UoA Student Centre & Library

Stormwater Management Plan

Prepared for University of Auckland
Prepared by Beca Limited
FTAA Substantive Consent Application

13 November 2026



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Appendix E1 – Stormwater Calculations

Revision History

Revision Nº	Prepared By	Description	Date
0	Luke Cameron and Selina Zhu	Issued for Substantive FTAA Application	30 October 2026
1	Luke Cameron	Issued for Substantive FTAA Application	13 November 2026

Document Acceptance

Action	Name	Signed	Date
Prepared by	Luke Cameron		13 November 2026
Reviewed by	Roshanak Rezaee		13 November 2026
Approved by	John Walmsley		13 November 2026
on behalf of	Beca Limited		

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Executive Summary

The University of Auckland (UoA or the University) Student Centre & Library (SC&L) development is a large brownfield redevelopment within the UoA City Campus. The site is approximately 6,000 m² and currently occupied by the existing Student Union buildings B311 and B312. The site drains toward Alfred Street and sits at the upper end of the local stormwater catchment.

The designed stormwater management approach has been developed in accordance with:

- Auckland Council's Regionwide Network Discharge Consent (NDC) – Schedule 4
- Auckland Unitary Plan (AUP) Chapters E1, E8, E9, E11, E12, and E36
- Auckland Region Guideline Document GD01, GD04, GD05
- The Auckland Code of Practice for Land Development and Subdivision Chapter 4: Stormwater (SWCoP) Version 4.0 incorporating Amendment March 2026
- Green Star stormwater credit criteria (two credits targeted)

Key existing site features include the existing Hiwa stormwater tank, public stormwater pipes along Alfred Street and Princes Street, and mapped overland flowpaths. The designed development layout retains these features and integrates stormwater management within the basement and plaza design.

The overarching stormwater management principles for the site are:

- Ensure that the capacity of the downstream network is not adversely affected
- Provide detention and retention storage to support Green Star credits
- Treat stormwater using GPTs and a proprietary device to support Green Star credits
- Protect te mauri o te wai by minimising contaminant discharge and maintaining safe flow conveyance

Maintain the existing minor overland flow path at the south-eastern corner of the site along Alfred Street, while directing a portion of the 100-year exceedance flow via Te Tūātea Plaza towards Princes Street. The designed flow regime has been assessed and is not expected to increase flood risk or adversely affect neighboring properties, infrastructure, or downstream receiving networks. Hydraulic assessments confirm:

- No adverse effects on downstream pipe capacity
- No increase in downstream flood hazard
- Overflow depth and velocity within the plaza remain safe for pedestrians
- Princes Street downstream effects remain low hazard

1 Existing Site Appraisal

1.1 Summary of data sources and dates

Existing Site Appraisal Item	Source and Date
Topography	• BN Walker Surveying Drainage Investigation As-builts, Rev 2, dated 25/09/2026 • BN Walker Surveying Service Investigation As-builts, Rev 0, dated 22/09/2026 • BN Walker Surveying Topographical As-built Survey, Rev 1, 27/08/2026
Geotechnical / Soil Conditions	• Tonkin & Taylor UoA Waipapa Taumata Rau, Library and Student Hub Geotechnical Interpretive Report, Version 2.1, dated 02/11/26 • Tonkin & Taylor University of Auckland Waipapa Taumata Rau, Library and Student Hub Contaminated Land Preliminary Site Investigation (PSI), Version 2.1, dated 28/10/2026 • Tonkin & Taylor UoA Library and Student Hub Project – Contamination Site Management Plan (CSMP), Issue No. 2.1, dated October 2026 • Tonkin & Taylor UoA Waipapa Taumata Rau, Student Centre and Library Geotechnical Groundwater and Settlement Effects Report, Version 2.1, dated 02/11/26
Existing Stormwater Network	• Auckland Council (AC) GIS • B310 Hiwa As-builts by Hawkins dated Feb 2024 • BN Walker Surveying Drainage Investigation As-builts, Rev 2, dated 25/09/2026
Existing Hydrological Features	• BN Walker Surveying Topographical As-built Survey, Rev 1, 27/08/2026 • AC GIS contours • Aerial photography
Flooding & Flowpaths	• AC GIS OLFP and floodplain layers
Cultural & Heritage Sites	• AUSA heritage building adjacent to site
Contaminated Land	• PSI (trace asbestos, elevated lead)

1.2 Location and general information

The SC&L development is located at the corner of Princes Street and Alfred Street within the UoA City Campus. The site area is approximately 6,000 m² and currently occupied by Buildings B311 and B312.

Existing Site Element	Description
Site Address	30-38 Princes Street Auckland Central Auckland 1010
Legal Description	Lot 1 DP 151178, Lot 2 DP 151178, SO 44422, SO 46532
Current Land Use	Student Union buildings B311 and B312; paved plaza areas
Current Building Coverage	Approx. 6,000 m² site area with full impervious coverage
Historical Land Use	Long-standing university campus buildings and paved areas

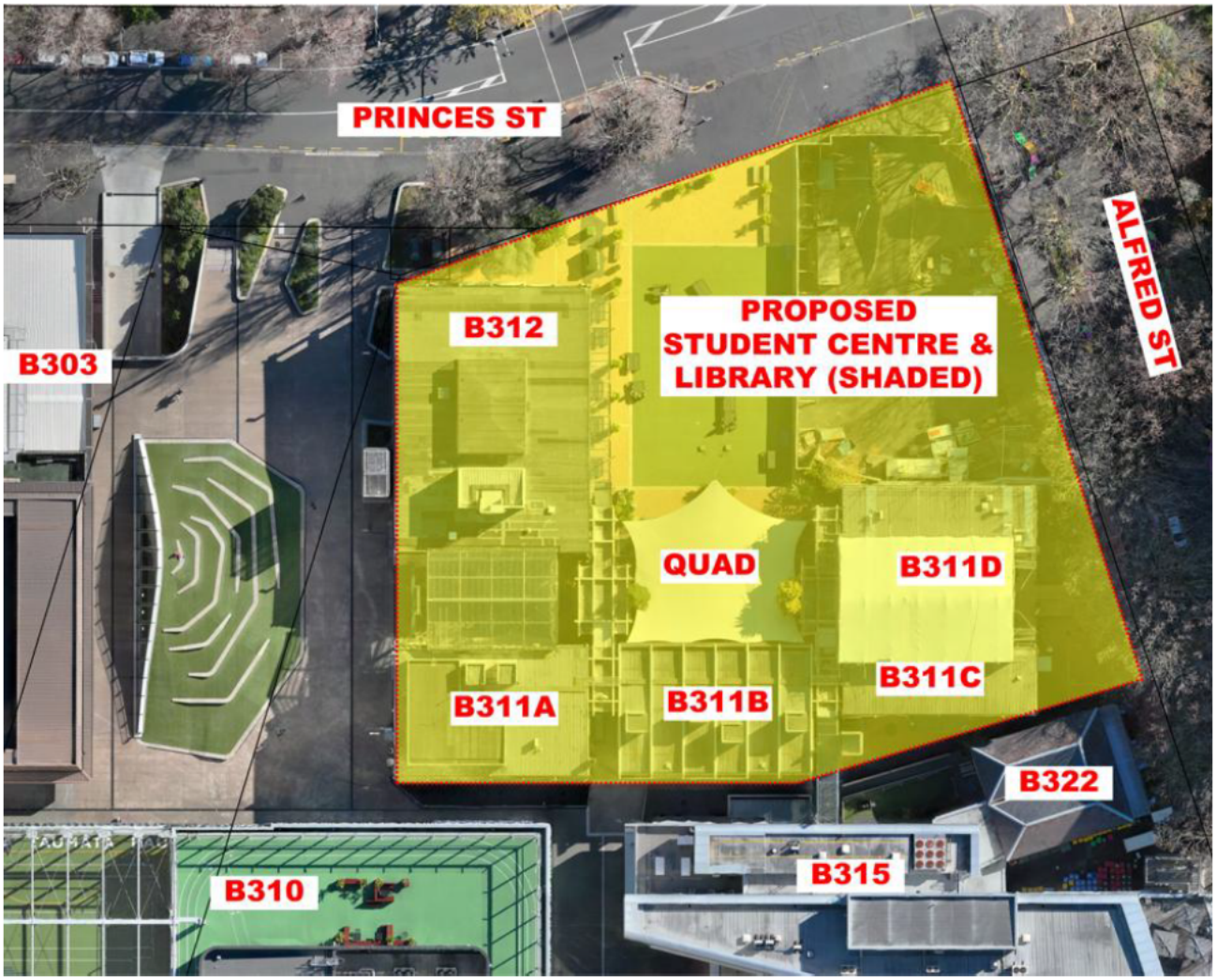


Figure 1-1 Aerial Site Plan (Source: BN Walker received on 30 June 2026)

1.3 Topography

The site slopes approximately 3 m from RL 45 m at the northern boundary to RL 42 m at Alfred Street as shown in Figure 1-2. This gradient directs runoff southwards toward the public stormwater network.



Figure 1-2 Site Contours Plan

1.4 Geotechnical

Based on the Tonkin & Taylor UoA Waipapa Taumata Rau, Library and Student Hub Geotechnical Interpretive Report (version 2.1 dated 2 November 2026) and contaminated land preliminary site investigation (version 2.1 dated 28 October 2026), the site is underlain by AVF ash over ECBF residual soils and rock. Groundwater is shallow and perched. Localised asbestos and lead contamination is present in shallow fill.

Recent groundwater level monitoring indicates that the site has exhibited groundwater levels ranging between RL 41.0m and RL 43m (approximately 2.5-4.5 m below ground level). Groundwater levels in the vicinity of the site are known to be relatively high and variable (Kate Edger Building RL 36.0–41.5m; B310 Hiwa Recreation and Wellness Centre RL 35.5-43.1m)[1].

The stormwater design will account for potential groundwater uplift effects on manholes, tanks, and other buried structures. Manholes will be designed as shallow as practicable, and where structure bases are anticipated to be at or below groundwater level, flotation checks will be undertaken and appropriate mitigation measures incorporated in detailed design stage. Invert levels and network layouts will also be optimised to minimise excavation below groundwater level and reduce the need for dewatering during construction.

1.5 Existing drainage features and stormwater infrastructure

Stormwater drainage across the SC&L site is currently provided through a combination of public stormwater infrastructure within Alfred Street and Princes Street and private stormwater reticulation servicing the existing campus buildings (B311, B312, B315, and B310 Hiwa Recreation Centre).

[1] University of Auckland Waipapa Taumata Rau, Library and Student Hub Geotechnical Interpretive Report Version 2.1 by Tonkin & Taylor dated 2 November 2026

1.5.1 Public Stormwater Network

Auckland Council GIS and BN Walker Surveying as-built investigations confirm the presence of the following public stormwater assets surrounding the site, refer to Figure 1-3:

- **Alfred Street:** DN225, DN300, DN375 and DN600 public stormwater pipes running parallel to the street alignment. These pipes form the primary downstream conveyance route for runoff from the SC&L catchment.
- **Princes Street:** DN450 public stormwater pipe running north–south, receiving flows from the upper campus and discharging toward the wider city network.

These public assets constrain connection locations and influence the design levels for the designed stormwater system. The Alfred Street network is the primary receiving system for the SC&L development.



Figure 1-3 Existing Public Stormwater Layout Plan

1.5.2 Private Stormwater Network

The existing site is currently serviced by private stormwater reticulation that conveys runoff from Buildings B311 and B312 to Alfred Street. Refer to drawing 5013381-CA-1100 Existing Site and Services Layout in Civil Infrastructure Report Appendix A for details. The private network includes:

- Existing roof drainage from B311 and B312
- Private stormwater laterals connecting to Alfred Street
- Private stormwater infrastructure associated with the adjacent B310 Hiwa Recreation Centre, including the existing Hiwa stormwater detention and retention tank

The existing Hiwa tank is a key asset within the campus stormwater system and has been incorporated into the designed SC&L stormwater strategy.

1.5.3 Existing Hiwa Stormwater Tank

The Hiwa tank provides both detention and retention storage for the existing recreation centre. As part of the SC&L development, a connection is designed between the Hiwa and SC&L basement levels. The existing Hiwa

stormwater pipework conflicts with the designed basement connection and would require significant diversion and rerouting works to maintain the current catchment arrangement. To avoid extensive modifications to the existing Hiwa drainage system, an alternative stormwater strategy was developed whereby the SC&L and Hiwa catchments are reassigned between the existing Hiwa tank and a new stormwater tank within the SC&L development. The reassignment is hydraulically feasible because the SC&L catchment is smaller and generates lower peak flows than the existing Hiwa catchment, while the new SC&L tank provides substantially greater detention storage capacity.

- SC&L runoff will be directed to the existing Hiwa tank
- Hiwa runoff will be directed to the new SC&L tank

This arrangement maintains hydraulic connectivity and supports Green Star stormwater credits.

1.5.4 Existing Stormwater Discharge

The existing site discharges to Alfred Street via private pipework. No soakage is present or feasible due to underlying ECBF soils and perched groundwater.

Refer to drawing 5013381-CA-1100 Existing Site and Services Layout in Civil Infrastructure Report Appendix A for details.

1.6 Receiving environment

Stormwater from the SC&L site ultimately discharges to the Waitematā Harbour via the public stormwater network. The receiving environment is highly urbanised, with no natural streams or riparian features within or adjacent to the site.

Key characteristics:

- No Significant Ecological Areas (SEAs) downstream
- No freshwater systems within the site
- No sensitive receiving environments requiring enhanced treatment beyond Green Star requirements
- No Stormwater Management Area Flow (SMAF) hydrology mitigation required (site not within SMAF overlay)

The stormwater management approach focuses on:

- Protecting downstream pipe capacity
- Avoiding increased peak flows
- Minimising contaminant discharge through GPTs and proprietary treatment devices
- Maintaining safe overflow pathways.

1.7 Existing hydrological features

The site is fully impervious and located at the upper end of the local catchment. Hydrological features include:

- Impervious coverage: 100% (roof, paved plaza, building footprint)
- Runoff direction: Southward toward Alfred Street
- No natural watercourses: No streams, swales, wetlands, or soakage features
- Existing tank infrastructure: Hiwa tank provides retention and detention
- Hydraulic connectivity: Maintained through private campus stormwater network

The absence of natural hydrological features simplifies stormwater management but increases reliance on engineered conveyance and detention systems.

1.8 Flooding and Flowpaths

1.8.1 Overland Flowpaths

AC GIS mapping identifies the following overland flow paths in the vicinity of the site as shown in Figure 1-4:

- A minor overland flow path (OLFP) entering the eastern corner of the site. Based on a review of the surrounding topography, this flow path is associated with a relatively small local catchment and is considered to represent localised surface flow and ponding behaviour.
- A major overland flow path located within the Princes Street road corridor, which conveys runoff from the wider upstream catchment towards the downstream stormwater network.



Figure 1-4 OLFP Layout Plan

The site is located at the upper extent of the local catchment, and the designed development does not obstruct or adversely affect the function of the identified overland flow paths.

1.8.2 Floodplain

The site is not located within a mapped floodplain as shown in Figure 1-4. No habitable floor level flooding risk is present.

1.9 Coastal inundation

Not applicable — site is inland.

1.10 Biodiversity

No ecological features or SEAs present.

1.11 Cultural and heritage sites

The site and the adjacent Auckland University Students' Association (AUSA) Building (B322) are located within a Historic Heritage Overlay, refer to Figure 1-5. Stormwater infrastructure and associated earthworks will be designed and constructed in coordination with the project's heritage and archaeological requirements to avoid adverse effects on the heritage values of the site and adjoining heritage assets.

Key considerations include:

- No known mana whenua sites have been identified within the stormwater catchment;
- No cultural water features are present within the site; and
- No stormwater discharges are designed to culturally sensitive receiving environments.

The stormwater management strategy supports te mauri o te wai by:

- Minimising contaminant discharge through stormwater treatment;
- Managing runoff through detention and retention measures;
- Maintaining safe overland flow conveyance routes; and
- Avoiding adverse downstream flooding effects on neighbouring properties and infrastructure.

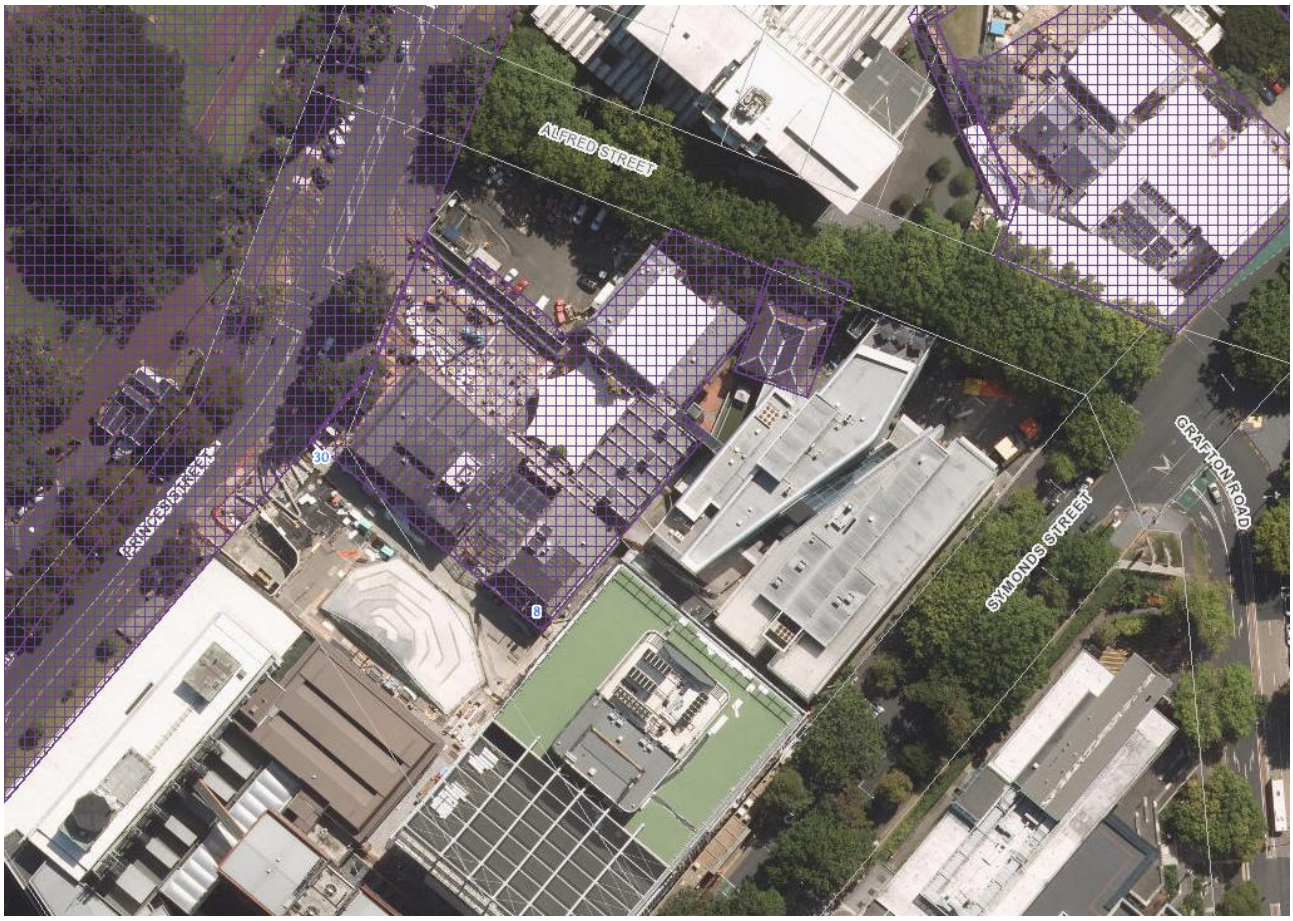


Figure 1-5 Historic Heritage and Special Character Overlay

1.12 Contaminated land

Trace asbestos and elevated lead identified; managed under CSMP.

2 Development summary and planning context

2.1 Regulatory and design requirements

Stormwater management for the SC&L development comply with the relevant provisions of the AUP Auckland Council's Regionwide Network Discharge Consent (NDC), and the Auckland Council SWCoP. The following documents form the regulatory basis for the stormwater design:

2.1.1 Auckland Unitary Plan

The civil design has been reviewed against the relevant AUP Auckland-wide provisions. The applicable matters and the designed management approach are summarised below.

