REPORT

Tonkin+Taylor

MILLWATER SUBDIVISION - ARRANS POINT PRECINCT 7 STAGE 1

Geotechnical Completion Report

Prepared for
WFH Properties Ltd
Prepared by
Tonkin & Taylor Ltd
Date
October 2016
Job Number
21854.0037/APP7S1.v1

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Executive summary

Tonkin + Taylor Ltd (T+T) was engaged by WFH Properties Ltd to monitor and provide earthworks certification for the 15 No. Residential Lots contained within Stage 1 of Arran's Point Precinct 7 at the Millwater Subdivision in Silverdale. Stage 1 comprises residential Lots 1 to 13 and Lots 200 to 201 (high density residential Lots), Reserve Lot 803 and Joint Owned Access Lanes Lots 603 and 604 inclusive as shown on the Woods Final Contour As–Built Plan (Woods Ref 37001–01–AB–100) in Appendix A1.

This Geotechnical Completion Report contains information required for subdivisional earthworks completion reporting, as well as outlining geotechnical design issues that need to be considered for subsequent building design and construction on each residential Lot.

Previous geotechnical investigation work across the subdivision was undertaken by T+T and reported in:

a 2000 and 2001 Preliminary feasibility reporting (Ref. [1] and [2]).

b 2003 Major reconnaissance report covering land in the Silverdale North and Orewa West areas (Ref. [3]).

c November 2011 Geotechnical Investigation Report for the North Bridge, Southern Abutment (Ref. [4]).

d November 2013 Geotechnical Investigation Report for Arran's Point Precinct 7 (Ref. [5]).

Woods Ltd (Woods) undertook the engineering design for this stage and the overall subdivision.

Bulk earthworks commenced on site in late 2010 and progressed through to the end of 2013, works at this stage being generally associated with the formation of Arrans Drive (including shear keys and retaining walls for the bridge abutments). Bulk earthworks associated with development of Stage 1 of Arrans Point (Precinct 7) commenced in March 2014 and were completed by February 2016. Earthworks comprised the following:

a Stripping of vegetation, organic materials and topsoil to stockpile.

b Installation of subsoil drains.

c Construction of 1 No. Shear Key (SK1) as shown on T+T Drawing 21854.0037–APP7S1–101 in Appendix A2.

d Cut to fill earthworks across the entire Stage 1 area, incorporating construction of 2 No. geogrid reinforced segmental block walls (i.e. part of Allan Block Wall 01 and Massbloc Wall 02) and 2 No. gabion basket walls (Walls 06 and 07), as shown on T+T Drawing 21854.0037–APP7S1–101 in Appendix A2.

Civil earthworks commenced on site in February 2016 and were completed by September 2016, and comprised the following:

a Minor cut to fill earthworks across parts of the site as part of final Lot development;

b Installation of roading and services.

Overall subdivisional soil types are moderately expansive (Class M), based on laboratory testing undertaken in accordance with AS 2870:2011 (Ref. [7]). Due to this classification, soils lie outside the definition of good ground within NZS 3604:2011 (Ref. [8]). Building foundations will require either specific foundation design for expansive soils or foundation design in accordance with AS 2870:2011 (Ref. [7]). Subject to design issues outlined in Section 3, and CSIRO recommendations outlined in the appendices relating to expansive soils foundation design and home owner maintenance, each residential Lot is considered to have a building platform area generally suitable for domestic residential development subject to specific geotechnical assessment and foundation design due to the presence of expansive soils and where Lots contain, or are adjacent to, land with slopes steeper than 1 in 4 (V:H).

Foundation design for residential development should proceed in accordance with Sections 6.5 to 6.10 of this report.

1 Introduction

1.1 General

Tonkin + Taylor Ltd (T+T) was engaged by WFH Properties Ltd to monitor and provide earthworks certification for the 15 No. Residential Lots contained within Stage 1 of Arran's Point Precinct 7 at the Millwater Subdivision in Silverdale. Stage 1 comprises residential Lots 1 to 13 and Lots 200 to 201 (high density residential Lots) inclusive as shown on the Woods Final Contour As–Built Plan (Woods Ref 37001–01–AB–100) in Appendix A1.

Previous geotechnical investigation work across the subdivision was undertaken by T+T and reported in:

a 2000 and 2001 Preliminary feasibility reporting (Ref. [1], [2]).

b 2003 Major reconnaissance report covering land in the Silverdale North and Orewa West areas (Ref. [3]).

c November 2011 Geotechnical Investigation Report for the North Bridge, Southern Abutment (Ref. [4]).

d November 2013 Geotechnical Investigation Report for Arran's Point Precinct 7 (Ref. [5]).

The preliminary (Ref. [1], [2]) and investigation (Ref. [3], [4], [5]) reports noted the presence of existing instability comprising landsliding, soil creep and shallow slope movement across much of Arran's Point Precinct 7. These features were proposed to be stabilised, and/or undercut and replaced with engineered fill, during development works. Stability analyses further indicated that shear keys and geotechnical remediation works were also required to achieve satisfactory factors of safety against instability for the finished development of Stage 1.

Construction of the North Bridge (immediately north-west of Stage 1) and associated abutments, incorporating part of the Reinfirced Earth slope now located within the Wetland (Lot 803) was undertaken between 2008 and 2013. Certification of these earthworks was included in the North South Link Part B Geotechnical Completion Report (T+T Ref 21854.012, dated December 2013).

Earthworks compaction control, in terms of minimum shear strengths and maximum air voids, was recommended, and, along with other recommendations, has been incorporated into our control of the works and, where applicable, included in completion reporting.

The scope of work covered by this completion report includes:

a Review of geotechnical investigation reporting for the site;

b Monitoring and certification of earthworks operations in compliance with NZS 4431:1989 (Ref. [6]), including construction of a reinforced earth slope within Lot 803;

c Monitoring and certification of construction of 2 No. geogrid reinforced segmental block (Allan Block and Screen Block) walls (Walls 01 and 02 respectively) and 2 No. gabion basket walls (Walls 06 and 07);

d Assessment of soils for expansive conditions in accordance with AS 2870:2011 (Ref. [7]);

e Certification of completed Lots for residential development in accordance with NZS 3604:2011 (Ref. [8]).

Woods Ltd (Woods) undertook subdivision engineering design and civil works construction observations. As-built plans showing final contours and cut and fill depths have been prepared by Woods and are attached in Appendix A1.

1.2 Description of Subdivision

The Millwater subdivision is situated to the north of the Silverdale Township, and west of the Metro Park East reserve area, and comprises approximately 260 hectares. The subdivision is bound to the south and west by Wainui Road, to the north by the Orewa Estuary and to the east by the Orewa Estuary and Millwater Parkway. The original site comprised a mix of farm properties and associated dwellings and existing residential developments.

The Arran's Point Precinct 7, Stage 1 area of the Millwater subdivision is located within what is known as Arran's Point Precinct 7 in the Silverdale North Structure Plan.

The Arran's Point Precinct 7 area is bound by Arran Drive to the west, Grand Drive to the north, the Orewa estuary to the south and east, Arran's Point Precinct 6 to the west, and Arran's Point Precinct 5 to the northwest. The overall Arran's Point Precinct 7 and Stage 1 areas are shown on T+T Drawing 21854.0037–APP7S1–100 in Appendix A2.

Pre-development gradients within the Stage 1 area were gentle to moderately steep (1 in 3 to 1 in 15 (V:H)) with an overall fall to the northwest.

Post-development gradients within the Stage 1 area remain gentle to moderately steep (1 in 3 to 1 in 15 (V:H)) and generally fall to the northwest as before. In order to form more level building platforms, 2 No. geogrid reinforced segmental block (Allan Block and Screen Block) walls have been constructed along some Lot boundaries as shown on T+T Drawing 21854.0037–APP7S1–101.

Stage 1 is presently accessed from the existing Arran Drive.

1.3 Geological Setting

Published geological mapping and information indicates the Arran's Point Precinct 7 area is underlain by East Coast Bays materials. In addition to the East Coast Bays materials, our investigations identified the presence of alluvial materials on site.

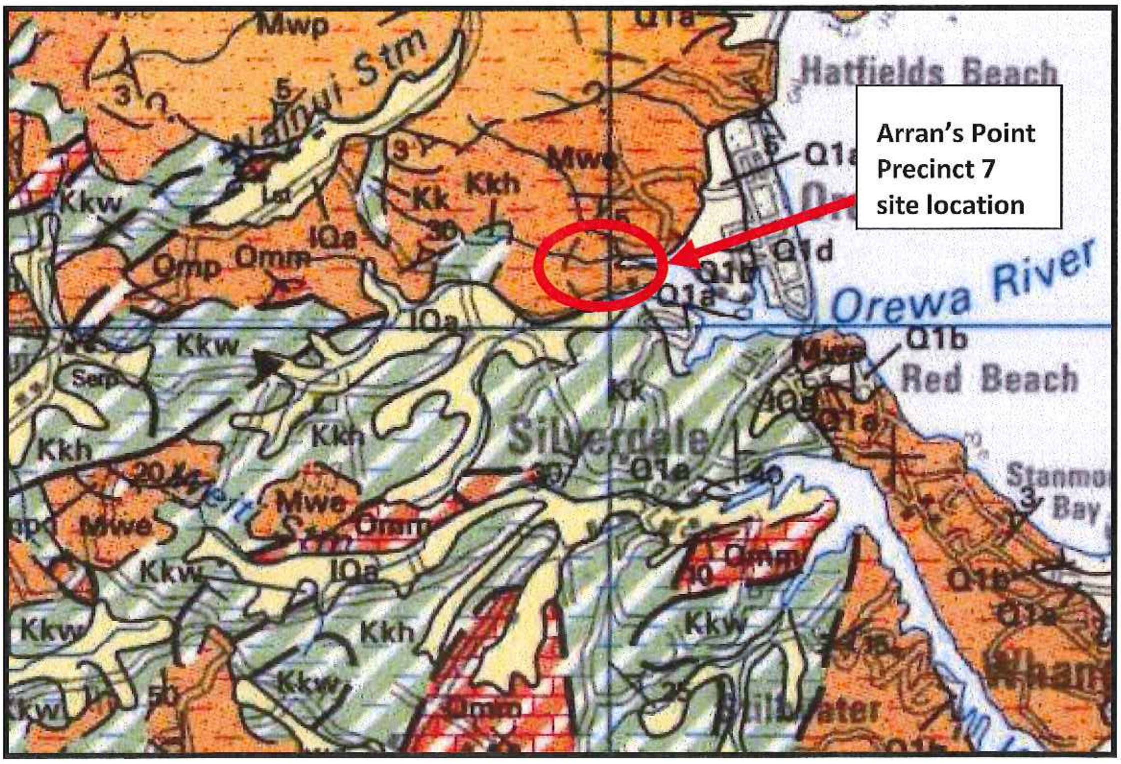

Figure 1 - Local Geology (from Edbrooke)

Summary descriptions of geological units in the Arrans Point area (after Kermode 1991) are as follows:

a East Coast Bays Formation

Alternating sandstone and mudstone with variable volcanic content (volcanic-poor lower in the sequence and mixed volcanic content higher) and interbedded volcaniclastic grit beds.

b Pleistocene Age Alluvium

Up to 20 m thick and from 3 to 10 m above present base level: forms higher coastal and valley terraces throughout the map area; in places locally discontinuous or absent. These alluvial deposits are typically very thinly to very thickly bedded, yellow-grey to orange-brown, angular to well rounded, mixed sizes (usually graded, coarse becoming fine upwards) of mud, sand and gravel, comprising rock fragments and weathered rock residue from the hinterland. They include some beds of black, humus-rich clay and white, pumice silt.

Geological cross-sections through the Arran's Point Precinct 7, Stage 1 area are enclosed as Drawing Number 21854.0037–APP7S1–103 in Appendix A2. Borehole logs from the post-earthworks investigations are enclosed in Appendix E.

Fill material placed across the site to form the final design profile typically comprised site-won East Coast Bays materials.

2 Earthworks Operations

2.1 Plant

Bulk earthworks and civil works were undertaken by Hick Bros Civil Construction Ltd (Hicks). Various areas of soft and/or wet materials were encountered during the works and were undercut and replaced with engineered fill. Much of this undercut material was considered suitable for re-use as engineered fill if conditioned appropriately. Accordingly, mixing of the cohesive fill materials with lime/cement to facilitate fill placement and compaction was undertaken by Hiway Stabilizers Ltd (Hiway) under Hicks' control. Construction of the retaining walls was undertaken by ICB Retaining and Construction Ltd (ICB), also under Hicks' control.

Various earthworks equipment was used to undertake the works, comprising D6 and D8 bulldozers and scoops, motor scrapers, tractors and discs, sheepsfoot compactors, padfoot rollers, and a number of 12 to 35 tonne excavators. This plant generally carried out all construction earthworks.

Specialist contractors and plant were brought on site for pavement construction. Certification of the pavement construction is beyond the scope of this report.

2.2 Construction Programme

Bulk earthworks commenced on site in late 2010 and progressed through to the end of 2013, works at this stage being generally associated with the formation of Arrans Drive (including shear keys, reinforced earth slopes and retaining walls for the bridge abutments). Subdivisional earthworks within Arran's Point commenced from March 2014 through to February 2016 under Hicks' control. Civil earthworks and construction for the residential Lots were also under Hicks' control and were undertaken progressively from February 2016 through to completion in September 2016.

Key Stage 1 earthworks components included:

a Stripping of vegetation, organic materials and topsoil to stockpile.

b Installation of subsoil drains.

c Cut to fill earthworks across the entire site as shown on the Woods Cut/Fill Contour As–Built Plan Lowest Surface – Final Surface (Woods Ref 37001–01–AB–110) in Appendix A1.

d Construction of 1 No. Shear Key (SK1), 1 No. Reinforced Earth slope, 2 No. geogrid reinforced segmental block walls (i.e. part of Allan Block Wall 01 and Screen Block Wall 02) and 2 No. gabion basket walls (Walls 06 and 07), as shown on T+T Drawing 21854.0037–APP7S1–101 in Appendix A2.

Key Stage 1 civil works components comprised installation of roading and services.

The earthworks, retaining walls, shear keys, undercuts and subsoil drainage as-built plans are included in Appendix A1 (Woods Drawings 37001–01–AB–100, 110 to 111, 120 to 121 and 130 to 133), and show the earthworks undertaken across the site.

2.3 Compaction Control

Compaction control criteria, consisting of maximum allowable air voids and minimum allowable shear strengths, were used for cohesive fill control. The Technical Specification included in our Geotechnical Investigation Report (Ref. [4],[5]) included the following requirement for the subdivisional earthworks:

Minimum Shear Strength and Maximum Air Voids Method

Minimum Undrained Shear Strength (Measured by insitu vane – IANZ calibrated)

General fills:

Average value not less than	140 kPa
Minimum single value	110 kPa

High Strength Structural fills (Shear Keys):

Average value not less than	150 kPa
Minimum single value	120 kPa

Maximum Air Voids Percentage (as defined in NZS 4402:1986)

General fills:

Average value not more than	10%
Maximum single value	12%

High Strength Structural fills (Shear Keys):

Average value not more than	8%
Minimum single value	10%

The average corrected shear strength value was determined over any ten consecutive tests.

Compaction control criteria consisting of minimum allowable Clegg Impact Values and minimum allowable in-situ dry density were used for cohesionless fill control. The Technical Specification included in our Geotechnical Investigation Report (Ref. [4],[5]) included the following requirement for the subdivisional earthworks (and in particular during construction of Walls 1 and 2):

Minimum Clegg Impact Value and Minimum In Situ Dry Density Method

Minimum Clegg Impact Value (Measured by Clegg Impact Hammer – IANZ calibrated)

General fills:

Average value not less than	20
Minimum single value	18

Minimum In-Situ Dry Density Percentage (as defined in NZS 4402:1986)

General fills:

Average value not less than	95%
Maximum single value	90%

The average Clegg Impact value was determined over any ten consecutive tests.

Regular in situ density, strength and water content tests were carried out on the filling at, or in excess of, the frequency recommended by NZS 4431:1989 (Ref. [6]). Test results are contained in Appendix E.

Quality Control (QC) testing showed that the results for the filling were consistently meeting the required undrained shear strength and air voids criteria, demonstrating that the water content of placed fill was consistently at, or close to, optimum. To the best of our knowledge, any problems encountered were rectified, where required, by close monitoring of the selection of borrow materials, discing and remixing of the available soil types and minor reworking.

3 Geotechnical Development Works

3.1 Subsoil Drainage

A network of subsoil drains has been installed across Arran's Point Precinct 7 during bulk earthworks as part of the shear key, reinforced earth slope and geogrid reinforced segmental block walls construction.

The subsoil drains installed within the shear key and reinforced earth slope were excavated into the underlying rock to intercept groundwater and springs, and are as detailed in Section 3.2.

Subsoil drains installed as part of the geogrid reinforced segmental block walls construction comprised the following:

a 160mm diameter, Hiway grade, perforated Nexus pipes along the backface of the wall and base of the rear of the reinforced soil block.

b SAP50 scoria over the top of the Nexus pipe and up the back face of the reinforced soil block, to within 1m of the ground surface (at time of construction).

c Bidim A19 geotextile filter-cloth over the top of the scoria prior to placement of the reinforced soil.

The retaining wall drains were connected to the reticulated stormwater system, as shown on the Woods Shear Key, Undercuts & Subsoil Drains As–Built Plans (Woods Ref 37001–01–AB–120 and 121) and the Retaining Wall As-Built Plans (Woods Ref 37001-01-AB-130 to 132) in Appendix A1, and on T+T Drawing 21854.0037–APP7S1–101 in Appendix A2.

3.2 Shear Keys

Based on stability analyses undertaken as part of the investigation reporting, shear keys were identified as being required across Arran's Point Precinct 7 to provide satisfactory factors of safety against instability for the finished development of Stage 1.

1 No. Shear Key (i.e. SK1) was excavated within Stage 1 during the bulk earthworks in the location shown on the T+T Drawing 21854.0037–APP7S1–101, included in Appendix A2. Excavations for the Shear Key were inspected and mapped by an Engineering Geologist to check that the key base had been extended sufficiently into the competent underlying ECBF rock materials, and that there were no apparent adverse structural features or lower strength materials exposed within the base and sides of the excavation. Any areas of suspect ground, including areas of identified land-slippage, were removed under the instruction of our site Engineering Geologist and replaced with well compacted engineered fill, placed in accordance with the bulk earthworks specification (Section 2.3 above).

The shear key long-section for SK1 was developed based on the mapping undertaken and is included in Appendix A2 (Drawing 21854.0037–APP7S1–110. This section shows the materials exposed within the side of the shear key excavation and relevant geological structural information mapped during our inspections.

Following completion of the shear key excavation, drainage blankets were placed along the rear face of the key, and comprised the following:

a 160mm diameter perforated Hiway grade Nexus drain pipe: This was run along the base of the rear of the excavation and discharges into the Orewa estuary in several locations (as per the Woods As-Built plans 37001–01–AB–120 to –121). Additional Novaflo pipes were also installed along mid-height benches where appropriate and connected into the key drainage outlet system.

b SAP50 scoria: A layer of minimum 300mm thickness of SAP 50 was placed across the entire rear face, and extended to within 2m of the top of the key. It should be noted that the top of the key at this stage generally coincided with the original ground surface.

c Bidim A19 geotextile filtercloth: This was placed over the surface of the SAP 50 scoria to prevent contamination of the drainage aggregate with overlying bulk earthworks materials.

The rear face drainage blanket was extended up to at least 1 metre above the soil / rock interface to intercept perched groundwater flows which typically flows along this interface. This in essence became the rear face drainage for the reinforced earth slope as well.

Ground conditions exposed during shear key construction were generally as anticipated from the design stage of the development. The slope stability analysis results from the original design phase are discussed in Section 4.

3.3 Wetland (Lot 803)

A stormwater wetland has been constructed during the development of Arrans Point Stage 1, within Lot 803.

Construction of the wetland comprised excavation to a minimum of 1m below proposed finished level, followed by placement of a (minimum) 1 metre thick compacted, engineered, high plasticity clay fill back up to finished level. High plasticity clays were used to provide a low permeability liner across the base and sides of the wetland, thus reducing the risk of leakage during the lifetime of the wetland. The southern batter slope of the wetland comprises the lower section of the reinforced earth slope discussed in Section 3.4 below.

3.4 Reinforced Earth Slope

A reinforced earth slope has been constructed below and adjacent to the southern abutment of the North Bridge, and this extends through the Wetland (Lot 803) below Arran Point Parade. This slope comprises horizontally laid biaxial geogrids placed at 0.5m (vertical) intervals within the engineered, compacted earth fill. The grids extend up to within 1.5 (vertical) metres of the slope crest. They have been placed at various lengths, starting at the face of the slope. Typical cross-section details through the RE Slope are shown on T&T Drawings 21854.0037-APP7S1-108 in Appendix A2.

The placement of the geogrid allows steeper finished gradients than is possible with bulk fills, and will minimise risk of instability across the face of the slope, particularly where finished gradients across the slopes are up to 1 in 1.5 (V:H).

Construction of the slope comprised the following:

a placement and compaction of fill to the required levels;

b placement of the geogrid, ensuring that the grid is held tightly in place;

c spreading of fill across the surface of the geogrid with lightweight plant;

d compaction and placement of further fill up to the level of the next grid layer.

The fill was placed and compacted beyond the limit of the final slope face and then trimmed back to ensure full compaction of the slope face was achieved.

A drainage blanket was installed at the rear of the reinforced block of soil (essentially an extension of the underlying shear key drainage) and comprises a minimum of 300mm thickness of SAP50 scoria, covered in Bidim A19 geotextile filter-cloth. A 160mm diameter Novaflo pipe at the base of the drainage blanket provides a discharge outlet for any groundwater captured in the drainage blanket. These drains are extended out to discharge to the adjacent stream system.

The slope has been designed to accommodate surcharge of up to 10kPa distributed load at the crest of the slope.

The slope faces will be subject to a covenant preventing construction within this area. Protection of the geogrids from damage also precludes construction across the slope faces and immediately adjacent to the slope crest. Accordingly, a building restriction zone has been applied across the slope.

3.5 Gabion Basket Retaining Wall

Two gabion basket retaining walls were constructed on either side of the wetland inlet during bulk earthworks within Stage 1 (Walls 06 and 07).

Construction of the gabion basket retaining walls comprised the following:

a placement and compaction of fill to the required levels;
b placement of the gabion basket units;
c compaction and placement of fill to backfill any over-excavation.

A typical cross-section of the gabion basket retaining wall is shown on T+T Drawing 21854.0037–APP7S1–107 in Appendix A2.

The gabion basket retaining walls have been designed to accommodate the maintenance access track immediately above.

Certification of these walls, in accordance with the relevant Engineering Approval, is to be supplied under separate cover.

3.6 Geogrid Reinforced Segmental Block Retaining Walls

Two geogrid reinforced segmental block walls (i.e. part of Allan Block Wall 01 and Screen Block Wall 02) were constructed during bulk earthworks within Stage 1.

Allan Block Wall 01 comprises uniaxial High Density Polyethylene (HDPE) geogrids placed at a maximum of 0.4m (vertical) intervals within the well compacted engineered hardfill, placed in accordance with the bulk earthworks specification (Section 2.3 above). The grids extend up to within 0.3m of the ground surface. For the section of Allan Block Wall 01 up to 1.0m retained height, the reinforced block is backfilled with no fines concrete (i.e. no geogrid reinforcement).

Construction of the Allan Block retaining wall comprised the following:

a placement and compaction of fill to the required levels;
b placement of the Allan Block units;
c placement of the geogrid and ensuring that the grid is held tightly in place;
d spreading of fill across the surface of the geogrid with lightweight plant;
e compaction and placement of further fill up to the level of the next grid layer.

Screen Block Wall 02 comprises uniaxial High Density Polyethylene (HDPE) geogrids placed at a maximum of 1.0m (vertical) intervals within the well compacted engineered hardfill, placed in accordance with the bulk earthworks specification (Section 2.3 above). The grids extend up to within 0.3m of the ground surface.

Construction of the Screen Block retaining wall comprised the following:

a placement and compaction of fill to the required levels;

b placement of the Screen Block units, including starter sections of geogrids cast into the blocks at the appropriate levels;

c placement of the geogrid and connection to the starter sections using a "Bodkin" joint, ensuring that the grid is held tightly in place;

d spreading of fill across the surface of the geogrid with lightweight plant;

e compaction and placement of further fill up to the level of the next grid layer.

Typical cross-sections of the retaining walls are shown on T+T Drawings 21854.0037–APP7S1–105 and 106 in Appendix A2.

As noted in Section 3.1, a drainage blanket was installed at the rear of the reinforced block of soil which comprises a minimum of 300mm thickness of SAP50 scoria, covered in Bidim A19 geotextile filtercloth. A 160mm diameter perforated Nexus pipe along the backface of the wall and base of the rear of the reinforced soil block provides a discharge outlet for any groundwater captured in the drainage blanket. The drainage pipes from behind the walls are connected into the stormwater system, as shown on the Woods subsoil drainage as-built plan in Appendix A1.

These walls have been designed to accommodate a maximum 10kPa surcharge, although development immediately behind/above the walls is likely to be precluded by Council planning rules.

Certification of these walls, in accordance with the relevant Engineering Approval, is to be supplied under separate cover.

3.7 Undercuts

Earthworks operations through the road alignments in Stage 1 resulted in the exposure of some areas of unsuitable subgrade materials (i.e. soft and wet). The unsuitable material has been undercut to expose more competent soils (minimum shear strength of 75kPa) and replaced with engineered, compacted fill, placed in accordance with the bulk earthworks specification (Section 2.3 above).

The extent of the undercut areas is shown on the Woods Shear Key, Undercuts & Subsoil Drains As–Built Plan (Woods Ref 37001–01–AB–120) in Appendix A1.

4 Stability Analyses

As noted in Section 3, slope stability analyses undertaken during the investigation stage of the project identified the need for shear keys to be constructed across Arran's Point Precinct 7, so as to provide acceptable factors of safety against slope instability for the finished development of Stage 1.

During excavation of Shear Key 1, the excavated faces were mapped to confirm the shear key had been extended sufficiently into the underlying competent ECBF rock materials and to check for any apparent adverse oriented geological structure or other features exposed within the sides and lower part of the key.

We are satisfied that the design stability analyses remain valid for the completed works on the following basis:

a the exposed ground conditions generally conform to those assumed for design;

b the as-built profiles match design levels;

c the earthworks monitoring shows compliance with specified criteria, upon which fill properties have been based.

5 Project Evaluation / Building Design Considerations

5.1 General

Ground conditions within Arran's Point Precinct 7, Stage 1 straddle a range of "design conditions" including cut ground, filled ground, expansive soils and constructed slopes up to 1 in 4 (V:H). The following sections set out relevant geotechnical design issues.

5.2 Bearing capacity for building foundations

All filled and natural ground within the influence of conventional residential shallow strip and pad foundation loads is assessed as generally having a geotechnical ultimate bearing capacity of 300kPa, as required by NZS 3604:2011 (Ref. [8]). This corresponds to a factored (Ultimate Limit State) bearing capacity of 150kPa and working (Serviceability Limit State) bearing capacity of 100kPa.

Due to the presence of expansive soils, foundation conditions fall outside the definition of "good ground" contained in NZS 3604:2011 (Ref. [8]). In terms of AS 2870:2011 (Ref. [7]), the soils present are considered to lie within Site Class M (moderately expansive) with characteristic surface movements anticipated to be in the range of 20mm to 40mm. Due allowance should be made for expansive soils, as discussed in Section 5.11.

Where a geotechnical ultimate bearing capacity greater than 300kPa is required to support any dwelling constructed outside the scope of NZS 3604:2011 (Ref. [8]), further specific site investigation and design of foundations will be required.

5.3 Settlement

From our inspections during earthworks operations, and the results of compaction quality control testing, we consider that differential settlement induced by self-weight of engineered fill should now be largely complete. Further settlements should be within normally accepted design tolerances of 25mm, as outlined in NZS 3604:2011 (Ref. [8]), with respect to conventional building development.

Settlement points were installed in the areas of greatest fill thickness following completion of earthworks operations, to monitor the settlement of the subgrade. This monitoring shows that settlements of up to 50mm occurred during development of Stage 1. This settlement occurred between January 2014 and June 2015, with negligible movement since that time.

In order to minimise the risk of ground settlements exceeding 25 mm, NZS 3604:2011 (Ref. [8]) allows a maximum fill surcharge of 600 mm over the building platform during future development. Filling in excess of this thickness should be subject to specific foundation design and assessment.

5.4 Retaining walls

Due to the shallow grades across most of the Stage 1 Lots, it is not anticipated that significant retaining walls will be required. However, if walls are required, then retaining wall design will be dependent on the site specific requirements.

For preliminary design we recommend the use of the following geotechnical design parameters:

$\gamma = 18$ kN/m^3,

$c' = 0$ kPa,

$\varnothing' = 30°$,

$K_a = 0.30$,

$K_p = 3.33$,

"Su" of 50kPa for the embedment soil (subject to confirmation during construction).

These values are based on level ground above and below the wall and will require appropriate amendment to allow for slope, traffic and other surcharges or toe slopes and the specific lot geometry and development requirements, as applicable.

All retaining walls should include a layer of free draining granular fill (with geotextile over the top) immediately behind the wall covered with a 0.3m thick (minimum) compacted clay fill cap, with intercepted groundwater seepage piped into the reticulated stormwater system.

Any walls greater than 1.5m retained height will require a geotechnical assessment, as a minimum, to check and confirm that the stability of the subject (or adjacent) Lot is not detrimentally affected.

