Stormwater Report for Resource Consent Application – Stage 2

State Highway 16: Brigham Creek to Kumeū Safety Improvements

22 November 2022

Revision D - For Resource Consent

DOCUMENT CONTROL

Details	For Resource Consent	Date:22.11.2022	Revision: D
Project Phase	For Resource Consent		
Project Name	SH16 Brigham Creek to Kumeū Safety Improvements		

Engineering Staff	Name & Surname	Signature	Date
Prepared by: (Designer)	Shannon Bridge		
Reviewed by: (Technical Subject Specialist)	Samantha Fraser		
Reviewed by: (Design Manager)	Gareth Clayton		
Reviewed by: (Planner)	Ashlie Carlyle		
Verified by: (Technical Subject Specialist)			
Approval: (Project Director)			

CONTENTS

APPENDICES

Appendix A – DRAWING PLANS

Appendix B – 1% AEP FLOOD MAP – Auckland Council GeoMaps

Appendix C – STORMWATER CATCHMENT PLAN – 3235084-SK-2004 to 2006

Appendix D – CROSS CULVERT CATCHMENT PLAN – 3235084-SK-2010

Appendix E – KUMEŪ RIVER AND NGONGETEPARA STREAM DESIGN MEMOS

1 Introduction

This Resource Consent Report has been prepared by Beca Limited (Beca) to support the Assessment of Effects on the Environment (AEE) report for Waka Kotahi NZ Transport Agency (Waka Kotahi) for the SH16 Stage 2 Brigham Creek to Kumeū Project ('the Project'). The Project comprises of road safety, efficiency and walking and cycling improvements between Brigham Creek and Kumeū.

This stormwater report supports the AEE which forms part of the NoR and supports the application for the required resource consents for the improvement works for the Project.

1.1 Resource Consents Required

The table below identifies the resource consents required for the stormwater design, as part of the SH16 project. These are required pursuant to the Auckland Unitary Plan (AUP) standards, in order to construct, operate and maintain the Project.

Table 1-1: Regional resource consents sought under the AUP:OP

Consent	Plan Ref	Status	Comments
E3 Lakes rivers streams and wetlands			
New structures and the associated bed disturbance or depositing any substance, reclamation, diversion of water and incidental temporary damming of water Any activities not complying with the general permitted activity standards in E3.6.1.1 or the specific activity standards in E3.6.1.14 to E3.6.1.23	E3.4.1(A44)	Discretionary (outside overlays)	E3.4.1(A44) applies to new structures where reclamation or disturbance is associated with those new structures in, on or over a stream or wetland. The Project involves new bridges over streams for the Shared Use Path. E3.6.1.1.(4) ensures that machinery must not sit directly on the wetted cross-section of the bed at the time of the works. No machinery will be required in any stream beds across the alignment The Project will comply with rest of the permitted activity standards in E3.6.1.1 for the following reasons: The proposed structures around any streams will not, after reasonable mixing, result in any of the listed effects in water bodies outlined in E3.6.1.1(1) The structures will not result in an increase of existing flood levels up to and including the 1 per cent annual exceedance probability (AEP) flood plain. The activity will not result in any erosion or land instability. No explosives will be used in the stream bed. Mixing of construction materials and refuelling or maintenance of equipment will not occur within 10m of the bed and best site management practice will be used to

Consent	Plan Ref	Status	Comments
			avoid contaminant discharging into the water. The structures will not affect any sites scheduled in the Historic Heritage Overlay or the Sites and Places of Significance to Mana Whenua Overlay. The activity will enhance public access along streams. E3.6.1.14 is relevant to the project for new structures in streams and wetlands. The proposed structures comply with E3.6.1.14 for the following reasons: The new SUP is considered a structure over the streams, it will not progressively encase or otherwise modify the bed of a river or stream. No part of the structure is within the stream bed. Scour protection will be required at both the Kumeū River and the Ngongetepara Stream. Scour protection at Kumu River will extend approximately 5m out from the edge of the structure on the south side and 3m on the northern side, on the banks of Kumeū River. Scour protection will be required for the SUP structure at Ngongetepara Stream, this will extend approximately 5m out from the edge of the structure on the south side and approximately 2m to the northern side. Due to the approximate lengths of the scour protection, it is likely they may slightly exceed 5m and will not comply with E3.6.1.14(b). Consent under E3.4.1(A44) is therefore sought. During construction bed disturbance upstream or downstream of the structure must not exceed 10m either side, excluding the length of the structure. Fish passage will not be obstructed as there will be no structures in any stream bed. The structures will not cause more than minor bed erosion, scouring or undercutting up or downstream. There will be no structures in the bed of the stream (aside from minor riprap which is covered under AUP:OP Chapter E8 provisions and not E3).