AUP provision	Relevance to the Development	Management Approach
E1 Water Quality and Integrated Management	The development incorporates stormwater management measures to support water quality outcomes, minimise effects on the receiving environment and promote integrated water management.	The stormwater strategy incorporates retention, detention, rainwater harvesting, stormwater treatment and controlled discharge measures. A 90 m^3 retention volume has been provided to support rainwater reuse and the targeted two Green Star credits. Stormwater quality treatment will be incorporated through a treatment train approach, supporting both water quality and stormwater quantity management objectives.
E8 Stormwater: Discharge and diversion	Stormwater from the redeveloped impervious areas will discharge to the existing public stormwater networks in Princes Street and Alfred Street. The development is classified as a large brownfield development.	The stormwater strategy incorporates detention, retention, controlled discharge and stormwater treatment. The assessment addresses hydrology, flooding and infrastructure effects. Stormwater flows will be managed so that the development does not adversely affect the downstream public network.
E9 Stormwater Quality: High contaminant-generating car parks and high-use roads	The development includes hardstand areas but does not include high-contaminant-generating car parks or high-use roads.	In accordance with E9, the development does not trigger stormwater quality treatment requirements; however, treatment has been incorporated to meet the Green Star objectives. Stormwater runoff from the plaza and will be treated through a treatment train that includes gross pollutant traps (GPTs) to capture gross pollutants (GP) and a proprietary device to achieve the required TSS reduction for the targeted Green Star stormwater pollution-reduction credit. Runoff is limited to pedestrian-only plaza surfaces, with no vehicle movements or waste storage areas, and

AUP provision	Relevance to the Development	Management Approach
		therefore poses a low contaminant risk to the public stormwater network.
E10 Stormwater Management Area Flow (SMAF)	The site is **not identified** as being within an AUP SMAF overlay.	SMAF-specific provisions and additional retention requirements are therefore Not Applicable. However, a 90 m^3 retention volume has nevertheless been incorporated to support rainwater harvesting and the targeted two Green Star credits.
E36 Natural hazards and flooding	A minor overland flow path (OLFP) is identified in the Auckland Council GIS mapping adjacent to the existing site. Based on a review of the surrounding topography, there is no defined catchment upstream of the development site contributing to this flow path, and it is considered to represent a localised low point subject to minor surface ponding rather than a significant overland flow conveyance route.	The design building will not alter the exit point of the mapped overland flow path (OLFP), and the finished ground levels will be locally adjusted to remove the existing depression area while maintaining existing overland flow behaviour.
PC120: Housing Intensification and Resilience	The site **is not within** a mapped Floodplain/ Flood Hazard, however a OLFP with a catchment of <4,000m^2 is present on the site. The building will not obstruct the identified overland flow path.	A hazard risk assessment for the OLFP has been undertaken in section 6.2.6.1.
E12 Land Disturbance: District	Significant excavation and earthworks will be required to form the Lower Ground and Basement levels.	Earthworks will be undertaken in accordance with an approved erosion and sediment control plan, incorporating appropriate staging, temporary diversions, dust control, stabilisation measures, and protection of existing services. Final earthworks volumes and the construction methodology will be prepared as part of the consent conditions.

2.1.1 Compliance with the Regionwide Network Discharge Consent

The stormwater management approach has been developed to align with the relevant requirements of Schedule 4 of Auckland Council's Regionwide Network Discharge Consent.

The development is classified as a large brownfield development, as the site area exceeds 5,000m² and the site is already developed. The proposal results in only minor changes to the existing stormwater catchment and does not adversely affect downstream flooding or overland flow behaviour. Accordingly, the stormwater management assessment has been addressed within this report.

The applicable Schedule 4 assessment matters are addressed within this report and summarised in Table 2-1 below.

Table 2-1 Summary of NDC Schedule 4 Requirement Assessment

Issue/receiving environment	Status	Comment
Water quality	Not Applicable	The site does not generate common stormwater contaminants, with runoff limited to clean roof areas and pedestrian-only plaza surfaces, and no waste storage areas or vehicle movements that would typically require water-quality treatment. As a result, GD01 water-quality devices are not required for compliance. Gross pollutant traps (GPTs) are considered for the plaza as a good-practice measure.
Stream hydrology (SMAF)	Not applicable	The site is not located within a SMAF area and does not require hydrology mitigation.
Flooding – 10% AEP event (property and pipe capacity)	Applicable	Downstream pipe capacity assessment confirms no adverse effects on downstream pipe capacity or neighbouring properties. Refer to Appendix E1 for detailed calculations.
Flooding – 1% AEP event (building protection)	Applicable	The site is not located within a floodplain and building floor levels are not affected by overland flow.
Stormwater infrastructure assets	Applicable	Existing public and private stormwater assets have been reviewed; no upgrades are required.

The assessment and recommended treatment, detention and overland flow management measures demonstrate that the development will not adversely affect the public stormwater network or downstream properties.

2.1.2 Auckland Council Stormwater Code of Practice

The stormwater design aligns with CoP requirements for:

- Primary and secondary conveyance
- Detention and controlled discharge
- Overland flowpath management

- Connection to public stormwater infrastructure

2.1.3 Guideline Documents

Guideline	Purpose	Application to SC&L
GD01 – Stormwater Management Devices	Design guidance for treatment and detention devices	Used for tank sizing, treatment device selection
GD04 – Water Sensitive Design	WSD principles for urban development	Applied through retention, reuse, and OLFP preservation
GD05 – Erosion and Sediment Control	ESCP requirements for construction	ESCP prepared for earthworks and basement excavation
GD15 - Climate Change Scenarios	Climate change allowances for stormwater design	Derive climate-change-adjusted rainfall depths for stormwater modelling and tank sizing
TP108	Rainfall modelling and hydrology	Used for design rainfall depths and climate change factors

2.1.4 Green Star Requirements

The project targets two Green Star stormwater credits, requiring:

- Retention volume (90 m^3 adopted)
- Detention to 80% of SC&L pre-development discharge for 2-, 5-, and 10-year events
- Water quality treatment for pollutant reduction

These requirements are integrated into the stormwater design.

3 Mana whenua: Te Ao Māori and mātauranga

3.1 Identification and incorporation of mana whenua values

Mana whenua engagement has been undertaken to inform the development and will continue through the FTAA process. The stormwater strategy supports te mauri o te wai by:

- Minimising contaminant discharge
- Maintaining natural flowpaths
- Reducing potable water demand through reuse
- Avoiding adverse downstream effects

4 Stakeholder Engagement and Consultation

The stormwater management approach has been developed in consultation with the wider project design team, including architectural, structural, geotechnical, landscape and building services disciplines, to ensure integration of the stormwater strategy with the designed development.

Engagement has also been undertaken with key stakeholders throughout the design process, including:

- Auckland Council Healthy Waters regarding stormwater servicing, overland flow paths and flood management considerations;
- Watercare Services Limited regarding wastewater servicing interfaces;
- Utility providers and other stakeholders, where relevant, regarding existing infrastructure affected by the development.

The stormwater design has been informed by available network information, previous University of Auckland projects in the surrounding area, and Auckland Council requirements. Further stakeholder engagement and consultation will continue during detailed design to confirm final stormwater infrastructure, discharge arrangements and operational requirements.

5 Designed Development

5.1 Location and area

The SC&L development is located within Sector 300 of Waipapa Taumata Rau, The University of Auckland City Campus, at the corner of Princes Street and Alfred Street, Auckland Central. The development site occupies an area of approximately 6,000 m² and is located within the upper reaches of the local stormwater catchment.

The site is bounded by:

- Hiwa Recreation and Wellness Centre (B310) to the southwest
- Kate Edger Information Commons (B315) to the southeast;
- Alfred Street to the northwest; and
- Princes Street to the northeast.

Refer to Appendix E1 for the development layout and stormwater catchment plans.

5.2 Purpose of the development

The development will provide a new social and academic hub for the University, comprising a modern library, teaching and study spaces, student support services, food and beverage tenancies, student association facilities and associated plant spaces.

The building comprises 23,859 m² GFA over two basement levels and six levels above ground, together with rooftop plant facilities. The development also includes the redevelopment and expansion of Te Tūātea Plaza.

The project targets a minimum of two Green Star stormwater credits through rainwater harvesting, stormwater detention and stormwater quality improvement measures.

5.3 Site layout and urban form

The site will be comprehensively redeveloped following demolition of the existing Student Union Buildings B311 and B312.

The development includes:

- A new multi-level academic building;
- Te Tūātea Plaza public realm upgrades;
- New private stormwater, wastewater and water infrastructure;
- Stormwater detention and rainwater harvesting systems;
- Subsoil drainage associated with the basement structures; and
- New utility and servicing connections.

The stormwater design has been integrated with the architectural and landscape design to optimise available space for detention, retention, treatment and safe overflow management.

5.4 Earthworks

The development requires significant excavation to construct the Lower Ground and Basement levels.

Earthworks include:

- Demolition of existing structures;

- Bulk excavation for basements;
- Retaining walls and foundation structures;
- Service trenching and utility relocations;
- Stormwater tank construction; and
- Associated landscape regrading.

Earthworks will be undertaken in accordance with the project Erosion and Sediment Control Management Plan (ESCMP). Temporary erosion and sediment controls will be implemented in accordance with Auckland Council GD05 requirements.

The designed earthworks do not alter the identified minor overland flow path at the eastern corner of the site and will maintain appropriate secondary flow conveyance across the development.

6 Stormwater Management

6.1 Principles of Stormwater Management

The stormwater management approach has been developed with reference to:

- Auckland Council Regionwide Network Discharge Consent (NDC) Schedule 4;
- The Auckland Code of Practice for Land Development and Subdivision Chapter 4: Stormwater (SWCoP) Version 4.0 incorporating Amendment March 2026
- Auckland Council Guideline Document GD01 Stormwater Management Devices;
- Auckland Council Guideline Document GD04 Water Sensitive Design Guide; and
- The University's Green Star sustainability objectives.

The stormwater management objectives are to:

- Minimise stormwater-related effects of redevelopment;
- Maintain or improve downstream flooding performance;
- Manage water quantity through detention and retention;
- Improve stormwater quality through treatment measures;
- Protect and maintain existing overland flow paths;
- Promote rainwater harvesting and water reuse; and
- Support the achievement of two Green Star stormwater credits.

6.2 Designed Stormwater Management

6.2.1 General

The site is classified as a large brownfield development under Schedule 4 of the Auckland Regionwide Network Discharge Consent (NDC). The stormwater management strategy has been developed to manage stormwater quantity, quality and flooding effects while supporting the project's sustainability objectives.

The strategy incorporates stormwater detention, retention, controlled discharge and water quality treatment measures to minimise adverse effects on the receiving stormwater network. The design also supports the achievement of the project's targeted two Green Star stormwater credits through attenuation and stormwater reuse.

The primary components of the stormwater management strategy are:

- Reuse of the existing Hiwa stormwater tank for attenuation of runoff from the SC&L catchment;
- Provision of a new detention and retention tank within the SC&L development for runoff from the Hiwa catchment;
- Controlled discharge to the downstream public stormwater networks;
- Water quality treatment incorporated within the site drainage network; and
- Provision of a secondary overland flow path via Te Tūātea Plaza during extreme rainfall events.

Design rainfall depths and design basis were derived from the following documents:

- The Auckland Code of Practice for Land Development and Subdivision Chapter 4: Stormwater Version 4.0 March 2026.
- Auckland Regional Council 1999, Technical Publication 108: Guidelines for stormwater runoff modelling in the Auckland Region (TP108).
- Stormwater Management Devices in the Auckland Region Guideline Document December 2017/001 Incorporating Amendment 2 (GD01).
- New Zealand Building Code Clause E1 Surface Water Acceptable Solutions and Verification Methods (E1).
- New Zealand Standard Land Development and Subdivision Infrastructure NZS 4404:2010 Amendment No. 1.

Table 6-1 Stormwater Design Parameters and Criteria

Item	**Criteria**			
	Conditions / Requirements	Rainfall Depth (mm)	Climate Change (CC) Factor	Rainfall Depth with CC Factor Applied (mm)
Rainfall Depth from TP108 (mm)	10% AEP (10-year ARI)	122	17%	143
	1% AEP (100-year ARI)	182.4	32.7%	242
Design Criteria				
Retention	Not specifically required, but provided	The site is not within an AUP Operative Plan SMAF overlay. A 90m³ retention volume, consistent with the existing B310 Hiwa building, has been adopted to support rainwater harvesting and the targeted two Green Star credits.		
Detention	Required	Detention storage with controlled discharge will manage the post-development discharge to 80% of pre-development conditions for the 2-, 5- and 10-year events in accordance with the two Green Star credit requirement and support the NDC Schedule 4 requirements for a large brownfield development.		
Quality	Hardstand and Roads	Not required. The SC&L development does not include any road infrastructure, high-use roads or high-contaminant-generating car parks. However, additional treatment has been incorporated to support the targeted two Green Star stormwater credits. The SC&L development does not include any road infrastructure.		
	Buildings	No high contaminant generating building materials.		
	Carparks	No high contaminant generating carparks.		
Conveyance	Primary network	10% AEP storm event		

Item	Criteria	
	Secondary network	1% AEP storm event
Flood	Onsite buildings	The site is located at the upper end of the catchment. The identified overland flow path does not traverse the building, and the building does not obstruct or alter the flow path. Accordingly, no additional floor level freeboard for overland flow path protection is considered necessary.
	Offsite properties	The stormwater displacement effect on surrounding properties is expected to be negligible.
Pipe Parameters		
K value	uPVC = 0.006	
	PE = 0.003	
	Concrete = 0.06	
Gradient	Minimum 0.5%	

6.2.2 Water quality

The development does not include high-use roads or high-contaminant-generating car parks. No regulatory stormwater treatment is therefore anticipated for these sources.

Roof runoff is considered relatively clean, as no contaminant-generating roofing or cladding materials will be used. The plaza is non-trafficable and does not receive vehicle runoff; therefore, oil-water separators and heavy-metal treatment systems are not anticipated.

To support the targeted two Green Star credits, a treatment train has been incorporated. Gross pollutant traps (GPTs), such as LittaTrap or Enviropod baskets, will be installed within plaza catchpits to provide low-maintenance pre-treatment by capturing litter, debris, coarse sediment, and other gross pollutants before flows enter the downstream network. As GPTs are not designed to provide primary TSS removal, a proprietary stormwater treatment device will be included to achieve the required TSS reduction and meet the Green Star pollution reduction credit criteria. A proprietary stormwater treatment device, such as an Up-Flo Filter or equivalent, is designed to achieve the TSS reduction required for the targeted Green Star two-credit outcome.

The specified pollution-reduction targets will be reviewed during detailed design to confirm treatment locations, device sizing, maintenance requirements, and compliance with Green Star stormwater credit requirements.

6.2.3 Stream hydrology

Although the site does not discharge directly to a natural stream receiving environment, attenuation has been incorporated to manage post-development runoff and maintain appropriate hydrological performance.

6.2.3.1 B310 Hiwa Stormwater Tank Reuse

Stormwater runoff from the neighbouring B310 Hiwa building's roof and plaza is currently captured by an existing storage system beneath the Princes Street ramp to the Basement car park. The system comprises 45m³ of detention storage and 90m³ of retention storage[2] as shown in Figure 6-1.

The associated internal pipework conflicts with the designed vehicle connection through the existing retaining wall into the SC&L Lower Ground level. Relocation of the pipework or existing tank has been assessed as impractical.

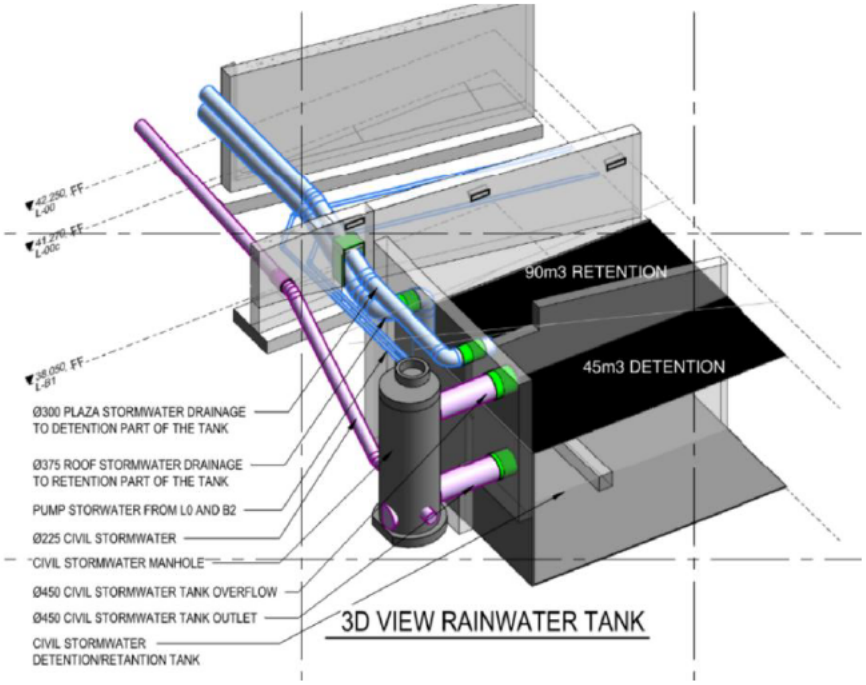


Figure 6-1 Existing B310 Hiwa Stormwater Tank Configuration

The following catchment areas have been used to inform the stormwater design:

Table 6-2 Summary of the Stormwater Catchment Areas for B310 Hiwa and SC&L

Building	Roof Area for Retention (m²)	Plaza Area for Detention (m²)	Total Area (m²)
B310 Hiwa	3,730	2,922	6,652
Student Centre and Library	3,140	2,275	5,415

As the B310 Hiwa and SC&L catchments are comparable in size, the existing B310 Hiwa tank will be reused to attenuate SC&L stormwater runoff, with B310 Hiwa runoff directed to a new tank within the SC&L basement. The SC&L catchment is approximately 19% smaller than the B310 Hiwa catchment, and its estimated peak flows is lower than those currently received by the existing B310 Hiwa tank. The existing Hiwa tank is therefore expected to provide a similar level of attenuation.

The reuse option has been adopted as the design servicing strategy and is considered feasible from a storage-capacity perspective. The concept design optioneering process identified this as the preferred approach, which has been carried forward into the current design Confirmation of the pipe route, levels and available grade will

[2]University of Auckland Recreation & Wellness Centre Civil Infrastructure Report for Resource Consent Revision B dated 26 June 2019

be undertaken during detailed design. Should any unforeseen constraints be identified, the design will be refined accordingly.

6.2.3.2 Stormwater Attenuation

The preferred stormwater management strategy will retain the existing B310 Hiwa stormwater tank to attenuate runoff from the SC&L catchment, while diverting runoff from the B310 Hiwa catchment to a new detention and retention tank within the SC&L building.

Hydraulic assessment indicates that peak runoff from the SC&L catchment is lower than the flow currently received by the existing B310 Hiwa tank. The reassignment is therefore not expected to increase the previously approved discharge limit of 107L/s or adversely affect the downstream network in Princes Street. Reuse of the existing B310 Hiwa tank is expected to limit discharge to approximately 95L/s. Refer to Appendix E1 for detailed calculations. No modifications to the existing tank volume, inlet and outlet levels, outlet control or downstream stormwater network are required.

The new SC&L tank will provide approximately 135m³ of detention, around three times the existing Hiwa detention volume, along with 90 m³ of retention storage. The retention volume will be reused inside the building for non-potable applications. This has been sized to achieve the targeted "two Green Star stormwater credits", by demonstrating that the controlled post-development discharge for the 2-, 5- and 10-year ARI events does not exceed 80% of the corresponding pre-development discharge and that the required stormwater quality targets are achieved.

A summary of the adopted tank configurations and hydraulic performance is provided in Table 6-3. Peak discharge comparisons and the tank-swap arrangement are illustrated in Figure 6-2.

