BEFORE THE WAIKATO DISTRICT COUNCIL INDEPENDENT HEARING PANEL

IN THE MATTER of Proposed Variation 3, under clause 16A of Schedule 1 of the Resource Management Act 1991, to the Proposed District Plan Change

AND
IN THE MATTER of submissions by Greig Developments No 2 Limited and Harrisville Twenty Three Limited, Tuakau.

To: The Hearings Co-ordinator
Waikato District Council

PRIMARY INFRASTRUCTURE & 3-WATERS EVIDENCE OF WARREN BOAG FOR HARRISVILLE TWENTY THREE LTD

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4 July 2023

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TABLE OF CONTENTS

MAY IT PLEASE THE PANEL

1. Introduction

1.1 My full name is Warren Russell Boag.

1.2 I am the Engineering Manager and project manager at The Surveying Company (**TSC**) in Pukekohe. I hold a New Zealand Certificate in Engineering (Civil) from the Authority for Advanced Vocational Awards (AAVA) in 1981. AAVA was a professional body that pre-dated the (current) New Zealand Qualifications Authority (NZQA).

1.3 I am a Chartered Professional Engineer (CPEng) in the field of civil engineering (registrant number 212403). I have held this designation since 2005. My assessed practice area is in project management, design and construction monitoring for land development and infrastructure design. I am also a Chartered member of Engineering New Zealand (EngNZ).

1.4 My relevant professional experience spans over 40 years in both the private and public sectors in New Zealand. I have been in my role at TSC for the last two years. I have been involved in engineering project management, civil and environmental engineering, land development and contract management in the following areas:

a) Acting as engineer/project manager for private developers seeking infrastructure approvals for the construction of residential, rural and commercial subdivisions.

b) The designing, drawing and construction supervision of civil engineering plans for telecommunications networks across New Zealand.

1.5 Working in the urban and rural environment of Franklin and Waikato over the last 2 years, I have had an association with both residential and rural

activities and have a good general understanding of issues within both environments and its interface.

1.6 I confirm that I have read the 'Expert Witnesses Code of Conduct' contained in the Environment Court of New Zealand Practice Note 2023. My evidence has been prepared in compliance with that Code in the same way as I would if giving evidence in the Environment Court. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

2. Scope of Evidence

2.1 This evidence is provided in support of the submission made by Greig Developments and Harrisville Twenty Three Limited on Variation 3 of the Proposed Waikato District Plan (**PWDP**). My evidence specifically addresses rezoning of land at 23A Harrisville Road to Medium Density Residential 2 Zone (**MDRZ 2**) through Variation 3 from an Infrastructure and 3-Waters perspective.

2.2 Previous specialist reporting had been prepared in relation to a proposed subdivision consent at 23 and 23A Harrisville Road, Tuakau for the development of the site to create fourteen (14) residential lots. The specialist report is **attached** as **Appendix A** and is titled Infrastructure Report for Harrisville Twenty-Three Ltd, dated 11th November 2022, Version 1.2.

2.3 This report is relevant to this evidence for rezoning the subject land with further statements included below based on the Concept Plan of Lots 9 & 10 DP 136581 - # 23 & 23A Harrisville Road Tuakau, dated June 2023, ref: J1257 Concept Plan 3-A. That indicative concept is based on the MDRZ 2 zoning sought, and is referred to in the Planning Evidence of Ms Addy.

2.4 The lot yield change based on a zone change would increase from seven (7) lots (current Rural-Residential/Large Lot Zoning) to approximately twenty-five (25) developable platforms (MDRS 2 zoning), being 18 additional lots/developable platforms. This is based on ultimate lot sizes of 350m^2 - 450m^2 as well as some larger lots, and only utilising an area of land that does not present unfavourable contours.

2.5 It is noted that the difference in lot yield between the current proposed subdivision consent layout producing fourteen (14) lots and the potential yield under MDRS 2 zoning potentially generating twenty-five (25) developable platforms is eleven (11) additional lots/developable platforms.

2.6 In an addendum to my original assessment for the fourteen (14) lot subdivision, I can support the additional lots potentially generated, by the Harrisville submission rezoning on the subject site, because:

a) The additional lots resulting in an approximate twenty-five (25) lot subdivision will see access provided to thirteen (13) lots with frontage onto the proposed new Public Road and twelve (12) lots with access off a shared right-of-way.

b) The submission relief would require additional stormwater, wastewater, and water supply infrastructure, to a currently complying development.

c) However, I understand that all 3 waters would be able to connect and run off the existing Council infrastructure, as there appears to be sufficient capacity within their networks.

3. Conclusion

3.1 Rezoning the subject site to MDRZ 2 zone will increase the ability to generate a higher density of residential development. I can support the increase in density from a 3 Waters perspective.

Warren Boag

4 July 2023

APPENDIX A – Infrastructure Report

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INFRASTRUCTURE REPORT FOR HARRISVILLE TWENTY-THREE LTD

SUBDIVISION AT 23 & 23A HARRISVILLE ROAD, TUAKAU

Version	Review/Amendment	Date
1.0	As Submitted for Resource Consent	October 2022
1.1	In response to Section 92 from WRC	November 2022
1.2	Update for ESC	November 2022

PROJECT REFERENCE: J1257

DATE: 16/11/2022

VERSION 1.2

1.0 INTRODUCTION

TSC have been engaged by Harrisville Twenty-Three Ltd to prepare Engineering Design Plans and this Infrastructure Report for the proposed 14 lot Residential subdivision at 23 & 23a Harrisville Road, Tuakau. This report addresses the site-specific issues in relation to stormwater, wastewater, water reticulation, earthworks, roading, retaining walls, erosion and sediment control.

1.1 EXISTING SITE

The site is located on 23 & 23a Harrisville Road, Tuakau and is legally described as Lot 9 & 10 DP 136581. The site is in pasture and used for dry stock grazing. The site contains predominantly broad gently sloping ridge crests, with steeper slopes extending along the gully to the North of the property. A stream flows towards the southwest along the Northern boundary of the property to a wetland located in the North-western part of the site.

The land surrounding the development is similar to this site and is zoned as part of the residential area of Tuakau.

1.2 SCOPE OF REPORT

Harrisville Twenty-Three Ltd seeks to subdivide their property on Harrisville Road, Tuakau into 14 Residential lots. The scope of this report is to describe the nature and extent of the engineering activities required to complete the proposed subdivision.

1.3 SOUND ENGINEERING PRACTICE

At all-times, sound engineering practice will be adopted to ensure minimal disturbance to the environment on the subject site and the surrounding areas. All hazardous materials and machinery not in use will be stored and located outside of the floodplain. Where possible, exposed clay areas will be stabilised at the end of each day and if extended periods of inclement weather have been forecast, no additional areas will be opened up for earthworks. At the start and end of each day, the erosion and sediment control measures will be checked and fixed where required.

1.4 CONSTRUCTION METHODOLOGY AND PROGRAMME

It is anticipated that the construction works will proceed in the following sequence:

- Establishment of machinery on site,
- Locate and protect services,
- Install erosion and sediment control devices,
- Strip topsoil to stockpile ensuring stockpiles are located within the erosion control area,
- Construct the timber retaining walls,
- Cut to fill earthworks to designed subgrade levels,
- Install wastewater and stormwater pipes and manholes,
- Install watermain,
- Install Chorus, power, and water connections,
- Import subbase, pour kerb and channel and basecourse material for the new road,
- Concrete proposed accessway,
- Seal new road,
- Respread topsoil and sow grass, and
- Remove machinery from site.

Work at the site will generally take place during the earthwork's construction season being 1st October to 30th April. The scope of the works described above is likely to take approximately 3 to 4 calendar

months to complete, subject to weather conditions. Works are likely to commence in the latter part of 2022, which means that the end of the works should fall inside of the earthworks season. We are aware that any work that will need to take place after 30th April will require a Winter Works application lodged in order to complete the work.

2.0 EARTHWORKS

It is proposed to undertake cut to fill earthworks on site to install the new public road and proposed private accessway. For the actual lots, the natural ground will be left as is, that is, no earthworks will be undertaken. The only exception to this is for lots 9 & 14, where part of those lots require some minor earthworks for the public stormwater system will be installed. Our modelling indicates that the total volume of earthworks will be 1,100 m³ with a shortfall of fill. The fill will need to be imported to be placed in behind the retaining wall. This will likely be suitable clay material or aggregate. Any unsuitable material will be removed to a suitable location offsite or taken to a clean fill site.

2.1 GEOTECHNICAL REPORT

Tilsley Engineering Limited (TEL) have provided a geotechnical report for the proposed subdivision. All recommendations from the report will be followed as part of the earthworks (see Appendix B).

2.2 EARTHWORKS QUANTITIES

It is proposed to undertake cut to fill earthworks on site to form the new public road which will service the subdivision. Firstly, approximately 1100m³ of topsoil will be stripped and stockpiled to allow cut to fill bulk earthworks to be undertaken. Some of this topsoil material will likely be surplus to requirements and need to be removed offsite. The cut material will be uplifted, transported, placed in 200-300mm layers (benched), and then compacted with a sheepsfoot roller to ensure the required compaction is obtained. Our modelling indicates that the total volume of cut material is 669m³ and the total volume of fill is 970m³. There will be a shortfall of fill material, that will need to be found, and this will increase if unsuitable material is encountered during construction or for any varying amount of topsoil indicated in the geotechnical report. The maximum depth of cut is all less than 1m and the maximum depth of fill is around 1.2m. Compaction testing will be carried out by a suitably qualified Geotechnical Engineer to ensure all material meets the relevant specifications. On completion of the bulk earthworks, topsoil will be placed with a minimum thickness of 100mm. Finally, the topsoil will be cultivated and revegetated.

As stated before, it is known that there will be a requirement to import material and remove material from site. The importation of approved aggregate metal and concrete will also be required and the removal of any unsuitable material and/or topsoil from site. The importation of metal and concrete will be used to form the road, accessway, footpaths and backfill trenches for stormwater, wastewater, and utilities. A summary of all the earthworks quantities is shown in the Table 2.1.

Earthworks Quantities	
Earthworks Area	6,390 m²
Cut Volume	669 m³
Fill Volume	970 m³
Additional fill Volume	301 m³
Topsoil Volume (assumed 250mm depth)	1100 m³
Maximum Cut Depth	1.0 m
Maximum Fill Depth	1.2 m

Table 2.1 – Earthworks Quantities

2.3 OVERLAND FLOWPATH & MINOR EARTHWORKS

The proposed development will provide three overland flow paths to facilitate runoff from the road, lots and the private accessway. Flow path 1 manages stormwater from the proposed Road 1, from the highpoint back to Harrisville Rd. Flow path 2 manages stormwater from proposed Road 1 to the head of the cul-de-sac. This then continues along the northern edge of lot 14 to an inlet structure and then to the stormwater detention tanks. Flow path 3 manages the stormwater along the proposed private accessway with final discharge to the existing stream, via the stormwater detention tanks. These new overland flow paths have been designed to convey the 1% AEP from about half of the development, the remaining half will continue as sheet flow as it was during pre-development times. Minor earthworks will need to be carried out at the northern side of lot 14 to provide the required capacity for Flow path 2.

2.4 EROSION AND SEDIMENT CONTROL

The erosion and sediment control has been designed in accordance with "Waikato Regional Council's Erosion and Sediment Control Guidelines for Soil Disturbing Activities (TR 2009/02) and Waikato Regional Councils Earthworks Series – Erosion and Sediment Control factsheets for Stabilised Construction Entrance, Decanting Earth Bund, and Diversion Bunds as illustrated on engineering plans, J1257-02 & 03 (see Appendix A).

2.4.1 EARTHWORKS CATCHMENTS

The earthworks site will be enclosed within two catchments (Area 2 & 3) and controlled using various methodologies as illustrated on the Erosion and Sediment Control Plan (sheet J1257-03 & 04 within Appendix A). Clean water diversion bunds will be installed to divert surface water around the proposed earthworks area and limit the earthworks catchment size. A Dirty water diversion bund will be installed to direct sediment laden water towards the decanting earth bund (DEB). Hay mulch or geocloth will be kept on site whilst this work is being carried out to ensure the site can be stabilised quickly if it begins to rain.

