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SANDERSON GROUP LTD & KOTARE DEVELOPMENTS LTD

STORMWATER MANAGEMENT PLAN

FRONTIER ROAD, TE AWAMUTU NZ

Te Awamutu Country Club

KOTARE PROPERTIES

REV 01 / July 2020 / Sanderson & Kotare

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APPENDICES

1 INTRODUCTION

Wainui Environmental has been commissioned by Sanderson Group and Kotare Properties to prepare a Stormwater Management Plan (SMP) for the proposed development located at Frontier Road, Te Awamutu. The purpose of the SMP is to outline how stormwater runoff from the post development surfaces will be managed for the proposed development. The report has been prepared to support the subdivision application to Waipa District Council (WDC) and the Discharge Consent Application to the Waikato Regional Council (WRC).

1.1 Report Scope

This report provides preliminary design of the proposed stormwater management system for the proposed development of a retirement village (Sanderson Group) and residential subdivision (Kotare Properties) at 52 Frontier Road (the 'subject site'). The report specifically addresses:

a) Description and analysis of the catchment and the downstream receiving environment.

b) A review of design criteria and stormwater management objectives

c) Assessment of stormwater management options to determine the design requirements and best practice options for site stormwater management, and

d) Preliminary design requirements for the recommended stormwater management measures

As noted, the scope of this SMP is focussed on the retirement village and residential subdivision development activities within the subject site area. This area comprises a localised/isolated development catchment which forms the southern portion of the larger T2 Growth Cell as identified in the Waipa District Council with the northern portion of the growth cell comprising a separate, subcatchment area which drains northward, independent of the subject sit to the Mangapiko Stream. While this SMP does not present a stormwater management regime for this separate northern part of the growth cell, the best practice design guidelines and stormwater management philosophies presented in this report are also applicable to the northern subcatchment and will be used to guide the future design of an appropriate stormwater management regime for that area at the time of development. It is notable that this future development area again comprises a separate subcatchment and hence the future design can be developed independently of the subject site without any specific need for integration of the stormwater management systems across the overall T2 Structure Plan area.

1.2 The Site

Street Address	52 Frontier Road, Te Awamutu
Legal Description	Lots 1 & 2 DPS 487281
Site Area	18.2ha
Local Authority	Waipa District Council
Site Location	The subject site is located on the western outskirts of the Te Awamutu urban area currently separated from the existing established residential development area by the T1 growth cell which is currently subject to large scale residential development activities.
Topography & Catchment	The site topography is characterised by a natural basin area which extends westward from the ridgeline located along the eastern site boundary as gentle to moderate pasture slopes falling towards a central site outlet point at the western site boundary. In this respect, the site comprises a localised headwater catchment area with all runoff occurring as surface runoff across the pasture surfaces to this outlet. The site is located within the Mangapiko Stream/Waipa River catchment.

1.2.1 *Receiving Environment*

As noted, the site extends westward from the existing ridgeline features along the eastern and southern boundaries and in this respect comprises a wide basin which forms the very upper reaches of a first order tributary drainage catchment.

The site area can generally be split into three separate sub-catchment areas with runoff within each of these areas being limited to surface flows down the existing pasture slopes during/following any rain events only.

Drainage from the central site sub-catchment area drains across the pasture slopes to enter an existing artificial farm pond located at the western site boundary. During site visits undertaken in May and June, 2020 this pond feature was found to be entirely dry with a thick layer of cracked mud covering the pond surface with establishing weed growth – refer Figure 2. Nonetheless, the pond is understood to hold some water through the winter months which is likely fed by both surface runoff and groundwater seepage flows during wet conditions.

Figure 2 – Existing farm pond

The pond discharges to the downstream channel via an informal overflow channel/spillway which is set at a low level only allowing for shallow surface ponding within the pond feature during wet periods.

Drainage from the northern and southern sub-catchment areas occurs as informal surface runoff across the sites pasture slopes to enter the downstream channel directly below the central catchment farm pond outlet.

The drainage outlet channel at this point comprises the very upper reaches of a first order tributary which commences at the western site boundary extending through the rural farmland in a north westerly direction from the site. At the site boundary this channel comprises a small artificial channel of around 0.5m wide to 0.5m deep with grassed banks/base being characteristic of an excavated/artificial drainage channel. During the site inspections the channel was observed to be entirely dry with no evidence of any recent flows – refer Figure 3.

Figure 3 – Site outlet watercourse

Immediately below the site boundary, the drainage channel passes through a farm culvert crossing to enter another on-line pond feature. At the time of inspection, this pond was again observed to be entirely dry with a thick layer of cracked mud covering the pond surface – refer Figure 4.

Figure 4 – On-line pond within downstream property.

Directly below this pond, the watercourse enters a wide, low gradient valley floor comprising a dairy grazing pasture environment. The watercourse extends north-westward through this area as an incised, straightened drain feature typically1.2m deep by 1.8m wide. Observations of this drainage channel observed shallow depths of ponded water with no noticeable flow and with an established weed coverage and with evidence of spraying to maintain channel capacity There was no evidence of channel erosion or clearance activities.– refer Figure 5.

Figure 5 – Drainage channel below on-line pond.

The watercourse extends north-westward through this farm-scape as a low gradient, modified drainage channel. The straightened, incised nature of the water course through this area along with the presence of numerous lateral, excavated drainage channels suggests the primary purpose of the identified channel modifications has been to suppress/convey the groundwater table through this low gradient, valley floor pasture landscape to assist pasture maintenance/grazing.

Approx. 2.5km below the site, the channel passes under Pirongia Road via a 1200mm culvert and shortly after enters another piped section where it is conveyed below an area of farmyards/sheds. The stream then discharges into the Mangapiko Stream approximately 3km below the subject development site. The Mangapiko Stream drains a large rural and urban (Te Awamutu urban area) catchment and flows westward flowing along a meandering course within an incised gully system eventuating in the Waipa River at Pirongia. The site catchment location and drainage flow path to the Mangapiko Stream is outlined in Figure 6.

Figure 6 – Site catchment location and drainage flow path

Review of historical aerial imagery has also been undertaken to help characterise the natural condition of the sites receiving watercourse and historic condition. An aerial image from 1944 appears to show the wide, low gradient gully floor area below the site as comprising an area of scrub/vegetation within the broader pasture environment, suggesting catchment flows as likely occurring through wetland type habitat conditions through this area at this time – refer Figure 7.

Figure 7 – 1944 aerial image suggesting wetland type habitat below the site.

Specific water quality assessment of the downstream watercourse has not been undertaken for the purposes of this SMP. However, it is considered likely that based upon the intensive dairy grazing activities occurring throughout the catchment, water quality would be impacted by elevated levels of nutrients and sediment within catchment runoff during and immediately following storm events. Water quality observed in the stream flows at the Pirongia Road culvert (during dry conditions) showed good water clarity although large depths of deposited fine sediments were observed around the culvert outlet basin.

The Mangapiko Stream drains a large catchment extending back to its headwaters on Maungatautari and receives runoff from an extensive agricultural catchment along with urban inputs from the Te Awamutu urban area. Water quality has been described as poor with high levels of bacterial contamination resulting from the wastewater treatment plant effluent; dairy factory effluent from Fonterra, and urban stormwater discharges from the Te Awamutu township. Stream flows are observed to be subject to significant discolouration during storm events due to catchment sediment inputs. Pollution impacts have affected the stream ecology leading to pollution-sensitive species being absent in more contaminated parts of the stream.

The tributary watercourse draining the site is not identified on the WRC water classification maps and hence defaults to a Waikato Surface Water classification under the Waikato Regional Plan (WRP). The Mangapiko Stream has an

indigenous fish and trout fishery classification under the WRP reflective of its large scale catchment area and connectivity to the Waipa River.

1.3 Strategic Context

1.3.1 *Resource Management Act 1991 (RMA)*

Section 5 of the RMA defines 'sustainable management' as follows:

> *In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—*
>
> *(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

To this end, the starting point of the proposed development is to avoid as far as possible any adverse effects on the environment. This Report will lay out strategies which will ensure the development occurs within the natural limitations of the site, by way of managing the stormwater in a way which ensures the life supporting capacity of the receiving environment is not degraded, with the local environment enhanced where possible. This will be balanced with providing for the communities social, economic and cultural wellbeing.

1.3.2 *National Policy Statement for Freshwater Management.*

The Freshwater Management NPS has policies and objectives that direct local government to manage water in an integrated and sustainable way while providing for economic growth within specified water quality and quantity limits. The NPS requires councils to develop Regional Policy Statements and standards to safeguard the life supporting capacity of water bodies, with the objective that water quality will be maintained or improved. This will involve protection of high-quality water bodies and implementation of methods to improve degraded water bodies.

Specifically, Section C of the Freshwater Management NPS relates to "Integrated Management" and has the below Objective and associated Policies.

> *Objective C1*
> *To improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment.*
>
> *Policy C1*
> *By every regional council:*
> *a) recognising the interactions, ki uta ki tai (from the mountains to the sea) between fresh water, land, associated ecosystems and the coastal environment; and*
> *b) managing fresh water and land use and development in catchments in an integrated and sustainable way to avoid, remedy or mitigate adverse effects, including cumulative effects.*
>
> *Policy C2*
> *By every regional council making or changing regional policy statements to the extent needed to provide for the integrated management of the effects of the use and development of:*
> *a) land on fresh water, including encouraging the co-ordination and sequencing of regional and/or urban growth, land use and development and the provision of infrastructure; and*
> *b) land and fresh water on coastal water.*

Managing developments in a holistic and whole of catchment way ensures that cumulative effects are identified at the planning stage and accounted for, with resources protected and used in a manner which ensures degradation is avoided and environmental improvement is the overall outcome. In accordance with this Objective, the proposed development

seeks to fulfil this directive through ensuring development and services are not designed in isolation of the wider catchment context.

At this point, no specific water quality standards are considered to have been established for these purposes within the subject catchment, however in the interim, when considering development proposals/consent applications, councils must have regard for any effects (actual or cumulative) that contaminants contained in the discharge from developments may have on freshwater and freshwater ecology. The principle of adopting best practicable options in order to minimise effects is included in the decision-making process under this policy.

1.3.3 *Waikato Regional Infrastructure Technical Specifications (RITS)*

The Regional Infrastructure Technical Specifications (RITS) was developed as a Regional document to set the specifications for designing and constructing transportation, water supply, wastewater, stormwater, and landscaping infrastructure. Prior to the RITS there were differing standards and requirements across the Waikato Region which were determined by each District and City Council. Consistency with the RITS when planning new infrastructure as part of any subdivision usually ensures compliance with the conditions set by councils as part of the resource consenting process.

This Report will outline the proposed design concepts for the infrastructure associated with the proposed development of the subject site that are in-line with the RITS standards and specifications.

1.3.4 *Waipa District Plan*

The site subject to the proposed development activities is located within Growth Cell T2 as identified within the Waipa District Plan (WDP). This growth cell has been earmarked for future residential development with the site having a Deferred Residential zoning under the WDP, meaning that residential development is appropriate in this location, although not currently anticipated to occur within the immediate future. However, a plan change is currently being sought by Sanderson Group/Kotare Properties to the Waipa District Plan to enable the planned development of the site within a more imminent timeframe.

