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Appendix E – Proposed Civil Infrastructure Resource Consent Drawings

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Appendix F – Proposed Civil Infrastructure Concept Design Drawings

Ryman Healthcare Proposed Comprehensive Care

Stormwater Management Plan

Kohimarama

Prepared for Ryman Healthcare Ltd
Prepared by Beca Limited

14 February 2020

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Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
A	**Conor O'Boyle**	Draft Issue for Resource Consent	14.02.20

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Conor O'Boyle**		
Reviewed by	**Ron Melton**		
Approved by	**Blaise Cummins**		
on behalf of	Beca Limited		

1 Introduction

1.1 Development Summary

Ryman Healthcare Ltd (Ryman) is proposing to construct and operate a comprehensive care retirement village on a 3.12 ha site at 223 Kohimarama Road and 7 John Rymer Place in Kohimarama, Auckland. This site is one of the last significant parcels of undeveloped land in the catchment surrounding the Pourewa Creek (with a total catchment area of approximately 126 hectares), which flows through to the Ōrākei Basin and Waitematā Harbour.

A Civil Design Report has been prepared to support the Resource Consent Application for this proposal. The stormwater section of that report provided a summary of the existing situation and proposed stormwater works. This Stormwater Management Plan (SMP) is intended to provide more detail and to demonstrate compliance with the conditions of the Regional Network Discharge Consent (RNDC).

1.2 Planning Context

It is proposed that the diversion and discharge of stormwater from this development can be authorised under Auckland Council's Regionwide Network Discharge Consent (NDC). Pre-application engagement between Ryman and Auckland Council has occurred since May/June 2019. This SMP is intended to provide more detail and to demonstrate consistency the NDC, specific only to the Ryman development area. Once reviewed and adopted by Auckland Council, this SMP will provide the framework for authorisation of stormwater diversion and discharge to Council's public network from the Ryman development.

Existing network discharge consent #4427 Hobson Bay / Waitematā, held by Auckland Council and expiring 31 December 2021, authorises discharges from the existing 1350mm diameter outfall currently serving John Rymer Pl. The network was consented in 1984 and varied in 1988 to account for improved understanding of the contributing catchment. The original network design and associated consent accounts for the north-eastern portion of both the Ryman Site and a portion of Selwyn College.

In this case, the proposal is considered a 'brownfields large' private development as it incorporates more than 5000m^2 of new/re-developed impervious surfaces. The associated framework in the NDC outlines the following synthesised issues and expected outcomes – noting there is no existing 'adopted' SMP in the area:

Water Quality (discharges to streams)	Treatment of all impervious areas, or, an alternative that represents the BPO
Stream Hydrology (discharges to streams outside of SMAF)	Provide hydrology mitigation to the equivalent of SMAF-1 (5mm retention and 95th percentile storm detention), or, an alternative that meets the NDC Objectives & Outcomes in Schedule 2, and which represents the BPO
Flooding (10% AEP event)	Demonstrate through an assessment that flows in excess of the pipe capacity in a 10% AEP event within the pipe network downstream of the connection point will not increase adverse effects on any other property

Flooding (1% AEP event)	Manage/mitigate 1% AEP peak flow to that immediately preceding development/redevelopment
Assets	All new assets that are intended to become part of the public stormwater network are to be designed and constructed to be durable and perform to the required level of service for the life of the asset, subject to reasonable asset maintenance.

2 Existing Site Appraisal

2.1 Site Description

The development land comprises of two parcels:

- a principal block of 3.08 ha at 223 Kohimarama Rd (Lot 1 DP 332284); and
- a small parcel of 451 m^2 at 7 John Rymer Pl (Lot 51 DP 163242).

Figure 2.1 shows the site location. Both land parcels are located within the mixed housing urban zone overlay of the Auckland Unitary Plan (AUP). There is no Stormwater Management Area: Flow (SMAF) overlay for the site.

Figure 2.1 – Site Location

2.2 Site Geomorphology

The site is located on an elongated wedge of land that is widest along Kohimarama Road and narrows to a width of 24m at the western end. It has a long northern boundary with Selwyn College, is bordered to the west by an undeveloped section of the Selwyn College site, to the east by Kohimarama road and houses accessed from Kohimarama Road, and to the south by existing residential development accessed from John Rymer Place. Current access to the site is from John Rymer Place through the undeveloped lot at 7 John Rymer Place.

The site has a total area of 31,216 m^2 (3.12 ha).

The western side of the site, the area east of the stream and an area in the middle of the site have regenerating native vegetation. The rest of the site is typically covered by long grass.

2.3 Topography

A site topographic survey is enclosed as **Appendix B**.

A low (approximately 1m high) timber pole wall along approximately half of the northern boundary retains a driveway and parking area in the adjacent school. The John Rymer Place properties backing onto the Ryman site have typically been developed with retaining walls along their rear boundary to support excavations for their site development. These walls are typically up to 2m high and are mainly timber pole type.

A level playing field has been formed in the eastern area of Lot 1. A gully extends northwards for approximately 40m from the northern corner of the field, and this environment has been confirmed as a 'stream' under the definitions of the AUP. The topographical survey indicates that the gradients of the western and eastern side slope of the gully are between 1V to 2.5H and 1V to 2H. The gully is heavily vegetated with small trees and scrub. An existing stormwater inlet structure has been constructed in the invert of the depression and consists of a 450mm diameter pipe.

The properties along the south-eastern boundary of Lot 1 have been developed with residential houses. The ground surface slopes downward towards the west at gradients between approximately 1V to 3.5H and 1V to 2.5H. There is a depression point near the south-eastern corner of site, immediately north of 17 & 19 John Rymer Place. An existing stormwater inlet structure has been constructed in the invert of the depression and consists of a 225mm diameter pipe.

The slope below the lower play field is generally covered by grass. The gradient of the slope varies between approximately 1V to 6H and 1V to 2.5H. The slope above and to the north- west of the lower play field appears to be a cut batter. The slope is generally grass covered, except the area above the western corner of the field where there are several medium sized trees and scrub. The gradient of the slope is relatively uniform at approximately 1V to 4H, except above the western slope which is also locally steeper above the northern corner of the field.