2.4.2 AREA 1 – 1100m^2

A stabilised construction entranceway will be built to allow for a clean entrance and exit from the site. The stabilised entrance will be located at the proposed intersection of Harrisville Road and the proposed Road 1. A silt fence will encompass the southern side of the property to pick up any dirty water runoff.

2.4.3 AREA 2 - 2993m^2

A dirty water diversion bund will encompass the southern and western side of this downstream area, and this will be connected to a DEB. The DEB will be installed to cater for bulk earthworks on this section of the site, though the main bulk earthworks will be on Road 1 and only minor removal of the humps in Lot 1 & 2. The maximum clearing area for earthworks in this area will be less than 3000m^2, which will be completed first. The DEB has been sized for a 0.3 ha catchment. A suitable weather window will be picked to ensure that the earthworks can be completed during dry weather.

2.4.4 AREA 3 - 2297m^2

A timber retaining wall is proposed to be constructed in this area. A silt fence will be installed on the lower side of the proposed wall before construction commences and a dirty water diversion bund will be installed above the proposed retaining wall and be connected to a DEB. Because of the length of the bund, some drop out pits will be constructed along the path to slow the velocity of any runoff. The DEB will be installed to cater for bulk earthworks on this section of the site. The maximum clearing area for earthworks in this area is around 2200m^2

which will be completed second. The DEB has been sized for a 0.22 ha catchment. A suitable weather window will be picked to ensure that the earthworks can be completed during dry weather. Once the wall is constructed and the ACCESSWAY has been raised to the subgrade level, the dirty water bund will be removed as the area will be stabilised.

2.4.5 AREA 4 - 5075m^2

A clean water diversion bund will capture flows above the earthworks area in this section and a silt fence will manage all flows downstream of this earthworks area. Once the construction of the timber retaining wall is complete, stormwater runoff within the accessway will be managed along the accessway.

2.4.6 CHEMICAL TREATMENT

Prior to the commencement of earthworks, a coagulant and flocculant treatment bench test will be carried out. This will determine if the DEB's require chemical treatment, the type of coagulant, the dosage rate, and the suitability for its release into the environment. We request that the bench testing be made a condition of consent.

3.0 STORMWATER

3.1 EXISTING STORMWATER

A stream at the northern end of the property picks up flows from the site and flows towards an existing wetland that encompasses part of the site at the western end. There was no overland flow path on the existing site as generally all flows were sheet flow down the slopes to the existing stream.

The stormwater from the properties on the Harrisville Rd appear to connect to the road kerb, although some may have onsite soakage. All road runoff is directed to the kerb and channel and is picked up via a reticulated system at Oak St, then discharging via an open drain towards the Whakapipi stream. There is no public stormwater reticulation in the vicinity of the development.

3.2 PROPOSED STORMWATER – DESIGN CRITERIA

The proposed primary stormwater system comprises of the following aspects and has been designed in general accordance with Section 4.2 of the RITS and TR2020/07.

- Stormwater reticulation designed to 10% AEP
- Treatment management:
  - Water quality treatment – we are proposing raingardens
  - Volume control
    - Retention of the initial abstraction volume
    - EDV for discharge to the stream runoff for small storms (EDV) are detained and released over a 24-hour period.
    - Peak flows in a 2-year storm event are detained and released at a rate not greater than pre-development levels for the upstream catchment.
    - Peak flows in a 10-year storm event are detained and released at a rate not greater than pre-development levels for the upstream catchment.
    - 100-year – According to Beca's report[1], "Attenuation for the 100-year ARI Storm is therefore not recommended for discharges to the Tutaenui/Whakapipi Stream and Whangarata Stream downstream of George Street/River Road."

[1] On the Tuakau Stormwater Management Plan dated 21 August 2019,

- RCP 6.0 – Our design is based on this sensitivity.
- RCP 8.5 – We have stress tested our design under this sensitivity.

3.3 PROPOSED STORMWATER – POSSIBLE OPTIONS

There have been iterations on the stormwater design as we came to the realisation that we needed to look at a variety of viable options. We briefly address these options below:

3.3.1 Option 1

This option we looked at using a stormwater pond to manage the quantity and quality controls, however, due to no suitable area for a pond, the possible size of the embankments required for a pond and the steepness of the site, this was eliminated.

3.3.2 Option 2

This option looked at using stormwater detention tanks, based close to the existing watercourse and raingardens along Road 1 and evenly spaced along the accessway. This option was discarded as access to the detention tanks was an issue for maintenance and the raingardens in the accessway were problematic.

3.3.3 Option 3

This option is a revamp of Option 2 where the stormwater detention tanks will be located further up the bank to provide the necessary maintenance requirements. Also, it is proposed to plant trees between the tanks and the stream, with stormwater overflow trenches providing discharge to these plants. Raingardens are still provided along Road 1 and placed at the end of the accessway where the grades are flatter and there is an area to install and maintain them.

3.4 STORMWATER DESIGN PROPOSAL

Most of the stormwater within the proposed development will be managed onsite and flow towards the existing stream on the north-western boundary. The only exception being ROAD 1 which has two catchments, catchment one discharging towards Harrisville Rd and catchment two discharging toward the existing stream.

Catchment one manages all the stormwater falling towards Harrisville Rd. Road 1 has a single crossfall and runoff will fall towards the south and reconnect to the existing kerb and channel on Harrisville Rd. Runoff in the kerb on the western side of Harrisville Rd, upstream of ROAD 1 will discharge to a new cesspit in ROAD 1 and bubble up in the cesspit on the southside of ROAD 1 and continue down Harrisville Rd. The addition of ROAD 1 catchment will add in 350m^2 of new pavement to the Harrisville Rd catchment.

The stormwater has been sized in accordance with Waikato Regional Infrastructure Technical Specifications (hereafter referred to as RITS in this report) – Section 4 – Stormwater. All stormwater pipelines have been sized appropriately to cater for storm events up to and including the 10% AEP storm. Any overland flow from ROAD 1 and ACCESSWAY 1 will travel down their relevant overland flow path to the stormwater tanks. The overland flow paths have been sized to convey the 1% AEP. The pipeline network and overland flow path calculations are both shown in Appendix C. Overland flows generated from the first section of ROAD 1 catchment in the 1% AEP storm will run down the road along the western side of Harrisville Road.

Our proposal is that each of the houses provides its own retention (water reuse) and detention (water attenuation) tanks and manages any stormwater at the boundary. For the roading component,

stormwater will be managed for quality via raingardens and quantity via tanks, which will be addressed later.

3.5 RUNOFF FROM ROAD 1 AND ACCESSWAY 1 (TO BE VESTED TO COUNCIL)

The design incorporates roadside rain gardens and stormwater detention tanks to manage stormwater runoff from the public road and accessway. The roadside rain gardens provide quality treatment for the contaminated stormwater runoff generated from traffic on the road. The stormwater detention tanks detain the stormwater runoff from the road/accessway, and discharges stormwater at a slower, controlled rate via a dispersal trench to the parameters discussed in the design criteria.

These devices are proposed to be owned and operated by Waikato District Council and are sized to manage the road/accessway runoff.

3.6 RUNOFF FROM LOTS (INDIVIDUAL LANDOWNER'S RESPONSIBILITY)

Each landowner of lots 1 to 14 are required to provide a stormwater retention/detention tank that will outlet to the proposed stormwater network via the lot connection. The stormwater detention tank detains stormwater runoff from their roof and releases the flow to network at a controlled rate such that peak flows from the lots are reduced to no more than the predevelopment flow in a 10-year storm event. We are proposing water re-use (retention) for garden watering and non-potable inside water use including laundries and toilets. We have provided example calculations for a 10,000-litre tank that could be used for retention/detention for roof areas between 150m^2 and 350m^2. These calculations are provided in Appendix E.

3.7 STORMWATER RETICULATION

The stormwater pipelines have been sized in accordance with Section 4.2 of the RITS (see Appendix C). A 10% AEP design storm event was used in sizing the pipeline in accordance with section 4.2.4 of the RITS. Design flow rates were determined using the Rational Formula. Historical Rainfall intensities were obtained from NIWA – High Intensity Rainfall Design V4 in August 2021. Rainfall intensity assessed as 95.2mm/hr and increased by 13.1% to accommodate for a 2.3°C increase due to climate change in accordance with Table 7-2 of the Waikato Regional Council Stormwater Modelling Guidelines. The time of concentration applied was 10 minutes to give a rainfall intensity of 123.8mm/hr (RCP 6.0) and stressed tested to 142.8mm/hr (RCP 8.5). A runoff coefficient of 0.7 was used, in accordance with section 4.2.4.1 (Residential), for the proposed lot areas and 0.9 was conservatively used for the proposed paved areas. See Table 3.1 for a summary of the stormwater design flows AT RCP 6.0.

Downstream Structure	Upstream Structure	Pipe Diameter (mm)	Design Grade (%)	Pipe Flow Capacity (l/s)	Design Flow (l/s)	Velocity (m/s)
SW Tanks	SWMH 1.1	375	2.35	272	188	2.46
SWMH 1.1	SWMH 1.2	300	3.98	196	147	2.77
SWMH 1.2	SWMH 1.3	300	5.58	108	122.5	3.28
SWMH 1.3	SWMH 1.4	225	15.71	181	98	4.56
SWMH 1.4	SWMH 1.5	225	6.01	112	49	2.82
SWMH 1.5	SWMH 1.6	225	1.83	62	24.5	1.55
SW Tanks	SWMH 2.1	375	5.0	397	226	7.2
SWMH 2.1	SWMH 2.2	225	14.6	175	120.5	4.4
SWMH 2.2	SWMH 2.3	225	4.0	92	24.5	2.3

SWMH 3.1	SWMH 2.2	300	1.35	114	49	1.61

Table 3.1 – Stormwater Summary

The stress testing on the pipeline under RCP 8.5 showed that the design pipe network below was able to handle the increased flows without surcharging. All stormwater manholes will be standard approved 1050Ø concrete manhole. All stormwater pipes will be RCRRJ Class 4 pipes.

3.8 STORMWATER QUANTITY CONTROL

The stormwater quantity control has been designed in general accordance with Section 4.2 of the RITS and Waikato Stormwater Runoff Modelling Guidelines. To service the runoff from the development, this subdivision proposes large stormwater detention tanks for the road and the accessway. HEC-HMS was used to model the 2-year and 10-year storm events with the outputs displayed in Appendix D. The 2-year and 10-year storm events were attenuated to match pre-development flows with allowance for climate change. According to Beca's report on the Tuakau Stormwater Management Plan dated 21 August 2019, "Attenuation for the 100-year ARI Storm is therefore not recommended for discharges to the Tutaenui/Whakapipi Stream and Whangarata Stream downstream of George Street/River Road."

3.8.1 DETENTION TANKS FOR QUANTITY CONTROL

The upper detention tanks (2x 20,000 litre) have been designed to cater for the stormwater generated from the new ROAD 1 as well as lots 1, 2, 12, 13 & 14, in general accordance with the RITS and Waikato Stormwater Management Guidelines. The catchment area of the upper tanks is 1,340m² of which 1,200m² is impervious and 140m² is pervious.

The lower detention tanks (2x 14,000 litre) have been designed to cater for the stormwater generated from the new ACCESSWAY 1 as well as lots 3 to 9, in general accordance with the RITS and Waikato Stormwater Management Guidelines. The catchment area of the lower tanks is 1,080m² of which 780m² is impervious and 300m² is pervious.

The proposed detention tanks have been designed to attenuate peak flows to pre-development levels for the EDV, 2-Year and 10-Year storm events. Figure 3.1 shows the basin model used in HEC-HMS to manage the stormwater attenuation.

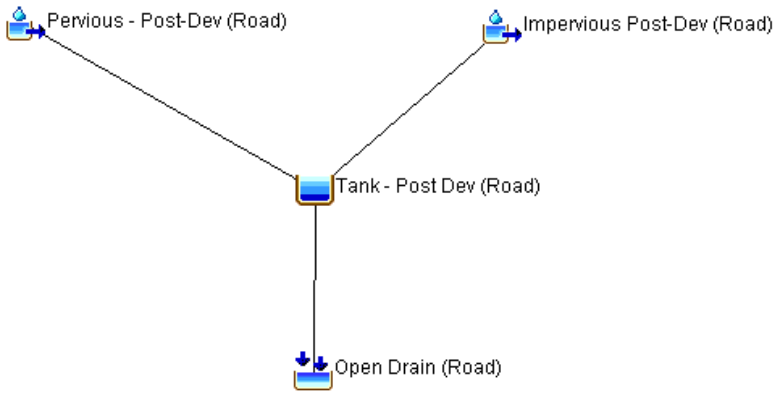


Figure 3.2 HEC-HMS Post Development Basin Model for public stormwater

Catchment areas used in the HEC-HMS model are listed below and configured as shown in Figure 3.3 for post development. The runoff was modelled using the SCS Hydrology Method in accordance with Waikato Regional Council Stormwater Modelling Guidelines. Time of concentration/Lag times were also calculated in accordance with the guidelines. A summary of the these are given below.