The existing geogrid reinforced segmental block walls constructed within the Stage 1 area are shown on the Woods Retaining Walls As–Built Plans (Woods Ref 37001–01B–AB–130 to 133). These walls have been designed to accommodate a maximum 10kPa surcharge, although development immediately behind/above the walls is likely to be precluded by Council planning rules. The presence of these walls should be taken into account for any proposed works downslope of the walls, specifically to ensure that any proposed cuts do not undermine the base of the walls. In general, earthworks should be limited to no closer than 1.5m from the toe of the walls.

For clarity, the Lots within Stage 1 that will need to consider the presence of the existing retaining walls during site development are:

a Allan Block Wall 01 – Lots 7 to 10 and 12 to 13 inclusive

b Massbloc Wall 02 – Lots 1 to 7 inclusive

5.5 Subsoil Drainage

Following shear key construction during bulk earthworks, groundwater drainage was installed using Nexus drains covered in geotextile cloth to permanently handle ground water flows.

The extent of the subsoil drainage systems are shown on the Woods Shear Key, Undercuts & Subsoil Drains As–Built Plan (Woods Ref 37001–01–AB–120) in Appendix A1, and on T+T Drawing 21854.0037–APP7S1–102 in Appendix A2.

This drainage system is relatively deep and located so that it is unlikely to be encountered during future residential site development and is expected to be maintenance free. Any deep excavations should take account of the presence of these drains nonetheless. If a drain is encountered, damaged, or identified as defective, repairs should be observed by a Chartered Professional (Geotechnical) Engineer familiar with this report, and notified to Auckland Council.

5.6 Post Earthworks Investigations

Following the completion of earthworks operations, T+T have undertaken supplementary fieldwork to confirm the consistency of the natural subsoils and engineered fill. From the investigations, we confirm that the subsoils are considered to have a geotechnical ultimate bearing capacity of 300kPa, as required by NZS 3604:2011 (Ref. [8]). This corresponds to a factored (Ultimate Limit State) bearing capacity of 150kPa and working (Serviceability Limit State) bearing capacity of 100kPa. Associated borehole logs and site plan (T+T Drawing 21854.0037–APP7S1–112) are attached in Appendix E.

5.7 Stormwater

Public stormwater services have been installed within Arran's Point Precinct 7, Stage 1. Stormwater and runoff from roofs, decks and paved areas, together with discharges from retaining wall drains and other subsoil drains must be connected directly into the public stormwater drainage network.

5.8 Service lines

Trench backfill has been compacted to minimise potential for future settlements. However, where building envelopes lie adjacent to or across service lines, all foundations should extend and be founded below the 45 degree zone of influence line from pipe inverts. This requirement is to avoid excessive pipe surcharges, and to allow for future maintenance of the system without detrimentally affecting adjacent structures. Subject to approval from Auckland Council, foundations may extend and bridge over service lines provided specific foundation design is undertaken.

A copy of the stormwater as–built plans (Woods Ref 37001–01–AB–300 to 303) is included in Appendix A1.

5.9 Road subgrades

Based on the fill monitoring and site observations during development, filled and natural ground within the road and vehicle access Lots is considered generally suitable for the proposed residential pavements. Subgrade strength testing was carried out following excavation to formation levels along the road alignments. These subgrade test results were passed on to Woods for use in their pavement design. All road subgrades have been lime and cement stabilised to assist in pavement strengths, and to minimise the impact of expansive soils on road pavements.

For future road construction in other parts of the Arran's Point Precinct 7 Stage 1 development, within natural ground, a design CBR of 2% is considered appropriate while, within engineered fill areas, a design CBR of 7% is appropriate.

5.10 Topsoil

Following completion of topsoil spreading and grassing, topsoil depths were measured in each of the Lots and these are shown on T+T Drawing 21854.0037–APP7S1–113 attached in Appendix E. Due to variations in placement depths and earth worked surface levels, topsoil depths may vary from those recorded.

5.11 Expansive soils

Expansive soils (or "reactive soils" using Australian terminology) are clay soils that undergo appreciable volume change upon changes in moisture content. The reactivity and the typical range of movement that could be expected from soils underlying any given building site depend on the amount of clay present, clay mineral type, and proportion, depth and distribution of clay throughout the soil profile. Moisture changes tend to occur slowly in clays and produce swelling upon wetting and shrinkage upon drying.

Apart from seasonal moisture changes (wet winters / dry summers) other factors that can influence soil moisture content include:

a Influence of garden watering and site drainage;

b The presence of large trees (especially fast growing Australian species such as eucalyptus) close to building envelopes, and;

c Initial soil moisture conditions at construction time.

Visually, the surfaces of expansive soils are noted for developing extensive cracking during dry periods (especially late summer through autumn in Auckland) and can be locally identified by this feature when sites are excavated and left for a week or two to dry out. Further information on expansive soils is given in Appendices C and D of this report.

In order to assess for the presence of expansive soils within this stage of the development, representative soil samples were retrieved from near surface strata and tested by Geotechnics Ltd to determine soil shrinkage characteristics in accordance with AS 1289.7.1.1.

Based on the laboratory results (attached in Appendix E), the foundation soils on this stage of the subdivision lie outside the definition of 'good ground' as outlined in NZS 3604:2011 (Ref. [8]).

In terms of AS 2870:2011 (Ref. [7]), the soils present are considered to lie within Site Class M (moderately expansive) with characteristic surface movements anticipated to be in the range of 20mm to 40mm.

Accordingly, building foundations on this stage of the subdivision will need to be subject to specific foundation design by a Chartered Professional Engineer familiar with the contents of this report and responsible for design of structural elements (including foundations) of the building. Reference should be made to AS 2870:2011 (Ref. [7]) for assistance.

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

I, Mr A. P. Stiles of Tonkin + Taylor Ltd, P O Box 5271, Wellesley St, Auckland, hereby confirm that:

6.1 I am a Chartered Professional Engineer experienced in the field of geotechnical engineering and an authorised representative of Tonkin + Taylor who was retained by WFH Properties Ltd as the Geotechnical Engineer on Arran's Point Precinct 7 Stage 1 (comprising residential Lots 1 to 13 and 200 to 201 inclusive) of the Millwater Residential Subdivision Development off the Millwater Parkway in Silverdale. Inspection and observation of the works have been carried out during construction by either myself or staff acting under my direction.

6.2 The extents of investigations are described in Tonkin + Taylor Ltd Geotechnical Investigation Report for Arran's Point Precinct 7 Ref No. 21854.0037 dated November 2013. The conclusions and recommendations of those documents have been re-evaluated in the preparation of this report. Details of all earthworks control tests performed are enclosed (Appendix E).

6.3 The Contractor has confirmed that the work undertaken has been completed in accordance with the drawings, specifications and any variations issued and is consistent with the inspections and observations carried out by Tonkin + Taylor Ltd. Complete Construction Certificates have been provided by the Contractors and are presented in Appendix B. Tonkin + Taylor Ltd accepts no liability for any errors or omissions represented by those documents.

6.4 On the basis of our observations and inspections together with the information supplied by others, including the Contractor's Construction Certificates, it is my professional opinion, not to be construed as a guarantee that:

6.4.1 The earth fills shown on the attached Woods drawings, Project No 37001, Millwater, Arran's Point Precinct 7, Stage 1, Drawing Numbers 37001–01–AB–110 to –111 and –120 to 121, have been generally placed in compliance with NZS 4431:1989 (Ref. ([6]).

6.4.2 The completed earthworks give due regard to land slope and foundation stability considerations.

6.5 **For Lots 1 to 13, 200 and 201 inclusive:**

6.5.1 Foundation design

The filled and natural ground within residential Lot boundaries is considered generally suitable for the erection thereon of light timber framed, flexibly clad residential buildings subject to clauses 6.5.2 to 6.5.5.

6.5.2 Bearing capacity

Foundation design for these Lots should limit geotechnical ultimate bearing capacity to 300 kPa (factored (ULS) 150 kPa, working (SLS) 100 kPa). This is as specified in NZS 3604:2011 (Ref. [8]).

6.5.3 Expansive soils

Due to the presence of expansive clay soils, foundation soils lie outside the definition of 'good ground' in NZS 3604:2011 (Ref. [8]). Soils are considered to lie in Site Class M (moderately expansive) as defined in AS 2870:2011 (Ref. [7]) with anticipated characteristic surface ground movements of 20mm to 40mm. Clause 6.5.3.1 of this Geotechnical Completion Report may be used for expansive soil foundation design on this subdivision:

6.5.3.1 Specific foundation design for expansive soils

Specific foundation design should be undertaken by a Chartered Professional Engineer familiar with the contents of this report and responsible for design of structural elements (including foundations) of the building.

The minimum specific design requirements set for expansive soils within this clause are:

i) Minimum foundation embedment of 600 mm following topsoil removal and benching of building platform areas to finished ground levels

ii) Four bar steel reinforcing cages should be used

iii) For buildings having brittle exterior cladding, for example brick veneer, stucco plaster, solid plaster, block work, styrofoam type cladding or sprayed plaster over harditex systems etc, the potential effects of seasonal ground movements need to be considered by the building designer.

The above minimum requirements within this clause may be superceded if individual engineers are able to demonstrate their specific design solutions are applicable to site soil conditions to the satisfaction of Auckland Council. Specific design may be undertaken by first principles or by reference to AS 2870:2011 (Ref. [7]), Section 4 and related documents.

6.5.4 Floor Slab Construction

Slab on grade construction is expected to be relatively straightforward across the subdivision, but problems can occur with slab construction on shrink/swell sensitive soils. In soils which become desiccated in summer, subsequent capillary moisture rise may cause dry soils to wet up and swell, causing slab uplift and building distress. Alternatively, construction during winter may result in subgrade soils with high moisture contents drying out through summer, with subsequent soil shrinkage and possible building deformation.

The structural engineer should take likely construction timeframes into account and confirm that their design and construction methodologies will accommodate the soil shrinkage or swelling that may occur.

The Contractor should ensure that the ground beneath the floor slab areas are suitably conditioned to ensure that the subgrade is neither too dry nor too wet prior to hardfill placement and concrete pouring to avoid undue shrink or swell movements.

6.5.5 Building maintenance - Owners responsibility

The owner is responsible for maintenance of the building and site and should be familiar with the performance and maintenance requirements set out in CSIRO sheet BTF18 Foundation Maintenance and Footing Performance: A Home Owners Guide. A copy of this sheet is included in Appendix D.

6.5.6 Retaining walls / Earthworks

No retaining wall construction in excess of 1.5 metres height and no earthworks involving fills in excess of 600mm depth should take place on these Lots unless endorsed by a suitable design undertaken by a Chartered Professional (Geotechnical)

Engineer familiar with the contents of this report and responsible for design of structural elements of the building.

6.6 **For Reserve Lot 803 inclusive:**

6.6.1 This Lot contains a "Building Line Restriction" relating to the 1 in 1.5(V:H) reinforced earth slope. It covers the entire reinforced earth slope. Excavation, filling and/or construction across this slope is not to be undertaken, to ensure stability of the slope is not compromised.

6.7 Underfill (Subsoil) drainage

Underfill (Subsoil) drains have been installed during subdivisional development in the locations shown on the Woods Shear Key, Undercuts & Subsoil Drains As–Built Plan (Woods Ref 37001–01–AB–120) in Appendix A1, and on T+T Drawing 21854.0037–APP7S1–102 in Appendix A2. These drains are considered to be maintenance free. This drainage system is relatively deep and located so that it is unlikely to be encountered during future residential site development. Although future works are unlikely to encounter the drains, their location should be considered prior to designing deep foundations and, if damaged, repairs should be observed by a Chartered Professional (Geotechnical) Engineer familiar with this report, and notified to Auckland Council.

6.8 Stormwater and Sanitary Sewer Lines

Where building envelopes lie adjacent to or across service lines, all foundations should extend and be founded below the 45 degree zone of influence line extending from pipe inverts. This requirement is to avoid excessive pipe surcharges, and to allow for future maintenance of the system without detrimentally affecting adjacent structures. Subject to approval from Auckland Council, foundations may extend and bridge over service lines provided specific foundation design is undertaken. A copy of the stormwater as-built plans are included in Appendix A1.

6.9 Road and Access Lots

Based on the fill monitoring and site observations undertaken during site development, the filled and natural ground within Arran's Point Precinct 7, Stage 1 is considered generally suitable for residential road and accessway construction. Scala penetrometer testing should be undertaken when road subgrades have been prepared to confirm subgrade strengths. Subject to such subgrade testing, for future road construction in other parts of the Arran's Point Precinct 7 Stage 1 development, within natural ground, a design CBR of 2% is considered appropriate, while within engineered fill areas, a design CBR of 7% is appropriate.

6.10 Unexpected ground conditions

Our assessment is based on interpolation between borehole positions, site observations and periodic earthworks control visits. Local variations in ground conditions may occur. Although unlikely, unfavourable ground conditions may be encountered during site benching and footing excavations. It is important that we be contacted in this eventuality, or in the event that any variation in subsoil conditions from those described in the report are found. Design assistance is available as required to accommodate any unforeseen ground conditions present.

7 Applicability

This report has been prepared for the benefit of WFH Properties Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

It does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling, especially in cases where concrete blockwork and/or brick veneer or stucco plaster buildings are sited partly on fill or partly on natural ground, or where they are entirely sited on filling whose depth changes significantly across the building platform.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Andrew Linton	Andrew Stiles
Senior Geotechnical Engineer	Project Director

JXXL
p:\21854\21854.0037 - arrans hill p7\gcr\stage 1\ajl 161025 app7s1-gcr - final.docx

8 References

[1] Tonkin & Taylor Ltd., October 2001. *Stoney Block,* T+T Ref. 18214.

[2] Tonkin & Taylor Ltd., May 2001. *Silverdale Blocks, Silverdale, Geotechnical Issues – Future Medium Density Development,* T+T Ref. 18213.

[3] Tonkin & Taylor Ltd., November 2003. *Silverdale North and Orewa West Blocks, Silverdale, Geotechnical Issues – Future Medium Density Development,* T+T Ref. 20914.

[4] Tonkin & Taylor Ltd., November 2011. *Millwater – North Bridge, Southern Abutment, Geotechnical Investigation Report,* T+T Ref. 21854.012.

[5] Tonkin & Taylor Ltd., November 2013. *Millwater Subdivision, Arrans Hill – Precinct 7 – Geotechnical Investigation Report,* T+T Ref. 21854.0037.

[6] New Zealand Standards, 1989. *NZS 4431:1989 Code of Practice for Earth Fill for Residential Development.*

[7] Standards Australia, 2011. *AS 2870:2011 Residential slabs and footings.*

[8] New Zealand Standards, 2011. *NZS 3604:2011 Timber Framed Buildings.*

Appendix A1: Woods Drawings

37001–01–AB–100	Final Contour As–Built Plan
37001–01–AB–110	Cut & Fill As–Built Plan - Lowest to Final Surface
37001–01–AB–111	Cut & Fill As–Built Plan – Original to Final Surface
37001–01–AB–120 to 121	Shear Key, Undercuts & Subsoil Drains As–Built Plans
37001–01–AB–130 to 133	Retaining Wall As–Built Plans
37001–01–AB–300 to 303	Stormwater Drainage As-Built Plans

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed:
Registered Professional Surveyor

Date: 27/09/2016

Name: ROWAN HALLAM

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27/09/2016

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

———	CONTOURS MAJOR
— — —	CONTOURS MINOR
▬ ▬	STAGE BOUNDARIES
———	LOT BOUNDARIES

CLIENT:

WFH PROPERTIES

WOODS
Engineers. Surveyors. Planners.
Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

FINAL CONTOUR
AS-BUILT PLAN
(SLC-62000)

AUCKLAND COUNCIL

DESIGNED: MB		AS-BUILT	
CHECKED: RDC		DRAWN: RDC	
APPROVED: MRH		SURVEYED: PK	
JOB NUMBER: 37001		SCALE: 1:1000 @ A3	
ISSUED: SEPT 2016			
DWG. NO. 37001-01-AB-100			REV. 1.

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I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: ______
Registered Professional Survoyor

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27-09-2016

NOTES

1. CONTOURS ARE AT 1.0 METRE INTERVALS

LEGEND

―	ZERO CONTOUR
―	CUT CONTOUR
―	FILL CONTOUR
‒ ‒ ‒	STAGE BOUNDARIES
―	LOT BOUNDARIES

CLIENT:

WFH PROPERTIES

WOODS
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MILLWATER
ARRAN POINT
STAGE 1

CUT & FILL AS-BUILT
LOWEST TO FINAL SURFACE
SHEET 1 OF 2
(SLC-62000)

AUCKLAND COUNCIL

DESIGNED:	MB	AS-BUILT	
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	PK
JOB NUMBER:	37001	SCALE:	1:1000 @ A3
ISSUED:	SEPT 2016		
DWG. NO.	37001-01-AB-110	REV.	1.

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I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: *Registered Professional Surveyor*

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27-09-2016

NOTES

1. CONTOURS ARE AT 1.0 METRE INTERVALS

LEGEND

───	ZERO CONTOUR
───	CUT CONTOUR
───	FILL CONTOUR
– – –	STAGE BOUNDARIES
───	LOT BOUNDARIES

CLIENT:

WFH PROPERTIES

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MILLWATER
ARRAN POINT
STAGE 1

CUT & FILL AS-BUILT
ORIGINAL TO FINAL SURFACE
SHEET 2 OF 2
(SLC-62000)

AUCKLAND COUNCIL

DESIGNED: MB	AS-BUILT
CHECKED: RDC	DRAWN: RDC
APPROVED: MRH	SURVEYED: PK
JOB NUMBER: 37001	SCALE: 1:1000 @ A3
ISSUED: SEPT 2016	
DWG. NO. 37001-01-AB-111	REV. 1.

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I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: ______________________

Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. ISSUED	MRH	27/09/16

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

—	NOVACOIL SUBSOIL DRAINS
—	REINFORCED EARTH & RETAINING WALL SUBSOIL DRAINS
····—	EXISTING STORMWATER DRAINAGE
—·—·—	NEW STORMWATER DRAINAGE
— — —	STAGE BOUNDARIES
—	LOT BOUNDARIES
- - - -	CONTOURS
☐	SHEAR KEY & UNDERCUT AREAS

CLIENT:

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MILLWATER
ARRAN POINT
STAGE 1

SHEAR KEY, UNDERCUTS, & SUBSOIL DRAINS
AS-BUILT PLAN
SHEET 1 of 2

AUCKLAND COUNCIL

DESIGNED:	MB	ISSUED FOR INFORMATION	
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	WOODS
JOB NUMBER:	37001	SCALE:	1:1000 @ A3
ISSUED:	16-09-2016		
DWG. NO.	37001-01-AB-120	REV.	1.

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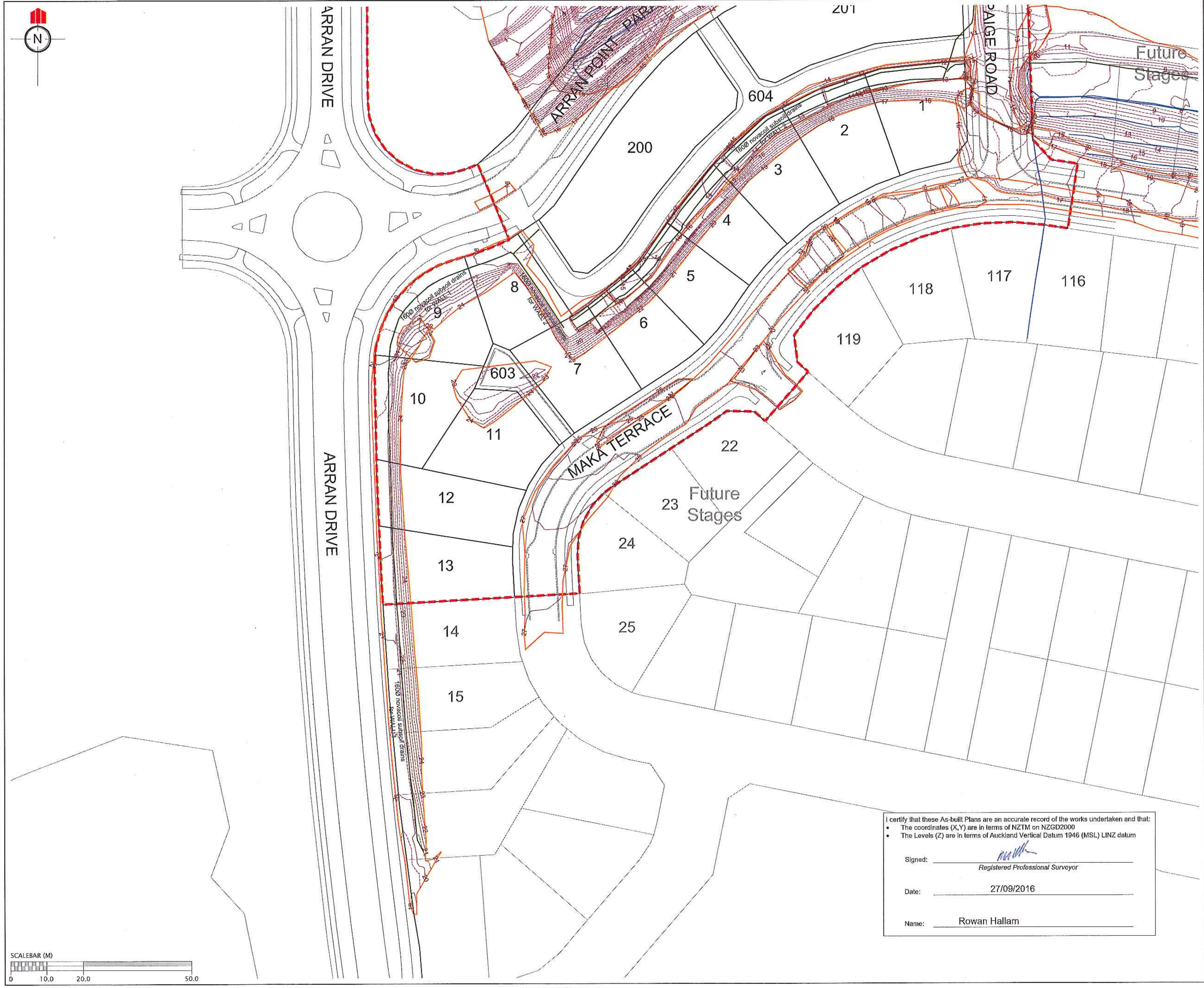

I certify that these As-built Plans are an accurate record of the works undertaken and that:

- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: ____________________
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued for information.	MRH	27-09-2016

NOTES

1. CONTOURS ARE AT 0.5 METRE INTERVALS

LEGEND

——	NOVACOIL SUBSOIL DRAINS
——	REINFORCED EARTH & RETAINING WALL SUBSOIL DRAINS
——	EXISTING STORMWATER DRAINAGE
—·—·—	NEW STORMWATER DRAINAGE
— — —	STAGE BOUNDARIES
——	LOT BOUNDARIES
- - - -	CONTOURS
▭	SHEAR KEY & UNDERCUT AREAS

CLIENT:

WFH PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

SHEAR KEY, UNDERCUTS, & SUBSOIL DRAINS AS-BUILT PLAN SHEET 2 of 2

AUCKLAND COUNCIL

DESIGNED:	MB	ISSUED FOR INFORMATION	
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	WOODS
JOB NUMBER:	37001	SCALE:	1:1000 @ A3
ISSUED:	16-09-2016		
DWG. NO.	37001-01-AB-121	REV.	1.

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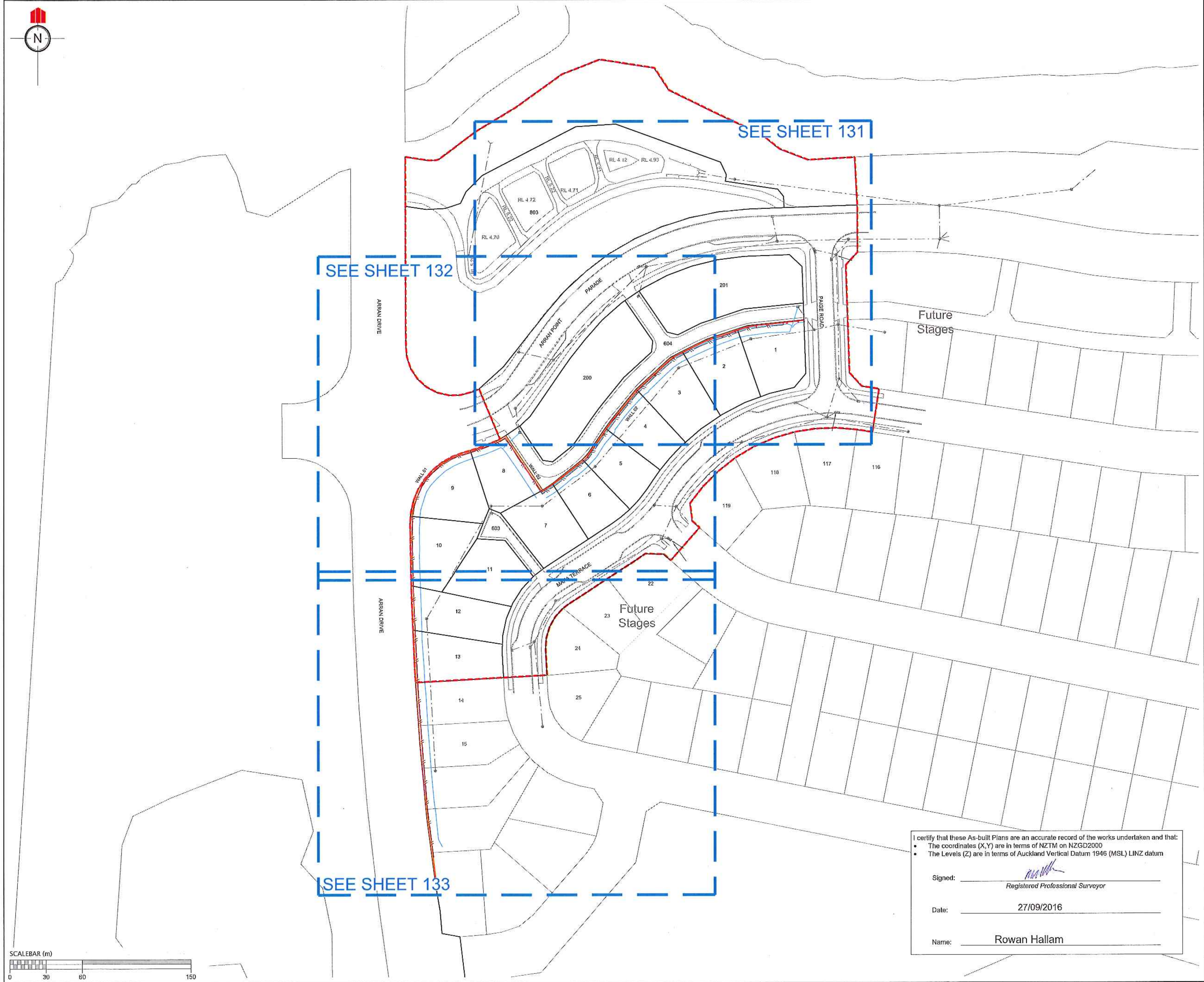

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: ______________________
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27-09-2016

LEGEND:

- - - - -	BOTTOM FACE OF WALL
——	TOP FACE OF WALL
▤	CATCH PIT/BERM SUMP
◉	STORMWATER MANHOLE
—‖—‖—	FENCE
—·—·—	STORMWATER LINE
——	BOUNDARY
——	WALL DRAINAGE LINE

CLIENT:

WFH PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

RETAINING WALL AS-BUILT
SHEET 1 OF 4

AUCKLAND COUNCIL

DESIGNED:	MB		AS-BUILT
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	PK
JOB NUMBER:	37001	SCALE:	1:1500 @ A3
ISSUED:	SEPT 2016		
DWG. NO.	37001-01-AB-130	REV.	1.