Table 6-3 Summary of B310 Hiwa and SC&L Tank Hydraulic Performance

Tank	Catchment	Catchment area (m²)	Water depth (m)	Detention volume (m³)	Retention volume (m³)	10yr post-dev peak flow (L/s)	Allowable discharge[3] (L/s)	Controlled outflow, 2yr / 5yr / 10yr (L/s)
Existing B310 Hiwa tank	SC&L	5,415	2.28	45	90	142	107	N/A / N/A / 95
New SC&L tank	B310 Hiwa	6,652	1.50	135	90	174.9	111	53.5 / 75.7 / 86.4

The new SC&L tank configuration is constrained by the available space, basement levels, incoming pipe invert and downstream connection level. Separate detention and retention tanks have therefore been adopted, with a maximum practical water depth of approximately 1.5m. A combined tank with an internal partition may be considered during detailed design if it provides constructability or spatial benefits.

The retention volume is consistent with the storage currently provided for the B310 Hiwa building and is considered appropriate, given the comparable roof catchment areas and site characteristics. The final tank configuration will be confirmed during detailed design.

The current assessment uses conventional orifice plate outlet controls, to limit flows to pre-development discharge rate. Alternative flow control devices may be considered during detailed design to optimise hydraulic

[3] Pre-development catchment flow for the 10-year ARI storm event without climate change

performance and storage requirements. The tank arrangement, dimensions and outlet controls will be reviewed as final catchment areas, building layouts and downstream network requirements are confirmed.

The assessment indicates that the designed attenuation system will reduce peak discharge to the downstream public stormwater network. Accordingly, network upgrades are not expected to be required because of the development. Stormwater quality requirements will be addressed through the designed treatment strategy, which will be finalised as the building layout and contributing catchments are confirmed.

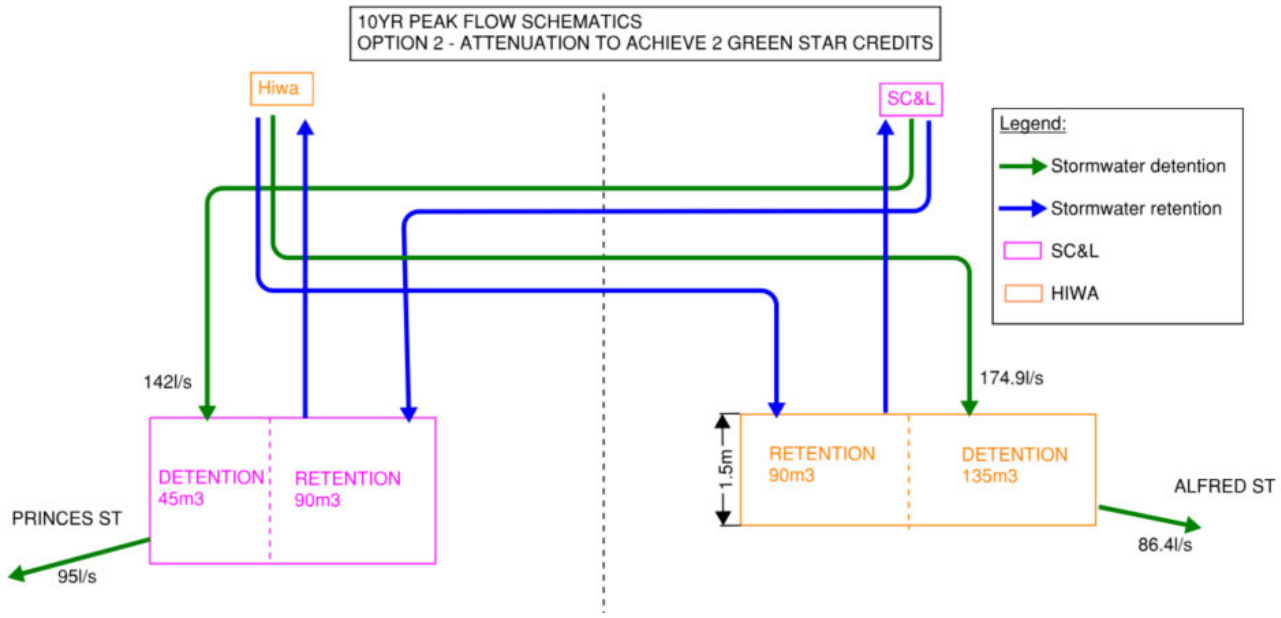


Figure 6-2 10yr ARI Peak Discharge and SC&L Tank Configuration Schematic - 2 Green Star Credits

6.2.4 Flooding 10 percent AEP event (Network Capacity)

Stormwater runoff from the SC&L catchment will be conveyed to the existing B310 Hiwa stormwater tank beneath the Princes Street basement car park entrance ramp before discharging to the public stormwater network in Princes Street.

Runoff from the B310 Hiwa catchment will be diverted to the new SC&L detention and retention tank and discharged via the existing private stormwater network along the southeastern side of the site to the public network in Alfred Street. This follows the current SC&L discharge arrangement.

Both catchments will be attenuated to their respective pre-development discharge rates. Based on the hydraulic assessment, the stormwater strategy will not increase peak discharge to the downstream public networks. Accordingly, no public network upgrades are anticipated to be required because of the development.

A hydraulic capacity assessment of the Alfred Street stormwater network has been undertaken and confirms that the receiving network has sufficient capacity for the attenuated B310 Hiwa discharge. Accordingly, discharge to Alfred Street stormwater network is considered appropriate for servicing the development and is not expected to result in adverse flooding effects or require upgrades to the public stormwater network.

In accordance with Schedule 4 of Auckland Council's Regionwide Network Discharge Consent (NDC), no additional assessment requirements are triggered in relation to stream hydrology or SMAF provisions. The site is not located within an AUP SMAF overlay and does not discharge to a stream. The downstream receiving environment for both the Princes Street and Alfred Street stormwater networks is the Waitematā Harbour.

6.2.5 Flooding 1 percent AEP event (Habitable floors)

Auckland Council flood hazard information indicates that the site is not located within a mapped floodplain or flood-prone area.

The designed development is therefore not expected to be affected by flood hazards during the 1% AEP event. Exceedance flows generated during extreme rainfall events will be managed through the secondary flow path system described in Section 6.2.6.

6.2.6 Overland Flowpath and floodplain management

Auckland Council GIS indicates that the SC&L site is not located within a mapped floodplain or flood-prone area, as shown in Figure 6-4 . Based on initial engagement with Auckland Council Healthy Waters, the site is generally not subject to flooding, with localised ponding of up to approximately 80 mm and a maximum flood level of 42.71m identified due to local depressions (refer to Figure 6-3). These local depressions relate to the former Maidment Theatre removal and will be removed as part of the new building construction.

The site is located at the upper end of the catchment, and no identified overland flow path traverses the SC&L building. Accordingly, the building will not obstruct or divert a defined overland flow path.

The adjacent B315 courtyard at the Alfred Street / Symonds Street intersection has historically experienced flooding, including manhole lid uplift during extreme events. The UoA Stormwater Improvement Options Report for B315 Courtyard, identifies that the existing courtyard network does not have sufficient capacity for the 10-year ARI event and that surcharge during the 100-year ARI event may result in ponding of approximately 300 mm within the courtyard. Recommendations have been provided in this report, with three options assessed. The recommended measures, including disconnecting the existing B315 roof catchments (with or without a new connection point), upgrading the existing courtyard pipe network, or providing attenuation tanks to help reduce the residual flood risk.

The report also identifies that the courtyard's depressed topography and lack of a defined secondary overland flow path can contain floodwater within the courtyard.

The SC&L stormwater strategy has been developed with consideration of the existing B315 courtyard constraints. Attenuated discharge from the development will reduce peak flows relative to existing conditions, and the arrangement is therefore expected to improve downstream flooding performance rather than exacerbate it. Further assessment during detailed design will confirm the interaction between the designed discharge and the existing B315 courtyard network.

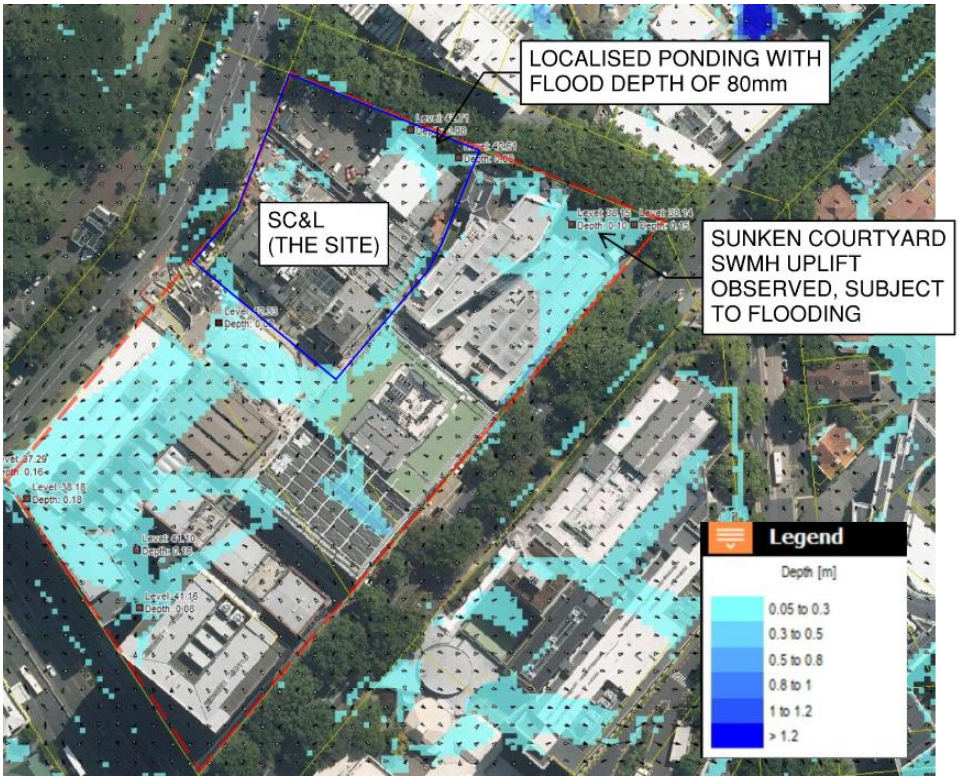


Figure 6-3 Flood Map provided by Healthy Waters (WaterRide Software)

Auckland Council GIS identifies a minor overland flow path with a contributing catchment of approximately 2,000-4,000 m² originating at the eastern corner of the site. The overland flow path extends from the eastern corner and flows away from the site towards the south-east, between Alfred Street and B315.

The location of the OLFP relative to the SC&L site is shown in Figure 6-4.

A further overland flow path, with a contributing catchment of approximately 4,000 m²-1 ha, is identified along Princes Street and joins other overland flow paths on Wellesley Street East.

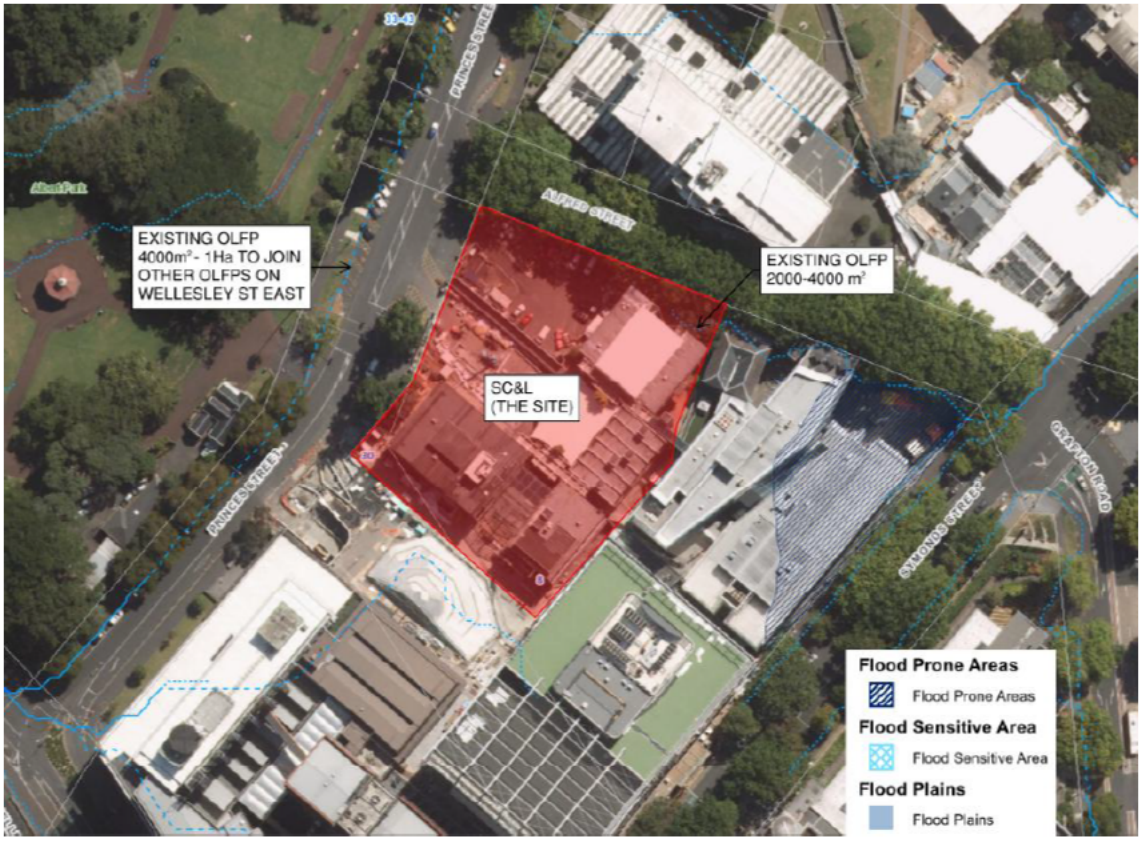


Figure 6-4 AC GIS Overland Flow Paths, Flood Plains, Flood Prone Areas, and Flood Sensitive Areas

6.2.6.1 AUP Hazard Risk Assessment under PC120

This hazard risk assessment identifies that the development site (#30-38 Princes Street) will be subject to an existing overland flow path. Below is an assessment of the proposal against the relevant AUP E36.9 (2) matters, including *"all the matters outlined in Policies E36.3(3), E36.3(4A) and E36.3(4B), including climate scenarios in Auckland Council Guideline Document 15: Climate change scenarios (GD15) November 2024."*

AUP Policy E36.3	Assessment Comment
(3) (a) the type, frequency, range and scale of the natural hazard(s), including: (i) where there may be coinciding, compounding and/or cascading hazards; (ii) whether the hazard risks will be temporary or permanent; (iii) whether natural hazard events of lower intensity and higher frequency than the 1 per cent AEP event will impact the property and proposed activity	AC GIS indicates there is a minor overland flow path originating at the eastern corner of the site, adjacent to Alfred Street. The site is not within a flood plain, a flood prone area or a flood sensitive area. The 1% AEP detention tank overflow is directed to the managed overland flow path towards Princes St and does not result in an increase in flood risk. (i) Not Applicable, no coinciding or compounding hazard (ii) The hazard risk will be permanent (iii) Any impacts will remain insignificant
(3) (c) the consequences of a natural hazard event in relation to the proposed activity;	The proposal has been designed to maintain the function of the existing overland flow path while

AUP Policy E36.3	Assessment Comment
	reducing the contributing catchment area. As a result, the consequences of a natural hazard event on the designed development and surrounding properties are considered negligible. The analysis below indicates the pre- and post-development conditions both fall within the Low Flood Hazard Area classification.
(3) (l) existing and proposed mitigation measures;	The designed development will incorporate flow attenuation measures, reducing the contributing catchment to the minor overland flow path and regrading of the area to avoid localised ponding.
(3) (m) residual risk;	Not Applicable – the development does not increase flood hazard risk and maintains an appropriate overland flow conveyance route.
(3) (n) any relevant management plan, strategy or hazard risk assessment relating to the area.	Existing catchment will be diverted towards Princes Street. See section 4.1.5.2 for assessment relating to OLFP in this area. Development will be undertaken in accordance with this SMP which represents the Best Practicable Option for the development.
(4A) Require all of the following matters to be considered when assessing consequences of natural hazards as part of a risk assessment: (a) accelerating or exacerbating the natural hazard and/or its potential impacts;	The designed development will incorporate flow attenuation measures and reduce the contributing catchment to the existing overland flow path and will not accelerate or exacerbate flood hazards.
(4A) (b) creating natural hazard risks that previously were not present at the location;	Not Applicable – the new development will not create new natural hazard risks that previously were not present at the location.
(4A) (c) the type of activity being undertaken and its sensitivity to natural hazard events;	The designed development comprises a new building and plaza development, which is considered potentially sensitive to the identified minor overland flow path under the AUP. The building platform and finished floor levels have been designed above the level of the overland flow path, and the development incorporates measures to maintain existing overland flow conveyance. As a result, the proposal has a low sensitivity to the identified hazard.
(4A) (d) creating or increasing the natural hazard risk(s) to people and communities, including long-term impacts from more frequent hazard events;	Not Applicable – the new proposal will not create or increase the flood risk hazards to people and communities.

AUP Policy E36.3	Assessment Comment
(4A) (e) creating or increasing the natural hazard risk(s) to other properties, infrastructure and the environment; and	Not Applicable – the new proposal will not create or increase the flood risk hazards to other properties, infrastructure, and the environment.
(4A) (f) cultural impacts, including consequences for Māori land, Treaty Settlement Land, marae, urupā, mana whenua cultural heritage and values.	No Māori land, treaty settlement land, marae, or urupā are located within proximity of the site. Engagement with mana whenua has been undertaken to ensure cultural values are addressed.
(4B) Require all of the following matters to be considered as part of a risk assessment of existing and future mitigation measures and residual risk:	
(a) whether any building, structure or activity located on land subject to natural hazards can be relocated within the site or removed	Not Applicable
(b) whether the use, design and construction of buildings and structures can mitigate risks associated with natural hazards;	The new building will convey flow away from the identified minor overland flow path hazard.
(c) the extent to which methods for long term maintenance of areas affected by natural hazards, such as easements, are provided;	The affected area is limited to a minor overland flow path located along the site boundary. The designed site grading maintains overland flow conveyance and does not rely on complex mitigation structures requiring ongoing maintenance. Standard maintenance of surface drainage systems and paved areas will support the continued function of the flow path.
(d) the ability for site layout and management to limit exposure of people and property to natural hazards, including safe egress during a natural hazard event;	The site layout directs overland flow away from the building footprint and maintains safe access around the development.
(e) the effect of structures to mitigate hazards on landscape values and public access;	No significant mitigation structures are required. Designed grading works will not adversely affect landscape values or public access and will maintain the existing function of the overland flow path.
(f) the robustness of the mitigation measures, their enforceability and the ability to carry out repairs and maintenance;	The designed mitigation measures comprise permanent ground regrading and conventional stormwater infrastructure. These measures are robust, readily maintainable, and can be inspected and repaired through standard asset management practices.

AUP Policy E36.3	Assessment Comment
(g) the potential consequences of events that exceed the design parameters of mitigation measures;	During events exceeding the 100-year climate change adjusted storm, overland flow rates may increase; however, the designed development maintains overland flow paths.
(h) the potential effects resulting from failure of structural and nature-based mitigation measures over a 100-year timeframe;	Failure or deterioration of site grading or drainage infrastructure could reduce the effectiveness of flood management measures. However, these elements can be readily maintained and repaired through routine asset management, resulting in a low long-term risk.
(i) the impacts of the mitigation on other people, properties, infrastructure and the environment;	The designed development has been designed to have insignificant adverse impacts on the existing minor overland flow path hazard to avoid negative consequences on the public & adjacent sites
(j) whether natural hazard risks can be reduced for Māori Land, Treaty Settlement Land, marae, urupā, mana whenua cultural heritage and values;	Not Applicable
(k) the use of conditions of consent, including the duration of consent, to monitor changes in risk and to limit the exposure of people and property to natural hazards;	The existing minor overland flow path will be maintained through site grading and hard surfacing. As the flow path function is preserved, no ongoing monitoring or consent conditions beyond standard construction and maintenance requirements are considered necessary.
(l) and the extent to which it is practicable to mitigate residual risk where infrastructure has a functional or operational need to locate in a natural hazard area	N/A – the Project is not considered infrastructure under the AUP.
GD15 (2024)	The Stormwater design has considered V4 of AC SW CoP, for climate change and it complies with GD15.