There is currently no established Structure Plan for development activities within the T2 Growth Cell. However from a stormwater management perspective, the site is identified as comprising a singular/isolated subcatchment area and hence is not considered to be reliant upon integration or adherence to any broader catchment stormwater management guidance/requirements to enable development activities within the site.

1.4 Geotechnical Assessment

A Geotechnical Investigation Report has been prepared for the development area by CMW Geosciences. This report outlines that the published geological map for the area depicts the local geology for the area as comprising alluvium dominated by primary and reworked, non-welded ignimbrite of the Walton Subgroup, and locally derived lacustrine mud, silt, gravel and peat of the Piako Subgroup. However, site geology encountered during site investigations was found to differ slightly to the published geology. Piako Subgroup soils were not encountered in the exploratory holes. Test pits and CPTs encountered Volcanic Ashes overlying Walton Subgroup soils, with Puketoka Formation soils encountered below 6.5m. The vertical distribution of the soils encountered is presented in Table 1.

Table 1 Soil Strata

Summary of Strata Encountered				
Strata	**Depth to top (m)**		**Thickness (m)**	
	Min	**Max**	**Min**	**Max**
Topsoil	GL	GL	0.3	0.3
Alluvium	0.3	5+	1	5
Colluvium (displaced Volcanic Ashes and Puketoka Formation soils)	0.3	0.3	5	5
Stiff to hard Silt/Clay (Volcanic Ash)	0.3	0.3	1.7	4.7
Firm to stiff Silt (Walton Subgroup)	2	5	3.5	9.5
Very stiff to hard Sandy Silt/Clayey Silt (Puketoka Formation)	6.5	14	2.5	>11

Sensitive Silt (Puketoka Formation)	9	17.5	1	1
Very stiff to hard Sandy Silt/Silty Sand (Puketoka Formation)	10	18.5	2	4.5
Dense to very dense Sand (Puketoka Formation)	12	15.5	-	-
Notes: Thickness only recorded were base of strata has been confirmed.				

Groundwater was encountered near ground surface level within the gully floor area in the area of the existing dry farm pond with increasing depth extending up the site slopes.

The stiff to hard clay/silt dominated geology has determined the use of ground soakage as unfeasible for stormwater disposal within the site.

1.5 Existing Services

As noted, the site catchment comprises a localised basin subcatchment area which drains westward, remote to any existing established stormwater reticulation network including the directly adjacent T1 growth cell development site to the east which drains northward within a separate sub-catchment to the Mangapiko Stream.

The only existing services available to the site comprise the existing 375mm watermain which extends along the southern site boundary within Frontier Road to convey the municipal supply from it's watertake location on Mount Pirongia to Te Awamutu. Two metered connections appear to be available to the southern site boundary from this main.

2 PROPOSED DEVELOPMENT

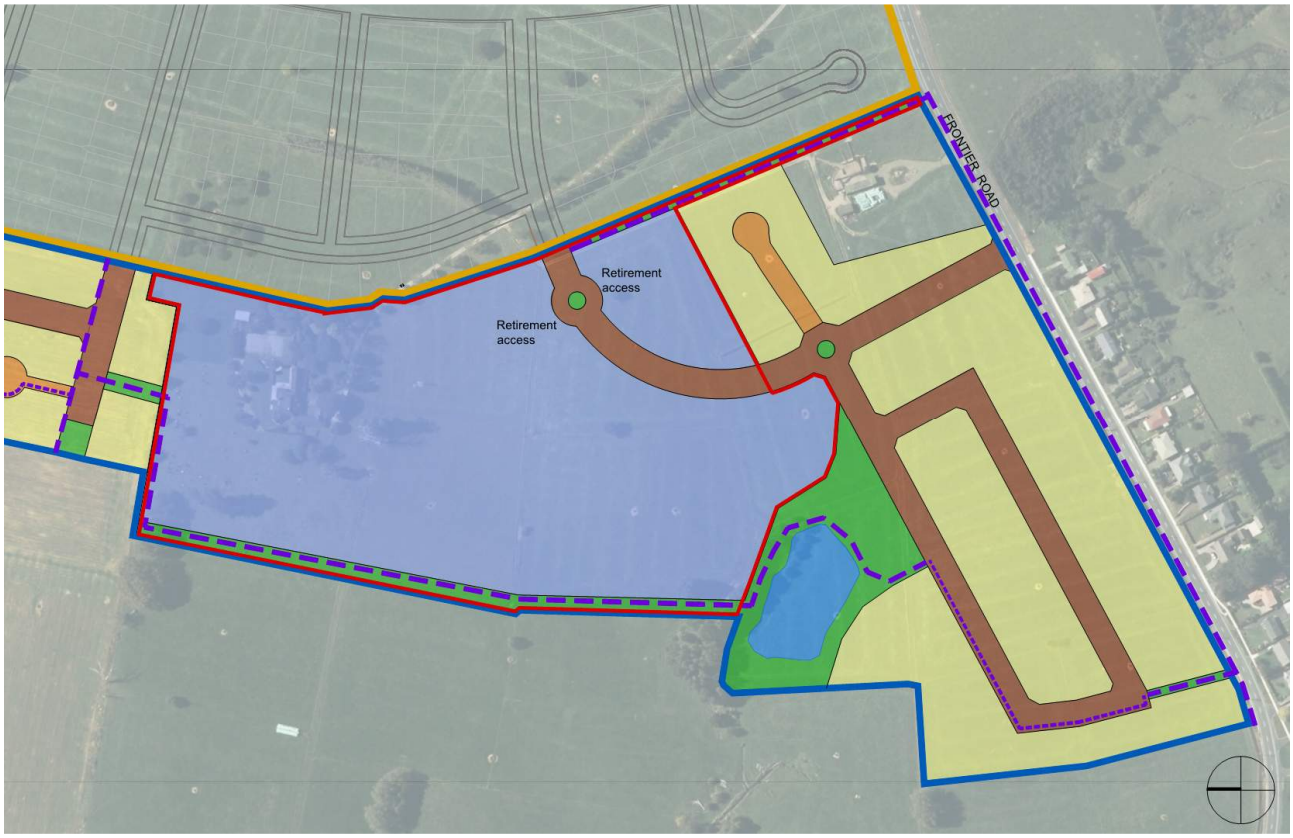
2.1 Introduction

The overall site development catchment will be split into two separate development types comprising the proposed Te Awamutu Country Club retirement village development within the northern half of the site and the Kotare Properties residential development within the southern half of the site.

Development of the retirement village activities will occur across an approximate 9.56ha area and will involve establishment of around 98 retirement units/dwellings, aged care facility/dementia unit and communal club house facilities along with associated roading and service infrastructure.

Development of the residential subdivison will occur across an approximate 8.65ha area and will involve establishment of 105 residential lots ranging from 500m^3 to 700m^3 along with associated roading and service infrastructure including a central reserve area containing a proposed stormwater management wetland device.

The proposed development layout/configuration is outlined on the plans contained within Appendix A.



3 STORMWATER MANAGEMENT PHILOSOPHY

Site development will result in the conversion of the existing site pasture slopes into areas of new impervious surfaces associated with the proposed retirement village/residential development including the development of dwellings/buildings and associated hard stand surfaces along with creation of the roading network and footpaths within the development site. Stormwater runoff from these surfaces will need to be captured and conveyed via a stormwater management system incorporating appropriate measures to manage the potential effects from these discharges within the site receiving environment.

The stormwater management system for the proposed development has considered the following guidance and policy documents:

- Waipa District Council's District Plan
- Waikato LASS Regional ITS (RITS)
- Objectives, policies, and rules for the management of water quality and stormwater discharges, as set out in the Proposed Waikato Regional Plan; and
- Waikato Regional Council Runoff Modelling Guidelines and Stormwater Management Guidelines 2020.

3.1 Discharge Parameters

Stormwater discharge parameters for the site are based on the requirements of the guidance documents above, the downstream receiving environment and current best practice. On this basis, the following discharge parameters and stormwater management principles have formed the basis for development of the sites stormwater management system.

- Treatment of stormwater runoff from all development surfaces to address any potential water quality effects;
- Attenuation of post development peak flows to predevelopment levels storm events to address any potential downstream flooding effects;
- Erosion control measures to mitigate any potential downstream channel effects;
- Discharge of all development flows in a controlled manner without creating adverse erosion/scour effects;
- Provision for conveyance of overland flows and greater than design events to prevent potential flooding/inundation with the subject development area;
- All discharges to be retained to the downstream western tributary watercourse;
- Maximise landscape and amenity values and public awareness of stormwater management devices; and
- Minimise operation and maintenance requirements.

3.1.1 *Water Quality Treatment Criteria*

Proposed water quality treatment criteria are outlined below in accordance with Table 4-3 of the RITS:

- Total suspended solids (TSS) (75% removal of post development loads taken as being at the discharge point from site).
- Total Metals (copper, zinc) to achieve maximum practical removal possible.
- Temperature (<25°C)
- Nutrients (total nitrogen, total phosphorus and ammoniacal nitrogen) to achieve maximum practical removal rates.
- Hydrocarbons to achieve maximum practical removal rates
- Removal of gross pollutants (litter and commercial waste).

3.1.2 *Stormwater Quantity Criteria*

- Match pre-development flow rates for the 2 and 10-year ARI events through controlled attenuation and multi-stage outlets.
- Extended Detention (capture and slow release of the 1/3 of the 2 year 24hour event over 24 hours.

- Conveyance of overland flows in excess of the reticulation networks capacity via the development roading network discharging to controlled outlet points.

There are no known flooding issues that have been identified within the downstream catchment with downstream landuses limited to open pasture grazing. Nonetheless, the provision for peak flow attenuation to predevelopment levels for the 2- and 10-year events is considered to comprise a best practice management approach to avoid exacerbation of flooding within the farmland environment or at the Pirongia Road culvert.

3.2 At-source Volume Control Consideration

The Waikato Stormwater Guideline 2020 refers to the potential for post development increases in stormwater runoff volumes to contribute to increased potential for downstream channel erosion effects and goes on to advocate two possible methods for managing these potential effects comprising runoff volume control (through at-source retention of the initial abstraction volume) and extended detention and slow release of 1/3 of the 2-year 24hour rainfall event over 24 hours.

An assessment of the receiving watercourse has been undertaken to assess the risk of potential stream channel erosion and determine the requirement for at-source retention within the development site with the following key features of the receiving environment noted:

- The immediate discharge environment for the site comprises a dry, heavily vegetated surface flow channel which conveys flows downstream into a large, existing, on-line farm pond feature;
- Below this feature, flows enter a lineal, heavily vegetated low gradient farm drainage channel extending through a wide valley floor pastoral environment. Historic habitat conditions within this area are considered likely to have comprised wetland habitat extending throughout the valley floor area with catchment runoff occurring as dispersed seepage flows. The current channel is considered to comprise an artificial drainage channel formed primarily to supress groundwater levels and convey intermittent catchment flows as low velocity flows through this drainage channel;
- Observations of both sections of the channel did not identify any evidence of adverse erosion effects, with the channel observed as comprising a stable, well vegetated condition with only shallow ponding and no discernible flows noted during the autumn 2020 site inspection.