2.4 Geotechnical

Tonkin and Taylor have carried out geotechnical investigations of this site and prepared a report titled Geotechnical Assessment of Environmental Effects dated October 2019. Key items from this report are:

- The subsurface conditions are predominantly ECBF rock and weathered rock (soil)
- Rockhead ranges from 10m to 19m below ground level, with the weathered ECBF material transitioning from rock to soil as it approaches ground level
- The flat area in the middle of the site comprises an infilled gully with fill up to 9.4m thick
- On the lower part of the site measured groundwater levels typically range from 1.5 to 10m below ground level, and are generally within 4m of the ground surface
- There is low potential for liquefaction
- Subsoil drainage will be required around basements and retaining walls
- The proposed village is not assessed as likely to be at risk of being affected by slippage, falling debris, or subsidence

Past documentation for the site explains that the Ministry of Works & Development undertook physical geotechnical remedial measures on the southern portion of the site in 1980 and in response to a slope failure in 1979.

2.5 Existing Drainage Features and Stormwater Infrastructure

2.5.1 Catchment

The Ryman site is part of a 19.0ha south-facing catchment which drains via a tributary to the Pourewa Creek and then into the Ōrākei Basin. This catchment is shown in Figure 2.2. The Ryman site is 3.12ha, or approximately 16% of the south-facing catchment. The total Pourewa Creek catchment, with lower extent defined by the tidal interface, is approximately 126ha with the Ryman site approximately 2.5% of the total catchment.

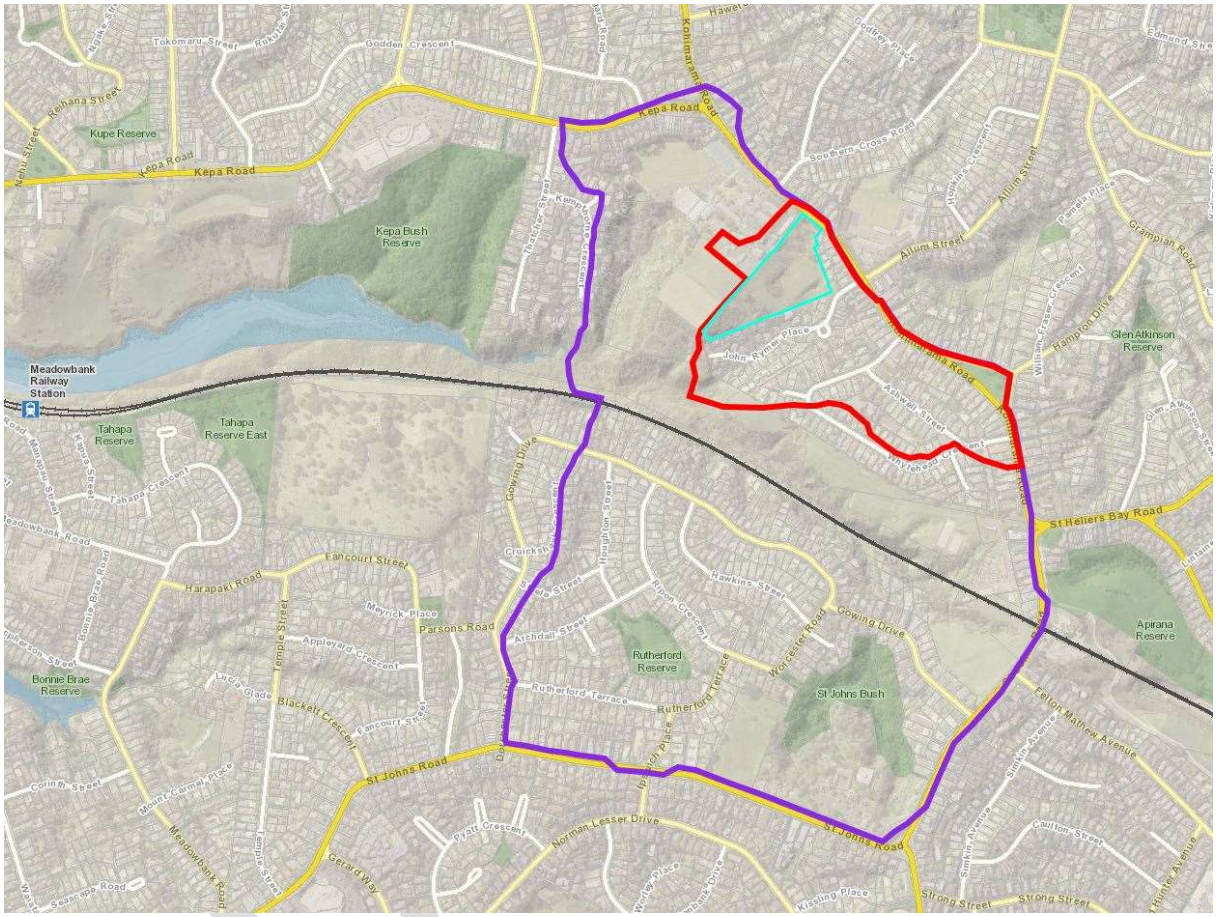

Figure 2.2 – Pourewa Creek Catchment (purple), south-facing sub-catchment (red), and Site Location (teal)

The Ryman site is one of three remaining vacant lots in the wider Pourewa Creek catchment, in addition to the playing fields on the adjacent Selwyn College site. The two other vacant lots including 348 St Johns Road and 57 Ripon Crescent – both in the upper reaches of the catchment.

The original open channels draining the 19.0ha sub-catchment have been piped apart from an 80m section from the Pourewa Creek and the section through the eastern side of the Ryman site. The section through the Ryman site has been modified by filling the mid-section for the construction of a playing field, which has effectively blocked the original open channel.

It is understood from reviewing record drawings, CCTV survey and on-site observation that flows from approximately 25% of the Selwyn College site and from a 270m length of Kohimarama Road are piped into the top of the open channel in the Ryman site.

2.5.2 Existing Site Conditions

Freshwater Solutions undertook an Assessment of Watercourse Status (site inspection October 2018, delivered July 2019) confirming the historic watercourse alignment and two remaining sections of intermittent or ephemeral stream (Figure 2.3).

Figure 2.3 – Existing Watercourse Definition (Freshwater Solutions, July2019)

The central section of the open channel has effectively been blocked by filling for the construction of the playing field, creating a hollow in the area above the field. The flows from this hollow are conveyed in a 450mm pipe to an existing stormwater manhole (NP4851) adjacent to the John Rymer Place development.

Filling for the John Rymer Place development extends into the Ryman site, damming the open channel and creating another hollow. This receives runoff from part of the Ryman site, and from residential properties outside the eastern boundary of the site. Flows from this hollow are conveyed in a 225mm pipe to manhole NP4851. From NP4851 a 600mm pipe passes under the house at 17 John Rymer Place and between 13B and 15 John Rymer Place to join the remainder of the catchment reticulation network. These features are schematically illustrated on Figure 2.4.