	Pre-Development				Post-Development			
Area	**Area (ha)**	**CN**	**Lag Time**	**Initial Abstraction**	**Area (ha)**	**CN**	**Lag Time**	**Initial Abstraction**
Road - Pervious	0.134	74	6.7	4.5	0.014	74	6.7	4.5
Road - Impervious		98	6.7	0.3	0.120	98	6.7	0.3
Accessway - Pervious	0.1085	74	6.7	4.5	0.030	74	6.7	4.5
Accessway - Impervious			6.7	0.3	0.078	98	6.7	0.3

Table 3.3 HEC-HMS Input Summary

Historical 24-hour rainfall depths were obtained from NIWA – High Intensity Rainfall Design V4 in August 2021. Rainfall depths for the 2-Year and 10-Year storm events were increased by 12.2% and 13.1% respectively to accommodate a 3.8°C increase due to climate change in accordance with the Waikato Stormwater Runoff Modelling Guidelines. The rainfall data is shown in following table.

ARI Storm Event	**Pre-Development 24hr Rainfall Depth (mm)**	**Post- Development 24hr Rainfall Depth (mm) (RCP 8.0)**
2 Year	64.6	82.3
10 Year	99.7	130.4

Table 3.4 Stormwater Rainfall Depths

The Stormwater tanks have been modelled in HEC-HMS using the elevation storage methodology to attenuate the EDV, 2-Year and 10-Year 24-hour storm events. The flow from the stormwater tanks will be restricted using a low flow orifice which outlets to a dispersal trench. Please refer to the engineering plans (J1257-8 to 10) and Appendix D for more details. A summary of the flow rates and runoff volumes are presented in the tables below.

Storm Event	**Pre-Development ROAD 1**		**Post Development ROAD 1**		**Orifice size (mm)**	**Height to Orifice (mm)**	**Peak Elevation (m)**	**Peak Storage (m^3)**
	Peak Flow (m^3/s)	Total Runoff (m^3)	Peak Flow (m^3/s)	Total Runoff (m^3)				
EDV			0.00086	28.4	24	150	0.62	10.8
2-Year AEP	0.006	32.3	0.0055	92.4	45	630	1.49	28.6
10-Year AEP	0.012	65.6	0.0125	151.0	60	1500	2.03	39.7

Table 3.5 – Upper Detention Tank - Stormwater Results Summary (From Road)

Storm Event	Pre-Development ACCESSWAY 1		Post Development ACCESSWAY 1		Orifice size (mm)	Height to Orifice (mm)	Peak Elevation (m)	Peak Storage (m^3)
	Peak Flow (m^3/s)	Total Runoff (m^3)	Peak Flow (m^3/s)	Total Runoff (m^3)				
EDV			0.00072	19.6	25	150	0.43	6.8
2-Year AEP	0.005	26.1	0.0048	68.9	45	440	1.0	18.6
10-Year AEP	0.01	53.1	0.0094	115.0	50	1.0	1.42	27.3

Table 3.6 – Lower Detention Tank - Stormwater Results Summary (From Private)

Discharge from the stormwater detention systems will be via a pipe into a stormwater dispersal trench to spread and dissipate the flows. A riprap apron will be installed to protect against erosion. See sheet J1257-8 for location of tanks and dispersal trenches.

We have also provided stormwater soakage areas through the base of the rain gardens 1, 2 & 3. This will help reduce the overall stormwater volume.

3.9 STORMWATER QUALITY TREATMENT

Treatment for this development has been designed in general accordance with Section 4.2 of the RITS and the Waikato Regional Council Stormwater Management Guidelines. Raingardens will be used to cater for the stormwater quality treatment for the development. Raingardens 1, 2 & 3 in ROAD 1 will all be bottomless gardens allowing for soakage into the natural ground. The raingarden 4 at the end of ACCESSWAY 1 is unique as this will need to contain a concrete base as it is located behind a timber retaining wall. We have allowed for the subsoil drain below the raingarden to be connected to the stormwater detention tank with an overflow to the adjacent stormwater disposal trench to allow sheet flow towards the stream and recharge of the adjacent ground.

3.10 LOW IMPACT DESIGN

Stormwater management has been designed to reduce the impact that the proposed development has on the receiving environment. The Low Impact Design (LID) matrix is shown in Appendix F and summarises the score for the proposed stormwater design. Water quality, peak flow control and volume control were required for this design, meaning a score of 15 was needed according to Table B-2. The design for this development achieved a score of 16. The proposed stormwater tanks cater for detention of the development. The development also minimises unnecessary disturbance of the site by only carrying out earthworks for the new road, accessway and the construction of the timber retaining walls. The remaining lots will be left undisturbed minimising the erosion during earthworks.

At the time of building consent for each lot, a primary stormwater management device will be required which will increase the effectiveness of the management of stormwater. This means that each lot will require a water tank which will enable water-reuse and water detention during rainfall events. The lot owner will be required to implement this device or an approved equivalent to the satisfaction of Waikato District Council. We have provided a simple guide in Appendix E to show a typical Stormwater retention/detention tank/orifice sizing for various impermeable areas

For the purposes of the LID matrix, high scores were achieved for water re-use (as discussed previously), the riparian margins of the stream will be enhanced with revegetation (we are proposing to plant the area between the stream and lots 9 -14, an area more than $4000m^2$). Bioretention devices (Rain gardens) are to be used which meets the retention requirements of the water quality storm.

Site disturbance will be reduced as earthworks is only required within the road and accessway corridors. We consider that these items will all help to increase the value of land and reduce the impact that a development has on its receiving environment. Additionally, native species will be included for the planting, increasing the biodiversity of the area, including native birds and insects. Overall, the design for the development is a low impact design and will benefit the environment that surrounds it.

3.11 MAINTENANCE – STORMWATER TANKS

We consider that there will be very little maintenance required on the stormwater tanks. Any maintenance will require a cleaning out of the tanks or flushing the orifices. No heavy equipment will be required to do this so it would be likely that a maintenance worker would only require access to the tanks. In the future (beyond 50 years), appropriate access with a large excavator may be required to replace any of the tanks. During the defect's liability period, maintenance of the stormwater tanks will be the developer's responsibility.

3.12 QUALITY ASSURANCE

To ensure the quality of the vested assets conforms with the RITS, the following inspections will be conducted during construction.

- Setout,
- Excavation and Bedding,
- Service Connections,
- Backfill,
- Haunching of Manholes, and
- Final Inspection.

CCTV of all stormwater pipelines will be conducted prior to completion of the works.

4.0 WASTEWATER

The wastewater for this subdivision has been sized in accordance with RITS, Section 5 – Wastewater. According to the GIS, there is an existing wastewater line (material undefined) that runs parallel with Harrisville Road with existing manholes located in #27 and #19 Harrisville Rd. At our Council meeting in late 2021, it was stated that the development could connect into the wastewater line as long as the wastewater pipe was replaced with 150mm dia PVC SN 16 pipe.

The location of the proposed manhole over the existing WW network will be located in the highest part of the site, thus meaning that the proposed subdivision will not be able to gravity feed to the network. This requires a low pressure rising main to pick up all the 14 houses and discharge to the WW network. Each property will have a boundary kit connecting to the low pressure rising main.

The two required wastewater manholes will be standard approved 1050Ø concrete. All wastewater, other than the low pressure rising main, pipes will be 150Ø uPVC class SN16. The wastewater pipeline has been designed in accordance with Section 5.2 of the RITS.

4.1 QUALITY ASSURANCE

To ensure the quality of the vested assets conforms with the RITS, the following inspections will be conducted during construction.

- Setout,
- Excavation and Bedding,

- Service Connections,
- Backfill,
- Haunching of Manholes, and
- Final Inspection.

The wastewater pipeline will be tested in accordance with Section 5.3.8 of the RITS. All pipelines with be pressure tested and CCTV of the line will be conducted.

5.0 WATER SUPPLY

The water supply for this subdivision has been sized in accordance with the RITS, Section 6 – Water Supply.

5.1 WATER RETICULATION

It is proposed to connect into the existing public network located within Harrisville Road (200Ø ID) to cater for the subdivision. A 125Ø OD (100Ø ID) MDPE watermain will be connected to the existing watermain and be trenched to run around ROAD 1. Sluice valves and thrust blocks will be installed in accordance with the RITS.

A fire hydrant will be installed within the new road reserve to ensure each lot is within 135m of a fire hydrant. This distance is measured along the vehicle path (where the hose would be laid in an emergency event). There are existing fire hydrants located outside #24 Harrisville Rd and #27 Harrisville Rd, which is approximately 15m and 35m, respectively, to the intersection of the new ROAD 1.

5.2 WATER METERS

Water meters will be installed to service each new residential lot. Water meters will be installed in accordance with the RITS (D6.6).

5.3 QUALITY ASSURANCE

The 125Ø OD MDPE watermain will be pressure tested prior to being connected to the existing network on Harrisville Road. The testing shall be in accordance with NZS 4404, Appendix C.

6.0 ROADING

The roading design for this subdivision has been carried out in accordance with the RITS, Section 3 – Transportation and New Zealand Standard 4404:2013 (NZS4404): Land Development and Subdivision Infrastructure. As part of this development, the footpath along Harrisville Road will be extended up the southern side of ROAD 1.

6.1 CROSS SECTION ROAD 1

The road cross section for the proposed subdivision (ROAD 1) has been designed based on recommendations from the Waikato Council Design Engineer. The legal width of the Road Reserve varies from 20m initially, down to 13.4m adjacent to the proposed housing lots. The carriageway width remains a constant 6m wide with kerb and channel on either side (D3.3.3) and a single crossfall towards the southern side. A 1.5m wide concrete footpath is proposed on the southern side of ROAD 1. A berm is proposed on the northern side of the road which varies in width from 3m to 7.5m and would batter upwards (at 1m over 4m) to tie into the adjoining property levels. We also consider that this berm would likely be planted with low shrubs to minimise maintenance and provide appropriate

sight distances. A grass berm is proposed on the southern side of ROAD 1, which varies in width from 2.5m, outside the proposed house lots, and up to 11m, where the existing house was located (23 Harrisville Road).

6.2 PARKING

On ROAD 1, a 4-bay parking area is proposed. This parking will be perpendicular to the road and provides additional parking for visitors to the area.

6.3 PAVEMENT DESIGN ROAD 1

The pavement for the new road has been designed in general accordance with the RITS 3.3.12.1. A specific design has been undertaken, utilising the methodology from Austroads Guide to pavement Technology, Part 2, and the NZ Supplement to the Austroads Pavement Design Guide. The design outputs and factors that have been adopted for the pavement design are outlined in table 6.1. According to the Mobile Roads Application, Harrisville Road currently has an estimated Annual Daily Traffic (ADT) count of 3400 with an estimated 4% of these being Heavy Commercial Vehicles (HCVs). This ADT would be considered conservative for the new road considering that the proposed road will be a cul-de-sac/no exit. The percentage of HCVs using the new road adopted a value of 4% for the calculations and was used as a conservative approach as outlined in the RITS. The Equivalent Standard Axles (ESA) using the road over the 25-year design life span is $4.6x10^4$. With an adopted subgrade CBR of 5, this gives a design pavement thickness of 300mm as determined using the Pavement Thickness Design Chart (Austroads 2004, figure 8.4)

Therefore, it is proposed to install 200mm of GAP65 as subbase and 100mm of TNZ/M4 AP40 as basecourse. A deviation from the standard depth of the subbase has been implemented to provide a conservative design.