Consent	Plan Ref	Status	Comments
			The 1per cent annual exceedance probability (AEP) flood will be accommodated by the SUP structure and by an overland flow path without increasing flood levels up stream or downstream. During construction, bed disturbance upstream and downstream of the new SUP structures will not exceed 10m either side of the structures or for the new SUP in the wetland at 522 SH16. Construction material and ancillary structures will be removed from the bed following completion of the activity. The 1per cent annual exceedance probability (AEP) flood has been accommodated by the structure and will not increase flood levels up stream or downstream of the structure. Calculation of flow rates will be made using the Auckland Council *Technical Publication 108: Guideline for stormwater runoff modelling in the Auckland Region*, April 1999. E3.6.1.16 is also relevant for bridges, a bridge for the SUP will be required over the Ngongetepara Stream and the Kumeū River. Compliance with E3.6.1.14 is set out above. Compliance will be achieved with E3.6.1.16 (2) as no piles will be located in stream bed. All piles will be on the stream bank.
E4 Other discharges of contaminants			
Discharge of water and/or contaminants (including washwater) onto or into land and/or into water from any of the following: cleaning, maintenance and preparation of surfaces of buildings, and associated structures; construction, repair, maintenance, upgrade or removal	E4.4.1(A11)	Controlled	The proposal involves removing stormwater outfalls in a few places across the alignment (including in Brigham Creek), and there may be discharge of contaminants from these activities. The only requirements are that discharges must not enter any areas identified in the Wetland Management Areas Overlay, Natural Lake Management Areas Overlay or Natural Stream Management Areas Overlay. None of these overlays are within the project corridor and thus the activity can comply with the Controlled activity standards.

Consent	Plan Ref	Status	Comments
of network utility infrastructure; or construction, repair, maintenance, upgrade or removal of any component of the stormwater or wastewater network			
E8 Stormwater - Discharge and diversion			
All other diversion and discharge of stormwater runoff from impervious areas not otherwise provided for	E8.4.1(A10)	Discretionary	The Project will not comply with E8.4.1(A5) as compliance with E8.6.4.1 (3) cannot be achieved. The works will not comply with hydrological mitigation in E10.6.3.1.1(1) when discharging to the tributary of Huruhuru Stream, Kumeū River and tributaries of Kumeū River. When discharging into Brigham Creek, the discharge is below RL1.7m therefore, this is a permitted activity (E10.4.1 – A1). The Project will comply with E8.6.4.1(2) as all ancillary road areas will be contained within the existing designations. The Project will comply with E8.6.1 General Standards. Specifically, the proposed design will not cause flooding or the inundation of buildings in the 1 or 10 per cent AEP. Around 246 SH16, the road is within the flood plain where the surrounding properties are flooded. The increase in impervious area is marginal at this location and the increase in water level will be minimal, not making the impact on the surrounding buildings any worse. No ground soakage is proposed. A discretionary activity is therefore sought under E8.4.1(A10). Lastly, the catchments discharging to the stream receiving environments also have less than 5,000m^2 increase in impervious area and under AUP E8, SMAF is not required of increases less than 5,000m^2
E9 Stormwater quality - High contaminant generating car parks and high use roads			
Development of a new or redevelopment of an existing, high use road that does not comply with the relevant permitted	E9.4.1(A9)	Restricted Discretionary	Under the AUP:OP, SH16 is classified as a high use road with more than 5000 vehicles per day. Therefore, stormwater runoff from the road carriageway is to be treated to an acceptable level before discharging to the receiving environment under E9. Where the new or redeveloped area cannot be kept