Figure 2.4 – Schematic Markup of Drainage Features through the Pre-development Site

The two hollows on the Ryman site currently provide an informal form of peak flow attenuation, reducing downstream flow rates relative to the incoming upstream flow.

Analysis of the existing piped network downstream of the Ryman site shows that:

- For the existing situation (with flow attenuation in the hollows and without future climate change allowance) peak flows from the 10% AEP rainfall event will surcharge the pipeline, with water levels rising to within 0.8m of the ground level at manhole NP4851 (located at the edge of the Site) and within 1.2m of the ground level at the manhole downstream of the site (NP4849). Stormwater may overflow or bypass the 225mm and 450mm diameter inlets within the Ryman site, due to blockage risk, leading to overland flows through at 17 John Rymer Place.
    - Without the flow attenuation in the hollows, the capacity of the downstream pipe network would be exceeded by peak flows from the 10% ARI rainfall event.

Overland flow from the site (and from adjacent areas crossing the site) to No. 17 John Rymer Place is represented on the graph shown in Figure 2.5. The Site encompasses an area of 3.12ha; 61% of which flows to the public stormwater network via the existing depression areas. Runoff from the remainder of the site discharges as sheet flow into the rear of the lots along the SE boundary (numbers 17 to 47 John Rymer Place). Site inspections show that flows are concentrated in some areas along this boundary, with a

significant existing 'natural' overland flow path into No. 17 and a smaller natural' overland flow path into No. and 35/35A John Rymer Place.

When the capacity of the 450mm pipe outlet from the top hollow is exceeded (or this pipe is blocked) water will backup within the hollow and flow overland to the lower hollow. When the capacity of the 225mm outlet pipe from this hollow is exceeded water will back up within the hollow but it is considered that the surcharge capacity of the pipe and storage volume of the hollow will accommodate the 1% AEP storm without overtopping. If this pipe is blocked it is considered that the storage within the hollow will be utilised prior to the peak flow, which will result in limited attenuation of the peak flow which will flow overland to the rear of 17 John Rymer Place, through its side yard and down the driveway to the road.

2.5.3 Existing Conditions – 17 John Rymer Place

The side yard area of 17 John Rymer Place is flat, and has a timber post and board fence that impedes the natural conveyance of overland flows in this area (Figure 2.5). The driveway has a moderate grade and is fenced both sides, providing control for overland flows.

Figure 2.5 – View down driveway of 17 John Rhymer Pl (left) and context for OLFP location (right)

The finish floor levels of the dwelling in No. 17 is estimated at approximately 0.2m above the side yard ground surface level, although this has not been verified by on-site measurements.

The capacity of the overland flow path at the site of No.17 drive has been estimated using basic critical flow calculations for various water depths as outlined in Table 2.1. For this analysis, it has been assumed that the side yard has a width of 3m, has no flow obstructions (optimistically) and is 200mm below the building finish floor level (FFL).

Table 2.1 – Estimated capacity of overland flow path without causing flooding to No.17 assuming the FFL is 200mm above the level of the driveway.

Water Depth	Relation to Assumed No. 17 FFL	Capacity of Overland Flow Path (m^3/s)
50mm	Allowing 150mm Freeboard to Assumed FFL	0.06
100mm	Allowing 100mm Freeboard to Assumed FFL	0.16
150mm	Allowing 50mm Freeboard to Assumed FFL	0.30
200mm	No Freeboard to Assumed FFL	0.45

It is estimated that during the 1% AEP rainfall event (with no climate change allowance and no pipe blockage) that a peak flow of 0.36m³/s will flow overland to the Number 17 John Rymer Place property. It has been estimated that there will be less than 50mm of freeboard between the peak overland flow levels during this event and the building finish floor level. Therefore it is considered to have a high risk of flooding during the 1% AEP event, even if the fence obstructing the overland flow path was removed (noting that the analysis does not account for the flow impedance associated with the existing fencing).

The hydrograph of the estimated overland flow through No. 17 during the 1% AEP rainfall event (with no climate change allowance) is illustrated in Figure 2.6.

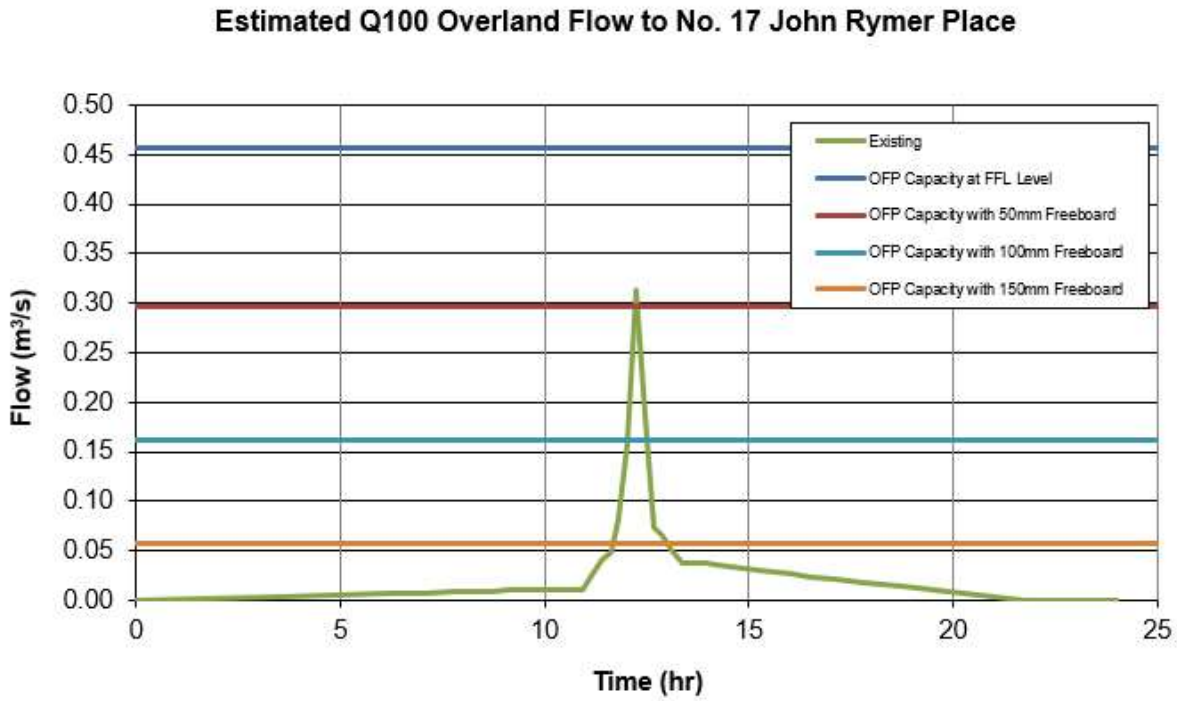

Figure 2.6 – Existing Hydrograph of Overland Flow to No 17 John Rymer Place During the 1% AEP rainfall event (with no climate change allowance)

Calculations indicate that in the 1% AEP rainfall event (with further climate change allowance) there will be less than 150mm freeboard between the house floor and water levels in the side yard, even if the fence is removed, and there is a high risk of flood water entering the building.