The designed regrading of the laneway between the SC&L and Kate Edger buildings will not adversely impact the existing OLFP. Finished surface levels have been designed to ensure the overland flow path exits the site at its existing location, with no risk of flow diversion into the laneway.

An assessment of the existing and post-development overland flow paths (OLFP) located at the eastern corner of the site was undertaken to support the natural hazard assessment. The analysis was completed using the peak flow rate of 0.095 m^3/s, based on the 1% AEP (100-year) event with a 3.8 °C climate change allowance obtained from Auckland Council GIS data. The location of the assessment is illustrated in Figure 6-5.

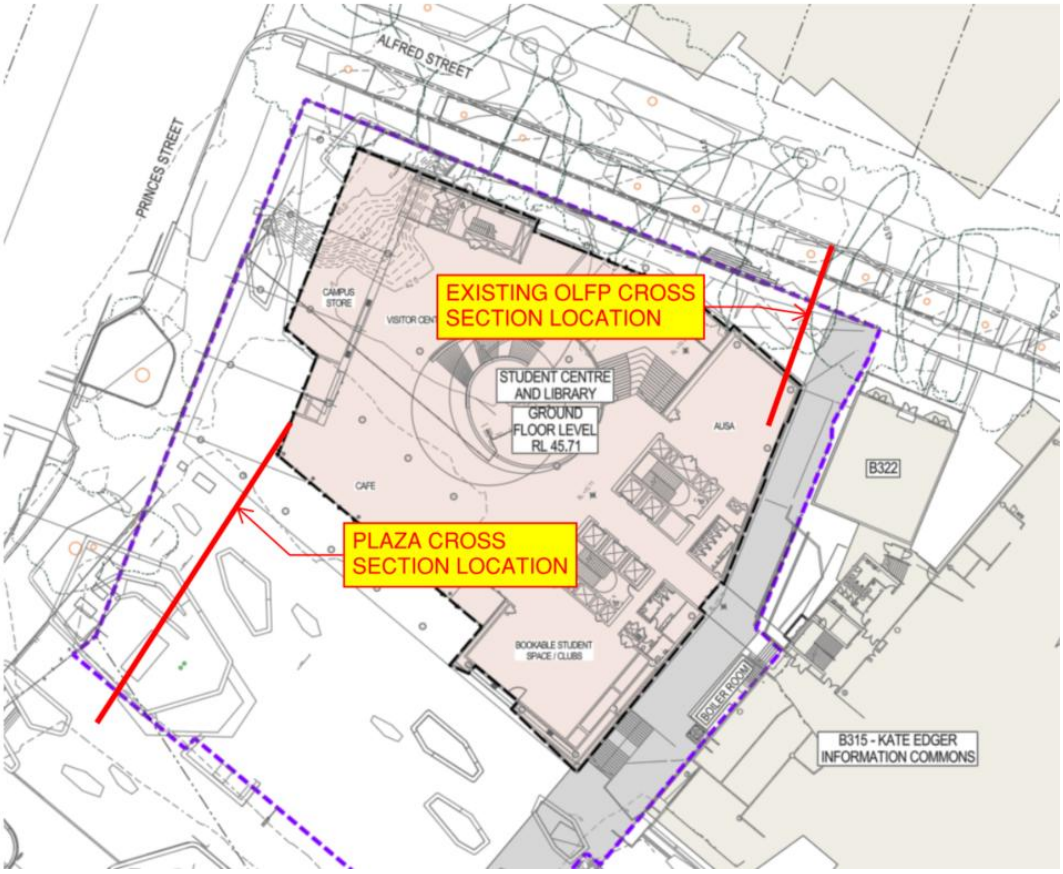
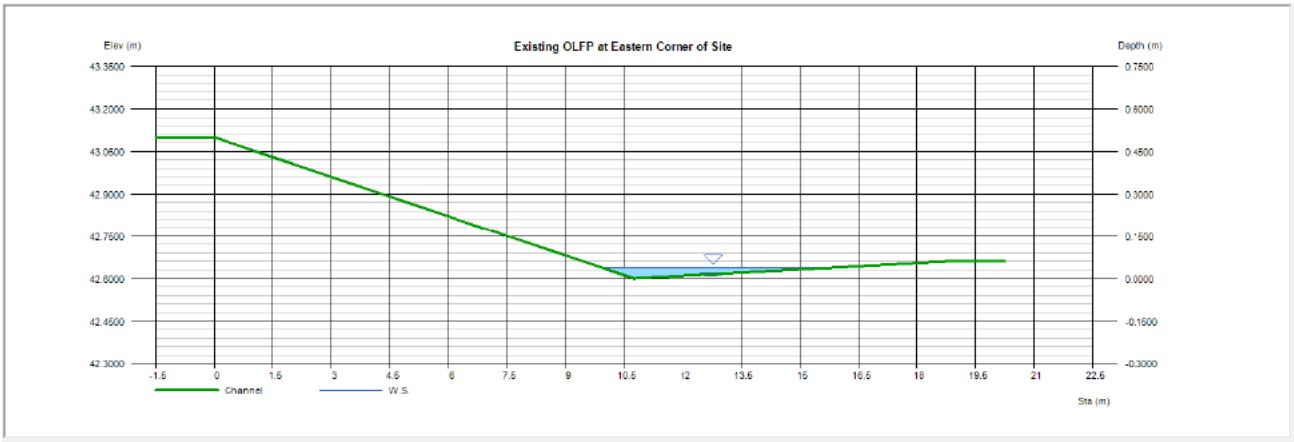


Figure 6-5: Location of Cross Sections

A north-south cross-section at the eastern corner of the site through the OLFP was analysed using Civil 3D Launch Express, with the results presented in Figure 6-6 and Figure 6-7. The assessment indicates a maximum flow depth of approximately 0.036 m and a flow velocity of approximately 0.92 m/s under existing conditions. The assessment with new post-development surface indicates a maximum flow depth of approximately 0.058 m and a flow velocity of approximately 1.17 m/s.

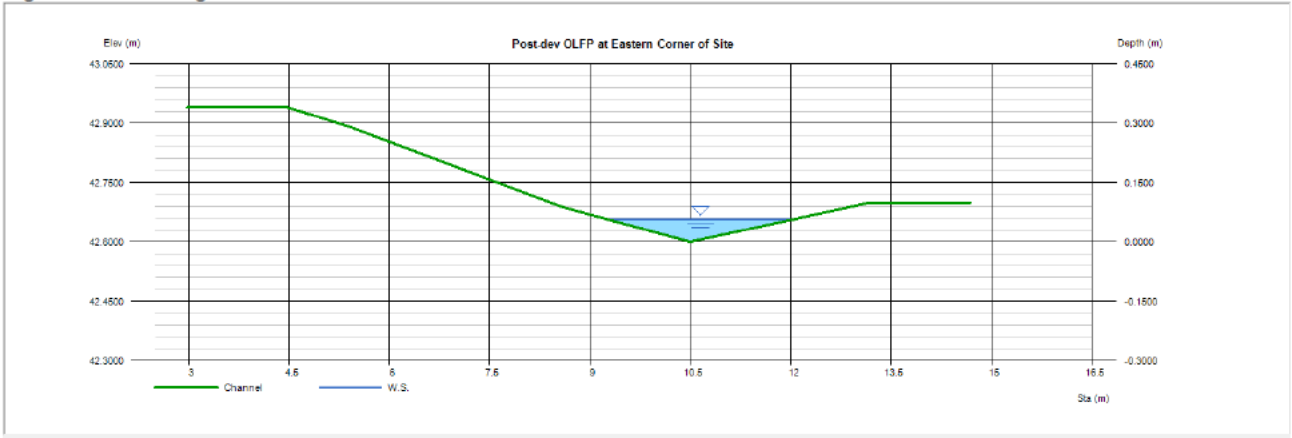
Applying the Auckland Unitary Plan flood hazard classification criteria, the resultant depth-velocity product (D×V) is approximately 0.033 m²/s for existing conditions and 0.068 m²/s for post-development conditions, which both fall within the Low Flood Hazard Area classification.

The analysis demonstrates that the identified OLFP is shallow and conveys a relatively low flow rate along the eastern boundary of the site. Consequently, the flood hazard associated with the OLFP is considered low and is not expected to present a significant risk to the designed development. The post-development condition considers the same contributing catchment as existing conditions however, a reduction in contributing catchment area is anticipated to further reduce the extent and magnitude of overland flow through this location.



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
0.0366	0.095	0.104	0.9156	5.6749	0.0518	5.6739	0.0793

Figure 6-6: Existing Overland Flow Path Assessment at Eastern Corner of Site



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
0.0579	0.095	0.081	1.1695	2.8078	0.0823	2.8054	0.1277

Figure 6-7: Post-Development Overland Flow Path Assessment at Eastern Corner of Site

The results of the hydraulic assessments are summarised in Table 6-4.

Table 6-4: Hydraulic Assessment Results Summary Table

Cross Section	100-yr Peak Flow Rate (m^3/s)	Peak Depth (m)	Peak Velocity (m/s)	D*V (m^2/s) Hazard Rating
Existing OLFP	0.095	0.036	0.92	0.033
Post-dev OLFP	0.095	0.058	1.17	0.068

6.2.6.2 Stormwater Overflow Management Strategy

The building internal stormwater pipework is designed for the 100-year ARI event, with provision for overflow in more severe storms, whereas the public stormwater network is intended to accept up to the 10-year ARI flow. Consequently, the SC&L attenuation system may receive 100-year ARI inflows, requiring a controlled and safe overflow pathway on site to avoid surcharging the public network and to mitigate known flooding issues at the B315 sunken courtyard.

Based on the design objectives and coordination with the wider project team, the preferred overflow arrangement allows 100-year ARI flows to overflow via two DN375 pipes which discharge vertically through a bubble up into the new SC&L plaza, where it will disperse as shallow sheet flow and continue towards Princes Street. Gratings will be heel-proof and integrated with landscape elements to maintain safety, amenity, and architectural intent. Robust detailing is required to ensure watertightness and manage slab penetrations at ground floor level.

As part of the Stormwater Management Plan, three alternative options were assessed, with overflow discharge to the plaza determined to be the Best Practicable Option (BPO) based on the project constraints and overall stormwater management outcomes.

Other overflow discharge options (2 and 3) were considered however deemed impractical. A summary of the options considered is shown in Table 6-5.

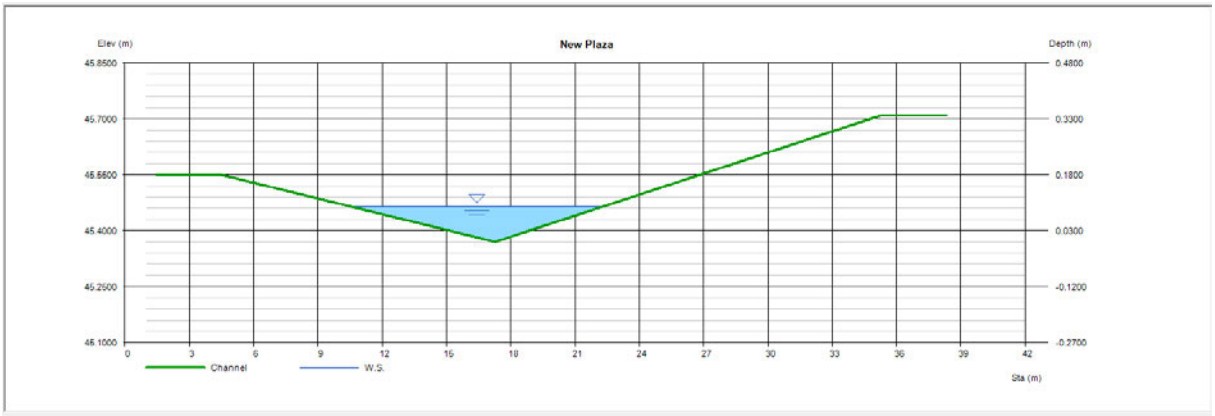
Table 6-5: Summary and Comparison of Options for Stormwater Overflow

Options	Benefits	Risks
1 - Overflow to plaza from tank	• On-site • Visible • Potential to integrate with landscape/amenity • Avoids pumping	• Safety and aesthetics of grates
2 - Overflow to south-west laneway bubble-up	• Maintains existing OLFP direction	• Tight corridor with extensive services • Challenging level reshaping • Manage and mitigate flood risk to B315, B322, and the proposed SC&L building • Potential adverse impacts on the existing flooding issues within the B315 Kate Edger Courtyard
3 - Overflow under building to Alfred Street bubble-up	• Maintains existing OLFP direction • Avoids pumping	• Bubble-up chambers discharge in a manner similar to kerb outlets and would result in concentrated stormwater flows being directed onto Alfred Street. • Works within tree drip lines undesirable • Under-building stagnant pipe sections • Higher maintenance and operational risk

Flood hazard assessments have been undertaken for both the private plaza and the downstream receiving network. The plaza assessment confirms that flow depths and velocities remain within acceptable limits and do not pose a risk to pedestrian safety. A separate downstream flood impact assessment demonstrates that discharge to Princes Street does not result in any significant increase in flood depths or flooding effects within the receiving road corridor. Refer to Appendix E1 for the assessment methodology and results.

A cross-section of the new plaza was modelled to assess the potential flood hazards associated with overland-flow conveyance through the site. The plaza comprises a shallow V-shaped channel with side slopes of approximately 1.4% and a longitudinal grade of approximately 0.4%. A peak flow rate of 0.313 m^3/s from the B310 Hiwa catchment was adopted for the assessment, representing the unattenuated 1% AEP overflow from the SC&L tank. The location of the assessment is illustrated in Figure 6-5.

Hydraulic calculations were undertaken using the Launch Express module within Autodesk Civil 3D to analyse flood depths and velocities within the plaza. The results, presented in Figure 6-8, indicate a flow depth of 94.5mm, a flow velocity of 0.56m/s and a depth x velocity value of 0.05m^2/s during the 1% AEP event. As per Flood Hazard Area Criteria from AUP, this flow provides no danger to pedestrian safety.



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
0.0945	0.313	0.554	0.5640	11.7343	0.0884	11.7327	0.1107

Figure 6-8: Launch Express Flood Assessment Results for New Plaza

To assess the downstream effects, pre-development and post-development flood conditions were evaluated at the intersection of Princes Street and Wellesley Street East. A digital terrain surface from Land Information New Zealand (LINZ) was used to extract a representative cross-section near the base of Princes Street. The existing OLFP, identified in Auckland Council GIS mapping along the north-western side of Princes Street, is assumed to remain operational following development. A portion of the SC&L catchment currently contributing to the Alfred Street existing OLFP will be diverted to Princes Street as part of the designed overflow arrangement.

The longitudinal slope at the assessment location was determined from the Auckland Council GIS OLFP data and adopted as 3.37%. The cross-section represents the north-western traffic lane of Princes Street, with ground levels derived from the LINZ surface and supplemented by an assumed 150 mm kerb height based on aerial imagery. The location of the assessment is illustrated in Figure 6-9.

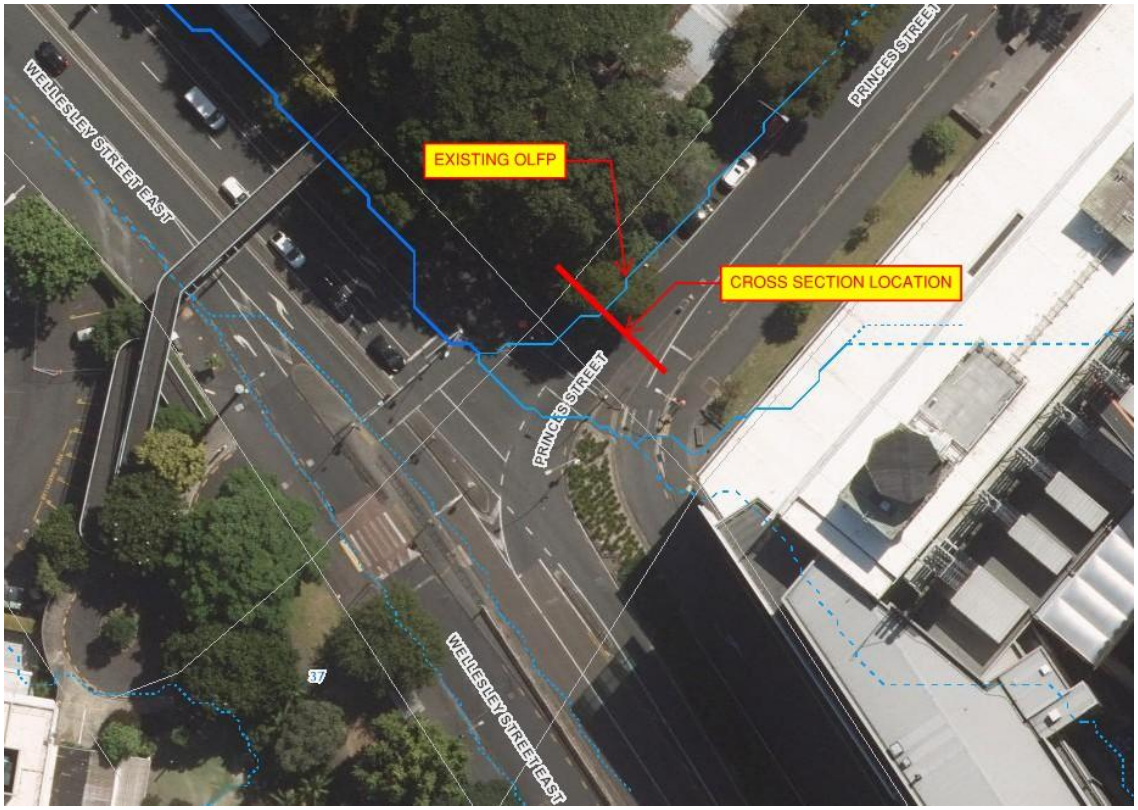
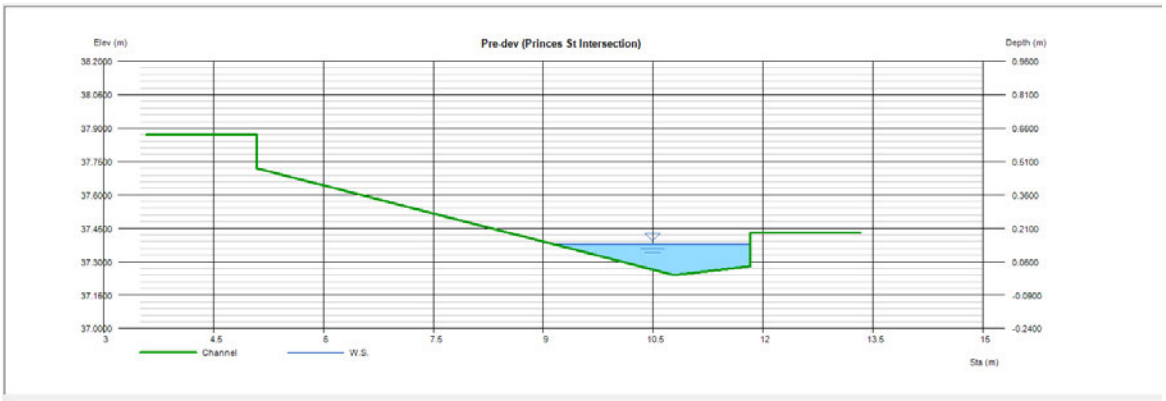


Figure 6-9: Location of Cross Section

For the pre-development assessment, a peak flow rate of 0.408 m^3/s was adopted, based on the 100-year peak flow rate with 3.8-degree CC scenario obtained from Auckland Council GIS. The post-development assessment incorporated an additional area of 2,610 m^2 shown in Figure 6-10. The catchment results in an additional discharge of 0.124 m^3/s, representing the 1% AEP overflow from the portion of the SC&L catchment to be diverted to Princes Street. The resulting hydraulic assessments for both scenarios are presented in Figure 6-11 and Figure 6-12.

