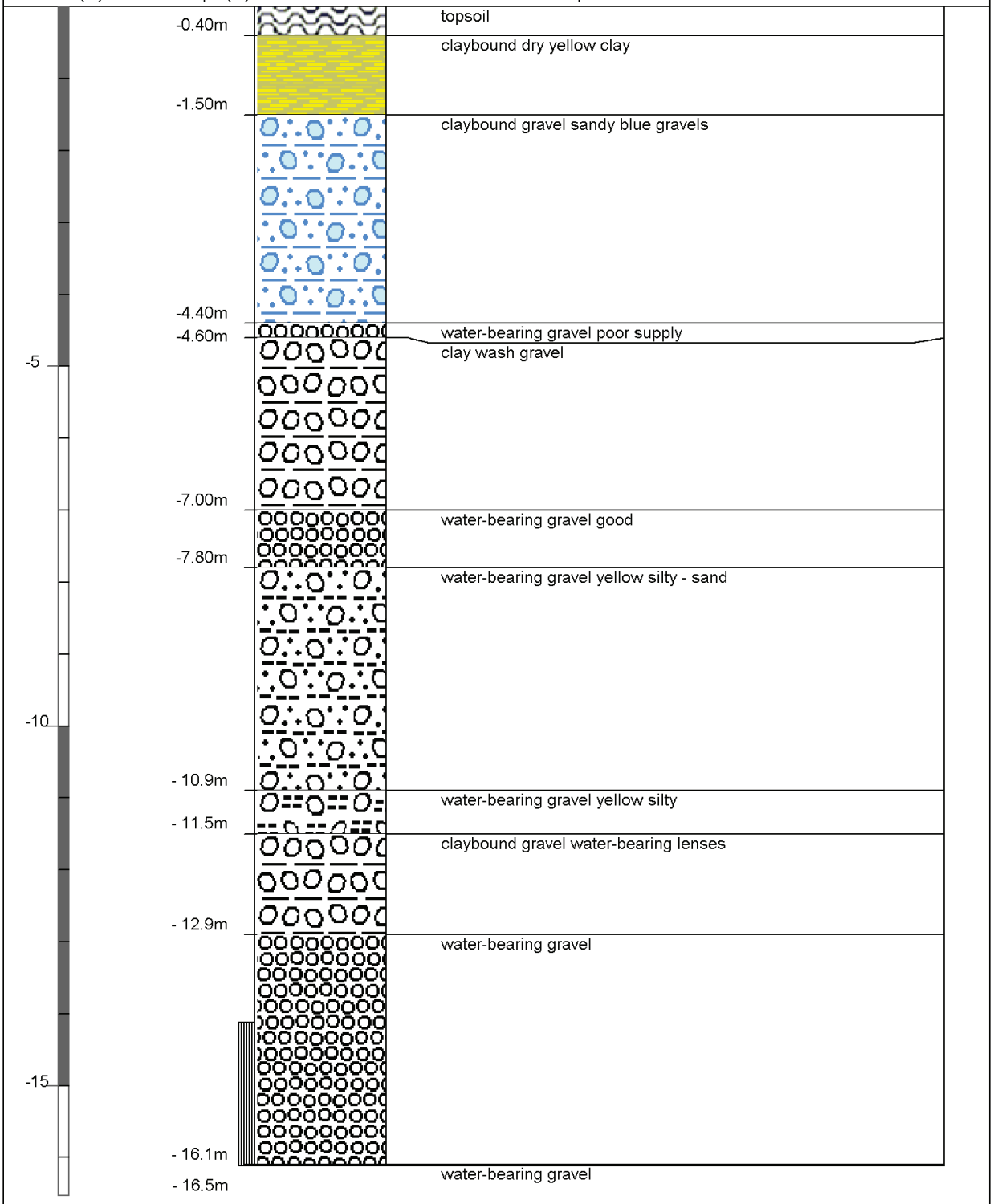
Environment Canterbury Regional Council



Borelog for well M35/11712

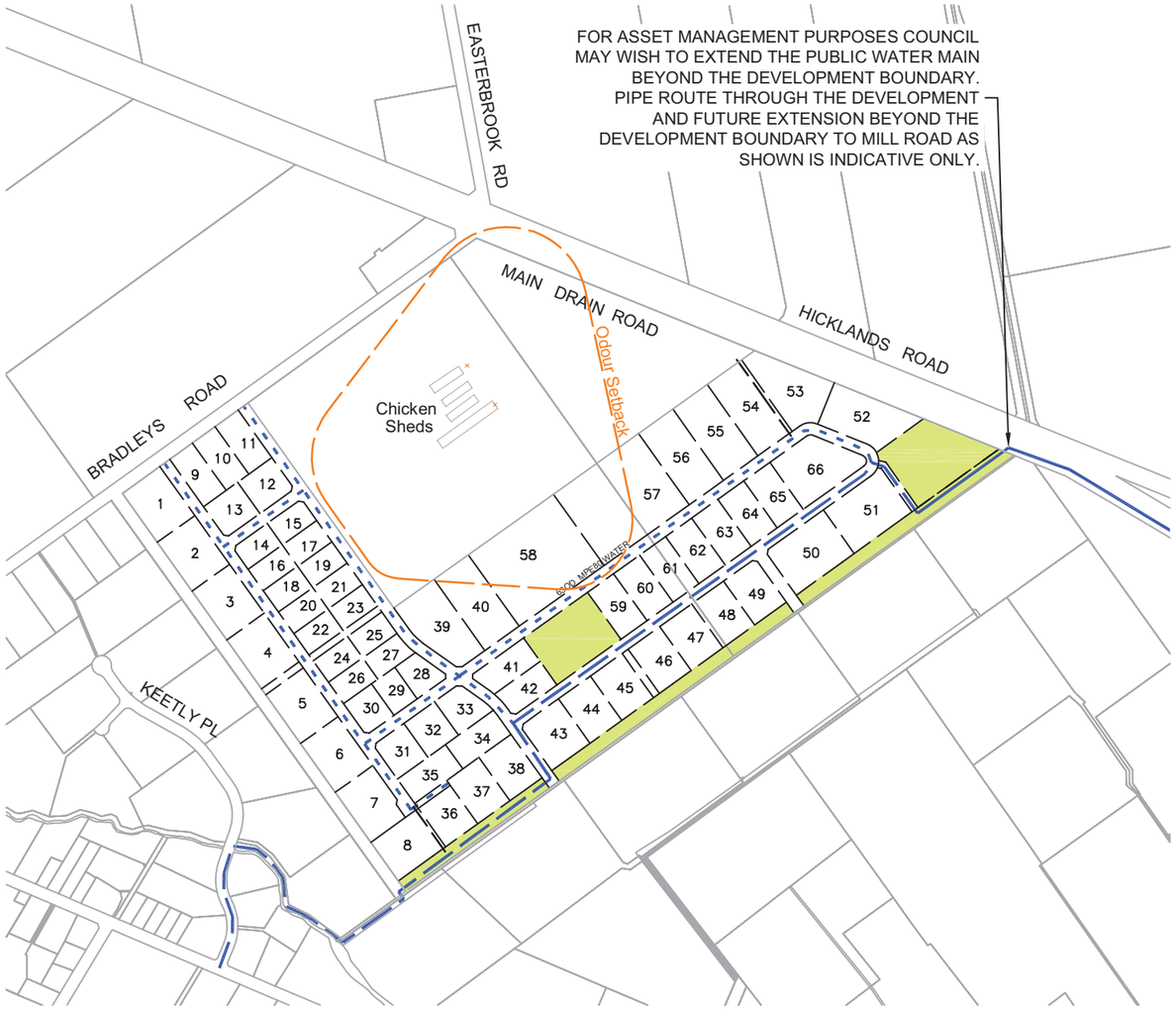
Gridref: M35:77317-60533 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 15.39 +MSD
Driller : Clemence Drilling Contractors
Drill Method : Rotary/Percussion
Drill Depth : -16.12m Drill Date : 18/07/2006