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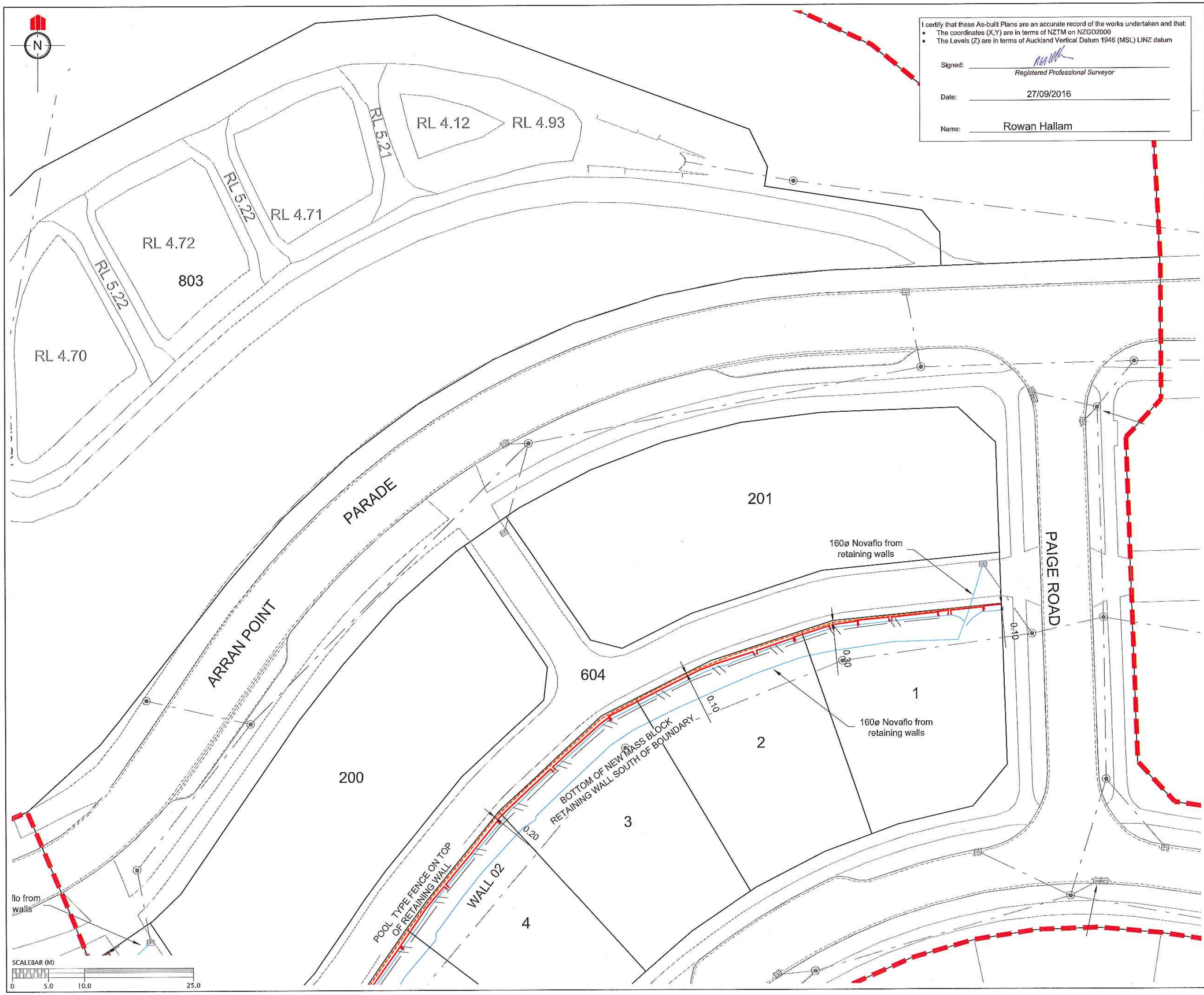
REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27-09-2016

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: RM Hallam
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam



LEGEND:

- - - -	BOTTOM FACE OF WALL
——	TOP FACE OF WALL
▤	CATCH PIT/BERM SUMP
◉	STORMWATER MANHOLE
—×—	FENCE
——	STORMWATER LINE
——	BOUNDARY
——	WALL DRAINAGE LINE

CLIENT:

WFH PROPERTIES

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Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

RETAINING WALL AS-BUILT
SHEET 2 OF 4

AUCKLAND COUNCIL

DESIGNED: MB		AS-BUILT	
CHECKED: RDC		DRAWN: RDC	
APPROVED: MRH		SURVEYED: PK	
JOB NUMBER: 37001		SCALE: 1:500 @ A3	
ISSUED: SEPT 2016			
DWG. NO. 37001-01-AB-131		REV. 1.	

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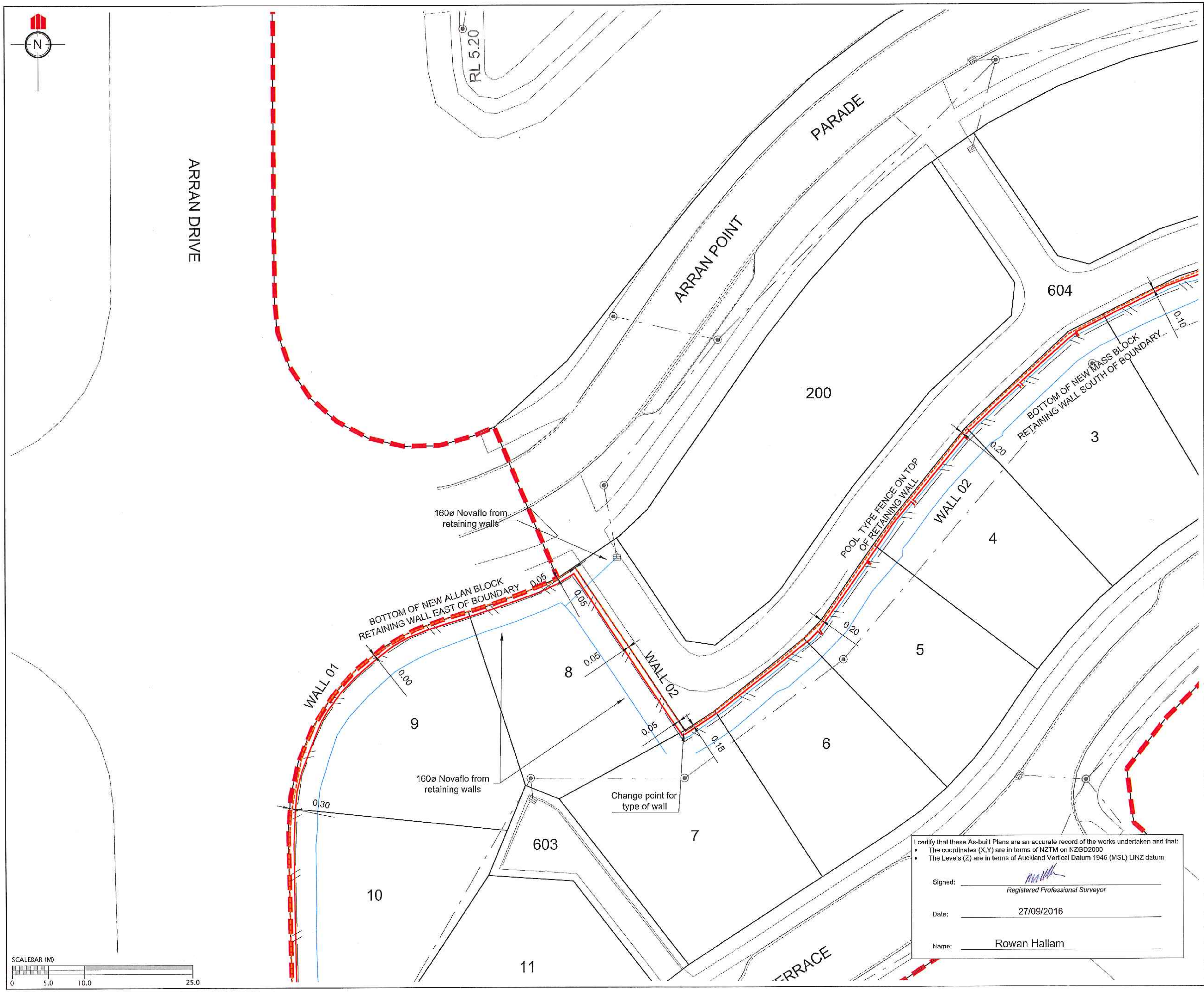

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	27-09-2016

LEGEND:

- BOTTOM FACE OF WALL
- TOP FACE OF WALL
- CATCH PIT/BERM SUMP
- STORMWATER MANHOLE
- FENCE
- STORMWATER LINE
- BOUNDARY
- WALL DRAINAGE LINE

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: _______ Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

CLIENT:

WFH PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

RETAINING WALL AS-BUILT
SHEET 3 OF 4

AUCKLAND COUNCIL

DESIGNED: MB		AS-BUILT	
CHECKED: RDC		DRAWN: RDC	
APPROVED: MRH		SURVEYED: PK	
JOB NUMBER: 37001		SCALE: 1:500 @ A3	
ISSUED: SEPT 2016			
DWG. NO. 37001-01-AB-132		REV. 1.	

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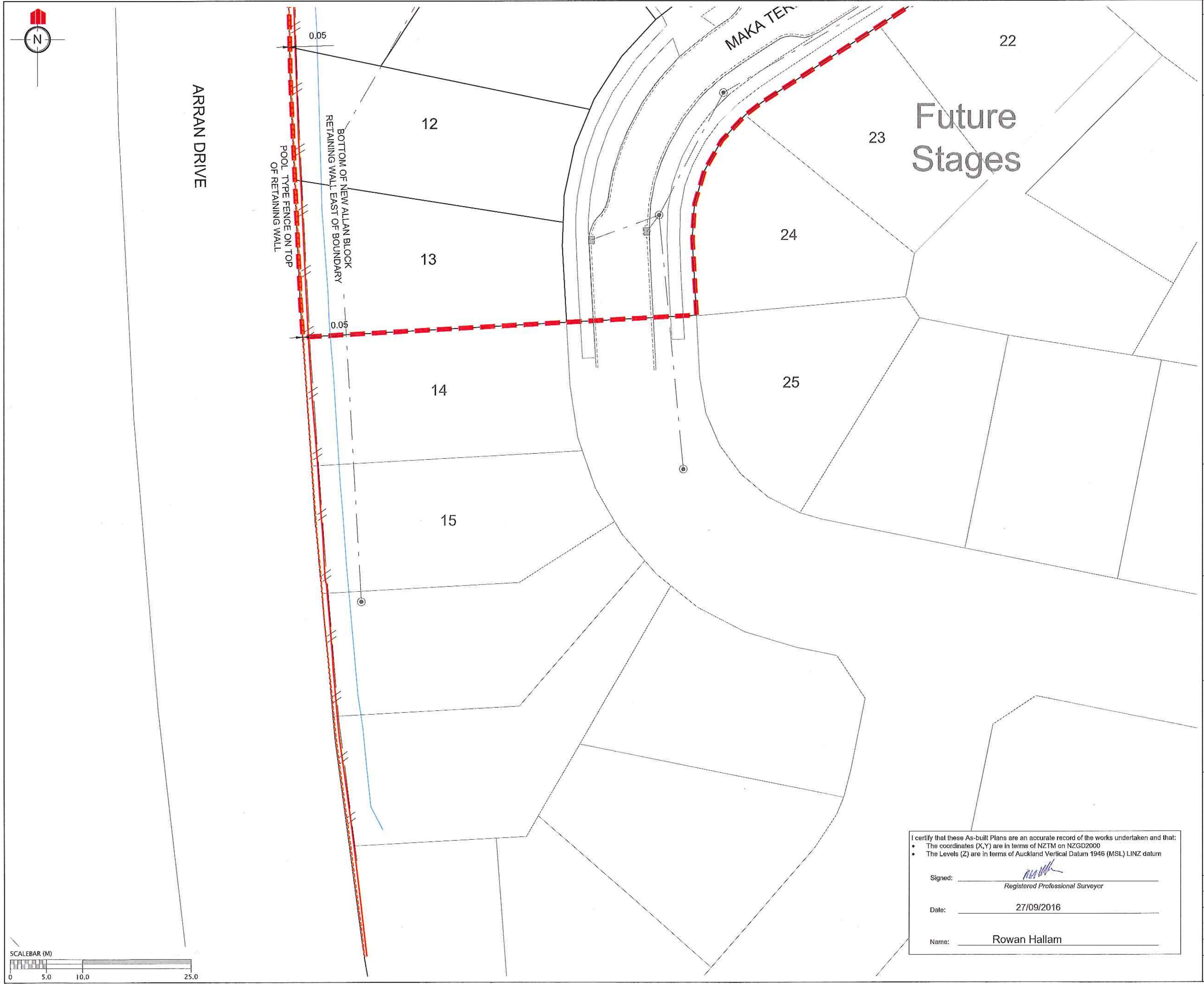

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: *Registered Professional Surveyor*

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued.	MRH	16-09-2016

LEGEND:

- - - - -	BOTTOM FACE OF WALL
———	TOP FACE OF WALL
▤	CATCH PIT/BERM SUMP
◉	STORMWATER MANHOLE
—x—x—	FENCE
·······	STORMWATER LINE
———	BOUNDARY
———	WALL DRAINAGE LINE

CLIENT:

WFH
PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

RETAINING WALL AS-BUILT
SHEET 4 OF 4

AUCKLAND COUNCIL

DESIGNED: MB	AS-BUILT
CHECKED: RDC	DRAWN: RDC
APPROVED: MRH	SURVEYED: PK
JOB NUMBER: 37001	SCALE: 1:500 @ A3
ISSUED: SEPT 2016	
DWG. NO. 37001-01-AB-132~~2~~3	REV. 1.

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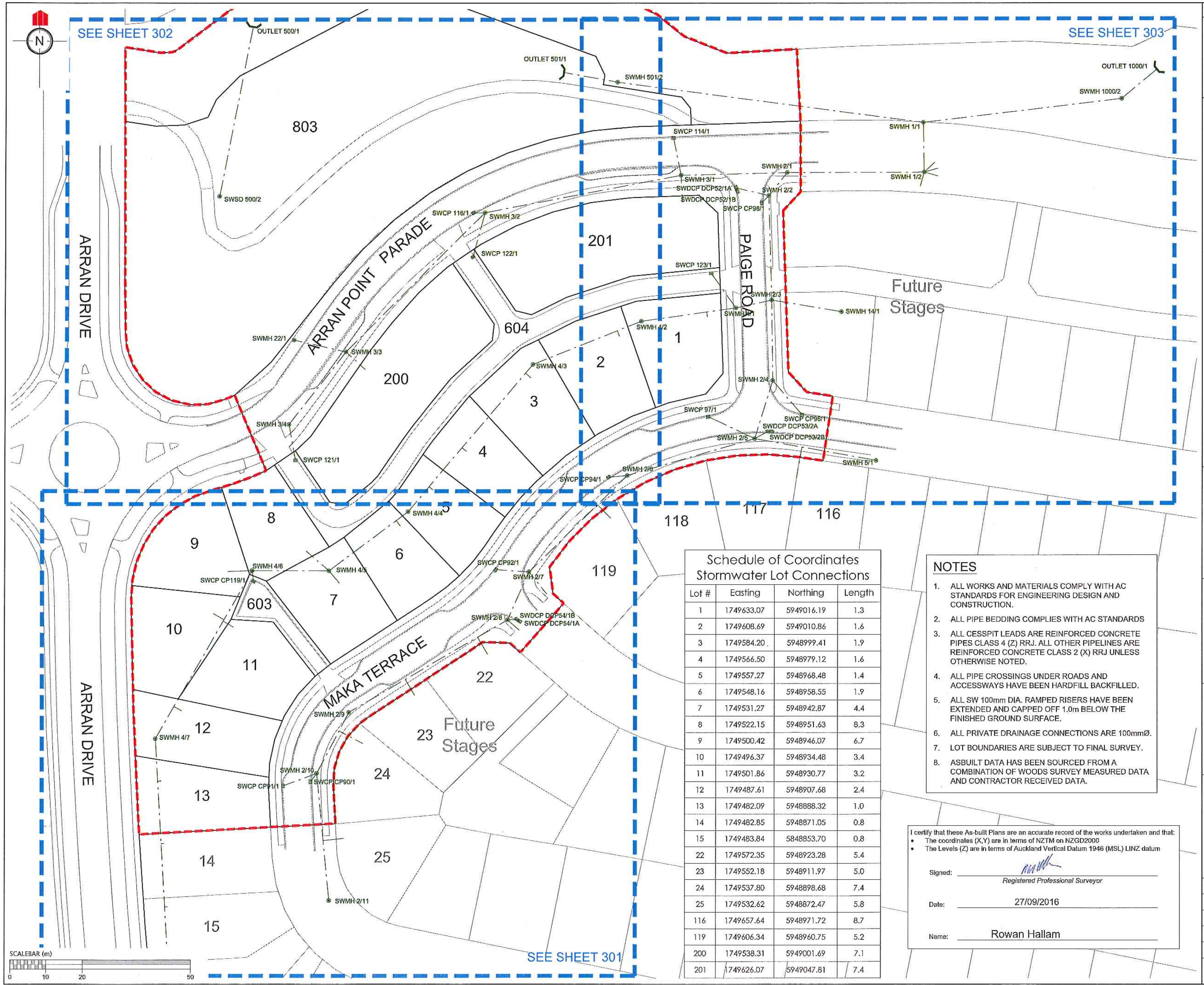

Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
1	1749633.07	5949016.19	1.3
2	1749608.69	5949010.86	1.6
3	1749584.20	5948999.41	1.9
4	1749566.50	5948979.12	1.6
5	1749557.27	5948968.48	1.4
6	1749548.16	5948958.55	1.9
7	1749531.27	5948942.87	4.4
8	1749522.15	5948951.63	8.3
9	1749500.42	5948946.07	6.7
10	1749496.37	5948934.48	3.4
11	1749501.86	5948930.77	3.2
12	1749487.61	5948907.68	2.4
13	1749482.09	5948888.32	1.0
14	1749482.85	5948871.05	0.8
15	1749483.84	5848853.70	0.8
22	1749572.35	5948923.28	5.4
23	1749552.18	5948911.97	5.0
24	1749537.80	5948898.68	7.4
25	1749532.62	5948872.47	5.8
116	1749657.64	5948971.72	8.7
119	1749606.34	5948960.75	5.2
200	1749538.31	5949001.69	7.1
201	1749626.07	5949047.81	7.4

NOTES

1. ALL WORKS AND MATERIALS COMPLY WITH AC STANDARDS FOR ENGINEERING DESIGN AND CONSTRUCTION.
2. ALL PIPE BEDDING COMPLIES WITH AC STANDARDS
3. ALL CESSPIT LEADS ARE REINFORCED CONCRETE PIPES CLASS 4 (Z) RRJ. ALL OTHER PIPELINES ARE REINFORCED CONCRETE CLASS 2 (X) RRJ UNLESS OTHERWISE NOTED.
4. ALL PIPE CROSSINGS UNDER ROADS AND ACCESSWAYS HAVE BEEN HARDFILL BACKFILLED.
5. ALL SW 100mm DIA. RAMPED RISERS HAVE BEEN EXTENDED AND CAPPED OFF 1.0m BELOW THE FINISHED GROUND SURFACE.
6. ALL PRIVATE DRAINAGE CONNECTIONS ARE 100mmØ.
7. LOT BOUNDARIES ARE SUBJECT TO FINAL SURVEY.
8. ASBUILT DATA HAS BEEN SOURCED FROM A COMBINATION OF WOODS SURVEY MEASURED DATA AND CONTRACTOR RECEIVED DATA.

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed:
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

REVISION DETAILS	NAME	DATE
1. Issued for information.	MRH	27/09/2016

LEGEND

STORMWATER MANHOLE	⦿
STORMWATER CESSPIT	▤
STORMWATER DOUBLE CESSPIT	▤▤
OVERLAND FLOW	➡
NEW STORMWATER	— · — · —
EXISTING STORMWATER	———
SUBSOIL DRAINAGE	———
STAGE BOUNDARY	— — — —

CLIENT:

WFH
PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER
ARRAN POINT
STAGE 1

STORMWATER ASBUILT
OVERALL LAYOUT
SHEET 1 OF 4
(SLC-62000)
AUCKLAND COUNCIL

DESIGNED:	MB		ASBUILT
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	PK
JOB NUMBER:	37001	SCALE:	1:1000 @ A3
ISSUED:	SEPT 2016		
DWG. NO.	37001-01-AB-300	REV.	1.

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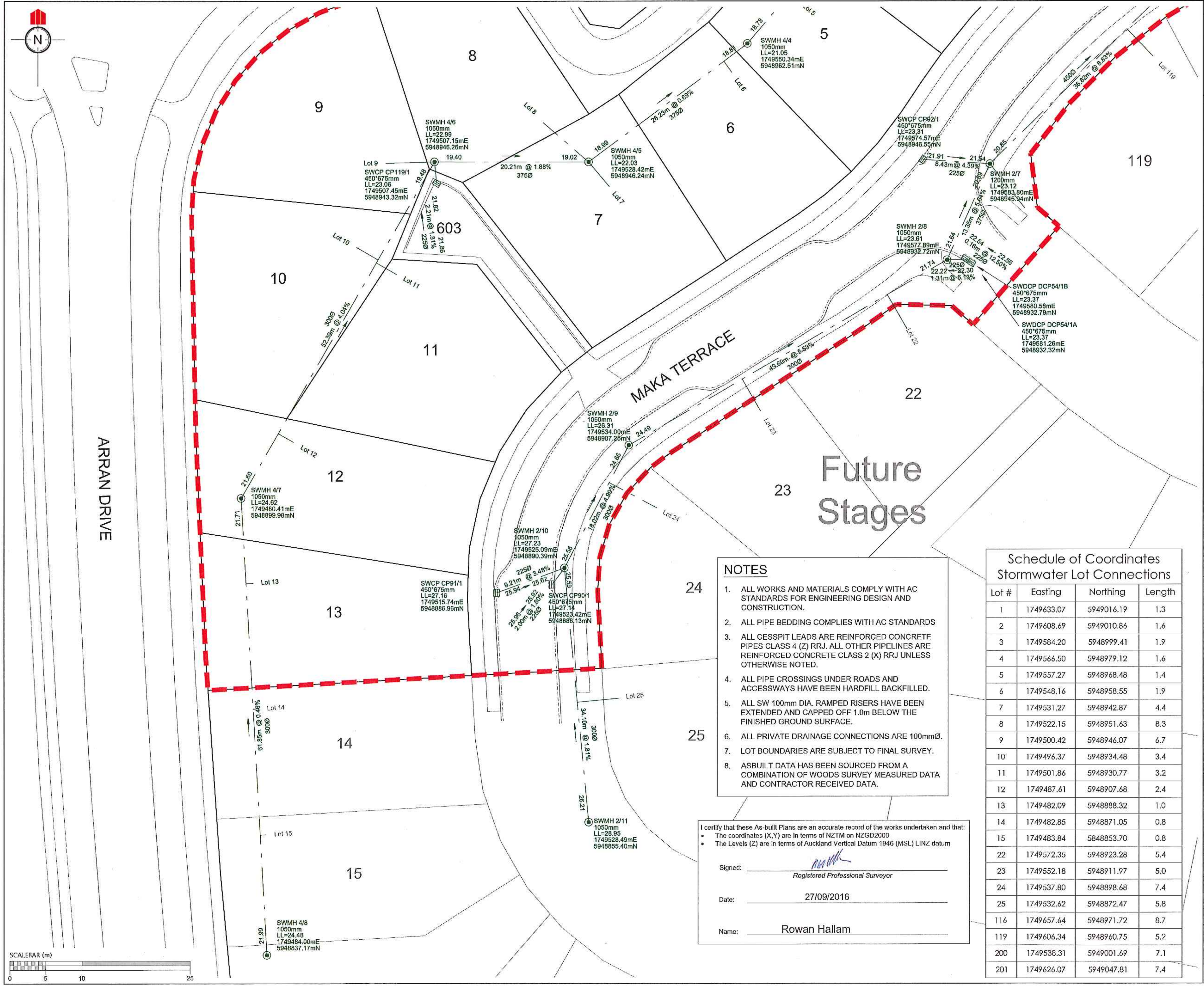

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- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed: ______________________
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
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8	1749522.15	5948951.63	8.3
9	1749500.42	5948946.07	6.7
10	1749496.37	5948934.48	3.4
11	1749501.86	5948930.77	3.2
12	1749487.61	5948907.68	2.4
13	1749482.09	5948888.32	1.0
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24	1749537.80	5948898.68	7.4
25	1749532.62	5948872.47	5.8
116	1749657.64	5948971.72	8.7
119	1749606.34	5948960.75	5.2
200	1749538.31	5949001.69	7.1
201	1749626.07	5949047.81	7.4

REVISION DETAILS	NAME	DATE
1. Issued for information.	MRH	27/09/2016

LEGEND

STORMWATER MANHOLE	◎
STORMWATER CESSPIT	▤
STORMWATER DOUBLE CESSPIT	▤▤
OVERLAND FLOW	➡
NEW STORMWATER	— · — · —
EXISTING STORMWATER	———
SUBSOIL DRAINAGE	———
STAGE BOUNDARY	▬ ▬ ▬

CLIENT:

WFH PROPERTIES

WOODS
Engineers. Surveyors. Planners. Urban Designers. Architects.

MILLWATER ARRAN POINT STAGE 1

STORMWATER ASBUILT SHEET 2 OF 4 (SLC-62000)

AUCKLAND COUNCIL

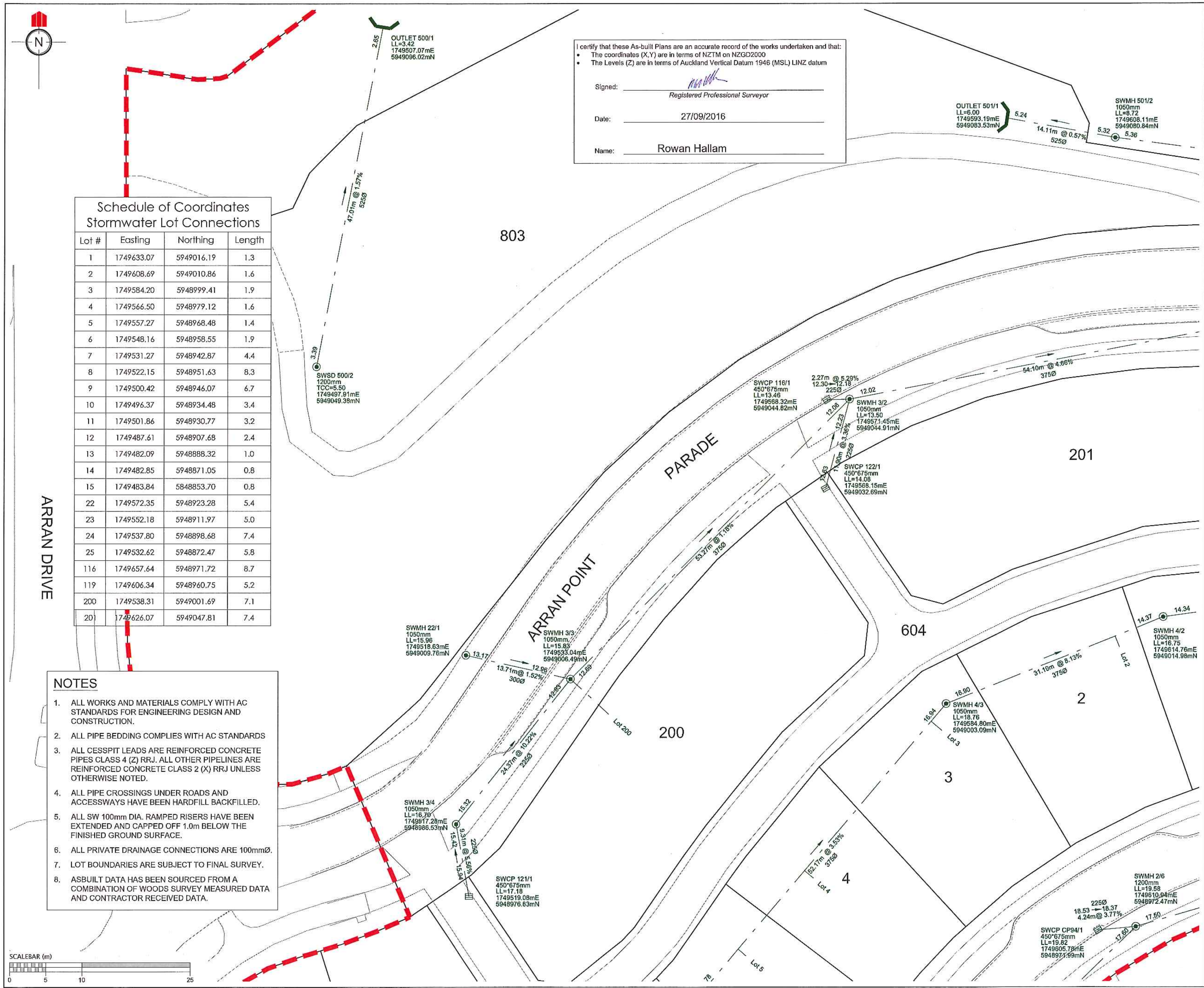
DESIGNED: MB	ASBUILT
CHECKED: RDC	DRAWN: RDC
APPROVED: MRH	SURVEYED: PK
JOB NUMBER: 37001	SCALE: 1:500 @ A3
ISSUED: SEPT 2016	
DWG. NO. 37001-01-AB-301	REV. 1.

I certify that these As-built Plans are an accurate record of the works undertaken and that:
- The coordinates (X,Y) are in terms of NZTM on NZGD2000
- The Levels (Z) are in terms of Auckland Vertical Datum 1946 (MSL) LINZ datum

Signed:
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam



Schedule of Coordinates Stormwater Lot Connections

Lot #	Easting	Northing	Length
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8	1749522.15	5948951.63	8.3
9	1749500.42	5948946.07	6.7
10	1749496.37	5948934.48	3.4
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25	1749532.62	5948872.47	5.8
116	1749657.64	5948971.72	8.7
119	1749606.34	5948960.75	5.2
200	1749538.31	5949001.69	7.1
201	1749626.07	5949047.81	7.4

NOTES

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6. ALL PRIVATE DRAINAGE CONNECTIONS ARE 100mmØ.
7. LOT BOUNDARIES ARE SUBJECT TO FINAL SURVEY.
8. ASBUILT DATA HAS BEEN SOURCED FROM A COMBINATION OF WOODS SURVEY MEASURED DATA AND CONTRACTOR RECEIVED DATA.

REVISION DETAILS	NAME	DATE
1. Issued for information.	MRH	27/09/2016

LEGEND

STORMWATER MANHOLE	◉
STORMWATER CESSPIT	▤
STORMWATER DOUBLE CESSPIT	▤▤
OVERLAND FLOW	➡
NEW STORMWATER	— · — · —
EXISTING STORMWATER	———
SUBSOIL DRAINAGE	———
STAGE BOUNDARY	▬ ▬ ▬ ▬

CLIENT:

WFH PROPERTIES

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MILLWATER ARRAN POINT STAGE 1

STORMWATER ASBUILT SHEET 3 OF 4 (SLC-62000)

AUCKLAND COUNCIL

DESIGNED: MB		ASBUILT	
CHECKED: RDC		DRAWN: RDC	
APPROVED: MRH		SURVEYED: PK	
JOB NUMBER: 37001		SCALE: 1:500 @ A3	
ISSUED: SEPT 2016			
DWG. NO. 37001-01-AB-302			REV. 1.

