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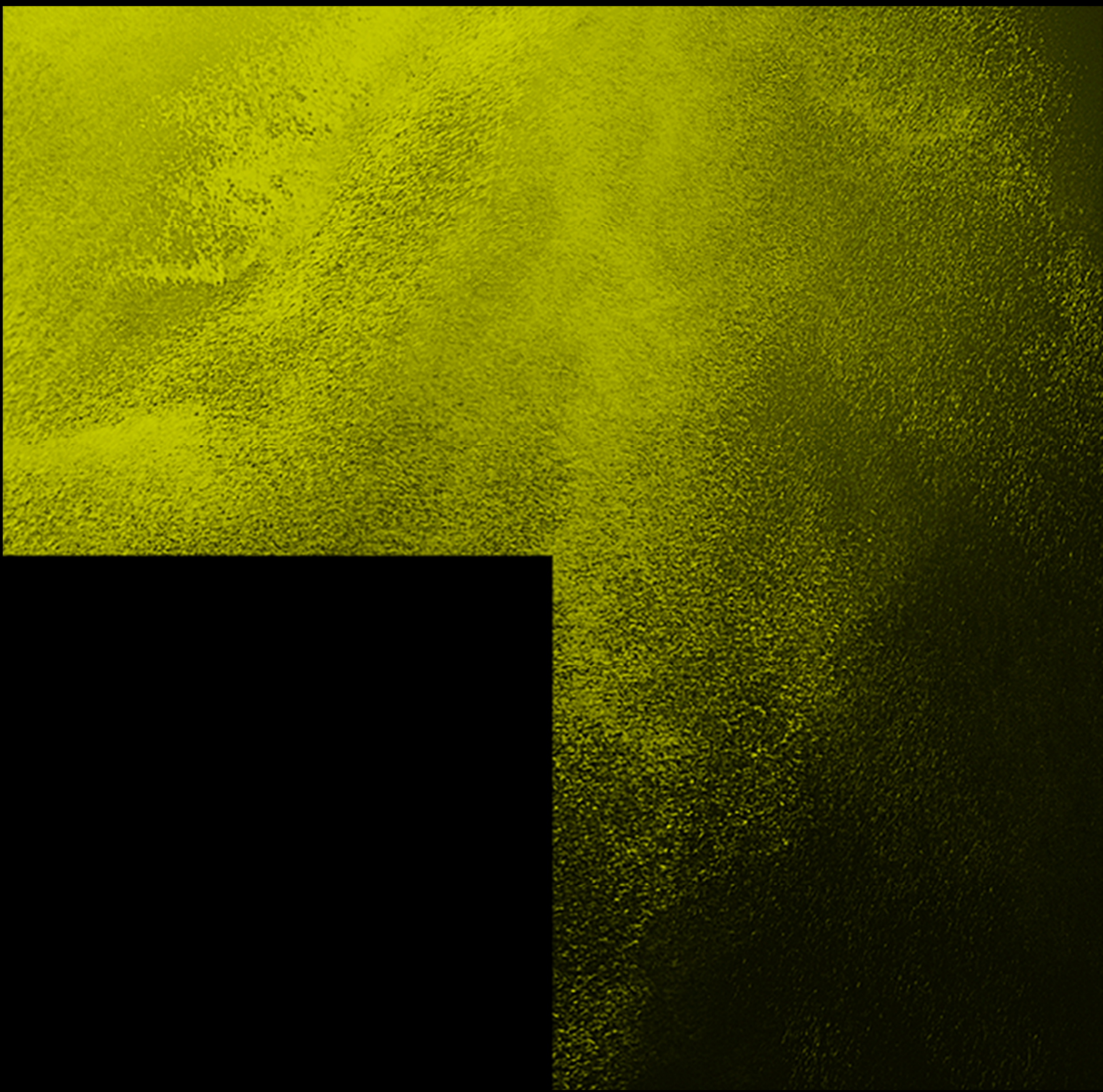
AMBERFIELD

Civil Infrastructure Report

Weston Lea Limited



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APPENDICES

Appendix 1	Preliminary Engineering Drawings (Harrison Grierson) **Bound Separately as Appendix X in Volume 8 and 9**
Appendix 2	Peacockes Road Preliminary Engineering Design (Traffic Design Group) **Bound Separately as Appendix V in Volume 5**
Appendix 3	Stormwater Calculations (AWA)
Appendix 4	Stormwater Calculations (Harrison Grierson)
Appendix 5	Utility Service provider correspondence

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1.0 INTRODUCTION

1.1 DEVELOPMENT BACKGROUND

This report refers to the Amberfield site located on Peacockes Road, Hamilton. The site is approximately 105 hectares in area and is subject to a proposed subdivision for approximately 1000 residential lots, reserves, roads and super lots for a future Suburban Centre. The site is located within the Peacockes Structure Plan area.

This report includes preliminary engineering design and an overview of the proposals for bulk earthworks, roading, wastewater, water supply, stormwater and earthworks.

Other relevant engineering assessments have been prepared by others and will accompany the subdivision consent application including for; bulk wastewater, bulk water supply, transportation and a Sub-catchment Integrated Catchment Management Plan (SC-ICMP).

1.2 PURPOSE

This report is intended to accompany the application for the subdivision consent, earthworks consent and stormwater discharge consent for the Amberfield site. The report includes and references the preliminary engineering design which is contained in **Appendices 1 and 2**.

1.3 SC-ICMP AND WATER IMPACT ASSESSMENT (WIA)

Both the SC-ICMP and this infrastructure report are considered to collectively satisfy the information requirements of a WIA. For this reason a separate WIA is not attached to this application.

The information requirements for a Type 1 WIA are outlined below (Table 1.2.2.5b HCC ODP). This table is modified with two additional columns which provide a reference to the ICMP and/or CIR which addresses that particular requirement (i-viii).

		TYPE OF WATER IMPACT ASSESSMENT AND WHAT INFORMATION IS TO BE PROVIDED (✓ = REQUIRED)		
INFORMATION TO BE PROVIDED		TYPE 1	AWA SC-ICMP	HG CIVIL INFRASTRUCTURE REPORT
i.	How the proposal is consistent with, or otherwise complies with, the recommendations, measures and targets of any relevant Integrated Catchment Management Plan.	✓		Directly aligns with the SC-ICMP
ii.	An assessment of any potential effects (including cumulative effects) of the development in relation to its catchment.	✓	Section 12.0	

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		TYPE OF WATER IMPACT ASSESSMENT AND WHAT INFORMATION IS TO BE PROVIDED (✓ = REQUIRED)		
INFORMATION TO BE PROVIDED		TYPE 1	AWA SC-ICMP	HG CIVIL INFRASTRUCTURE REPORT
iii.	Details of what water-sensitive techniques are proposed.	✓	Section 14.3	Section 5.2
iv.	Details of the expected water efficiency benefits arising from the proposed water-sensitive techniques compared to the same development without using those water-sensitive techniques.		Section 7.5 (SW) Section 8.0 (WW) Section 9.4 (WS)	
v.	Details of how the water-sensitive techniques will be operated and maintained to ensure ongoing water efficiency benefits.		Section 7.4.1 Section 15.4	
vi.	Where no water-sensitive techniques are proposed, an assessment containing reasons and justification for not incorporating water-sensitive techniques, having particular regard to the objectives and policies of the Volume 1, **Chapter 25.13: City-wide – Three Waters.**		n/a	
vii.	Confirmation of available Three Waters infrastructure and capacity to appropriately service the proposal.	✓	Section 14.5 Section 14.6	Section 3.2 Section 4.3
viii.	Details of the water demand (flow and pressure) and water sources.	✓	Section 9.0 Section 14.0	Section 4.3

1.4 MASTER PLAN

The district plan requires subdivision consent applications to be accompanied by a Master Plan. The matters to be addressed in a Master Plan are set out in Appendix 1.2.2.3 of the District Plan and are broadly as follows.

a) Transport network.

b) Infrastructure and servicing.

c) Natural environment network.

d) Open space network.

e) Land use.

f) Detailed development response (with respect to urban form).

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g) Staging.

This report includes supporting engineering information for the Master Plan. It addresses preliminary civil design for the roading network, proposed drainage and water supply and staging. This report should be read in conjunction with other reports which relate to transportation and infrastructure and form part of the application documents, including the Integrated Transport Assessment, Sub-Catchment ICMP, Bulk Wastewater Report and Bulk Water Supply Report.

All design will be in accordance with Hamilton City Council standards (unless otherwise stated or approved), and ultimately assets will be vested with Council. Reference is made to the Hamilton Infrastructure Technical Standards (HCC ITS) throughout this report which is the main guiding document for engineering design for the subdivision. Aspects of the Hamilton City Operative District Plan (District Plan) are also relevant.

2.0 ROADING

2.1 GENERAL

All roads have been designed in accordance with the HCC ITS – Section 3 – Transportation and generally in accordance with relevant district plan rules and requirements. Refer to **Appendix 1** for the internal road network design and **Appendix 2** for the Peacockes Road upgrade design.

TABLE 2.1: TABLE OF PRELIMINARY ROADING PLANS

DRAWING NO.	TITLE
141842-1041-1042	Road Hierarchy Plan Sheet
141842-1046	Staging Plan
141842-1301-1323	Roading Detail and Surfacing Plan
141842-1351-1382	Roading Longitudinal Sections
141842-1401-1403	Typical Road Cross-sections
141842-1601-1602	Roading Standard Details
141842-1701-1723	Road Marking and Signage Plan

2.2 TRANSPORT NETWORK

This report does not assess the proposed transport network within the development, nor the affect it may have on the wider Hamilton road transport network. Network related effects are considered in the Integrated Transport Assessment prepared by Traffic Design Group.

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2.3 PEACOCKES ROAD

As part of the Southern Links designation process, AECOM completed a concept design for the future minor arterial upgrade of Peacockes Road along the length of the site boundary north of the planned suburban centre. Traffic Design Group have further developed the AECOM design in both horizontal and vertical alignment, to reduce encroachment into adjacent properties and to better align with the existing road corridor and the Amberfield site boundary (refer **Appendix 2**).

Traffic Design Group have also developed a conceptual design for Peacockes Road upgrades south of the planned suburban centre to collector road standard (refer **Appendix 2**).

The length of Peacockes Road north of the planned suburban centre might be constructed as either a minor arterial road or a collector road depending on whether Hamilton City Council elects to fund an upgrade of the road to its final intended minor arterial standard. However, the length of road south of the planned suburban centre is intended to be upgraded by Amberfield to collector road standard only. Any future upgrade of that section of road to minor arterial standard by Hamilton City Council is understood to be long term and would occur by further widening on the western side of Peacockes Road. Further details are provided in the Integrated Transport Assessment.

All of the new connections from Peacockes Road to the Amberfield site (intersections and vehicle crossings) have been designed to integrate with Traffic Design Group's updated Peacockes Road alignment. It is envisaged that the Amberfield development will progressively be constructed concurrent with the upgrade of Peacockes Road which is likely to occur in a staged manner. Provision has been made for temporary road tie–ins to the existing Peacockes Road carriageway if timing of construction between the Amberfield development and Peacockes Road is not aligned.

The completed Peacockes Road berm adjacent to the site will be similar in nature to the internal roads, eg similar driveway geometries, bio-retention, tree planting, recessed car parking, etc. Conceptual layout geometries within Peacockes Road are provided on the HG drawing set. Further detail of the eastern berm of Peacockes Road will be provided for the approval of Hamilton City Council with the Engineering detailed design, if requested by Council. Council are to determine what would be constructed on the west side of Peacockes Road.

2.4 INTERNAL ROAD LAYOUT

All internal roads have been designed in accordance with the HCC ITS – Section 3 Transportation standards. In principal, the proposed finished site levels and vertical road geometries have been designed to generally follow the existing underlying terraced terrain to respect the existing landform and to maintain views to the Waikato River and beyond. Road levels have been set to avoid the need to remove excess earthworked material offsite.

Where necessary in the eastern part of the site, ground levels will be raised to ensure final road levels are above the Waikato River flooding level of RL 19.50m as outlined in the Flood Hazard Report prepared by Awa.

In other areas, where allowable by other design criteria, ground levels will be lowered, as recommended in the Geotechnical Investigation Report, to reduce the risk of potential long term road stability issues adjacent to steep existing batters.

Alongside the river corridor, the majority of roads have been designed with a one way cross fall to reduce disturbance to existing ground levels and the riverbank vegetation. Earthworks to form the riverside roads have been designed to terminate clear of the adjacent vegetation, particularly adjacent to the SNA. This will assist in maintaining the

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majority of the riverbank vegetation to preserve its function as a buffer to the Waikato River, as discussed within the ecological assessment report.

A reinforced earth embankment or other geotechnical measures will be employed to stabilize steep embankments adjacent to some of the river edge roads. Locations and typical cross-sections of these works are included within the engineering drawing set and discussed further in the geotechnical report prepared by Engeo.

Also refer to the Boffa Miskell report for mitigation recommendations such as buffer planting and other soft scape measures.

On all roads geometries will comply with the ITS – Section 3 as below.

- Carriageway cross-fall minimum 2%, maximum cross fall 4%.
- Single cross-fall carriageways will be less than 7.0m.
- No roads will need a super elevation applied.
- Minimum gradient is > 0.4%.
- Maximum gradient (on arterial, collector and industrial roads) is 1 in 12.
- Maximum gradient (on residential roads) is < 1 in 8.
- Vertical curves comply with the requirements of Austroads Guide to Road Design Part 3: Geometric Design, Section 8.6 Vertical Curves. All roads have speeds of ≤ 50 km/h. Vertical curves have a minimum length of 20m, except where the grade change is ≤ 1%.

Access into the Amberfield development will be achieved through several new intersections along Peacockes Road. Points of access are designed to distribute peak traffic flows through the internal road network and onto Peacockes Road. The site has a primary local north-south road running from one end to the other with a series of looped minor roads off the spine road to service adjacent lots.

A bridge spanning approximately 50m over a gully is proposed to Precinct 2 ("the island"). The depth of the gully in this location is approximately 13m at its deepest point. The bridge geometry and its foundation supports have been designed and positioned to avoid disturbance to the underlying gully watercourse. A second crossing to Precinct 2 is proposed to the south from Precinct 3 which will be a fill embankment and culvert. The gully is much shallower in this location (approximately 6m) and there is no flowing waterway so a bridge is not necessary.

The road geometries and intersections (including roundabouts) have been assessed by Traffic Design Group and are compliant with HCC ITS – Section 3 'Transportation' standards and Austroads.

Some of the proposed residential lots will have relatively steep gradients, however, the road design allows vehicle access to all sites with no more than 1 in 20 driveway gradients. Vehicle crossings will be formed as part of the civil construction works, rather than at building consent stage. Location and geometry of the vehicle crossings also considers integration between the crossings, stormwater devices (bio-retention), indented car parking and landscaping. Jointly owned private access ways will also be constructed as part of the development works.

2.4.1 PATH AND CYCLEWAYS

As part of the proposed development, a river corridor esplanade reserve will be provided containing a 3m wide shared path/cycleway network with the ability to be extended to connect to the wider regional 'Te Awa River Ride'. In locations where it is not practical to construct the shared path within the esplanade reserve (for instance due to

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topography), a 3m wide shared path will be provided within the road reserve in the adjoining river edge road and linkages will be made between the off-road and on-road sections.