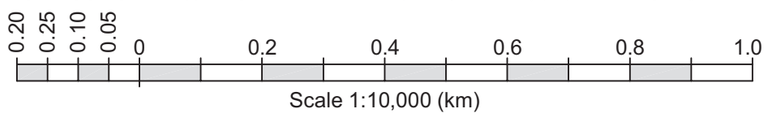
Environment Canterbury Regional Council

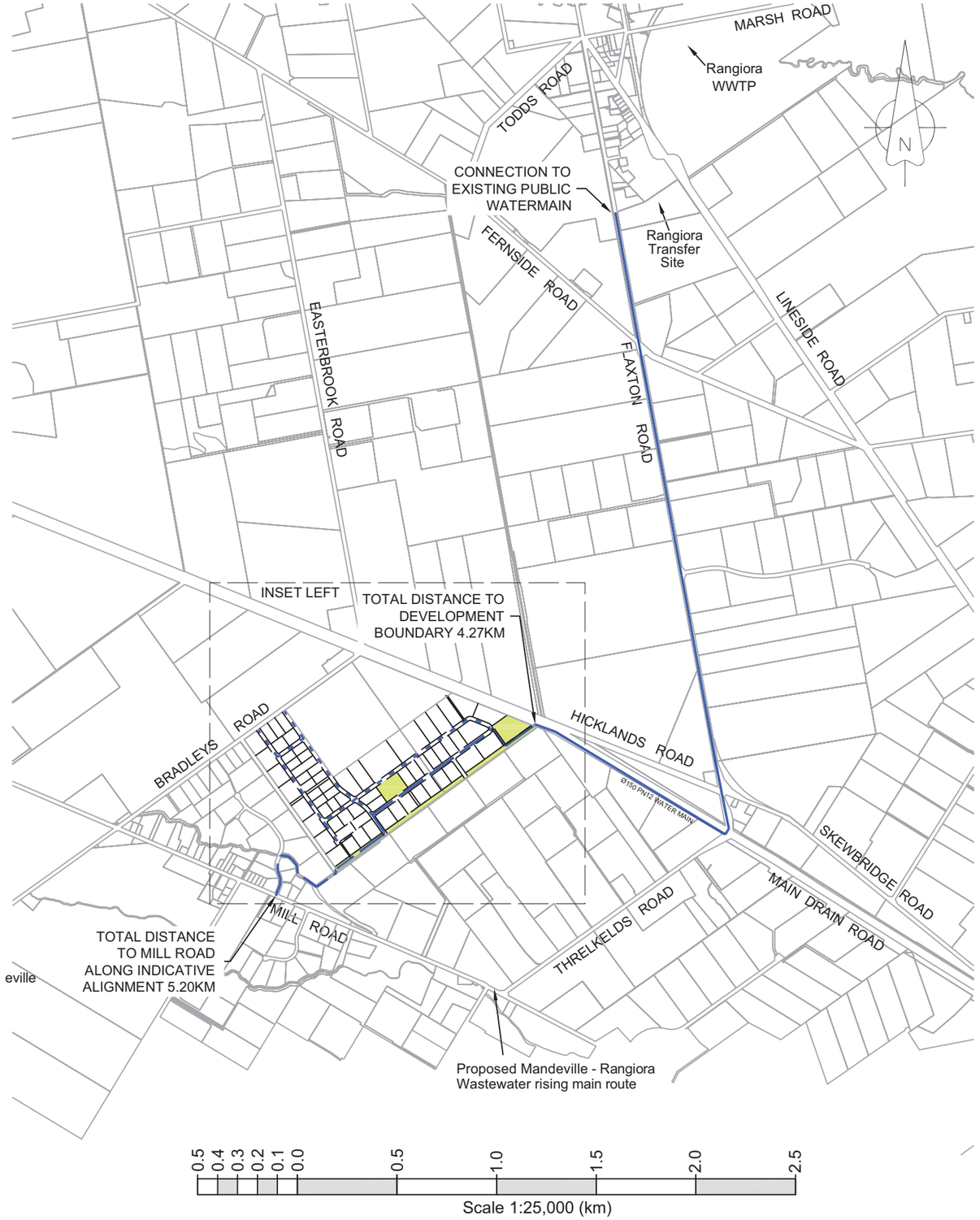


Appendix B

Water, Wastewater & Stormwater schematics







LEGEND

- Ø100/150mm PN12 uPVC Water Main
- Ø100/150mm Possible upgrade/extension to public water main (indicative route only)
- Ø32/63mm OD PE80B Pipe

Note: All pipe sizes and alignments shown are indicative only and subject to change.