In accordance with WRC Stormwater Management Guidelines an assessment of the flow velocities in the downstream channel reaches was undertaken to determine whether catchment flows are erosive in the pre and post development scenario. Two reaches of the channel were assessed, Reach 1- the short section of farm drain immediately downstream of the existing pond discharge, and Reach 2 the larger drain downstream of the dry farm pond. Reach 2 is typical of the remaining channel up to the Pirongia Road culver.

A summary of the assessment is presented below.

Drain Reach 1:

- Drain width 0.7m with 1V:0.8H banks
- Manning's n= 0.08 (Heavily vegetated base and sides)
- Pre-developed 2 Year ARI flow rate (and wetland discharge) = 1.10m^3/s
- Velocity = 0.97m/s

Drain Reach 2:

- Drain width 1.8m with 1V:0.5H banks
- Manning's n= 0.08 (Heavily vegetated base and sides)
- Pre-developed 2 Year ARI flow rate = 1.25m^3/s (includes downstream greenfields catchment)
- Velocity = 0.70m/s

Soil types found within the low-lying gully basins within the subject site generally comprised alluvium and colluvium soils consisting of volcanic ash and silts and it is inferred that these soils continue through the downstream catchment. Maximum permissible velocities for these soil types are in the order of 0.6-0.76m/s as presented in Table 7-1 from the WRC SW Management Guidelines 2020.

Based upon the above it is recognised that the first reach of channel, immediately downstream of the proposed wetland discharge has the potential for erosion effects, however in the further downstream channel the conditions would be considered to present minimal potential for adverse erosion effects as a result of site discharges.

The development site comprises an isolated, confined sub-catchment area and comprises the western extent of anticipated urban development activities within Te Awamutu. In this respect, the site comprises the only portion of this catchment which is identified for urban development with the balance of the catchment comprising a significant rural catchment with no anticipated landuse changes thus avoiding the potential for any future cumulative stormwater volume impacts upon the receiving watercourse.

For these reasons, the proposed stormwater management approach incorporating provision of extended detention exclusive of specific volume retention measures is considered to present an appropriate level of control to address any potential for downstream channel erosion effects which may arise within this catchment.

4 STORMWATER MANAGEMENT STRATEGY

Based upon the above assessment of the downstream receiving environment and associated stormwater discharge parameters/criteria, a stormwater management strategy has been developed for the site which comprises the following features.

1. Conveyance of catchment flows from the entire Kotare Properties residential development area, a portion of the existing Frontier Road carriageway at the southern site boundary and approximately 4.9ha of the retirement village development catchment via a piped stormwater reticulation network (sized to provide a 10-yr ARI primary level of service) discharging to a constructed stormwater management wetland device located within a central reserve area. The wetland is designed to provide water quality treatment, extended detention and peak flow attenuation of the 2- and 10-year events with discharges occurring via a controlled outlet to the downstream channel. The wetland will be vested to WDC within a combined drainage/recreation reserve area.
2. Conveyance of catchment flows from the remaining north-western retirement village development catchment (approx. 4.4Ha) directly to a planted treatment swale device extending down the western site boundary of the retirement village site. The swale is designed to provide water quality treatment and extended detention of catchment flows. At the southern end of the swale the Water Quality/ED event flows will discharge via an outlet into the site outlet channel directly below the proposed wetland device outlet. Larger flows will be diverted into the constructed wetland for attenuation of 2 and 10-year ARI peak flows. The proposed swale will be a private stormwater measure, owned and maintained in perpetuity by the Te Awamutu Country Club.
3. Design of appropriate energy dissipation/outfall erosion control structures, including wetland spillway to prevent any adverse erosion and scour effects at both the wetland and swale outfall points.
4. Secondary overland flow paths provided via the roading network (where possible) designed to accommodate flows from a 100-yr ARI rainfall event. These flows will be safely conveyed from lot/road surfaces to the downstream watercourse.

Further details of the above stormwater management features are presented in the following sections and are outlined on the plans included within Appendix B.

4.1 Stormwater Conveyance Systems

4.1.1 *Primary Reticulation*

The primary reticulated drainage network throughout the proposed development will need to be sized provide a 10-year ARI level of service in accordance with the RITS. Reticulation will convey flows to the wetland forebay or swale device.

Where possible high-flow by-passes will be incorporated, diverting flows from larger events around the forebay and directly into the main wetland body.

4.1.2 *Secondary Overland Flow*

Secondary overland flow paths are required to convey flows up to the 100-year ARI event safely though the site.

Where possible overland flows will discharge to the road corridors where they will be conveyed to or around the proposed wetland. Where this cannot be achieved overland flow-paths will be required. These will be designed at detailed engineering stage.

4.2 Sub-catchment Wetland

4.2.1 *Design Process*

Hydrologic modelling has been undertaken using HEC-HMS v4.2 to reflect the proposed development and associated imperviousness within the catchment. Flows have been routed via channel links through the proposed wetland.

The RITS Manual requires that for all catchments where detention storage is required, stormwater modelling shall be undertaken using 24-hour nested design storm. Rainfall data was taken from Hirds v4 software for the subject site. The post development analysis was determined using the 2.1 degree climate change adjusted rainfall with percentage change factors taken from Table 7-2 in the WRC Stormwater Management Guidelines.

The Water Quality Volumes were calculated based on 1/3rd of the 2-year 24hour rainfall event.

The EDV storm has been routed through the proposed wetland with the nested storm profile used for the 24mm rainfall event. Model runs of 48-hour duration were undertaken and the outflow curve analysed to determine the peak orifice discharge and the EDV discharge duration (the point at which the EDV is considered to be fully discharged has been taken at the 'knee' of the outflow hydrograph as beyond this point the 'tail' of the graph becomes infinitely long).

4.2.2 *Wetland Catchment Description*

Aerial LIDAR survey, specific topographic survey, design levels and proposed development layouts were utilised to determine the catchment extents and various physical properties of the site catchments.

The total wetland catchment extents (described above) consist of approximately 19.95Ha of future residential lots, proposed retirement village and associated roads.

The residential sub-catchments have been assumed to be fully developed according to their proposed land use and have been assigned impervious fractions according to the maximum allowable levels in the District Plan (70%). Road catchments have been assigned impervious percentages based on typical road cross-sections (typically 75%).

Noteworthy attributes of the sub-catchment breakdown are outlined below:

- The pre-developed site discharges via several different flow paths and ephemeral drains, with all channels ultimately converging into the main drain (described as Reach 2 above) downstream of the site. In the post developed scenario, it is proposed to reticulate the site to the wetland and discharge flows to the drain on the western boundary. The downstream section of drain will experience an increase in flows from this cross-catchment discharge, however the effects are contained to a short reach or stream "Reach 1' and are diminished once flows reach the main drain.
- Approximately 0.84Ha of the far NE corner of the site slopes to the NE and hasn't been included in the pre-developed catchment. In the post-developed scenario this part of the site will be collected and discharged to the wetland. The allowable wetland discharges don't however include this sub-catchment.
- The wetland has been designed for approximately 1.0Ha of Frontier Road and assumes a fully urbanised road (kerb channel, footpath etc.).
- The wetland design also allows for the treatment and attenuation (for climate change) of the existing water reservoir site located at the south-eastern corner of the site. Surface flows from this area are to be conveyed through to the subdivision reticulation – subject to detailed engineering design.

Table 2 below presents the adopted post-developed sub-catchments and their associated properties. Refer to Appendix B for the adopted catchment plan.

Table 2: Adopted Wetland Catchments

Description	Area (ha)
Kotare Wetlands Residential Area	8.65
Te Awamutu Country Club Retirement Village (2 and 10-year attenuation only)	9.56
Frontier Road	0.47
WDC Water Reservoir Site	0.90
Total Wetland Catchment	19.58

The wetland is located generally in the bottom corner of the catchment. Pre-developed times of concentration were calculated based on existing overland flow travel times and flows in channel links to the proposed wetland site. Post developed sub-catchments time of concentration were calculated to be 10 minutes.

Runoff calculations were undertaken in accordance with the methodology outlined in the WRC Stormwater Modelling Guidelines 2020. Soil types and CN numbers have been adopted based on soil testing across several sites within the catchment and with supporting information from S-Maps Online. S-Maps confirm soils within the wetland catchment range from moderately well drained soils consisting generally of silty loams over clay and the pre-developed soil types throughout the catchment have been broadly classified as Soil Type C.

It has been assumed that no soil remediation will be undertaken across the catchment as lots are developed so an increase in soil type and subsequent CN number has been adopted for post developed pervious areas in accordance with WRC methodology.

Weighted CN runoff curve numbers were calculated based on proposed impervious percentages and the soil types found within the catchment (where possible). A summary of soil types and CN numbers is provided below.

Table 3: Surface Types and CN Numbers

Surface Type	Surface Type	Soil Type	CN number
Pre-developed Site	Pasture	C	74
Post-developed Pervious	Grassed lots	D	80
Post Developed Impervious	Roof/ Sealed Area	D	98

See attached WRC SW calculations in Appendix C for further details.

4.2.3 *Hydrology Results*

HEC HMS modelling results and WRC stormwater calculations can be found in the attachments. The HEC HMS model is available on request.

A summary of the peak discharge rates and required detention volumes is presented in Table 4 below.

Table 4: Wetland Results

Return Period (ARI)	Greenfields discharge rate (m^3/s)	Wetland Peak outflow (m^3/s)	Peak Stage RL (m)	Peak Storage (m^3)
Extended Detention*	-	0.034	62.00	1,088
2- Year	1.12	1.069	62.69	4,356
10- Year	2.23	2.035	63.10	6,482

'* ED catchment excludes the Country Club Swale catchment

A summary of the wetland design is below.

- Normal Water Level Area = 4,000m^2 (approx. 2.7% of the catchment)
- Permanent Storage Zone (PSZ) = 1,550m^3 (increased by 25% to account for planting)
- Batters above and below NWL = minimum 1V:3H
- Top of batter area (excluding paths, tracks etc.) = Approx. 6,340m^2
- Total 10-year ARI volume = 6,480m^3
- Total Stormwater Reserve Area = 10,350m^2

4.2.4 *Wetland Forebay*

A sediment forebay is required within the wetland. The sediment forebay is provided to capture coarse sediments and is located to ensure ease of access to remove sediment accumulation. The forebay shall be designed to provide minimum 30% of the adjusted Water Quality Volume in accordance with WRC requirements. Preliminary design of the forebay requires a total volume of 350m^3.

4.2.5 *Water Quality Treatment*

As the wetland will provide extended detention, the required dead storage/permanent water volume is equal to 50% of the calculated WQV. Calculations show the required WQV = 1164m^3 (based on the 24mm water quality storm). The actual WQV provided has been increased by 25% to account for planting in accordance with the RITS, giving a total volume of 1,550m^3.