The cycleway infrastructure will also provide east-west connections between the recreational cycle access along the river corridor and the shared path along the section of Peacockes Road that is proposed to be upgraded. In addition, a 2-2.5m shared path is proposed on the eastern side of the rural section of Peacockes Road north of the site to link the site to the existing urban area.

The path network enables easy cycle and pedestrian connectivity to the Waikato River edge.

2.4.2 PARKING

A parking ratio of 1 carpark for every 3 residential lots has been provided throughout the development in the preliminary engineering design. This ratio will be maintained as a minimum and further detailed at detailed design stage.

The HCC ITS and district plan are both silent on on-street car parking requirements. The 1:3 ratio is consistent with the recommendations in the Integrated Transport Assessment prepared by Traffic Design Group.

2.4.3 ACCESS WAYS

The subdivision layout has been designed to avoid rear lots wherever possible. Eight jointly owned access lots (JOALs) will be provided throughout the development to service rear lots or front lots that will have rear laneways.

The proposed access ways will be a formed of concrete driveway and grassed berm similar to the Edge Lane form proposed in the structure plan. The access ways will remain in private ownership rather than being vested to Council due to minimal berm width which ensures the buildable area on the adjacent lots is maximised.

Grades of the access ways will be managed to be no steeper than allowed for a private driveway, and where practicable to be no steeper than that allowed for a local street.

2.4.4 STREET LIGHTING

Street lighting will be detailed in the detailed design phase at Engineering Plan Approval stage of the project. Lighting will be designed in accordance with Section 3.2.20 of the HCC ITS and will be Category P. An energy efficient LED lighting design for all roads and park paths will be provided at a later date and will include consideration of the areas of the site adjacent to the river where bat sensitive lighting will be required as recommended in the ecological assessment.

2.5 PAVEMENT DESIGN

The pavements for all roads will comprise of a flexible pavement made up of an asphaltic surface, kerbs both sides, aggregate base course and subbase founding layer.

The pavement depths will be designed in accordance with Section 3.2.12 of the HCC ITS and the recommendations contained within the Geotechnical Report prepared by Engeo. The road pavements will be designed to cater for an ESA of 10,000 vehicle movements per day, based on the recommendations provided by Traffic Design Group.

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The Engeo report indicates a variable range of underlying soils types with expected low strengths in the order of CBR 2-3%. A typical pavement depth of 400mm is recommended with the weak subgrade areas stabilized with a cement/lime mixed into the top 300mm layer of subgrade. Alternative subgrade improvement methods are available if required.

JOALs will consist of a concrete pavement and underlying subbase layer with a utility service berm on one side.

2.6 DRAINAGE AND SERVICES WITHIN ROAD CORRIDORS

Stormwater runoff from road carriageways will be captured by a hybrid catch pit, piped, bio-retention, soakage system as detailed within the drawings and stormwater section of this report.

Where longitudinal grades are flat, bio-retention devices will treat and dispose stormwater run-off via soakage. Where longitudinal grades are steep, precast raingarden units will be installed within road berms to cater for the treatment and disposal requirements. In the event of an overflow of these primary devices a conventional piped network has been designed, with flows in excess of a 10 year storm event directed down carriageways to adjacent waterways.

All services within the carriageways and other pavement areas will be backfilled with hard fill to avoid long term settlement and subsequent damage to road surfaces.

Refer to Section 5.0 below for further stormwater drainage and mitigation details.

3.0 WASTEWATER

3.1 GENERAL

This section of the report outlines the proposed wastewater infrastructure servicing of the Amberfield development.

The development's internal wastewater network will comprise of gravity service mains, laterals and pump stations with rising mains. Three satellite pump stations and a main pump station will collect wastewater from the development. The main pump station will discharge to HCC's existing wastewater network.

Refer to the following plans in **Appendix 1** for an overview of the proposed wastewater system for the Amberfield development.

TABLE 3.1: TABLE OF WASTEWATER PLANS

DRAWING NO.	TITLE
141842-3001-3023	Wastewater Gravity Mains Detail Plan Sheets
141842-PS100, PS200, PS300, PS400	Pump Station Plans
141842-WW500-WW514	Main Pump Station Trunk Rising Main
141842-WW520-WW525	Satellite Pump Station Rising Mains

3.2 CAPACITY OF COUNCIL SERVICES

Two potential options for the wastewater discharge location in the existing network were discussed with HCC – the 'Eastern Option' and the 'Western Option'. We understand that there are still ongoing discussions with HCC to determine the peak discharge flow rate from the development and to confirm the discharge location. Our design of the main pump station and rising main is based on the Eastern Option.

Long term, the main Amberfield pump station will only pump to Weston Lea Drive where it will discharge into a gravity pipe flowing to the proposed Peacockes Transfer Pump Station, once this is commissioned. The Peacockes Transfer Pump Station is to be constructed and commissioned by HCC in the future.

3.2.1 EASTERN OPTION

This option involves the main Amberfield pump station rising main discharging into HCC's proposed Far Eastern Interceptor (FEI), near Crosby Road. The length of the rising main is approximately 8.6km and consists of two different sized pipes (to be confirmed at detailed design stage):

- 280 OD from the pump station to the north bank of the river (approximately 2.6km)
- 355 OD from the north bank of the river to the discharge near Crosby Rd (approximately 6.0km long). This is to be a combined rising main with incoming flows from other parts of HCC's network.

3.2.2 WESTERN OPTION

The option of discharging into HCC's Western Interceptor via the Lorne St Pump station was investigated. We understand that this is not HCC's preference, however, modelling was carried to confirm the design parameters if this option goes ahead.

The modelling showed that pumped flow rates from the main pump station will need to be restricted and that this pump station requires storage to balance wet weather flow peaks and to allow for off-peak pumping, in addition to emergency storage (approximately 3,000m^3 total).

This option would not be a viable long solution because of the likelihood of increased overflows within the Western Interceptor system during heavy wet weather. HCC would require all flows from the Peacockes Structure Plan area to be pumped into the FEI in the long term.

3.3 DESIGN CRITERIA

The sections below identify the design considerations that will be assessed during the detailed design of the wastewater network for the Amberfield development.

3.3.1 CATCHMENT DESIGN

The wastewater gravity service main, pump station and rising main installed as part of Amberfield development have been designed with all future flows accounted for. This includes:

- All residential lots with the Amberfield boundary
- An allowance for commercial town centre development (assumed to be the same density as residential)

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- An additional 6.4ha area to the northwest of the Amberfield site, assumed to eventually be developed at a residential density and flow into the Amberfield catchment.

- An additional 22.8ha area to the south of the Amberfield site, assumed to eventually be developed at a residential density and flow into the Amberfield catchment.

The design flows for the Amberfield development, and consideration of future precincts, will be based on Section 5 of the HCC ITS – Section 5 Flows have been calculated based on known proposed lot densities rather than using the area method.

3.3.2 WET WEATHER FLOWS

The wastewater infrastructure will be designed to minimise infiltration and direct ingress of stormwater into the system. However the sizing of the system does allow for peak flow infiltration allowances in accordance with Table 5.2.4 of the HCC ITS.

3.3.3 FLOW VELOCITIES

Gravity Systems

To ensure self-cleaning of the gravity network, the minimum pipe grades will be designed to Table 5.4 of the HCC ITS. For the Amberfield development, this requires 0.55% and 0.33% for 150 diameter and 225 diameter gravity mains respectively.

Rising mains

Design velocities will ensure solids are not left to settle within pipes. Good practice is to try and achieve velocities of 1-2m/s where possible. The HCC ITS states a minimum velocity of 1m/s for self-cleaning.

The design will also achieve a maximum velocity less than 3m/s.

3.3.4 DESIGN LIFE

All wastewater infrastructure, with the exception of mechanical and electrical components, will be designed to have a design life of 100 years, as per Section 5.2.1 of the HCC ITS.

3.3.5 PIPE ALIGNMENTS

The pipe alignment will be designed in accordance with the HCC ITS.

Road Corridor

Wastewater gravity pipes within the road corridor will be located 2m out from the kerb line where possible. Wastewater rising mains for the three satellite pump stations will also be located within the road corridor, generally 0.7m out from the kerb line.

Where road crossings are required, an angle of 45 degrees or more shall be designed for, to reduce the extent of pipework and reinstatement needed to cross the road.

Main Amberfield Pump Station Rising Main

We understand that the alignment of the main Amberfield pump station rising main is currently being discussed with HCC and will be confirmed at the detailed design stage.

Parent Lots and Superlots

Some of the residential lots have been included in 'parent lots' and are intended for medium density development (such as duplexes and terraced dwellings). In addition,

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two superlots are proposed for the town centre which will be subject to future subdivision and development.

Where any wastewater gravity pipes may pass close to buildings with road frontage, that is, shops or apartments within the parent/superlots, minimum separation distances will be provided as per Table 5.7 of the HCC ITS. This will ensure building foundations are not compromised if at any time in the future a pipe needs to be exposed for repairs or renewal.

3.3.6 LIFE CYCLE COST

The life-cycle-cost to build and operate the wastewater network will be kept to a minimum. One of the major costs of running the network is the pumping and treatment of wastewater. This can be greatly reduced by ensuring infiltration and ingress (I&I) is minimised, by use of modern UPVC pipe with rubber ring jointed system and good quality control during construction.

Other water reduction measures will be employed during the house construction including installing roof runoff water tanks for use in gardens and emergencies and low flow plumbing fittings for internal water fixtures and facilities.

3.3.7 RESILIENCE

The resilience of the system will be given consideration during detailed design. Consideration will be given to pipe materials used, and their performance under seismic loading.

ICMP Strategic Objective 7 – Wastewater generation is minimised and discharge managed so that there are no adverse effects on HCC's existing infrastructure network and natural environment.

Section 8.4 of the SC-ICMP acknowledges the system will be under pressure in the future so volume minimisation will also be beneficial. Options such as grey water re-use at source maybe considered in the future however due to their complexity, environmental and health concerns, these options are not currently preferred.

3.3.8 EXTENT OF WORKS

The wastewater network for the Amberfield development will, for the gravity mains and satellite pump stations, be within the development boundary and Peacockes Road corridor.

The rising main for the main pump station will extend outside of the site to HCC's designated discharge point.

3.4 DESIGN FLOWS

In designing the wastewater system, consideration will be given to the fully developed Amberfield subdivision, along with additional areas assumed to be in the main pump station catchment (see above), so that the main Amberfield pump station (PS4) is adequately sized.

The wastewater system will be designed to provide sufficient capacity for wet weather flow, without surcharge.

The calculation of design flows during detailed design will be confirmed by consultation with HCC.

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3.4.1 TRADE WASTE

It is not anticipated that there will be any trade waste discharges from the development.

3.5 WASTEWATER NETWORK

3.5.1 AMBERFIELD SUBDIVISION

The wastewater system for Amberfield development will consist of the following, which are each described in more detail in the sections below.

- Gravity service mains (150 to 225 diameter uPVC, sizes confirmed during detailed design).
- Three satellite pumping stations (PS1, 2 and 3).
- Main Amberfield pump station (PS4).

3.5.2 GRAVITY SERVICE MAINS

The gravity service mains collecting flows from property laterals will be designed in accordance with the HCC ITS. All dwellings will be serviced by gravity laterals.

The wastewater system will have spare capacity to cater for additional dwellings and other development on the parent lots and superlots.

3.5.3 PUMP STATIONS

The four pump stations servicing the development will be designed in accordance with the HCC ITS, with design flows being confirmed by consultation with HCC during detailed design. Pump stations will be built progressively to service the respective stages of development.

The southern end of the access road to the main Amberfield pump station (PS4) is currently shown over a minor watercourse. The access road will be realigned at the detailed design stage so that it is clear of the minor watercourse.

Preliminary flow rates and 9-hour emergency storage volumes for each of the pump stations are shown in the table below.

TABLE 3.2: TABLE OF PUMP STATION DETAILS

SERVICE TYPE	PRELIMINARY DESIGN FLOW (L/S)	9 HOUR EMERGENCY STORAGE VOLUME (M)
Pump Station 1	7.8	50
Pump Station 2	8.1	60
Pump Station 3	9.1	65
Pump Station 4 (main)	52.1*	369*

* Discussions with HCC are currently being carried out to confirm these design parameters.

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4.0 WATER SUPPLY

4.1 GENERAL

4.1.1 TRUNK WATER MAINS

Trunk water infrastructure installed under the Amberfield civil works will follow the recommendations from Jacobs' Water Supply report. A 250 OD PE trunk water main will be installed along Peacockes Road, from the water treatment plant's DN750 bulk supply outlet on Waiora Terrace Road.

Connections to this bulk main, to service the Amberfield development, will be made at limited points to provide supply to the local reticulation.

An additional DN150 trunk main will be installed parallel to the DN250 main (on the opposite side of Peacockes Road) to act as a resilience main, running from the water treatment plant to the first Amberfield access road. This trunk main will also provide a cross-connection to the existing DN63 main on Peacockes Lane to boost the pressure to rural dwellings in this area.

Approximate lengths of trunk water mains within Peacockes Road are as follows:

- 250 OD PE – 3.3km
- 150 OD PE - 1.4km long.

4.1.2 INTERNAL RETICULATION NETWORK

Within the Amberfield development, standard water main and rider main configurations will be installed. The HCC ITS – Section 6 will be met through the design of this infrastructure.

4.1.3 FIRE HYDRANTS

Fire hydrants have been located within a distance of 135m of each other to conform to the FW2 requirements of SNZ PAS 4509:2008, the New Zealand Fire Service Firefighting Water Supplies Code of Practice.

4.2 ALIGNMENT

All water mains and connections will be designed, constructed and commissioned in accordance with the HCC ITS.

For an overview of the water supply to the site, and for the internal reticulation network, refer to the following plans in **Appendix 1**.

TABLE 4.1: TABLE OF WATER SUPPLY PLANS

DRAWING NO.	TITLE
141842-WS600-WS606	Water Supply Trunk Watermains
141842-4001-4023	Water Detail Plan
141842-4201-4202	Watermain Standard Details

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4.3 CAPACITY OF COUNCIL SERVICES

Jacobs' Water Supply report recommends a connection to the water treatment plant's DN750 bulk supply outlet. The report states that this has sufficient flow and pressure to supply properties for the Amberfield development.

SC-ICMP Strategic Objective 9 Water Networks accommodate growth in accordance with water conservation and demand management objectives and potable water consumption is managed to minimise peak and total demand.

Section 9.4 of the SC-ICMP provides options for water conservation techniques. Rainwater harvesting using tanks on each private lots is currently proposed. Other techniques such as greywater recycling technologies and low flow plumbing fittings, can be implemented using planning controls in the District Plan for on-site water efficiency measures; however these techniques are not presented in detail within this application.

4.4 MODELLING

Water pressure modelling using EPANET or WaterGEMS software will be carried out at the detailed design stage. This modelling will ensure all properties within the Amberfield development will have sufficient water pressure, that is, well above the minimum 100kPa and 25 l/min required in the HCC ITS.

The water model will be created during the detailed design phase of the development, and will assess all likely flow scenarios, including firefighting flows.