Pavement Design Variables and Outputs	
Design Life	25 Years
Annual HCV Growth Factor	3 %
Load Factor for ESA/HCV	1.44
% HCV Residential	4
ADT (From Mobile Roads)	153 Vehicles/day
Adopted Subgrade CBR	5
Design Traffic (ESAs)	$4.6 x10^4$
Design Pavement Thickness	300mm
Suggested Pavement Thickness	300mm

Table 6.1 – Pavement Design

6.4 PRIVATE ACCESSWAY

Lots 3 to 12 will have access via the private accessway off ROAD 1. ACCESSWAY 1 will be 135m in length and have a legal width of 10m decreasing to 6m at the end.

The accessway cross section includes 6m of seal, vertical kerb and channel (LHS)/kerb and nib (RHS) of either side, a 2.0% single crossfall towards the left edge of the accessway will be constructed to control stormwater runoff and a 2m wide carparking area with a 1m berm on both sides of the road. No footpath has been included in the accessway as it is expected that pedestrians will use the seal road area to walk on. It is proposed the pavement thickness for the accessway will be 200mm of

concrete on a 150mm GAP 65 subbase. Stormwater runoff will be controlled within the channel and directed towards the rain garden at the end of the accessway.

6.5 QUALITY ASSURANCE

The new road subgrade will be tested in general accordance with the RITS. It proposed to perform a Benkelman Beam test on the subgrade as well as Scala Penetrometers. If undercutting or subgrade improvement is required, this will be discussed with the Waikato District Council Development Engineer at the time.

The basecourse will be tested using the Benkelman Beam test and Clegg Hammer. The expectation is that the average deflection for the new road will be less than 1.1mm in accordance with the RITS, Table 3.23: Maximum Benkelman Beam Deflections. It is also expected that a CIV value of 35 is achieved for the Clegg Tests on the new road.

The subgrade, subbase and basecourse of the new road will be strung to check for grades and depth of pavement.

Scala Penetrometers will be performed on the subgrade of the footpath and the wetland accessway.

6.6 STREETLIGHTING

Street lighting will be installed at the intersection and along ROAD 1. Specialist streetlighting designers will be engaged and preliminary plans drawn up. These designers will liaise directly with Council throughout the Engineering Plan Approval process.

6.7 RETAINING WALLS

The geotechnical report requires that a palisade wall be installed in lots 11 & 12 to prevent further movement of the ground at this location. The design of the wall has been done by Tilsley Engineering and is included in the drawing set.

A timber retaining wall will be constructed along the left-hand side of accessway 1 to raise the ground to a manageable level and enable access to lots 4 to 11. The height of the wall is up to 2m high and tapers to a lower level at each end of the wall. The design of the wall has been undertaken by Tilsley Engineering and is included in the drawing set.

7.0 UTILITY SERVICES

Counties Energy and Chorus have both been engaged and indicative plans have been drafted to show the servicing of the subdivision. The cross section and plan for some of the utility layout has also been shown on the engineering plans in Appendix A. At this stage, no transformer will be required to service the subdivision.

Author: Warren Boag
The Surveying Company Ltd.
Engineering Manager

REVIEWED BY: Ed Armstrong
The Surveying Company Ltd.
Civil Engineer

ATTACHMENTS

APPENDIX A: Engineering Plans
APPENDIX B: Geotechnical Report
APPENDIX C: Public Stormwater Calculations
APPENDIX D: Public Stormwater Calculations - HEC HMS outputs
APPENDIX E: Private Stormwater Calculations – Data & HEC-HMS outputs
APPENDIX F: Low Impact Design Scoring Matrix

APPENDIX A: Engineering Plans

APPENDIX B: Geotechnical Report

APPENDIX C: Public Stormwater Calculations

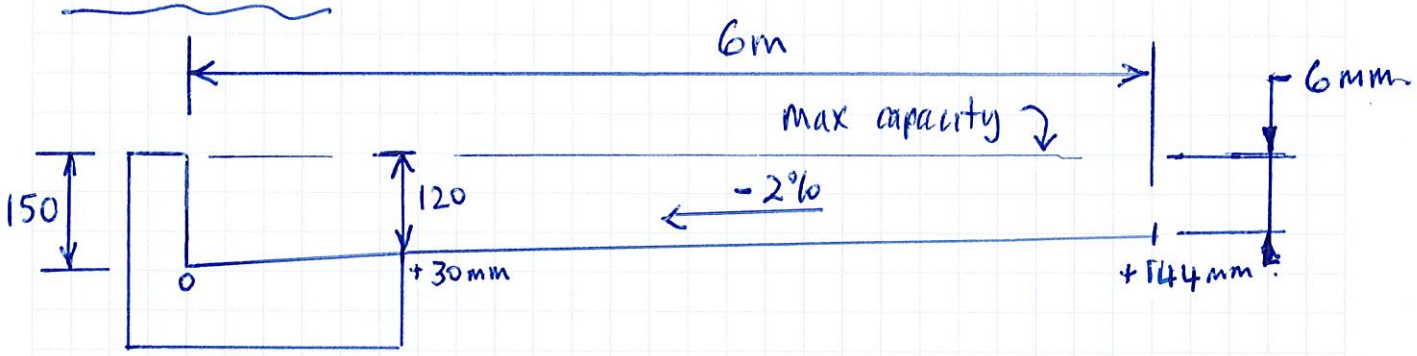
23a Harrisville Rd																
Date	1/11/2022			Rainfall Intensity (mm/hr) =		123.8	(includes climate change RCP 6.0)									
Engineer	Warren Boag															
				STORMWATER CALCULATION												
SWMH	**Catchment Desc**	**Area**	**Run-off coeff.**	**Time of conc.**	**Rainfall intensity**	**Calc Flow**	**Upstream Flow**	**Junction Flow**	**Junction Description**	**Design flow**	**Pipe size**	**Design velocity**	**Minimum Pipe slope**	**Pipe Slope**	**Pipe flow**	**Pipe velocity**
1.6 - 1.5																
	Lot 3	1000	0.7	10	123.80	24.5	0									
	Total					24.5	0	0		24.5	225	0.62	0.29%	**1.83%**	**62**	**1.55**
1.5 - 1.4																
	Lot 4	1000	0.7	10	123.80	24.5	0									
	Total					24.5	24.5	0		49	225	1.23	1.15%	**6.01%**	**112**	**2.82**
1.4 - 1.3																
	Lot 5	1000	0.7	10	123.80	24.5	0									
	Lot 6	1000	0.7	10	123.80	24.5	0									
	Total					49.0	49	0		98	225	2.46	4.58%	**15.71%**	**181**	**4.56**
1.3 - 1.2																
	Lot 7	1000	0.7	10	123.80	24.5	0									
	Total					24.5	98	0		122.5	300	1.73	1.56%	**5.58%**	**232**	**3.28**
1.2 - 1.1																
	Lot 8	1000	0.7	10	123.80	24.5	0									
	Total					24.5	122.5	0		147	300	2.08	2.24%	**3.98%**	**196**	**2.77**
1.1 - Tanks																
	RG-4	655	0.9	10	123.80	20.5	0									
	Lot 9	1000	0.7	10	123.80	20.5	0									
	Total					41.0	147.0	0		188	375	1.70	1.12%	**2.35%**	**272**	**2.46**
2.3 - 2.2																
	Lot 1	1000	0.7	10	123.80	24.5	0									
	Total					24.5	0	0		24.5	225	0.62	0.29%	**4.01%**	**92**	**2.30**
2.2 - 2.1																
	Lot 2	1000	0.7	10	123.80	24.5	0									
	RG-2	432	0.9	10	123.80	13.5	0									
	RG-3	281	0.9	10	123.80	9	0									
	CP-1	0	0.9	10	123.80	0	0									
	Total					47.0	24.5	49		120.5	225	3.03	6.92%	**14.56%**	**175**	**4.39**
2.1 - Tanks																
	Lot 14	1000	0.7	10	123.80	24.5	0									
	Line 3															
	Overland Flow Path	713	1	10	184.50	37	0									
	Total					61.5	120.5	44		226.0	375	2.05	1.62%	**5.00%**	**397**	**3.59**
3.1 - 2.2																
	Lot 12	1000	0.7	10	123.80	24.5	0									
	Lot 13	1000	0.7	10	123.80	24.5	0									
	Total					49.0	0	0		49	300	0.69	0.25%	**1.35%**	**114**	**1.61**

23a Harrisville Rd																	
Date	1/11/2022				Rainfall Intensity (mm/hr) =		142.8	(includes climate change RCP 8.5)									
Engineer	Warren Boag																
				STORMWATER CALCULATION													
SWMH	**Catchment Desc**	**Area**	**Run-off coeff.**	**Time of conc.**	**Rainfall intensity**	**Calc Flow**	**Upstream Flow**	**Junction Flow**	**Junction Description**	**Design flow**	**Pipe size**	**Design velocity**	**Minimum Pipe slope**	**Pipe Slope**	**Pipe flow**	**Pipe velocity**
1.6 - 1.5																
	Lot 3	1000	0.7	10	142.80	28.0	0									
	Total					28.0	0	0		28	225	0.70	0.38%	**1.83%**	**62**	**1.55**
1.5 - 1.4																
	Lot 4	1000	0.7	10	142.80	28.0	0									
	Total					28.0	28	0		56	225	1.41	1.50%	**6.01%**	**112**	**2.82**
1.4 - 1.3																
	Lot 5	1000	0.7	10	142.80	28	0									
	Lot 6	1000	0.7	10	142.80	28	0									
	Total					56.0	56	0		112	225	2.82	5.98%	**15.71%**	**181**	**4.56**
1.3 - 1.2																
	Lot 7	1000	0.7	10	142.80	28.0	0									
	Total					28.0	112	0		140	300	1.98	2.03%	**5.58%**	**232**	**3.28**
1.2 - 1.1																
	Lot 8	1000	0.7	10	142.80	28	0									
	Total					28.0	140	0		168	300	2.38	2.92%	**3.98%**	**196**	**2.77**
1.1 - Tanks																
	RG-4	655	0.9	10	142.80	23.5	0									
	Lot 9	1000	0.7	10	142.80	23.5	0									
	Total					47.0	168.0	0		215	375	1.95	1.47%	**2.35%**	**272**	**2.46**
2.3 - 2.2																
	Lot 1	1000	0.7	10	142.80	28	0									
	Total					28.0	0	0		28	225	0.70	0.38%	**4.01%**	**92**	**2.30**
2.2 - 2.1																
	Lot 2	1000	0.7	10	142.80	28	0									
	RG-2	432	0.9	10	142.80	15.5	0									
	RG-3	281	0.9	10	142.80	10.5	0									
	CP-1	0	0.9	10	142.80	0	0									
	Total					54.0	28	56		138	225	3.47	9.07%	**14.56%**	**175**	**4.39**
2.1 - Tanks																
	Lot 14	1000	0.7	10	142.80	28	0									
	Line 3															
	Overland Flow Path	713	1	10	184.50	37	0									
	Total					65.0	138	44		247.0	375	2.24	1.94%	**5.00%**	**397**	**3.59**
3.1 - 2.2																
	Lot 12	1000	0.7	10	142.80	28	0									
	Lot 13	1000	0.7	10	142.80	28	0									
	Total					56.0	0	0		56	300	0.79	0.33%	**1.35%**	**114**	**1.61**

At chainage 120

Road width = 6m.
Longitudinal grade = 10.3%.
Crossfall = 2%.

Std Kerb



Area = $(0.135 \times 0.3) + (0.063 \times 5.7) = 0.17 + 0.359 = 0.53\ m^2$

P = 0.15 + 6 + 0.006 = 6.156.

A/P = R = 0.0861 n = 0.012

$$Q = \frac{AR^{2/3} S^{1/2}}{n}$$

$$Q = \frac{0.53 \times 0.0861^{2/3} \sqrt{0.103}}{0.012}$$

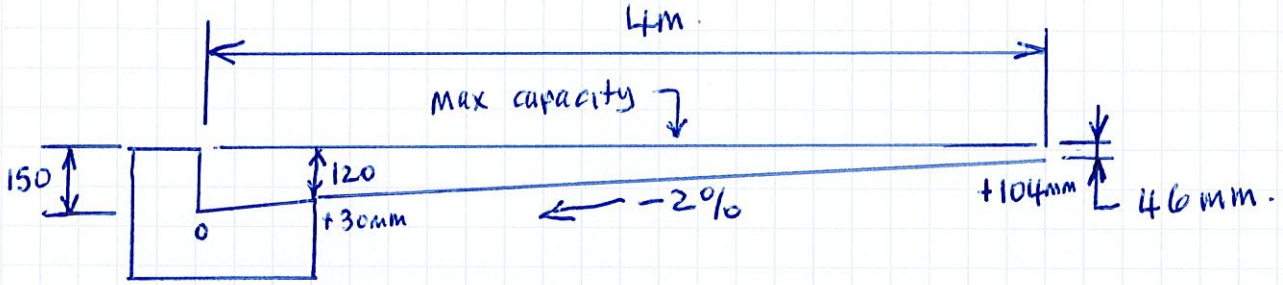
$$= 2.76\ m^3/s$$

Using a grade of only 4%,
Q = 1.72 m^3/s.