Banded bathymetry is provided within the wetland as a series of raised bunds which are proposed to maximise contact with vegetation and prevent short-circuiting. Wetland bathymetry has been designed in accordance with the RITS and to ensure minimum 80% vegetated area.

4.2.6 *Extended Detention*

In accordance with WRC requirements the capture and slow release of 1/3 of the 2-year ARI 24hr storm is required for erosion control. In accordance with WRC methodology the ED event has been routed through the wetland, discharging over 24 hours. A summary of the EDV event is below;

- EDV = 1,088m^3
- ED depth within wetland = RL62.00m (250mm above PWL)
- Peak Discharge @ ED level, Q_p = 0.035m^3/s
- EDV emptying time = 24hrs (to the 'knee' of the hydrograph)

4.2.7 *Outlet Structure and Spillway*

The wetland will discharge via an outlet structure (manhole) with the attenuation orifices and weirs. The outlet structure will discharge via a 1200mm pipe to the existing drain. Design of the outlet structure will be undertaken at detailed design stage.

In the event the main outlet structure and pipe becomes blocked, an emergency spillway is proposed on the north-western side of the wetland. the spillway will discharge flows down the batter to the drain below. Preliminary spillway design shows unattenuated 10-year ARI flows will discharge via a 14m wide spillway with a depth of approx. 350mm. The spillway deign includes 300mm freeboard to the top of the wetland bund.

The development layout has several overland flowpaths which discharge overland flows directly to the downstream land in larger events, by-passing the wetland. Calculations show peak 100-year ARI flows discharging to the wetland are significantly less than the unattenuated 10-year ARI flows for the entire development. Accordingly, peak 100 year ARI flows will also discharge via the 14m wide spillway with a flow depth of around 250mm.

4.2.8 *Wetland Planting/Landscaping*

Landscaping of the constructed wetland shall be undertaken in general accordance with the RITS Section 4.2.24 including Table 4-35 – Approved Plant Species.

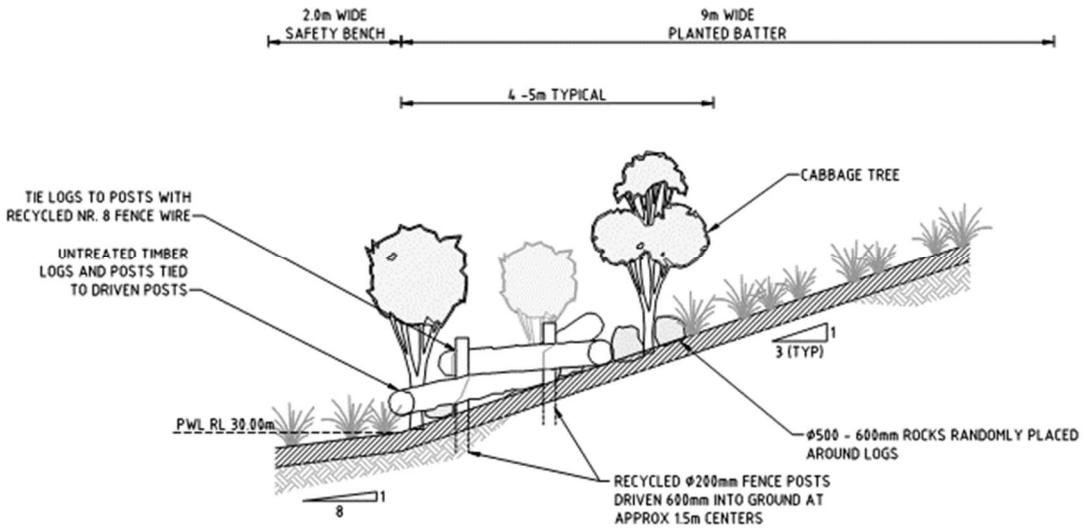
A planting plan and planting schedule will be prepared as part of the detailed design process. Planting will be undertaken below the permanent water levels of the wetland (submerged zone) to meet a target of 80% vegetative cover.

Specimen trees such as Rimu, Cabbage and Pohutukawa are proposed around the wetland to shade areas of open water, to reduce thermal warming effects and contribute to enhanced amenity around the wetland feature. Refer Figure 7 below which contains a photo of an established constructed wetland device with good vegetative cover.

Figure 7 - Glaisdale planted stormwater wetland, Hamilton City

4.2.9 *Habitat Enhancements*

Constructed stormwater wetlands provide a range of feeding, nesting, brood rearing, loafing and resting sites for native birds. Opportunities also exist to create habitat for skinks by planting species that provide optimal habitat structure i.e. dense, low growing vegetation. Skinks also appreciate a range of conditions from shady to dry and sunny. Habitat potential is proposed to be enhanced by placing logs and snugs around the perimeter of the wetland amongst vegetation and along pathways to provide skink refugia. Rock mounds are also proposed to allow for basking next to dense grass and shrubs.



4.2.10 *Wetland Operation and Maintenance*

An operation and maintenance manual will be prepared for the wetland as part of the detailed design process.

Forebay access and maintenance track will be incorporated into the wetland design in accordance with the RITS. Pedestrian and vehicle access to the remainder of the wetland will be in accordance with the RITS.

The long term operation and maintenance of the wetland will be undertaken by the Waipa District Council stormwater assets team.

4.3 Te Awamutu Country Club Treatment Swale

Treatment of the northern end of the Country Club retirement village development (approx. 4.4Ha including the dwellings and road network) is via a planted water quality treatment swale proposed along the western boundary of the site. The swale has been designed to provide Water Quality treatment to the contributing catchment as well as providing extended detention.

Refer to attached plan for the Water Quality catchment breakdown. A preliminary layout and typical section of the swale is also attached.

4.3.1 *Preliminary Swale Design*

Preliminary design of the swale has been undertaken and is summarised below.

- Swale base width = 2m
- Side batters = 1V:3H
- Max. Longitudinal Slope = 1.5%
- Manning's number. N = 0.25
- WQ Flow depth = 0.275m
- Total swale depth = 0.60m

The swale has capacity to convey the 10-year ARI flows from the catchment to the wetland.

It is intended that the swale will have a slight meandering path, mimicking a natural stream channel where possible.

Treated WQ and ED flows will be discharged via a low flow diversion pipe directly to the drain within the downstream property. Flows in excess of the ED event will be directed into the constructed wetland.

4.3.2 *Water Quality Treatment*

The primary form of water quality treatment shall be provided via vegetative filtering through dense vegetation in the base of the swale, ensuring a minimum 9-minute residence time is achieved. Water quality treatment is provided by passing stormwater flows through vegetation. Passage through vegetation and providing contact with organic matter allows physical, chemical and biological processes to occur that reduce contaminant delivery downstream.

Peak flows were calculated using the Graphical Peak/NCRS methodology based on proposed catchment surface types.

A manning's Channel formula was used to check the velocity of flows adopting the proposed swale parameters. The proposed swale parameters resulted in a residence time of approximately 25minutes, well in excess of the minimum required 9 minutes.

Refer attached WQ flow and Manning's calculations.

4.3.3 *Extended Detention*

It is proposed to include Extended Detention for the contributing catchment within the swale. Check dams will be used to provide the required volume, with low flow pipes through the dams to ensure peak flows discharge over 24 hours.

Extended detention will also improve the WQ treatment efficiency of the swale, with runoff held in the vegetated swale for extended periods.

Detailed design of the swale check dams and ED outlets will be undertaken as part of the detailed design process.

4.3.4 *Swale Planting/Landscaping*

In accordance with general best practice WSUD, it is proposed to integrate the swale into the surrounding area. It is proposed to form the swale as a semi-naturalised overland flow path optimising both the water quality treatment efficiency, ecological benefits and landscape enhancement. It is intended that the reserve area which contains the swale include a walking track adjacent providing enhanced urban amenity.

Other key considerations for the swale will include:

- A legible relationship with natural flow paths and topography
- Integration with adjacent planting schemes or natural plant communities
- Wide undulating channels as subtle overland flow paths
- Unimpeded pedestrian movement and access, including the use of pedestrian boardwalks etc. as check dams in swales.
- The use of rock weir structures or logs as check dams in naturalised swales.
- Transition between landscape spaces, land uses, and natural environments

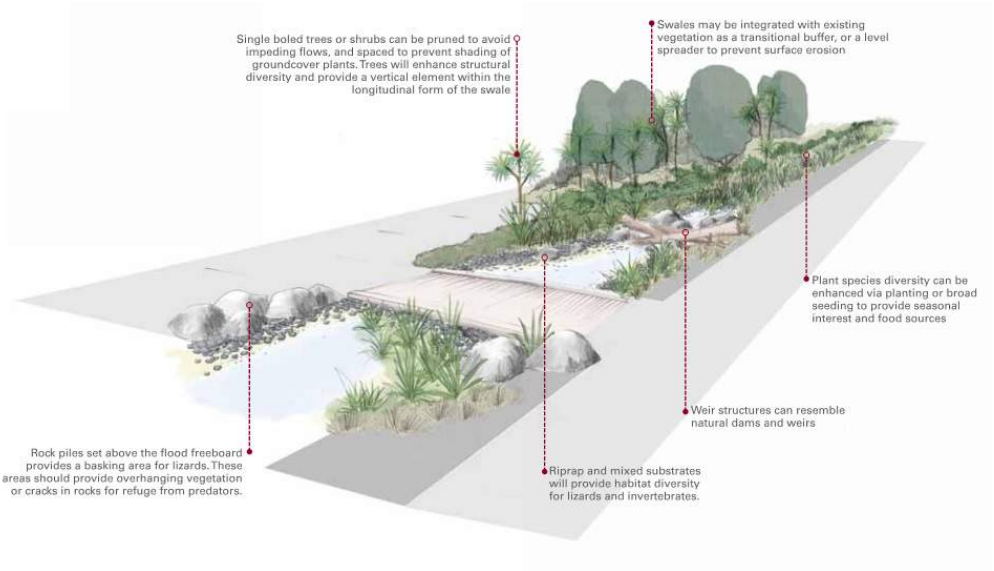


Figure 8 - Design elements to provide for a naturalised overland flow path (Source: Landscape and Ecology Values within Stormwater Management - Auckland Regional Council Technical Report TR2009/083)

Landscaping of the constructed swale shall be undertaken in general accordance with the RITS Section 4.2.24 including Table 4-35 – Approved Plant Species.

A planting plan and planting schedule will be prepared as part of the detailed design process. Planting will likely comprise planting of the swale invert with a thick swathe of typical wetland rush species such as oioi and carex species with other terrestrial species such as flaxes extending up the swale banks/batters to maximise stability and shading of the swale – refer Figure 8 below for a photo of a planted swale example.

Figure 8– Planting swale example

4.3.5 ***Swale Operation and Maintenance***

The proposed swale device will be retained in the ownership of the Te Awamutu Country Club and hence will fall within the scope of operation and maintenance associated with the overall retirement village site. In this respect, the swale maintenance will benefit from provision of a permanent maintenance team responsible for all aspects of site maintenance including landscaping, buildings and infrastructure.

The specific maintenance requirements for the swale will again be outlined within a detailed Operation and Maintenance Plan which can be referenced by site staff to ensure the stormwater treatment/detention functions of this device are maximised in the long term.