4.5 MAINTENANCE

The following considerations have been given to maintenance of the water supply assets and will be addressed during detailed design:

- Root protection along landscaped areas to protect pipelines from damage by tree roots.
- All mains within access ways will be covered by an easement in gross in favour of HCC to ensure access to the pipe at all times.
- Location and servicing of air valves.
- Scouring of the trunk water mains, and discharge of water to an appropriate point.
- Location of valves and ability to isolate sections of the water main for servicing, with minimal impact on the network.
- Materials will be compliant with the HCC ITS, with a preference for PE pipes for all locations.

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5.0 STORMWATER

5.1 BACKGROUND

The stormwater design follows the guiding principles outlined within the Sub-Catchment Integrated Catchment Management Plan (SC-ICMP) prepared by AWA in particular the preferred HCC stormwater management disposal hierarchy of managing stormwater runoff at source by retention and soakage.

We understand that a suite of preliminary stormwater management solutions were presented at a Best Practicable Options workshop with Hamilton City Council and other relevant stakeholder attendees. The best practical options are discussed further in the SC-ICMP in Section 14.

The engineering design solutions outlined in this application are aligned directly with the solutions presented conceptually in the SC-ICMP. As such the appropriate mitigation measures that were identified to address the environmental impacts of the proposed development have been incorporated into the design as shown within the consent drawings with supporting information provided in this report.

The stormwater solutions can be summarised as:

1. Following the best practice stormwater hierarchy outlined in the HCC ITS – Section 4 (now mostly incorporated into the Draft Regional ITS [RITS]) and the Draft Waikato Stormwater Management Guidelines (intended to replace TP 10)

2. Stormwater controlled at source on private lots using on site water efficiency measures to firstly minimise demand (water, wastewater), then re-use for gardens and emergencies (stormwater), then treat and dispose to ground (soakage devices).

3. Runoff from the roof will be directed to a rain tank connected via an overflow to on-lot soakage devices. Where technically feasible, runoff from driveways and other hardstand areas will be directed to soakage devices.

4. Water quality treatment using bio-retention devices within the road reserve.

5. Primary flows up to the 10% AEP event managed within soakage trench devices and disposed to ground within the road reserve. In doing so providing additional level of water quality treatment.

6. Secondary flows up to the 1% AEP + CC managed within the road reserve. Depths and velocities will be managed in accordance with the flood hazard matrix and flood risk objectives outlined in the RITS, as well as Waikato Stormwater Management Guidance and the Regional Flood Modelling Specification.

7. 50% AEP 'interim' pipe reticulation to manage flows during the construction phase to safeguard the WSD devices (bio-retention/soakage trenches) prior to bringing them online. **Long term this reticulation network will only 'kick in' when the capacity of the primary soakage system is exceeded**. Refer to the SC-ICMP Section 7.4 "System Protection" for further details.

8. A limited 10% AEP reticulated network linking with the 50% AEP network (sized accordingly) to service steeper road areas (following treatment within modular raingardens within those steeper areas) where a soakage trench system is not feasible.

This system will firstly capture (via drop kerb and channel), treat and then dispose of the majority of stormwater that is generated within the proposed development (up to the 'primary' 10% AEP flow). The excess water ('secondary' flow up to the 1% AEP + CC event) will be conveyed via the road network to the most appropriate low point before spilling across the riparian margin (within an appropriately shaped berm/swale with flat side slopes) to the Waikato River. All of the stormwater from privately owned lots (roof, driveways and hardstand) will be collected within a rain tank and then overflow, treated and disposed at source, via soakage devices located within each lot.

Through the use of bio-retention devices the stormwater will be treated effectively before soaking to the ground to continue to recharge groundwater. This solution is therefore likely to provide a level of treatment above that specified in the guidance because following bio-retention and/or pre-treatment, soakage in itself provides a high level of treatment (noting the groundwater levels are likely to remain well below the base of the trench).

The Amberfield groundwater catchment area is obviously very small in relation to the overall Waikato River recharge zone. Notwithstanding, the objective to maintain recharge and groundwater levels is considered best practice and most importantly results in a runoff volume loss discharged to the Waikato River. Returning runoff to ground aligns strongly with the cultural and spiritual aspects of managing rainwater runoff close to where it falls at source.

To re-cap, private lots will be managed at source with soakage devices. Water quality treatment (volume allowance in accordance with the HCC ITS) for public roads will be provided using bio-retention devices. Primary (10% AEP) flows then within a sub-surface soakage trench apart from a small number of steep road catchments which will connect to a pipe network following treatment within precast raingardens.

Secondary flows up to the 1% AEP + CC will be conveyed within the road corridor to low points and then managed within broad flat sided swales through the riparian margin to the Waikato River. Refer to the following plans in **Appendix 1**.

TABLE 5.1: TABLE SHOWING PRELIMINARY STORMWATER PLANS

DRAWING NO.	TITLE
141842-2001-2023	Stormwater Detail Plan
141842-2201	Stormwater Outlet Details
141842-2212-2217	Bio-Retention Devices Details
141842-2301-2323	100 Year Overland Flow Path Plan
141842-01-2331-2353	Bio-Retention Devices Catchment Plan

5.2 PRIMARY STORMWATER SYSTEM

5.2.1 OVERVIEW

As outlined in the background section, the options for capture, treatment and conveyance of stormwater (up to and including the 10% AEP) within the subdivision, consist of stormwater bio-retention devices linking to a sub-surface soakage trench. A 50% AEP piped network to conventional headwall outfall points will be provided as an interim management solution prior to the full bio-retention and trench network coming online once construction is completed.

This interim design is to protect the bio-retention and soakage network from sediment blockage and degradation due to construction operations at either sub catchment, super lot and/or individual lot building level. The bio-retention devices will be lined with a sediment control blanket during the construction phase that will allow an element of

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filtered soakage through the base of the device while protecting the intake (scruffy/grate) to the sub-surface soakage trench.

5.2.2 WATER QUALITY TREATMENT

a) The design parameters below support the Proposed Stormwater Design Statement in the SC-ICMP Sections 7.2 to 7.4.

b) Bio-retention will generally be located in the berm for roads with gradients less than 5%.

c) Precast rain garden units will be used to manage surface water within road reserves with gradients greater than 5%. Precast units (HYNDS or similar) will have an open base in order to allow disposal to ground with an overflow pipe to an adjacent sump. This pipe will be connected to the 10% AEP piped system.

d) Soak holes – all lot owners will have a soak hole (sized to accommodate the 10% AEP critical duration event) which will discharge directly to the ground - supported by the soakage methodology in the SC-ICMP (Section 7.2). The implementation of on lot devices will be controlled via consent notices registered with HCC.

e) The outfall structures for the 50% AEP interim network will be a low-profile design with suitable erosion control at the outlet. Visual impacts will be reduced, and discharge velocities will be minimised to protect against erosion or damage to the Waikato River bank.

f) Runoff from Peacockes Road will be managed using the same guiding principles outlined in the SC-ICMP and within this application ie. bio-retention treatment followed by primary soakage disposal.

5.2.3 TREATMENT DEVICE SIZING

The SC-ICMP provides preliminary sizing calculations for the soakage trench and for the bio-retention devices. Currently the bio-retention devices have been sized based on the grass TP 10 WQV swale sizing (sized approximately 30% of the road reserve catchment). The consent plans therefore show fragmented bio-retention areas with a combined treatment area designed to match the total area required for grass swales based on sizing tables provided in the SC-ICMP.

This presents somewhat of a mismatch because the intention is not to provide for ‘grass swale’ treatment and conveyance throughout the development site. The intention is to provide bio-retention for treatment. The areas shown in the drawing can therefore be viewed as conservative compared to the areas that will be actually be required for treatment via bio-retention.

The final area (footprint) required for bio-retention treatment will be determined at detailed design and at that time further thought will be given to accommodating additional car parking spaces and street trees working alongside our design partners - Boffa Miskell.

To support this approach, an example ‘bio-retention’ treatment footprint is provided with this report (Section 5.2.4) to highlight the reduction in footprint that can be achieved when switching from a grass swale treatment to a more intensive bio-retention treatment.

In summary, while the position of treatment devices has been broadly determined, the final infrastructure details and sizing will be undertaken during a subsequent detailed design stage and this will be a refinement of the sizes provided in the SC-ICMP.

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The bio-retention devices will either comprise of a 45° natural battered raingarden/bio-retention swale or a Hynds precast concrete raingarden unit (or similar) with channel and drop kerbs to allow for stormwater inflow.

The bio-retention devices will store and filter the stormwater through a media layer before soaking into a gravel underdrain layer via a heavy duty perforated PVC pipe wrapped in filter fabric. For larger flows up to the 10% AEP event, when the bio-retention devices are at capacity, flows will access the sub-surface primary soakage trench via a scruffy dome or letter box grate or similar which will sit proud of the base (mulch layer) to allow for live storage.

It is also proposed that all stormwater runoff from private lots will be treated via an onsite soak hole. This system will comprise of a privately owned cesspit which will capture water from hardstand areas such as driveways before being piped to the soak hole.

5.2.4 BIO-RETENTION SIZING EXAMPLE BASED ON THE ITS

An example road sub catchment is used below to illustrate the difference in bio-retention sizing (conceptual to engineering approval). The current proposal (Figure 1) shows areas for bio-retention on the north side (single cross fall road) based on the AWA sizing table. However final sizing as shown below will result in smaller device footprints in the order of ~5%. This smaller footprint will provide opportunities for additional car parking areas as per the example in Figure 2.

a) Devices be sized to provide a footprint of approximately **5%** of the contributing impervious area.

b) Based on a minimum depth for the majority of the treatment layers (mulch, planting media, gravel/sand layer) – changing the live storage depth can have the effect of reducing the footprint %.

c) Assuming 80% impervious for the following sub catchment example:

This means for catchment **DCP187-1** the total bio-retention footprint is in the order of **21.3 m²** (total catchment area: 0.1020ha). For catchment **CP188-1** the total raingarden area is 22.2 m² (total catchment area: 0.1064ha).

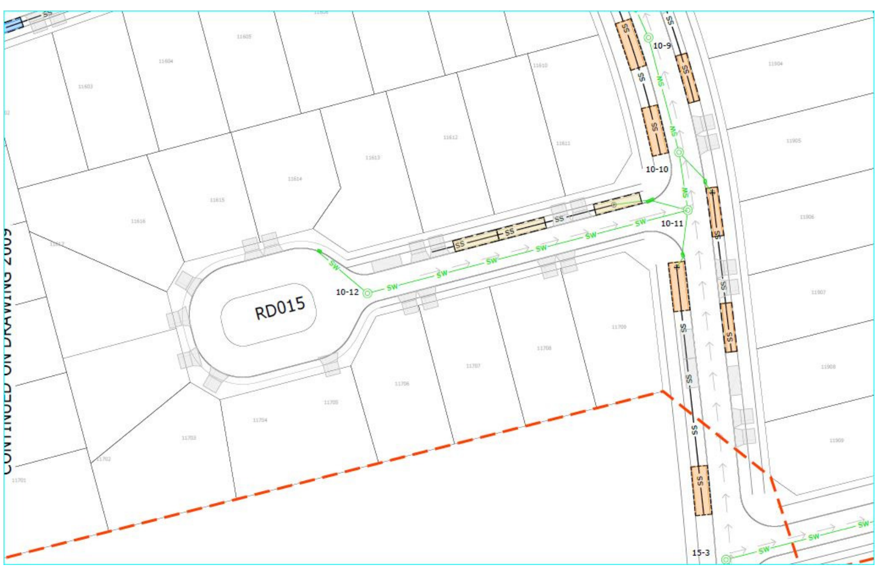

FIGURE 1: CATCHMENT DCP187-1 (ROAD CUL-DE-SAC)

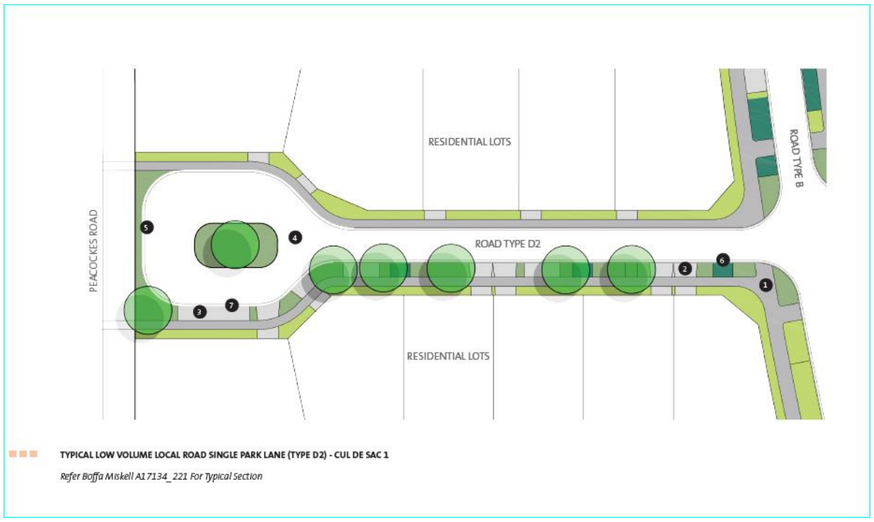

FIGURE 2: CATCHMENT DCP187-1 (ROAD CUL-DE-SAC) – BOFFA MISKELL TYPOLOGY

5.2.5 PIPED NETWORK SIZING AND OUTFALL DESIGN

While the extent of the piped network and outfall positions have been broadly determined, the final infrastructure details and sizing will be undertaken during a subsequent design stage. It is important to note, that locations, alignments and outflow impacts on the downstream environment have carefully been considered, including the Significant Natural Areas (SNAs) identified in the district plan adjacent to the river edge.

None of the proposed stormwater outlet structures will be located inside the SNA as can be seen on the stormwater drawings. The only structure that will be within the SNA is a subsoil outlet drain. The subsoil drain will be drilled to minimise disturbance to the riverbank. It will be designed to daylight from the riverbank in a location that minimises vegetation disturbance.

Some of the outlet structures will be within the Gully Hazard Area overlay identified in the district plan. These outlet structures will be located at detailed design stage in positions to minimise riverbank vegetation disturbance. The pipes will be drilled and all materials and construction required for the outlets will be barged in via the river. The outlets will include erosion protection.

In some locations the outlet structures have been designed to be located above the river edge embankment. A Cirtex “AquaSock” extension (Figure 3) will be fitted to these outlet structures and will be rolled out down the bank and through the tree zone by hand and pinned in place. No construction machinery will be utilised within the riverbank area.

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FIGURE 3: AQUA SOCK

5.3 SECONDARY STORMWATER SYSTEM

The existing flood hazard associated with flows from the Waikato River (WRC regional model) and from localised runoff (AWA Environmental) is discussed within the SC-ICMP (Section 7.1 and Flood Risk Report Appendix G). The flood risks have been discussed and managed during the SC-ICMP process and therefore the earthworks model and resulting floor levels will be in alignment with the flood risk management strategy.

For post development, secondary overland flow paths have been considered in preparing the scheme plans and general earthworks concepts. The overarching solution is to manage overland flows by containment within the road reserves, with "spills" down into the lower gullies where appropriate, and in an engineered manner that will minimise damage to the environment.

For engineering approval, further hydraulic modelling will be undertaken (once all aspects of the layout are finalised). This modelling will route flows along the road in order to generate maximum depth and velocity maps.