Consent	Plan Ref	Status	Comments
or controlled activity standards.			separate from the existing road discharge, it is proposed that all the road runoff is treated, where the existing drainage network is being modified. This runoff will flow through a treatment device, provided it is practical to do so given the site and operational constraints. However, as a result the project cannot comply with E9.6.2.2(1) for a controlled activity as the Project will not treat all impervious areas along the corridor. . Overall, Waka Kotahi is proposing to treat approximately 90% of the total impervious road area (67,373m^2 of treated area out of 75,242m^2 total impervious area). The stormwater runoff from the SUP is considered 'clean water' and therefore does not require stormwater treatment. However, when it discharges to the road this has been considered in the treatment requirements. All stormwater management devices will be designed and sized in accordance with Auckland Council's Guidance Document *Stormwater Management Devices in the Auckland Region* (GD01), as well as a Best Practical Option approach. This can not be met in all locations (E9.6.2.2) and therefore requires a restricted discretionary consent under E9.4.1(A9)

1.2 Project Overview

Waka Kotahi is seeking to undertake safety, capacity, walking and cycling improvements to State Highway 16 (SH16) between Whenuapai and Kumeū. These proposed improvements form Stage 2 of the wider SH16 Brigham Creek to Waimauku Project, which was identified as a section of rural state highway that qualifies for the Safe Roads and Roadsides Programme. The safety improvements involve retrofitting the corridor with short-term safety mechanisms specifically designed to reduce the incidents of deaths and serious injuries.

The SH16 Stage 2 Project corridor extends from the end of the Auckland North-Western Motorway at the intersection of SH16, Brigham Creek Road and Fred Taylor Drive (Whenuapai) through to Weza Lane (east of Kumeū), and is a total distance of approximately 4.3km. This SH16 corridor is zoned Strategic Transport Corridor within the Auckland Unitary Plan: Operative in Part (AUP:OP) and is also designated by Waka Kotahi NZ Transport Agency. The corridor has been divided into four sections, based on key characteristics, so that appropriate treatments and options could be developed and assessed. The sections include:

- Section A: From Brigham Creek roundabout through to Coatesville-Riverhead Highway intersection.
- Section B: The SH16 / Coatesville-Riverhead Highway intersection.
- Section C: From Coatesville-Riverhead Highway intersection through to Taupaki Road / Old North Road roundabout.
- Section D: From Taupaki Road / Old North Road roundabout through to Weza, east of Kumeū.

The Project comprises the following physical changes to the SH16 corridor:

- Additional traffic lanes between Brigham Creek roundabout and Taupaki Road Roundabout
- A new two-lane roundabout at the intersection of Coatesville-Riverhead Highway
- Widened road shoulders
- Flexible median safety barrier between Brigham Creek roundabout and Taupaki Road
- A flush median between Taupaki Road and Kumeū
- A new 3 metre wide shared-use path between Brigham Creek and Kumeū on the south side of SH16 including new footbridges over Brigham Creek and Kumeū River
- Retaining walls
- Stormwater network improvements; and
- Landscaping