5 WRC Low Impact Design (LID) Matrix

The proposed development layout and SW management methodology has been assessed using the WRC LID scoring matrix in accordance with the requirements for the WRC Stormwater Management Guidelines 2020. Refer to the assessment below.

Based on the downstream receiving environment both Water Quality and Water quantity control are considered necessary for stormwater discharges from the site. Volume Control to protect against downstream erosion is not considered necessary. Accordingly, a Target Score of 10 is recommended for the site.

Implementation elements	Typical Components	Score	Comment
Source control maximised	Water re-use	0	
	Site disturbance reduced from a conventional development approach	0	
	Impervious surfaces reduced from a traditional approach	0	Park and SW Reserve Areas approximately 8% of the total development
	Use of building or site materials that do not contaminate	1	Non-contaminating roof materials to be used
	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	No existing streams, riparian corridors or bush area on the existing site.
	Riparian corridors are protected, enhanced or created	0	
	Protection and future preservation of existing native bush areas	0	
LID stormwater device/practice used	Infiltration devices to reduce runoff volume	0	
	Revegetation of open space areas as bush	0	
	Bioretention	0	
	Swales and filter strips	1	A proposed Water Quality treatment swale is proposed along the western boundary of the Country Club This has a catchment of approx.. 4.4Ha which equates to approx.. 25% of the development site. The swale provides WQ treatment, ED and conveys the 2- and 10-year ARI events to the wetland. A total of 3 points has been pro-rated to the swale catchment area
	Tree pits	0	
Traditional mitigation	Constructed wetlands	4	All stormwater to be treated by constructed stormwater wetlands. Wetlands designed for WQ, ED and flow attenuation in the 2 and 10 year ARI event.
	Wet ponds	0	
	Innovative devices	0	

	Detention ponds (normally dry)	0	
Urban design	Stormwater management is designed to be an integral and well considered part of the urban design.	2	Both the stormwater wetland and swale will provide an enhanced landscape and ecological function to the development. Wetland environments represent the intersection of aquatic and terrestrial ecologies and support a wide variety of vegetation types. The wetland and swale will be designed as a landscape feature of significant amenity, with diverse habitat types, and opportunities for passive recreation.
Tangata Whenua Values	Stormwater management has been designed considering Tangata Whenua values and demonstrates that these have been incorporated into the design	0	
Total score		**8.0**	

The proposed development receives a total score of 8.0 points out of 10 required.

6 Conclusion

Development of this SMP has included assessment of the existing site and downstream receiving environment characteristics along with the provisions of relevant Council guidelines and design standards. Subsequently, the preferred stormwater management proposal outlined in this report is considered to present a best practice and practical approach to stormwater management for the site to manage drainage within the development site while also avoiding any adverse effects within the downstream receiving environment.

The proposal will be subject to further refinement and development as part of the detailed engineering design process required to satisfy both WDC subdivision and WRC discharge consent requirements.

APPENDIX A – DEVELOPMENT LAYOUT/SCHEME PLAN

Te Awamutu Country Club

Frontier Drive, Te Awamutu

Proposed facilities

1. Care Facility
2. Club House
3. Health Spa
4. Pond
5. Bowls Lawn
6. Croquet Green
7. Campervan Parking
8. Hobby Shed
9. Golf Putting Green

98 Retirement Villas

105 Residential Lots

Te Awamutu Country Club

A 98 Villa
8.96 Hectare
Sanderson Group
Development

KOTARE PROPERTIES

KOTARE WETLANDS

A 9.26 Hectare
105 RESIDENTIAL
LOT SUBDIVISION

DRAFT

Lot 7
DP 461400

20.12

Lot 1
DP 453448

LOT 116
TE AWAMUTU COUNTRY CLUB
8.15 Ha

T1 - 20m wide

Lot 1
DP 516135

LOT 114
Road to Vest
3930 m²

LOT 115
TE AWAMUTU COUNTRY CLUB
8119 m²

Lot 3
DP 487281

LOT 112
1.0140 Ha
(SW Management)
RESERVE

SW

Sewer Pump

LOT 111
2700 m²
RESERVE

LOT 113
Road to Vest
1.7280 Ha

ROAD 2 (15m) - 100m

Lot 110 1091 m²

Walkway (6m)

Section 1
SO 466626
DRAFT

DATUM:
IRON BOLT
RL 80.45

Lot 3
DP 444190

25m x 15m Playground

ROAD 1 (20m) - 372m

ROAD 3 (18m) - 668m

FRONTIER ROAD Legal Road Sealed and In Use

Pt Allot 228
Mangapiko Psh

LOT 1
DPS 4408

AVERAGE RESIDENTIAL
LOT SIZE = 533m²

PROPERTY DETAILS:
LEGAL DESCRIPTION:
LOTS 1 & 2 DP 487281
– AREA: 18.2142 Ha
– COMPRISED IN 696840 / 696841
– WAIPA DISTRICT COUNCIL
– ZONING: RURAL

NOTES:

1. HEIGHTS ARE IN TERMS OF MOTURIKI VERTICAL DATUM 1953
2. DATUM MARK IB 1 SO 466626 RL=80.45
3. CONTOUR INTERVAL 1.0m
4. AREAS AND DIMENSIONS SHOWN ARE SUBJECT TO FINAL SURVEY.

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Cambridge 3450

PROJECT TITLE

SUBDIVISION CONCEPT PLAN

LOTS 1–116 BEING A SUBDIVISION
OF LOTS 1 & 2 DP 487281
AT 10 & 52 FRONTIER ROAD, TE AWAMUTU

ALTERATION	JOB	SHEET
	4500	03
CAD CPM	ORIGINAL SCALE AT A3	REV 12
DATE 7 JULY 2020	1:2000	

C:\USERS\CIARAN\NICKLIN CE\NICKLIN CE TEAM SITE – DOCUMENTS\4500 SANDERSON GROUP (52 FRONTIER ROAD, TE AWAMUTU)\4500–03 SUBDIVISION CONCEPT PLAN REV12.DWG

APPENDIX B – STORMWATER PRELIMINARY DESIGN PLANS

LEGEND:

- 39.0 CONTOURS (MAJOR 2.5m)
- 39.1 CONTOURS (MINOR 0.5m)
- SWD PROPOSED STORMWATER
- DEVELOPMENT BOUNDARY
- TREATMENT FLOW DIRECTION
- PERMANENT WATER LEVEL
- PROPOSED RETAINING WALL

WETLAND PLANTING ZONE AND DEPTHS

ZONE	COLOR	MINIMUM ELEVATION (m)	MAXIMUM ELEVATION (m)	2D AREA (m^2)
EPHEMERAL ZONE		0.200	0.000	500
SHALLOW MARSH ZONE		0.000	-0.200	1441
DEEP MARSH ZONE		-0.200	-0.400	1450
SUBMERGED MARSH ZONE		-0.400	-0.500	62
OPEN WATER		-0.500	-1.500	751

No.	BY	DATE	DESCRIPTION	APPD
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SCALE (AT ORIGINAL SHEET SIZE) — SHEET SIZE A1

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NOTES

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CLIENT: Te Awamutu Country Club — KOTARE PROPERTIES