At chainage 150m.

Road width = 4m.
Longitudinal grade = 4%.
Crossfall = 2%

Std Kerb



Area = $(0.135 \times 0.3) + (0.083 \times 3.7) = 0.3476\ m^2$

P = $(0.15 + 4 + 0.046) = 4.196$.

R = A/P = 0.08284 $\qquad$ n = 0.012

$$Q = \frac{AR^{2/3} S^{1/2}}{n} = \frac{0.3476 \times 0.0828^{2/3} \times \sqrt{0.04}}{0.012}$$

$$= 1.1\ m^3/s.$$

Driveway

Sta 120 – Flows @ this location

High pt = ch 30

∴ 90m length of driveway.

driveway width = 6m.

∴ Area of driveway = $540m^2$

I = 160mm/hr. C = 0.9

$$Q = \frac{CIA}{360}$$

$$= \frac{0.9 \times 160 \times 540/10000}{360}$$

$$= 22 \ell/s.$$

Assuming all lots drain to driveway from CH 30 – 120 minus roof area of $200m^2$/site

Lots 4 – lot 7 = $4000m^2$

minus Roof area = $800m^2$

= $3200m^2$ + driveway = $3740m^2$

$$Q = \frac{0.9 \times 160 \times 3740/10000}{360}$$

$$= 150 \ell/s.$$

Assuming total runoff to driveway - sta 30 - 150

				Area
driveway width	6m	- sta	30 - 105	450m²
"	"	4m	- sta 130 - 150	125m²
				80m²
			(C = 0.9)	655m²

Lots 4 - 8 = 5000m² (C = 0.7) lets use C = 0.8

I = 160 mm/hr

$$Q = \frac{CIA}{360}$$

$$= \frac{0.8 \times 160 \times 5655/10000}{360}$$

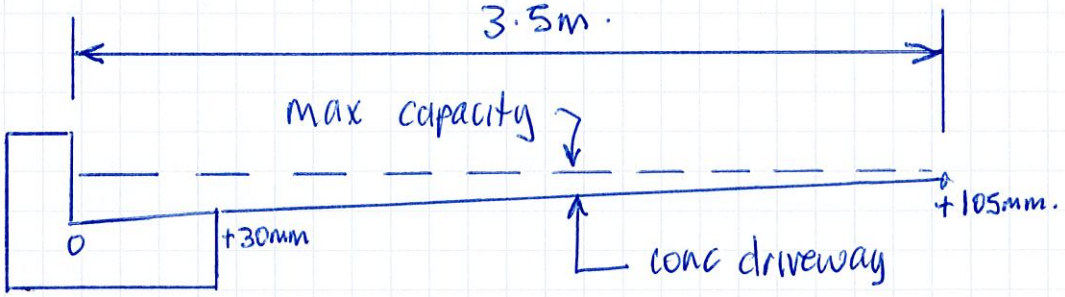
$$= 200 \text{ l/s}.$$

∴ Kerb capacity exceeds max flow in driveway.
(200 l/s) (150 l/s)

Concrete driveway

Width 3.5m.
Longitudinal grade = 15%.
crossfall – 3%.

OLFP Q = 37 l/s.



Area = $0.184 m^2$

n = 0.015

P = 3.605

$R = A/P = \frac{0.184}{3.605} = 0.51$

$Q = \frac{AR^{2/3} S^{1/2}}{n} = \frac{0.184 \times 0.051^{2/3} \sqrt{0.15}}{0.015}$

$= 653 l/s.$

APPENDIX D: Public Stormwater Calculations – HEC-HMS outputs

Project: Harrisville Road Simulation Run: EDV

Start of Run: 01Jan2000, 00:00 Basin Model: C Post-development
End of Run: 02Jan2000, 00:00 Meteorologic Model: EDV
Compute Time: 31Oct2022, 16:18:17 Control Specifications: Control 1

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Impervious Post-Dev (Road)	0.00	0.00520	01Jan2000, 12:02	0.02815
Pervious - Post-Dev (Road)	0.00	0.00012	01Jan2000, 12:03	0.00069
Tank - Post Dev (Road)	0.00	0.00086	01Jan2000, 12:59	0.02839
Open Drain (Road)	0.00	0.00086	01Jan2000, 12:58	0.02839
Pervious - Post-Dev (Access)	0.00	0.00026	01Jan2000, 12:03	0.00151
Impervious - Post Dev (Acc)	0.00	0.00338	01Jan2000, 12:02	0.01830
Tank - Post Dev - (Access)	0.00	0.00072	01Jan2000, 12:55	0.01966
Open Drain (Access)	0.00	0.00072	01Jan2000, 12:54	0.01966

Project: Harrisville Road Simulation Run: EDV

Reservoir: Tank - Post Dev (Road)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	EDV
Compute Time:	31Oct2022, 16:18:17	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.00532 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:01
Peak Discharge:	0.00086 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:59
Inflow Volume:	0.02885 (1000 M3)	Peak Storage:	0.01081 (1000 M3)
Discharge Volume	0.02839 (1000 M3)	Peak Elevation:	0.62417 (M)

Project: Harrisville Road Simulation Run: EDV

Reservoir: Tank - Post Dev - (Access)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	EDV
Compute Time:	31Oct2022, 16:18:17	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.00364 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:02
Peak Discharge:	0.00072 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:55
Inflow Volume:	0.01981 (1000 M3)	Peak Storage:	0.00683 (1000 M3)
Discharge Volume	0.01966 (1000 M3)	Peak Elevation:	0.43158 (M)

Project: Harrisville Road Simulation Run: 2 Year - Pre-Dev

Start of Run: 01Jan2000, 00:00 Basin Model: A Pre-development
End of Run: 02Jan2000, 00:00 Meteorologic Model: 2 Year Predevelopment
Compute Time: 31Oct2022, 16:18:51 Control Specifications: Control 1

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Pervious Pre-Dev (Road)	0.00	0.00596	01Jan2000, 12:03	0.03227
Open Drain (Road)	0.00	0.00596	01Jan2000, 12:02	0.03227
Pervious Pre-Dev (Access)	0.00	0.00482	01Jan2000, 12:03	0.02613
Open Drain (Access)	0.00	0.00482	01Jan2000, 12:02	0.02613

Project: Harrisville Road Simulation Run: 2 Year - Post Dev

Start of Run: 01Jan2000, 00:00 Basin Model: C Post-development
End of Run: 02Jan2000, 00:00 Meteorologic Model: 2 year
Compute Time: 31Oct2022, 16:18:43 Control Specifications: Control 1

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Impervious Post-Dev (Road)	0.00	0.01624	01Jan2000, 12:02	0.09231
Pervious - Post-Dev (Road)	0.00	0.00094	01Jan2000, 12:03	0.00505
Tank - Post Dev (Road)	0.00	0.00549	01Jan2000, 12:23	0.09239
Open Drain (Road)	0.00	0.00549	01Jan2000, 12:22	0.09239
Pervious - Post-Dev (Access)	0.00	0.00206	01Jan2000, 12:03	0.01101
Impervious - Post Dev (Acc)	0.00	0.01056	01Jan2000, 12:02	0.06000
Tank - Post Dev - (Access)	0.00	0.00477	01Jan2000, 12:19	0.06889
Open Drain (Access)	0.00	0.00477	01Jan2000, 12:18	0.06889

Project: Harrisville Road Simulation Run: 2 Year - Post Dev

Reservoir: Tank - Post Dev (Road)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	2 year
Compute Time:	31Oct2022, 16:18:43	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.01718 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:01
Peak Discharge:	0.00549 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:23
Inflow Volume:	0.09736 (1000 M3)	Peak Storage:	0.02864 (1000 M3)
Discharge Volume	0.09239 (1000 M3)	Peak Elevation:	1.49175 (M)

Project: Harrisville Road Simulation Run: 2 Year - Post Dev

Reservoir: Tank - Post Dev - (Access)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	2 year
Compute Time:	31Oct2022, 16:18:43	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.01259 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:01
Peak Discharge:	0.00477 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:19
Inflow Volume:	0.07101 (1000 M3)	Peak Storage:	0.01855 (1000 M3)
Discharge Volume	0.06889 (1000 M3)	Peak Elevation:	1.00218 (M)

Project: Harrisville Road Simulation Run: 10 Year - Pre-Dev

Start of Run: 01Jan2000, 00:00 Basin Model: A Pre-development
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10 year predevelopment
Compute Time: 31Oct2022, 16:18:34 Control Specifications: Control 1

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Pervious Pre-Dev (Road)	0.00	0.01233	01Jan2000, 12:03	0.06559
Open Drain (Road)	0.00	0.01233	01Jan2000, 12:02	0.06559
Pervious Pre-Dev (Access)	0.00	0.00999	01Jan2000, 12:03	0.05311
Open Drain (Access)	0.00	0.00999	01Jan2000, 12:02	0.05311

Project: Harrisville Road Simulation Run: 10 Year - Post Dev

Start of Run: 01Jan2000, 00:00 Basin Model: C Post-development
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10 year
Compute Time: 31Oct2022, 16:18:25 Control Specifications:Control 1

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Impervious Post-Dev (Road)	0.00	0.02593	01Jan2000, 12:02	0.14976
Pervious - Post-Dev (Road)	0.00	0.00194	01Jan2000, 12:03	0.01028
Tank - Post Dev (Road)	0.00	0.01252	01Jan2000, 12:15	0.15107
Open Drain (Road)	0.00	0.01252	01Jan2000, 12:14	0.15107
Pervious - Post-Dev (Access)	0.00	0.00424	01Jan2000, 12:03	0.02239
Impervious - Post Dev (Acc)	0.00	0.01685	01Jan2000, 12:02	0.09734
Tank - Post Dev - (Access)	0.00	0.00936	01Jan2000, 12:16	0.11499
Open Drain (Access)	0.00	0.00936	01Jan2000, 12:15	0.11499

Project: Harrisville Road Simulation Run: 10 Year - Post Dev

Reservoir: Tank - Post Dev - (Access)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	10 year
Compute Time:	31Oct2022, 16:18:25	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.02107 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:01
Peak Discharge:	0.00936 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:16
Inflow Volume:	0.11973 (1000 M3)	Peak Storage:	0.02727 (1000 M3)
Discharge Volume	0.11499 (1000 M3)	Peak Elevation:	1.42328 (M)