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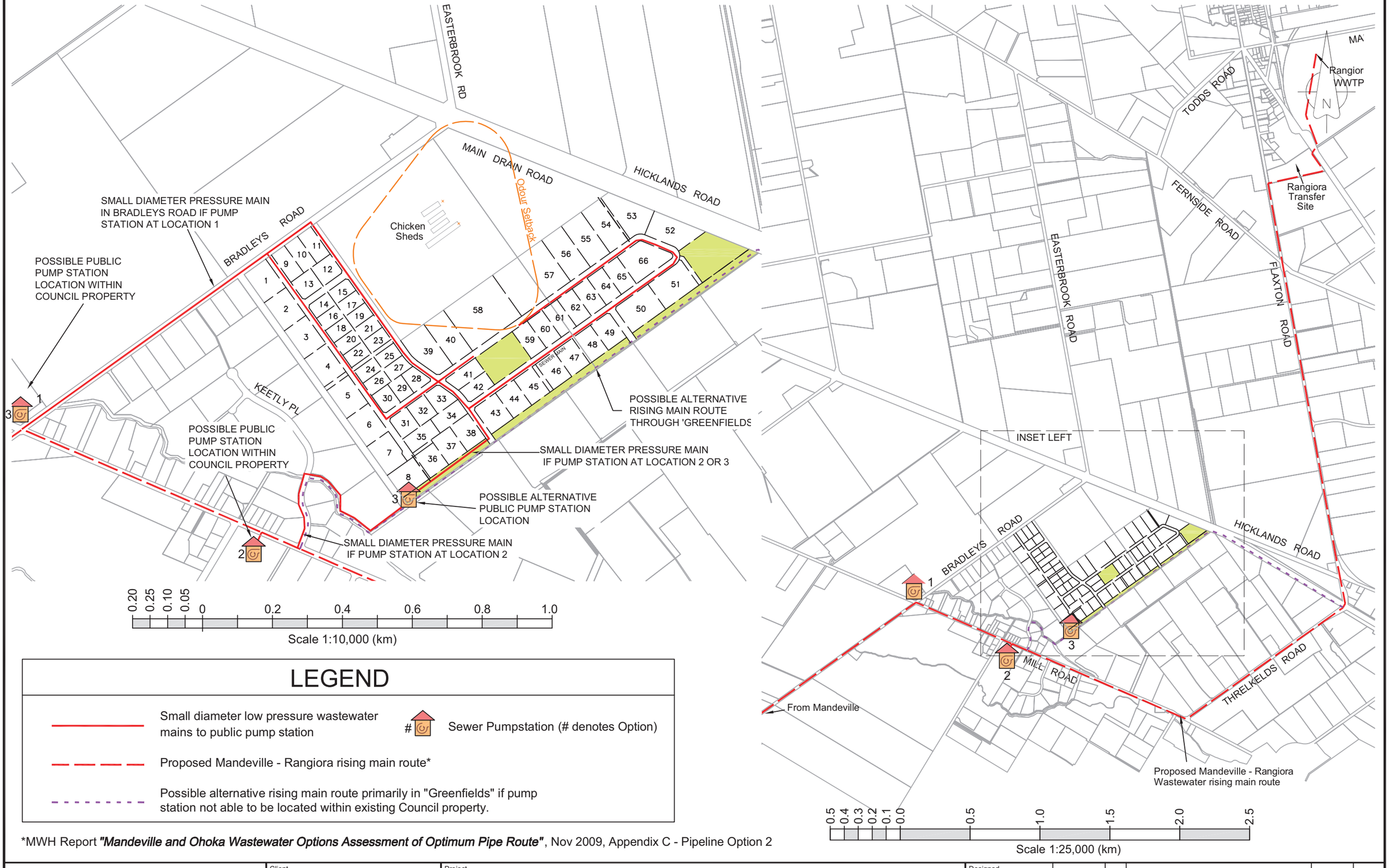
Client: P. & A. BAGRIE

Project: BAGRIE PRIVATE PLAN CHANGE

Title: PRELIMINARY WATER SUPPLY LAYOUT
BRADLEYS ROAD - OHOKA

Designed	TM				
Drawn	ADF				
Checked		REV	COMMENTS	DATE	APR
Approved		Scale	As Shown	Drawing No	Revision
Date	30 MAR 2012	Sheet	1 of 3	11041-01-001	A



LEGEND

- Small diameter low pressure wastewater mains to public pump station
- # Sewer Pumpstation (# denotes Option)
- Proposed Mandeville - Rangiora rising main route*
- Possible alternative rising main route primarily in "Greenfields" if pump station not able to be located within existing Council property.

*MWH Report ***"Mandeville and Ohoka Wastewater Options Assessment of Optimum Pipe Route"***, Nov 2009, Appendix C - Pipeline Option 2