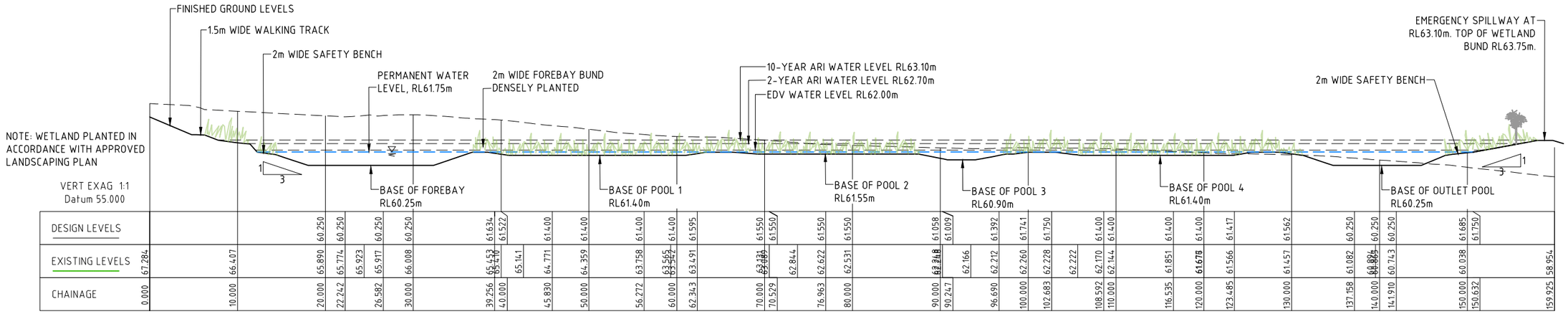
PROJECT: 52 FRONTIER ROAD TE AWAMUTU

STORMWATER WETLAND PLAN

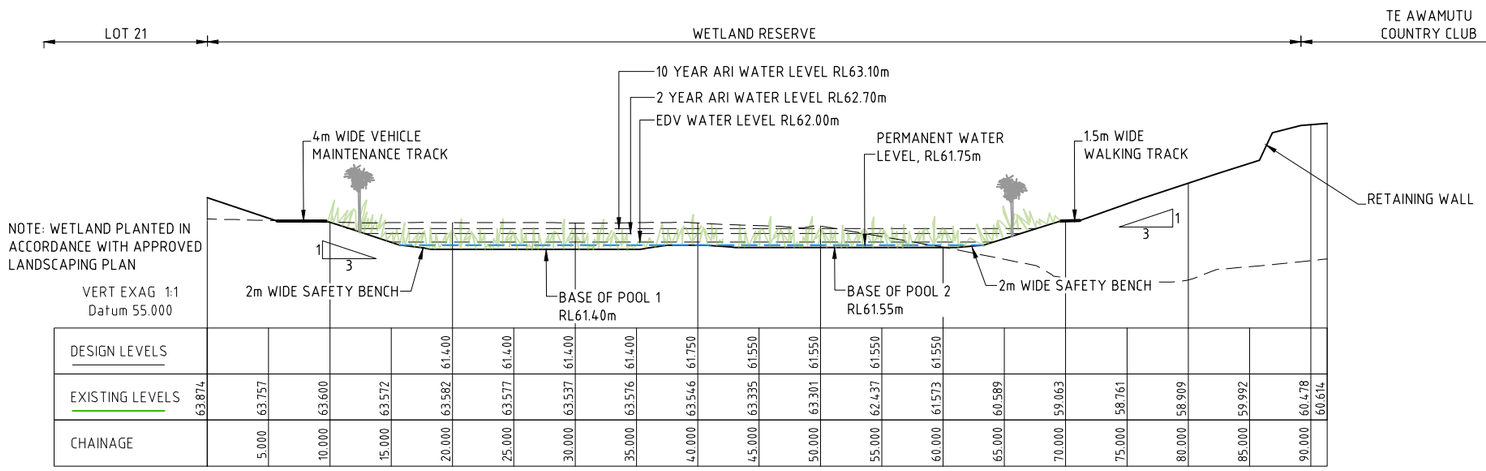
Status: PRELIMINARY

DRAWING NUMBER: WE2014- 400

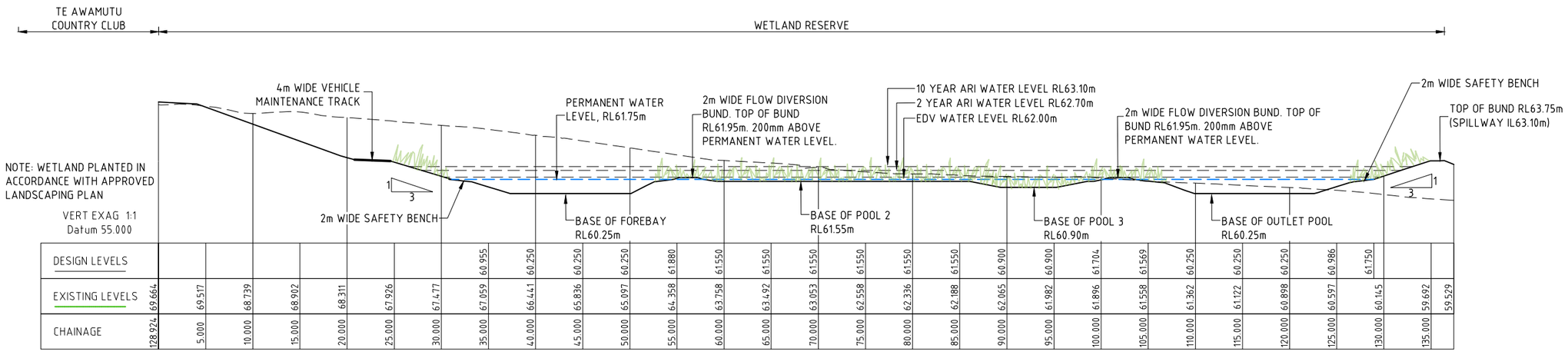
Rev.: A



WETLAND LONG SECTION 1



WETLAND LONG SECTION 2



WETLAND LONG SECTION 3

No.	BY	DATE	DESCRIPTION	APPD
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SCALE 5 0 5 10 1:250

NOTES

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CLIENT: Te Awamutu Country Club; KOTARE PROPERTIES

PROJECT: 52 FRONTIER ROAD TE AWAMUTU

STORMWATER WETLAND TYPICAL SECTIONS

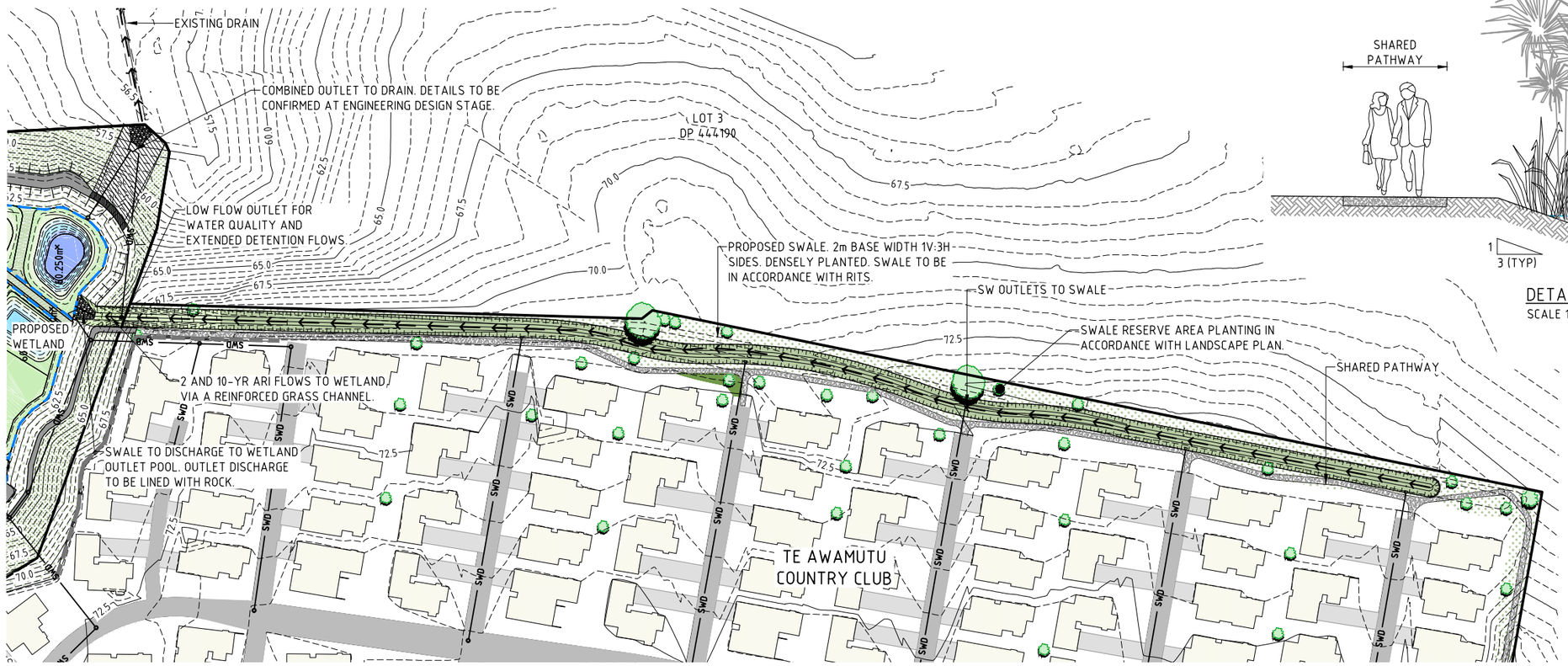
Status: PRELIMINARY

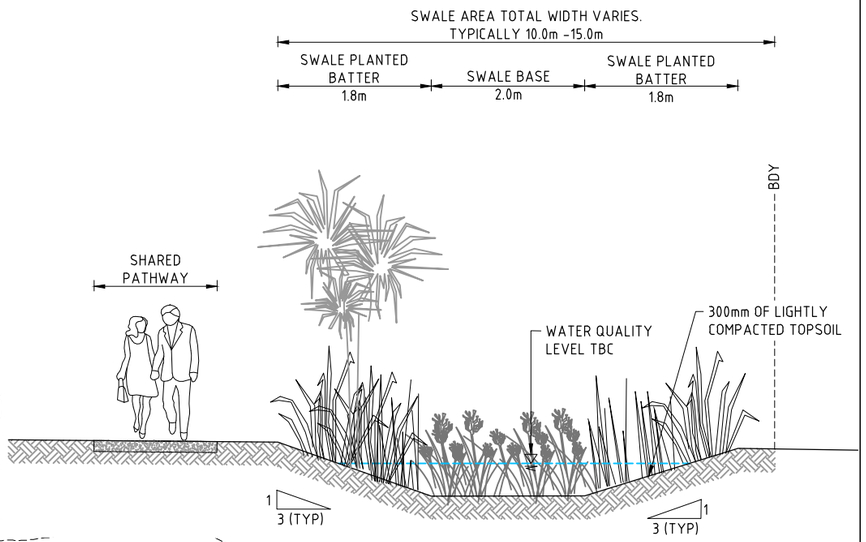
DRAWING NUMBER: WE2014- 420

Rev.: A

LEGEND:

- 39.0 EXISTING CONTOURS (MAJOR 5m)
- 39.1 EXISTING CONTOURS (MINOR 1m)
- SWD PROPOSED STORMWATER
- DEVELOPMENT BOUNDARY
- PROPOSED RETAINING WALL





DETAIL 1 - TYPICAL SWALE CROSS-SECTION
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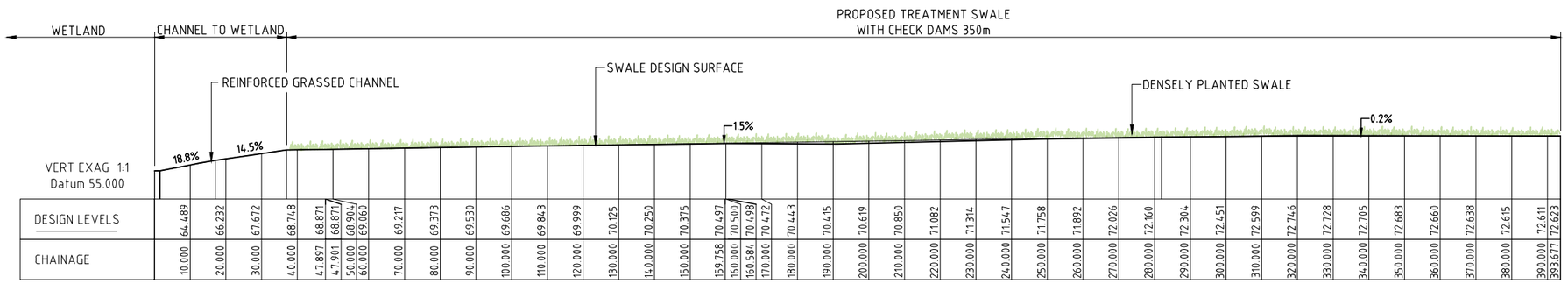

SWALE LONG SECTION

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SHEET SIZE A1

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CLIENT: Te Awamutu Country Club; KOTARE PROPERTIES

PROJECT: 52 FRONTIER ROAD TE AWAMUTU

STORMWATER SWALE
TYPICAL PLAN AND SECTIONS

Status: PRELIMINARY

DRAWING NUMBER: WE2014- 430

Rev.: A

APPENDIX C – STORMWATER DESIGN CALCULATIONS/MODELLING INFORMATION

LEGEND:

- 39.0 DESIGN CONTOURS (MAJOR 2.5)
- 39.1 DESIGN CONTOURS (MINOR 0.5)
- SWD EXISTING STORMWATER
- EXISTING HYDROLOGICAL CATCHMENTS
- PRE DEVELOPMENT CATCHMENTS
- DRAIN/FLOW LINES

EXISTING STREAM 'REACH 2'

EXISTING BASIN

EXISTING STREAM 'REACH 1'

EXISTING BASIN

ADOPTED PRE-DEVELOPED WETLAND CATCHMENT

KOTARE PROPERTIES PRE-DEVELOPED SUB-CATCHMENT AREA= 8.75Ha

FRONTIER ROAD PRE-DEVELOPED CATCHMENT AREA = 0.47Ha

TE AWAMUTU COUNTRY CLUB PRE-DEVELOPED SUB-CATCHMENT AREA= 8.55Ha

DEVELOPMENT BOUNDARY

WDC WATER RESERVOIR SUB-CATCHMENT AREA = 0.904Ha

FRONTIER ROAD

This drawing is confidential and shall only be used for the purposes of this project.