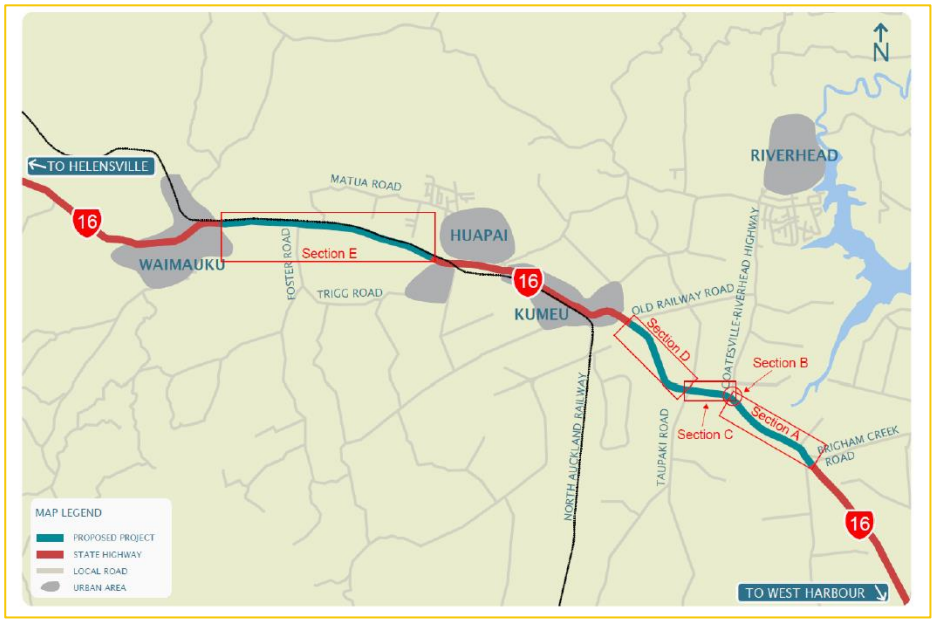


Figure 1-1 Section Location of SH16 from Brigham Creek to Waimauku Corridor. SH16 Stage 2 Project includes Section A – D.

1.3 Stormwater Objectives

A stormwater management system has been designed to suit the new infrastructure proposed for this Project. The new stormwater drainage has been designed in accordance with the Auckland Unitary Plan – Operative in Part 2016 (AUP) to manage the change in impervious area, road alignment, provide stormwater quality improvements as well as minimising the impact on the stream environments. It is noted that the project has been initiated primarily for safety improvements and there are a number of constraints within the network which have had an impact on the stormwater design.

The stormwater design requirements are outlined in Section 3 of this report (Design Requirements).

At a high level, the stormwater design typically follows the requirements in the Auckland Unitary Plan, Waka Kotahi and Local Authority design requirements and guidelines. It is noted in some areas, the Best Practical Option (BPO) has been adopted where the design standards and guidelines cannot be achieved. This could be a result of:

- Site and operational constraints
- Requirements to provide for and protect other utility services
- The function of the road as overland flow paths to convey stormwater runoff from surrounding land uses which the road controlling authority has limited ability to control
- Safety and operational constrains of the road or discharges; and
- Topographical limitations and geotechnical and structural requirements.

1.4 Drawings

This stormwater report is supported with the draft detailed design drawings and sketches as follows (refer to the Appendices):

a. Drawings (Appendix A)

- 3235084-CD-2100, Rev C Stormwater Notes and Legend
- 3235084-CD-2100 to 2127, Rev C Stormwater Layout Plans
- 3235084-CD-2201 to 2299, Rev C Stormwater Long Sections

b. Sketches (Appendix C and D)

- 3235084-SK-2004 to 2006, Rev C Catchment Plan, Post Development Plan
- 3235084-SK-2010 Rev C Stormwater Culvert Crossing Catchment Plan

The design has been developed with consideration of the following elements and effects for the proposed stormwater management facilities, which are detailed in this section of this report.

- Flood risks to the road
- Flood risks to others
- Secondary flow
- Carriageway drainage and cross drainage, including fish passage requirements
- Hydrology Mitigation (Retention, detention)
- Stormwater Quality
- Erosion and Scour Protection.

1.5 Source of Existing information

The following information are used as inputs for this phase of the design for the development of detailed design.

- Auckland Council GIS data:
  - Stormwater assets extracted at Business Case phase in late 2016

  - LiDAR ground contour extracted in March 2018
  - NZTA RAMM data, initially provided at Business Case phase in late 2016 and again in March 2018.
- Beca Survey Information dated:
  - January 2019: Preliminary data
  - September 2020: Initial Release
  - November 2020: Addition of Kumeū Bridge
  - January 2021: Data updated
  - August 2021: Update for Private Properties
  - September 2021: Update for Private Properties
  - October 2021: Update for Private Properties
  - January 2022: Update for Private Properties

Survey information of some existing drainage structures, existing ground surface and channel details are currently not available due to access limitations. These areas are to be confirmed on Site during the construction phase. Best available information and assumptions have been made to complete the design.