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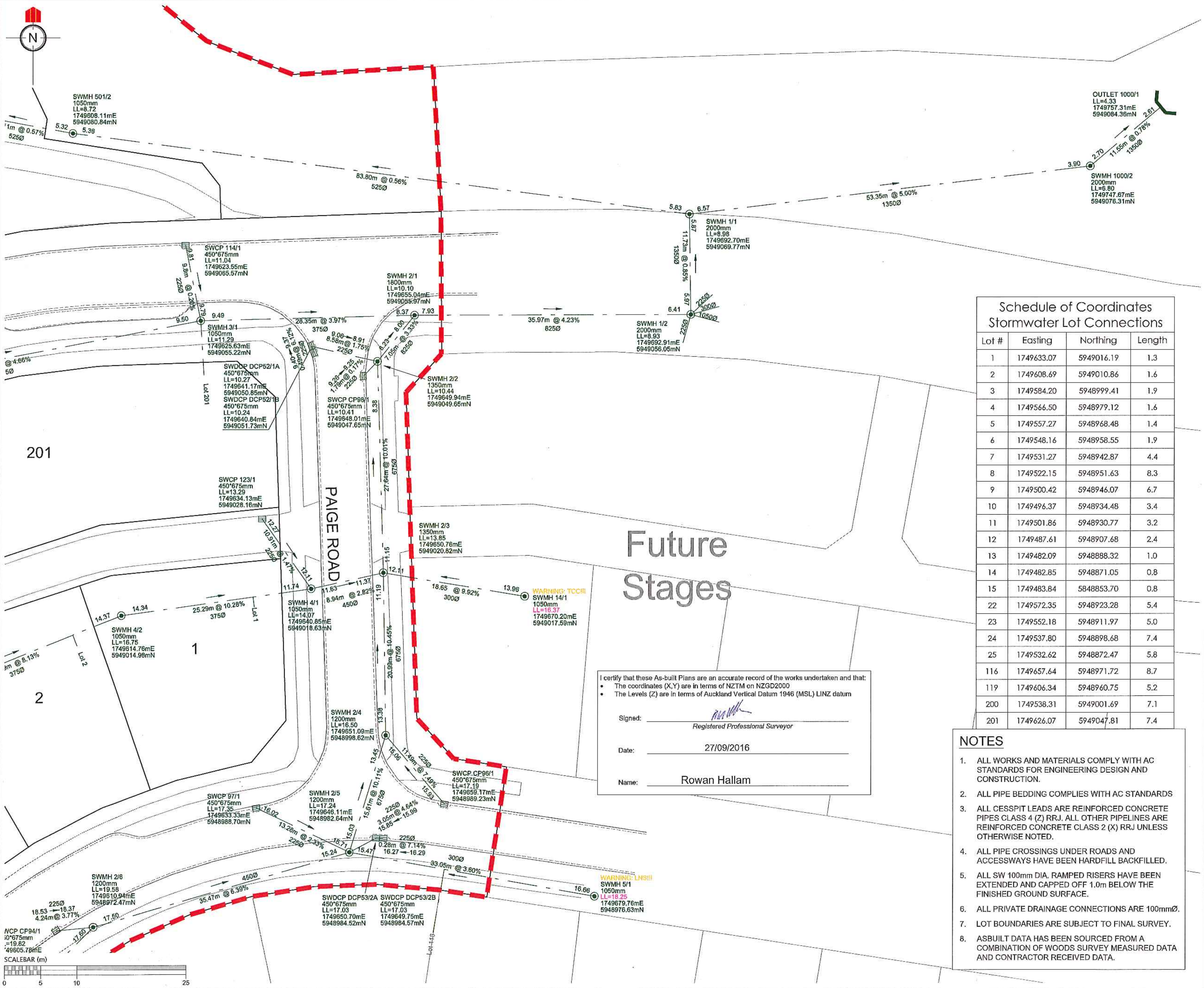

Schedule of Coordinates Stormwater Lot Connections			
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200	1749538.31	5949001.69	7.1
201	1749626.07	5949047.81	7.4

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Signed: ______________________
Registered Professional Surveyor

Date: 27/09/2016

Name: Rowan Hallam

NOTES

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REVISION DETAILS	NAME	DATE
1. Issued for information.	MRH	27/09/2016

LEGEND

STORMWATER MANHOLE	⦿
STORMWATER CESSPIT	▤
STORMWATER DOUBLE CESSPIT	▤▤
OVERLAND FLOW	➡
NEW STORMWATER	— · —
EXISTING STORMWATER	———
SUBSOIL DRAINAGE	———
STAGE BOUNDARY	▬ ▬ ▬

CLIENT:

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MILLWATER
ARRAN POINT
STAGE 1

STORMWATER ASBUILT
SHEET 4 OF 4
(SLC-62000)

AUCKLAND COUNCIL

DESIGNED:	MB		ASBUILT
CHECKED:	RDC	DRAWN:	RDC
APPROVED:	MRH	SURVEYED:	PK
JOB NUMBER:	37001	SCALE:	1:500 @ A3
ISSUED:	SEPT 2016		
DWG. NO.	37001-01-AB-303	REV.	1.

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Appendix A2: T+T Drawings

21854.0037–APP721–100	Drawing List and Site Location Plan
21854.0037–APP721–101	Geotechnical Works Plan
21854.0037–APP721–102	Geotechnical Works Subsoil Drain Plan
21854.0037–APP721–103	Geological Cross Sections 1 & 4
21854.0037–APP721–104	Geological Cross Section 2
21854.0037–APP721–105	Allan Block Wall 1 Typical Cross Section Detail
21854.0037–APP721–106	Screen Block Wall 02 Typical Cross Section Details
21854.0037–APP721–107	Gabion Basket Wall 6 and 7 Typical Cross Section Details
21854.0037–APP721–108	Reinforced Earth Slope Typical Detail
21854.0037–APP721–109	Shear Key 1 Plan
21854.0037–APP721–110	Shear Key 1 Long Section
21854.0037–APP721–111	Geology Legend and Definition of Terms

WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION
MILLWATER - ARRANS POINT PRECINCT 7 (STAGE 1)
Completion Report Issue

DRAWING	Rev	Title
GENERAL		
● 21854.0037-APP7S1-100	1	Drawing List and Location Plan
● 21854.0037-APP7S1-101	1	Geotechnical Works Plan
● 21854.0037-APP7S1-102	1	Geotechnical Works Subsoil Drian Plan
● 21854.0037-APP7S1-103	1	Geolgical Cross Sections 1 & 4
● 21854.0037-APP7S1-104	1	Geological Cross Section 2
● 21854.0037-APP7S1-105	1	Allan Block Wall 1 Typical Cross Section Detail
● 21854.0037-APP7S1-106	1	Retaining Wall 02 Typical Cross Section Details
● 21854.0037-APP7S1-107	1	Gabion Basket Wall 6 and 7 Typical Cross Section
● 21854.0037-APP7S1-108	1	Reinforced Earth Slope Typical Details
● 21854.0037-APP7S1-109	1	Shear Key 1 Plan
● 21854.0037-APP7S1-110	1	Shear Key 1 Longsection
● 21854.0037-APP7S1-111	1	Geology Legend and Definition of Terms
● 21854.0037-APP7S1-112	1	Post Earthworks Investigation Plan
● 21854.0037-APP7S1-113	1	Topsoil Depths Plan
● 21854.0037-APP7S1-114	1	Earthworks Testing Location Plan

- Denotes drawing this issue: 28/10/2016

Street map sourced from Land Information New Zealand data (Crown Copyright Reserved).

LOCATION PLAN
NOT TO SCALE

A3 SCALE 1:5000
0 50 100 150 200 250 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: COMPLETION REPORT

				DESIGNED :	JXXL	Oct. 16
				DRAWN :	JC	Oct. 16
				DESIGN CHECKED :		
				DRAFTING CHECKED :		
				CADFILE : \\21854.0037–APP7S1–100.dwg		
				APPROVED : NOT FOR CONSTRUCTION This drawing is not to be used for construction purposes unless signed as approved		
1	Completion Report Issue					
REVISION DESCRIPTION		BY	DATE	COPYRIGHT ON THIS DRAWING IS RESERVED		

NOTES :

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

CLIENT, PROJECT
WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION
TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Drawing List and Location Plan
SCALES (AT A3 SIZE) 1: 5000
DWG. No. 21854.0037–APP7S1–100
REV. 1

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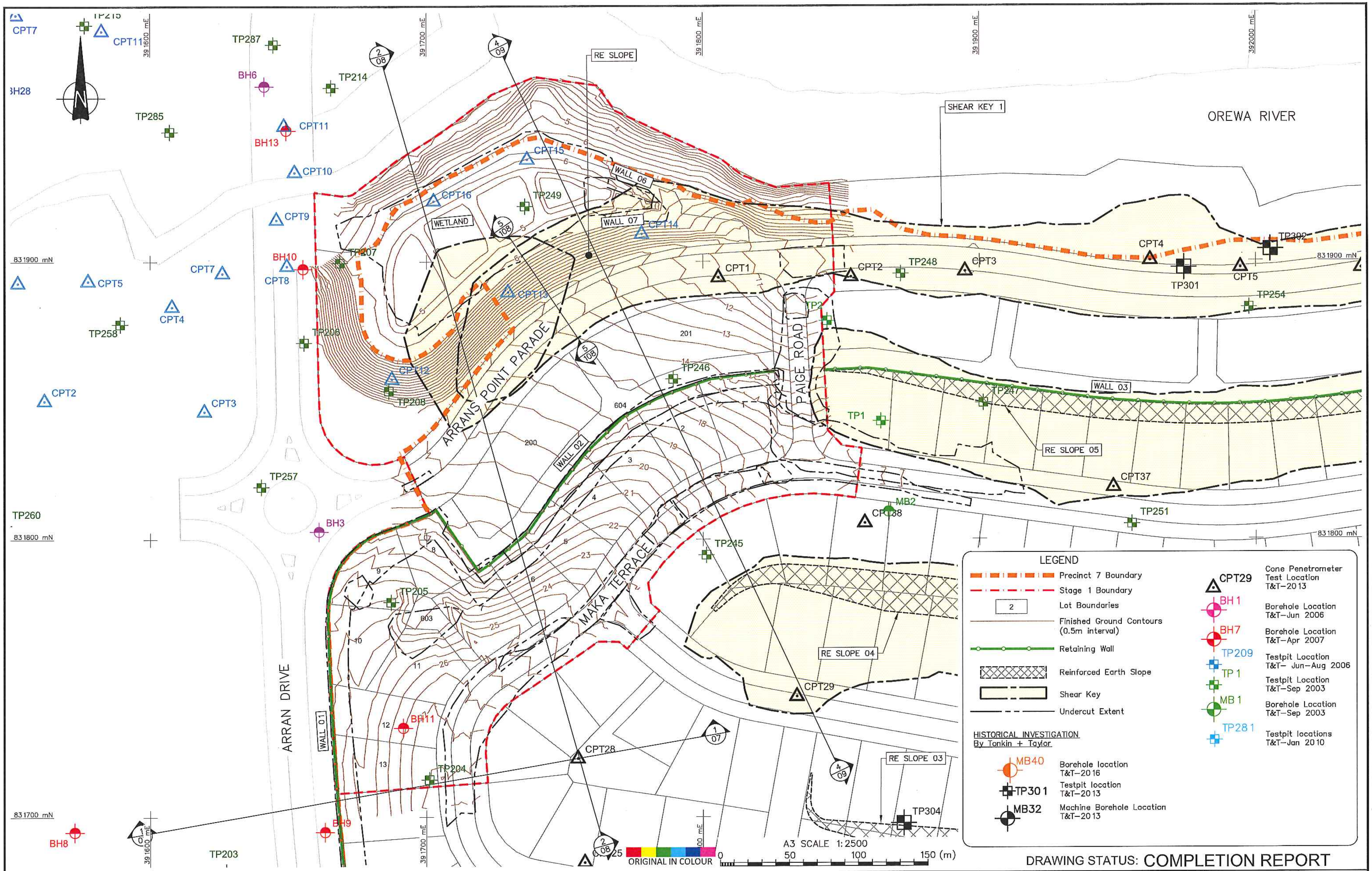

DRAWING STATUS: COMPLETION REPORT

1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	JXXL	Oct. 16
DRAWN :	JC	Oct. 16
DESIGN CHECKED :		
DRAFTING CHECKED :		

CADFILE : \\21854.0037–APP7S1–00.dwg

APPROVED :
NOT FOR CONSTRUCTION
This drawing is not to be used for construction purposes unless signed as approved

NOTES :

1. All dimensions are in millimetres unless noted otherwise.
2. Baseplan supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Information.dwg" dated August 2016.
3. Finished Ground, undercut and shearkey supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Info 160901.dwg" dated Sep 2016
4. Coordinate Datum: NZGD2000, Mt Eden Circuit Circuit Coordinates.
Origin: Lat 36 52 47S Long 174 45 51E 800,000mN 400,000mE

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

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WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION

TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Geotechnical Works Plan

SCALES (AT A3 SIZE)	DWG. No.	REV.
1: 1250	21854.0037–APP7S1–101	1

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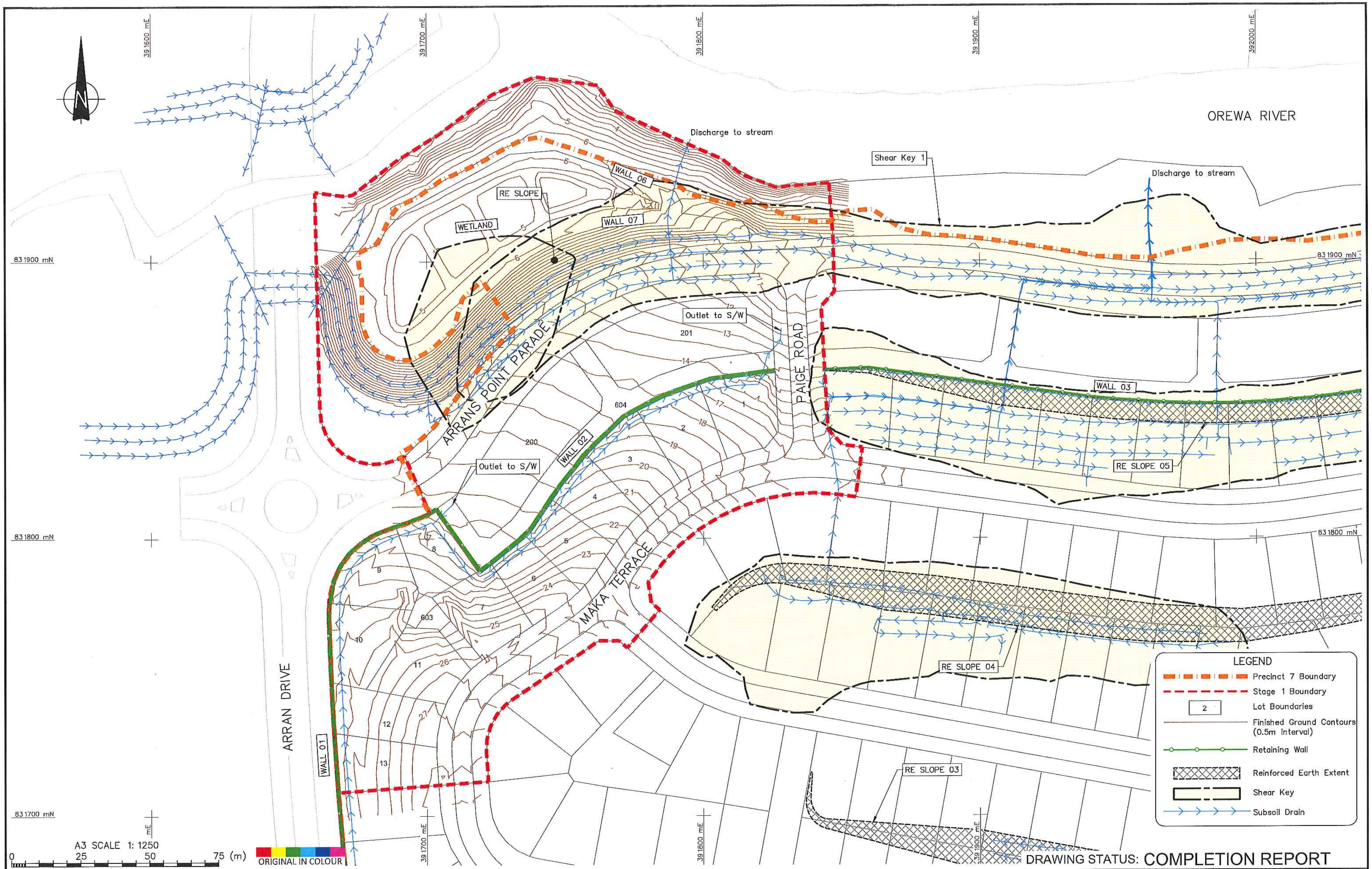

DRAWING STATUS: COMPLETION REPORT

1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	JXXL	Oct. 16
DRAWN :	JC	Oct. 16
DESIGN CHECKED :		
DRAFTING CHECKED :		

CADFILE : \\21854.0037–APP7S1–00.dwg

APPROVED :
NOT FOR CONSTRUCTION
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NOTES :

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2. Baseplan supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Information.dwg" dated August 2016.
3. Finished Ground, undercut and shearkey supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Info 160901.dwg" dated Sep 2016
4. Coordinate Datum: NZGD2000, Mt Eden Circuit Circuit Coordinates. Origin: Lat 36 52 47S Long 174 45 51E 800,000mN 400,000mE

REFERENCE :

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkintaylor.co.nz

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WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION

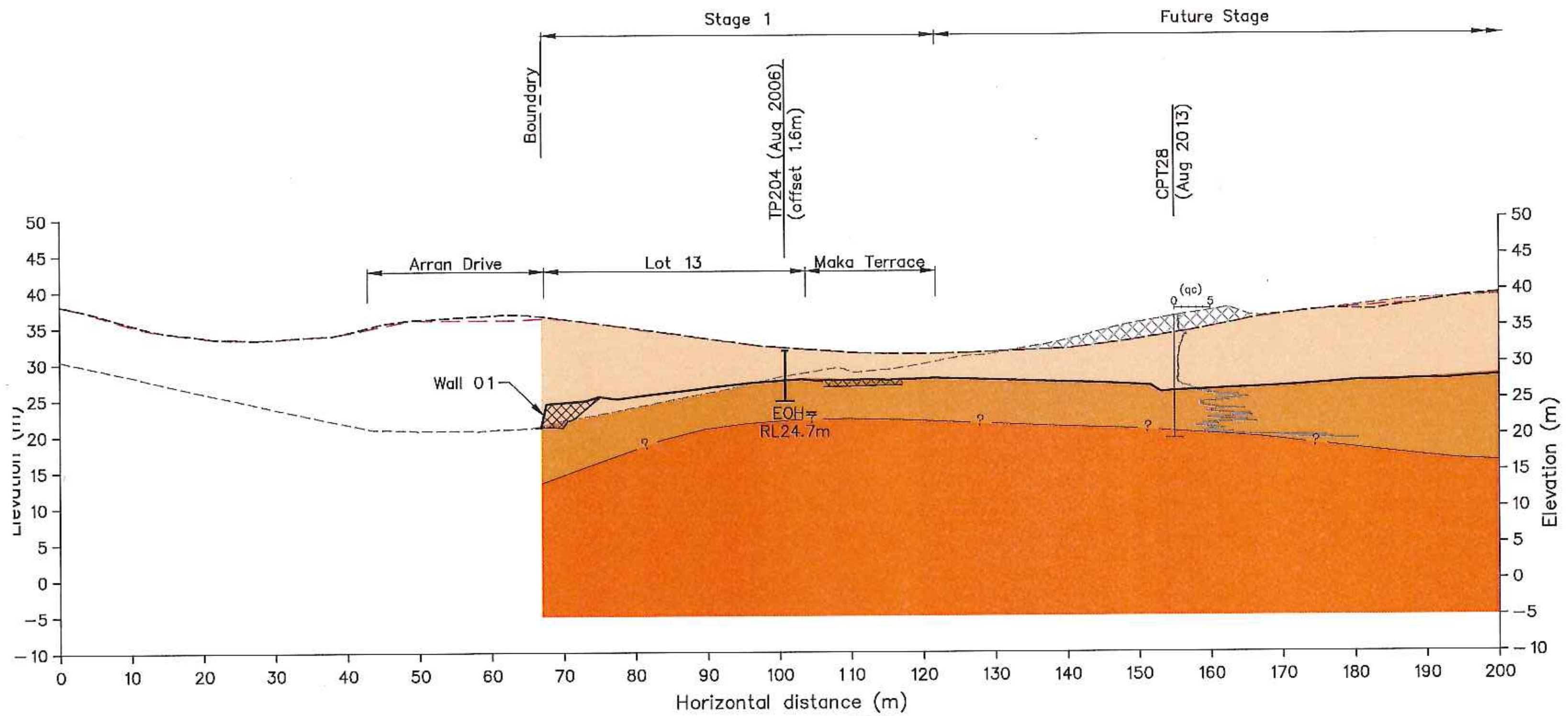
TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Geotechnical Works Subsoil Drain Plan

SCALES (AT A3 SIZE) 1: 1250
DWG. No. 21854.0037–APP7S1–102
REV. 1

Geological sections are an interpretation of the investigation data which is available only at discrete locations. Additional Paleo-valleys and variability in soil layers and ECBF Rock interface may be present in areas between test locations.

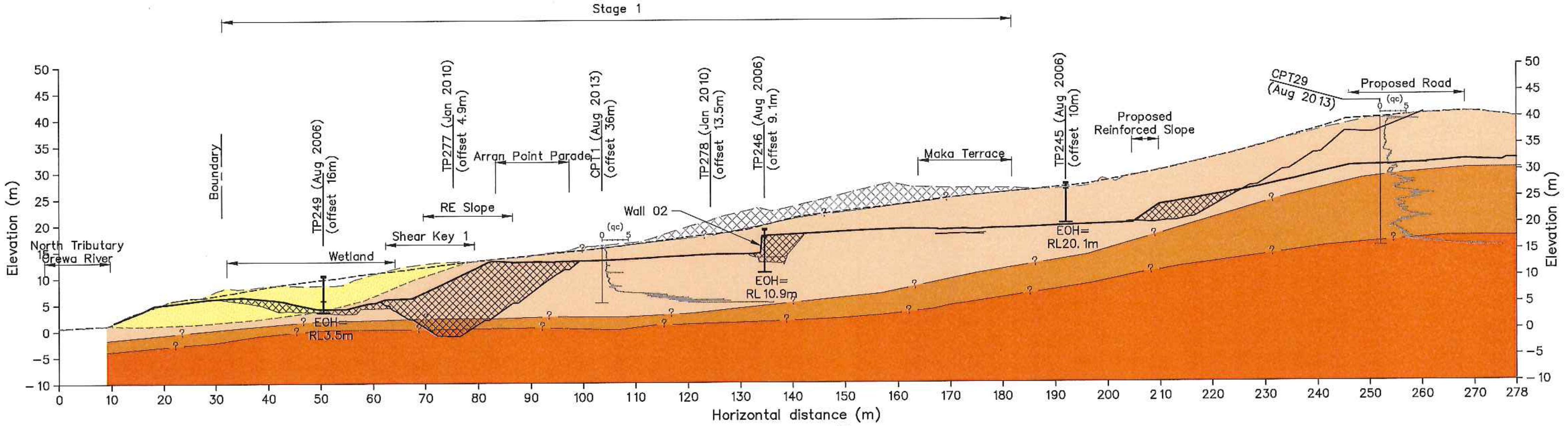
LEGEND

- - - - - -	Original 2009 Ground profile
- - - - - -	2013 Ground profile
———	Stage 1 Finished Ground level
—— ? ——	Inferred geological boundary
▨	Existing Stockpile
▨	Engineered Fill
🟨	Alluvium
🟧	Residual Soils/ Completely Weathered ECBF
🟧	Highly to Slightly Weathered ECBF
🟧	Slightly Weathered to Unweathered ECBF



SECTION 1/101

SCALE 1:1000



SECTION 4/101

SCALE 1:1000

A3 SCALE 1: 1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: COMPLETION REPORT

1	Completion Report Issue	
REVISION DESCRIPTION	BY	DATE

DESIGNED : JXXL Oct.16

DRAWN : JC Oct.16

DESIGN CHECKED :

DRAFTING CHECKED :

CADFILE : \\21854.0037–APP7S1–103_104.dwg

APPROVED :

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NOTES :

1. All dimensions are in millimetres unless noted otherwise.

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CLIENT, PROJECT
WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION

TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Geolgical Cross Sections 1 & 4

SCALES (AT A3 SIZE) 1: 1000

DWG. No. 21854.0037–APP7S1–103

REV. 1

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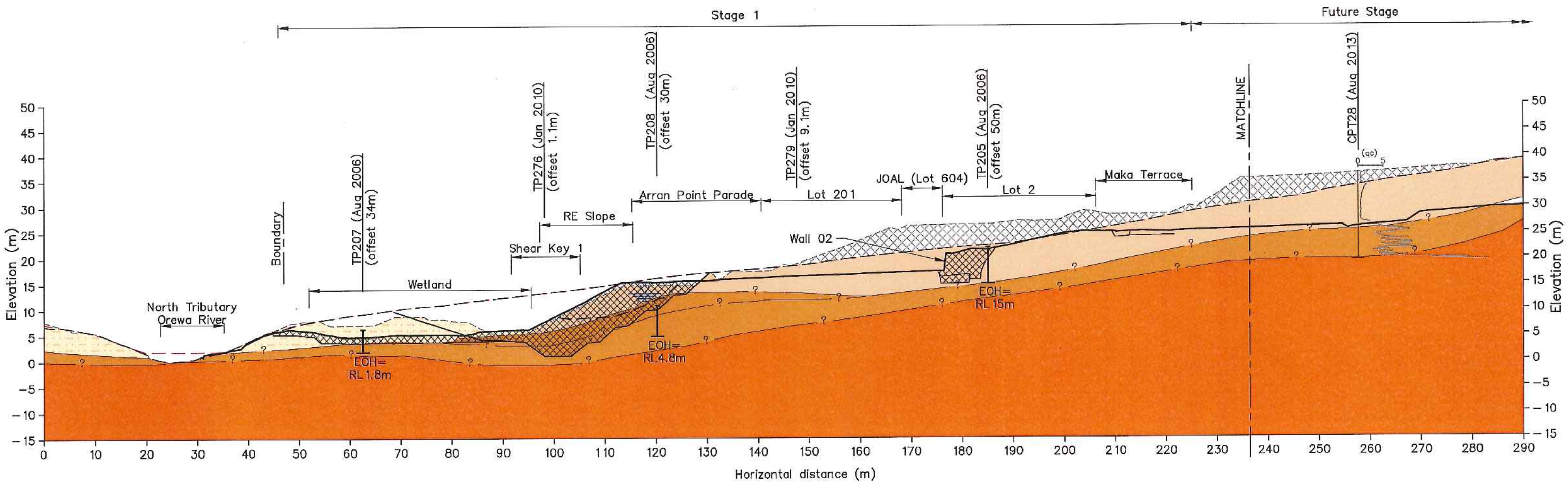

SECTION 2/101
SCALE 1:1000

Geological sections are an interpretation of the investigation data which is available only at discrete locations. Additional Paleo-valleys and variability in soil layers and ECBF Rock interface may be present in areas between test locations.

LEGEND

- - - - - - -	Original 2009 Ground profile
– – – – – – –	2013 Ground profile
———	Stage 1 Finished Ground level
——?——	Inferred geological boundary
▨	Existing Stockpile
▩	Engineered Fill
🟨	Alluvium
▭	Residual Soils/ Completely Weathered ECBF
🟧	Highly to Slightly Weathered ECBF
🟧	Slightly Weathered to Unweathered ECBF

A3 SCALE 1: 1000
0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DRAWING STATUS: COMPLETION REPORT

REV.	DESCRIPTION	BY	DATE
1	Completion Report Issue		

DESIGNED :	JXXL	Oct. 16
DRAWN :	JC	Oct. 16
DESIGN CHECKED :		
DRAFTING CHECKED :		

CADFILE : \\21854.0037–APP7S1–103_104.dwg

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Geological Cross Section 2

SCALES (AT A3 SIZE)	DWG. No.	REV.
1: 1000	21854.0037–APP7S1–104	1

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NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. Foundation to be inspected by T&T geotechnical engineer. The subgrade material shall have minimum undrained shear strength of greater than 120 kPa
3. The bottom geogrid layer shall start at finished ground level.
4. All fill shall be placed and compacted according to the construction specification.
5. The Contractor shall ensure that temporary excavated faces are stable.
6. Excavation in front of the wall to be reinstated with compacted, engineered fill.
7. Hard fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the hard fill to cascade onto the grids.
8. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the Allan Block. The plant used for compacting this zone shall be restricted to:–
   - a)Vibrating rollers having a total mass not exceeding 1000kg
   - b)Vibrating plate compactors having a total mass not exceeding 100kg
   - c)Vibro tampers having a mass not exceeding 75kg
9. Density testing of backfill around grids is required (refer to Specification)
10. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of GAP65 fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of GAP65 fill on, or staking, the free end. They shall remain tensioned whilst the balance of GAP65 fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
11. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
12. Wall setout to be as provided by Woods and confirmed on site by the Engineer.