Flows up to the 1% AEP + CC event will be managed in accordance with the relevant guidance in terms of the maximum depth and velocity to ensure adequate freeboard levels are maintained to property and to ensure safety of roads users (pedestrians and cars). Secondary flow paths are provided in the drawing set.

Secondary overland flow from lot soakage devices will occur during exceedance events. Flow paths will either spread locally within each lot and eventually infiltrate back to ground or during more intense events, discharge to roadside conveyance network. Soak holes will be positioned in accordance with NZBS E1 and set away from the building foundation on the downslope of each lot.

A 1% AEP + CC event has been undertaken using 12d Software and 1D road cross-sections and the sub catchment plan. Preliminary results - for the largest overland flow discharge point – show a peak flow of 1.75m3/s. All other outlets are at least 50% smaller than this value.

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6.0 UTILITY SERVICES

Existing overhead communications and low voltage electricity services are located along the full length of Peacockes Road adjacent to the western site boundary with overhead electricity transformers mounted on some of the utility service poles. A low voltage overhead electricity line traverses the site through Precinct 1 and across the Waikato River to the industrial area in Riverlea. This line will be replaced with an underground power line to be located within the common utility service trench within the road berm.

The existing overhead Peacockes Road services will be replaced with new in-ground services including; electricity, communications, new gas and trunk water main in the eastern berm of Peacockes Road. The common utility services trench will be installed to contain these services at sufficient depth and location suitable for both the existing berm levels and future levels to avoid future realignment at a later date. The overhead services will be under-grounded and new services installed within Peacockes Road as the Amberfield development is progressively constructed.

All new utility services within the Amberfield development will be installed within common utility services trenches within the rear berm of all roads as generally shown on the road cross-sections contained within the engineering drawing set.

All roads including Peacockes Road, that will contain a common utility service trench, will meet the district plan requirements of having adequate width to accommodate services with required separation between service types.

All service providers have been supplied with an indicative scheme plan layout. All of the network utility operators, being WEL Networks (electricity), Chorus and Ultrafast (telecommunications) and First Gas, have confirmed the site can be serviced based on lot yields provided by HG. Refer to **Appendix 5** for service provider correspondence.

7.0 EARTHWORKS

7.1 PHILOSOPHY

The earthworks design has considered reducing the level of soil disturbance within the site and in particular near the river bank, during all stages of the development. The extent of secondary earthworks required (at the dwelling construction stage) will be reduced by contouring the land during the initial bulk earth working phase in a manner that provides suitable building platforms, reducing the need for retaining walls or other extensive cut and fills to enable building construction.

The site’s existing topography encompasses a number of broad river terraces with steep transition between terraces and large, steep free face slopes close to the Waikato River. A more comprehensive site description is given in the Geotechnical Investigation Report (GIR) prepared by Engeo.

This earthworks design approach has also been reflected in the proposed stormwater management, which has tried to match the site’s current catchment areas, overland flow paths and discharge points as closely as possible.

The varying soil conditions identified within the GIR across the site have been taken into consideration when determining the bulk earthwork volumes and finished surface levels. Mitigation measures to avoid ongoing or future geotechnical issues will include weak road sub-grades improved with cement/lime stabilization. High ground water lowered with counterfort drainage, unstable batters stabilized with reinforced earth batters, or other appropriate engineered solutions as recommended in the GIR. Other areas of weak or unsuitable fill material will be mixed, dried and or condition with better quality material from within the site to ensure a high standard of earthworks is carried out.

A full earthworks specification will be developed during detailed design, and will form part of the earthworks contract.

It is anticipated that there will be close to a cut-to-fill earthworks balance across the site. A surplus of excess cut material will be utilized to landscape reserve areas and areas with high water tables as preload to reduce the risk of long term settlement. Some of the fill material with higher porosity will be mixed to form a composite fill in areas that are not so freely draining in order to improve the soakage rates of the in situ clay materials.

All earthworks and silt/erosion control works and associated activities are located clear of the SNA and protected trees and will be vigilantly monitored by a suitably experienced and qualified Engineer during construction works.

7.2 VOLUMES

The earthworks drawings in **Appendix** 1 provide an overview of the extent and scope of earthworks required to complete the development.

TABLE 6.1: TABLE OF PRELIMINARY EARTHWORK PLANS

DRAWING NO.	TITLE
141842-1046	Staging Plan
141842-1101-1106	Erosion and Sediment Control Plan
141842-1201-1206	Earthworks Cut/Fill Plan
141842-1211-1216	Finished Contour Plan

The table below provides preliminary earthworks volumes (solid in place) for Amberfield. A bulking factor of 1.2 will be used when calculating actual volumes of cut and fill, prior to any works starting on site. When bulking factors, topsoil strip and replacement volumes are factored in, the surplus volumes calculated will likely be significantly reduced.

TABLE 6.2: PRELIMINARY EARTHWORK VOLUMES ACROSS THE FULL SITE

ACTIVITY	VOLUME (M)
Cut	780,000
Fill	630,000
Surplus	150,000

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7.3 ACTIVITIES

The following soil disturbing activities will be involved in the construction of Amberfield:

- Bulk earthworks including stripping top soil, carting materials, cutting, filling and compacting
- Vegetation removal
- Trenching for installation of services eg water, sewer, water supply, utilities
- Installation of piles and retaining walls
- Installation of sub-soil drainage
- Construction of stormwater inlet structures, outlet structures and erosion protection measures eg rock armour
- Road corridor formation including sub-grade preparation, base course, asphalting and footpaths.

Appropriate controls and measures will be put in place for each of the above activities, as outlined below.

7.4 EROSION AND SEDIMENT CONTROL

The site is located on the western banks of the Waikato River, south of Hamilton City. Typical land and soil issues associated with this area include soil quality, river bank erosion, and bio-diversity. These will all be assessed in further detail during preparation of the site specific Erosion and Sediment Control Plan (E&SCP), which will need to be approved by HCC and WRC prior to works commencing.

This application includes preliminary design of the necessary Erosion, Sediment and dust control measures. Refer to Drawings 141842-01-1101-1106 contained within the appendices for further information.

The E&SCP will be prepared based on:

- HCC ITS – Section 2 Earthworks and Geotechnical Requirements.
- WRC Guidelines for Soil Disturbing Activities (2009), Erosion.
- Section 2.3.7 of NZS 4404:2010.

The following key principles, which are discussed in further detail in the subsequent sections:

- Managing and controlling sediment
- Staged construction
- Site stabilisation
- Assessment and adjustment of the plan.

7.4.1 MANAGING & CONTROLLING SEDIMENT

A number of erosion and sediment control measures are proposed to be implemented for the duration of site works to generally accord with the WRC Guidelines. The figures below show the typical types of E&SC devices which will be utilised by the earthwork contractor on site to minimise and control any sediment runoff from the site. These figures have been sourced from the WRC Erosion & Sediment Control Guidelines.

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FIGURE 6.1

Runoff water diversion channels

Minimising the amount of erodible soil will reduce the loading on each of the devices, and ultimately the amount of sediment entering the river or any water course. The other key approach is keeping clean runoff separate to sediment contaminated runoff from worked areas. This will reduce the load on devices, effectively reducing the volume of water which needs to be treated prior to discharge. Typical examples include contour drains or clean water diversion channels. Clean water/dirty water diversion channels or bunds will also be used to convey the sediment laden water to the necessary sediment retention ponds.

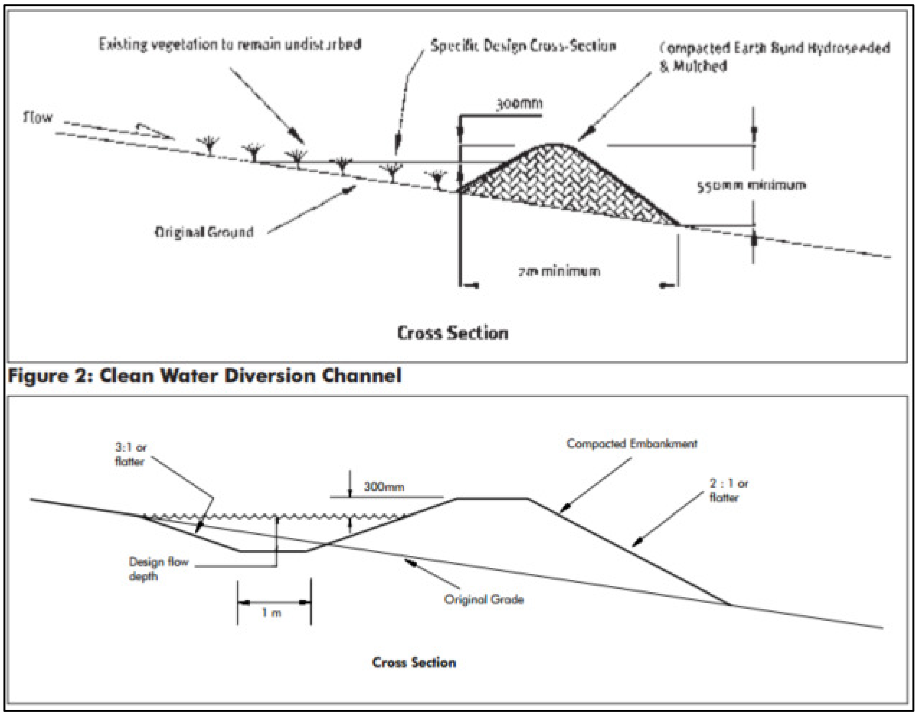

FIGURE 6.2

Water cut-off drains

Catchment areas can also be split into smaller and more manageable catchments by use of water cut-off drains. This can enable areas to be stabilised and run-off considered as clean, while other areas within the same catchment which are exposed can be diverted to devices such as ponds or silt fences.

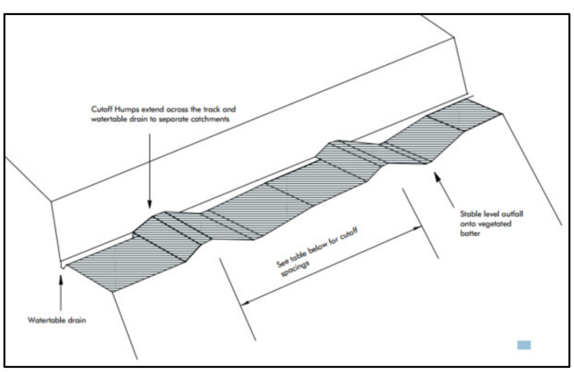

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FIGURE 6.3
Silt Fences

Silt fences can be used to intercept sheet flow ie not suitable for channelized flows or pipe discharges. The silt fence detains flows and allows sediment to settle out, and only let clean water filter through. They are cost effective and quick to erect, often used to contain an area until it has been stabilised.

Fences need to be regularly cleared of sediments which have been captured.

FIGURE 6.4
Inlet protection

As the earthworks and civil works progress, inlets will need to be protected to ensure sediments do not enter the recently installed stormwater systems.

Inlets can be protected using sock bunds, gravel filters, hay bales or geotextiles.

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FIGURE 6.5
Sediment retention ponds

Ponds will also be formed and used to treat sediment-laden runoff, reducing the volume of sediment being discharged into the environment. A decant system will ensure only clean water from the pond surface will be discharged.

Due to the presence of sandy/silty soils in some areas of the site it may be necessary to provide a liner for the detention ponds in order to provide adequate permeability rates.

The ponds will be sized to cater for 3% of the catchment. Coagulant chemicals may be used in the ponds to increase the rate of sediments settling. This will need to be assessed during construction, once the nature of the soils is better understood.

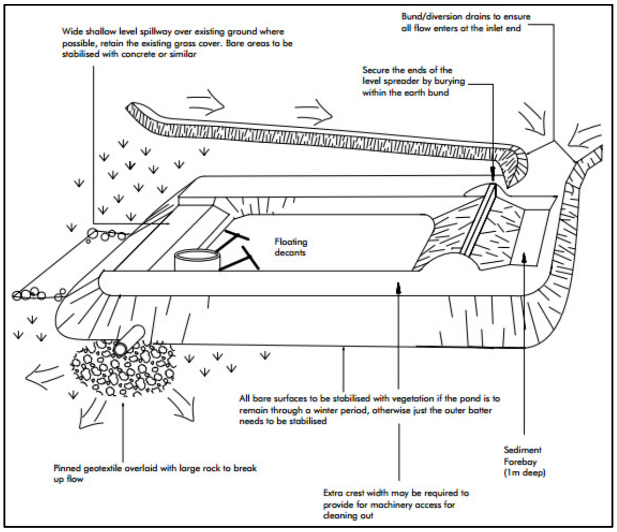

FIGURE 6.6
Sediment Pits

Sediment pits will also be utilised to treat sediment laden runoff from smaller catchments such as road corridors or tracks where sediment ponds are no longer suitable.

The pits size and location can be determined on site but are required to be at least 1m deep and every 40m for slopes less than 12%.

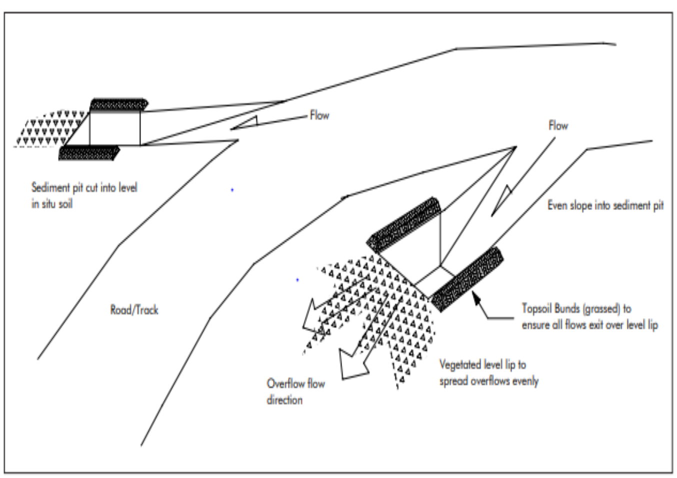

Figure 8: Sediment pits

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FIGURE 6.7

Stabilised Construction Entrance

A stabilised aggregate pad will be constructed at any point where traffic will be entering or leaving the construction site. This is to prevent site access from becoming sediment sources and help minimise dust generation and disturbance of areas surrounding the site entrance.

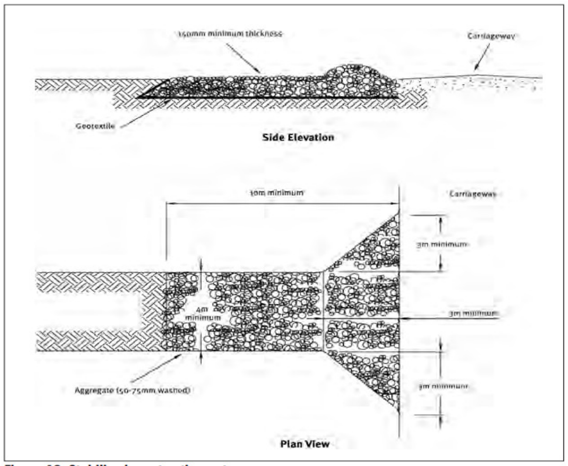

Figure 13: Stabilised construction entrance

7.4.2 STAGED CONSTRUCTION

The Amberfield development will likely be staged. As such, each progressive stage will be bulk earthworked to get as close to an earthworks balance as possible. Across most stages an exact cut-to-fill balance will not be achievable, therefore earthworks will need to extend into the adjacent stage to borrow fill material or place surplus cut material to avoid material being carted off site.