Overland flows on John Rymer Place appear to be controlled within the road corridor and via the driveway of 64 John Rymer Place (serving the Watercare sewer pump station) to the stream, based on site observations.

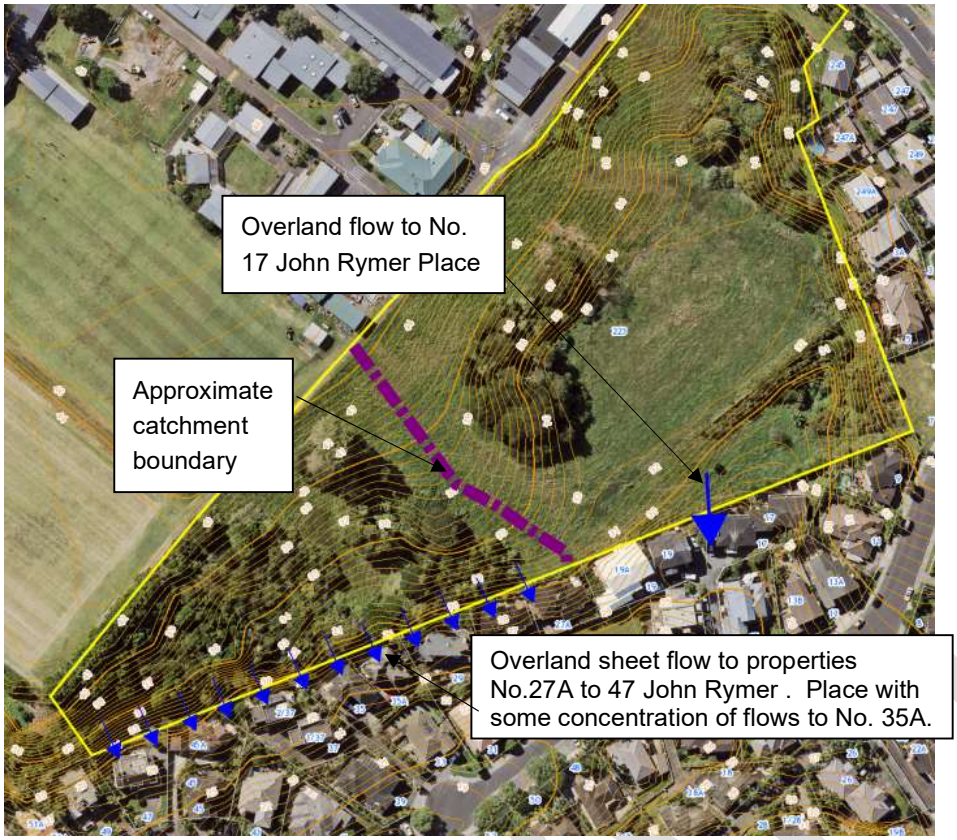

Figure 2.7 – Schematic mark-up of existing stormwater flow from the site

2.6 Receiving Environment

The piped stormwater network for this catchment discharges to an approximately 80m-long tributary of the Pourewa Creek, which discharges to the tidal reaches of the Ōrākei Basin approximately 0.6km downstream. Both the watercourse and the Pourewa Creek run through a Significant Ecological Area (reference 'SEA_T_5242') – noted for its terrestrial values.

The Watercourse Management Plan for the Hobson Bay Catchment prepared by Golder Associates and Fraser Thomas in May 2014 has investigated and reported on Pourewa Creek and the tributary downstream of John Rymer place (Hob Trib 32).

A further assessment of this 80m long watercourse was carried out by Freshwater Solutions Ltd in December 2019. Key items from this report were:

- This watercourse is a permanent stream with channel widths between 0.2 – 1.8m (mean = 1.07m)
- The streambed comprises silt, fine gravels and weathered clay
- There was no evidence of accelerated bank erosion
- Instream habitat comprises medium to large pools, runs and occasional chutes formed over willow tree roots
- It is a low gradient stream with good connectivity to the floodplain so has the capacity to handle additional volumes of water, as there is plenty of room for spill over to occur. However, weedy vegetation chokes the channel in places resulting in multiple channels forming and its possible more may form with additional volumes of water during high flow events, which may create scour and erosion. The creation of multiple channels is not preferable as it is likely that some will be intermittent

in nature particularly in summer, thus reducing available habitat for fish in the drier months and overall reducing the available wetted habitat in the main body of the stream

- The Stream Ecological Value (SEV) score for this watercourse was 0.586, which is indicative of moderate ecological function
- Water samples showed moderate to low temperatures, circumneutral pH, low DO, moderate to high conductivity and elevated levels of copper, zinc, nickel, E. coli and nitrogen
- The stream had a slightly turbid appearance reflecting the highly developed nature of the catchment
- The watercourse supported an invertebrate community with low taxa richness
- The MCI-sb score for the community was 69.6, indicative of poor stream health
- Shortfin eel were surveyed with banded kōkopu observed on a previous visit. Banded kōkopu were also previously observed in a small pool in the headwaters of Watercourse A (Figure 2.3) upstream of the piped section.

Key information from the Hobson Bay WMP on the Section of the Pourewa Creek downstream of the unnamed stream are:

- The creek transitions from a mangrove dominated area as it flows into the Orakei Basin to a freshwater environment, creating a significant transitional zone that includes the interface from marine, brackish to freshwater ecosystems
- The tidal influence extends to approximately 0.3km below the confluence of the tributary with the Pourewa Creek main channel
- The cross-section varies from an entrenched floodplain with an average wetted width of 3.2m to a lower floodplain with average wetted width of 5m. Velocities are very low at 0.01m/s
- There is a silt-sand substrate
- Erosion % is 40 to 20, with good to fair bank vegetation and extensive bank undercut
- No spawning habitat is reported

Consent #4427 Hobson Bay / Waitematā described both the tributary and the Pourewa Creek as having no signs of erosion in the early 1980's. The location of the proposed outfall was to a flatter slope, mostly swampy, but with a small defined channel for approximately 80m to the Pourewa Creek. The consent recognised potential for erosion to occur with new outfall – and recommended erosion mitigation. The recent site inspection confirms no evidence of accelerated bank erosion since installation of the outfall demonstrating effective design of the existing outfall.