- Other files:
  - SH16/Taupaki Rd/Old Nth Road Intersection, As Builts Signed 2012, Downer (pdf)
  - BP Connect Kumeū at 538 SH16, Construction Issue, Dated 09-2020, Technitrades Architecutre

2 Existing Environment

2.1 Location and Stormwater Catchments

The SH16 Stage 2 Project extends from Brigham Creek Road Roundabout through to Kumeū Township. The works extends through two stormwater catchments as shown in the image below. These catchments are as follows:

- Redhills Catchment (Orange catchment):
  - Extent of SH16: Brigham Creek Roundabout to Taupaki Road Roundabout
  - Discharge location: This catchment drains to Ngongetepara Stream and into the Waitemata Harbour via Brigham Creek
- Taupaki Catchment and Kumeū-Huapai Catchments (part of), sub-catchment of the Kaipara-Kumeū Catchment (Purple catchment):
  - Extent of SH16: Taupaki Road Roundabout to Kumeū
  - Discharge location: This catchment drains to Kumeū River into the Kaipara Harbour.

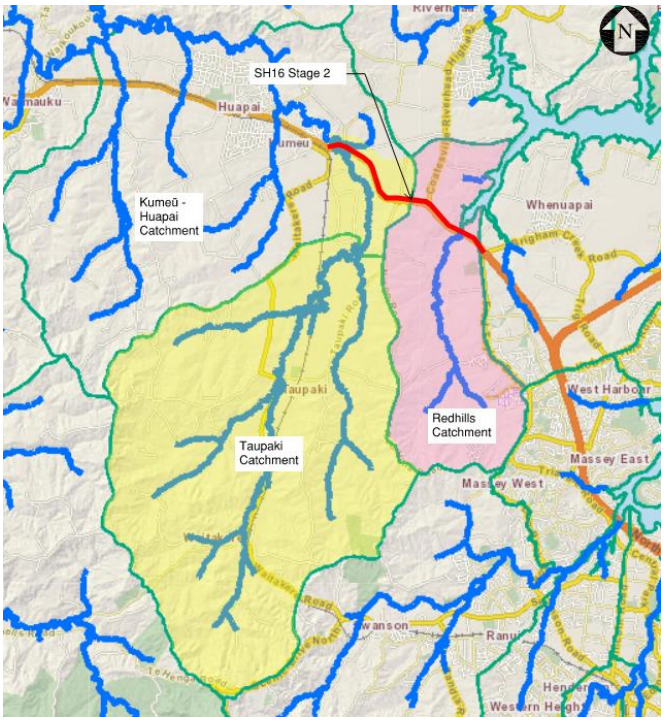


Figure 2-1 Catchments Upstream of Stage 2. Redhills catchment is shown in pink and the Taupaki and Kumeū-Huapai Catchment is shown in yellow. Extent of Stage 2 shown in Red.

2.2 Contributing Catchment Landcover

The AUP Zoning varies across the extent of works within the two stormwater catchments. The design has been based on the current AUP provisions in 2022.

The Redhills catchment zoning is 36% Rural Countryside Living Zone and 63% is a form of urban or future urban development zone, with the remaining 1% comprising of the SH16 road corridor.

The Taupaki and Kumeū-Huapai catchment, is a combination of Rural - Countryside Living Zone, Rural - Mixed Rural Zone, Rural - Rural Production Zone, Rural - Waitakere Ranges Zone and Rural - Waitakere Foothills Zone. Refer to the Unitary Plan for details and definitions of the various zones.

Observations based on existing aerial photographs confirms that area within the catchments are typically utilised as rural and are undeveloped. Therefore, we have assumed 7% of impervious area for stormwater runoff calculations for the existing 'pre-development' scenario based on the current aerial imagery.

2.3 Primary Conveyance and Treatment

The existing stormwater network consists of a combination of piped networks, roadside drains and open channels, which is based on information from RAMM data, Auckland Council GEOMap stormwater assets and topographical survey. There are some stormwater assets along the extent of the project which require ownership confirmation.

The existing primary stormwater is generally discharged into nearby watercourses or farm drains via overland flow, roadside channels or outlet structures. There are a number of existing discharge points which discharge to private properties, then into watercourses. This includes discharge to the following properties:

- 256 SH16
- 324 SH16 (opposite Coatesville Riverhead Highway)
- 299 SH16
- 16 Old North Road / 1368 SH16 (opposite Soljans)
- 464 SH16 (stormwater from SH16 discharges to an existing pond, which is privately owned)
- 538 SH16 (BP Petrol Station)
- 7 Main Road

As-built pdf drawings have been provided by Waka Kotahi for the SH16/Taupaki Rd/Old Nth Road Intersection upgrade in 2012. These indicates some level of treatment through a grassed swale on the south-western and north-western side of Taupaki Road on SH16. The design level of stormwater treatment is currently unknown, as the upstream catchment (east of Taupaki Road) is captured in catchpits and pipework, which discharges into the grassed swale for treatment. West of Taupaki Road, SH16 typically has single crossfall, limiting the flow into the grassed swales.