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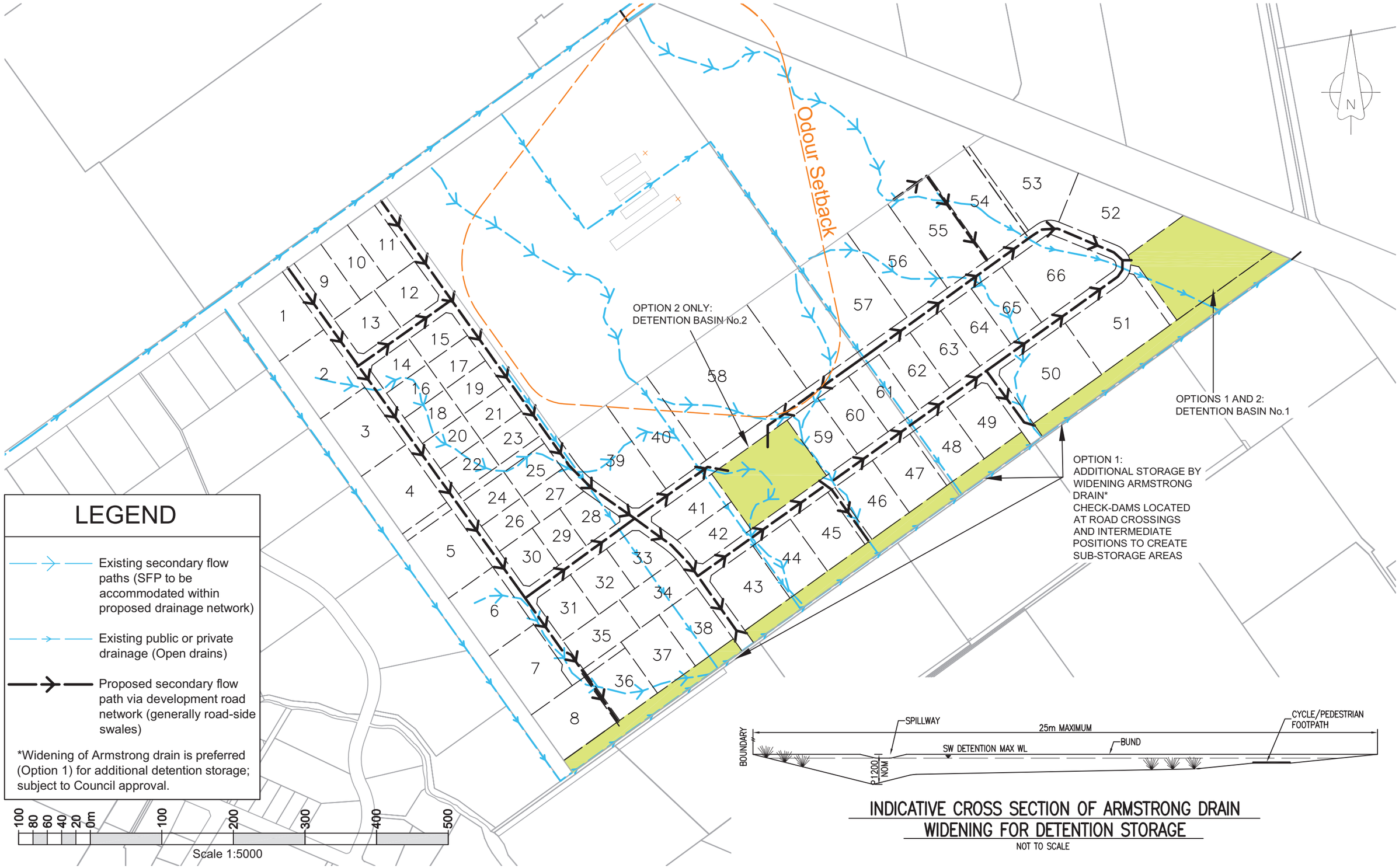
Client: P. & A. BAGRIE

Project: BAGRIE PRIVATE PLAN CHANGE

Title: CONCEPT WASTEWATER RETICULATION LAYOUT BRADLEYS ROAD - OHOKA

Designed	TM				
Drawn	ADF				
Checked		REV	COMMENTS	DATE	APR
Approved		Scale	As Shown	Drawing No	Revision
Date	30 MAR 2012	Sheet	2 of 3	11041-01-001	A



LEGEND

- Existing secondary flow paths (SFP to be accommodated within proposed drainage network)
- Existing public or private drainage (Open drains)
- Proposed secondary flow path via development road network (generally road-side swales)

*Widening of Armstrong drain is preferred (Option 1) for additional detention storage; subject to Council approval.

100 80 60 40 20 0m 100 200 300 400 500

Scale 1:5000

INDICATIVE CROSS SECTION OF ARMSTRONG DRAIN WIDENING FOR DETENTION STORAGE

NOT TO SCALE

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Client: P. & A. BAGRIE

Project: BAGRIE PRIVATE PLAN CHANGE

Title: CONCEPT STORMWATER RETICULATION LAYOUT
BRADLEYS ROAD - OHOKA

Designed	TM				
Drawn	ADF				
Checked		REV	COMMENTS	DATE	APR
Approved		Scale	As Shown	Drawing No	Revision
Date	30 MAR 2012	Sheet	3 of 3	11041-01-001	A

Appendix C

Rising main route drawing