2.7 Coastal Inundation

The Council GIS shows a flood plain extending up the Pourewa Creek and the stream to the bottom of John Rymer Place at an elevation of RL 18m. This information is only intended to be indicative and not an accurate reflection of the actual flood hazard extents in this area.

The contour layer on the Council GIS shows the 4m contour point approximately 0.2km below the confluence of the Pourewa Creek and the tributary, indicating the extent of coastal inundation may reduce the Pourewa Creek length by approximately 100m. The tributary and existing 1350mm diameter outfall serving John Rymer Place (ID 2000688912) will not be impacted by predicted coastal inundation.

The Ryman site is elevated well above sea level (minimum RL on the site is approximately 27m) and well above any possible coastal inundation effects.

3 Mana Whenua Values

The Auckland Design Manual promotes Te Aranga Māori Design Principles; a set of outcome-based principles founded on intrinsic Māori cultural values and designed to provide practical guidance for enhancing outcomes for the design environment. The principles have arisen from a widely held desire to enhance mana whenua presence, visibility and participation in the design of the physical realm. The design principles and outcomes sought are summarised as follows:

- **Mana** - The status of iwi and hapū as mana whenua is recognised and respected
- **Whakapapa** - Māori names are celebrated
- **Taiao** - The natural environment is protected, restored and / or enhanced
- **Mauri Tu** - Environmental health is protected, maintained and / or enhanced
- **Mahi Toi** - Iwi/hapū narratives are captured and expressed creatively and appropriately
- **Tohu** - Mana whenua significant sites and cultural landmarks are acknowledged
- **Ahi Kā** - Iwi/hapū have a living and enduring presence and are secure and valued within their rohe.

These guiding principles align with and relate to the concepts of *Te Mana o te Wai* and *Te Mauri o te Wai*, which are firmly embedded into National frameworks for freshwater management.

4 Stakeholder Engagement

Ryman and the project design team have engaged with Auckland Council representatives through pre-application processes for this project since mid-2019. Minutes from these engagement processes are included in Appendix C, and the stormwater-related meeting outcomes are addressed throughout this SMP.

5 Proposed Village

The Proposed Village comprises:

- A multi-storey Village Centre building, B01, with basement carpark
- Buildings B02 to B06 set on a podium, with bowling green on top and shared basement carpark below

The main entry/exit to the Site will be from John Rymer Place while the connection to Kohimarama Road will be a left turn in/out only.

The total proposed impervious area is estimated at 16,573m^2, 12,428m^2 of which is buildings. The overall impervious coverage is approximately 53% of the total site area, with maximum impervious area being less than the 60% provided for in the Residential – Mixed Housing Urban Zone.

The Landscape Masterplan showing the Site layout is shown in Figure 3.1.

Figure 3.1 – Landscape Masterplan (Design Square Landscape Architects)

6 Stormwater Management

6.1 Proposed Stormwater Management

6.1.1 General

It is intended that the stormwater diversion and discharge from the proposed Ryman development can be authorised by Councils Regional Network Discharge Consent (RNDC). Key requirements of this Consent that are applicable to this 'brownfields large' development are outlined in Section 1.2 above, and addressed in detail below.

6.1.2 Water Quality

Schedule 4 of the Regional Network Discharge Consent (RNDC) sets requirements for large brownfields developments to limit adverse effects on the water quality of streams and coastal areas. Compliance can be achieved by either:

- Treatment of all impervious areas by a water quality device designed in accordance with GD01/TP10 for the relevant contaminants; or
- An alternative level of mitigation determined through a SMP, justified as the BPO for the site.

The proposed development has a large roof area, and relatively small road area, none of which meet the AUP definitions associated with 'High Contaminant Generating Areas'.

Roofs will be constructed of inert materials to avoid need for treatment.

A separate private reticulation network is proposed for runoff from road areas, with runoff from 10mm/hr of rainfall being directed to proprietary filtration devices (indicatively, Stormwater360 StormFilter manhole chambers). In order to control the flow entering the filter vaults, a weir will be placed in the manhole immediately upstream of the vault which will divert flows exceeding the water quality flow to the main reticulation network, thus ensuring that the unit operates efficiently. This is consistent with the Auckland Council approval for such devices.

Filter devices are capable of providing pollutant removal which is in line with removal efficiencies outlined in Auckland Council GD01 (Guideline Document - Stormwater Management Devices in the Auckland Region) to achieve 75% TSS removal on a long term annual average basis, and together with catchpits have capability to remove gross pollutants and hydrocarbons. Operation and maintenance of the stormwater filtration treatment device will be undertaken on behalf of Ryman as part of an ongoing contract with the device supplier.

Runoff from building roof and podium areas will discharged directly to the diverted stream onsite or to a separate reticulation network bypassing the storm filter.

The use of rain gardens and other forms of 'green infrastructure' for treatment were considered, but discounted due to the steepness of the internal roads and limited areas to locate a raingarden at the low point of the site.

6.1.3 Stream Diversion

The existing hollows and intermittent streams sections, illustrated as A and C in Figure 2.3 are to be diverted, and the stream channel also diverted. This diverted channel will be longer than the existing section of open channel, as it is proposed to restore part of the existing piped network on-site.

To limit the longitudinal grade on the stream four waterfalls will be constructed in the stream. These will provide drops ranging between 2.3 and 3.1m matching the floor level changes in the building. The area

available for the stream is constricted by the buildings and the steep slopes adjacent. Typical cross-sections and long sections have been developed for hydraulic analysis and site grading design.

The ecology assessment of the existing site notes that Banded Kokopu have also been observed within the existing stream on-site. The details of the waterfalls are to be further developed to ensure that they do not create a barrier to the Banded Kokopu.

6.1.4 Stream Hydrology

Schedule 4 of the Regional Network Discharge Consent (RNDC) sets requirements for large brownfields developments to limit adverse effects on streams, with compliance achieved by either:

- Providing retention of a minimum 5mm runoff depth for all impervious areas, and detention for the increased runoff in the 95th percentile, 24hr rainfall event minus the retention volume; or
- An alternative level of mitigation determined through a SMP.

The information in the Watercourse Management Plan for the Hobson Bay Catchment and in the Freshwater Solutions report of 9 December 2019 indicates that the provision of specific hydrology mitigation (including retention and detention) on the Ryman site would provide limited if any benefit to the downstream sections of open waterway. This is reinforced by the existing consent for the John Rymer Place network which drew attention to the potential for erosion downstream of the outfall proposed and built in the 1980s. However recent investigations have shown that the erosion risks have not manifested in the period since.