On some stages surplus cut material will need to be stockpiled for future placing as fill. Indicative locations of temporary stockpiles of topsoil and surplus clay is as identified on the Erosion and Sediment Control Plan. Stockpiles will be stabilised and run-off contained.

7.4.3 METHODOLOGY

The methodology for the proposed earthworks is as follows:

1. install clean water diversions. Clean water will initially be diverted to prevent water ingress to the area of work. This will be achieved via diversion channels or bunds, which will be sized to accommodate flows from a 5% AEP storm event.

2. construction of the silt control pond, dirty water diversion channels and/or bunds and silt fences

3. preparation of a chemical treatment plan and installation of a flocculation shed for the pond

4. asbuilting of the devices to ensure that they are adequately sized. Inspections with Council will then occur prior to any further work being undertaken on site.

5. de-watering and mucking out of the existing ponds followed by backfill under geotechnical supervision.

6. stripping of topsoil and unsuitables. Generally, stripped areas will be kept to a minimum.

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7. cut-to-fill earthworks. Exposed areas of cut and fill surfaces will be kept to a minimum to allow for an efficient earthworks operation. Works will be undertaken progressively, generally in cut/fill sequence.

8. when cut and/or fill areas reach finished levels, topsoil will be re-spread in locations that will not be affected by subsequent drain laying and road construction activities. Where possible, topsoil will be stripped directly to finished fill areas to minimise double handling.

9. stabilisation of top soiled area.

10. road and drain laying will follow the bulk earthworks. As they are completed topsoil will be re-spread and then stabilised.

11. on completion of the roading and footpaths, berms will be completed.

All earthworks will be carried out in accordance with NZS 4431 Code of Practice for Earth Fill for Residential Development and will be monitored by a suitably qualified geotechnical engineer.

7.4.4 SITE STABILISATION

Immediately following completion of a stage of earthworks, or as soon as necessary, exposed areas will be stabilised. Common methods of stabilisation that will be utilised on this site include sowing grass, hydro-seeding, geotextiles, straw mulching or co-polymer sprays.

7.4.5 ASSESS AND ADJUST

As the lay of the land will be modified during earthworks, the E&SC plan will be evaluated and modified as required. This may require additional devices to be installed, new overland flow paths and discharge points to be established, etc. Other factors such as slope steepness, soil types encountered, and weather may also require a modification to the plan. Any modification will be done in consultation with HCC and WDC.

All devices and controls will be regularly assessed by the consultant overseeing the earthworks. Instructions to make repairs or modifications will be recorded and communicated with the contractor, as well as feedback following audits of E&SC devices.

7.4.6 EROSION AND SEDIMENT CONTROL MONITORING

Erosion and Sediment Control monitoring will be undertaken by the contractor's project supervisor, the site Engineer and a Council representative. Erosion and Sediment Control monitoring will include:

1. inspection for scour and breach of diversion channels/bunds

2. inspection of stabilised construction entrance to check condition/wear

3. inspection of silt ponds for correct operation and damage

4. inspection of silt fences for areas of collapse/decomposition/ ineffectiveness

5. inspection of bunds for overtopping.

Monitoring will be undertaken on a weekly basis with increased monitoring during times of heavy rainfall. Visual checks will be conducted to ensure the quality of water in the receiving environment(s) is not compromised.

7.5 DUST

As earthworks will be occurring over the dry months, dust generation and erosion by wind from un-stabilised site areas may potentially be an issue. Dust will be suppressed by the contractor, and there are various methods which may be employed such as water carts, wheel washes, sprinkler systems, mulch or co-polymer sprays.

One of the main causes of dust will be from trucks leaving and entering the site, which may stir up dust or track dust onto the public roads. To reduce the risk of dust from vehicles, a stabilised construction entrance will be formed. This may be in the form of aggregate laid on filer cloth.

Other measures that will be applied to minimise the spread of airborne dust include controlling the route and speed of vehicles traversing the site and choosing work areas to suit wind conditions. However, if the stated measures are inadequate or insufficient then further measures may be required such as wind break fences, geo-fabric over stock piles and/or the ceasing of works until wind strength has decreased.

7.6 TESTING AND QUALITY ASSURANCE

Prior to works occurring on site, further site investigations will be carried out by the project geotechnical engineer, to confirm suitability of materials for cutting and filling. This will include laboratory testing of soils, including compaction testing, solid densities and moisture content (MC).

During earthworks on site, the geotechnical engineer will be responsible for testing and certifying the earthworks. Earthwork activities will need to be in accordance with the specific earthworks specification which will be prepared prior to works commencing.

The follow risks will be assessed during construction, and monitored and mitigated accordingly:

- presence of sensitive or allophonic soils which may require blending with more suitable soils, or optimising MC
- settlement of compressible alluvial soils in gully areas, which may require undercutting to provide a suitable sub-grade for filling
- erosion of steep slopes, which can be addressed with vegetation of some of the devices described in the E&SC section above.

In general, the anticipated soils on site for cutting filling are expected to be suitable for engineered fill. Earthworks are expected to be straight forward, requiring standard techniques and machinery.

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8.0 LIMITATIONS

8.1 GENERAL

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This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

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APPENDICES

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APPENDIX 1
PRELIMINARY ENGINEERING DRAWINGS (HARRISON GRIERSON)

(Bound separately as Appendix X in Volume 8 and 9)

DRAWING NO.	TITLE
141842-1041-1042	Road Hierarchy Plan Sheet
141842-1046	Staging Plan
141842-1301-1323	Roading Detail and Surfacing Plan
141842-1351-1382	Roading Longitudinal Sections
141842-1401-1403	Typical Road Cross-sections
141842-1601-1602	Roading Standard Details
141842-1701-1723	Road Marking and Signage Plan
141842-3001-3023	Wastewater Gravity Mains Detail Plan Sheets
141842-PS100, PS200, PS300, PS400	Pump Station Plans
141842-WW500 - WW514	Main Pump Station Trunk Rising Main
141842-WW520 - WW525	Satellite Pump Station Rising Mains
141842-WS600 - WS606	Water Supply Trunk Watermains
141842-4001-4023	Water Detail Plan
141842-4201-4202	Watermain Standard Details
141842-2001-2023	Stormwater Detail Plan
141842-2201	Stormwater Outlet Details
141842-2212-2217	Bio-Retention Devices Details
141842-2301-2323	100 Year Overland Flow Path Plan
141842-2331-2353	Bio-Retention Devices Catchment Plan
141842-1101-1106	Erosion and Sediment Control Plan
141842-1201-1206	Earthworks Cut/Fill Plan
141842-1211-1216	Finished Contour Plan

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APPENDIX 2
PEACOCKES ROAD PRELIMINARY ENGINEERING DESIGN (TRAFFIC DESIGN GROUP)

(Bound separately as Appendix V in Volume 5)

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APPENDIX 3
STORMWATER CALCULATIONS (AWA)

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AWA ENVIRONMENTAL

Memo

To:

From: Awa Environmental

CC:

Date: 13 March 2018

Re: Bioretention: Swale and Linear Infiltration Trench Design Detail

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This memo summaries the methodology used to calculate the required length of Swale for managing water quality, and linear infiltration trenches for managing primary stormwater disposal. It details the inputs used in HEC for the swale and Linear Infiltration Trench devices as below;

HEC Flow Analysis

The flows from the catchment were calculated in HEC.

Each catchment was divided into three areas:

- Residential Areas
- Pervious Road Areas
- Impervious Road Areas

Residential Areas-Impervious

The impervious component of the residential area will be disposed of via a lot soakage device – therefore this component does NOT does not need to be calculated as part of the swale Linear Infiltration Trench device sizing.

Residential Areas - Pervious

The residential areas were assessed using the plan see Figure 1.

50% of the area is assumed to go to the swale and the Linear Infiltration Trench devices.

For the residential areas the following HEC inputs were used:

Storage Ratio Residential	0.107
Initial Abstraction Residential (mm)	5
Time of Concentration Residential (hr)	0.25

Road - Pervious Area

Using schematic road plans, pervious road areas were calculated for short sections of road. This produced an average pervious area per length of road. For each subcatchment, the average pervious area was multiplied by the road length to give a pervious road area. See Figure 2.

For the road – pervious areas the following HEC inputs were used:

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Storage Ratio Pervious	0.07
Initial Abstraction Pervious (mm)	5
Time of Concentration Pervious (hr)	0.166

Road - Impervious Area

Using schematic road plans, impervious road areas were calculated for short sections of road. This produced an average impervious area per length of road. For each subcatchment, the average pervious area was multiplied by the road length to give a pervious road area for each subcatchments. See Figure 2.

For the road – impervious areas the following HEC inputs were used:

Storage Ratio Impervious	0.055
Initial Abstraction Impervious (mm)	0
Time of Concentration Impervious (hr)	0.166

HEC Output

Outputs from the HEC model of the 2yrCC peak flow and the 10yr CC volume where then input into the swales and Linear Infiltration Trench devices.

Subcatchments E_152 & C_2 are combined as the road in C_2 is very steep. The subcatchments were combined after the HEC analysis.

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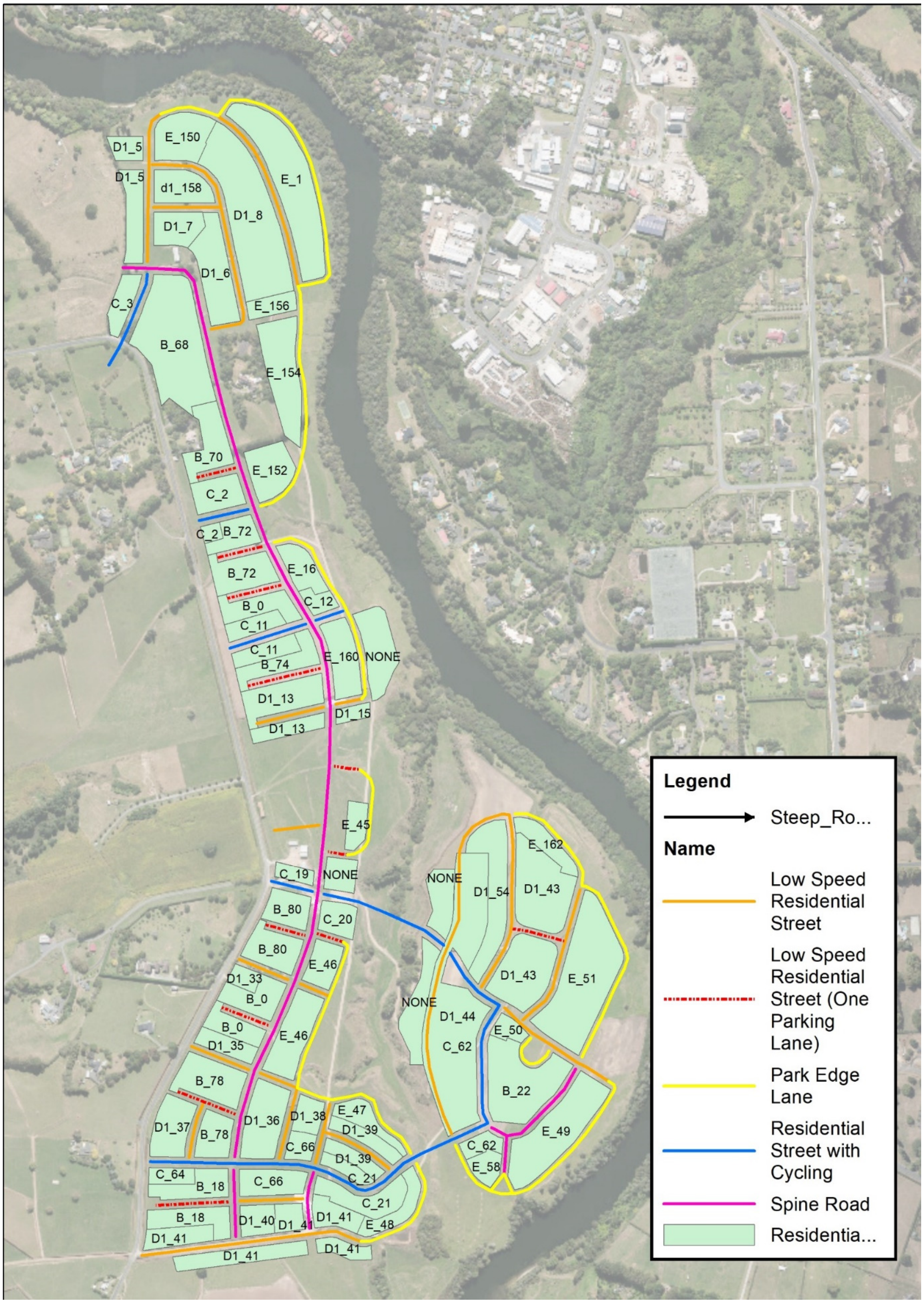

Figure 1 Residential Areas

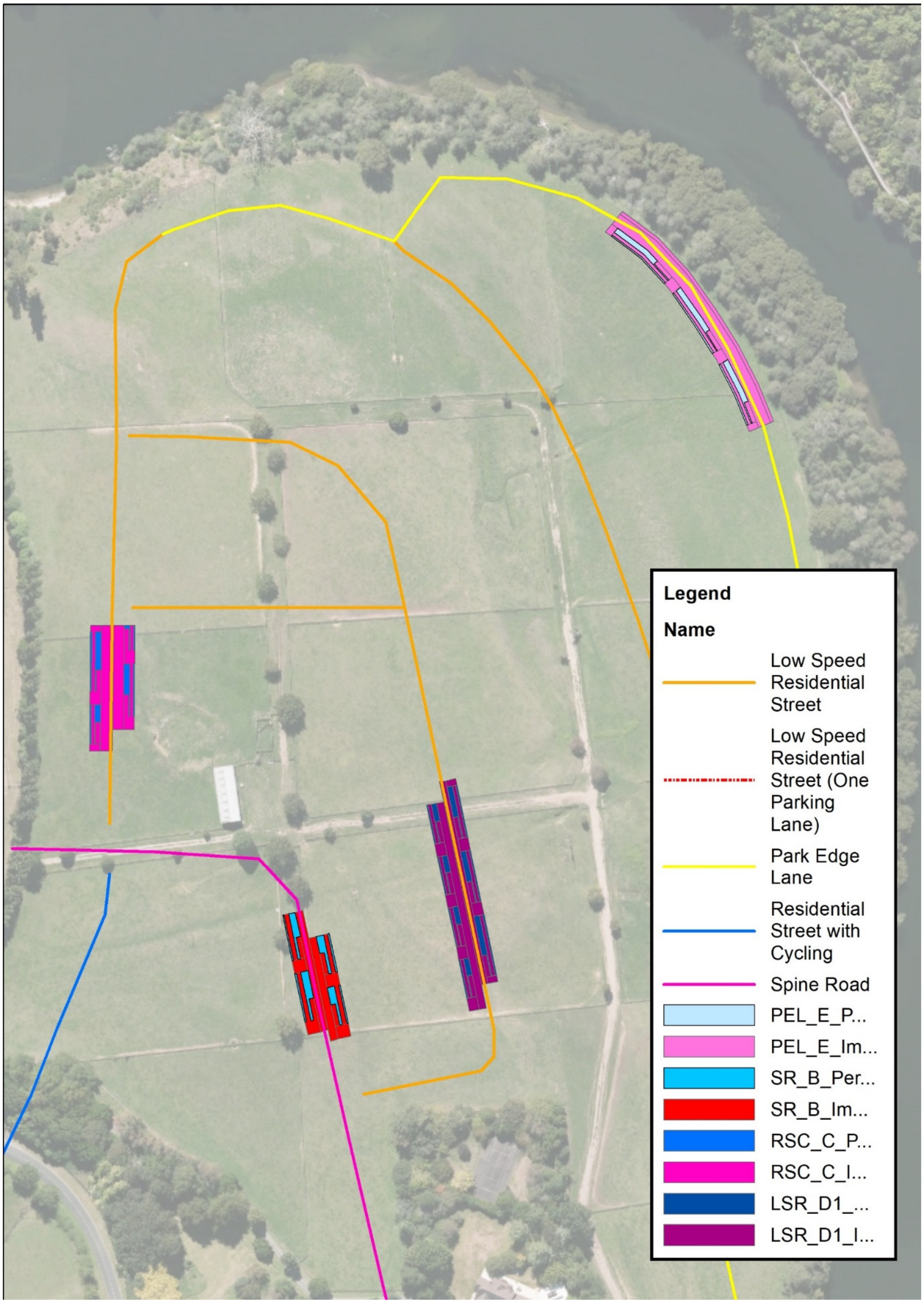

Figure 2 Sample impervious and pervious areas.