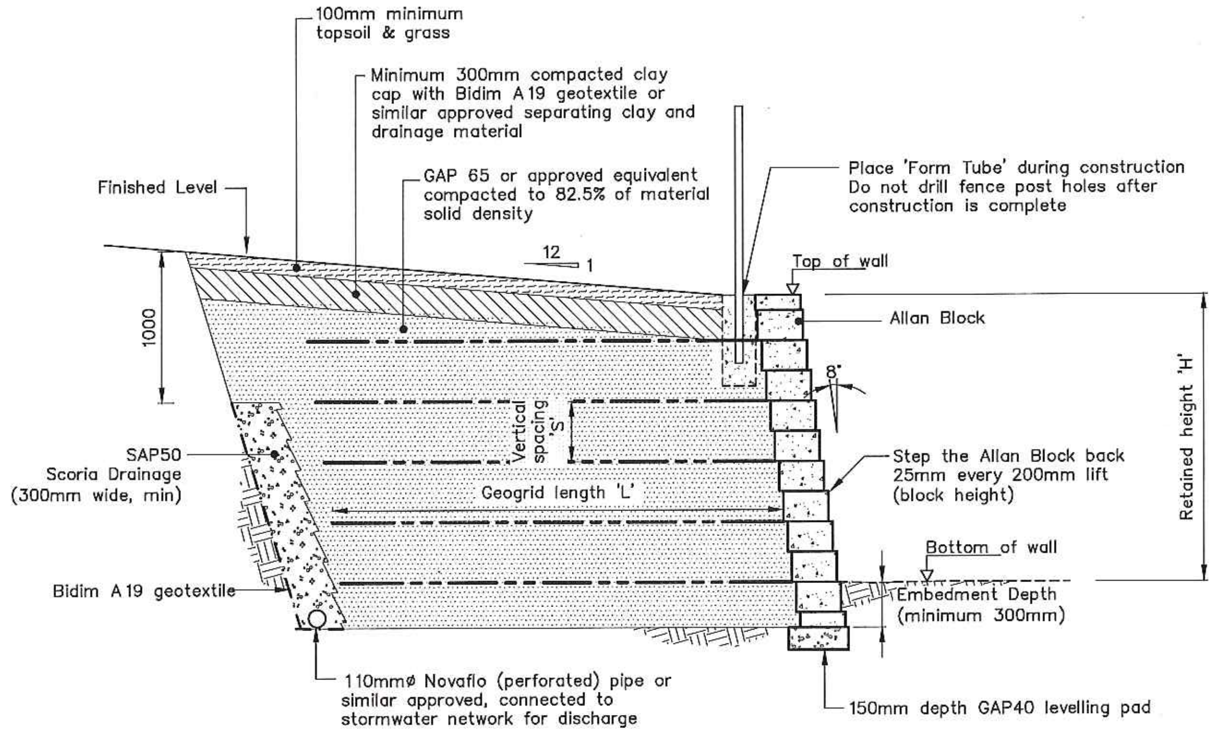
TABLE 1: Reinforcement Details

Retained Height 'H' (m)	Geogrid Type	Min Geogrid Length 'L' (m)	Max. Vertical Spacing 'S' (m)
1.0 – 3.0	Tensar RE540	3.0	0.4

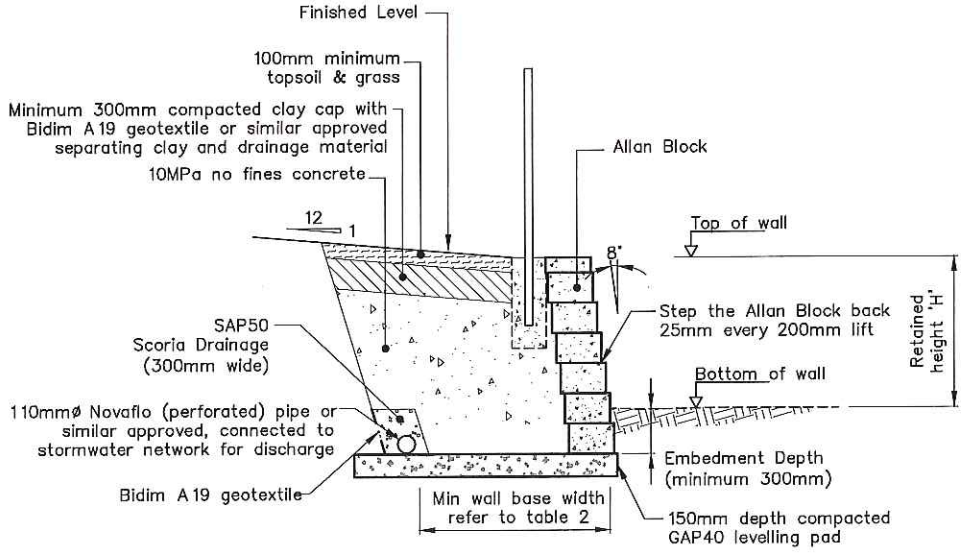
NOTE: Refer to Table 2 for walls with retained height less than 1m

TABLE 2: Minimum wall width for walls ≤1m height

Reinforced height 'H' (m)	Min. base width (m)
< 0.5	1.1
0.5 – 1.0	1.4



TYPICAL ALLAN BLOCK WALL (FOR WALLS > 1m HEIGHT)
SCALE 1:50



TYPICAL ALLAN BLOCK WALL (FOR WALLS <1m HEIGHT)
SCALE 1:50

A3 SCALE 1:50
0 0.5 1.0 1.5 2.0 2.5 (m)

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1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	JXXL	Oct.16
DRAWN :	JC	Oct.16
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DRAWING STATUS: COMPLETION REPORT

CLIENT, PROJECT
WFH PROPERTIES LTD
RESIDENTIAL SUBDIVISION

TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Allan Block Wall 1 Typical Cross Section Detail

SCALES (AT A3 SIZE): 1:50
DWG. No.: 21854.0037–APP7S1–105
REV.: 1

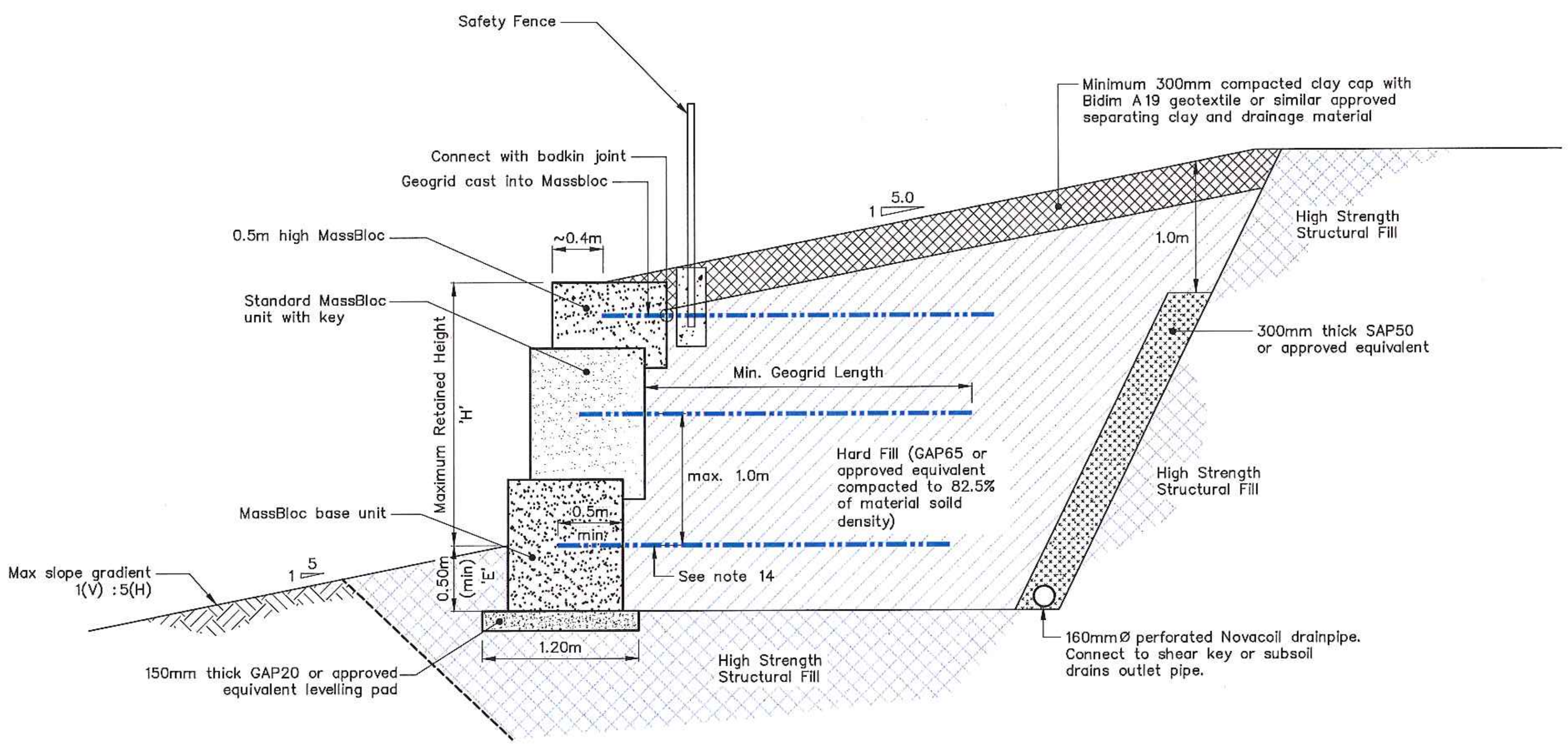
WALL SPECIFICATION				
Max. Retained Height 'H'	Min. Embedment Depth 'E'	Geogrid Type	Min. Length of Geogrid	Max. Geogrid vertical spacing
3.0 m	0.5 m	Tensar RE560	2.5 m	1.0 m

LEGEND

—·—··	Tensar RE540 (Primary Geogrid)
▨	Hard Fill
▩	Structural Fill

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. Foundation to be inspected by geotechnical engineer.
3. The bottom geogrid layer has to start at finished ground level.
4. Geogrid spacing is no more than 1.0m (vertical).
5. All fill shall be placed and compacted according to the hardfill specification.
6. The Contractor shall ensure that temporary excavated faces are stable.
7. Excavation in front of the wall to be reinstated with High Strength Structural Fill.
8. Hard fill shall be spread using mechanical plant such as an excavator bucket or a dozer with an opening bucket, which causes the hard fill to cascade onto the grids.
9. All construction plant and other vehicles having a mass exceeding 1000kg shall not be used within 1.0m of the back face of the MassBloc. The plant used for compacting this zone shall be restricted to:–
   - a)Vibrating rollers having a total mass not exceeding 1000kg
   - b)Vibrating plate compactors having a total mass not exceeding 100kg
   - c)Vibro tampers having a mass not exceeding 75kg
10. Density testing of backfill around grids is required (refer to specification).
11. Geogrids shall be laid horizontally (perpendicular to wall) on compacted layers of fill. They shall be tensioned to remove all slack prior to back filling and anchored by either placing a small volume of fill on or staking the free end. They shall remain tensioned whilst the balance of fill is placed. No traffic or site plant shall be permitted to travel on the grids where cover is less than 100mm.
12. The Engineer shall inspect and approve installation of at least the first layer of geogrid and other layers as necessary.
13. Geogrid starters to be cast into MassBloc during manufacture and joined to geogrid using bodkin joints.
14. Actual extent of base level of blocks to be inspected by Engineer and tested to confirm minimum Su>120KPa.



RETAINING WALL 02 – MASSBLOC WALL TYPICAL SECTION

SCALE 1:50

A3 SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 (m)

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1	Completion Report Issue		
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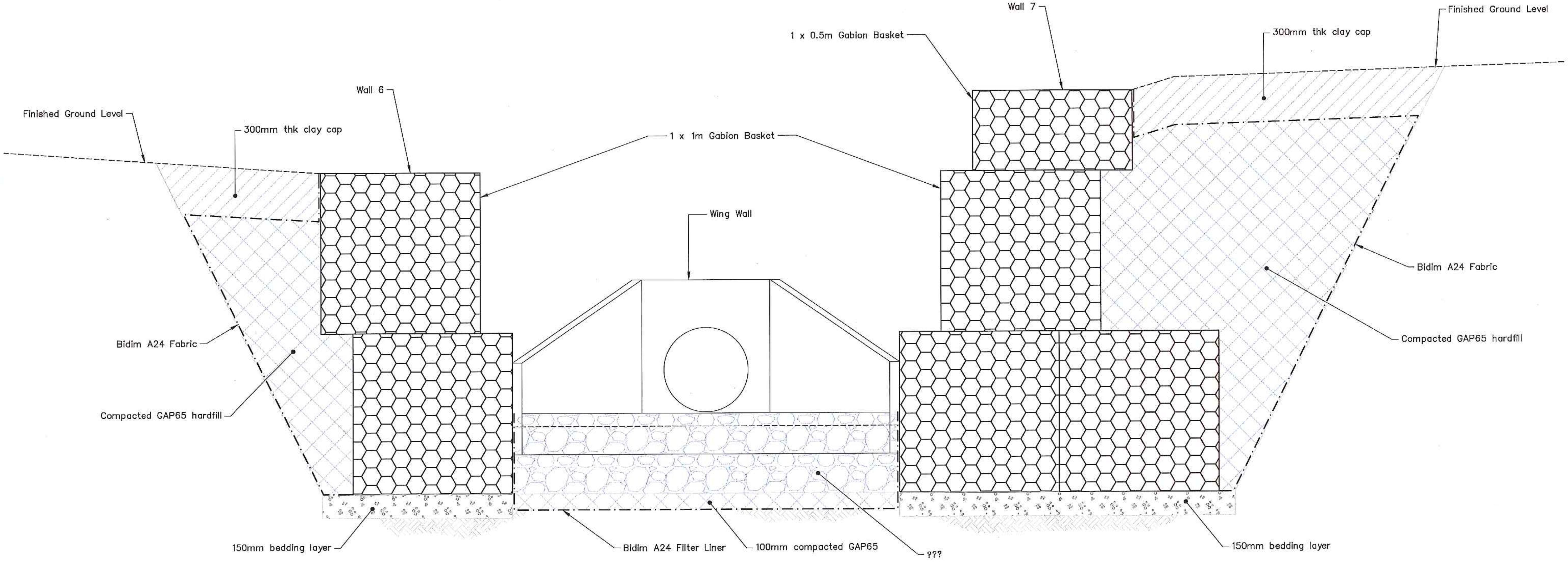
TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Retaining Wall 02 Typical Cross Section Details

SCALES (AT A3 SIZE) AS SHOWN

DWG. No. 21854.0037–APP7S1–106

REV. 1



RETAINING WALLS 06 & 07 – GABION BASKET WALL TYPICAL SECTION

SCALE 1:25

A3 SCALE 1:25
0 0.5 1.0 1.5 (m)

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1	Completion Report Issue		
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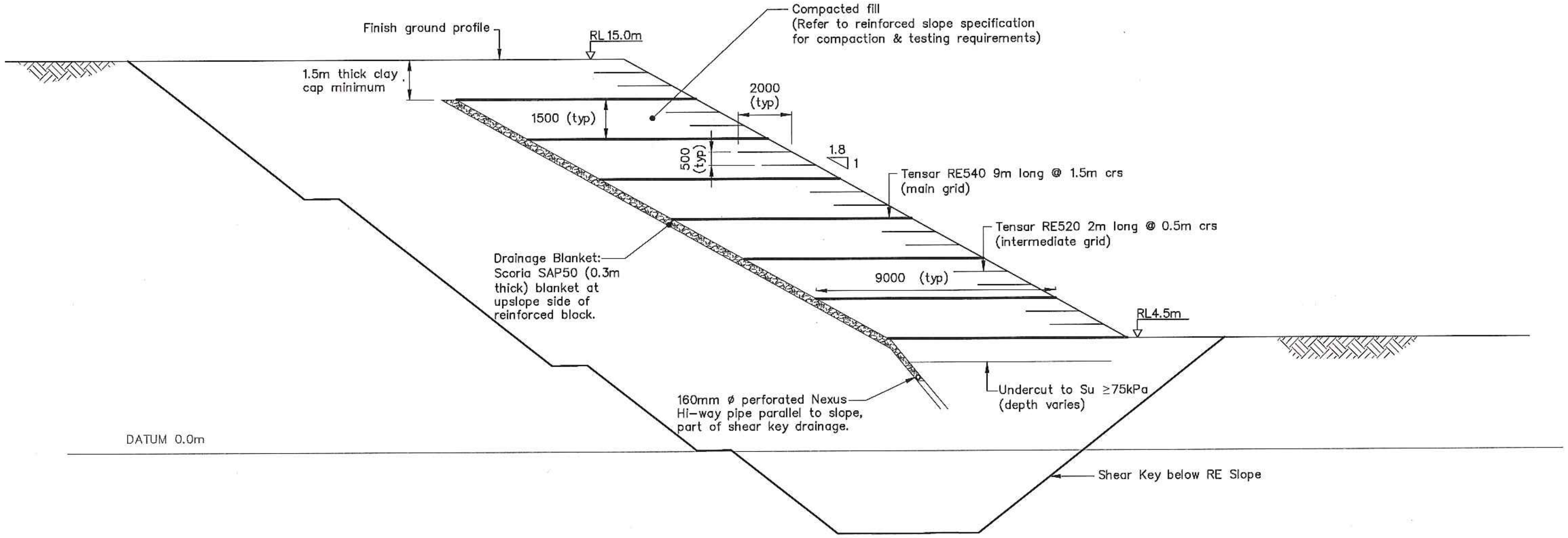
TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Gabion Basket Wall 06 and 07 Typical Cross Section

SCALES (AT A3 SIZE) 1:25
DWG. No. 21854.0037–APP7S1–107
REV. 1



A3 SCALE 1:25
0 0.5 1.0 1.5 (m)

SECTION 5/101 RE SLOPE TYPICAL DETAILS
SCALE 1:200

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1	Completion Report Issue		
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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Reinforced Earth Slope Typical Details

SCALES (AT A3 SIZE) 1: 200
DWG. No. 21854.0037–APP7S1–108
REV. 1

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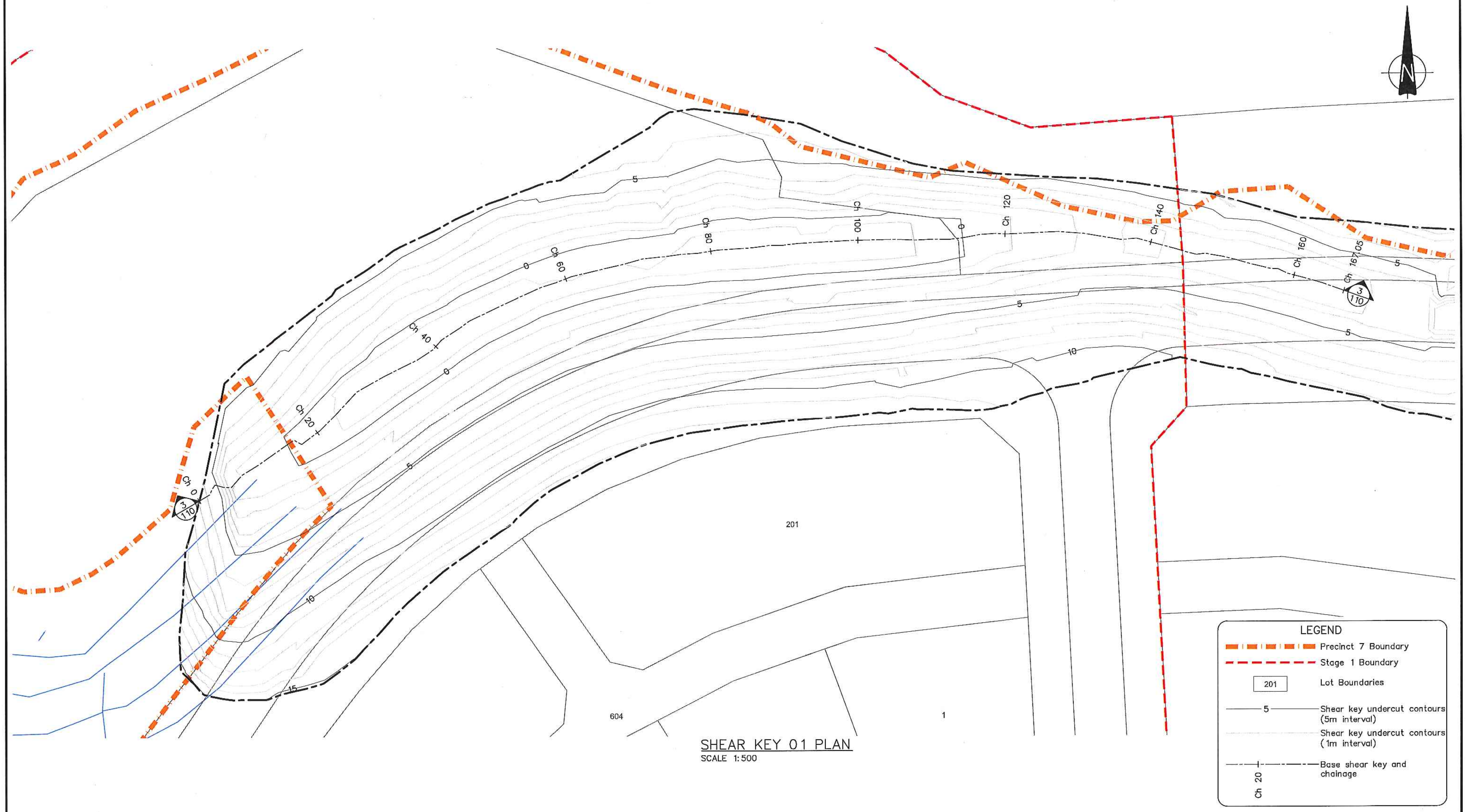

SHEAR KEY 01 PLAN

SCALE 1:500

A3 SCALE 1:500

0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

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NOTES :

1. All dimensions are in millimetres unless noted otherwise.
2. Baseplan supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Information.dwg" dated August 2016.
3. Finished Ground, undercut and shearkey supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Info 160901.dwg" dated Sep 2016

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Shear Key 1 Plan

SCALES (AT A3 SIZE) 1:500

DWG. No. 21854.0037–APP7S1–109

REV. 1

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(1) B 17° to 136° PL, SM, T, CN

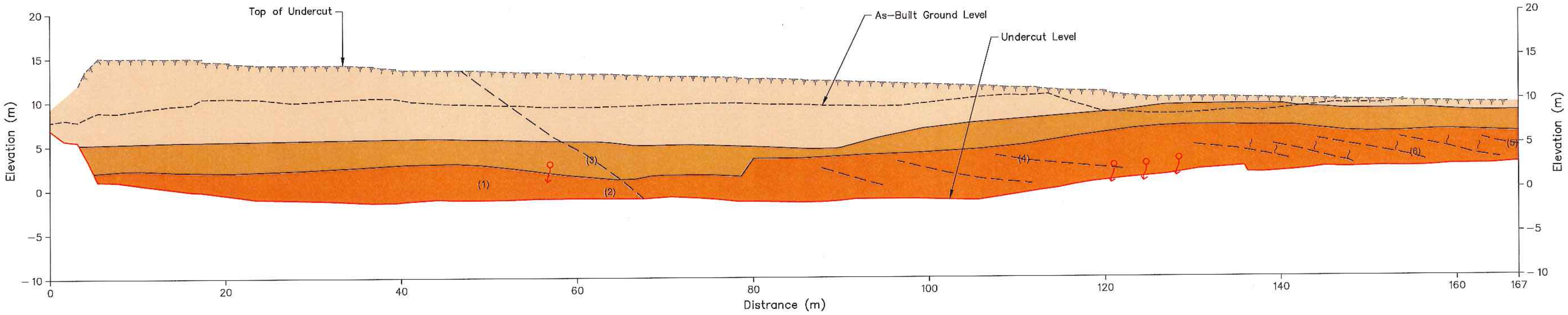
(2) B 11° to 121° PL, SM, VT, CN

(3) F 40° to 82° SC, SM, T, FeSt
within 500mm either side of fault

(4) B 19° to 157° PL, SM, VT, CN

(5) B 18° to 157° PL, SM, VT, CN

(6) J 65°–80° to 80° PL, SM, VT, CN
spaced 200–500mm in both
siltstone and sandstone beds,
laterally discontinuous, no iron
staining



LONG SECTION 3/109
SCALE 1:500

Note: Refer Dwg. No. 21854.0037–APP7S1–111 for Geology Legend and Definition of Terms

A3 SCALE 1:500
0 5 10 15 20 25 (m)

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1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED : JXXL Oct. 16
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NOTES :
1. All dimensions are in millimetres unless noted otherwise.
2. Refer to Dwg.21854.0037–APP7S1–110 for Geology Legend and Definition of Terms.
3. Nature and continuity of subsoil conditions away from these boreholes are inferred and it must be appreciated that actual conditions could vary from the assumed model.

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Shear Key 1 Longsection

SCALES (AT A3 SIZE) 1: 500
DWG. No. 21854.0037–APP7S1–110
REV. 1

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LONGSECTION MATERIAL LEGEND

🟨	Alluvium Silty Clay and Clayey Silt, firm to stiff, moist to wet, light grey to white, organic layers, generally thinly bedded (subhorizontal)
🟨	Colluvium Clayey Silt, firm to stiff, moist, light grey mottled orange/brown
🟧	East Coast Bays Formation Soils Stiff to very stiff Silty Clay, Clayey Silt and minor Silty Sand, moist to wet, light yellow to light grey
🟧	MW East Coast Bays Formation Moderately Weathered ECBF, Silty Clay and Clayey Silt, minor Silty Sand, very stiff, wet, dark grey, thinly bedded
🟧	SW–UW East Coast Bays Formation Slightly to unweathered ECBF. Interbedded Sandstone, Siltstone and Mudstone. Sandstone, Silty, very weak, dark grey. Siltstone and Mudstone, extremely weak to very weak, dark grey
⊠	Engineered Fill
🟩	Concretion Typically moderately strong, Sandstone units
↓	Groundwater seepage
→	Shear Surface
━	Existing Ground Level
—	Undercut Level
~~	Bedding Feature

DEFECT CODE LEGEND

SHAPE		ROUGHNESS		APERTURE		
TERM	CODE	DESCRIPTION OF JOINT SURFACE	CODE	TERM	SYMBOL	DESCRIPTION (Seperation)
Planar	PL	Slickensided	SL	Very Tight	VT	less than 0.1mm
Slightly Curved	SC	Smooth	SM	Tight	T	0.1 to 1.0mm
Curved	CV	Defined Ridges	DR	Open	O	1.0 to 10.0mm
Irregular	IR	Small Steps	ST	Very Open	VO	more than 10mm
Stepped	ST	Rough	R			
Wavy	WV	Very Rough	VR			

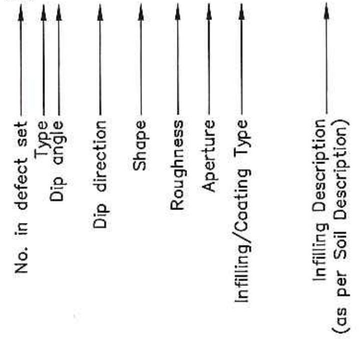
INFILLINGS AND COATINGS

Clay Gouge	CG	Joints have openings between opposing faces of intact rock substance in excess of 1mm filled with clay gouge. Clay is generally described in terms of soil properties.
Clay Veneers	CV	Joints contain clay coating whose maximum thickness does not exceed 1mm. Note: Describe clay in terms of soil properties.
Penetrative Limonite	PL	Joint traces are marked in terms of well defined zones of slightly to moderately weathered ferruginised rock–substance within the adjacent rock.
Limonite Stained	FeSt	Joint surfaces are stained or coated with limonite, although the rock substance immediately adjacent to the joints is fresh.
Coated	CT SC	Joints exhibit Coatings other than clay or limonite, eg. Carbonate (CT) or silica (SC)
Cemented	CL CS CC	Joints are cemented with limonite (CL), silica (CS), or carbonates (CC)
Clean	CN	Joint surfaces show no trace of clay, limonite, or other coatings

TYPE		
TERM	CODE	SYMBOL
Bedding	B	15° ← Dip angle ← Strike
Joint	J	55° ← Dip angle ← Strike
Shear zone	SZ	20° ← Dip angle ← Strike
Fault trace	F	40° ← Dip angle ← Strike

TYPICAL EXAMPLE:

③ J60/152°, PL, SL, T, CV, stiff green CLAY



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DRAWING STATUS: COMPLETION REPORT

1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	JXXL	Oct. 16
DRAWN :	JC	Oct. 16
DESIGN CHECKED :		
DRAFTING CHECKED :		

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1
Geology Legend and Definition of Terms

SCALES (AT A3 SIZE) 1: 1000
DWG. No. 21854.0037–APP7S1–111
REV. 1

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Appendix B: Contractors Certificates

- Hick Bros - Producer Statement PS3 – Contract 37000-02 (Stage 1 Bulk Earthworks, Wall 1 and Wall 2)
- Hick Bros - Producer Statement PS3 – Contract 37001-02 (All Stage 1 Civil works, Fencing above Walls 1, 2, 6 & 7)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Allan Block Wall 01 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Massbloc Wall 02 Construction)
- ICB Retaining and Construction Ltd – Producer Statement 3 (Gabion Basket Wall Construction)
- Getgroup.co.nz Ltd – Producer Statement 3 (Walls 01, 02 and Gabion Basket Wall Fences)

PS3 - FORM OF PRODUCER STATEMENT- CONSTRUCTION

ISSUED BY: HICK BROS CIVIL CONSTRUCTION LIMITED

TO: WFH PROPERTIES

IN RESPECT OF: PRECINT 7 OREWA WEST BULK EARTHWORKS AND GEOTECHNICAL REMEDIATION
AT: PRECINCT 7 CONTRACT 37000-02

HICK BROS CIVIL CONSTRUCTION LTD has contracted to WFH PROPERTIES to carry out and complete certain building works in accordance with a contract, titled PRECINT 7 OREWA WEST BULK EARTHWORKS AND GEOTECHNICAL REMEDIATION ("the contract")

I JAMES BILKEY a duly authorized representative of HICK BROS CIVIL CONSTRUCTION LIMITED believe on reasonable grounds that HICK BROS CIVIL CONSTRUCTION LIMITED has carried out and completed part only as specified in the attached particulars of the contract works in in accordance with the contract.