Hydrology mitigation is intended to restore natural hydrologic processes in streams that are negatively impacted as a result of urbanisation. In particular, to prevent erosion from frequently occurring rainfall events and to retain stream baseflows with progressive urbanisation. Steep site grades and historic stability concerns mean retention via infiltration is an unsuitable solution. However, 100m³ of retention will be provided on site (in excess of the 82.9m³ required for 16,573m² impervious) for irrigation of the extensive landscaping and amenity areas. The John Rymer Pl tributary is considered a low erosion-risk receiving environment (Section 2.6) with detention to prevent erosion unlikely to add significant value given the currently stability of the tributary and anticipated resilience to additional flows. The stability of this tributary varies greatly from the downstream tributaries joining the Pourewa Creek, including that from the Selwyn College site, which are incised and demonstrate active erosion.

The Pourewa Creek continues approximately 300m downstream of the confluence with the John Rymer tributary before reaching the zone of tidal influence. The majority of this length remains a broad, low-grade receiving environment with little sign of active erosion other than when impacted by instream fallen debris. Approximately 100m of this downstream channel length will potentially be inundated via sea level rise, becoming an estuarine receiving environment in time.

Also as noted previously, the Ryman site represents a small portion of the overall Pourewa Creek catchment and is one of only three remaining parcels of vacant land within this wider catchment. One of the other two vacant sites off St Johns Road is also subject to a proposed retirement village, and resource consent for that development was sought through 2017-2018. This development was subject to particular scrutiny in respect of stormwater matters and was approved in this regard via a connection to existing public stormwater infrastructure which contributes to the Pourewa Creek via a tributary joining approximately 200m downstream of the John Rymer Pl tributary. It is understood that the development scheme that was approved in respect of stormwater matters did not incorporate hydrology mitigation on the basis of no material benefits downstream.

6.1.5 Flooding – 10% AEP Event

Schedule 4 of the Regional Network Discharge Consent (RNDC) sets requirements to ensure that the flooding or other adverse effects on downstream properties is not increased in the 10% AEP event. This can be demonstrated by either:

- Demonstrating sufficient capacity is available within the downstream pipe network to cater for the additional stormwater runoff associated with the development; or
- Demonstrating that flows in excess of the pipe capacity will not increase flooding of any other property or increase adverse effects on any other property.

Methods identified to achieve these outcomes include:

- Attenuating and reducing stormwater flows on site such that there is no increase in the piped peak flow in a 10% AEP event from the site compared to that prior to the new development.
- Attenuating and reducing stormwater flows on site such that there is no increase in the overland flow from the site to adjacent properties in a 10% AEP event from the site compared to that prior to the new development.

In this case, the downstream network has capacity constraints relative to existing catchment conditions. The proposal hence incorporates measures to attenuate flows on-site and thereby ensure that there is no increase in the piped peak flow in a 10% AEP event, as well as no increase in the overland flow from the site to adjacent properties in the same event. Alternative options for on-site mitigation were considered, including the construction of a new pipeline to convey surplus flows through Selwyn College land and the Significant Ecological Area (SEA) to the west of the Site, and down to the Pourewa Creek. These options are outlined and assessed in more detail in Table 6.2 below.

Pre and post development peak runoff from the Ryman site (including the upstream catchment) in the 10% AEP event (both without, and with account of proposed on-site attenuation measures for the post-development condition) are set out in Table 6.1 with contributing catchments shown in Appendix A. Note also that the predevelopment flows include the effects of attenuation in the two hollows on site.

Table 6.1 – Comparison of Pre-development and post development peak 10% AEP flows

	Piped Discharge from MH NP 4851 (m^3/s)	**Overland to 17 JRP** (m^3/s)	**Sheet flow to 19 to 47 JRP** (m^3/s)	**Total site discharge** (m^3/s)
Pre-development	0.48 (0.52)	0.17 (0.20)	0.14 (0.17)	0.79 (0.89)
Post development (without mitigation)	0.52 (0.52) *Based on estimated capacity of downstream network without flooding*	0.61 (0.74)	0.07 (0.09)	1.20 (1.35)
Post development (proposed mitigation)	0.47 (0.48)	0.03 (0.14)	0.07 (0.09)	0.57 (0.71)

The figures in brackets are if allowance is made for the effects of global warming on the peak runoff

Table 6.2 Assessment of Options for Reducing Peak Network Flows in the 10% AEP event

	Attenuate Flows	New Pipeline
General description	A storage tank would be constructed under the level 0 of Building B01. This would be controlled so that when flows approach the capacity of the outlet pipe water would spill over a weir into the tank controlling peak flows to the downstream network	A new pipeline would be constructed from the eastern side of Building B03 through the school property and Significant Ecological Area (SEA) to a new outlet into Pourewa Creek.
Details	Required attenuation volume approx. 1350m^3 to account for 10% AEP and 1% AEP events.	Required pipe size across the site of 675mm with a 450mm down the relatively steep gradient to the Pourewa Creek to account for 10% AEP and 1% AEP events.
Design and Construction issues	1. Need additional excavation under B01 2. Construction is simple 3. Tank could be utilised for erosion and sediment control during construction 4. Tanks construction would add time (weeks) to program	1. Need to construct pipeline on steep vegetated slope, which may be feasible to directionally drill. Vegetation clearance would be required 2. Additional H&S issues associated with working on steep slopes 3. Obtaining approval to cross the school property is not assured, as there is no legal right and could take a year. Access for construction could be restricted by school terms 4. Existing gully demonstrating active erosion and channel incision with existing flood risk to #51C John Rymer Place 5. Would need to work with HW and Council ecologists over outlet design and construction through the SEA – would take months
Approvals required	1. Building Consent 2. Engineering Plan Approval (for pipe network to confirm tank size and details) 3. SMP adopted under AC Regionwide NDC	1. E8 Discharge and Diversion consent 2. Land use consent for pipeline and new outfall, and vegetation clearance in the SEA to provide hydrological mitigation. 3. Engineering Plan Approval required.

		4. Land owner Approvals for work on Selwyn College and Council land
Key advantages / disadvantages	Ryman have more control over program 5. No need for third party landowner approvals. More straightforward overall. 6. Does not require the installation of any new stormwater infrastructure to any of the downstream watercourses.	Work could possibly be carried out in parallel with building construction.

Following an initial analysis of these options, it is proposed to proceed with the attenuation option because of the clear advantages.