Swale Calculation

An AWA tool was used to calculate the swale dimensions. The calculation is based on the TP 10 manual (http://www.aucklandcity.govt.nz/council/documents/technicalpublications/TP10%20Design%20guideline%20manual%20stormwater%20treatment%20devices%20Chapter%209%20-%202003.pdf).

The following assumptions were made:

Slope (m/m)	0.01
Bank Slope (m/m)	4.5
Hydraulic Residence Time (mins)	9

These assumptions have not been changed from TP10.

Mannings

The roughness is calculated based on the depth, and grass height.

Grass Height

The calculation gives two options for grass height, 50mm or 150mm. Both were calculated but generally 50mm grass was found to be marginally more conservative (between 0-20% longer). For simplicity results with grass length of 50mm were shared. Table 1 shows the difference in length between a swale with 50mm grass and 150mm grass.

Swale Output

The output from the swale is the swale width, the swale length and the flow velocity for the peak flow during a two-year event.

Table 1 difference between 50mm grass and 150mm grass

	Grass Height = 150mm		Grass Height =50mm			
Road Name	Depth of Flow	Length	Depth of Flow	Length	Difference	% Change
D1_13	0.13	91.5	0.11	96.7	5.2	6
D1_15	0.075	32.7	0.07	37.2	4.5	14
D1_158	0.12	78.8	0.11	96.7	17.9	23
D1_32	0.085	41.3	0.075	50.4	9.1	22
D1_33	0.09	46.0	0.08	53.3	7.3	16
D1_34	0.07	28.8	0.067	32.1	3.3	12
D1_35	0.11	67.0	0.09	66.5	-0.5	-1
D1_36	0.14	105.1	0.12	113.8	8.7	8
D1_37	0.11	67.0	0.09	66.5	-0.5	-1
D1_38	0.1	56.0	0.09	66.5	10.4	19
D1_39	0.12	78.8	0.1	80.9	2.1	3
D1_40	0.1	56.0	0.09	66.5	10.4	19
D1_41	0.17	151.1	0.15	172.8	21.6	14
D1_42	0.13	91.5	0.11	96.7	5.2	6
D1_43	0.18	168.2	0.15	172.8	4.6	3
D1_44	0.18	168.2	0.15	172.8	4.6	3
D1_5	0.14	105.1	0.12	113.8	8.7	8
D1_54	0.17	151.1	0.14	151.8	0.7	0
D1_56	0.1	56.0	0.09	66.5	10.4	19
D1_6	0.15	119.6	0.13	132.2	12.6	11
D1_7	0.11	67.0	0.1	80.9	14.0	21
D1_8	0.18	168.2	0.16	194.9	26.7	16
B_0	0.14	105.1	0.12	113.8	8.7	8
B_17	0.095	50.9	0.08	53.3	2.4	5
B_18	0.085	41.3	0.076	48.4	7.1	17
B_22	0.14	105.1	0.12	113.8	8.7	8
B_23	0.08	36.9	0.072	41.6	4.7	13
B_68	0.16	134.9	0.14	151.8	16.9	13
B_70	0.14	105.1	0.12	113.8	8.7	8
B_72	0.15	119.6	0.13	132.2	12.6	11
B_74	0.13	91.5	0.12	113.8	22.3	24
B_76	0.15	119.6	0.13	132.2	12.6	11
B_78	0.14	105.1	0.12	113.8	8.7	8
B_80	0.13	91.5	0.12	113.8	22.3	24
E_1	0.2	204.8	0.18	242.9	38.1	19
E_150	0.12	78.8	0.1	80.9	2.1	3
E_152	0.11	67.0	0.1	80.9	14.0	21
E_154	0.15	119.6	0.13	132.2	12.6	11
E_156	0.085	41.3	0.075	50.4	9.1	22
E_16	0.13	91.5	0.11	96.7	5.2	6
E_160	0.13	91.5	0.11	96.7	5.2	6
E_162	0.13	91.5	0.11	96.7	5.2	6
E_45	0.13	91.5	0.11	96.7	5.2	6
E_46	0.16	134.9	0.14	151.8	16.9	13
E_47	0.14	105.1	0.12	113.8	8.7	8
E_48	0.13	91.5	0.11	96.7	5.2	6
E_49	0.16	134.9	0.14	151.8	16.9	13
E_50	0.1	56.0	0.09	66.5	10.4	19
E_51	0.17	151.1	0.15	172.8	21.6	14
E_52	0.065	25.0	0.06	24.2	-0.8	-3
E_53	0.065	25.0	0.062	26.0	1.0	4
E_58	0.1	56.0	0.09	66.5	10.4	19
E_60	0.07	28.8	0.065	29.4	0.6	2
C_11	0.14	105.1	0.12	113.8	8.7	8
C_12	0.09	46.0	0.08	53.3	7.3	16
C_19	0.1	56.0	0.09	66.5	10.4	19
C_2	0.12	78.8	0.1	80.9	2.1	3
C_20	0.15	119.6	0.13	132.2	12.6	11
C_21	0.17	151.1	0.15	172.8	21.6	14
C_3	0.14	105.1	0.12	113.8	8.7	8
C_62	0.2	204.8	0.17	218.3	13.5	7
C_64	0.13	91.5	0.11	96.7	5.2	6
C_66	0.14	105.1	0.12	113.8	8.7	8

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Infiltration Device

A soakage spreadsheet was used to calculate the Linear Infiltration Trench device dimensions. The discharge hydrograph for the 10YR CC event was input into the spreadsheet. The soakage rate, depth, porosity and width soakage inputs remained constant. The length of the device was then adjusted until soakage of the hydrograph was achieved.

Soakage Rate (mm/hr)	75.0
Depth (m)	0.8
Porosity (n)	0.2
Width (m)	3.5

The soakage rate of 75mm/hr is considered conservative.

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Catchment Areas

Road Name	Total Subcatchment Area (km2)	Road Length (m)	Pervious Area (km2)	Impervious Area (km2)	Residential Area (km2)	50% Residential Area (km2)
D1_13	0.014137	125.5	0.00042	0.00116	0.003713	0.00596
D1_15	0.002609	48.8	0.00016	0.00045	0.001703	0.000851
D1_158	0.008705	171.6	0.00058	0.00158	0.005854	0.002927
D1_32	0.001425	82.3	0.00028	0.00076	No Residential	No Residential
D1_33	0.003714	97.1	0.00033	0.00090	0.001995	0.000998
D1_34	0.000921	55.1	0.00019	0.00051	No Residential	No Residential
D1_35	0.005746	113.6	0.00038	0.00105	0.003736	0.001868
D1_36	0.012873	205.3	0.00069	0.00189	0.009237	0.004618
D1_37	0.008677	100.4	0.00034	0.00093	0.007017	0.003508
D1_38	0.005036	111.2	0.00038	0.00103	0.003142	0.001571
D1_39	0.008914	134.4	0.00045	0.00124	0.002967	0.00332
D1_40	0.005396	115.2	0.00039	0.00106	0.003425	0.001713
D1_41	0.028925	407.0	0.00137	0.00376	0.002735	0.010189
D1_42	0.004659	234.0	0.00079	0.00216	No Residential	No Residential
D1_43	0.031399	268.5	0.00091	0.00248	0.014243	0.013054
D1_44	0.036888	525.2	0.00177	0.00485	0.008977	0.004489
D1_5	0.014672	278.1	0.00094	0.00257	0.002604	0.00421
D1_54	0.017486	330.1	0.00111	0.00305	0.011677	0.005838
D1_56	0.001839	131.7	0.00044	0.00122	No Residential	No Residential
D1_6	0.015013	273.0	0.00092	0.00252	0.010458	0.005229
D1_7	0.007112	124.3	0.00042	0.00115	0.005143	0.002571
D1_8	0.032623	353.0	0.00119	0.00326	0.026561	0.01328
B_0	0.01532	179.5	0.00082	0.00264	0.004217	0.007718
B_17	0.001777	103.5	0.00047	0.00152	No Residential	No Residential
B_18	0.016601	121.8	0.00056	0.00179	0.005835	0.005697
B_22	0.019824	212.9	0.00098	0.00313	0.01568	0.00784
B_23	0.001017	70.3	0.00032	0.00103	No Residential	No Residential
B_68	0.034287	349.6	0.00160	0.00515	0.024172	0.012086
B_70	0.01277	214.5	0.00098	0.00316	0.007356	0.003678
B_72	0.02412	237.7	0.00109	0.00350	0.006931	0.005571
B_74	0.011528	156.6	0.00072	0.00231	0.005723	0.002861

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Hec Inputs	Residential			Pervious			Impervious			Hec Output		
Curve Number	Storage Ratio Residential	Initial Abstraction Residential	Time of Concentration Residential (hr)	Storage Ratio Pervious	Initial Abstraction Pervious	Time of Concentration Pervious (hr)	Storage Ratio Impervious	Initial Abstraction Impervious	Time of Concentration Impervious (hr)	HEC Peak 2yr Flow (m3/s)	HEC 10yr Flow Volume (m3)	HEC Peak 10yr Flow (m3/s)
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0324	304.44	0.0594
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0089	78.19	0.0149
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0310	273.28	0.0521
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0119	92.62	0.0180
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0159	136.65	0.0258
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0080	62.10	0.0121
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0209	183.03	0.0349
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0400	357.50	0.0686
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0227	209.00	0.0405
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0193	168.19	0.0320
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0269	242.17	0.0466
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0202	176.46	0.0336
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0818	737.06	0.1417
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0339	263.41	0.0512
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0833	768.04	0.1489
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0845	714.02	0.1346
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0489	428.21	0.0815
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0735	639.80	0.1215
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0190	148.23	0.0288
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0508	450.49	0.0861
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0236	210.32	0.0403
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0822	760.81	0.1477
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0715	635.36	0.1215
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0237	183.55	0.0357
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0175	252.91	0.0381
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0662	592.21	0.1136
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0161	124.62	0.0242
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.1066	950.93	0.1821
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0639	562.70	0.0996
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0775	669.98	0.1268
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0611	510.69	0.0963

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Swale Calculation Inputs						Swale Calculation Outputs			Infiltration Inputs				Infiltration Output
Grass Height (mm)	Slope (m/m)	Bank Slope (m/m)	Hydraulic Residence Time (mins)	Depth of Flow (m)	Mannings Calculated (n)	Swale Width (m)	Swale Length (m)	Velocity (m/s)	Soakage Rate (mm/hr)	Depth (m)	Porosity (n)	Width (m)	Length (m)
50	0.01	4.5	9	0.11	0.127	2.1	96.7	0.179	75.0	0.8	0.2	3.5	150
50	0.01	4.5	9	0.07	0.244	2.2	37.2	0.069	75.0	0.8	0.2	3.5	40
50	0.01	4.5	9	0.11	0.127	2.1	96.7	0.179	75.0	0.8	0.2	3.5	130
50	0.01	4.5	9	0.075	0.189	2.0	50.4	0.093	75.0	0.8	0.2	3.5	50
50	0.01	4.5	9	0.08	0.186	2.4	53.3	0.099	75.0	0.8	0.2	3.5	70
50	0.01	4.5	9	0.067	0.275	2.3	32.1	0.059	75.0	0.8	0.2	3.5	30
50	0.01	4.5	9	0.09	0.162	2.3	66.5	0.123	75.0	0.8	0.2	3.5	90
50	0.01	4.5	9	0.12	0.115	2.1	113.8	0.211	75.0	0.8	0.2	3.5	170
50	0.01	4.5	9	0.09	0.162	2.5	66.5	0.123	75.0	0.8	0.2	3.5	100
50	0.01	4.5	9	0.09	0.162	2.1	66.5	0.123	75.0	0.8	0.2	3.5	80
50	0.01	4.5	9	0.1	0.143	2.2	80.9	0.150	75.0	0.8	0.2	3.5	120
50	0.01	4.5	9	0.09	0.162	2.2	66.5	0.123	75.0	0.8	0.2	3.5	90
50	0.01	4.5	9	0.15	0.088	2.4	172.8	0.320	75.0	0.8	0.2	3.5	350
50	0.01	4.5	9	0.11	0.127	2.2	96.7	0.179	75.0	0.8	0.2	3.5	130
50	0.01	4.5	9	0.15	0.088	2.4	172.8	0.320	75.0	0.8	0.2	3.5	370
50	0.01	4.5	9	0.15	0.088	2.4	172.8	0.320	75.0	0.8	0.2	3.5	340
50	0.01	4.5	9	0.12	0.115	2.5	113.8	0.211	75.0	0.8	0.2	3.5	210
50	0.01	4.5	9	0.14	0.095	2.5	151.8	0.281	75.0	0.8	0.2	3.5	300
50	0.01	4.5	9	0.09	0.162	2.1	66.5	0.123	75.0	0.8	0.2	3.5	70
50	0.01	4.5	9	0.13	0.104	2.2	132.2	0.245	75.0	0.8	0.2	3.5	220
50	0.01	4.5	9	0.1	0.143	2.0	80.9	0.150	75.0	0.8	0.2	3.5	100
50	0.01	4.5	9	0.16	0.081	2.1	194.9	0.361	75.0	0.8	0.2	3.5	370
50	0.01	4.5	9	0.12	0.115	3.4	113.8	0.211	75.0	0.8	0.2	3.5	300
50	0.01	4.5	9	0.08	0.186	3.4	53.3	0.099	75.0	0.8	0.2	3.5	90
50	0.01	4.5	9	0.076	0.198	2.9	48.4	0.090	75.0	0.8	0.2	3.5	100
50	0.01	4.5	9	0.12	0.115	3.2	113.8	0.211	75.0	0.8	0.2	3.5	280
50	0.01	4.5	9	0.072	0.223	3.2	41.6	0.077	75.0	0.8	0.2	3.5	60
50	0.01	4.5	9	0.14	0.095	3.3	151.8	0.281	75.0	0.8	0.2	3.5	450
50	0.01	4.5	9	0.12	0.115	3.1	113.8	0.211	75.0	0.8	0.2	3.5	250
50	0.01	4.5	9	0.13	0.104	3.0	132.2	0.245	75.0	0.8	0.2	3.5	320
50	0.01	4.5	9	0.12	0.115	3.0	113.8	0.211	75.0	0.8	0.2	3.5	240