Date: 4th August 2016

(Signature of Authorized Agent on behalf of)

HICK BROS CIVIL CONSTRUCTION LIMITED
(Contractor)

42 FORGE ROAD, SILVERDALE
(Address)

Attachments:

1) List detailing works carried out

ATTACHMENT 1

PRECINT 7 OREWA WEST BULK EARTHWORKS AND GEOTECHNICAL REMEDIATION

LIST OF WORK CARRIED OUT:

1) All the earthworks within Stage 1
2) Construction of Wall 1
3) Construction of Wall 2
4) Construction of Palisade Wall 1

PS3 - FORM OF PRODUCER STATEMENT- CONSTRUCTION

ISSUED BY: HICK BROS CIVIL CONSTRUCTION LIMITED

TO: WFH PROPERTIES

IN RESPECT OF: PRECINT 7 OREWA WEST STAGE 1 & 2 CIVIL WORKS
AT: PRECINCT 7 CONTRACT 37001-02

HICK BROS CIVIL CONSTRUCTION LTD has contracted to WFH PROPERTIES to carry out and complete certain building works in accordance with a contract, titled PRECINT 7 OREWA WEST STAGE 1 & 2 CIVIL WORKS ("the contract")

I JAMES BILKEY a duly authorized representative of HICK BROS CIVIL CONSTRUCTION LIMITED believe on reasonable grounds that HICK BROS CIVIL CONSTRUCTION LIMITED has carried out and completed part only as specified in the attached particulars of the contract works in in accordance with the contract.

Date: 4th August 2016

(Signature of Authorized Agent on behalf of)

HICK BROS CIVIL CONSTRUCTION LIMITED
(Contractor)

42 FORGE ROAD, SILVERDALE
(Address)

Attachments:
1) List detailing works carried out

ATTACHMENT 1

PRECINT 7 OREWA WEST STAGE 1 & 2 CIVIL WORKS

LIST OF WORK CARRIED OUT:

1) All of the works in Stage 1
2) Fencing above Wall 1
3) Fencing above Wall 2
4) Fencing next to road 1
5) Fencing of inlet structure to wetland

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers**
(Principal)

IN RESPECT OF **Allen Block Wall No. 1**
(Description of Contract Works)

AT **Lot 1 DP 463561, Silverdale 0931, (Arran Point, Millwater Precent 7)**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Allen Block Wall No. 1, Arran Point, Millwater Precent 7 *(The Contract)*
(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

15 August 2016
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers**
(Principal)

IN RESPECT OF **Mass Block Wall No. 2**
(Description of Contract Works)

AT **Lot 1 DP 463561, Silverdale 0931, (Arran Point, Millwater Precent 7)**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Mass Block Wall No. 2, Arran Point, Millwater Precent 7 *(The Contract)*
(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

15 August 2016
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers**
(Principal)

IN RESPECT OF **Gabion Basket Wall No. 6**
(Description of Contract Works)

AT **Lot 1 DP 463561, Silverdale 0931, (Arran Point, Millwater Precent 7)**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Gabion Basket Wall No. 6, Arran Point, Millwater Precent 7 *(The Contract)*
(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

15 August 2016
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

SIXTH SCHEDULE

(NZS 3910:2003)

FORM OF PRODUCER STATEMENT CONSTRUCTION

ISSUED BY **ICB Retaining & Construction Limited**
(Contractor)

TO **Hick Brothers**
(Principal)

IN RESPECT OF **Gabion Basket Wall No. 7**
(Description of Contract Works)

AT **Lot 1 DP 463561, Silverdale 0931, (Arran Point, Millwater Precent 7)**
(Address)

ICB Retaining & Construction Ltd
(Contractor)

has contracted to **Hick Brothers**
(Principal)

to carry out and complete certain building works in accordance with a contract, titled

Gabion Basket Wall No. 7, Arran Point, Millwater Precent 7 *(The Contract)*
(The Project)

I, ***Chris Burke*** a duly authorised
(Duly Authorised Agent)

representative of **ICB Retaining & Construction Limited**
(Contractor)

Believe on reasonable grounds that **ICB Retaining & Construction Limited**
(Contractor)

has carried out and completed:
☑ All ☐ Part only as specified in the attached particulars of the building works in accordance with the Building Consent No. and any Authorised Instruction / Variations that have been issued during the course of the work.

(Signature of Authorised Agent on Behalf of)

15 August 2016
(Date)

ICB Construction Limited
(Contractor)

PO Box 303 340, North Harbour, Auckland
(Address)

Producer statement construction (PS3)
General construction work

Auckland Council
Te Kaunihera o Tāmaki Makaurau

All sections of this form must be completed

TO BE COMPLETED BY THE PERSON WHO HAS UNDERTAKEN THE BUILDING WORK

Author name: DAN WRIGHT

Building consent No:

Author company: GETGROUP.CO.NZ LTD

Author Registration No:

Description of building work: WALL 1 FENCE

Performance standard for maintenance and inspection, if applicable: SUBJECT TO ONGOING CORROSION PROTECTION ☐ N/A

Legal description:

Site address: PRECINCT 7, OREWA WEST STAGE 1+2 CIVIL WORKS

NZBC clauses: (select as applicable)

[✓ B1]	[✓ B2]	C1	C2	C3	C4	C5	C6	D1	D2	E1	E2	E3
F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3	G4	G5
G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	H1		

I have sighted the above building consent and read the attached conditions of consent and confirm that I have undertaken the building work described above in accordance with the consented plans and specifications.

I understand that Council will rely upon this producer statement, for the purposes of establishing compliance with the above building consent.

Signature:

Date: 17/8/16

Tradesperson's contact details:

Address: 17 KAHIKATEA FLAT ROAD, DAIRY FLAT Postcode: 0794

Business: 09 4275421

Fax:

Mobile: 027 25 25 227

Email dan@getgroup.co.nz

COUNCIL USE ONLY

☐ Central ☐ Henderson ☐ Manukau ☐ Orewa ☐ Papakura ☐ Pukekohe ☐ Takapuna

☐ Accepted in support of inspection ☐ Accepted instead of inspection

Register checked: Council ☐ LBP ☐ N/A ☐

Name:

Date:

Producer statement accepted as establishing compliance with the consented plans: YES ☐ NO ☐

Producer statements are accepted solely at Auckland Council's discretion; please refer to the Producer Statement Policy which can be found on Councils website for further details

http://www.aucklandcouncil.govt.nz/EN/ratesbuildingproperty/consents/Consent%20documents/ac2301producerstatementpolicy.pdf

Producer statement construction (PS3)
General construction work

Auckland Council
Te Kaunihera o Tāmaki Makaurau

All sections of this form must be completed

TO BE COMPLETED BY THE PERSON WHO HAS UNDERTAKEN THE BUILDING WORK

Author name: DAN WRIGHT
Building consent No:
Author company: GETGROUP.CO.NZ LTD
Author Registration No:
Description of building work: WALL 2 FENCE
Performance standard for maintenance and inspection, if applicable: SUBJECT TO ONGOING CORROSION PROTECTION ☐ N/A
Legal description:
Site address: PRECINCT 7, OREWA WEST STAGE 1+2 CIVIL WORKS

NZBC clauses: (select as applicable)

[✓ B1]	[✓ B2]	C1	C2	C3	C4	C5	C6	D1	D2	E1	E2	E3
F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3	G4	G5
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I understand that Council will rely upon this producer statement, for the purposes of establishing compliance with the above building consent.

Signature:
Date: 17/8/16.

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Address: 17 KAHIKATEA FLAT ROAD, DAIRY FLAT Postcode: 0794
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☐ Accepted in support of inspection ☐ Accepted instead of inspection

Register checked: Council ☐ LBP ☐ N/A ☐

Name:
Date:

Producer statement accepted as establishing compliance with the consented plans: YES ☐ NO ☐

Producer statements are accepted solely at Auckland Council's discretion; please refer to the Producer Statement Policy which can be found on Councils website for further details
http://www.aucklandcouncil.govt.nz/EN/ratesbuildingproperty/consents/Consent%20documents/ac2301producerstatementpolicy.pdf

Producer statement construction (PS3)
General construction work

Auckland Council
Te Kaunihera o Tāmaki Makaurau

All sections of this form must be completed

TO BE COMPLETED BY THE PERSON WHO HAS UNDERTAKEN THE BUILDING WORK

Author name: DAN WRIGHT

Building consent No:

Author company: GETGROUP. CO.NZ

Author Registration No:

Description of building work: GABION BASKET WALL FENCE

Performance standard for maintenance and inspection, if applicable: SUBJECT TO ONGOING CORROSION PROTECTION ☐ N/A

Legal description:

Site address: PRECINCT 7 OREWA WEST STAGE 1+2 CIVIL WORKS

NZBC clauses: (select as applicable)

[✓ B1]	[✓ B2]	C1	C2	C3	C4	C5	C6	D1	D2	E1	E2	E3
F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	G3	G4	G5
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I have sighted the above building consent and read the attached conditions of consent and confirm that I have undertaken the building work described above in accordance with the consented plans and specifications.

I understand that Council will rely upon this producer statement, for the purposes of establishing compliance with the above building consent.

Signature:

Date: 17/8/16.

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Address: 17 KAHIKATEA FLAT ROAD, DAIRY FLAT Postcode: 0794

Business: 09 4275421

Fax:

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☐ Accepted in support of inspection ☐ Accepted instead of inspection

Register checked: Council ☐ LBP ☐ N/A ☐

Name:

Date:

Producer statement accepted as establishing compliance with the consented plans: YES ☐ NO ☐

Producer statements are accepted solely at Auckland Council's discretion; please refer to the Producer Statement Policy which can be found on Councils website for further details

http://www.aucklandcouncil.govt.nz/EN/ratesbuildingproperty/consents/Consent%20documents/ac2301producerstatementpolicy.pdf

Appendix C: NZS 3604:2011 Expansive Soils (Extract)

NZS 3604:2011 Expansive Soils (Extract)

Expansive soils tend to be moderately to highly plastic clays that undergo appreciable volume change upon changes in moisture content. Technically, they are defined in NZS 3604:2011 as those soils having a liquid limit of more than 50% and a linear shrinkage of more than 15%. Where soils are quite silty or sandy, shrink and swell is less of a problem, due to the lower clay contents.

Building damage resulting from expansive soil movement can range from relatively minor brick veneer cracking and internal cracking on wall corners and wall ceiling corners with attendant door and windows jamming, through to extensive cracking of foundation block framework, extensive internal visual cracking and significant warping of building frames. Damage is dependent on building construction and materials and is rarely of structural concern.

NZS 3604:2011 "Timber Framed Buildings" defines good ground as follows:

"Any soil or rock capable of permanently withstanding an ultimate bearing capacity of 300 kPa (i.e. an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

a) *Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids;*

b) *Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested in accordance with NZS 4402 Test 2.6, and*

c) *Any ground which could forseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots."*

Foundations on expansive soils are outside the scope of NZS 3604:2011 as an acceptable solution to the New Zealand Building Code (NZBC). Specific engineering design of foundation elements is involved where expansive soils are present with a recommendation that AS 2870:2011 is used for building design. While not mandatory, AS 2870 designs will allow for a non-specific design foundation to be used without resorting to further ongoing investigation or design.

This geotechnical completion report has classified the soils present on this subdivision to be in Site Class M as per the requirements of AS 2870:2011. Descriptions of the various site classes, together with characteristic surface ground movements are outlined below.

Allowing for some correlation with NZS 3604, the various site classes applicable to NZ conditions are considered to be:

Characteristic Surface Movements	Site Class	Description
a) 20 mm (Note NZS 3604:2011 assumes movement of 25 mm as part of underlying design.	Class A (sand) and/or Class S (Silts) Equivalent to NZS 3604:2011 "Good Ground" sites	Poor to slightly expansive
b) 20 mm – 40 mm	Class M	Moderately expansive
c) 40 mm – 60 mm	Class H1	Highly expansive
d) 60 mm – 75mm	Class H2	Highly expansive
e) > 75 mm	Class E	Extremely expansive

AS 2870 uses a range of factors to assess characteristic soil movement including:

i. Building distress due to ground movement visible on adjacent structures,

ii. Known soil properties and site specific testing to determine the shrink / swell index of a soil (Test 7.1.1 in AS 1289 – Methods of Testing Soils for Engineering Purposes).

AS 2870 is based on defining soil types into various hazard classes based on expected surface movement and depth of desiccation that could occur. It then applies various foundation designs and embedment depths based on the form of building construction (slab on ground, strip footing, stiffened raft, stiffened slab with deep edge beams, etc). AS2870 uses more reinforcing steel than NZ designs generally would to create stiffer foundations that are better able to tolerate ground movement.

The Australian approach also regards expansive soil to a considerable extent being a home owner maintenance issue and significant emphasis is put into ensuring that people understand the influence that trees and dry summers etc may have on foundation performance. See Appendix D.

Appendix D: CSIRO – BTF18 – Foundation Maintenance and Footing Performance: A Homeowners Guide

Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

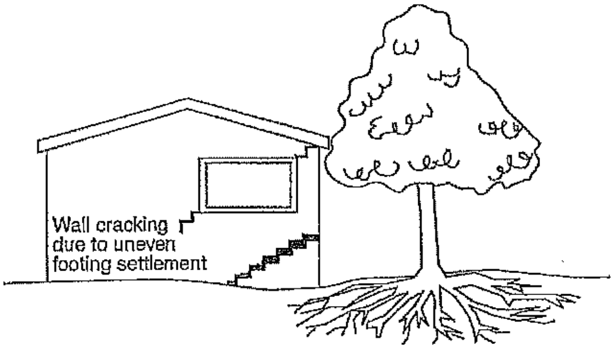
Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

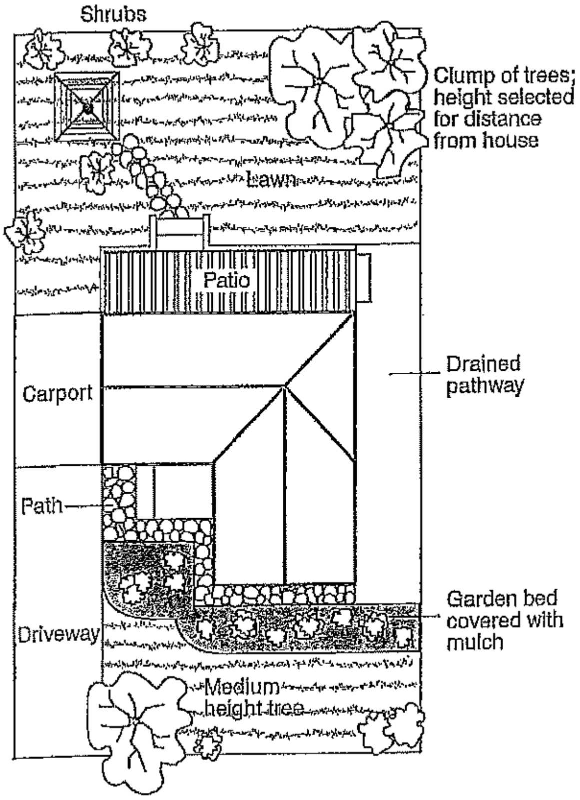
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out formightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Appendix E: Test Results

- 21854.0037–APPP7S1–112 Post Earthworks Investigation Plan
- 21854.0037–APPP7S1–113 Topsoil Depths Plan
- 21854.0037–APPP7S1–114 Earthworks Testing Location Plan
- Soil Expansion Test Results
- Post Earthworks Investigation Borehole Logs HA1 to HA8 - 02 December 2015
- Post Earthworks Investigation Borehole Logs HA1 to HA4 – 28 January 2016 December 2015
- Post Earthworks Investigation Borehole Logs HA1 to HA3 – 20 September 2016
- Earthworks Test Results

DRAWING STATUS: **COMPLETION REPORT**

REV.	REVISION DESCRIPTION	BY	DATE
1	Completion Report Issue		

DESIGNED :	JXXL	Oct. 16
DRAWN :	JC	Oct. 16
DESIGN CHECKED :		
DRAFTING CHECKED :		

CADFILE : \\21854.0037–APP7S1–00.dwg

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NOTES :

1. All dimensions are in millimetres unless noted otherwise.
2. Baseplan supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Information.dwg" dated August 2016.
3. Finished Ground, undercut and shearkey supplied by WOODS, reference data "37001–02 Arran Point Stage 1 – GCR Info 160901.dwg" dated Sep 2016
4. Coordinate Datum: NZGD2000, Mt Eden Circuit Circuit Coordinates.
   Origin: Lat 36 52 47S Long 174 45 51E 800,000mN 400,000mE

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Post Earthworks Investigation Plan

SCALES (AT A3 SIZE) 1: 1250
DWG. No. 21854.0037–APP7S1–112
REV. 1

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				CADFILE : \\21854.0037–APP7S1–00.dwg		
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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Topsoil Depths Plan

SCALES (AT A3 SIZE) 1: 1250
DWG. No. 21854.0037–APP7S1–113
REV. 1

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DRAWING STATUS: COMPLETION REPORT

1	Completion Report Issue		
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	JXXL	Oct. 16
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CADFILE : \\21854.0037–APP7S1–00.dwg

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TITLE
MILLWATER – ARRANS POINT PRECINCT 7 (STAGE 1)
Earthworks Testing Location Plan

SCALES (AT A3 SIZE)	DWG. No.	REV.
1: 1250	21854.0037–APP7S1–114	1

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Site: **Arran Point Stage 1, Silverdale**

Page of

Your Job No: 21854.0037

Our Job No: 616987.000

Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

Lot No.:			**200**	**200**	**201**	**201**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	48.2	33.1	46.2	43.0
	Bulk Density	(t/m³)	1.71	1.78	1.73	1.74
	Dry Density	(t/m³)	1.15	1.34	1.18	1.22
	Final Water Content	(%)	48.9	35.1	47.8	44.7
	Swelling Strain	(%)	0.03	0.04	0.04	0.05
SHRINKAGE TEST	Initial Water Content	(%)	40.9	32.1	47.6	40.3
	Estimated Shrinkage Limit	(%)	18.5	13.2	18.3	20.8
	Shrinkage Strain	(%)	6.0	2.0	7.6	4.0
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Moderate	Moderate	Moderate	Moderate
SHRINK - SWELL INDEX		**(%)**	**3.3**	**1.1**	**4.3**	**2.2**

Entered by: ST Date: 25/08/2016 Checked by: MP Date: 25/08/2016

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File:P:\616987.000\Working Material\ArranPoint_Shrink_Swell_Summary.xlsx

Site: **Arran Point Stage 1, Silverdale**

Page of

Your Job No: 21854.0037

Our Job No: 616987.000

Test Method Used: **AS 1289.7.1.1 - 2003 Determination of the Shrink - Swell Index**

SUMMARY OF SHRINK - SWELL TEST RESULTS

BH No.:			**1**	**1**	**6**	**6**	**9**	**9**	**13**	**13**
DEPTH		**(m)**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**	**0.5**	**1.0**
Applied Pressure		**(kPa)**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
SWELL TEST	Initial Water Content	(%)	27.0	22.9	31.9	31.8	33.8	31.5	41.0	49.1
	Bulk Density	(t/m³)	1.92	1.99	1.86	1.67	1.78	1.78	1.73	1.66
	Dry Density	(t/m³)	1.51	1.62	1.41	1.27	1.33	1.35	1.23	1.11
	Final Water Content	(%)	28.4	23.1	32.8	33.7	35.4	34.2	43.7	51.4
	Swelling Strain	(%)	0.18	0.03	0.12	0.01	0.04	0.02	0.11	0.02
SHRINKAGE TEST	Initial Water Content	(%)	27.0	20.7	27.1	30.9	32.9	38.9	29.2	47.8
	Estimated Shrinkage Limit	(%)	8.1	5.5	8.3	12.8	14.9	14.1	11.7	19.3
	Shrinkage Strain	(%)	3.5	1.0	4.4	1.2	3.6	8.5	3.3	8.1
	Inert Material Estimate in the Soil Specimen	(%)	0	0	0	0	0	0	0	0
	Soil Crumbling During Shrinkage		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Cracking of the Shrinkage Specimen		Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
SHRINK - SWELL INDEX		**(%)**	**2.0**	**0.5**	**2.5**	**0.7**	**2.0**	**4.7**	**1.9**	**4.5**

Entered by: ST　Date: 25/08/2016　Checked by: MP　Date: 25/08/2016

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BOREHOLE LOG

BOREHOLE No.: **HA1**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7

LOCATION: Arran's Hill, Precinct 7, Millwater

JOB No.: 21854.0037

CO-ORDINATES:
(NZTM 2000)

R.L.:

DATUM:

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID:

HOLE STARTED: 02/12/2015

HOLE FINISHED: 02/12/2015

DRILLED BY: NTW/CHM

LOGGED BY: CHM/NTW

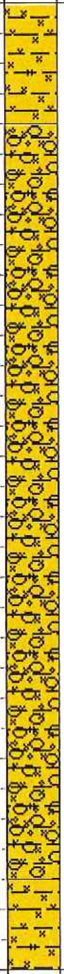
CHECKED:

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT,
GENERIC NAME,
ORIGIN,
MATERIAL COMPOSITION.

FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations



Residual Soil

HAND AUGER

TESTS	DEPTH (m)
● >198 kPa	
● >198 kPa	
● 107/30 kPa	1
● 66/33 kPa	
● >198 kPa	
● 190/79 kPa	
● 99/45 kPa	2
● 198/41 kPa	
● >198 kPa	
● 190/96 kPa	3
	4

Clayey SILT; light yellow brown with mottled light grey. Moist, non-plastic to low plasticity.

Clayey SILT, with minor gravels; light yellow brown with mottled light grey. Moist, non-plastic to low plasticity.

0.9m: low plasticity.

1.4m: low to moderate plasticity.

1.6m: non-plastic to low plasticity.

1.9m: low plasticity.

2.1m: yellow brown with mottled dark grey.

2.2m: moderate to high plasticity.

2.3m: low plasticity.

Clayey SILT; light yellow brown with light grey and light brown mottles. Moist, low plasticity.

3.2m: END OF BOREHOLE

COMMENTS:

Hole Depth
3.2m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.: **HA2**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7

LOCATION: Arran's Hill, Precinct 7, Millwater

JOB No.: 21854.0037

CO-ORDINATES:
(NZTM 2000)

R.L.:

DATUM:

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID:

HOLE STARTED: 02/12/2015

HOLE FINISHED: 02/12/2015

DRILLED BY: NTW/CHM

LOGGED BY: CHM/NTW

CHECKED:

GEOLOGICAL

GEOLOGICAL UNIT,
GENERIC NAME,
ORIGIN,
MATERIAL COMPOSITION.

FLUID LOSS (%) 25 50 75 | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | RL (m) | DEPTH (m)

ENGINEERING DESCRIPTION

GRAPHIC LOG | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (cm) 20 60 200 600 2000 | Description and Additional Observations

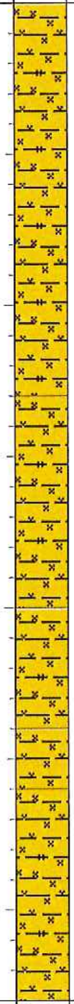
Residual Soil

HAND AUGER

Moisture condition: M

Tests:

- ● 157/82 kPa
- ● 150/73 kPa
- ● 152/69 kPa
- ● 140/58 kPa
- ● 162/63 kPa
- ● 140/58 kPa
- ● 99/46 kPa
- ● 96/41 kPa
- ● 107/49 kPa
- ● 82/40 kPa
- ● >198 kPa



Depth (m): 1, 2, 3, 4

Clayey SILT; light yellow brown with mottled dark grey. Moist, low plasticity.

0.8m: light yellow brown with mottled light grey.

Clayey SILT; light grey with mottled yellow brown. Moist, low plasticity.

Clayey SILT; light yellow brown with light grey mottles. Moist, low to moderate plasticity.

Clayey SILT; light grey with light yellow brown mottles. Moist, low to moderate plasticity.

Clayey SILT; light yellow brown with light grey mottles. Low to moderate plasticity.

3.3m: END OF BOREHOLE

COMMENTS:

Hole Depth
3.3m

Scale 1:25

BoreLog - 19/09/2016 11:40:10 a.m. - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA3**
Hole Location: Refer site plan.
SHEET: 1 OF 1

PROJECT: Millwater AHP7
LOCATION: Arran's Hill, Precinct 7, Millwater
JOB No.: 21854.0037

CO-ORDINATES: (NZTM 2000)
R.L.:
DATUM:

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 02/12/2015
HOLE FINISHED: 02/12/2015
DRILLED BY: NTW/CHM
LOGGED BY: CHM/NTW
CHECKED:

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
											M					Clayey SILT; light grey with mottled yellow brown. Moist, low plasticity.
						● 99/30 kPa										
																Clayey SILT; light yellow brown. Moist, low to moderate plasticity.
						● 101/31 kPa										
						● 86/33 kPa										
									1							
						● 73/26 kPa										
																Clayey SILT; light grey with yellow brown mottles. Moist, moderate plasticity.
Residual Soil				HAND AUGER		● 71/83 kPa										
						● 73/35 kPa										
						● 73/30 kPa			2							
																Clayey SILT; light yellow brown with light grey mottles. Moist, moderate plasticity.
						● 135/79 kPa										
						● 138/89 kPa										
						● 61/36 kPa										
									3							3m: END OF BOREHOLE 3.0m: Target depth.
									4							

COMMENTS:

Hole Depth
3m

Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA4**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7
LOCATION: Arran's Hill, Precinct 7, Millwater
JOB No.: 21854.0037

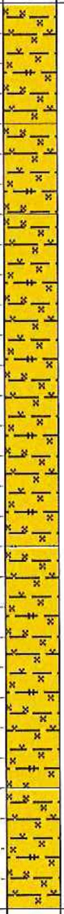
CO-ORDINATES:
(NZTM 2000)
R.L.:
DATUM:

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 02/12/2015
HOLE FINISHED: 02/12/2015
DRILLED BY: NTW/CHM
LOGGED BY: CHM/NTW
CHECKED:

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	25 50 75 FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 20 60 200 600 2000	Description and Additional Observations
Residual Soil				HAND AUGER							M					Clayey SILT; light grey with yellow brown mottles. Moist, low plasticity.
						● 74/33 kPa										
																Clayey SILT; light yellow brown with light grey mottles. Moist, low to moderate plasticity.
						● 96/36 kPa										
																Clayey SILT; light yellow brown with light grey and reddish brown mottles. Moist, moderate plasticity.
						● 59/26 kPa										
									1							
						● 74/33 kPa										
																1.5m: low plasticity.
						● 120/53 kPa										
																Clayey SILT; light yellow/orange brown. Moist, low plasticity.
						● 79/30 kPa										
						● 104/40 kPa			2							2.1m: low to moderate plasticity.
						● 99/66 kPa										
																Clayey SILT; light grey with light yellow brown and reddish brown mottles. Moist, low to moderate plasticity.
						● 79/43 kPa										
						● 89/49 kPa			3							3m: END OF BOREHOLE 3.0m: Target depth.
									4							

COMMENTS:

Hole Depth
3m

Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA5**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7

LOCATION: Arran's Hill, Precinct 7, Millwater

JOB No.: 21854.0037

CO-ORDINATES:
(NZTM 2000)

R.L.:

DATUM:

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID:

HOLE STARTED: 02/12/2015

HOLE FINISHED: 02/12/2015

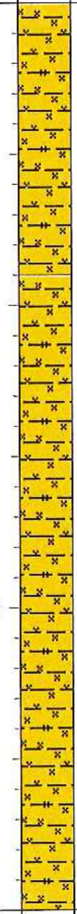
DRILLED BY: NTW/CHM

LOGGED BY: CHM/NTW

CHECKED:

GEOLOGICAL		ENGINEERING DESCRIPTION			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	METHOD	TESTS	DEPTH (m)	MOISTURE CONDITION / WEATHERING	Description and Additional Observations
Residual Soil	HAND AUGER			M	Clayey SILT; light brown with light grey mottles. Moist, low plasticity.
		● 61/23 kPa			
					0.4m: low to moderate plasticity.
		● 59/23 kPa			0.7m: moderate plasticity.
		● 84/33 kPa			Clayey SILT; light yellow brown with light gey and reddish brown mottles. Moist, moderate plasticity.
			1		
		● 61/28 kPa			
		● 61/26 kPa			
					1.8m: low to moderate plasticity.
		● 102/43 kPa			
			2		
		● 119/46 kPa			
		● 89/58 kPa			
		● 99/96 kPa			
		● 79/43 kPa			
			3		3m: END OF BOREHOLE 3.0m: Target depth.
			4		

Other columns: FLUID LOSS (%) 25 50 75; WATER; CORE RECOVERY (%); CASING; SAMPLES; RL (m); GRAPHIC LOG; STRENGTH/DENSITY CLASSIFICATION; SHEAR STRENGTH (kPa) 10 25 50 100; COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250; DEFECT SPACING (cm) 20 60 200 600 2000



COMMENTS:

Hole Depth
3m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.: **HA6**

Hole Location: Refer site plan.