No.	BY	DATE	DESCRIPTION	APPD
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CLIENT Te Awamutu Country Club / KOTARE PROPERTIES

PROJECT 52 FRONTIER ROAD TE AWAMUTU

PRE-DEVELOPED SUB-CATCHMENT PLAN

Status PRELIMINARY

DRAWING NUMBER WE2014- 412

Rev. A

LEGEND:

- 39.0 DESIGN CONTOURS (MAJOR 2.5)
- 39.1 DESIGN CONTOURS (MINOR 0.5)
- SWD EXISTING STORMWATER
- CATCHMENT BOUNDARIES

EXISTING DRAIN 'REACH 2'

EXISTING BASIN

EXISTING DRAIN 'REACH 1'

PROPOSED WETLAND

PROPOSED SWALE

STORMWATER RESERVE SUB-CATCHMENT AREA =1.01Ha

FRONTIER ROAD SUB-CATCHMENT AREA = 0.47Ha. WQ, ED, 2 AND 2 AND 10 YEAR ARI FLOWS TO WETLAND

KOTARE PROPERTIES SUB-CATCHMENT AREA = 7.84Ha WATER QUALITY, EXTENDED DETENTION AND 2 AND 10-YR ARI FLOWS TO WETLAND

TE AWAMUTU COUNTRY CLUB SUB-CATCHMENT 'B' AREA= 4.43Ha WATER QUALITY, EXTENDED DETENTION FLOW TO SWALE. 2 AND 10-YR ARI FLOWS TO WETLAND

TE AWAMUTU COUNTRY CLUB SUB-CATCHMENT 'A' AREA = 4.92Ha WATER QUALITY, EXTENDED DETENTION AND 2 AND 10-YR ARI FLOWS TO WETLAND

WDC WATER RESERVOIR SUB-CATCHMENT AREA = 0.904Ha WATER QUALITY, EXTENDED DETENTION AND 2 AND 10-YR ARI FLOWS TO WETLAND

FRONTIER ROAD

No.	BY	DATE	DESCRIPTION	APPD
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SCALE 25 0 25 50 1:1250

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CLIENT Te Awamutu Country Club / KOTARE PROPERTIES

PROJECT 52 FRONTIER ROAD TE AWAMUTU

POST-DEVELOPMENT CATCHMENT PLAN

Status PRELIMINARY

DRAWING NUMBER WE2014-414

Rev. A

calculation sheet

PRE-DEVELOPMENT - Hydrology

client: Sanderson Group Ltd
project: Frontier Road
job No. WE2014

computed: MRS
date: 27/07/2020
revision: 1

Notes:

SCS for Pervious is hydrologic soil group is C based on smaps information and soils observed durng site visit. Cover type is mostly pasture, grassland in good condition.

SCS Number is 74 in according to Table 2-2c from TR201802 WRC TR 2018.

CATCHMENT		KOTARE PROPERTIES PRE		TE AWAMUTU COUNTRY CLUB PRE		FRONTIER ROAD PRE		WDC WATER RESERVOIR PRE		TOTAL	
Total Area	Ha	8.7500		8.5500		0.4700		0.9040		18.6740	
	km^2	0.0875		0.0855		0.0047		0.0090		0.1730	
Fraction Impervious		0%		8%		36%		55%		3%	
		Perv	*Imperv*	*Perv*	*Imperv*	*Perv*	*Imperv*	*Perv*	*Imperv*	*Perv*	*Imperv*
Area	Ha	8.7500	0.0000	7.8863	0.6637	0.3024	0.1676	0.4080	0.4960	18.1628	0.5112
SCS Curve Number		74	98	74	98	74	98	74	98	74	98
CN (weighted)		74.0		75.9		82.6		87.2		74.7	
Initial Abstraction, Ia	mm	4.46	0.26	4.46	0.26	4.46	0.26	4.46	0.26	4.46	0.26
Weighted Initial Abstraction	mm	4.46		4.14		2.96		2.16		4.35	
Catchmemt Storage, S	mm	89.2	5.2	89.2	5.2	89.2	5.2	89.2	5.2	89.2	5.2
Channelisation Factor , C		1.0		1.0		1.0		1.0			
Catchment Length	km	0.404		0.366		0.404		0.404			
Catchment Slope, Sc	m/m	0.0530		0.0720		0.0530		0.0530			
Runoff factor (RF)		0.587		0.611		0.703		0.773			
Time of Concentration (tc)	hrs	0.25		0.21		0.23		0.21			
	min	14.94		12.49		13.53		12.85			
S (Slope)	%	5.300		7.200		5.300		5.300			
Mannings Surface roughness	n	0.030		0.030		0.030		0.030			
Length pf overland flow	m	404.000		366.000		404.000		404.000			
ToC (calculated)	min	15.573		14.178		15.573		15.573			
SCS Lag (tp)	min										
Adopted Tc	min	15.00		13.00		15.00		15.00			
SCS Lag (tp)	min	10.00		8.67		10.00		10.00			

calculation sheet

POST-DEVELOPMENT Catchment Hydrology

client: Sanderson Group Ltd
project: Frontier Road
job No. WE2014

computed: MRS
date: 27/07/2020
revision: 1

Notes:

2-YR 24-HR STORM DEPTH = 76.34 mm

		TE AWAMUTU COUNTRY CLUB						KOTARE PROPERTIES				EXTERNAL SUBCATCHMENTS				TOTAL	
		SUB-CATCHMENT A (TO WETLAND)		SUB-CATCHMENT B (WQ AND ED TO SWALE)		SUB-TOTAL		RESIDENTIAL DEVELOPMENT		STORMWATER RESERVE AREA		FRONTIER ROAD		WDC WATER RESERVOIR			
Total Area	ha	4.9200		4.4300		9.3500		7.8400		1.0310		0.4700		0.9040		19.6	
	km^2	0.0492		0.0443		0.0935		0.0784		0.0103		0.0047		0.0090		0.1960	
Site Impervious	%	75%		65%		70%		71%		40%		75%		55%		68%	
		Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious
Area	ha	3.685	1.235	2.886	1.544	6.571	2.779	5.579	2.261	0.412	0.619	0.353	0.118	0.496	0.408	13.410	6.185
	km^2	0.037	0.012	0.029	0.015	0.066	0.028	0.056	0.023	0.004	0.006	0.004	0.001	0.005	0.004	0.134	0.062
CN Weighted		93.23		91.38		92.35		92.52		86.60		93.25		87.17		92.00	
SCS Curve Number		98.0	79.0	98.0	79.0	98.0	79.0	98.0	79.0	98.0	79.0	98.0	79.0	98.0	74.0	98.0	79.0
Catchment Storage , S		5.18	67.52	5.18	67.52	5.18	67.52	5.18	67.52	5.18	67.52	5.18	67.52	5.18	89.24	5.18	67.52
Initial Abstraction, Ia		0.26	3.38	0.26	3.38	0.26	3.38	0.26	3.38	0.26	3.38	0.26	3.38	0.26	4.46	0.26	3.38
weighted Initial Abstraction, Ia		1.04		1.35		1.19		1.16		2.13		1.04		2.16		1.24	
Channelisation Factor , C		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Time of concentration, min		10		10		10		10		10		10		10		10	
SCS Lag (tp), min		6.67		6.67		6.67		6.67		6.67		6.67		6.67		6.67	
WQV STORAGE																	
1/3 24hr rainfall depth P24 mm		25.4	25.4			25.4	25.4	25.4	25.4			25.4	25.4	25.4	25.4	25.4	25.4
Runoff Depth, Q24 mm		20.890	5.438			20.890	5.438	20.890	5.438			20.890	5.438	20.890	3.995	20.890	5.438
Runoff Volume, V24 m3		769.77	67.2			1372.6	151.1	1165.4	123.0			73.6	6.4	103.6	16.3	2112.4	212.8
TOTAL WQV BY CATCHMENT		836.93				1523.73		1288.38				80.03		119.91		2325.25	
ED Provided ? (WQV *0.5)		418.46				761.86		644.19				40.01		59.96		1162.63	

Wetland

Water Quality Catchment Area (ha)	14.13	
Calculated WQV (m^3)	1162.63	
Adjusted volume to account for Planting (m^3)	1550.17	(Divide calculated WQV by 0.75 to account for planting)
Permanent Water Area (m2)	4000.44	2.830%
FOREBAY VOLUME (30% WQV) (m^3)	348.79	(30% of the adjusted WQV)

calculation sheet

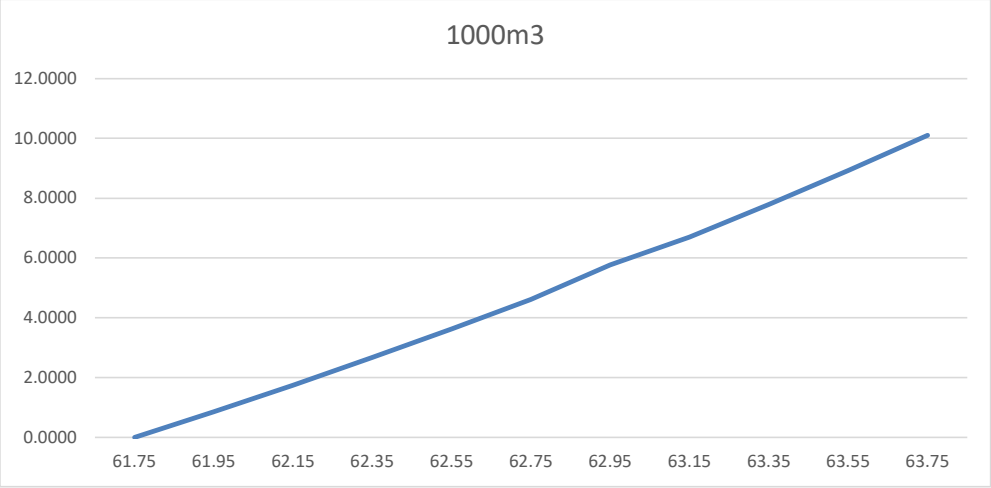
PRELIMINARY WETLAND STAGE AREA RELATIONSHIP

client: Sanderson Group Ltd
project: Frontier Road
job No. WE2014

computed: MRS
date: 27/07/2020
revision: 1

Wetland			
RL (m)	Total Volume(m^3)	Live Volume (m^3)	1000m^3
61.75	1652.00	0.00	0.0000
61.95	2508.00	856.00	0.8560
62.15	3398.36	1746.36	1.7464
62.35	4320.90	2668.90	2.6689
62.55	5276.60	3624.60	3.6246
62.75	6265.99	4613.99	4.6140
62.95	7421.45	5769.45	5.7695
63.15	8349.65	6697.65	6.6977
63.35	9445.07	7793.07	7.7931
63.55	10577.40	8925.40	8.9254
63.75	11754.79	10102.79	10.1028

Permanent Water Level Volume = 1652 m^3



calculation sheet

HEC HMS RESULTS

client:	Sanderson Group Ltd	computed:	MRS
project:	Frontier Road	date:	27/07/2020
job No.	WE2014	revision:	1

1. Pre-Developed Catchment Peak Flows

2 Yr-ARI

Project: 52 Frontier Road - For Cons Simulation Run: 01-2 Yr ARI Pre
Sink: Receiving Environment

Start of Run:	01Jan2000, 00:00	Basin Model:	Pre-Development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	01- 2Yr ARI Pre-Dev
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	24 hr