Project: Harrisville Road Simulation Run: 10 Year - Post Dev

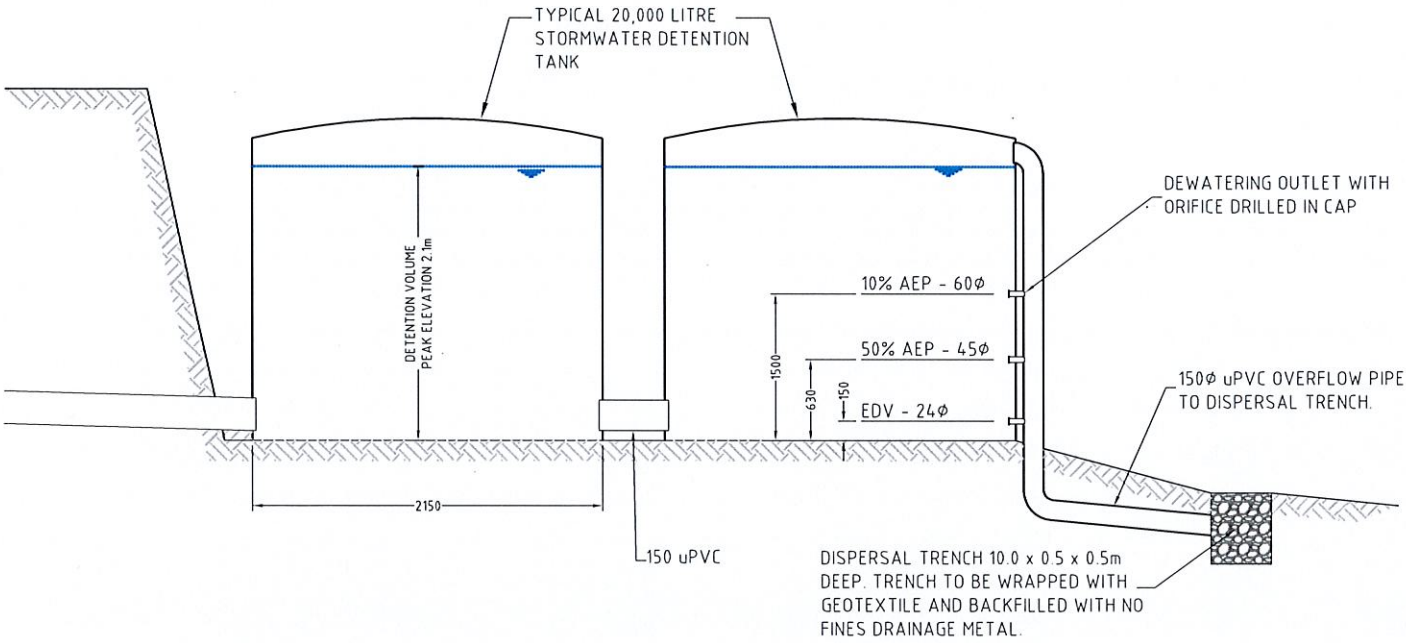
Reservoir: Tank - Post Dev (Road)

Start of Run:	01Jan2000, 00:00	Basin Model:	C Post-development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	10 year
Compute Time:	31Oct2022, 16:18:25	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Inflow:	0.02787 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:01
Peak Discharge:	0.01252 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:15
Inflow Volume:	0.16003 (1000 M3)	Peak Storage:	0.03973 (1000 M3)
Discharge Volume	0.15107 (1000 M3)	Peak Elevation:	2.03018 (M)



TYPICAL DETENTION TANK DETAIL - TWIN 20,000 LITRE TANK

NTS

DETENTION TANK DATA -TWIN 14,000 LITRE TANK		
RAINFALL EVENT	ELEVATION FROM BASE OF TANK (mm)	ORIFICE DIAMETER (mm)
EDV	150	25
50% AEP	440	45
10% AEP	1000	50
PEAK ELEVATION	1420	

Upper Tank & Lower Tank

Stormwater tanks

Stormwater retention /detention tanks

Go Underground

Add value and retain the beauty of your property with an inground retention and or detention and or re-use tank.
Overview

- 3,700 litres up to 22,500 litres (5,000 gallons)
- In ground (saves taking up valuable realty)

- Council approved product – all products carry PS 1 certificates
- Child proof entry risers and manhole lids
- 25 year guarantee
- Manufactured from 100% solid poured high strength certified concrete
- Thick wall construction for optimum strength
- Cool dark interior– ideal conditions for water storage
- Under driveway roof design is available with a swivel spacer ring (for driveway gradients) and a Heavy Duty cast iron lid and frame combo, including a T-handle lifter.

STORMWATER RETENTION/DETENTION/RE USE

Sizes and Dimensions

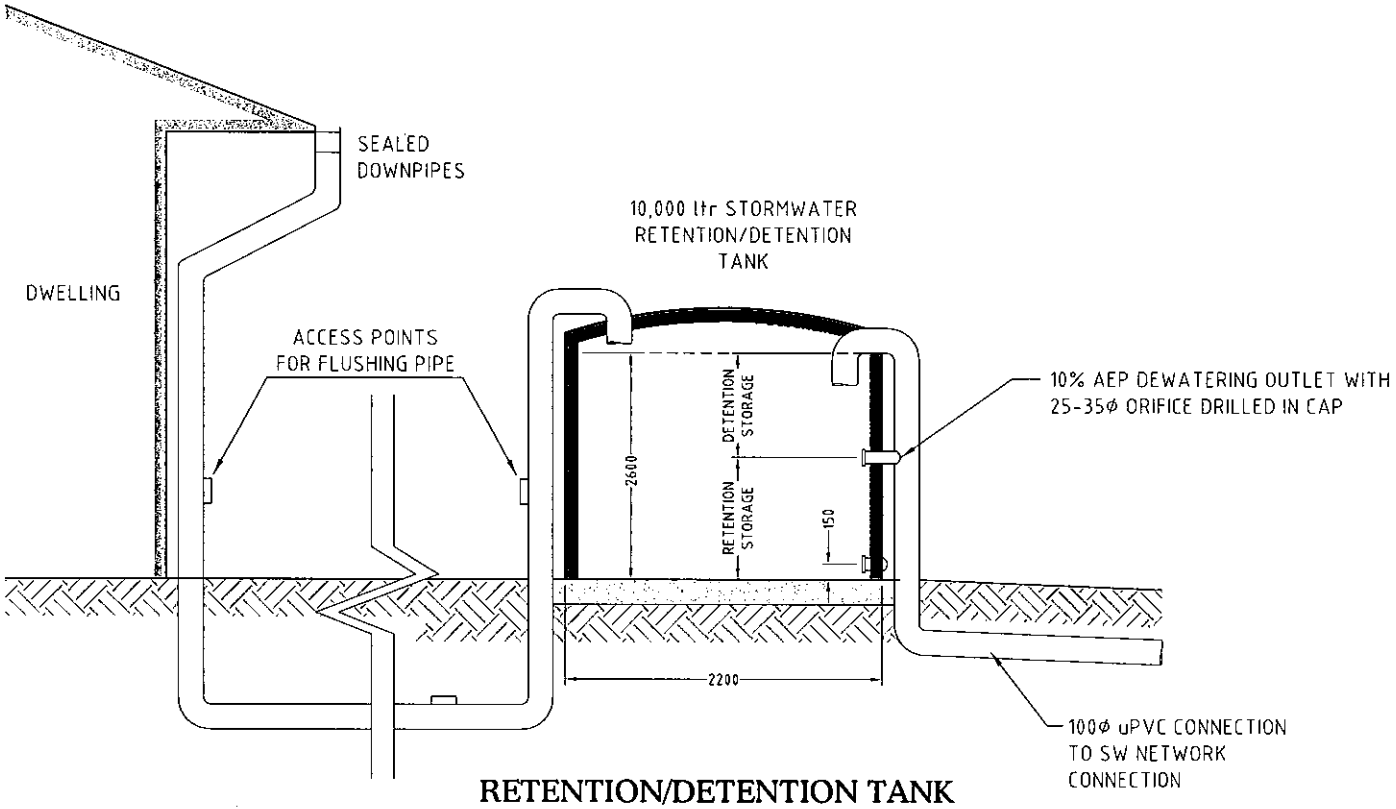
Round Diameter 2.150 – 325L per 100mm of Wall Height		
Size	Wall height	Finished height
3,700L	1.200m	1.360m
4,500L	1.380m	1.540m

5,000L	1.530m	1.690m
6,000L	1.830m	1.990m

Round Diameter 2.800 – 523L per 100mm of Wall Height		
Size	Wall height	Finished height
6.000L	1.350m	1.510m
8,000L	1.730m	1.890m

Round Diameter 3.620 – 1000L per 100mm of Wall Height		
Size	Wall height	Finished height
9,000L	1.000m	1.180m
10,000L	1.100m	1.280 m
11,000 L	1.200 m	1.380 m
12,000L	1.300m	1.480m
13,000L	1.400m	1.580m
14,000L	1.500m	1.680 m
15,000 L	1.600 m	1.780 m
16,000L	1.700m	1.880m
17,000L	1.800m	1.980m
18,000 L	1.900 m	2.080 m
19,000L	2.000m	2.180m
20,000L	2.100m	2.280m
21,000L	2.200m	2.380m
22,500L (or 5,000 gallons)	2.300m	2.480m

APPENDIX E: Private Stormwater Calculations – Data & HEC-HMS outputs



RETENTION/DETENTION TANK

RETENTION /DETENTION TANK DATA			
ROOF AREA (m2)	DETENTION STORAGE HEIGHT (mm)	RETENTION STORAGE HEIGHT (mm)	ORIFICE DIAMETER (mm)
150	2000	600	25
200	1800	800	30
250	1700	900	30
300	1400	1200	30
350	1400	1200	35

150m² House - 10,000L TANK

Project: J1257
Address: 23 Harrisville Road, Tuakau
Date: 29/06/2022
Prepared by: Ed Armstrong

Orifice discharge: $Q = 0.62 \times A \times (2g\,(h - D/2))^{0.5}$

Parameters:

Impervious area:	150	m²		
Number of tanks:	1			
Tank diameter:	2.2	m		
Tank height:	2.90	m		
Orifice outlet coefficient:	0.62			
Initial Abstraction:	0.0045	m	4.5	mm
Retention Volume Required:	0.675	m³	675	l
Retention Volume Supplied:	7	m³	7000	l
10 year Rainfall Depth (10% AEP)	99.7	mm		
Climate Change Rainfall Depth (+ 13.2%)	112.9	mm		
Depth to 10 year orifice	2000	mm		
10 Year Pre-Development Flow:	0.0014	m³/s	1.4	l/s
10 Year Post-Development Flow:	0.0011	m³/s	1.1	l/s
10 year orifice Ø:	25	mm		
10 year orifice area:	0.000490874	m²		

Elevation above base	Height above base	Storage
(m)	(mm)	(1000 m³)
0.00	0	0.00000
0.20	200	0.00076
0.40	400	0.00152
0.60	600	0.00228
0.80	800	0.00304
1.00	1000	0.00380
1.20	1200	0.00456
1.40	1400	0.00532
1.60	1600	0.00608
1.80	1800	0.00684
2.00	2000	0.00760
2.20	2200	0.00836
2.40	2400	0.00912
2.60	2600	0.00988
2.80	2800	0.01064
2.90	2900	0.01102

200m² House - 10,000L TANK

Project: J1257
Address: 23 Harrisville Road, Tuakau
Date: 29/06/2022
Prepared by: Ed Armstrong

Orifice discharge: $Q = 0.62 \times A \times (2g\,(h - D/2))^{0.5}$

Parameters:

Impervious area:	200	m²		
Number of tanks:	1			
Tank diameter:	2.2	m		
Tank height:	2.90	m		
Orifice outlet coefficient:	0.62			
Initial Abstraction:	0.0045	m	4.5	mm
Retention Volume Required:	0.9	m³	900	l
Retention Volume Supplied:	6.25	m³	6250	l
10 year Rainfall Depth (10% AEP)	99.7	mm		
Climate Change Rainfall Depth (+ 13.2%)	112.9	mm		
Depth to 10 year orifice	1800	mm		
10 Year Pre-Development Flow:	0.0018	m³/s	1.8	l/s
10 Year Post-Development Flow:	0.0017	m³/s	1.7	l/s
10 year orifice Ø:	30	mm		
10 year orifice area:	0.000706858	m²		

Elevation above base	Height above base	Storage
(m)	(mm)	(1000 m³)
0.00	0	0.00000
0.20	200	0.00076
0.40	400	0.00152
0.60	600	0.00228
0.80	800	0.00304
1.00	1000	0.00380
1.20	1200	0.00456
1.40	1400	0.00532
1.60	1600	0.00608
1.80	1800	0.00684
2.00	2000	0.00760
2.20	2200	0.00836
2.40	2400	0.00912
2.60	2600	0.00988
2.80	2800	0.01064
2.90	2900	0.01102

250m² House - 10,000L TANK

Project: J1257
Address: 23 Harrisville Road, Tuakau
Date: 29/06/2022
Prepared by: Ed Armstrong

Orifice discharge: $Q = 0.62 \times A \times (2g\,(h - D/2))^{0.5}$

Parameters:

Impervious area:	250	m²		
Number of tanks:	1			
Tank diameter:	2.2	m		
Tank height:	2.90	m		
Orifice outlet coefficient:	0.62			
Initial Abstraction:	0.0045	m	4.5	mm
Retention Volume Required:	1.125	m³	1125	l
Retention Volume Supplied:	6.25	m³	6250	l
10 year Rainfall Depth (10% AEP)	99.7	mm		
Climate Change Rainfall Depth (+ 13.2%)	112.9	mm		
Depth to 10 year orifice	1700	mm		
10 Year Pre-Development Flow:	0.0023	m³/s	2.3	l/s
10 Year Post-Development Flow:	0.0020	m³/s	2.0	l/s
10 year orifice Ø:	30	mm		
10 year orifice area:	0.000706858	m²		

Elevation above base	Height above base	Storage
(m)	(mm)	(1000 m³)
0.00	0	0.00000
0.20	200	0.00076
0.40	400	0.00152
0.60	600	0.00228
0.80	800	0.00304
1.00	1000	0.00380
1.20	1200	0.00456
1.40	1400	0.00532
1.60	1600	0.00608
1.80	1800	0.00684
2.00	2000	0.00760
2.20	2200	0.00836
2.40	2400	0.00912
2.60	2600	0.00988
2.80	2800	0.01064
2.90	2900	0.01102

300m² House - 10,000L TANK

Project: J1257
Address: 23 Harrisville Road, Tuakau
Date: 29/06/2022
Prepared by: Ed Armstrong

Orifice discharge: $Q = 0.62 \times A \times (2g\,(h - D/2))^{0.5}$

Parameters:

Impervious area:	300	m²		
Number of tanks:	1			
Tank diameter:	2.2	m		
Tank height:	2.90	m		
Orifice outlet coefficient:	0.62			
Initial Abstraction:	0.0045	m	4.5	mm
Retention Volume Required:	1.35	m³	1350	l
Retention Volume Supplied:	5.1	m³	5100	l
10 year Rainfall Depth (10% AEP)	99.7	mm		
Climate Change Rainfall Depth (+ 13.2%)	112.9	mm		
Depth to 10 year orifice	1400	mm		
10 Year Pre-Development Flow:	0.0027	m³/s	2.7	l/s
10 Year Post-Development Flow:	0.0023	m³/s	2.3	l/s
10 year orifice Ø:	30	mm		
10 year orifice area:	0.000706858	m²		

Elevation above base	Height above base	Storage
(m)	(mm)	(1000 m³)
0.00	0	0.00000
0.20	200	0.00076
0.40	400	0.00152
0.60	600	0.00228
0.80	800	0.00304
1.00	1000	0.00380
1.20	1200	0.00456
1.40	1400	0.00532
1.60	1600	0.00608
1.80	1800	0.00684
2.00	2000	0.00760
2.20	2200	0.00836
2.40	2400	0.00912
2.60	2600	0.00988
2.90	2900	0.01102

350m² House - 10,000L TANK

Project: J1257
Address: 23 Harrisville Road, Tuakau
Date: 29/06/2022
Prepared by: Ed Armstrong

Orifice discharge: $Q = 0.62 \times A \times (2g\,(h - D/2))^{0.5}$

Parameters:

Impervious area:	350	m²		
Number of tanks:	1			
Tank diameter:	2.2	m		
Tank height:	2.90	m		
Orifice outlet coefficient:	0.62			
Initial Abstraction:	0.0045	m	4.5	mm
Retention Volume Required:	1.575	m³	1575	l
Retention Volume Supplied:	5.1	m³	5100	l
10 year Rainfall Depth (10% AEP)	99.7	mm		
Climate Change Rainfall Depth (+ 13.2%)	112.9	mm		
Depth to 10 year orifice	1400	mm		
10 Year Pre-Development Flow:	0.0032	m³/s	3.2	l/s
10 Year Post-Development Flow:	0.0031	m³/s	3.1	l/s
10 year orifice Ø:	35	mm		
10 year orifice area:	0.000962113	m²		

Elevation above base	Height above base	Storage
(m)	(mm)	(1000 m³)
0.00	0	0.00000
0.20	200	0.00076
0.40	400	0.00152
0.60	600	0.00228
0.80	800	0.00304
1.00	1000	0.00380
1.20	1200	0.00456
1.40	1400	0.00532
1.60	1600	0.00608
1.80	1800	0.00684
2.00	2000	0.00760
2.20	2200	0.00836
2.40	2400	0.00912
2.60	2600	0.00988
2.80	2800	0.01064
2.90	2900	0.01102

EN1010000

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Choose quality and style with our range of large corrugated tanks, designed for superior performance and peace of mind.

These ultra strong tanks are engineered to last and compliment every landscape with their contemporary look.

Promax ENDURO tanks are so strong they are the only plastic water tanks in NZ that can be buried up to 1 metre in the ground and still retain a 20 year warranty!

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- Certification to AS/NZ 4766 - Polyethylene storage tank standard

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$2,979.00 *(incl. GST)*

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Code	Description	Capacity(L)	Diameter(mm)	Width(mm)	Height(mm)	Weight(kg)	Manhole Dia(mm)	Outlets(mm)
EN1010000	ENDURO Water Tank 10,000 Ltr	10000	2200	2200	2900	180	450	1x50mm

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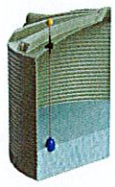

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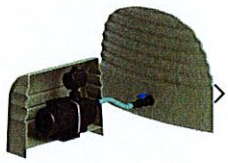

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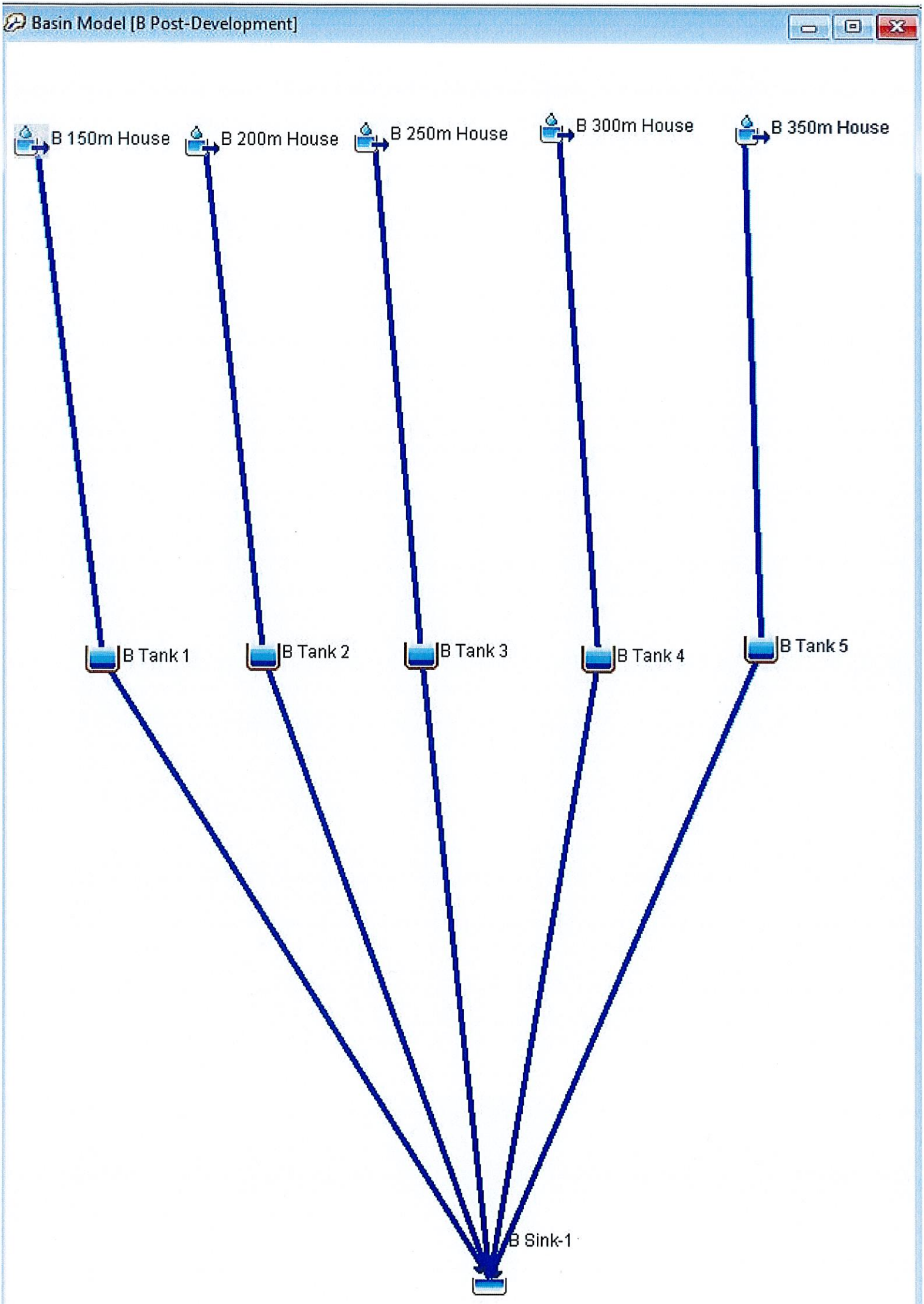
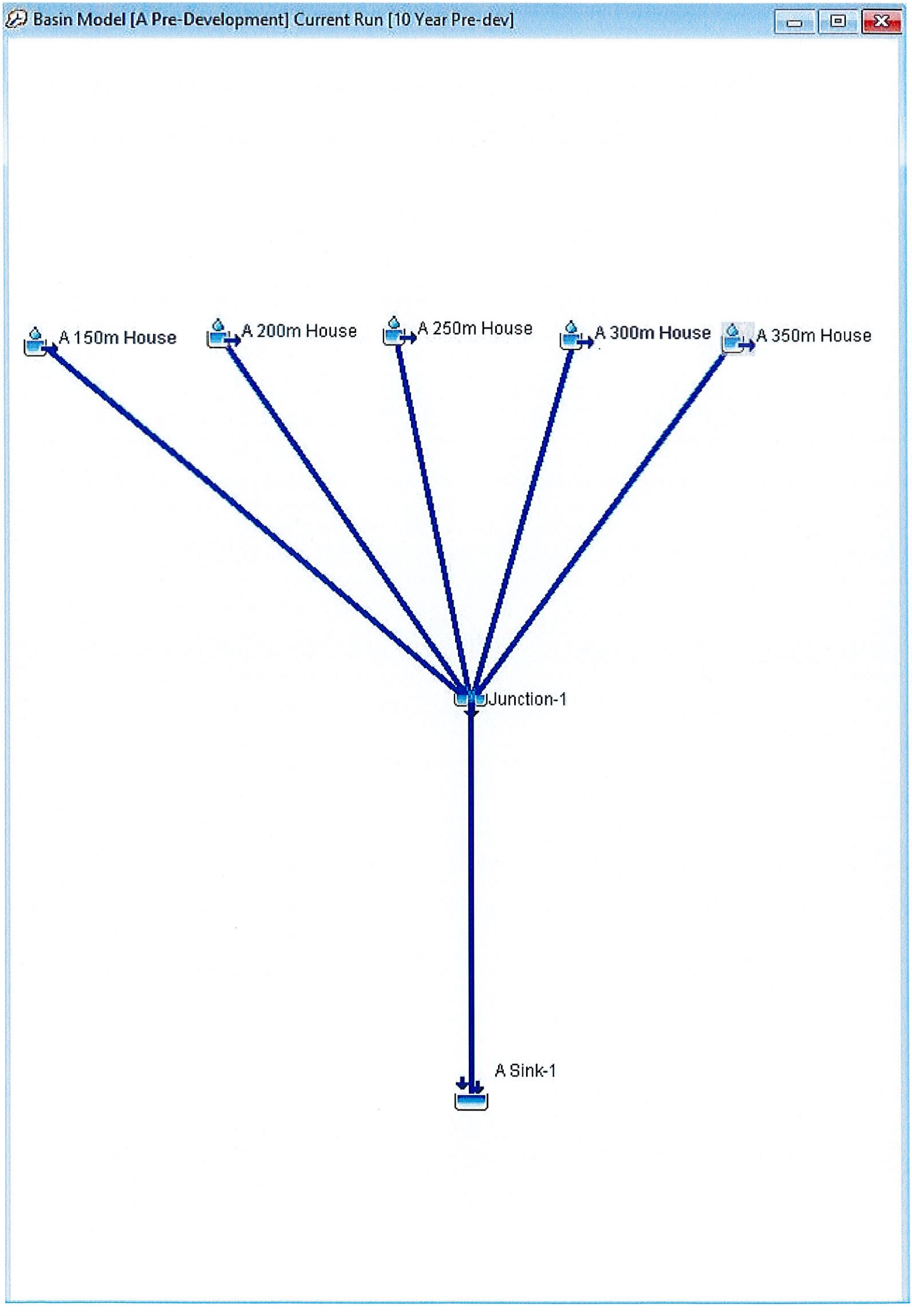