SHEET: 1 OF 1

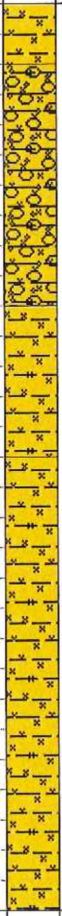
PROJECT: Millwater AHP7
LOCATION: Arran's Hill, Precinct 7, Millwater
JOB No.: 21854.0037

CO-ORDINATES:
(NZTM 2000)
R.L.:
DATUM:

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 02/12/2015
HOLE FINISHED: 02/12/2015
DRILLED BY: NTW/CHM
LOGGED BY: CHM/NTW
CHECKED:

GEOLOGICAL		ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75 · WATER · CORE RECOVERY (%) · METHOD · CASING · TESTS · SAMPLES · RL (m) · DEPTH (m)	GRAPHIC LOG · MOISTURE CONDITION / WEATHERING · STRENGTH/DENSITY CLASSIFICATION · SHEAR STRENGTH (kPa) 10 25 50 100 · COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 · DEFECT SPACING (cm) 20 60 200 600 2000 · Description and Additional Observations



Geological	Method	Tests	Depth (m)	Moisture Condition	Description and Additional Observations
Residual Soil	HAND AUGER	● 115/33 kPa		M	Clayey SILT, with minor gravel; light brown with light grey and yellow brown mottles. Moist, low to moderate plasticity.
		● 148/82 kPa			
		● 162/96 kPa	1		Clayey SILT; light brown with light grey mottles. Moist, low plasticity.
		● 115/40 kPa			
		● 129/63 kPa			Clayey SILT; light yellow brown with light grey mottles. Moist, low plasticity.
		● 112/46 kPa	2		
		● 102/46 kPa			
		● 119/51 kPa			2.5m: low to moderate plasticity.
		● 119/46 kPa			
		● 112/54 kPa	3		3m: END OF BOREHOLE 3.0m: Target depth.
			4		

COMMENTS:

Hole Depth
3m

Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA7**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7

LOCATION: Arran's Hill, Precinct 7, Millwater

JOB No.: 21854.0037

CO-ORDINATES:
(NZTM 2000)

R.L.:

DATUM:

DRILL TYPE: Hand Auger

DRILL METHOD: HA

DRILL FLUID:

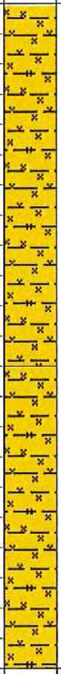
HOLE STARTED: 02/12/2015

HOLE FINISHED: 02/12/2015

DRILLED BY: NTW/CHM

LOGGED BY: CHM/NTW

CHECKED:



GEOLOGICAL GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	ENGINEERING DESCRIPTION Description and Additional Observations
											M					Clayey SILT; light grey with yellow brown mottles. Moist, low plasticity.
						● 99/33 kPa										
						● 69/26 kPa										
						● 132/40 kPa										0.9m: low to moderate plasticity.
Residual Soil				HAND AUGER					1							
						● 96/36 kPa										Clayey SILT; light orange brown with light grey mottles. Moist, low plasticity.
						● 92/49 kPa										
						● 105/53 kPa										
									2							
						● 155/56 kPa										
																2.2m: END OF BOREHOLE 2.2m: Refusal.
									3							
									4							

COMMENTS:

Hole Depth
2.2m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.: **HA8**

Hole Location: Refer site plan.

SHEET: 1 OF 1

PROJECT: Millwater AHP7
LOCATION: Arran's Hill, Precinct 7, Millwater
JOB No.: 21854.0037

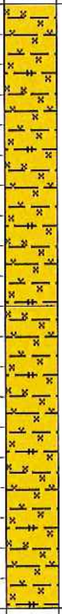
CO-ORDINATES: (NZTM 2000)
R.L.:
DATUM:

DRILL TYPE: Hand Auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 02/12/2015
HOLE FINISHED: 02/12/2015
DRILLED BY: NTW/CHM
LOGGED BY: CHM/NTW
CHECKED:

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	METHOD	TESTS	DEPTH (m)	MOISTURE CONDITION / WEATHERING	Description and Additional Observations
Residual Soil	HAND AUGER	● 129/45 kPa ● 102/36 kPa ● 115/59 kPa		M	Clayey SILT; light grey with light yellow brown mottles. Moist, low plasticity.
		● 119/40 kPa ● 119/59 kPa ● 137/66 kPa	1		Clayey SILT; light yellow brown with light grey mottles. Moist, low plasticity. 1.6m: low to moderate plasticity.
			2		2m: END OF BOREHOLE 2.0m: Refusal
			3		
			4		



COMMENTS:

Hole Depth
2m

Scale 1:25

BOREHOLE LOG

BOREHOLE No:HA01
Hole Location: Refer to site plan

SHEET 1 OF 1

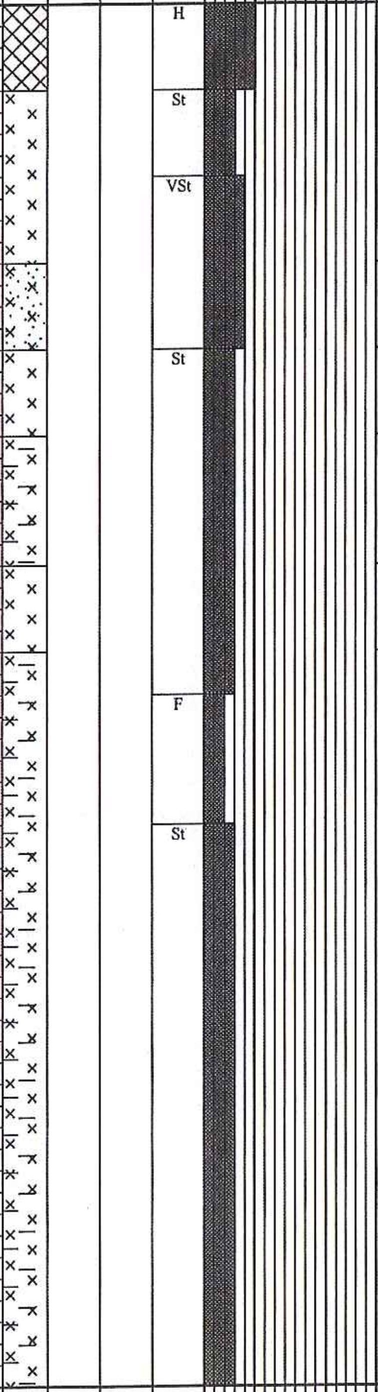
PROJECT: MillwaterAHP7-largelots
LOCATION: Arran Point
JOB No: 21854.0037
CO-ORDINATES:
DRILL TYPE: 50mm hand auger
HOLE STARTED: 28/1/16
HOLE FINISHED: 28/1/16
DRILL METHOD: HA
R.L.:
DRILLED BY:
DATUM:
DRILL FLUID:
LOGGED BY: rbe
CHECKED:

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.



GEOLOGICAL	TESTS	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION
FILL		H	sandy SILT, non plastic, moist, hard, yellowish brown and light greyish white
RESIDUAL SOILS	● 98/22kPa	St VSt	SILT, trace clay, non plastic, moist, light brownish white
	● 131/25kPa		sandy SILT, non plastic, moist, yellowish brown mottled light greyish white
	● 63/16kPa	St	SILT, minor clay, non plastic, moist, yellowish brown
	● 85/32kPa		clayey SILT, low plasticity, moist, light brownish white
			SILT, non plastic, moist, light brownish white
	● 79/16kPa ● 47/16kPa ● 52/13kPa ● 57/21kPa ● 55/17kPa ● 82/22kPa	F St	clayey SILT /SILT, with some clay, low plasticity, moist, light brownish white mottled yellowish brown
			END OF BOREHOLE 3.2m (target depth)

WATER: Hole dry on completion

T+T DATATEMPLATE.GDT rbe

Log Scale 1:17.5

BORELOG 616818.GPJ 28-Jan-2016

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No:HA02
Hole Location: Refer to site plan

SHEET 1 OF 1

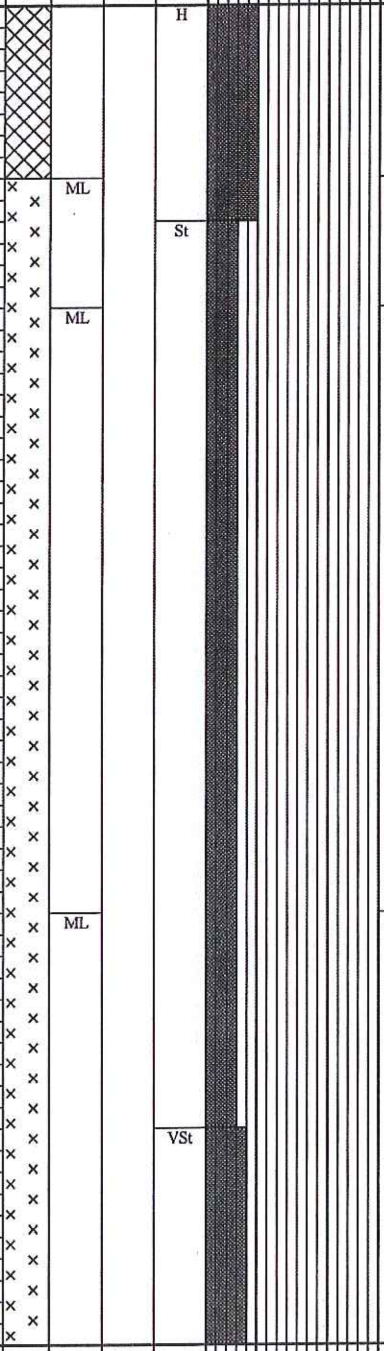
PROJECT: MillwaterAHP7-largelots
LOCATION: Arran Point
JOB No: 21854.0037

CO-ORDINATES:
R.L.:
DATUM:

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 28/1/16
HOLE FINISHED: 28/1/16
DRILLED BY:
LOGGED BY: rbe
CHECKED:

GEOLOGICAL GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
FILL												H	clayey SILT, low to medium plasticity, moist, yellowish brown and brown, minor fine gravel
RESIDUAL SOILS						>221kPa 79/30kPa			0.5	ML		St	SILT, non plastic, moist, light whitish brown mottled yellowish brown
						73/14kPa 73/25kPa 63/19kPa 62/17kPa			1.0 1.5 2.0	ML			SILT, minor clay, low plasticity, moist, light brownish white -orange brown -orange brown mottled light brownish white -light brown and reddish brown
COMPLETELY WEATHERED ECBF		Hole dry on completion				108/35kPa 63/17kPa 136/47kPa 142/49kPa			2.5 3.0	ML		VSt	SILT, some clay, low plasticity, moist, grey
									4				**END OF BOREHOLE 3.1m (target depth)**



Log Scale 1:17.5

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No:HA03
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: MillwaterAHP7-largelots
LOCATION: Arran Point
JOB No: 21854.0037

CO-ORDINATES:
DRILL TYPE: 50mm hand auger
HOLE STARTED: 28/1/16
HOLE FINISHED: 28/1/16
DRILL METHOD: HA
DRILLED BY:
R.L.:
DATUM:
DRILL FLUID:
LOGGED BY: rbe
CHECKED:

GEOLOGICAL
ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

GEOLOGICAL UNIT	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL / ROCK DESCRIPTION
FILL													St				SILT, friable, dry to moist, yellowish brown, minor fine gravel
						● 90/32kPa											SILT, some clay, low plasticity, moist, light yellowish brown
COMPLETELY WEATHERED ECBF											ML						SILT, some clay, low plasticity, moist, grey
									0.5								
						● 89/30kPa											
						● 68/19kPa											
									1.0								
						● 96/16kPa											
											MS						sandy SILT, non plastic, moist, grey
						● 60/21kPa			1.5								
											ML						SILT, some clay, low plasticity, moist, grey
						● 60/19kPa											
									2.0								
						● 68/22kPa											
						● 82/17kPa											
									2.5								
						● 71/25kPa											
		Hole dry on completion				● 89/32kPa			3.0								
																	END OF BOREHOLE 3.1m (target depth)
									4								

T+T DATATEMPLATE.GDT rbe

Log Scale 1:17.5

BORELOG 616818.GPJ 28-Jan-2016

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No:HA04
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: MillwaterAHP7-largelots
LOCATION: Arran Point
JOB No: 21854.0037

CO-ORDINATES:
DRILL TYPE: 50mm hand auger
HOLE STARTED: 28/1/16
HOLE FINISHED: 28/1/16
DRILL METHOD: HA
DRILLED BY:
R.L.:
DATUM:
DRILL FLUID:
LOGGED BY: rbe
CHECKED:

GEOLOGICAL

ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 200	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
RESIDUAL SOILS											MC		St				clayey SILT, medium plasticity, moist, yellowish brown
																	-yellowish brown mottled light greyish white
						● 95/40kPa											
																	-low plasticity
									0.5		ML						SILT, some clay, low plasticity, moist, yellowish brown and light brownish white
						● 65/32kPa					MC						clayey SILT, low plasticity, moist, yellowish brown mottled light brownish white
						● 84/38kPa											
									1.0								
						● 77/30kPa											
						● 54/16kPa			1.5								
						● 60/14kPa											
									2.0								
						● 76/24kPa											
COMPLETELY WEATHERED ECBF											ML						SILT, some clay, low plasticity, moist, grey
						● 89/30kPa											
									2.5								
													VSt				
		Hole dry on completion				● 108/40kPa											
											MS		H				sandy SILT, non plastic, moist, grey
						● 209/57kPa			3.0		MC						clayey SILT, low plasticity, moist, grey
																	END OF BOREHOLE 3.1m (target depth)
									4								

Log Scale 1:17.5

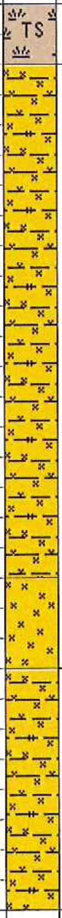
Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA1**
Hole Location: Lot 9
SHEET: 1 OF 1

PROJECT: MILLWATERAHP7
LOCATION: Arran's Point - P7 S1
JOB No.: 0021857.0037
CO-ORDINATES: (NZTM 2000)
R.L.:
DATUM:
DRILL TYPE: 50mm hand auger
DRILL METHOD:
DRILL FLUID:
HOLE STARTED: 20/09/2016
HOLE FINISHED: 20/09/2016
DRILLED BY: TRJM
LOGGED BY: TRJM
CHECKED: AJFG

GEOLOGICAL | ENGINEERING DESCRIPTION



GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
Topsoil												0.0m: Topsoil.
Fill						● >201 kPa				M	VSt-H	0.2m: clayey SILT; light grey mottled yellowish brown. Hard, moist, low plasticity.
						● >201 kPa						0.7m: light yellowish brown mottled light grey.
						● 190/89 kPa			1			0.9m: Very stiff.
						● 164/83 kPa						1.1m: Moderate plasticity.
						● 98/63 kPa						1.5m: Stiff.
						● 118/34 kPa						1.8m: mottled brownish grey and reddish brown. Very stiff.
									2		H	1.9m: SILT with some clay; light grey mottled brown and reddish brown. Hard, moist, low plasticity.
						● >201 kPa						
										D-M		2.2m: clayey SILT with trace fine gravel; light yellowish brown. Hard, moist, low plasticity; gravel: subangular, basalt, unweathered.
						● >201 kPa						2.4m: dry to moist, low to non-plastic.
		20/09/2016: DRY				● >201 kPa						
						● >201 kPa			3			3m: Target depth
									4			

COMMENTS:

Hole Depth
3m

Scale 1:25

Tonkin+Taylor

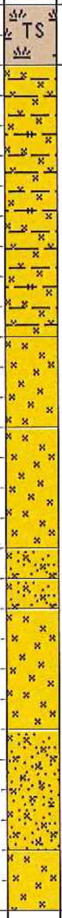
BOREHOLE LOG

BOREHOLE No.: **HA2**
Hole Location: Lot 13
SHEET: 1 OF 1

PROJECT: MILLWATERAHP7	LOCATION: Arran's Point - P7 S1	JOB No.: 0021857.0037
CO-ORDINATES: (NZTM 2000)	DRILL TYPE: 50mm hand auger	HOLE STARTED: 20/09/2016
		HOLE FINISHED: 20/09/2016
R.L.:	DRILL METHOD:	DRILLED BY: TRJM
DATUM:	DRILL FLUID:	LOGGED BY: TRJM CHECKED: AJFG

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	TESTS	DEPTH (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
Topsoil						0.0m: Topsoil.
Fill		● 164/75 kPa ● 162/90 kPa ● 132/65 kPa	1	M	VSt	0.2m: clayey SILT; light yellowish brown mottled light grey. Very stiff, moist, low to moderate plasticity. 0.5m: mottled light brown.
East Coast Bays Formation		● 98/49 kPa			St	1.1m: SILT with some clay; dark grey. Stiff, moist, low plasticity.
		● 146/46 kPa			VSt	1.4m: SILT with minor sand and clay; dark grey. Very stiff, moist, non-plastic.
		● 175/63 kPa				1.8m: SILT with some sand; dark grey. Very stiff, moist, non-plastic.
			2			1.9m: sandy SILT; dark grey. Very stiff, moist, non-plastic.
		● 98/46 kPa			St	2.0m: SILT with minor clay; dark grey. Stiff, moist, low to non-plastic.
	20/09/2016; DRY	● 132/57 kPa			VSt	2.4m: SILT with minor sand; dark grey. Very stiff, moist, non-plastic.
		● 132/55 kPa ● 109/46 kPa	3			2.8m: SILT with minor clay; dark grey. Very stiff, moist, low to non-plastic.
			4			3m: Target depth



COMMENTS:

Hole Depth
3m

Scale 1:25

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **HA3**
Hole Location: Lot 1
SHEET: 1 OF 1

PROJECT: MILLWATERAHP7
LOCATION: Arran's Point - P7 S1
JOB No.: 0021857.0037

CO-ORDINATES:
(NZTM 2000)
R.L.:
DATUM:

DRILL TYPE: 50mm hand auger
DRILL METHOD:
DRILL FLUID:

HOLE STARTED: 20/09/2016
HOLE FINISHED: 20/09/2016
DRILLED BY: TRJM
LOGGED BY: TRJM
CHECKED: AJFG

GEOLOGICAL GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	TESTS	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
Topsoil				TS			0.0m: Topsoil.
Fill		● >201 kPa			D-M	H	0.2m: clayey SILT; light yellowish brown mottled light grey and brown. Hard, moist, low plasticity. 0.5m: dry to moist.
		● >201 kPa ● 158/98 kPa	1		M	VSt-H	0.6m: clayey SILT; light yellowish brown mottled dark grey. Hard, moist, low plasticity. 0.9m: Very stiff.
East Coast Bays Formation		● >201 kPa				H	1.2m: SILT with some sand; dark grey. Hard, moist, non-plastic.
		● 172/50 kPa				VSt	1.4m: SILT with minor clay; dark grey. Very stiff, moist, low plasticity.
		● 161/40 kPa					1.8m: SILT with some sand; dark grey. Very stiff, moist, non-plastic.
		● 135/32 kPa	2				2.0m: SILT with minor clay; dark grey. Very stiff, moist, low to non-plastic.
		● 184/78 kPa					2.3m: SILT with some sand; dark grey. Very stiff, moist, non-plastic.
	20/09/2016: DRY	● 129/50 kPa					2.6m: SILT with minor clay; dark grey. Very stiff, moist, low to non-plastic.
		● 132/46 kPa	3				3m: Target depth
			4				

COMMENTS:

Hole Depth
3m

Scale 1:25

GEOTECHNICS
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Auckland 1023, New Zealand
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w. www.geotechnics.co.nz

Job: Millwater Arran's Point Precinct 7
Stage 1
Client: Tonkin & Taylor
T&T Job #: 21854.0037

Job # 614089.032/1
Entered By: YA
Checked By:

Page of

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech.	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments
												Test 1	Test 2	Test 3	Test 4				
1	2660017.64	6510652.72		North Gully	MP	30/03/2010	1.73	1.17	48	2.7	0.5	185	202	202	202	198		P	
							1.75	1.18	48	2.7	0								
2	2660005.29	6510705.36		North Gully	MP		1.83	1.41	29	2.7	6.1	202	202	202	202	202		P	
							1.82	1.41	29	2.7	6.6								
3	2660019.18	6510658.59		North Gully	MP		1.76	1.29	36	2.7	5.7	195	UTP	191	202	196		P	
							1.75	1.28	36	2.7	6.2								
4	2660001.74	6510692.53		North Gully	MP		1.83	1.33	37	2.7	0.9	UTP	150	174	179	168		P	
							1.82	1.32	37	2.7	1.5								
5	2660009.49	6510660.2		North Gully	MP	31/03/2010	1.78	1.3	37	2.7	4.1	142	130	130	179	145		P	
							1.78	1.3	37	2.7	4								
6	2660000.78	6510689.13		North Gully	MP		1.76	1.28	38	2.7	4.4	UTP	UTP	202	145	174		P	
							1.76	1.28	38	2.7	4.5								
7	2660010.39	6510704.11		North Gully	MP	1/04/2010	1.72	1.24	39	2.7	5.6	156	159	191	202	177		P	
							1.73	1.24	39	2.7	5.2								
S14-021/1	2659977.532	6510634.072	25.051	Bulk Earthworks	YA	30/09/2014	1.81	1.35	34.4	2.7	3.6	150	140	178	154	156		P	
							1.82	1.35	34.4	2.7	3.5								
S14-021/2	2659980.806	6510597.003	24.203	Bulk Earthworks	YA	30/09/2014	1.79	1.32	35.5	2.7	4.4	133	137	150	171	148		P	
							1.78	1.31	35.5	2.7	4.7								
S14-025/2	2659984.222	6510588.862	24.47	Bulk Earthworks	YA	2/10/2014	1.78	1.30	36.2	2.7	4.5	130	147	154	161	148		P	
							1.77	1.30	36.2	2.7	5.1								
S14-025/3	2659981.243	6510610.096	26.369	Bulk Earthworks	YA	2/10/2014	1.74	1.29	35.5	2.7	6.6	133	140	154	161	147		P	
							1.75	1.29	35.5	2.7	6.5								
S14-026	-	-	-	Bulk Earthworks	YA	3/10/2014	-	-	-	-	-	140	150	150	160	150		P	
							-	-	-	-	-								
S14-044/1	2659981.814	6510603.425	26.661	Bulk Earthworks	YA	10/10/2014	1.75	1.26	38.9	2.7	4.1	154	154	171	188	167		P	
							1.75	1.26	38.9	2.7	4.2								
S14-044/2	2659986.544	6510580.69	27.417	Bulk Earthworks	YA	10/10/2014	1.76	1.27	38.8	2.7	3.9	137	154	171	188	163		P	
							1.76	1.27	38.8	2.7	3.8								
S14-515/1	2660086.472	6510788.957	-0.149	Shear Key	HA	3/03/2015	1.79	1.20	49.1	2.7	0.0	171	137	137	205	163		P	
							1.78	1.19	49.1	2.7	0.0								
S14-522/1	2660087.034	6510791.995	1.776	Shear Key	HA	4/03/2015	1.83	1.37	33.4	2.7	3.4	171	154	145	188	165		P	
							1.83	1.37	33.4	2.7	3.3								
S14-531/1	2660078.367	6510782.903	2.717	Shear Key	HA	5/03/2015	1.81	1.33	36.3	2.7	2.7	154	154	171	188	167		P	
							1.80	1.32	36.3	2.7	2.9								
S14-531/2	2660100.06	6510786.33	4.001	Shear Key	HA	5/03/2015	1.80	1.32	36.3	2.7	3.0	188	188	205	205	197		P	
							1.80	1.32	36.3	2.7	3.4								
S14-536/1	-	-	-	Bulk Earthworks	HA	5/03/2015	-	-	-	-	-	86	205	205	205	175		-	
							-	-	-	-	-								
	-	-	-	Bulk Earthworks	HA	5/03/2015	-	-	-	-	-	205	205	-	-	205		-	
							-	-	-	-	-								
S14-536/2	-	-	-	Bulk Earthworks	HA	5/03/2015	-	-	-	-	-	137	120	162	205	156		-	
							-	-	-	-	-								
																			Hand Auger and SV investigation to 1.0 metre depth of fill.

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Job: Millwater Arran's Point Precinct 7
Stage 1

Client: Tonkin & Taylor
T&T Job #: 21854.0037

Job # 614089.032/1
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URN	Easting	Northing	RL	Location	Tech.	Date	Nuclear Wet Density (t/m³)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments
												Test 1	Test 2	Test 3	Test 4				
	-	-	-	Bulk Earthworks	HA	5/03/2015	- -	- -	- -	- -	- -	162	UTP	-	-	162		-	
S14-536/3	-	-	-	Bulk Earthworks	HA	5/03/2015	- -	- -	- -	- -	- -	162	154	188	145	162		-	
	-	-	-	Bulk Earthworks	HA	5/03/2015	- -	- -	- -	- -	- -	205	137	-	-	171		-	
S14-537/1	2660081.304	6510791.434	4.802	Shear Key	HA	5/03/2015	1.80 1.80	1.31 1.31	37.1 37.1	2.7 2.7	2.8 2.8	205	145	154	205	177		P	
S14-537/2	2660086.77	6510791.055	3.536	Shear Key	HA	5/03/2015	1.78 1.78	1.30 1.30	36.9 36.9	2.7 2.7	4.1 3.9	171	154	205	180	178		P	
S14-538/1	2660477.769	6510568.701	15.928	RE Wall	HA	6/03/2015	1.80 1.86	1.40 1.45	28.9 28.9	2.7 2.7	7.8 4.7	UTP	205	UTP	UTP	205		P	
S14-539/1	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	154	120	111	205	148		-	Hand Auger and SV investigation to 1.0 metre depth of fill.
	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	188	205	-	-	197		-	
S14-539/2	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	120	188	128	197	158		-	
	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	205	205	-	-	205		-	
S14-539/3	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	188	205	205	UTP	199		-	
	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	UTP	UTP	-	-	UTP		-	
S14-539/4	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	188	123	205	205	180		-	
	-	-	-	Bulk Earthworks	HA	6/03/2015	- -	- -	- -	- -	- -	205	205	-	-	205		-	
S14-540/1	2660078.681	6510790.285	5.698	Shear Key	HA	6/03/2015	1.86 1.85	1.42 1.41	30.9 30.9	2.7 2.7	3.6 4.0	162	188	145	188	171		P	
S14-540/2	2660113.608	6510785.88	2.875	Shear Key	HA	6/03/2015	1.84 1.84	1.37 1.37	34.5 34.5	2.7 2.7	2.3 2.3	205	162	188	205	190		P	
S14-546/1	2660130.192	6510791.143	3.604	Shear Key	HA	6/03/2015	1.88 1.88	1.43 1.43	31.5 31.5	2.7 2.7	1.8 2.0	UTP	UTP	154	154	154		P	
S14-546/2	2660070.978	6510785.348	4.91	Shear Key	HA	6/03/2015	1.84 1.84	1.26 1.26	46.2 46.2	2.7 2.7	0.0 0.0	205	205	205	UTP	205		P	
S14-548/1	2660075.101	6510791.121	3.807	Shear Key	HA	7/03/2015	1.85 1.86	1.44 1.45	28.0 28.0	2.7 2.7	6.1 5.7	154	188	UTP	205	182		P	
S14-555/1	2660088.879	6510775.73	-2.839	Shear Key	HA	9/03/2015	1.89 1.89	1.47 1.47	28.4 28.4	2.7 2.7	3.9 3.8	154	188	188	205	184		P	
S14-555/2	2660106.438	6510795.679	5.743	Shear Key	HA	9/03/2015	1.84 1.84	1.43 1.42	29.0 29.0	2.7 2.7	5.9 6.0	154	205	188	205	188		P	
S14-560/1	2660082.561	6510792.461	6.39	Shear Key	HA	9/03/2015	1.85 1.86	1.39 1.40	33.2 33.2	2.7 2.7	2.5 1.9	145	154	188	205	173		P	