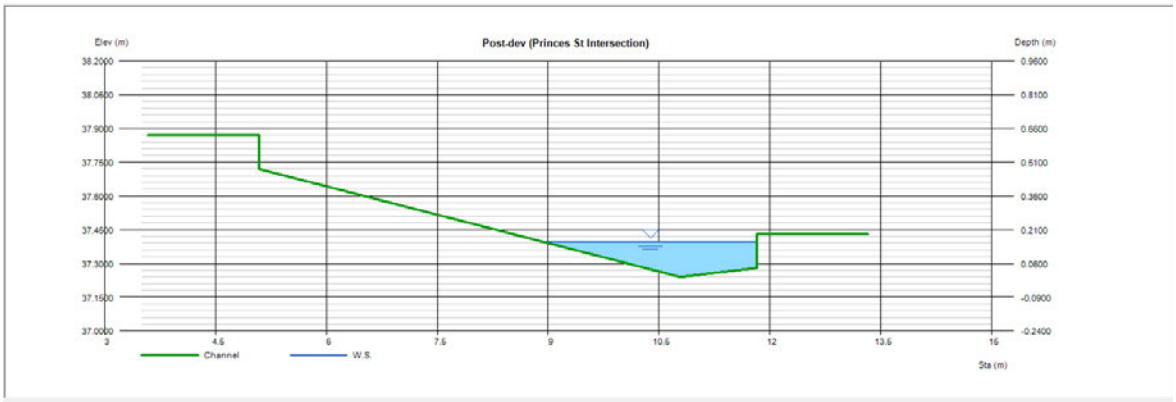


Figure 6-10: Catchment area to be diverted as OLFP along Princes Street



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
0.1372	0.408	0.234	1.7456	2.7743	0.1890	2.6706	0.2926

Figure 6-11: Launch Express Assessment Results for Pre-dev Princes Street



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(m)	(cms)	(sqm)	(m/s)	(m)	(m)	(m)	(m)
0.1554	0.532	0.285	1.8696	3.0107	0.2134	2.8879	0.3337

Figure 6-12: Launch Express Assessment Results for Post-dev Princes Street

The results of the hydraulic assessments are summarised in Table 6-6.

Table 6-6: Hydraulic Assessment Results Summary Table

Cross Section	100-yr Peak Flow Rate (m^3/s)	Peak Depth (m)	Peak Velocity (m/s)	D*V (m^2/s) Hazard Rating
New Plaza	0.313	0.09	0.56	0.05
Pre-dev Princes Street	0.408	0.14	1.75	0.24
Post-dev Princes Street	0.532	0.16	1.87	0.29

All scenarios are assessed in flood depths of less than 300mm during the 1% AEP event. In accordance with the Auckland Unitary Plan PC120 J1 Definitions flood hazard criteria, these conditions are classified as a low flood hazard area. Figure 6-13 is a snip from the AUP PC120 J1 Definitions and shows the criteria for a low flood hazard area. The assessment therefore indicates that conveyance of additional flows from the site to the existing Princes Street overland flow path can be accommodated without creating a significant flood hazard. The increase in flood depth is minor and does not materially worsen downstream flooding conditions. It is also noted that the designed attenuation system has been sized to achieve the Green Star stormwater management objectives by reducing peak discharge rates from the development. As a result, the proposal provides a beneficial reduction in runoff entering the downstream public stormwater network, including during major storm events, thereby reducing potential downstream flooding impacts associated with the 100-year design event.

- Low flood hazard area –
  - for floodplains and overland flow paths, where floodwaters have depth equal to or less than 300mm or depth x velocity product less than or equal to 0.24m^2/s in a 1 per cent AEP event
  - for flood prone areas, all other flood prone areas not meeting the definition for very high, high and medium flood hazard areas

Figure 6-13: Low Flood Hazard Area Criteria from AUP

6.2.7 Subsoil Drainage

Subsoil drainage will be provided below the basement and foundation structures to manage any perched groundwater and prevent adverse effects on the building structure. The system will be designed in coordination with the structural and geotechnical design, with discharge arrangements and outlet locations confirmed during detailed design. Any subsoil drain discharges will be pumped to approved outlets, with appropriate backflow prevention provided.

6.2.8 Development staging

Stormwater infrastructure will be constructed progressively as part of the redevelopment works.

Temporary erosion and sediment control measures will be implemented in accordance with the project Erosion and Sediment Control Plan (ESCP) and Auckland Council GD05 requirements. Construction access points from Alfred Street and Princes Street will be stabilised to minimise sediment tracking onto the surrounding road network.

Permanent stormwater management measures will be operational prior to completion of the development.

6.3 Hydraulic connectivity

The site currently discharges to the public stormwater network via connections to Alfred Street. Under the designed stormwater management strategy, runoff from the SC&L catchment will discharge via the existing Hiwa stormwater tank to the public network in Princes Street, while runoff from the Hiwa catchment will discharge to the Alfred Street network through the new SC&L detention and retention system.

The designed discharge arrangement maintains hydraulic connectivity with the existing public stormwater network and does not introduce any new receiving environments. The existing discharge points will continue to convey runoff to the downstream public network through controlled discharge.

The designed attenuation measures reduce post-development discharge rates relative to the existing condition and therefore improve the existing hydraulic performance of the catchment.

6.4 Asset ownership

The stormwater infrastructure associated with the development will comprise a combination of existing and new private assets.

The existing Hiwa stormwater tank located beneath the Princes Street basement entrance ramp will remain in the ownership of UoA. The designed detention and retention tank, private stormwater reticulation, treatment devices, manholes and associated infrastructure constructed as part of the SC&L development will also be privately owned and maintained by UoA.

Existing public stormwater pipes within Alfred Street and Princes Street will remain under the ownership and operational control of Auckland Council.

6.5 Ongoing maintenance requirements

The successful operation of the stormwater management system relies on routine inspection and maintenance throughout the life of the development.

The following maintenance activities will be undertaken by UoA or its appointed maintenance contractor:

- Inspection and cleaning of catchpits, sumps and treatment devices;
- Inspection and maintenance of the stormwater detention and retention tanks;
- Inspection of flow control devices, overflow structures and pipework;
- Removal of accumulated sediment and debris where required; and
- Additional inspection following significant rainfall events.

Detailed maintenance requirements and inspection frequencies will be developed during detailed design and incorporated into the University's asset management procedures.

6.6 Implementation of stormwater management measures

The stormwater management measures outlined in this SMP will be implemented as part of the SC&L redevelopment works.

The existing Hiwa stormwater tank will be retained and repurposed to service the SC&L catchment. A new detention and retention tank will be constructed within the SC&L development to service the Hiwa catchment. New stormwater reticulation, outlet controls, treatment devices and overflow infrastructure will be installed and commissioned prior to occupation of the development.

Construction works will be undertaken in accordance with the project Erosion and Sediment Control Management Plan (ESCP), Construction Management Plan (CMP) and relevant consent conditions.

6.7 Dependencies

Implementation of the stormwater management strategy is dependent on:

- Confirmation of the final architectural and landscape design;
- Verification of existing stormwater infrastructure, invert levels and pipe connectivity;
- Detailed hydraulic design of the detention and retention systems;
- Confirmation of stormwater treatment requirements to achieve the targeted two Green Star credits;
- Completion of detailed coordination between civil, structural, architectural and building services disciplines; and
- Obtaining all necessary statutory approvals and utility operator approvals.

These matters will be progressively resolved through the detailed design phase.

6.8 Risks

The principal stormwater-related risks identified at this stage are:

- Potential uncertainty associated with existing private underground infrastructure and service records;
- Constraints associated with achieving private gravity connections between the SC&L development and the existing Hiwa stormwater tank;
- Potential changes to the architectural layout, levels or foundation design affecting stormwater infrastructure;
- Construction-stage impacts on existing stormwater systems; and
- Final confirmation of detailed stormwater treatment requirements to achieve the targeted Green Star credits.

These risks are considered manageable and will be addressed through further investigation, detailed design development and construction planning.

7 Departures from regulatory or design codes

No departures from the applicable regulatory or design requirements have been identified at this stage.

The designed stormwater management approach includes provision of stormwater retention despite the site not being located within an AUP SMAF overlay. This has been incorporated voluntarily to support rainwater harvesting and achievement of the project's targeted two Green Star stormwater credits.

Any design refinements arising during detailed design will be assessed against the applicable standards and discussed with Auckland Council where required.

8 Conclusions and recommendations for future work

The designed stormwater management strategy has been developed for the SC&L redevelopment in accordance with the objectives of Schedule 4 of the Auckland Regionwide Network Discharge Consent for a large brownfield development.

The assessment demonstrates that:

- Stormwater quality effects are expected to be low and can be appropriately managed through the designed treatment measures;
- The designed attenuation strategy will manage post-development discharge rates below existing discharge conditions;
- The downstream public stormwater networks in Alfred Street and Princes Street have sufficient capacity to accommodate the attenuated discharges;
- The designed development will not adversely affect identified overland flow paths or downstream flood behaviour;
- The designed 100-year storm overflow route across Te Tūātea Plaza provides an appropriate secondary flow path; and
- The stormwater management objectives associated with the targeted two Green Star credits can be achieved.

The following matters should be progressed during detailed design:

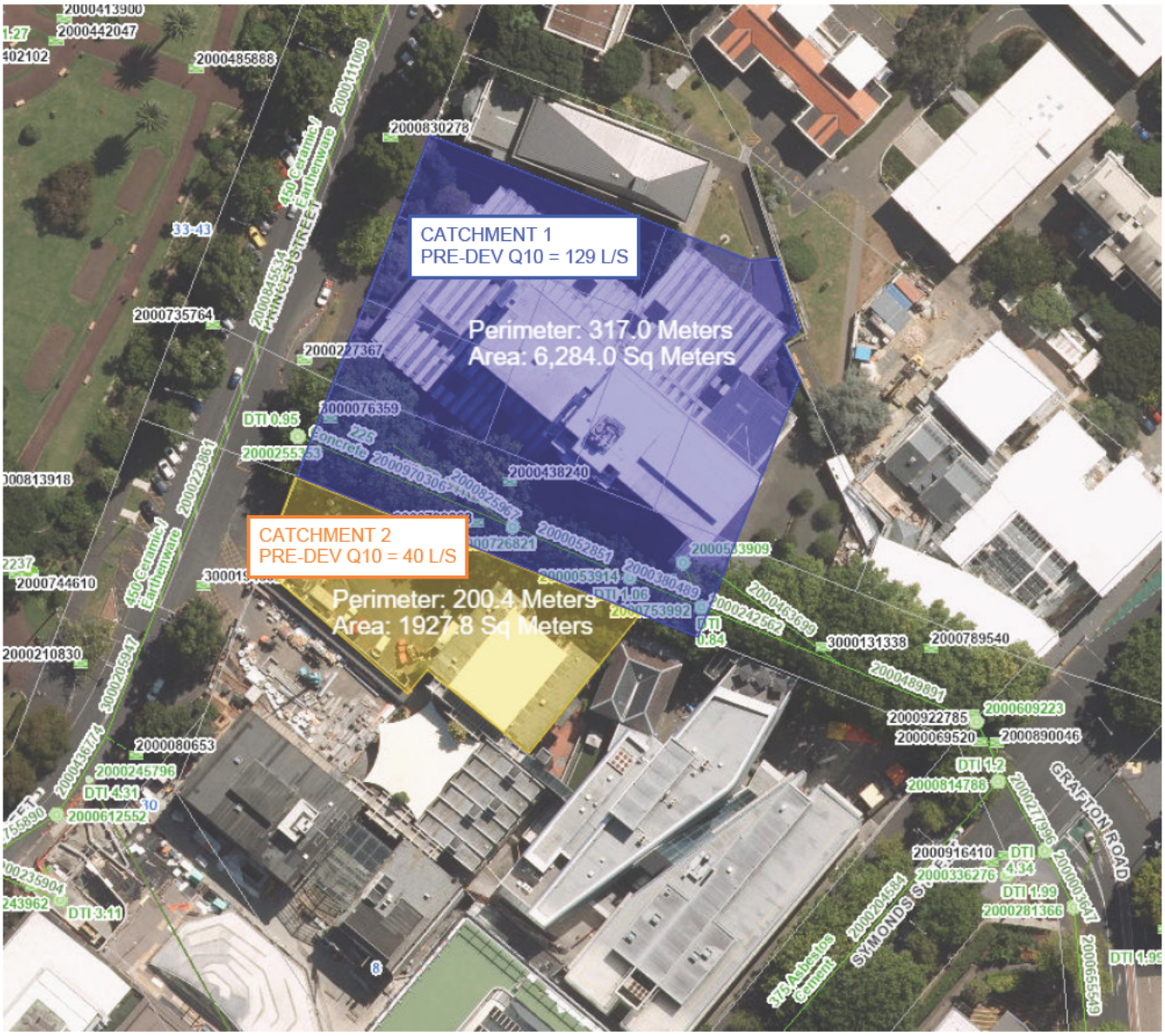
- Verification of existing stormwater infrastructure, invert levels and network connectivity;
- Confirmation of final catchment areas, outlet controls and tank configuration;
- Development of the detailed stormwater quality treatment strategy;
- Confirmation of stormwater asset operation and maintenance requirements; and
- Detailed coordination of stormwater infrastructure with architectural, structural, landscape and building services design.

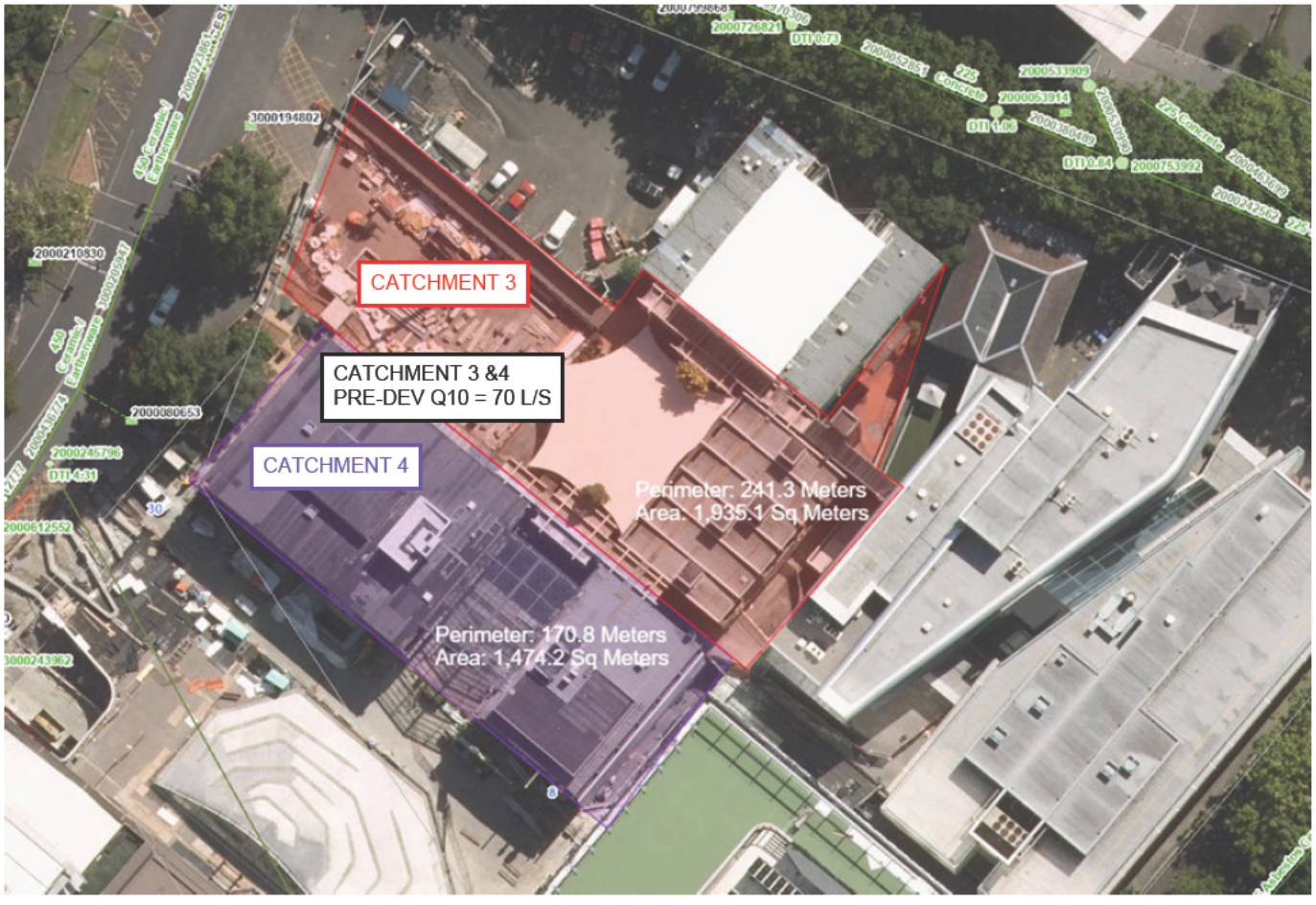
Subject to the above refinements, the designed stormwater management strategy is considered appropriate for the development and is not expected to result in adverse effects on the public stormwater network, neighbouring properties or the receiving environment. Through the provision of detention, retention and controlled overland flow management, the development will improve existing downstream stormwater performance by reducing peak discharge rates and managing exceedance flows in a controlled manner.

E1

Appendix E1 – Stormwater Calculations

10-Year ARI Existing Catchment Plans





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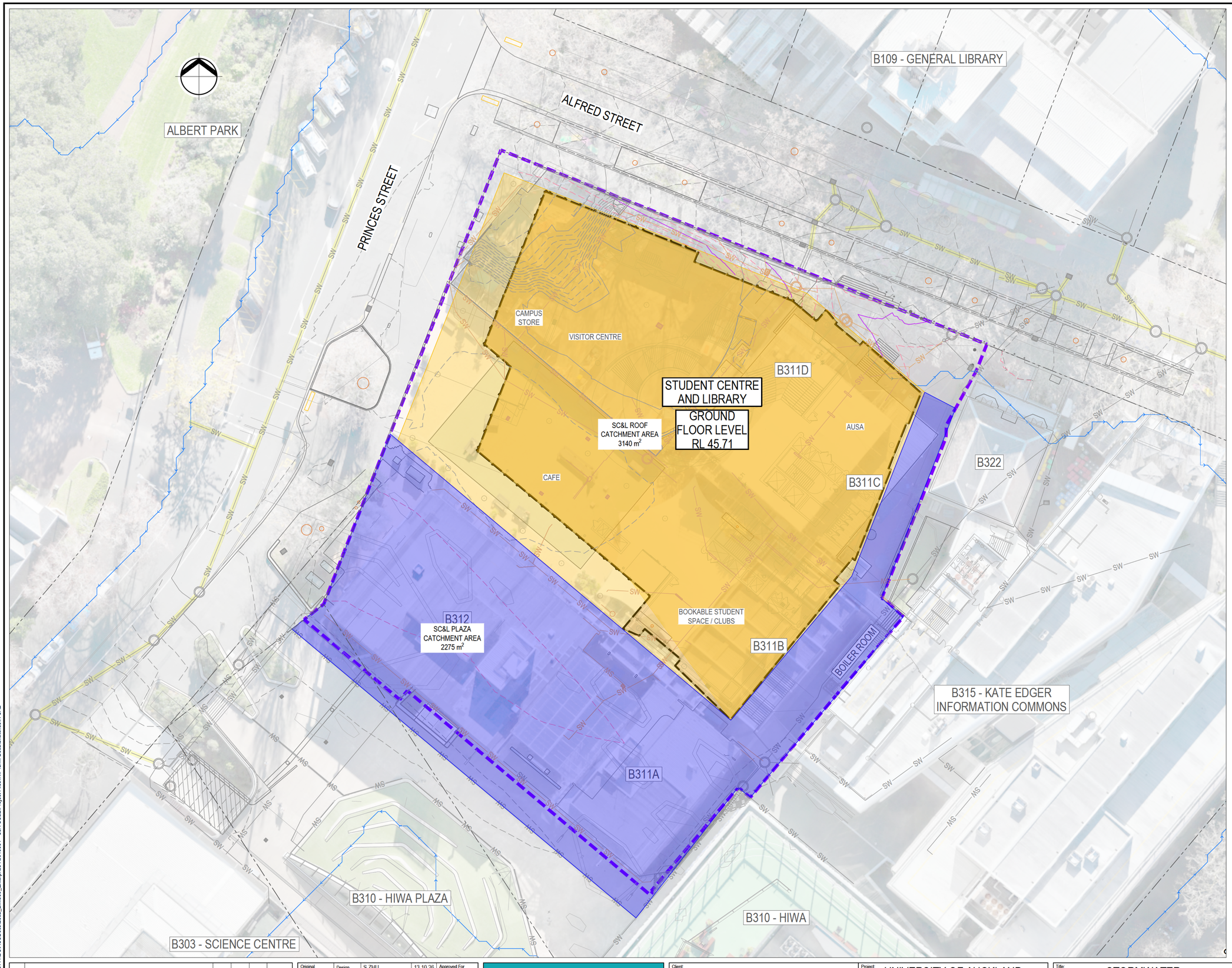

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FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	SZ	RR	CJB	20.10.26

Original Scale (A1) 1:250
Reduced Scale (A3) 1:500

Design	S.ZHU	13.10.26	Approved For Construction*
Drawn	S.ZHU	13.10.26	
Dsg Verifier			
Drg Check			Date

* Refer to Revision 1 for Original Signature

Client: Waipapa Taumata Rau University of Auckland

Project: UNIVERSITY OF AUCKLAND STUDENT CENTRE AND LIBRARY

Title: STORMWATER CATCHMENT PLAN

Discipline: CIVIL ENGINEERING

Drawing No.: 5013381-CA-K410

Rev.: A

Document No. 5013381-CA-K410.DWG

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DO NOT SCALE FOR SET OUT DIMENSIONS

IF IN DOUBT ASK.