Basin Model [B Post-Development]
B 150m House
B 200m House
B 250m House
B 300m House
B 350m House
B Tank 1
B Tank 2
B Tank 3
B Tank 4
B Tank 5
B Sink-1


Basin Model [A Pre-Development] Current Run [10 Year Pre-dev]
A 150m House
A 200m House
A 250m House
A 300m House
A 350m House
Junction-1
A Sink-1

Global Summary Results for Run "10 Year Pre-dev"

Project: Project 2 Simulation Run: 10 Year Pre-dev

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 29Jun2022, 14:42:27

Basin Model: A Pre-Development
Meteorologic Model: 10 year Pre-dev
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: ○ MM ◉ 1000 M3 | Sorting: Hydrologic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
A 350m House	0.000350	0.00320	01Jan2000, 12:03	0.0170
A Reach-5	0.000350	0.00320	01Jan2000, 12:09	0.0170
A 300m House	0.000300	0.00274	01Jan2000, 12:03	0.0146
Reach-4	0.000300	0.00274	01Jan2000, 12:09	0.0145
A 250m House	0.000250	0.00229	01Jan2000, 12:03	0.0121
Reach-3	0.000250	0.00229	01Jan2000, 12:09	0.0121
A 200m House	0.000200	0.00183	01Jan2000, 12:03	0.0097
A Reach-2	0.000200	0.00183	01Jan2000, 12:09	0.0097
A 150m House	0.000150	0.00137	01Jan2000, 12:03	0.0073
A Reach-1	0.000150	0.00137	01Jan2000, 12:09	0.0073
Junction-1	0.001250	0.01144	01Jan2000, 12:09	0.0606
A Reach-10	0.001250	0.01144	01Jan2000, 12:09	0.0606
A Sink-1	0.001250	0.01144	01Jan2000, 12:08	0.0606

Global Summary Results for Run "10 Year Post-dev"

Project: Project 2 Simulation Run: 10 Year Post-dev

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 29Jun2022, 14:42:22

Basin Model: B Post-Development
Meteorologic Model: 10 year Post-dev
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: ○ MM ◉ 1000 M3 | Sorting: Hydrologic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
B 150m House	0.000150	0.00288	01Jan2000, 12:02	0.0162
B Reach-5	0.000350	0.00672	01Jan2000, 12:08	0.0376
B 350m House	0.000350	0.00672	01Jan2000, 12:02	0.0377
B Tank 5	0.000350	0.00308	01Jan2000, 12:21	0.0376
B Reach-50	0.000350	0.00308	01Jan2000, 12:21	0.0376
B Reach-4	0.000300	0.00576	01Jan2000, 12:08	0.0322
B 300m House	0.000300	0.00576	01Jan2000, 12:02	0.0323
B Tank 4	0.000300	0.00228	01Jan2000, 12:23	0.0322
B Reach-40	0.000300	0.00228	01Jan2000, 12:23	0.0322
B Reach-3	0.000250	0.00480	01Jan2000, 12:08	0.0269
B 250m House	0.000250	0.00480	01Jan2000, 12:02	0.0269
B Tank 3	0.000250	0.00201	01Jan2000, 12:22	0.0269
B Reach-30	0.000250	0.00201	01Jan2000, 12:22	0.0269
B Reach-2	0.000200	0.00384	01Jan2000, 12:08	0.0215
B 200m House	0.000200	0.00384	01Jan2000, 12:02	0.0215
B Tank 2	0.000200	0.00173	01Jan2000, 12:21	0.0215
B Reach-20	0.000200	0.00173	01Jan2000, 12:21	0.0215
B Reach-1	0.000150	0.00288	01Jan2000, 12:08	0.0161
B Tank 1	0.000150	0.00112	01Jan2000, 12:23	0.0161
Reach-10	0.000150	0.00112	01Jan2000, 12:23	0.0161
B Sink-1	0.001250	0.01022	01Jan2000, 12:21	0.1343

APPENDIX F: Low Impact Design Scoring Matrix

Appendix B: Low impact design scoring matrix

Table B-1: Low impact design scoring matrix

Implementation elements	Typical components	Scoring details	Score
Source control maximised	Water re-use	0-4 depending on % of runoff capture	3
	Site disturbance reduced from a conventional development approach	0-3 depending on % of runoff capture	1
	Impervious surfaces reduced from a traditional approach	0-3 depending on % of runoff capture	0
	Use of building or site materials that do not contaminate	0 or 1 for residential 0-3 for commercial or industrial	1
	Existing streams and gullies located on site (including ephemeral) are protected and enhanced. The entire stream other than possible crossings shall be protected to qualify for points.	0 or 3	3
	Riparian corridors are protected, enhanced or created	0-3	1
	Protection and future preservation of existing native bush areas	0-2 depending on percentage of site area	—
LID stormwater device/practice used	Infiltration devices to reduce runoff volume	0-6 depending on % of runoff capture	—
	Revegetation of open space areas as bush	0-3 depending on % of site covered	3
	Bioretention	0-6 depending on % of runoff capture	2
	Swales and filter strips	0-3 depending on % of runoff capture	
	Tree pits	0-6 depending on % of runoff capture	
Traditional mitigation	Constructed wetlands	0-4 depending on % of runoff capture	—
	Wet ponds	0-1 depending on % of runoff capture	—
	Proprietary devices	0-1 depending on % of runoff capture	—
	Dry detention ponds	0	—
Urban design	Stormwater management is designed to be an integral and well considered part of the urban design.	0–2	1
Tangata whenu values	Stormwater management has been designed considering tangata whenua values and demonstrates that these have been incorporated into the design	0-2	0
Total score			15

The scoring matrix outlined above relates to stormwater management and focusses on encouraging LID in particular. This doesn't replace the need to consider other values including cultural, social, environmental and economic.

Whilst a number of the items outlined in the matrix are outside the scope of what is consented by the Waikato Regional Council, and relate to land use hence are under the jurisdiction of territorial authorities, it is important to consider how stormwater can be managed holistically irrespective of jurisdictions.

Once the total score is calculated, the minimum score in terms of acceptability is shown in Table B-2 and Table B-3Table 6-3 below. Scores lower than those shown will have to justify rejection for those items not incorporated.

Table B-2 shows the minimum target scores for the two main elements of the scoring matrix: source control and the inclusion of low impact design devices/practices within the proposed development. The target scores vary depending on whether there are existing natural features that need to be protected and what the design criteria are for the site.

Table B-2: Target scores (excluding highway projects)

Design criteria for the site	Existing natural features to protect			No existing natural features to protect		
	Source control target	LID devices target	Total target	Source control target	LID devices target	Total target
• Water quality treatment required • Peak flow control required • Volume control required	6	6	15	4	6	12
• Water quality treatment required • Peak flow control required	6	4	13	4	4	10
• Water quality treatment required • Volume control required	6	3	12	4	3	9
• Water quality treatment required	6	2	11	4	2	8

Highway projects are different from normal development projects and the ability to provide source control is limited. Highway projects must still consider LID and traditional mitigation devices and must achieve a score according to Table B-3Table 6-3.

Table B-3: Target scores for highway projects

Design criteria for the site	Existing natural features to protect	
	Yes	No
• Water quality treatment required • Peak flow control required • Volume control required	8	6
• Water quality treatment required • Peak flow control required	6	4
• Water quality treatment required • Volume control required	6	4
• Water quality treatment required	4	3

Waikato Regional Council recommends that stormwater management systems are located in public spaces (carriageways, drainage reserves, public open spaces) and that they are vested to territorial authorities to ensure that ongoing management of the systems is assured.

As stated in Section 1, the Waikato Regional Council uses a Best Practicable Option (BPO) approach for assessing the adequacy of technical design for discharge consents. As such, being unable or unwilling to meet the thresholds indicated above does not automatically mean the consent application will be declined. If an applicant chooses to use another approach to site development then an analysis should accompany the application to demonstrate that similar outcomes are achieved when compared to if a low impact design approach was taken.

Scoring matrix values

It is important to provide a consistent approach to selecting values for each category component. The following subsections provide scoring values for each component so that the values selected are not arbitrary.

Source control

1. Water re-use
    - Flow detention only is 1 point.
    - Site use for garden watering is 2 points.
    - Site use for garden watering and for non-potable inside waters uses including laundry and toilets is 3 points.
    - Site use for full water supply is 4 points
2. Site disturbance reduced from a conventional development approach
    - 10 % reduction from a conventional development is 2 points.
    - 20% and greater reduction from conventional development is 3 points
3. Impervious surfaces reduced from a conventional development approach
    - 5% reduction is 2 points.
    - 10% reduction is 3 points.
4. Use of building or site materials that do not contaminate
    - Residential roofs, gutters, down spouts made of non-contaminant leaching materials is 1 point.
    - Commercial roof, gutters, down spouts made of non-contaminant leaching materials is 3 points.
5. Existing streams and gullies (including ephemeral streams) are protected and enhanced
    - Preservation and protection of natural streams and gullies is 3 points.
6. Riparian corridors are protected, enhanced or created
    - Riparian corridor protection scores depend on the width of corridor provided. 5 metres on either side of the stream is 1 point, 10 metres is 2 points and greater than 10 metres is 3 points.
7. Protection and future preservation of existing native bush areas
    - Protection, preservation and, if needed, enhancement of native bush areas that exceed 10% of the site is given 2 points.

LID stormwater devices/practices used

1. Infiltration devices to reduce runoff volume
    - Meeting the capture and infiltration requirements of the initial abstraction volume is given 2 points.
    - Meeting the capture and infiltration requirements for the site water quality storm is given 3 points.
    - Meeting the capture and infiltration requirements for the 2-year ARI event for the site is given 6 points.
2. Revegetation of open areas as bush

- Planting open space and providing maintenance of planting for 3 years if open space is equal to or exceeds 10% of overall site area is given 3 points.

3. Bioretention (including tree pits)
    - Meeting the capture and retention requirements of the initial abstraction volume is given 2 points.
    - Meeting the capture and retention requirements for the site water quality storm is given 3 points.
    - Meeting the capture and retention requirements for the 2-year storm for the site is given 6 points.
4. Swales and filter strips
    - All impervious surfaces draining to swales and filter strips that have capacity for treating and conveying the water quality event is given 2 points.
    - All impervious surfaces draining to swales and filter strips that have capacity for treating the water quality event and conveying the 2-year ARI event is given 3 points.
5. Constructed wetlands
    - Meeting the water quality design storm criteria is given 2 points.
    - Meeting extended detention and peak control requirements is given an additional 2 points.

Traditional mitigation

1. Wet ponds
    - Use of a wet pond for stormwater quantity control and stream channel protection is 1 point.
2. Proprietary devices
    - Meeting water quality requirements using council accepted proprietary devices is given 1 point.
3. Dry detention ponds
    - As this device provides negligible water quality benefit, and generally has poor operation and performance in the long term, use of the device for quantity control is given 0 points.

Urban design

1. Stormwater management is designed to be an integral and well considered part of the urban design. 2 points can be obtained by demonstrating, in a narrative, how the site design incorporated LID principles into the overall site design.

Tangata whenua values

1. Stormwater management has been designed considering tangata whenua values and demonstrates that these have been incorporated into the design. 2 points can be obtained by demonstrating, in a narrative and with design components, how the stormwater management system incorporates tangata whenua values.

There will be situations in the source control and low impact design categories where the entire site cannot have a given device / practice or where a given category cannot achieve the level of coverage that point scores are based upon. In those situations, a pro-rata score can be achieved based on the percentage of coverage.

As an example, revegetation of open areas as bush that exceeds 10% of site area is awarded 3 points. If there is only space available for achieving 5% of site coverage, then using a pro-rata approach will allow for the award of 1.5 points for revegetation. A similar approach may be used for other items to determine an overall site score.