The proposed reticulation network is shown on 044-RCT_401_C0-021 & 044-RCT_401_C0-022. A schematic drawing of the flow control structures is shown in 044-RCT_401_C3-081.

6.1.6 Flooding – 1% AEP Event (Assuming Pipe Network is not Blocked)

Schedule 4 of the Regional Network Discharge Consent (RNDC) sets requirements for large brownfields developments to ensure that the flooding or other adverse effects on buildings is not increased in the 1% AEP event. This can be demonstrated by either:

- Manage/mitigate 1% AEP peak flow to that immediately preceding development; or
- An alternative level of mitigation determined through a SMP.

In this case, the proposal incorporates measures to manage and mitigate the 1% AEP peak flow to improve on the conditions preceding development, achieving consistency with the requirements of the NDC. A comprehensively designed on-site attenuation tank system has been designed to capture flows up to (and beyond) the 1% AEP event, and ultimately discharge these flows in a manner that mitigates the downstream risk of flooding for the 10% AEP and 1%AEP events.

Pre and post development peak runoff from the Ryman site during the 1% AEP event are set out in Table 6.3. Note that the predevelopment flows include the effects of attenuation in the two hollows on site, and the results for post-development conditions include with and without the proposed mitigation.

Table 6.3 – Comparison of Pre-development and post development peak 1% AEP flows

	To MH NP 4851 (m^3/s)	**Overland to 17 JRP** (m^3/s)	**Sheet flow to 19 to 47 JRP** (m^3/s)	**Total site discharge** (m^3/s)
Predevelopment	0.52 (0.52) *Based on estimated capacity of downstream network without flooding*	0.31 (0.46)	0.260 (0.32)	1.09 (1.30)

Post development (without mitigation)	0.52 (0.52) *Actual design flow likely to be more and cause significant down stream flooding.*	1.19 (1.49)	0.13 (0.16)	1.84 (2.17)
Post development (proposed mitigation)	0.48 (0.49)	0.26 (0.36)	0.13 (0.16)	0.87 (1.01)

The figures in brackets are if allowance is made for the effects of global warming on the peak runoff.

Overland flow paths internally within the Ryman development site will provide for full 1% AEP flows with the relevant freeboard provisions.

The section of overland flow path immediately downstream of the Ryman site is through No. 17 John Rymer Place, and calculations indicate that there is a high risk of the house on this property being flooded in a 1% AEP event. The proposed on-site attenuation will mitigate the flood risk of this house relative to existing conditions. The hydrograph of the estimated overland flow to No. 17 John Rymer Place for the 1% AEP predevelopment and post development events is illustrated in Figure 6.1 (with no climate change allowance). It is considered that he proposed design results in a reduction in the flood risk to No.17 John Rymer Place during the 1% AEP rainfall event.

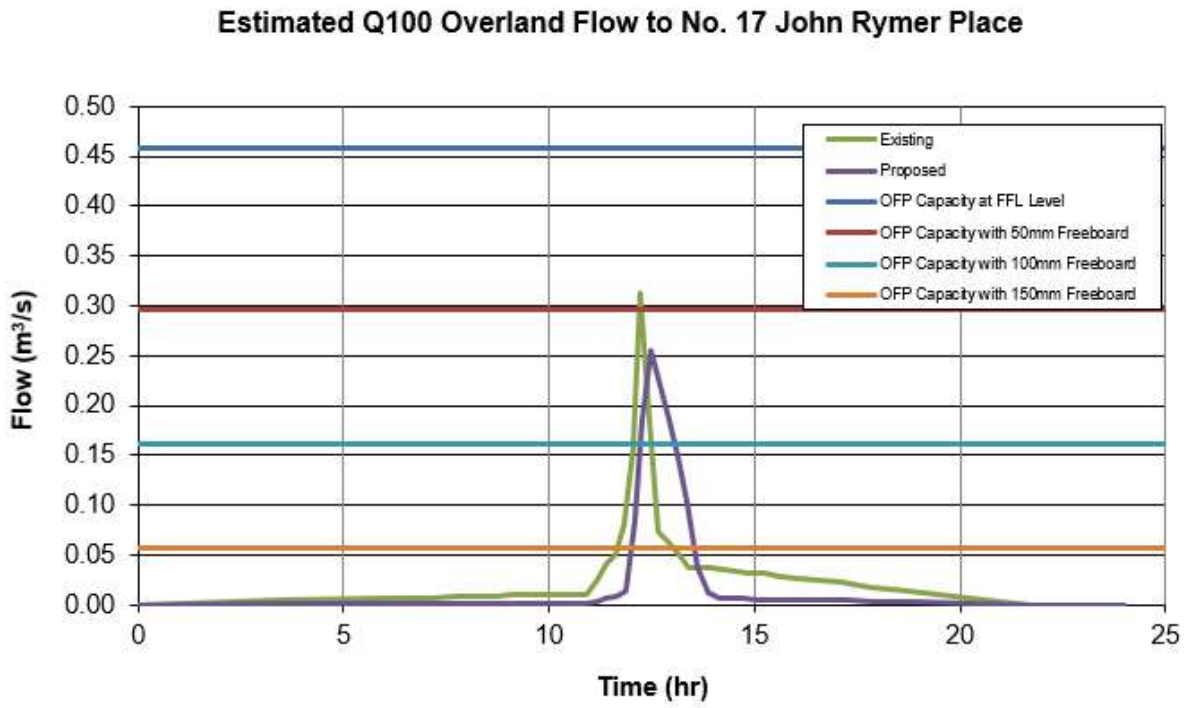

Figure 6.1 – Comparison of the predevelopment and post development Hydrograph of Overland Flow to No 17 John Rymer Place During the 1% AEP rainfall event (with no climate change allowance)

6.1.7 Flooding – 1% AEP Event (Assuming Pipe Network is Blocked in Accordance with the Stormwater Code of Practice)

The pre and post development peak flows from the Ryman site and upstream catchments in the 1% AEP event (without allowance for the effects of global warming) are shown in Table 6.4. The predevelopment flows include the effects of attenuation in the hollows and the post development flows to manhole NP4851 have been routed through the tank. Note that these flows have been based on the assumption that in the 1% AEP event pipes smaller than 600mm will be inoperable, and 600mm and larger pipes will be at 50% capacity (in line with the Stormwater Code of Practice). This includes the existing 225 and 450mm diameter pipes which are assumed to be inoperable, therefore no flow is assumed to enter the pipe system in the pre-development condition. However, some flows through the network are considered in the post-development condition.