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Pre-development Upstream Catchment and Peak Flow Summary				
Catchment	**Area (ha)**	**10% AEP rainfall depth (TP108) (mm)**	**TP108 Peak flow 10% AEP (m^3/s)**	**TP108 Peak flow 10% AEP (L/s)**
Catchment 1	0.6284	122	0.129	129
Catchment 2	0.1928	122	0.040	40
Catchment 3	0.1935	122	0.070	70
Catchment 4	0.1474	122		
Pre-development Total	**1.1621**	122	0.239	239
SC&L Site	0.5415	122	0.111	111

Post-development Catchment and Peak Flow Summary						
Catchment	**Area (ha)**	**10% AEP rainfall depth (TP108) (mm)**	**10% AEP Un-attenuated Peak Flow (m^3/s)**	**10% AEP Attenuated Peak Outflow from Tank (m^3/s)**	**Target (Allowed) Outflow (m^3/s)**	**Comments**
SC&L (to Hiwa Tank)	0.5415	142.7	0.142	0.095	0.107	less than targeted flow, ok
Hiwa (to SC&L Tank)	0.6652	142.7	0.175	0.0864	0.089	less than targeted flow, ok
Catchment 1	0.6284	122	0.129	-	-	No change to existing catchment
Post-development Total	**1.2936**	-	0.304	0.215		Post-dev peak flow to downstream public network less than pre-dev

	TP108 rainfall depth without climate change (mm) - *Figure 1,2,and 3*	CC factor - *Figure 4*	TP108 rainfall depth with climate change (mm)
2-year ARI	75	15.1%	**86.3**
5-year ARI	105	16.4%	**122.2**
10-year ARI	122	17.0%	**142.7**

Figures: 1, 2, and 3. Daily rainfall depth maps - AC TP108

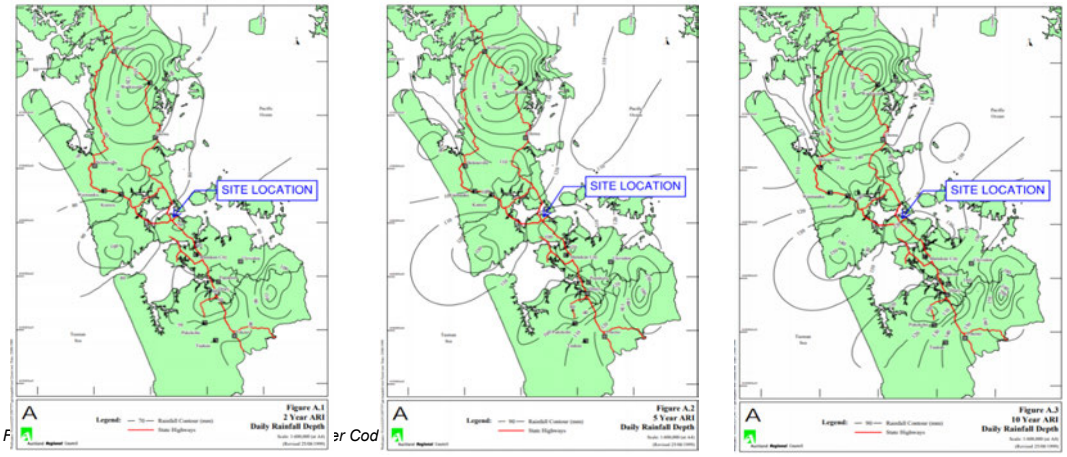

Table 1: Percentage increase in TP108 24-hour design rainfall depth

Annual exceedance probability (AEP)	Percentage Increase in 24-hour design rainfall depth due to future climate change – 2.1°	Percentage Increase in 24-hour design rainfall depth due to future climate change – 3.8°
50%	15.1%	27.4%
20%	16.4%	29.6%
10%	17.0%	30.8%
5%	17.2%	31.2%
2%	17.6%	31.9%
1%	18.1%	32.7%

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JOB NO: 5013381
CALCS BY: Luke C — DATE 9/07/2026
REVIEWED BY: Selina Z — DATE 29/10/2026

Hydrographs- SCS Method:

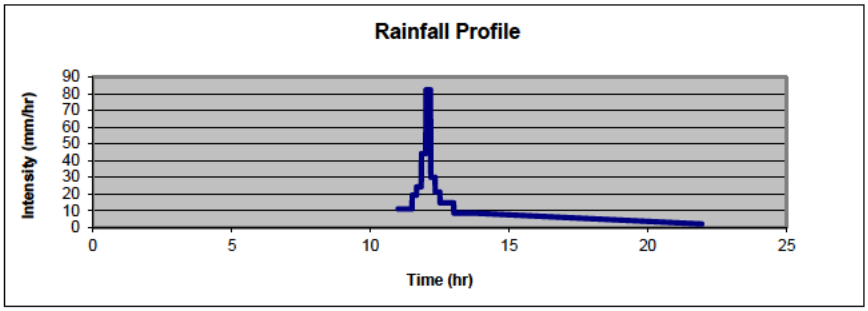
Project Description Catchment 1 Pre-development (to Alfred Street)

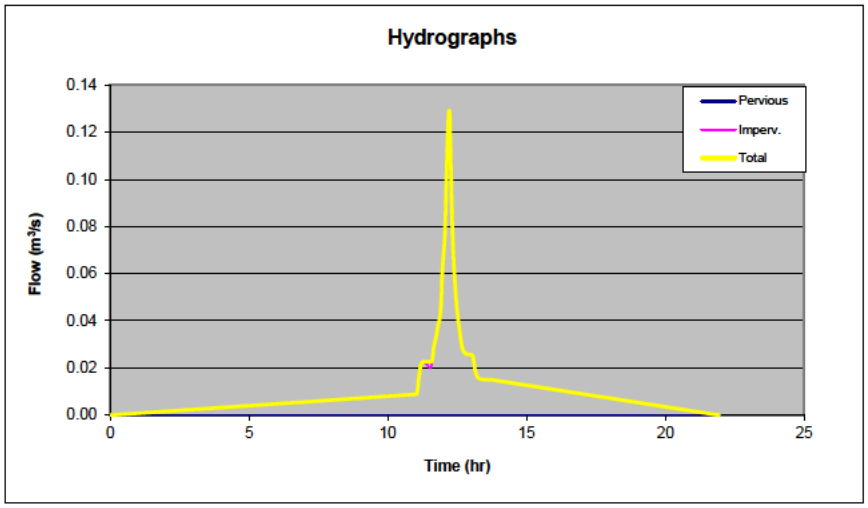
Rainfall Depth (mm) 122

Notes:
1. *Inputs*
2. *Typical inputs for CN are in 'Typical CN Values' Sheet*
3. *Method based on ARC TP108*

Catchment Data	Pervious Area	Impervious Area
Area (ha)	**0**	0.6284
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0	0.6284	0.6284
Runoff (mm)	66.4	117.0	117.0
Peak Flow (m^3/s)	0.000	0.129	0.129
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	82.35	82.35	82.35
Runoff Coefficient - Peak	0.00	0.90	0.90
Runoff Coefficient - Volume	0.54	0.96	0.96





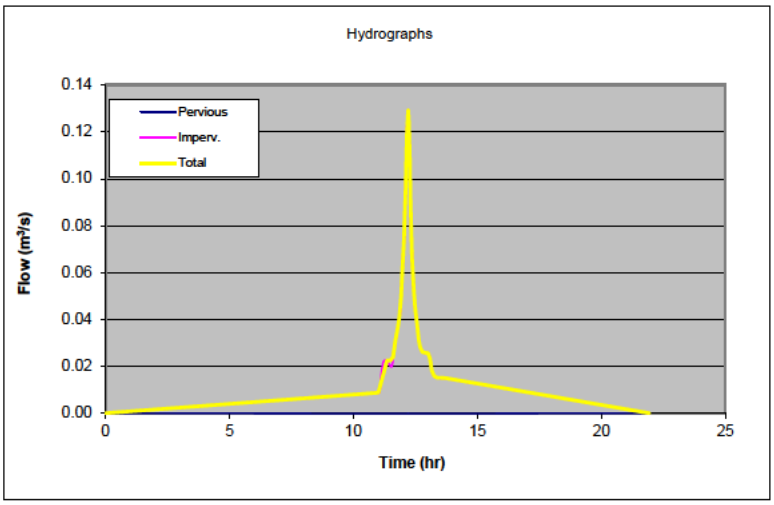
JOB NO: 0

Hydrographs- SCS Method:

Project Description Catchment 1 Pre-development (to Alfred Street)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m^3/s)
0.000	0.000
11.001	0.009
11.347	0.023
11.491	0.023
11.601	0.024
11.694	0.031
11.776	0.036
11.850	0.040
11.918	0.050
11.981	0.064
12.040	0.074
12.096	0.095
12.150	0.119
12.201	0.129
12.232	0.125
12.264	0.110
12.297	0.092
12.331	0.077
12.365	0.067
12.400	0.059
12.437	0.052
12.474	0.046
12.513	0.042
12.553	0.039
12.594	0.035
12.637	0.031
12.682	0.029
12.729	0.027
12.778	0.026
12.830	0.026
12.886	0.026
12.945	0.026
13.010	0.026
13.082	0.023
13.163	0.018
13.260	0.016
13.386	0.015
13.690	0.015
21.936	0.000
-1.000	0.000

Beca Ltd

JOB NO: 5013381
CALCS BY: Luke C — DATE 9/07/2026
REVIEWED BY: Selina Z — DATE 29/10/2026

Hydrographs- SCS Method:

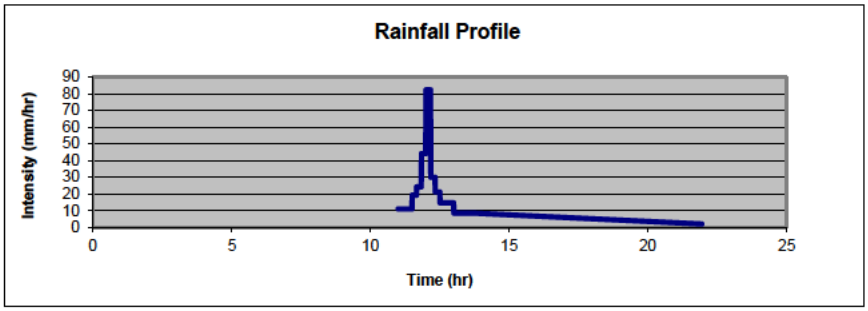
Project Description Catchment 2 Pre-development (to Alfred Street)

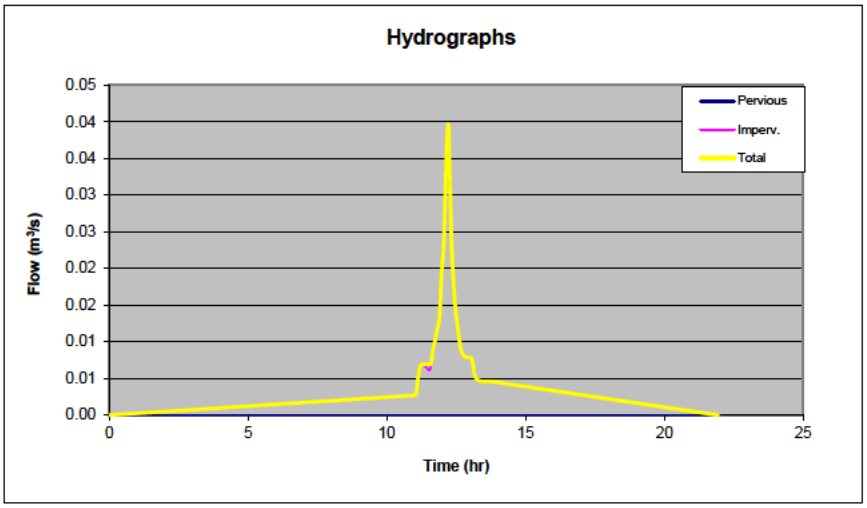
Rainfall Depth (mm) 122

Notes:
1. *Inputs*
2. *Typical inputs for CN are in 'Typical CN Values' Sheet*
3. *Method based on ARC TP108*

Catchment Data	Pervious Area	Impervious Area
Area (ha)	**0**	0.19278
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0	0.19278	0.19278
Runoff (mm)	66.4	117.0	117.0
Peak Flow (m^3/s)	0.000	0.040	0.040
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	82.35	82.35	82.35
Runoff Coefficient - Peak	0.00	0.90	0.90
Runoff Coefficient - Volume	0.54	0.96	0.96





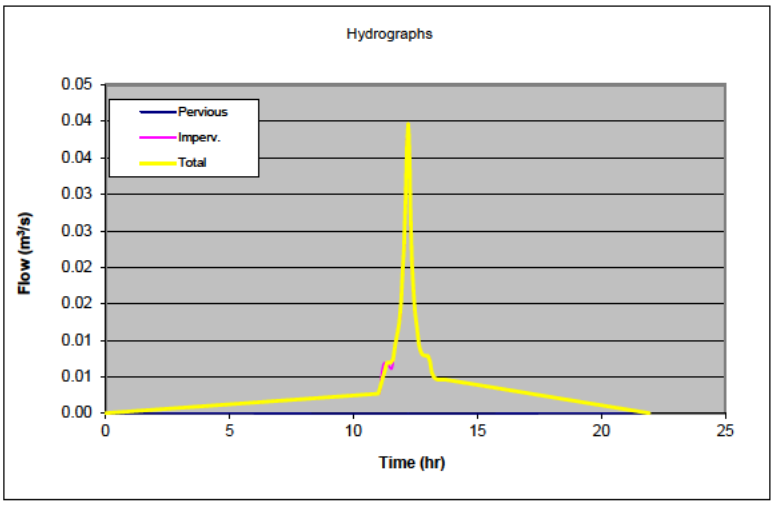
JOB NO: 0

Hydrographs- SCS Method:

Project Description Catchment 2 Pre-development (to Alfred Street)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m^3/s)
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11.347	0.007
11.491	0.007
11.601	0.007
11.694	0.010
11.776	0.011
11.850	0.012
11.918	0.015
11.981	0.020
12.040	0.023
12.096	0.029
12.150	0.036
12.201	0.040
12.232	0.038
12.264	0.034
12.297	0.028
12.331	0.024
12.365	0.020
12.400	0.018
12.437	0.016
12.474	0.014
12.513	0.013
12.553	0.012
12.594	0.011
12.637	0.010
12.682	0.009
12.729	0.008
12.778	0.008
12.830	0.008
12.886	0.008
12.945	0.008
13.010	0.008
13.082	0.007
13.163	0.006
13.260	0.005
13.386	0.005
13.690	0.005
21.936	0.000
-1.000	0.000

Beca Ltd

JOB NO:	5013381		
CALCS BY:	Luke C	DATE	9/07/2026
REVIEWED BY:	Selina Z	DATE	29/10/2026

Hydrographs- SCS Method:

Project Description Catchment 3 and 4 Pre-development (Existing Catchments to Alleyway)

Rainfall Depth (mm) 122

Notes:

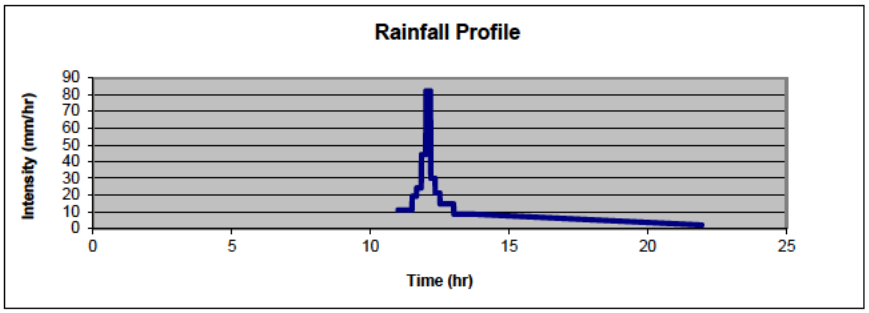
1. Inputs

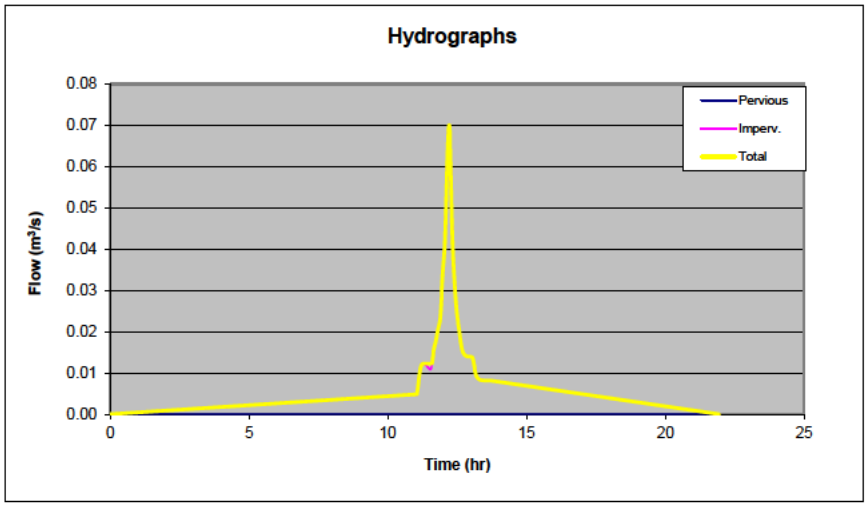
2. Typical inputs for CN are in 'Typical CN Values' Sheet

3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0	0.34093
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0	0.34093	0.34093
Runoff (mm)	66.4	117.0	117.0
Peak Flow (m^3/s)	0.000	0.070	0.070
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	82.35	82.35	82.35
Runoff Coefficient - Peak	0.00	0.90	0.90
Runoff Coefficient - Volume	0.54	0.96	0.96





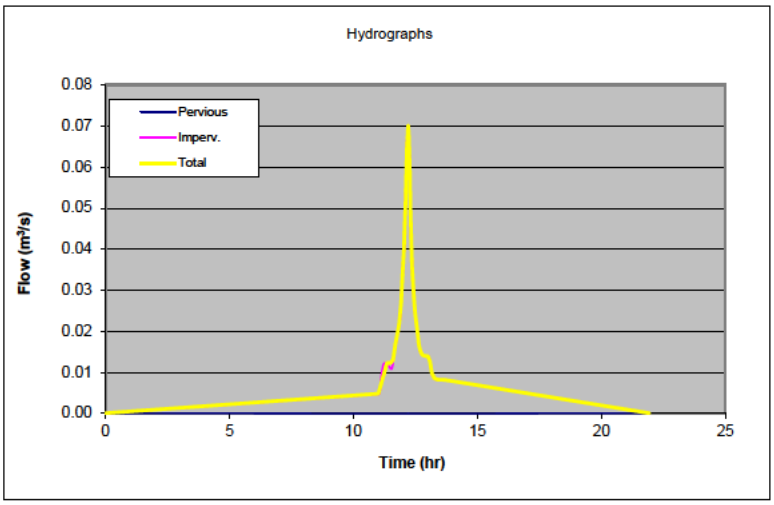
JOB NO: 0

Hydrographs- SCS Method:

Project Description Catchment 3 and 4 Pre-development (Existing Catchments to Alleyway)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m^3/s)
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11.347	0.012
11.491	0.012
11.601	0.013
11.694	0.017
11.776	0.020
11.850	0.022
11.918	0.027
11.981	0.035
12.040	0.040
12.096	0.052
12.150	0.064
12.201	0.070
12.232	0.068
12.264	0.060
12.297	0.050
12.331	0.042
12.365	0.036
12.400	0.032
12.437	0.028
12.474	0.025
12.513	0.023
12.553	0.021
12.594	0.019
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13.082	0.013
13.163	0.010
13.260	0.009
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13.690	0.008
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-1.000	0.000

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JOB NO:	5013381		
CALCS BY:	Luke C	DATE	25/08/2026
REVIEWED BY:	Selina Z	DATE	26/08/2026

Hydrographs- SCS Method:

Project Description Existing Site

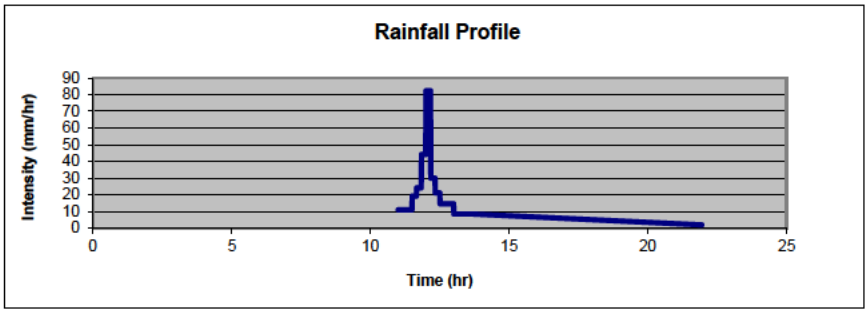
Rainfall Depth (mm) 122

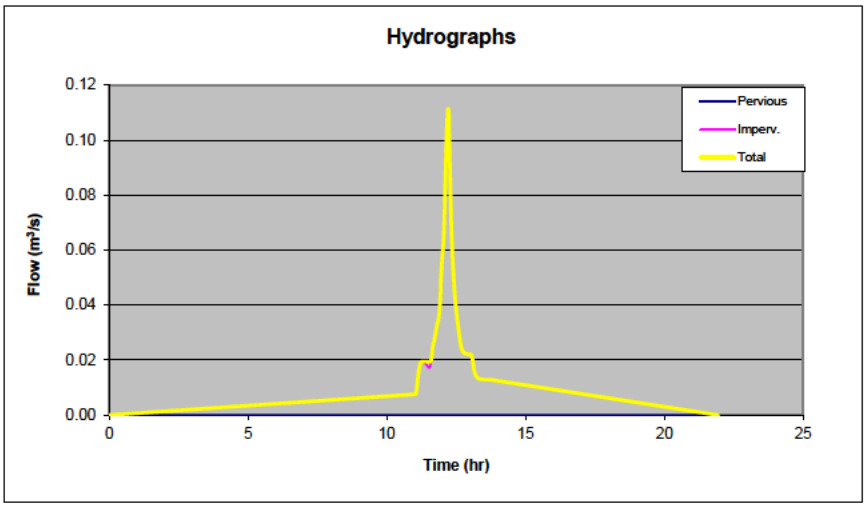
Notes:
1. *Inputs*
2. *Typical inputs for CN are in 'Typical CN Values' Sheet*
3. *Method based on ARC TP108*

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0	0.5415
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0	0.5415	0.5415
Runoff (mm)	66.4	117.0	117.0
Peak Flow (m^3/s)	0.000	0.111	0.111
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	82.35	82.35	82.35
Runoff Coefficient - Peak	0.00	0.90	0.90
Runoff Coefficient - Volume	0.54	0.96	0.96

80% of pre-development flow
0.08914 89.14





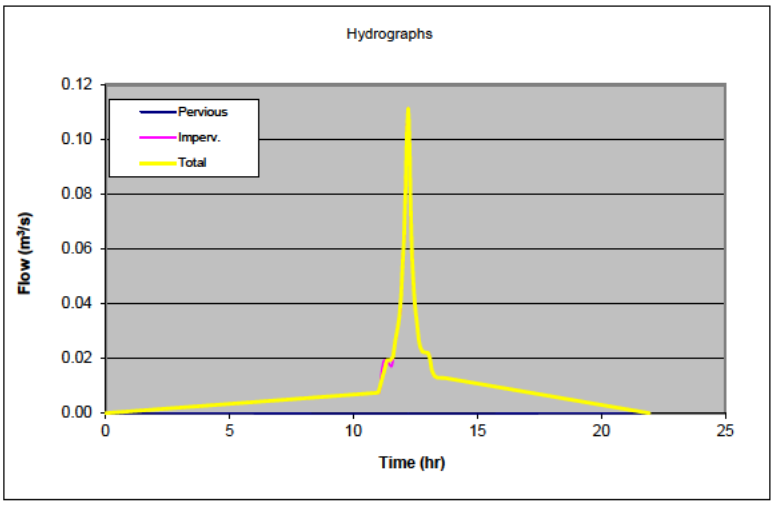
JOB NO: 0

Hydrographs- SCS Method:

Project Description Existing Site

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m^3/s)
0.000	0.000
11.001	0.008
11.347	0.020
11.491	0.020
11.601	0.021
11.694	0.027
11.776	0.031
11.850	0.035
11.918	0.043
11.981	0.055
12.040	0.064
12.096	0.082
12.150	0.102
12.201	0.111
12.232	0.107
12.264	0.095
12.297	0.079
12.331	0.066
12.365	0.057
12.400	0.051
12.437	0.045
12.474	0.040
12.513	0.036
12.553	0.034
12.594	0.030
12.637	0.027
12.682	0.025
12.729	0.023
12.778	0.023
12.830	0.022
12.886	0.022
12.945	0.022
13.010	0.022
13.082	0.020
13.163	0.016
13.260	0.014
13.386	0.013
13.690	0.013
21.936	0.000
-1.000	0.000

Beca Ltd

JOB NO: 5013381
CALCS BY: Luke C — DATE 9/07/2026
REVIEWED BY: Selina Z — DATE 26/08/2026

Hydrographs- SCS Method:

Project Description SC&L Post-development (to Existing Hiwa Tank)

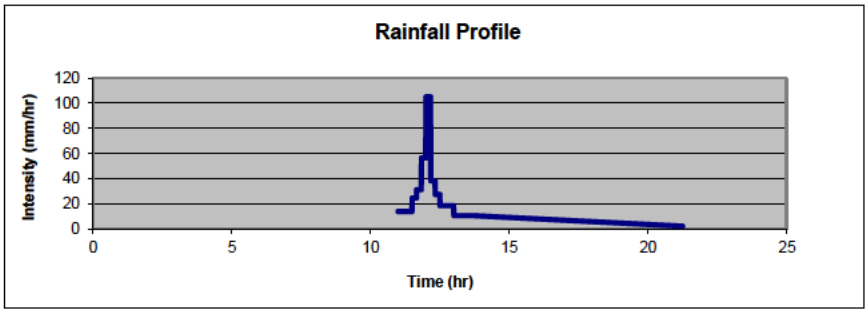
Rainfall Depth (mm) 142.74

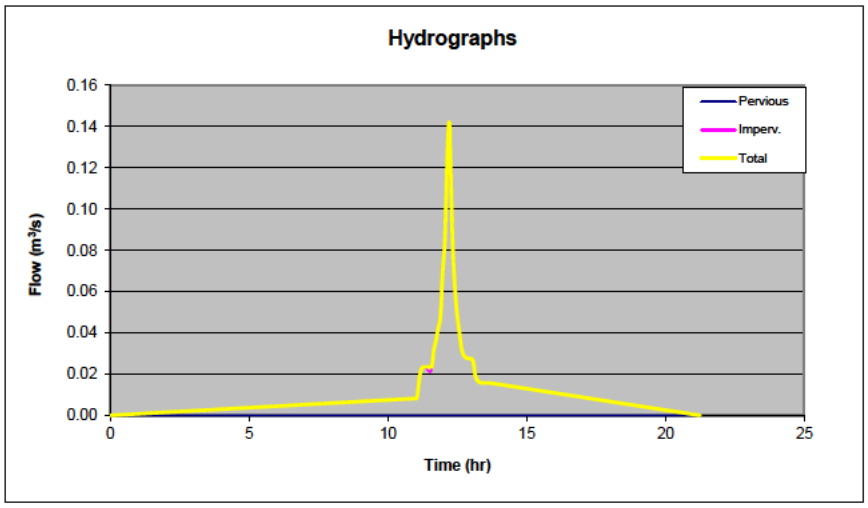
Notes:
1. Inputs
2. Typical inputs for CN are in 'Typical CN Values' Sheet
3. Method based on ARC TP108

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0	0.5415
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Area (ha)	0	0.5415	0.5415
Runoff (mm)	83.6	137.7	137.7
Peak Flow (m^3/s)	0.000	0.142	0.142
Time (hr) at Peak Flow	12.21	12.20	12.20
Rainfall (mm/h) over tc	105.03	105.03	105.03
Runoff Coefficient - Peak	0.00	0.90	0.90
Runoff Coefficient - Volume	0.59	0.96	0.96

Runoff Volume (m^3) 745.85





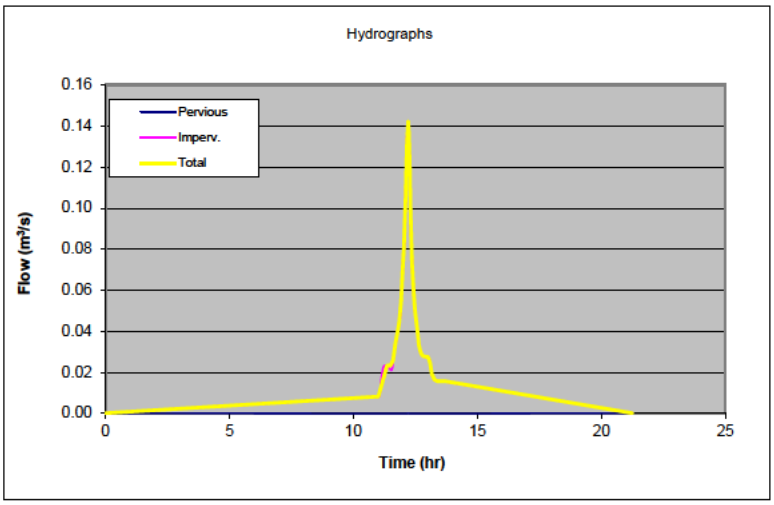
JOB NO: 0

Hydrographs- SCS Method:

Project Description SC&L Post-development (to Existing Hiwa Tank)

Total Hydrograph in tabular form: (based on simulation from above)

Volumetric error in scaling 0.01%



Time (hr)	Flow (m^3/s)
0.000	0.000
11.001	0.008
11.347	0.023
11.491	0.023
11.601	0.026
11.694	0.034
11.776	0.040
11.850	0.044
11.918	0.055
11.981	0.070
12.040	0.082
12.096	0.105
12.150	0.131
12.201	0.142
12.232	0.137
12.264	0.121
12.297	0.101
12.331	0.084
12.365	0.073
12.400	0.065
12.437	0.057
12.474	0.051
12.513	0.046
12.553	0.043
12.594	0.039
12.637	0.034
12.682	0.031
12.729	0.029
12.778	0.028
12.830	0.028
12.886	0.028
12.945	0.028
13.010	0.028
13.082	0.025
13.163	0.019
13.260	0.016
13.386	0.016
13.690	0.016
21.245	0.000
-1.000	0.000

Beca Ltd

Hydrograph Routing

JOB NO: 5013381
CALCS BY: Luke C — DATE: 9/07/2026
REVIEWED BY: Selina Z — DATE: 26/08/2026

Project Description HIWA existing tank under ramp

Stability Coefficient (0.5-1.0)	0.75
Start time (hr)	0
Finish time (hr)	24
Extraction rate (m^3/s)	0.00

1. Input data should be in ascending order in the boxes provided. The maximum no. of values is 40, 20 & 20. If a lesser no. of values is needed then terminate as a -1 for the x value.
2. If there is instability in the results then check that the depth/ vol. and/or the flow rating covers the flow range. Otherwise increase the stability coefff. towards 1.0. A value close to 0.5 has better accuracy.
3. Initial pond level will be taken as the RL corresponding to the initial flow on the inflow hydrograph.
4. Extraction rate applies to external pumping or infiltration.

Inflow Hydrograph

Time (hr)	Flow (m3/s)
0.000	0.000
11.001	0.008
11.347	0.023
11.491	0.023
11.601	0.026
11.694	0.034
11.776	0.040
11.850	0.044
11.918	0.055
11.981	0.070
12.040	0.082
12.096	0.105
12.150	0.131
12.201	0.142
12.232	0.137
12.264	0.121
12.297	0.101
12.331	0.084
12.365	0.073
12.400	0.065
12.437	0.057
12.474	0.051
12.513	0.046
12.553	0.043
12.594	0.039
12.637	0.034
12.682	0.031
12.729	0.029
12.778	0.028
12.830	0.028
12.886	0.028
12.945	0.028
13.010	0.028
13.082	0.025
13.163	0.019
13.260	0.016
13.386	0.016
13.690	0.016
21.245	0.000
-1.000	0.000

Depth/ Volume Relationship

RL (m)	Volume (m^3)
0.000	0.00
0.100	3.70
0.200	7.30
0.300	11.00
0.400	14.60
0.500	18.30
0.600	21.70
0.700	25.00
0.800	28.00
0.900	30.80
1.000	33.40
1.100	35.80
1.200	37.90
1.300	39.90
1.400	41.60
1.500	42.10
1.600	42.10
-1.000	

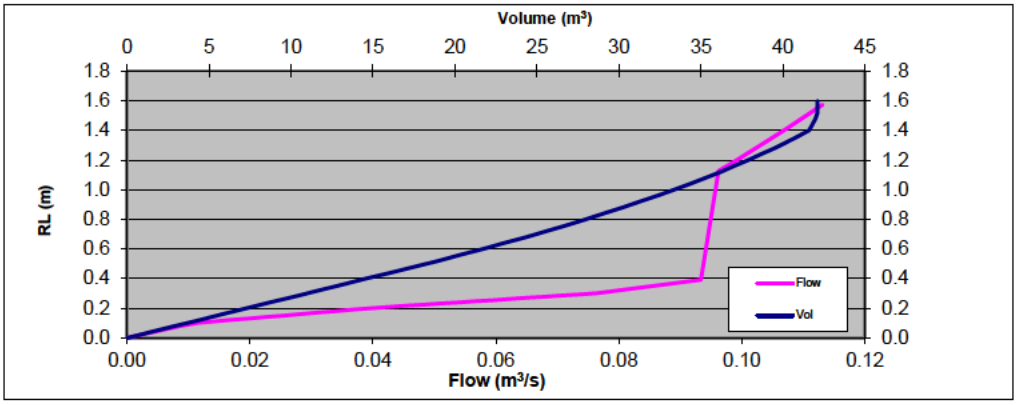
Used the same table as per Conor's design for HIWA

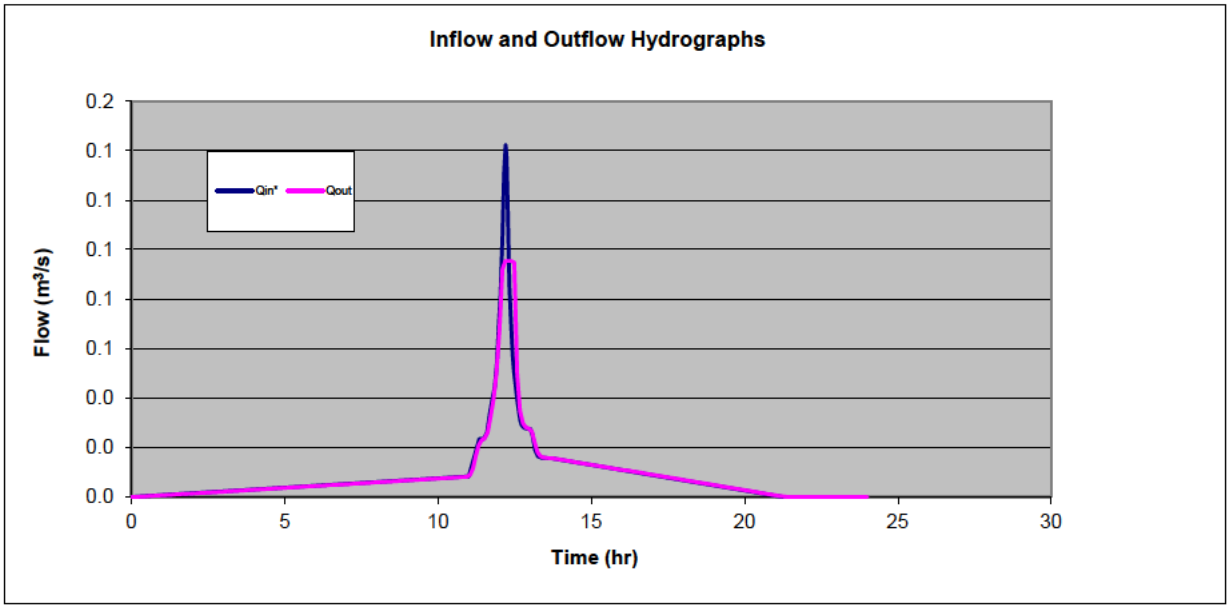
Flow Rating Curve

RL (m)	Flow (m3/s)
0.000	0.000
0.100	0.011
0.200	0.039
0.300	0.076
0.400	0.095
0.500	0.095
0.600	0.095
0.700	0.095
0.800	0.095
0.900	0.095
1.000	0.095
1.100	0.095
1.200	0.099
1.300	0.103
1.400	0.107
1.500	0.111
1.600	0.114
-1.000	

Results:

Max.Inflow (m^3/s)	0.142
Time at Max. Inflow (hr)	12.19
Max. Outflow (m^3/s)	0.095
Time at Max. Outflow (hr)	12.38
Initial RL (m)	0.000
Max. RL (m)	1.037
Max. Volume (m^3)	34.3
Inflow Volume (m^3)	756.3
Volumetric error	0.00%
Extraction Volume (m^3)	0.0





Beca Ltd

JOB NO: 5013381
CALCS BY: Luke C DATE 9/07/2026
REVIEWED BY: Selina Z DATE 26/08/2026

Hydrographs- SCS Method:

Project	UoA Student Centre and Library
Designer	Selina
Structure	New tank attenuate HIWA flow to achieve 2 GS credits for SC&L

Attenuation Criteria
2, 5, 10, 20, 50, 100 Yr ARI

Rainfall depths (mm)						
Case	2yr ARI	5yr ARI	10yr ARI	20yr ARI	50yr ARI	100yr ARI
24hr Depth	75	105	122	140	160	182.4
Climate Change	15.1%	16.4%	17.0%	31.2%	31.9%	32.7%
24hr CC Depth	86.3	122.2	142.7	183.7	211.0	242.0

TP108 Rainfall Maps Data
AC SWCoP v. 4

Catchment Areas					
		To Attenuation Tank		Uncontrolled Discharge	
Case	Total Area (ha)	Pervious (ha)	Impervious (ha)	Pervious (ha)	Impervious (ha)
Pre-dev	0.6652			0.0000	0.6652
Post-dev	0.6652	0.0000	0.6652	0.0000	0.0000

*Pre-development flows are based off scaling the whole site's existing impervious % value, to the proposed sub-catchment area for a pre-post development comparision