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Catchment Areas

Road Name	Total Subcatchment Area (km2)	Road Length (m)	Pervious Area (km2)	Impervious Area (km2)	Residential Area (km2)	50% Residential Area (km2)
B_76	0.007742	344.1	0.00158	0.00506	No Residential	No Residential
B_78	0.018684	161.1	0.00074	0.00237	0.004912	0.006741
B_80	0.015957	169.6	0.00078	0.00250	0.006406	0.005618
E_1	0.027847	511.4	0.00109	0.00506	0.021079	0.010539
E_150	0.010152	110.4	0.00023	0.00109	0.008088	0.004044
E_154	0.015667	284.0	0.00060	0.00281	0.011914	0.005957
E_156	0.004036	54.3	0.00012	0.00054	0.003172	0.001586
E_16	0.007856	204.0	0.00043	0.00202	0.004661	0.002331
E_160	0.009645	170.2	0.00036	0.00168	0.007154	0.003577
E_162	0.008224	200.0	0.00042	0.00198	0.004341	0.00217
E_45	0.007706	188.4	0.00040	0.00186	0.003013	0.001506
E_46	0.018145	287.6	0.00061	0.00284	0.008942	0.006653
E_47	0.007857	269.5	0.00057	0.00267	0.004168	0.002084
E_48	0.007878	216.4	0.00046	0.00214	0.004505	0.002253
E_49	0.02019	284.7	0.00060	0.00282	0.016042	0.008021
E_50	0.004553	106.2	0.00023	0.00105	0.002177	0.001088
E_51	0.03029	363.2	0.00077	0.00359	0.023841	0.011921
E_52	0.000365	38.8	0.00008	0.00038	No Residential	No Residential
E_53	0.000416	39.9	0.00009	0.00039	No Residential	No Residential
E_58	0.004125	109.6	0.00023	0.00108	0.002899	0.001449
E_60	0.000758	49.5	0.00011	0.00049	No Residential	No Residential
C_11	0.010239	145.8	0.00052	0.00246	0.003892	0.003654
C_12	0.003158	52.4	0.00019	0.00088	0.002163	0.001081
C_19	0.003419	77.2	0.00028	0.00130	0.001918	0.000959
C_20	0.00915	240.6	0.00086	0.00406	0.003906	0.001953
C_21	0.015666	296.8	0.00106	0.00501	0.006828	0.004614
C_3	0.007745	181.3	0.00065	0.00306	0.003875	0.001937
C_62	0.01267	431.9	0.00155	0.00728	0.018956	0.010735
C_64	0.005375	142.9	0.00051	0.00241	0.002524	0.001262
C_66	0.011084	148.8	0.00053	0.00251	0.005587	0.004046
E_152	0.019274	194.9	0.00053	0.00257	0.013419	0.0067095

Hec Inputs										Hec Output		
	Residential			Pervious			Impervious					
Curve Number	Storage Ratio Residential	Initial Abstraction Residential	Time of Concentration Residential (hr)	Storage Ratio Pervious	Initial Abstraction Pervious	Time of Concentration Pervious (hr)	Storage Ratio Impervious	Initial Abstraction Impervious	Time of Concentration Impervious (hr)	HEC Peak 2yr Flow (m3/s)	HEC 10yr Flow Volume (m3)	HEC Peak 10yr Flow (m3/s)
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0787	610.19	0.1187
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0678	598.66	0.1142
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0615	539.41	0.1027
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.1001	884.58	0.1687
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.5432	239.41	0.0463
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0559	494.18	0.0943
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0118	106.71	0.0205
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0353	301.56	0.0568
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0335	296.29	0.0565
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0344	292.54	0.0551
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0364	300.23	0.0568
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0652	574.69	0.1095
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0447	371.17	0.0700
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0370	313.91	0.0591
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0612	551.39	0.1059
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0181	153.54	0.0289
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0824	749.74	0.1445
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0059	45.25	0.0088
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0060	46.45	0.0090
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0194	167.45	0.0316
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0075	57.64	0.0112
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0450	389.86	0.0738
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0156	133.63	0.0252
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0217	179.65	0.0339
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0658	531.56	0.1013
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0853	715.97	0.1345
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0505	413.30	0.0783
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.1329	1152.02	0.2181
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0393	318.58	0.0606
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0467	406.49	0.0771
45	0.107	5	0.25	0.07	5	0.166	0.055	0	0.166	0.0543	486.64	0.0933

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Swale Calculation Inputs						Swale Calculation Outputs			Infiltration Inputs				Infiltration Output
Grass Height (mm)	Slope (m/m)	Bank Slope (m/m)	Hydraulic Residence Time (mins)	Depth of Flow (m)	Mannings Calculated (n)	Swale Width (m)	Swale Length (m)	Velocity (m/s)	Soakage Rate (mm/hr)	Depth (m)	Porosity (n)	Width (m)	Length (m)
50	0.01	4.5	9	0.13	0.104	3.1	132.2	0.245	75.0	0.8	0.2	3.5	290
50	0.01	4.5	9	0.12	0.115	3.2	113.8	0.211	75.0	0.8	0.2	3.5	290
50	0.01	4.5	9	0.12	0.115	3.0	113.8	0.211	75.0	0.8	0.2	3.5	260
50	0.01	4.5	9	0.18	0.070	2.0	242.9	0.450	75.0	0.8	0.2	3.5	420
50	0.01	4.5	9	0.1	0.143	2.2	80.9	0.150	75.0	0.8	0.2	3.5	120
50	0.01	4.5	9	0.13	0.104	2.3	132.2	0.245	75.0	0.8	0.2	3.5	240
50	0.01	4.5	9	0.075	0.189	2.0	50.4	0.093	75.0	0.8	0.2	3.5	60
50	0.01	4.5	9	0.11	0.127	2.3	96.7	0.179	75.0	0.8	0.2	3.5	150
50	0.01	4.5	9	0.11	0.127	2.2	96.7	0.179	75.0	0.8	0.2	3.5	140
50	0.01	4.5	9	0.11	0.127	2.2	96.7	0.179	75.0	0.8	0.2	3.5	140
50	0.01	4.5	9	0.11	0.127	2.3	96.7	0.179	75.0	0.8	0.2	3.5	140
50	0.01	4.5	9	0.14	0.095	2.3	151.8	0.281	75.0	0.8	0.2	3.5	270
50	0.01	4.5	9	0.12	0.115	2.3	113.8	0.211	75.0	0.8	0.2	3.5	180
50	0.01	4.5	9	0.11	0.127	2.4	96.7	0.179	75.0	0.8	0.2	3.5	150
50	0.01	4.5	9	0.14	0.095	2.2	151.8	0.281	75.0	0.8	0.2	3.5	260
50	0.01	4.5	9	0.09	0.162	2.0	66.5	0.123	75.0	0.8	0.2	3.5	80
50	0.01	4.5	9	0.15	0.088	2.4	172.8	0.320	75.0	0.8	0.2	3.5	360
50	0.01	4.5	9	0.06	0.339	2.5	24.2	0.045	75.0	0.8	0.2	3.5	30
50	0.01	4.5	9	0.062	0.322	2.3	26.0	0.048	75.0	0.8	0.2	3.5	30
50	0.01	4.5	9	0.09	0.162	2.2	66.5	0.123	75.0	0.8	0.2	3.5	80
50	0.01	4.5	9	0.065	0.294	2.4	29.4	0.054	75.0	0.8	0.2	3.5	30
50	0.01	4.5	9	0.12	0.115	2.3	113.8	0.211	75.0	0.8	0.2	3.5	190
50	0.01	4.5	9	0.08	0.186	2.3	53.3	0.099	75.0	0.8	0.2	3.5	70
50	0.01	4.5	9	0.09	0.162	2.4	66.5	0.123	75.0	0.8	0.2	3.5	90
50	0.01	4.5	9	0.13	0.104	2.7	132.2	0.245	75.0	0.8	0.2	3.5	250
50	0.01	4.5	9	0.15	0.088	2.5	172.8	0.320	75.0	0.8	0.2	3.5	340
50	0.01	4.5	9	0.12	0.115	2.5	113.8	0.211	75.0	0.8	0.2	3.5	200
50	0.01	4.5	9	0.17	0.075	2.7	218.3	0.404	75.0	0.8	0.2	3.5	540
50	0.01	4.5	9	0.11	0.127	2.5	96.7	0.179	75.0	0.8	0.2	3.5	150
50	0.01	4.5	9	0.12	0.115	2.4	113.8	0.211	75.0	0.8	0.2	3.5	200
50	0.01	4.5	9	0.11	0.127	3.3	96.7	0.179	75.0	0.8	0.2	3.5	230

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APPENDIX 4
STORMWATER CALCULATIONS (HARRISON GRIERSON)

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Raingarden - HCC ITS

Adare

Battered Slope Raingardens for Water Quality

DATE: 03 March 2017
HG PROJECT NUMBER: 9820 141842 01

Input

	WQV
Design Rainfall (mm)	24.1

		CN	Ia (mm)	Tc (hr)
PRE	Pervious	74	5	0.167
	Impervious	98	0	0.167
POST	Pervious	74	5	0.167
	Impervious	98	0	0.167

Catchment Area (ha) 100sqm Road Reserve Example

CATCHMENT	PRE	POST
Pervious	0.0100	0.0000
Impervious	0.0000	0.0100
Total	**0.0100**	**0.0100**

Output

	WQV (Reduced Water Quality)
Volume of Runoff (m^3)	
PRE	n/a
POST	1.98
Design Volume	**1.98**
Design Depth (mm)	**19.8**

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Raingarden - HCC ITS

Adare

Battered Slope Raingardens for Water Quality Volume (HCC ITS)

DATE: 03 March 2017
HG PROJECT NUMBER: 9820 141842 01

Draft - Raingarden sizing for Water Quality Treatment Only

Design Volume

WQV =	1.98	m^3

Raingarden Depth

Total Raingarden Depth =	**1.10**	**m**
Live Storage Depth =	0.20	m
Planting Media Depth =	0.50	m
Sand Layer Depth =	0.10	m
Drainage Layer Depth =	0.30	m

Side Slope

Cross Sec	1	V : H	1
	1	V : H	1
Long Sec	1	V : H	1
	1	V : H	1

Raingarden Media Void Ratio

Planting Media Void Ratio =	0.30
Sand Layer Void Ratio =	0.30
Drainage Layer Void Ratio =	0.30

Raingarden Width

Max Top Width =	2.40	m
Planting Media Top Width =	2.00	m
Planting Media Bottom Width =	1.00	m
Drainage Layer Width =	1.00	m

Raingarden Surface Area - for Treatment

Min Treatment Surface Area (2% of Imp Area)		
Amin =	**2.0**	**m^2**

Live Storage Check

Minimum percentage of live storage =	20	%	
Live storage to be provided =	0.40	m^3	
Top Length Required =	1.08	m	
Surface Area Required for Live Storage			
Als =	**2.60**	**m^2**	**>= Amin, use Als**

Filtration Check

Planting Media Coefficient of permeability =	1.8	m/day	
Avg height of water = 1/2 max depth =	0.1	metres	
Time to pass through soil bed =	1	day	
Surface Area Required for Filtration			
Af =	**0.9**	**m^2**	**too small, use Als**

Raingarden Dimensions

Raingarden Width =	**2.4**	**m**
Raingarden Length =	**1.1**	**m**
Raingarden Surface Area =	**2.6**	**m^2**
Percentage of Catchment Area =	**2.6**	**%**