Volume Units: ○ MM ◉ 1000 M3

Computed Results

Peak Discharge:	1.12165 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:16
Volume:	5.0014 (1000 M3)		

10 Yr-ARI

Project: 52 Frontier Road - For Cons Simulation Run: 02-10 yr ARI Pre
Sink: Receiving Environment

Start of Run:	01Jan2000, 00:00	Basin Model:	Pre-Development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	02 -10Yr ARI Pre-Dev
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	24 hr

Volume Units: ○ MM ◉ 1000 M3

Computed Results

Peak Discharge:	2.22629 (M3/S)	Date/Time of Peak Discharge	01Jan2000, 12:16
Volume:	9.4928 (1000 M3)		

calculation sheet

HEC HMS RESULTS

client: Sanderson Group Ltd
project: Frontier Road
job No. WE2014

computed: MRS
date: 27/07/2020
revision: 1

2. Pond Performance

Extended Detention

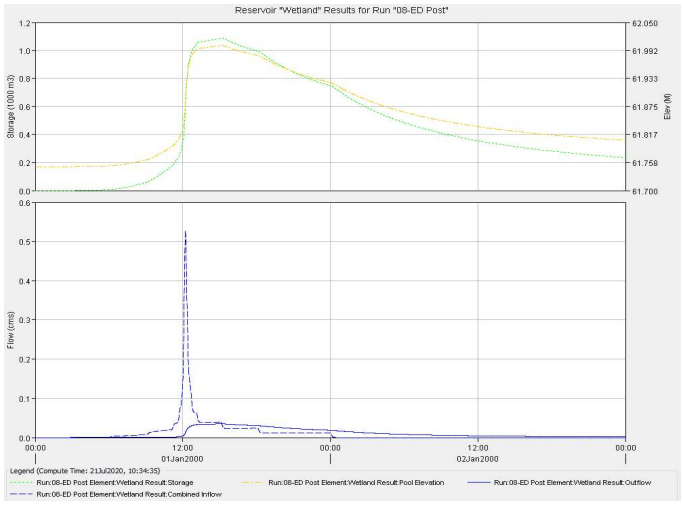
Project: 52 Frontier Road - For Cons Simulation Run: 08-ED Post
Reservoir: Wetland

Start of Run:	01Jan2000, 00:00	Basin Model:	Post-Development ED
End of Run:	03Jan2000, 00:00	Meteorologic Model:	08-ED Post
Compute Time:	21Jul2020, 10:34:35	Control Specifications:	48 hrs

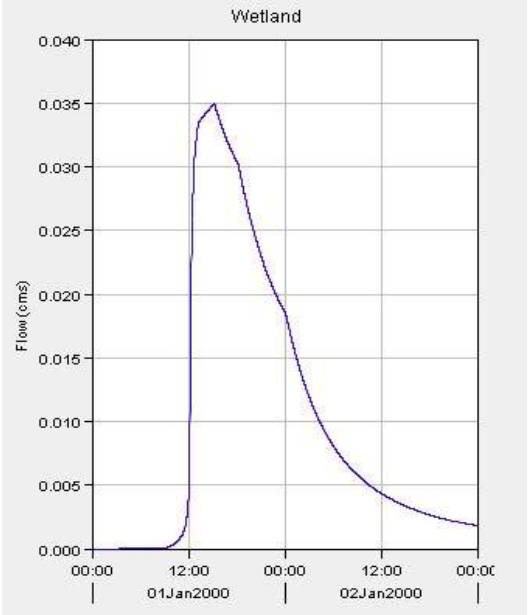
Volume Units: ○ MM ◉ 1000 M3

Computed Results

Peak Inflow:	0.52783 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:13
Peak Discharge:	0.03493 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 15:11
Inflow Volume:	1.9529 (1000 M3)	Peak Storage:	1.0884 (1000 M3)
Discharge Volume:	1.7178 (1000 M3)	Peak Elevation:	62.0022 (M)



Extended Detention Outlet Outflow



calculation sheet

HEC HMS RESULTS

client: Sanderson Group Ltd
project: Frontier Road
job No. WE2014

computed: MRS
date: 27/07/2020
revision: 1

2Yr-ARI

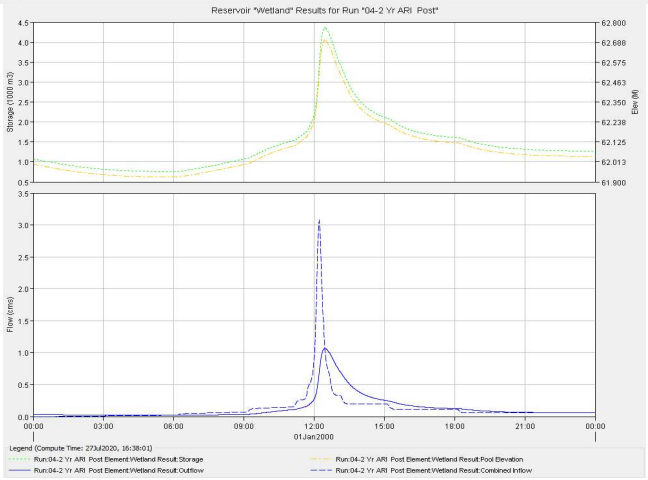
Project: 52 Frontier Road - For Cons Simulation Run: 04-2 Yr ARI Post
Reservoir: Wetland

Start of Run:	01Jan2000, 00:00	Basin Model:	Post-Development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	04-2Yr ARI Post-Dev
Compute Time:	27Jul2020, 16:38:01	Control Specifications:	24 hr

Volume Units: ◯ MM ◉ 1000 M3

Computed Results

Peak Inflow:	3.06193 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:13
Peak Discharge:	1.06911 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:27
Inflow Volume:	11.3972 (1000 M3)	Peak Storage:	4.3561 (1000 M3)
Discharge Volume:	11.2084 (1000 M3)	Peak Elevation:	62.6979 (M)



10Yr-ARI

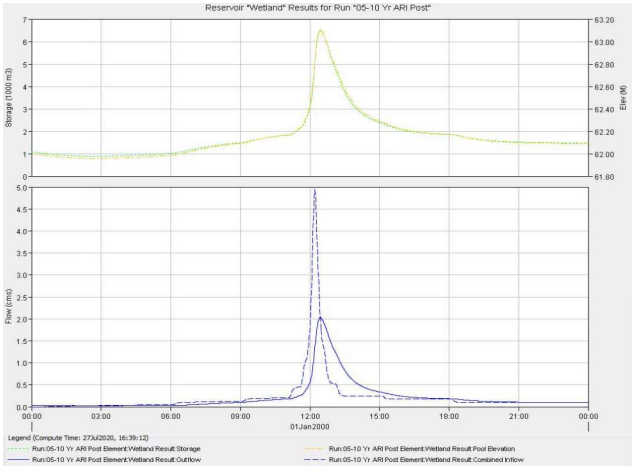
Project: 52 Frontier Road - For Cons Simulation Run: 05-10 Yr ARI Post
Reservoir: Wetland

Start of Run:	01Jan2000, 00:00	Basin Model:	Post-Development
End of Run:	02Jan2000, 00:00	Meteorologic Model:	05-10Yr ARI Post-Dev
Compute Time:	27Jul2020, 16:39:12	Control Specifications:	24 hr

Volume Units: ◯ MM ◉ 1000 M3

Computed Results

Peak Inflow:	4.93366 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:13
Peak Discharge:	2.03526 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:27
Inflow Volume:	18.8945 (1000 M3)	Peak Storage:	6.4821 (1000 M3)
Discharge Volume:	18.4931 (1000 M3)	Peak Elevation:	63.1036 (M)



calculation sheet

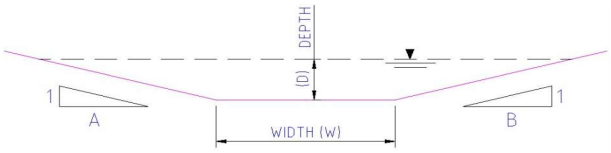
WATER QUALITY TREATMENT SWALE DESIGN

client:	Sanderson Group Ltd	computed:	MRS
project:	Frontier Road	date:	27-Jul-20
job No.	WE2014	revision:	A

TREATMENT SWALE

WQ Conveyance for treatment swale		
Catchment Area (ha)	4.430	
	IMP.	PERV.
% Impervious	75%	25%
Area (ha)	3.323	1.108
2yr-24hr Rainfall Depth (mm)	76	76
WQD Depth , P_{24} (mm)	25.45	25
Peak Rainfalll rate (mm/hr)	17.2	17.2
Weighted CN	98	79.00
Ia (mm)	0.26	3.38
Runoff Storage S (mm)	5.18	67.52
Rainfall/runoff	0.91	0.23
Peak runoff rate (m^3/s)	0.14486	0.012
Peak catchment runoff (m^3/s)	0.15693	
Peak catchment runoff damped (m^3/s)	0.1397	
Swale length (m)	315	
WQ velocity (m/s)	0.175	
Residence time (mins)	33.78	

10 year Conveyance		
Catchment Area (ha)	4.430	
	IMP.	PERV.
% Impervious	75%	25%
Area (ha)	3.323	1.108
C Runoff Coef	0.80	0.40
Weighted C Runoff Coef	0.70	
Peak rainfall rate (10yr 10min)	113	
Peak runoff rate (m^3/s)	0.976	



PARAMETERS TABLE

W	**2.00**	Channel width in metres
A	**3**	Grade of left hand channel bank.
B	**3**	Grade of right hand channel bank.
S	**1.5**	Slope of channel bed in percent.
n	**0.25**	Manning's "n" which is the channel roughness
n_{10}	**0.100**	Manning's "n" which is the channel roughness. 10 year event
d_{WQ}	**0.285**	flow Depth - WQ Event
d_{10}	**0.49**	flow Depth - 10year ARI event
L	**355**	Swale length

OPEN CHANNEL FLOW CALCULATIONS -WATER QUALITY STORM

FLOW AREA m^2	WET PERIM. m	HYDRAULIC RADIUS m	FLOW RATE m^3/s	VELOCITY m/s	D-V PRODUCT	Residence Time
0.814	**3.80**	**0.21**	**0.1425**	**0.175**	**0.050**	**33.78**

OPEN CHANNEL FLOW CALCULATIONS - 10 YEAR ARI EVENT

FLOW AREA m^2	WET PERIM. m	HYDRAULIC RADIUS m	FLOW RATE m^3/s	VELOCITY m/s	D-V PRODUCT
1.676	**5.07**	**0.33**	**0.9810**	**0.585**	**0.284**

Notes

1 This spreadsheet calculates flow in an open channel using Manning's equation.

2 Typical roughness values are:

Concrete	0.013
Bitumen	0.015
Turf	0.032
Med grass	0.035
Long grass	0.050
Heavy weeds	0.050
Dense brush	0.100

For further examples of Manning's n refer OPEN-CHANNEL HYDRAULICS by Chow

3 The table of parameters to be specified refer to the following design channel.

4 Rectangular channel can be modelled by setting "A" and "B" to equal zero.