Table 6.4 - Comparison of Pre-development and post development peak 1% AEP flows with allowance for Network Blockages

	Predevelopment (m^3/s)	Post Development (m^3/s)
From manhole NP4851	0 (0)	0.26 (26)
Overland to 17 JRP	1.08 (1.31)	1.20 (1.50)
Overland to 19 – 47 JRP	0.38 (0.47)	0.21 (0.26)

The figures in brackets are if allowance is made for the effects of global warming on the peak runoff.

It is considered that the existing stormwater network has a greater risk of blockage than the proposed network due to the configuration and design of the stormwater inlets, as well as the regular maintenance regime adopted by Ryman. Therefore, it is considered that there is no increase in the flood risk to downstream properties as it is less likely for such blockages to occur in the proposed development than the existing development.

Overall, the proposed development, incorporating a comprehensive on-site attenuation design and operation/maintenance regime will lower the risk of downstream flood hazards relative to pre-development conditions for the 1% AEP event; thereby achieving consistency with the requirements of the NDC.

6.2 Asset Ownership

The following public assets are proposed on the Ryman site:

- The stormwater pipeline and outlet structure conveying water from Selwyn College to the stream. This will be re-aligned to suit the changes to site grading and stream alignment. The outlet will be reconstructed.
- The stormwater pipeline conveying water from Kohimarama Road to the stream. This will be re-aligned to suit the changes to site grading and stream alignment. The outlet will be reconstructed.
- The stormwater pipeline from the existing residential properties east of the site where it crosses through the SE corner of the site.
- The drop structures on the diverted stream channel.
- The intake structure at the downstream end of the reconstructed open channel and the section of pipeline from the intake to the site boundary. This will include the flow control manhole.

Stormwater assets which will remain in private / Ryman ownership but are required in order to protect downstream properties and buildings include:

- The storage tank under Building 01
- All connecting pipework between the storage tank and the public stormwater network, and from the storage tank to the overland flow path at 17 John Rymer Place
- The proposed stream channel

Council's interests in these assets will need to be protected by Consent Notices or similar mechanism.

Stormwater network not specifically referenced above, including the proprietary treatment device, will remain in Ryman ownership.

6.3 Ongoing Maintenance Requirements

Ryman prepare Stormwater Operations and Maintenance Manuals for all their retirement villages. The nonstandard items that will need to be addressed in their Manual for the Kohimarama Village include:

- The storage tank
- Inlet and outlet systems
- Overland flow paths
- Subsoil drainage/vegetation maintenance of the stream banks.

Ryman will also be required to prepare a Stormwater Operations and Maintenance Manual for nonstandard assets which will be taken over by Council. These will include:

- Outlet structures
- The drop structures on the diverted stream channel
- The inlet to the piped network (from the downstream end of the open channel)
- The flow control manhole

Note that maintenance of the section of open stream through the Ryman property will be a Council obligation. However, in order to protect Ryman interests, it is likely that day to day maintenance of this will be included in the Ryman village O&M manual.

6.4 Implementation

The existing stormwater flows from this site are to be reduced by the informal attenuation function provided by the two hollows on site. In developing the construction methodology/program for the development, the effects of this will need to be considered and managed appropriately. Erosion and sediment control ponds will provide attenuation of flows, but the storage volumes will be less than in the existing hollows.

Before construction commences a new inlet needs to be constructed allowing surface runoff to be collected and piped to existing stormwater manhole NP4851 such that the full capacity of the downstream network can be utilised. This would be expected to cater for all runoff in up to at least the 50% AEP event. The existing overland flow path to 17 John Rymer Place should be cleared out and tidied to prevent uncontrolled flows.

The risks in this regard are reduced by the likelihood of low frequency storm events occurring during the comparatively short-duration construction period.

6.5 Dependencies

The proposed work outlined in this report is not dependant on the completion of any works beyond the site boundaries.

6.6 Risks

- E36.9 of the AUP requires a Hazard Risk Assessment when development takes place on land which may be subject to a number of hazards being;
    a) Coastal erosion
    b) Coastal storm inundation 1% AEP
    c) Coastal storm inundation 1% AEP plus 1m sea level rise
    d) 1% AEP flood plain
    e) Overland flow paths
    f) Land instability
- For these site conditions, sub-sections (d), (e) and (f) are relevant.
- Overland flow paths and flood risks have been addressed in Section 4.2.5 of this report. The risks of flooding to property and buildings will need to be addressed throughout detailed design of both the stormwater reticulation network and stream upgrade works, in the preparation of the village Operation and Maintenance Manual, and in the ongoing maintenance of the stormwater network. The level of flood risk to downstream properties and buildings will be mitigated primarily because there will be better maintenance of the network and overland flow paths, in tandem with the specifically-designed and comprehensive on-site attenuation systems.

Land stability issues have been addressed in the Geotechnical Assessment of Environmental Effects report prepared by Tonkin and Taylor (dated October 2019). The proposed drainage and construction works would be expected to reduce the potential for instability effecting the primary and secondary stormwater networks.

7 Departures

7.1 Freeboard

From initial analysis it is considered that the existing dwelling within 17 John Rymer Place does not achieve freeboard above the overland flow path required by the Building Code and recommended within the SW CoP. Peak flows post development will be limited to not greater than in the predevelopment situation. Detailed design will ensure overland flows are not concentrated at the boundary, with design to spread flows and reflect the current condition of flow entry into the neighbouring site.

7.2 Surcharging of Pipelines

The existing pipeline receiving flows from the site and upstream catchment areas is currently surcharged in the 10% AEP predevelopment event. Peak flows to this pipeline post development will be limited to not greater than in the predevelopment situation for the 10% AEP event.

7.3 Drops through manholes greater than 1m

Due to the steep topography on-site large drops are proposed within the piped stormwater network at manholes. These manholes will require a specific design at the detailed design stage – noting these will be private infrastructure elements and not strictly subject to the SW CoP.

7.4 Velocities

The SW CoP limits velocities in stormwater lines to 4m/s. The steepness of roads on this development are such that this velocity is likely to be exceeded. The CCAA advises that concrete pipes can withstand velocities of up to 8m/s. Where (normal) velocities exceed 8m/s PE pipes will be used, and flow depths will be limited to 70% of pipe diameter to avoid potential cavitation issues.

7.5 Drop structures in the stream

Structures within stream channels are normally to be avoided where possible, however, to coordinate with the changing building and ground levels, it is proposed that the stream will contain drops ranging between 2.3m and 3.1m. The details for the stream and drop structure are subject to further design development will allow for low velocities in the open stream channel allowing for the creation of natural stream habitats and also suitable provision for fish passage.