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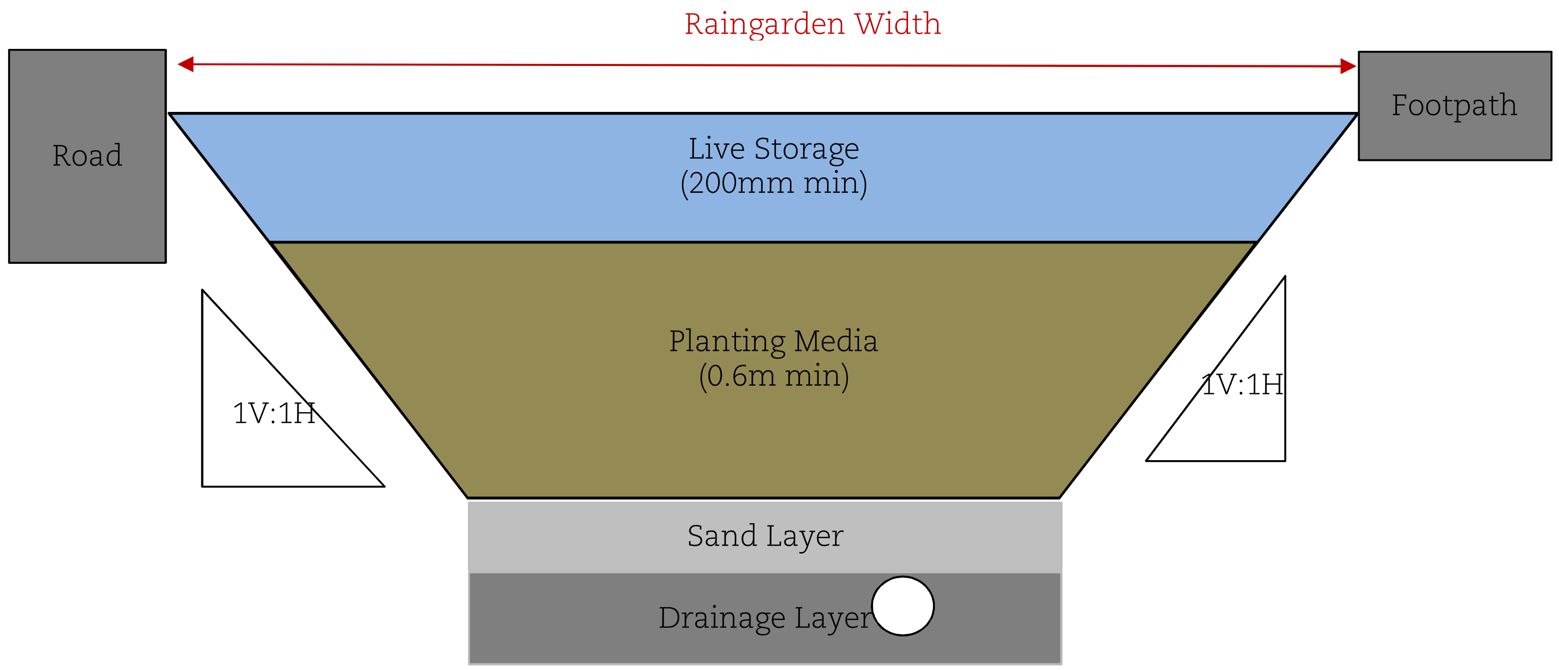
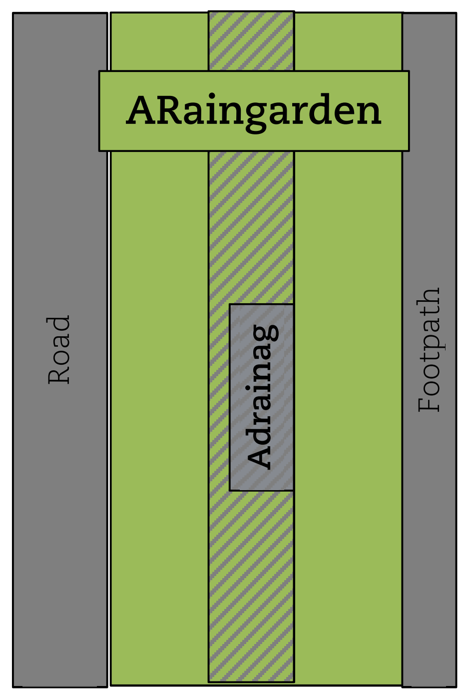
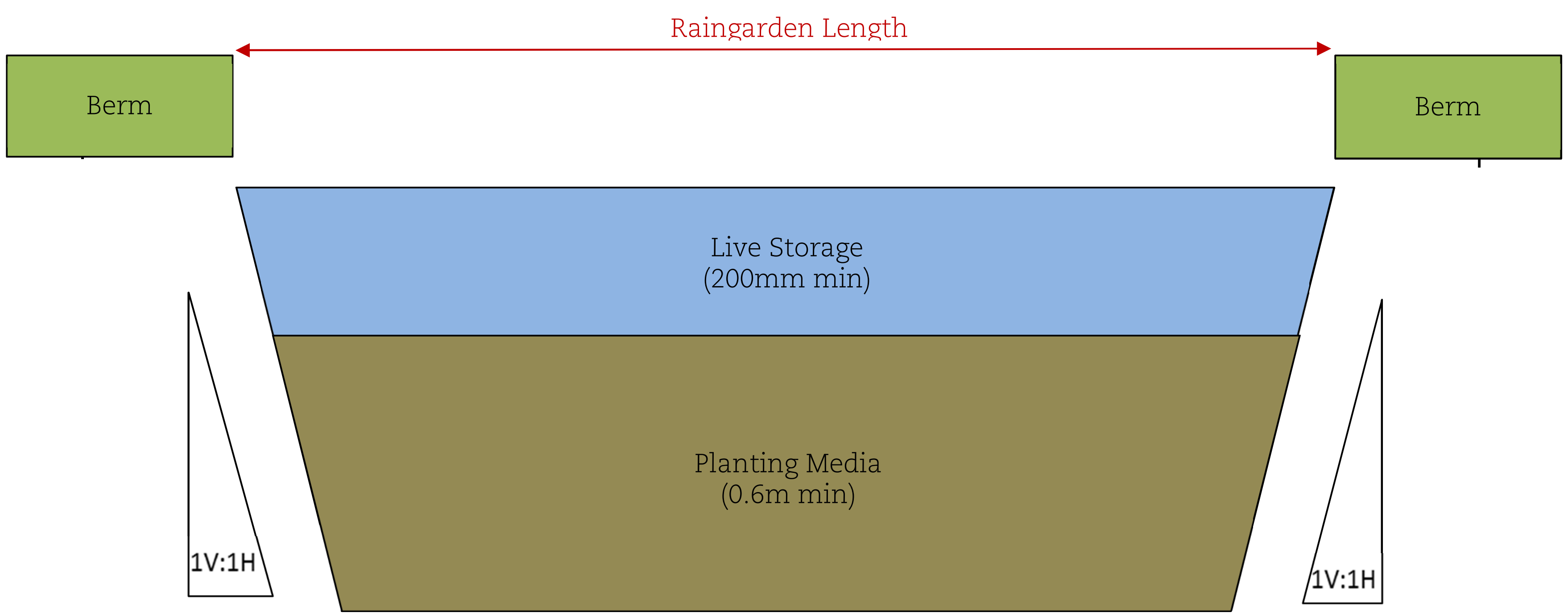


Cross Section



Plan View



Long Section

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APPENDIX 5

UTILITY SERVICE PROVIDER CORRESPONDENCE

Received
PLANNING GUIDANCE
15 June 2018

WEL Networks

Your Ref: 40043639 / Our Ref: 141842

9 May 2018

Ben Inger
Harrison Grierson
678 Victoria Street
HAMILTON

Dear Ben

RE: PROPOSED SUBDIVISION – ADARE STAGE 2a, 337-461 PEACOCKES ROAD, HAMILTON

Thank you for your enquiry regarding the power availability for the proposed subdivision of 337-461 Peacockes Road.

We have investigated the electricity supply requirements for the above proposed subdivision and we are able to supply the electrical reticulation.

In order for us to give clearance to the Hamilton City Council it will be necessary for the power to be extended to the boundary of all lots.

An easement will be required over the existing 11kV line in favour of WEL Networks Ltd, which currently runs through Precinct 1 on this property, if it is not relocated into road reserve. Further easements will be required in favour of WEL Networks Ltd over any electrical reticulation installed along private right of ways.

WEL will prepare the easement and apportionment of any costs associated with this, the survey, LINZ registration fees will be determined once the design for the new lots is completed. Any landowner legal fees will be the developer's responsibility.

Please advise if this project is likely to proceed and we will arrange for the necessary easement documents to be forwarded for signing.

Private easements will be required over the existing service line supplying existing dwellings if they cross any of the new lots.

If you wish us to proceed with pricing for the installation of the electrical reticulation please contact us at www.wel.co.nz/get-connected/subdivision .

We thank you for your enquiry. If you have any further queries or require additional information, please do not hesitate to contact me.

Yours faithfully

Miranda McLean
PROJECT MANAGER

Received
PLANNING GUIDANCE
15 June 2018

Firstgas

11 May 2018

Ben Inger
Level 2, 678 Victoria Street
Hamilton

Sent via email: B.Inger@harrisongrierson.com

Dear Ben,

Availability of natural gas to the Adare subdivision

Thank-you for your enquiry regarding the availability of natural gas for the proposed Adare subdivision.

First Gas will be reticulating the Peacockes Area

We currently have gas to 217 Peacockes Road. We will be extending the networks into the Peacockes area to accommodate the future subdivision plans. While we usually develop our network with the road upgrades we are in the process of determining the best option for getting gas to the Adare development prior to the road work being conducted.

We can confirm that there will be gas available to the Adare subdivision (as proposed in the draft drawing 1842-1011).

We will be liaising and working with the council over the coming months to determine the most efficient approach to extend our network.

If you have any questions regarding this matter, please contact Paul Bird on 04 979 5367 or via email at paul.bird@firstgas.co.nz.

Yours faithfully,

Matt Wilson
Gas Distribution Commercial Manager
First Gas Ltd
matt.wilson@firstgas.co.nz

Received
PLANNING GUIDANCE
15 June 2018

Ref: Harrison Grierson Surveying – 141842 Adare
ID: HN-145-01

01/05/2018

ultrafastfibre.co.nz

CONFIRMATION FROM ULTRAFAST FIBRE LIMITED AS A NETWORK OPERATOR
SUBDIVISION DETAILS: HN-145-01 Peacockes Rd337 - Harrison Grierson 141842 Adare (the "**Subdivision**")

Ultrafast Fibre Limited ("**Ultrafast Fibre**") confirms the following:

1. For the purposes of the Telecommunications Act 2001, Ultrafast Fibre is a network operator.

2. Ultrafast Fibre owns and operates a fibre optic telecommunications network which is located at (or in close proximity to) the boundary of the Subdivision (the "**Existing Communal Network**").

3. Subject to; by Adare Limited (the "**Developer**") and Ultrafast Fibre agreeing the terms of the **Ultrafast Fibre Installation Agreement**, Ultrafast Fibre will extend the Existing Communal Network from the boundary of the Subdivision into and throughout the Subdivision and outside the boundary of each lot within the Subdivision (the "**New Communal Network**").

4. The New Communal Network will be installed in accordance with:

   (a) the requirements and standards set by the Hamilton City Council (the "**Council**") and notified to Ultrafast Fibre by the Council; and

   (b) the requirements of the Telecommunications Act 2001 and all other applicable laws, regulations and codes (as amended).

5. Subject to:

   (a) the owner of a lot within the Subdivision ("**End User**") ordering a telecommunication service from the End User's selected telecommunications service provider (who must be authorised to sell services on the Ultrafast Fibre network (each referred to as a "**Service Provider**"); and

   (b) Ultrafast Fibre building additional network from the New Communal Network from the boundary of the End User's lot into the End User's premises (each referred to as a "**Connection**"),

   all of the owners (End Users) in the Subdivision will be able to order and receive a telecommunications service from their Service Provider on the Ultrafast Fibre network.

6. Ultrafast Fibre will be the network operator in relation to (and owner of) all of the Existing Communal Network and the New Communal Network.

7. Ultrafast Fibre is not responsible for the terms offered by Service Providers to End Users.

SIGNED for and on behalf of
ULTRAFAST FIBRE LIMITED by:

Signature:

Name: Russell Gibson

Date: 01st May 2018

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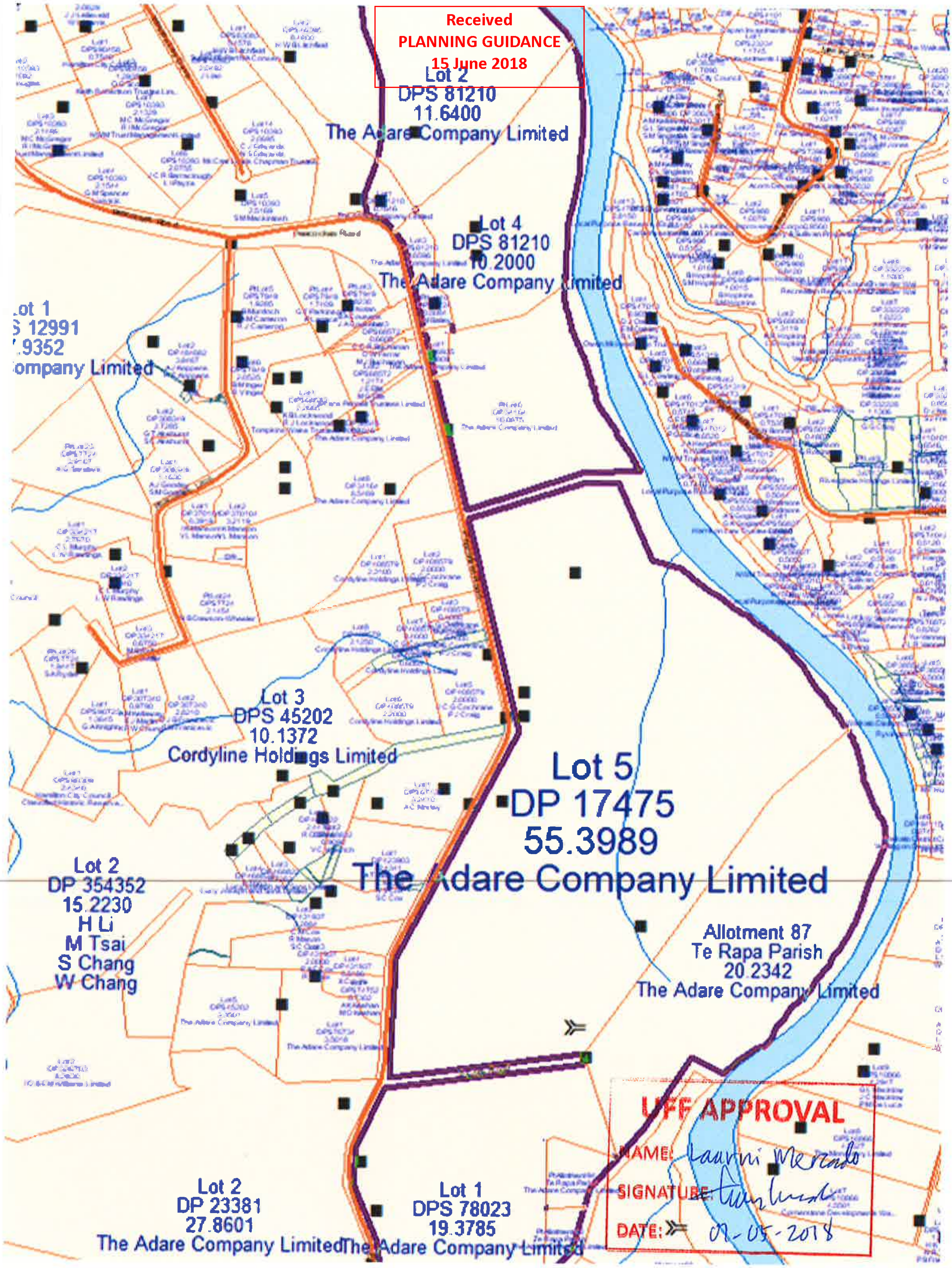
15 June 2018



UFF APPROVAL
NAME: Laurini Mercado
SIGNATURE:
DATE: 09-05-2018

Received
PLANNING GUIDANCE
15 June 2018

Song Khoo

From: Stephanie Gleeson <Stephanie.Gleeson@chorus.co.nz>
Sent: Tuesday, 17 April 2018 12:47 PM
To: Ben Inger
Subject: FW: [#HG Ref: 141842] Proposed Adare Development, Peacockes
Attachments: Attachment 1 - Development Plans.pdf; Adare Letter to Chorus 16-4-18.pdf

Hi Ben

Thank you for providing an indication of your development plans in this area. I can confirm that we have infrastructure in the general land area that you are proposing to develop. Chorus will be able to extend our network to provide connection availability. However, please note that this undertaking would of course be subject to Chorus understanding the final total property connections that we would be providing, roll-out of property releases/dates and what investment may or may not be required from yourselves and Chorus to deliver the infrastructure to and throughout the site in as seamless and practical way as possible.

Chorus is happy to work with you on this project as the network infrastructure provider of choice. What this ultimately means is that the end customers (business and home owners) will have their choice of any retail service providers to take their end use services from once we work with you to provide the physical infrastructure.

Once confirmed, we will come back to you with the final costs to extend our network to your development.

Cheers

Stephanie Gleeson | Business Development – Subdivisions
Chorus | **T :** 07 959 2940 | **M :** 022 024 4644

From: Stephanie Gleeson
Sent: Monday, 16 April 2018 9:58 p.m.
To: 'Ben Inger' <B.Inger@harrisongrierson.com>
Subject: RE: [#HG Ref: 141842] Proposed Adare Development, Peacockes

Hi Ben

Thanks for your request. We'll get a job in the system but I should be able to supply confirmation in the next day or so.

Cheers

Stephanie Gleeson | Business Development – Subdivisions
Chorus | **T :** 07 959 2940 | **M :** 022 024 4644

From: Ben Inger [mailto:B.Inger@harrisongrierson.com]
Sent: Monday, 16 April 2018 5:33 p.m.
To: Stephanie Gleeson <Stephanie.Gleeson@chorus.co.nz>
Subject: [#HG Ref: 141842] Proposed Adare Development, Peacockes

Hi Stephanie

Refer attached. I look forward to receiving your response.

Regards

Received
PLANNING GUIDANCE
15 June 2018

BEN INGER
Hamilton Manager

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