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												Test 1	Test 2	Test 3	Test 4				
S14-560/2	2660116.445	6510794.467	5.048	Shear Key	HA	9/03/2015	1.82	1.28	41.6	2.7	0.0	205	205	162	171	186		P	
							1.81	1.28	41.6	2.7	0.0								
S14-562/1	2660075.635	6510786.366	5.356	Shear Key	HA	10/03/2015	1.82	1.36	34.0	2.7	3.7	154	188	205	162	177		P	
							1.81	1.35	34.0	2.7	3.8								
S14-570/1	2660087.849	6510800.087	6.442	Shear Key	HA	10/03/2015	1.84	1.40	31.8	2.7	3.7	154	154	188	205	175		P	
							1.84	1.40	31.8	2.7	3.7								
S14-570/2	2660119.619	6510789.752	6.544	Shear Key	HA	10/03/2015	1.80	1.30	38.3	2.7	1.8	154	154	145	188	160		P	
							1.79	1.30	38.3	2.7	2.4								
S14-582/1	2660105.38	6510791.446	7.207	Shear Key	HA	11/03/2015	1.78	1.37	30.1	2.7	8.4	154	162	162	162	160		P	
							1.81	1.39	30.1	2.7	6.8								
S14-582/2	2660151.04	6510790.713	5.406	Shear Key	HA	11/03/2015	1.89	1.48	27.7	2.7	4.4	154	154	145	171	156		P	
							1.89	1.48	27.7	2.7	4.3								
S14-588/1	2660166.261	6510782.889	5.252	Shear Key	HA	11/03/2015	-	-	-	-	-	145	145	103	86	120		F	
							-	-	-	-	-								
S14-588/2	2660107.277	6510787.507	9.726	Shear Key	HA	11/03/2015	1.85	1.40	32.6	2.7	2.8	154	154	188	205	175		P	
							1.80	1.35	32.6	2.7	5.7								
S14-596/1	2660106.334	6510783.097	9.047	Shear Key	HA	12/03/2015	1.86	1.37	35.8	2.7	0.1	145	145	188	145	156		P	
							1.86	1.37	35.8	2.7	0.2								
S14-596/2	2660172.278	6510779.895	4.199	Shear Key	HA	12/03/2015	1.91	1.45	31.5	2.7	0.6	188	188	145	205	182		P	
							1.92	1.46	31.5	2.7	0.1								
S14-603/1	2660091.187	6510786.701	7.355	Shear Key	HA	12/03/2015	1.90	1.43	33.4	2.7	0.0	188	154	205	205	188		P	
							1.89	1.42	33.4	2.7	0.1								
S14-603/2	2660140.148	6510788.997	6.749	Shear Key	HA	12/03/2015	1.90	1.42	33.6	2.7	0.0	188	145	188	205	182		P	
							1.89	1.41	33.6	2.7	0.2								
S14-611/1	2660161.799	6510779.432	6.177	Shear Key	HA	13/03/2015	1.81	1.30	39.4	2.7	0.5	162	171	145	171	162		P	
							1.80	1.29	39.4	2.7	1.1								
S14-614/1	2660170.785	6510780.656	7.682	Shear Key	HA	13/03/2015	1.84	1.37	34.5	2.7	2.2	171	162	188	162	171		P	
							1.84	1.37	34.5	2.7	2.0								
S14-614/2	2660115.051	6510781.723	8.186	Shear Key	HA	13/03/2015	1.84	1.41	30.3	2.7	4.8	205	205	205	205	205		P	
							1.83	1.41	30.3	2.7	5.4								
S14-615/1	2660163.322	6510777.59	11.338	Shear Key	HA	14/03/2015	1.91	1.44	32.7	2.7	0.0	145	188	180	180	173		P	
							1.91	1.44	32.7	2.7	0.0								
S14-615/2	2660137.197	6510782.307	8.315	Shear Key	HA	14/03/2015	1.90	1.44	31.6	2.7	1.2	162	205	205	180	188		P	
							1.87	1.42	31.6	2.7	2.4								
S14-747/1	2660042.761	6510781.431	5.306	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.83	1.38	32.7	2.7	3.7	205	171	180	154	178		P	
							1.83	1.38	32.7	2.7	3.8								
S14-747/2	2660063.295	6510792.329	4.715	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.76	1.27	38.7	2.7	4.0	205	162	180	171	180		P	
							1.76	1.27	38.7	2.7	3.7								
S14-747/3	2660069.657	6510805.607	5.484	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.79	1.28	40.0	2.7	1.7	162	171	128	180	160		P	
							1.79	1.28	40.0	2.7	1.7								
S14-750/1	Missing GPS	Missing GPS	Missing GPS	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.80	1.33	35.4	2.7	3.5	162	154	162	188	167		P	
							1.80	1.33	35.4	2.7	3.8								
S14-750/2	2660037.149	6510777.598	2.982	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.79	1.30	36.8	2.7	3.7	145	145	171	205	167		P	
							1.79	1.31	36.8	2.7	3.3								

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												Test 1	Test 2	Test 3	Test 4				
S14-750/3	Missing GPS	Missing GPS	Missing GPS	R.e Wall Plus Silt Pond Wall	HA	21/04/2015	1.86	1.40	32.5	2.7	2.6	171	145	145	171	158		P	
							1.86	1.41	32.5	2.7	2.3								
S14-754/1	2660042.625	6510777.039	5.844	R.E Wall	HA	22/04/2015	1.83	1.36	34.2	2.7	3.1	145	145	180	171	160		P	
							1.82	1.36	34.2	2.7	3.3								
S14-754/2	2660060.068	6510786.985	5.658	R.E Wall	HA	22/04/2015	1.82	1.36	33.5	2.7	3.9	205	188	171	205	192		P	
							1.82	1.36	33.5	2.7	3.9								
S14-761/1	2660069.796	6510785.599	6.082	R.E Wall	HA	22/04/2015	1.81	1.32	37.4	2.7	1.8	145	188	145	154	158		P	
							1.81	1.32	37.4	2.7	1.9								
S14-761/2	2660039.278	6510771.563	6.028	R.E Wall	HA	22/04/2015	1.80	1.36	32.4	2.7	5.5	145	171	205	205	182		P	
							1.80	1.36	32.4	2.7	5.8								
S14-767/1	Missing GPS	Missing GPS	Missing GPS	R.E Wall + Shear Key	HA	23/04/2015	1.79	1.28	39.4	2.7	1.8	188	145	205	162	175		P	
							1.79	1.28	39.4	2.7	2.1								
S14-767/2	2660030.715	6510765.139	8.73	R.E Wall + Shear Key	HA	23/04/2015	1.81	1.33	35.8	2.7	3.0	154	154	145	162	154		P	
							1.81	1.33	35.8	2.7	3.0								
S14-776/1	2660080.173	6510788.175	8.231	R.E Wall + SiltPond	HA	1/05/2015	1.80	1.31	37.6	2.7	2.4	154	154	188	205	175		P	
							1.80	1.31	37.6	2.7	2.2								
S14-776/2	2660068.466	6510816.748	6.493	R.E Wall + SiltPond	HA	1/05/2015	1.83	1.38	32.3	2.7	4.0	205	188	171	205	192		P	
							1.83	1.38	32.3	2.7	4.2								
S14-780/1	2660070.061	6510774.899	13.233	R.E Wall + Shear Key	HA	2/05/2015	-	-	-	-	-	145	154	154	188	160		P	
							-	-	-	-	-								
S14-780/2				R.E Wall + Shear Key	HA	2/05/2015	-	-	-	-	-	171	188	145	154	165		P	
							-	-	-	-	-								
S14-784/1	2660061.881	6510779.407	9.163	R.E Wall + Shear Key	HA	4/05/2015	1.83	1.35	35.1	2.7	2.5	205	188	205	205	201		P	
							1.83	1.36	35.1	2.7	2.1								
S14-784/2	2660028.066	6510753.77	10.894	R.E Wall + Shear Key	HA	4/05/2015	1.81	1.34	34.6	2.7	3.9	154	154	171	205	171		P	
							1.80	1.34	34.6	2.7	4.2								
S14-787/1	2660049.723	6510797.061	5.506	R.E Wall + SiltPond	HA	4/05/2015	-	-	-	-	-	205	154	171	188	180		P	
							-	-	-	-	-								
S14-787/2				R.E Wall + SiltPond	HA	4/05/2015	-	-	-	-	-	154	171	154	205	171		P	
							-	-	-	-	-								
S14-791/1	2660057.164	6510776.661	9.984	R.E Wall + Shear Key	HA	5/05/2015	1.81	1.29	40.4	2.7	0.3	154	162	145	145	152		P	
							1.81	1.29	40.4	2.7	0.3								
S14-791/2	2660100.273	6510786.392	10.175	R.E Wall + Shear Key	HA	5/05/2015	1.75	1.25	39.5	2.7	4.1	120	128	162	171	145		P	
							1.76	1.26	39.5	2.7	3.7								
S14-795/1	2660089.519	6510778.937	6.776	R.E Wall + Shear Key	HA	5/05/2015	1.83	1.33	38.1	2.7	0.3	154	145	154	145	150		P	
							1.84	1.33	38.1	2.7	0.2								
S14-798/1	2660037.491	6510760.911	11.208	R.E Wall + Shear Key	YA	6/05/2015	1.74	1.29	34.9	2.7	7.4	137	127	154	171	147		P	
							1.74	1.29	34.9	2.7	7.0								
S14-798/2	2660067.464	6510777.519	11.167	R.E Wall + Shear Key	YA	6/05/2015	1.74	1.30	33.6	2.7	8.1	154	137	171	154	154		P	
							1.75	1.31	33.6	2.7	7.3								
S14-802/1	2660080.239	6510774.676	11.192	R.E Wall + Shear Key	YA	6/05/2015	1.79	1.32	36.0	2.7	3.8	120	137	154	185	149		P	
							1.78	1.31	36.0	2.7	4.4								
S14-802/2	2660047.035	6510757.299	11.332	R.E Wall + Shear Key	YA	6/05/2015	1.78	1.30	37.5	2.7	3.3	120	137	154	185	149		P	
							1.80	1.31	37.5	2.7	2.4								
S14-808/1	2660106.858	6510785.29	12.896	R.E Wall + Shear Key	HA	7/05/2015	-	-	-	-	-	205	205	154	145	177		P	
							-	-	-	-	-								

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Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech.	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments
												Test 1	Test 2	Test 3	Test 4				
S14-808/2		.		R.E Wall + Shear Key	HA	7/05/2015	- -	- -	- -	- -	- -	154	UTP	205	188	182		P	
S14-811/1	2660057.348	6510771.761	11.733	R.E Wall + Shear Key	HA	7/05/2015	1.81 1.80	1.34 1.34	35.1 35.1	2.7 2.7	3.6 3.7	137	162	128	154	145		P	
S14-811/2	2660105.834	6510783.649	11.653	R.E Wall + Shear Key	HA	7/05/2015	1.83 1.83	1.30 1.31	40.5 40.5	2.7 2.7	-1.0 -1.2	205	188	154	145	173		P	
S14-957/1	2660139.31	6510744.166	14.178	Undercut	RHN	13/07/2015	1.89 1.88	1.46 1.45	29.3 29.3	2.7 2.7	3.1 3.6	205	205	205	205	205		P	
S14-957/2	2660137.914	6510728.909	15.857	Undercut	RHN	14/07/2015	1.83 1.83	1.39 1.38	32.1 32.1	2.7 2.7	4.1 4.3	205	188	154	171	180		P	
S14-970A/1				Mass block wall	RHN	17/07/2015	- -	- -	- -	- -	- -	154	123	154	171	150		P	Subgrade
S14-970A/2				Mass block wall	RHN	17/07/2015	- -	- -	- -	- -	- -	120	137	137	120	128		P	
S14-970A/3				Mass block wall	RHN	17/07/2015	- -	- -	- -	- -	- -	154	154	137	140	146		P	
S14-970A/4				Mass block wall	RHN	17/07/2015	- -	- -	- -	- -	- -	205	137	154	140	159		P	
S14/979/1	2660082.672	6510796.289	7.238	Bulkfill	RHN	22/07/2015	1.83 1.85	1.40 1.42	30.4 30.4	2.7 2.7	5.3 4.4	171	188	154	150	166		P	
S14/979/2	2660152.174	6510734.04	8.586	Undercut	RHN	22/07/2015	1.81 1.79	1.38 1.37	30.6 30.6	2.7 2.7	6.5 7.1	150	188	205	188	183		P	
S14-1002/1				Mass block wall	RHN	10/08/2015	- -	- -	- -	- -	- -	140	144	171	171	156		P	Subgrade
S14-1002/2				Mass block wall	RHN	10/08/2015	- -	- -	- -	- -	- -	188	171	154	188	175		P	
S14-1002/3				Mass block wall	RHN	10/08/2015	- -	- -	- -	- -	- -	171	168	188	171	174		P	
S14-1002/4				Mass block wall	RHN	10/08/2015	- -	- -	- -	- -	- -	171	147	161	171	162		P	
S14-1007/1				Mass block wall	RHN	11/08/2015	- -	- -	- -	- -	- -	89	99	111	103	100		F	Subgrade
S14-1007/2				Mass block wall	RHN	11/08/2015	- -	- -	- -	- -	- -	123	79	82	109	98		F	
S14-1007/3				Mass block wall	RHN	11/08/2015	- -	- -	- -	- -	- -	205	171	154	188	180		P	
S14-1007/4				Mass block wall	RHN	11/08/2015	- -	- -	- -	- -	- -	188	171	188	168	179		P	
S14-1008/1				Mass block wall	RHN	12/08/2015	- -	- -	- -	- -	- -	120	137	123	127	127	Y	P	Bench 5 under cut 500, retest of URN S14-1007/1 & 2 subgrade shear strength
S14-1008/2				Mass block wall	RHN	12/08/2015	- -	- -	- -	- -	- -	140	171	120	106	134	Y	P	
S14-1008/3				Mass block wall	RHN	12/08/2015	- -	- -	- -	- -	- -	120	109	137	127	123	Y	P	
S14-1008/4				Mass block wall	RHN	12/08/2015	- -	- -	- -	- -	- -	130	127	147	123	132	Y	P	
S14-1012				Bench 5 backfill	RHN	13/08/2015	1.82 1.82	1.33 1.33	37.0 37.0	2.7 2.7	1.8 1.4	130	127	147	123	132		P	Engineered backfill
S14-1023/1	2660119.617	6510731.83	15.826	Bulkfill	RHN	21/08/2015	1.80 1.79	1.34 1.33	34.6 34.6	2.7 2.7	4.2 4.8	137	161	171	161	157		P	
S14-1023/2	2660125.322	6510731.265	15.044	Bulkfill	RHN	21/08/2015	1.83 1.82	1.38 1.37	33.3 33.3	2.7 2.7	3.3 3.9	188	188	171	188	184		P	

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Job: Millwater Arran's Point Precinct 7
Stage 1
Client: Tonkin & Taylor
T&T Job #: 21854.0037
Job # 614089.032/1
Entered By: YA
Checked By:
Page of

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.1 Direct Transmission Mode
NZGS August 2001 Guidelines for hand held shear vane test.

URN	Easting	Northing	RL	Location	Tech.	Date	Nuclear Wet Density (t/m^3)	Oven Dry Density (t/m3)	Oven Moisture content (%)	Solid Density (t/m3) assumed	Oven Calculated Air Voids (%)	Shear Strength (kPa) (UTP = Unable to penetrate)				Average Shear Strength (kPa)	Re - Test (Y)	pass / fail Specification > 140 kPa and < 10 % Air Voids)	Comments
												Test 1	Test 2	Test 3	Test 4				
S14-1023/3	2660131.929	6510720.501	16.171	Bulkfill	RHN	21/08/2015	1.83	1.36	33.8	2.7	3.4	UTP	UTP	UTP	UTP	UTP		P	
							1.82	1.36	33.8	2.7	3.5								
S14-1027/1	2660115.481	6510731.303	14.771	Bulkfill	RHN	24/08/2015	1.80	1.31	37.3	2.7	2.8	188	188	205	186	192		P	
							1.79	1.31	37.3	2.7	2.9								
S14-1027/2	2660099.115	6510728.796	14.75	Bulkfill	RHN	24/08/2015	1.76	1.21	45.7	2.7	-0.1	205.2	205	188	188.1	197		P	
							1.77	1.21	45.7	2.7	-0.5								
S14-1037/1	2660064.645	6510705.911	16.366	Bulkfill	RHN	28/08/2015	1.74	1.25	39.0	2.7	4.7	136.8	171	154	136.8	150		P	
							1.73	1.24	39.0	2.7	5.5								
S14-1037/2	2660080.435	6510719.231	16.148	Bulkfill	RHN	28/08/2015	1.74	1.24	41.0	2.7	3.5	153.9	171	171	153.9	162		P	
							1.74	1.24	41.0	2.7	3.5								
S14-1037/3	2660096.622	6510728.529	16.219	Bulkfill	RHN	28/08/2015	1.71	1.22	40.1	2.7	5.7	153.9	154	171	153.9	158		P	
							1.72	1.23	40.1	2.7	5.3								
S14-1037/4	2660110.443	6510729.903	16.17	Bulkfill	RHN	28/08/2015	1.75	1.25	40.1	2.7	3.8	136.8	188	171	153.9	162		P	
							1.72	1.23	40.1	2.7	5.4								
S14-1052/1	2660115.673	6510731.296	15.552	Behind Mass block wall	JED	9/09/2015	1.66	1.11	50.5	2.7	3.2	165	180	195	165	176		P	
							1.66	1.10	50.5	2.7	3.4								
S14-1052/2	2660087.217	6510722.724	16.595	Behind Mass block wall	JED	9/09/2015	1.71	1.21	40.8	2.7	5.6	195	195	195	195	195		P	
							1.71	1.21	40.8	2.7	5.6								
S14-1052/3	2660070.791	6510709.855	14.329	Behind Mass block wall	JED	9/09/2015	1.66	1.18	41.2	2.7	7.9	195	165	195	180	184		P	
							1.66	1.17	41.2	2.7	8.1								
S15-067/1				Above Wall 2	TAJ	15/10/2015	1.76	1.31	33.5	2.7	7.3	196	196	196	196	196		P	
							1.74	1.31	33.5	2.7	7.9								
S15-067/2				Above Wall 2	TAJ	15/10/2015	1.78	1.33	33.8	2.7	6.0	196	196	196	196	196		P	
							1.77	1.33	33.8	2.7	6.1								
S15-067/3				Above Wall 2	TAJ	15/10/2015	1.76	1.32	33.6	2.7	6.9	196	196	196	196	196		P	
							1.76	1.32	33.6	2.7	7.0								
S15-067/4	2660026.166	6510664.094	21.011	Above Wall 2	TAJ	15/10/2015	1.75	1.30	34.3	2.7	7.0	196	196	196	196	196		P	
							1.75	1.30	34.3	2.7	7.0								
S15-071/8	2659999.114	6510656.364	23.224	Above Wall 2	TAJ	20/10/2015	1.83	1.34	37.0	2.7	1.0	196	196	196	196	196		P	
							1.84	1.34	37.0	2.7	0.8								

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Job: Millwater
Site: Arrans Point - P7
Job # 614089.032 T+T Job # 21854.0037

Form #	
Result Rev No.	0
Entered By:	RHN
Checked By:	

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.2 Backscatter Mode
ASTM D5874-02 Determination of Impact Value (IV) of soil.

URN	Tech.	Date	Location	Material Type	Layer	Easting	Northing	RL	Nuclear Wet Density (t/m^3)	Nuclear Dry Density (t/m^3)	Nuclear water content (%)	Solid Density (t/m^3) ~~measured/~~ assumed	Maximum Dry Density (MDD) Std/~~Hvl~~/Vib (t/m^3)	Percentage maximum Dry Density MDD (%)	Average of 10 consecutive tests (% of MDD)	Percenatge of Solid Density (%)	Impact Value (IV)	Pass / Fail	Retest (Y)	Comments
S14-972/1	RHN	17/07/2015	mass block wall base	Gap 40	Bench 1 Levelling pad	2660122.031	6510738.067	12.721	2.05	1.95	5.0	2.72	2.22	87.9%		71.7%		P		
S14-972/2			mass block wall base	Gap 40		2660110.004	6510737.247	12.385	2.07	1.95	5.7	2.72	2.22	88.0%		71.9%		P		
S14-977/1	RHN	22/07/2015	mass block wall base	Gap 40	bench 1 Levelling pad	2660106.444	6510735.847	12.603	1.93	1.84	5.1	2.72	2.22	82.8%		67.6%		F		
S14-977/2			mass block wall base	Gap 40		2660095.838	6510733.014	12.687	2.03	1.90	7.0	2.72	2.22	85.6%		69.9%		P		
S14-977/3			mass block wall base	Gap 40		-	-	-	2.08	1.94	7.2	2.72	2.22	87.4%		71.3%		P	Y	Retest of URN S14-977/1
S14-977/4			mass block wall base	Gap 40		-	-	-	2.06	1.92	7.2	2.72	2.22	86.5%		70.6%		P	Y	Retest of URN S14-977/2
S14-988/1a	RHN	25/07/2015	mass block wall base	Gap 40	Bench 2 Levelling pad	2660077.87	6510724.591	13.82	2.05	1.925	6.5	2.72	2.22	86.7%		70.8%		P		
S14-988/2a			mass block wall base	Gap 40		2660088.701	6510730.812	17.887	2.23	2.073	7.7	2.72	2.22	93.4%		76.2%		P		
S14-988/1	RHN	25/07/2015	mass block wall backfill Plateau test	Gap 65	Plateau test	2660114.902	6510735.469	13.072	1.96	1.87	4.6	2.72	2.22	84.4%		68.9%		-		1 Vib return pass between tests, this increased to 2 return passes from test 7 onwards
S14-988/2				Gap 65					1.95	1.87	4.3	2.72	2.22	84.2%		68.7%		-		
S14-988/3				Gap 65					2.02	1.94	4.0	2.72	2.22	87.6%		71.5%	27	-		
S14-988/4				Gap 65					2.06	1.97	4.5	2.72	2.22	88.6%		72.3%		-		
S14-988/5				Gap 65					2.05	1.94	5.2	2.72	2.22	87.6%		71.5%		-		
S14-988/6				Gap 65					2.08	1.99	4.8	2.72	2.22	89.4%		73.0%	37	-		
S14-988/7				Gap 65					2.08	1.97	5.2	2.72	2.22	88.9%		72.6%		-		
S14-988/8				Gap 65					2.08	1.99	4.5	2.72	2.22	89.6%		73.1%	38	-		
S14-988/9				Gap 65					2.16	2.07	4.3	2.72	2.22	93.2%		76.1%		-		
S14-988/10				Gap 65					2.19	2.10	4.6	2.72	2.22	94.4%		77.0%	40	-		
S14-988/11				Gap 65					2.15	2.07	4.1	2.72	2.22	93.2%		76.0%		-		
S14-988/12				Gap 65					2.18	2.08	4.9	2.72	2.22	93.8%		76.5%	44	-		
S14-993/1	RHN	29/07/2015	mass block wall base	Gap 40	Bench 2 Levelling pad	-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-993/2				Gap 40		-	-	-	-	-	-	-	-	-	-	-	22	P		
S14-993/3				Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-993/4				Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-993/5				Gap 40		-	-	-	-	-	-	-	-	-	-	-	25	P		
S14-993/6				Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-997/1	RHN	30/07/15	mass block wall backfill	Gap 65	Bench 1, layer 1	2660115.427	6510735.084	12.927	2.31	2.20	5.1	2.72	2.22	99.1%		80.9%	30	P		
S14-997/2			mass block wall backfill	Gap 65		2660109.795	6510734.52	12.933	2.20	2.09	5.6	2.72	2.22	94.0%		76.7%	34	P		Passed by engineer as exception for first layer.
S14-997/3			mass block wall base	Gap 65	Bench 3 Levelling pad	-	-	-	-	-	-	-	-	-	-	-	27	P		
S14-997/4			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	25	P		
S14-997/5			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-998/1	RHN	31/7/15	mass block wall backfill	Gap 65	Bench 1,Layer 2	2660115.05	6510736.048	13.372	2.20	2.12	4.2	2.72	2.22	95.3%	-	77.8%	44	P		
S14-998/2			mass block wall backfill	Gap 65		-	-	-	-	-	-	-	-	-	-	-	44	P		
S14-998/3			mass block wall backfill	Gap 65		-	-	-	-	-	-	-	-	-	-	-	42	P		
S14-998/4			mass block wall backfill	Gap 65		-	-	-	-	-	-	-	-	-	-	-	38	P		
S14-998/5			mass block wall backfill	Gap 65		-	-	-	-	-	-	-	-	-	-	-	44	P		
S14-999/1	RHN	4/08/2015	mass block wall backfill	Gap 65	Bench 1. Layer 3	2660118.847	6510736.391	13.509	2.20	2.11	4.1	2.72	2.22	95.0%		77.5%	40	P		
S14-999/2			mass block wall backfill	Gap 65		2660099.522	6510732.672	13.596	2.29	2.19	4.2	2.72	2.22	98.8%		80.7%	43	P		
S14-999/3			mass block wall backfill	Gap 65	Bench 2, Layer 1	2660077.405	6510722.679	14.255	2.21	2.11	4.6	2.72	2.22	95.2%		77.7%	39	P		
S14-1004/1	RHN	11/08/15	mass block wall base	Gap 40	Levelling pad	-	-	-	-	-	-	-	-	-	-	-	25	P		
S14-1004/2			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	30	P		
S14-1004/3			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-1004/4			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	15	F		
S14-1004/5			mass block wall backfill	Gap 65	Bench 2, Layer 2				2.24	2.13	5.0	2.72	2.22	95.9%		78.3%	40	P		
S14-1004/6			mass block wall backfill	Gap 65					2.29	2.16	6.4	2.72	2.22	97.1%		79.2%	38	P		
S14-1004/7			mass block wall base	Gap 40	Levelling pad	-	-	-	-	-	-	-	-	-	-	-	22	P	Y	retest of S14-1004/4
S14-1004/8			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	21	P	Y	
S14-1009/1	RHN	12/08/15	mass block wall backfill	Gap 40	Bench 4 Levelling pad	-	-	-	-	-	-	-	-	-	-	-	20	P		
S14-1009/2			mass block wall backfill	Gap 40		-	-	-	-	-	-	-	-	-	-	-	22	P		
S14-1009/3			mass block wall backfill	Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-1013/1			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	23	P		

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Job: Millwater
Site: Arrans Point - P7
Job # 614089.032 T+T Job # 21854.0037

Form #	
Result Rev No.	0
Entered By:	RHN
Checked By:	

NZS 4407:1991 Field water content and field dry density using a nuclear densometer
Test 4.2.2 Backscatter Mode
ASTM D5874-02 Determination of Impact Value (IV) of soil.

URN	Tech.	Date	Location	Material Type	Layer	Easting	Northing	RL	Nuclear Wet Density (t/m^3)	Nuclear Dry Density (t/m^3)	Nuclear water content (%)	Solid Density (t/m^3) ~~measured/~~ assumed	Maximum Dry Density (MDD) ~~Std/Hvl/Vib~~ (t/m^3)	Percentage maximum Dry Density MDD (%)	Average of 10 consecutive tests (% of MDD)	Percenatge of Solid Density (%)	Impact Value (IV)	Pass / Fail	Retest (Y)	Comments
S14-1013/2	RHN	13/08/15	mass block wall base	Gap 40	Bench 5 Levelling pad	-	-	-	-	-	-	-	-	-	-	-	23	P		
S14-1013/3			mass block wall base	Gap 40		-	-	-	-	-	-	-	-	-	-	-	25	P		
S14-1019/1	RHN	18/08/15	mass block wall backfill	Gap 65	Bench 1, Layer 4				2.22	2.11	5.2	2.72	2.22	95.1%		77.6%	38	P		
S14-1019/2			mass block wall backfill	Gap 65					2.25	2.15	4.8	2.72	2.22	96.8%		79.0%	39	P		
S14-1021/1	RHN	19/08/2015	mass block wall backfill	Gap 65	Bench 1, Layer 5 plus bench 2 layer 3				2.33	2.17	7.8	2.72	2.22	97.5%		79.6%	34	P		
S14-1021/2			mass block wall backfill	Gap 65					2.27	2.13	6.1	2.72	2.22	96.2%		78.5%	32	P		
S14-1021/3			mass block wall backfill	Gap 65					2.27	2.12	6.7	2.72	2.22	95.7%		78.1%	31	P		
S14-1028/1	RHN	25/08/2015	mass block wall backfill	Gap 65					2.02	1.94	4.4	2.72	2.22	87.2%		71.2%	35	F		
S14-1028/2			mass block wall backfill	Gap 65	Comment^				2.15	2.04	5.5	2.72	2.22	91.8%		74.9%	29	F		
S14-1028/3			mass block wall backfill	Gap 65					2.22	2.12	4.4	2.72	2.22	95.6%		78.0%	38	P		
S14-1028/4			mass block wall backfill	Gap 65					2.31	2.21	4.5	2.72	2.22	99.7%		81.4%	40	P		
S14-1028/5			mass block wall backfill	Gap 65					2.23	2.15	4.1	2.72	2.22	96.7%		78.9%	37	P		
S14-1030/1	RHN	26/08/2015	mass block wall backfill	Gap 65					2.25	2.15	4.6	2.72	2.22	97.1%		79.2%	41	P		
S14-1030/2			mass block wall backfill	Gap 65					2.26	2.14	5.7	2.72	2.22	96.2%		78.5%	44	P		
S14-1030/3			mass block wall backfill	Gap 66					2.33	2.20	6.1	2.72	2.22	99.0%		80.8%	43	P		
S14-1030/4			mass block wall backfill	Gap 65					2.35	2.21	6.3	2.72	2.22	99.5%		81.2%	40	P		
S14-1030/5			mass block wall backfill	Gap 65					2.33	2.22	4.9	2.72	2.22	100.2%		81.8%	45	P		
S14-1030/6			mass block wall backfill	Gap 65					2.28	2.16	5.7	2.72	2.22	97.3%		79.4%	43	P		
S14-1030/7			mass block wall backfill	Gap 65					2.26	2.18	4.4	2.72	2.22	98.2%		80.1%	34	P		
S14-1041/1	RHN/JED	3/09/2015	mass block wall backfill	Gap 65					2.33	2.19	6.3	2.72	2.22	98.8%		80.7%	43	P		
S14-1041/2			mass block wall backfill	Gap 65					2.28	2.15	6.3	2.72	2.22	96.8%		79.0%	36	P		
S14-1041/3			mass block wall backfill	Gap 65					2.21	2.07	6.9	2.72	2.22	93.1%		76.0%	33	P		Pass given due to CIV result
S14-1043/1	RHN	4/09/2015	mass block wall backfill	Gap 65					2.24	2.11	6.2	2.72	2.22	94.9%		77.5%	33	P		
S14-1043/2			mass block wall backfill	Gap 65					2.34	2.22	5.4	2.72	2.22	99.8%		81.5%	34	P		
S14-1043/3			mass block wall backfill	Gap 65					2.21	2.11	4.7	2.72	2.22	95.3%		77.7%	34	P		
S14-1043/4			mass block wall backfill	Gap 65					2.29	2.15	6.5	2.72	2.22	96.9%		79.1%	38	P		
S14-1046/1	RHN		mass block wall backfill	Gap 65					2.06	1.96	5.1	2.72	2.22	88.3%		72.1%	25	F		Area undercut by 500mm, back filled with gap65. Passed by engineer as first layer on top of subgrade.
S14-1046/2			mass block wall backfill	Gap 65					2.07	1.97	5.1	2.72	2.22	88.8%		72.5%	28	F		

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