CN	
Pervious	74
Impervious	98

Time of Concentration	
Case	Minutes
Pervious	10
Impervious	10

Tank Classification
Cubic tank

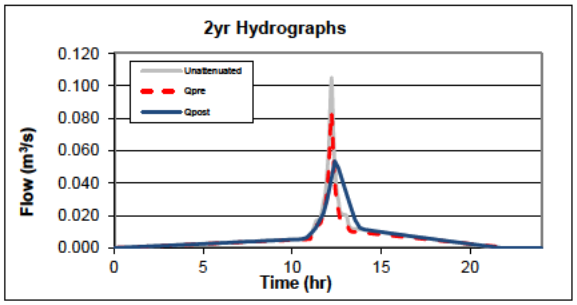
Singular Tank Dimentions	
Length (m)	10
Width (m)	9
Height (m)	1.5
Void Ratio	1.00
Volume (m^3)	135

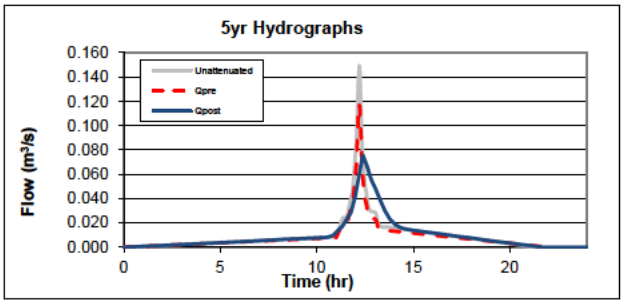
# of Tanks	
Rows	1
Columns	1
Stacked	1
Length (m)	10.00
Width (m)	9.00
Height (m)	1.50
Area (m^2)	90.00
Volume (m^3)	135.00

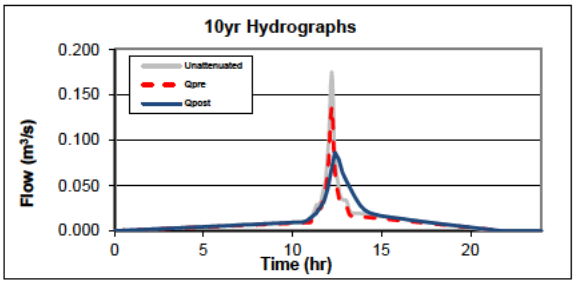
Slope Along Tank Length
0.00%

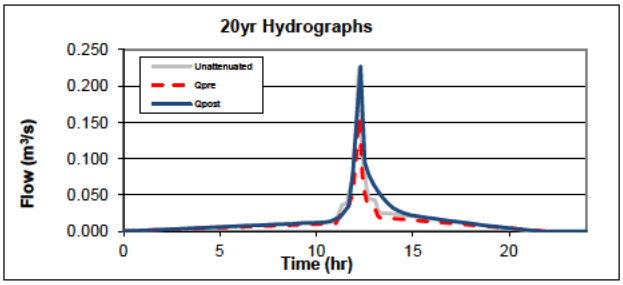
Structure outlet (Relative to Tank IL)			
Outlet	Orifice/weir	Invert (m)	Dia/width (m)
Primary	*Orifice*	0.00	0.168
Secondary	*Orifice*	1.00	0.090
Tertiary	*Weir*	1.50	0.375

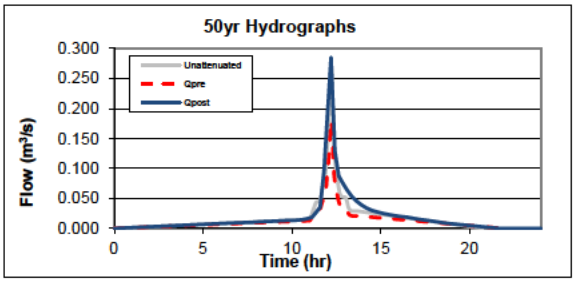
	Peak Discharge (L/s)							
Case	Post-dev flow (Hiwa)	80% SC&L Pre-dev flow	Stored Volume (m^3)	Tank Depth (m)	*Unattenuated Post-dev flow (L/s)*	*Minimum Attenuation Required (L/s)*	Peak Attenuated Tank Discharge (L/s)	OK?
2yr ARI	53.5	54.3	69.531	0.773	105.0	50.7	53.5	OK
5yr ARI	75.7	76.6	110.345	1.226	149.5	72.9	75.7	OK
10yr ARI	86.4	89.1	133.808	1.487	174.9	85.7	86.4	OK

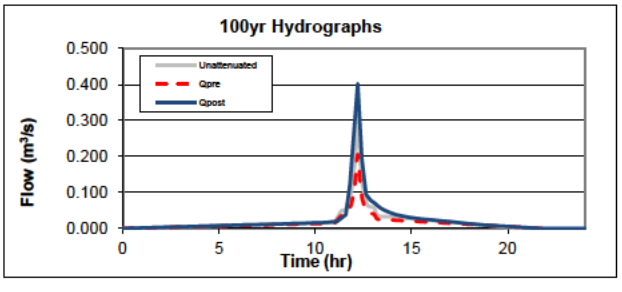












Beca Ltd

Beca

JOB NO: 5013381
CALCS BY: Luke C DATE 13/07/2026
REVIEWED BY: Selina Z DATE 26/08/2026

Hydraulic Grade Line Analysis:

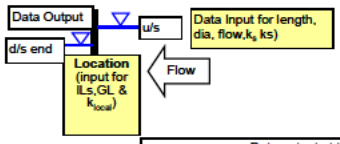
Project Description Alfred St Pre-development

Downstream HGL (m)	37.78
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Basis of computations
Calculations are from downstream (d/s) to upstream (u/s) as per the table input.
Energy ($E_{u/s}$)= $E_{d/s}+S_f\Delta x+k_{local}v^2/2g$
$HGL_{u/s}=E_{u/s}-v^2/2g$
Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.
If HGL falls below the pipe overt, some partial full condition is assumed.

Notes:
Input
The following table can input 20 components.
Inputa data starts at the d/s end and progresses u/s
Input data on pipe dia, flow, and k_s applies to the pipe u/s.
Terminate list by making length = -1.0

Grade 1 150



Location	Length (to u/s-m)	Pipe dia. (m)	Invert level (d/s-RL m)	Invert level (u/s-RL(m)	Ground level (d/s-RL m)	Specified Flow (m^3/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram): Distance (m)	Actual Flow (m^3/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
SWMH 16	15.1	0.6	37.18	37.22	40.67	0.239	1.5	0.5	0.00	0.239	0.85	0.0742	37.80	37.83	2.87
SWMH 15	6.1	0.6	38.34	38.39	41.50	0.169	1.5	0.2	15.10	0.169	0.60	0.0607	38.66	38.78	2.84
SWMH 14	-1		38.76	38.79	41.86		1.5	0.2	21.20				39.02	39.13	2.84

REFER TO TOPOGRAPHICAL SURVEY 7119-600-01 REVISION 2 FOR MANHOLE LOCATIONS



Recommended local manhole losses (k_{local}) for haunched MHs
(Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge Lateral inflow: None	With Surcharge Lateral inflow: Some	Drop MH
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m)	**1.31**
Energy loss due to friction (m)	0.03
Energy loss due to local headlosses (m)	0.03
Energy loss due to geometry (m)	1.26

Beca Ltd

JOB NO: 5013381
CALCS BY: Luke C DATE: 13/07/2026
REVIEWED BY: Selina Z DATE: 26/08/2026

Hydraulic Grade Line Analysis:

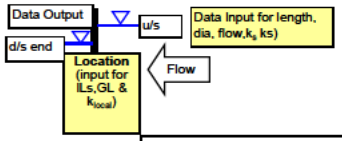
Project Description Alfred St Post-development

Downstream HGL (m)	37.78
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Basis of computations
Calculations are from downstream (d/s) to upstream (u/s) as per the table input.
Energy ($E_{u/s}$)= $E_{d/s}+S_f\Delta x+k_{local}\,v^2/2g$
$HGL_{u/s}=E_{u/s}-v^2/2g$
Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.
If HGL falls below the pipe overt, some partial full condition is assumed.

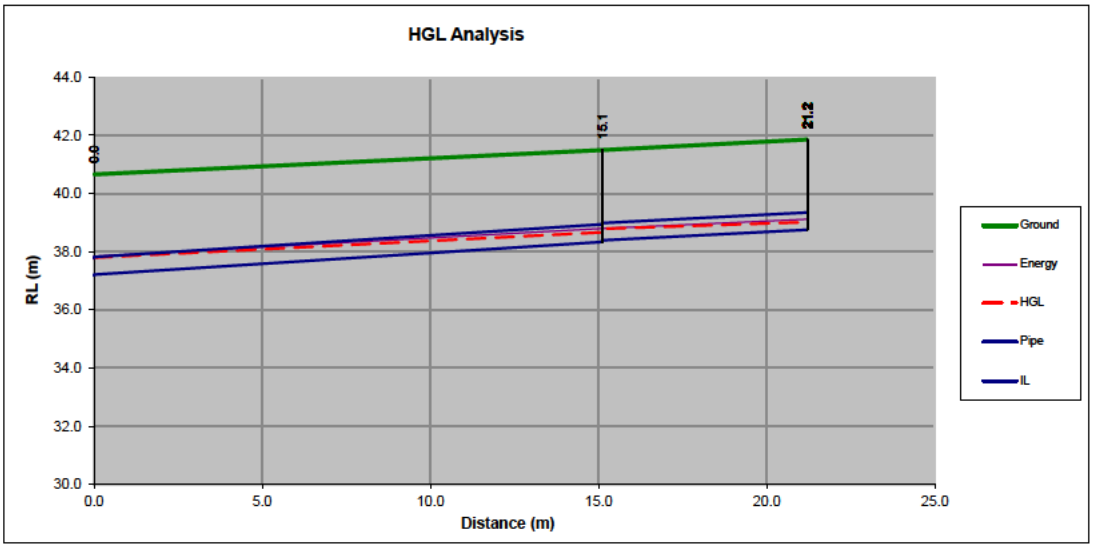
Notes:
Input
The following table can input 20 components.
Inputa data starts at the d/s end and progresses u/s
Input data on pipe dia, flow, and k_s applies to the pipe u/s.
Terminate list by making length = -1.0

Grade 1 150



Location	Length (to u/s-m)	Pipe dia. (m)	Invert level (d/s-RL m)	Invert level (u/s-RL(m)	Ground level (d/s-RL m)	Specified Flow (m^3/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram) Distance (m)	Actual Flow (m^3/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
SWMH 16	15.1	0.6	37.18	37.22	40.67	0.251	1.5	0.5	0.00	0.251	0.89	0.0742	37.80	37.84	2.87
SWMH 15	6.1	0.6	38.34	38.39	41.50	0.165	1.5	0.2	15.10	0.165	0.58	0.0607	38.67	38.80	2.83
SWMH 14	-1		38.76	38.79	41.86		1.5	0.2	21.20				39.02	39.12	2.84

REFER TO TOPOGRAPHICAL SURVEY 7119-600-01
REVISION 2 FOR MANHOLE LOCATIONS



Recommended local manhole losses (k_{local}) for haunched MHs
(Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge Lateral inflow None	With Surcharge Lateral inflow Some	Drop MH
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m)	**1.30**
Energy loss due to friction (m)	0.03
Energy loss due to local headlosses (m)	0.03
Energy loss due to geometry (m)	1.24

Beca Ltd

JOB NO: 5013381
CALCS BY: Luke C DATE 13/07/2026
REVIEWED BY: Selina Z DATE 26/08/2026

Hydraulic Grade Line Analysis:

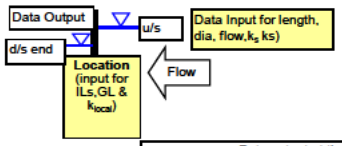
Project Description Existing Laneway Pre-development

Downstream HGL (m)	38.69
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Basis of computations
Calculations are from downstream (d/s) to upstream (u/s) as per the table input.
Energy ($E_{u/s}$)= $E_{d/s}+S_f\Delta x+k_{local}v^2/2g$
$HGL_{u/s}=E_{u/s}-v^2/2g$
Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.
If HGL falls below the pipe overt, some partial full condition is assumed.

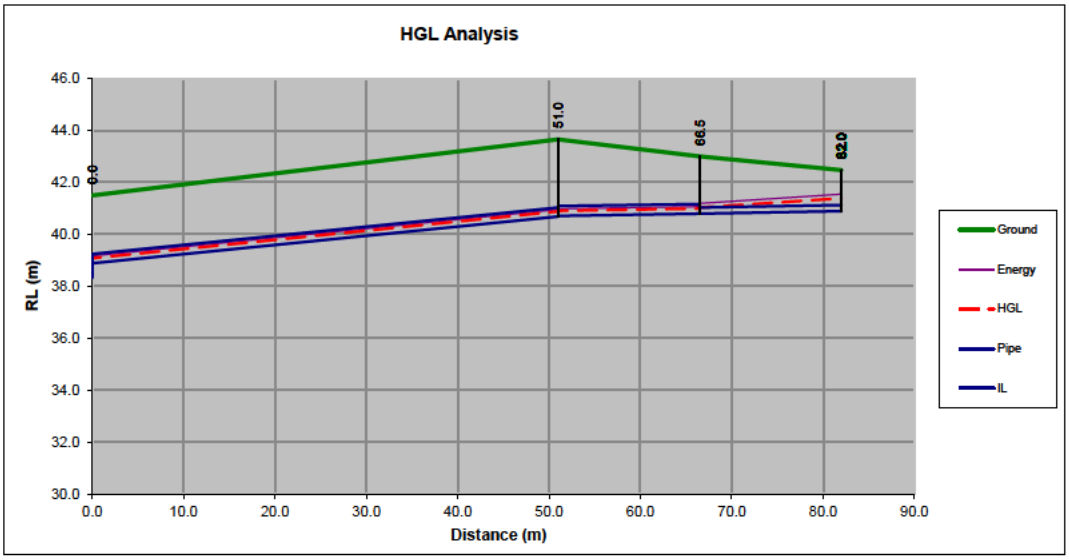
Notes:
Input
The following table can input 20 components.
Inputa data starts at the d/s end and progresses u/s
Input data on pipe dia, flow, and k_s applies to the pipe u/s.
Terminate list by making length = -1.0

Grade 1 150



Location	Length (to u/s-m)	Pipe dia. (m)	Invert level (d/s-RL m)	Invert level (u/s-RL(m)	Ground level (d/s-RL m)	Specified Flow (m^3/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram) Distance (m)	Actual Flow (m^3/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
SWMH 15	51	0.35	38.34	38.89	41.50	0.070	1.5	0.5	0.00	0.070	0.73	0.0351	39.09	39.17	2.41
SWMH 17	15.5	0.375	40.68	40.71	43.66	0.070	1.5	0.2	51.00	0.070	0.63	0.0058	40.88	40.96	2.78
Change in size	15.5	0.225	40.80	40.80	43.00	0.070	1.5	0.2	66.50	0.070	1.76	0.0065	40.99	41.07	2.01
SWMH 19	-1		40.90	40.92	42.47	0.070	1.5	0.2					41.39	41.55	1.08

REFER TO TOPOGRAPHICAL SURVEY 7119-600-01 REVISION 2 FOR MANHOLE LOCATIONS



Recommended local manhole losses (k_{local}) for haunched MHs
(Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge Lateral inflow None	With Surcharge Lateral inflow Some	Drop MH
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m)	**2.83**
Energy loss due to friction (m)	0.51
Energy loss due to local headlosses (m)	0.02
Energy loss due to geometry (m)	2.30

Beca Ltd

Beca

JOB NO: 5013381
CALCS BY: Luke C
REVIEWED BY: Selina Z
DATE 13/07/2026
DATE 26/08/2026

Hydraulic Grade Line Analysis:

Project Description Existing Laneway Post-development

Downstream HGL (m)	38.69
Downstream Distance (m)	0
Flow Factor	1 (Actual/Specified)

Basis of computations

Calculations are from downstream (d/s) to upstream (u/s) as per the table input.

Energy ($E_{u/s}$)= $E_{d/s}+S_f\Delta x+k_{local}v^2/2g$

$HGL_{u/s}=E_{u/s}-v^2/2g$

Where S_f is the friction slope based on Colebrook-White and v is the pipe velocity.

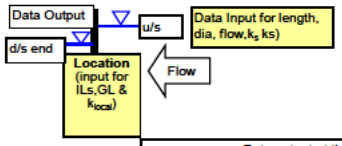
If HGL falls below the pipe overt, some partial full condition is assumed.

Notes:

Input

The following table can input 20 components.
Inputa data starts at the d/s end and progresses u/s
Input data on pipe dia, flow, and k_s applies to the pipe u/s.
Terminate list by making length = -1.0

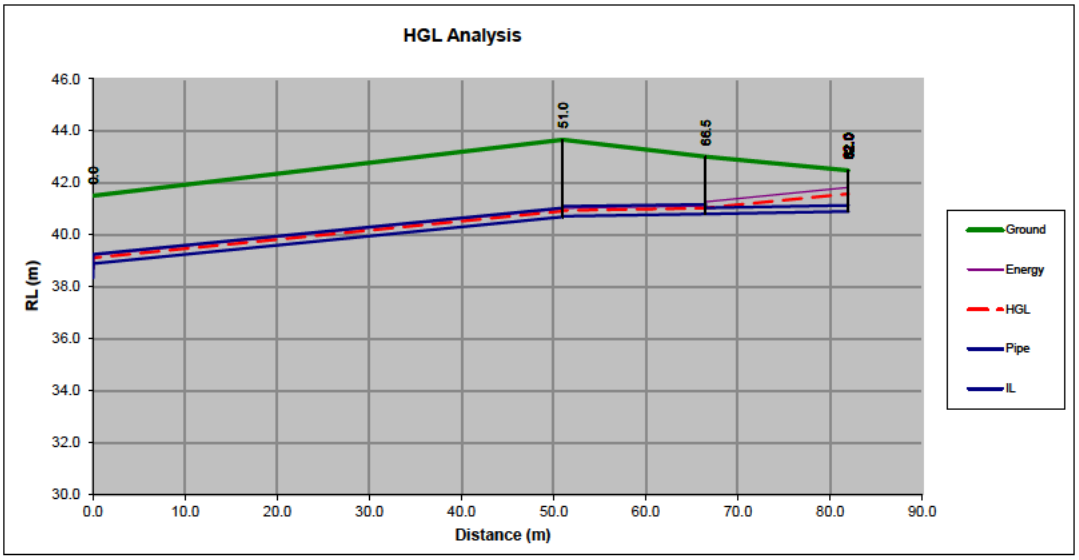
Grade 1 150



Location	Length (to u/s-m)	Pipe dia. (m)	Invert level (d/s-RL m)	Invert level (u/s-RL(m)	Ground level (d/s-RL m)	Specified Flow (m^3/s)	k_s (mm)	k_{local} (u/s)	Data output at the u/s end of the pipe (see diagram) Distance (m)	Actual Flow (m^3/s)	Pipe full Vel (m/s)	Pipe slope (m/m)	HGL (m)	Energy (m)	Freeboard to GL (m)
SWMH 15	51	0.35	38.34	38.89	41.50	0.086	1.5	0.5	0.00	0.086	0.90	0.0351	39.11	39.20	2.39
SWMH 17	15.5	0.375	40.68	40.71	43.66	0.086	1.5	0.2	51.00	0.086	0.78	0.0058	40.90	40.99	2.76
Change in size	15.5	0.225	40.80	40.80	43.00	0.086	1.5	0.2	66.50	0.086	2.17	0.0065	41.02	41.10	1.98
SWMH 19	-1		40.90	40.92	42.47	0.086	1.5	0.2					41.58	41.82	0.89

REFER TO TOPOGRAPHICAL SURVEY 7119-600-01 REVISION 2 FOR MANHOLE LOCATIONS

PEAK OUTFLOW FROM NEW SC&L TANK



Recommended local manhole losses (k_{local}) for haunched MHs

(Losses based on d/s velocity)

Deviation Angle °	No surcharge	With Surcharge Lateral inflow None	With Surcharge Lateral inflow Some	Drop MH
0	0.2	0.2	0.5	1.5
45	0.5	0.5	1.0	1.5
90	1.2	1.5	1.5	2.0

Total energy change (m)	**3.09**
Energy loss due to friction (m)	0.77
Energy loss due to local headlosses (m)	0.04
Energy loss due to geometry (m)	2.29