Fred Taylor Drive at Brigham Creek Roundabout has stormwater treatment. The level of stormwater treatment in currently unknown.

There are no other records from Waka Kotahi of stormwater treatment provided within the extent of SH16 for this Project.

2.4 Cross Culverts and Stream crossings

Across the extent of the SH16 Stage 2 Project, there are a number of culverts and a bridge structure to allow the crossing of the permanent watercourses under SH16. There are also smaller culverts under SH16 to convey stormwater runoff from external catchments and overland flowpaths.

The permanent stream culvert crossings and bridge structures allow for watercourses to cross beneath the SH16 road corridor. The culverts and bridge structures located at stream crossings, along with their chainage along the State Highway are as below. Refer to the stormwater culvert crossing catchment plan in Appendix D.

Table 2-1 Culvert and bridge structure chainage

Name Reference	Stream Name	Stream Classification	Structure	Chainage	Comment
Brigham Creek Culvert	Ngongetepara Stream	Permanent River or Stream	8.75m wide Arch Armco Culvert, 37.5m length	CH. 190630	West of Kennedys Road

Name Reference	Stream Name	Stream Classification	Structure	Chainage	Comment
					BSN196. Invert level of stream ~RL1.3 – 1.9
429 SH16	Kumeū River Tributary	Upstream SH16: Modified, Intermittent Stream Downstream SH16: Permanent Watercourse	600Ø culvert	CH. 192570	500m west of Old North Road Roundabout US invert: 25.56m RL DS invert: not located
Kumeū No.1 Road Bridge	Kumeū River	Permanent River or Stream	BRIDGE	CH. 193990	BSN230
Kumeū footbridge	Kumeū River	Permanent River or Stream	BRIDGE	CH. 193990	On northern side of road bridge

There are also several smaller existing culvert crossings along the corridor. These crossings convey runoff and overland flow from catchments within the existing corridor and from external catchments. The pipe sizes of these culverts range from 225Ø – 600Ø. Invert levels have been taken from survey data and as-built information where available.

Table 2-2 Culvert pipe sizes

Size	Chainage	Comment	Upstream RL	Downstream RL
600Ø concrete pipe (MH connections)	CH. 191900	From existing wetland at 366 SH16 (Soljans Estate) flowing North (external Catchment). Discharge to farm drain with road drainage. Pond Bottom of bank ~RL39.5m Stormwater culvert passes through 3 manholes, with carriageway drainage prior to discharge to existing private open channel	Invert not accessed. Scruffy Dome Lid Level RL39.96m.	37.981m (at open channel on private property)
375Ø concrete culvert (connect to MH)	CH. 192430	From external catchment at 418A SH16 flowing North. Discharge to headwall grate into roadside drain	TBC on Site (located on private property)	28.28 (at MH)
300Ø concrete culvert (Connect to pipe network)	CH. 192920	Roadside drain and external catchment. Flow North to South, adjacent to 464 SH16 pipe network	TBC	TBC - Manhole
450Ø concrete culvert (Connect to pipe network)	CH. 192940	Roadside drain and external catchment. Flow North to South, adjacent to 464 SH16 pipe network	TBC - Catchpit	TBC - Manhole
375Ø concrete culvert	CH. 193260	External Catchment flow north to south. Discharge to roadside drain	31.59	31.24

Size	Chainage	Comment	Upstream RL	Downstream RL
375Ø concrete culvert	CH. 193510	Culvert at wetland. Culvert end on northern side of road not found. Not confirmed which way it flows.	25.18 (south side)	TBC – not found

Existing culverts have been identified using RAMM, AC GeoMaps, survey (where possible) and aerial photography and the locations of these are shown on the drawings. The existing culverts are to remain in place and operations during and after the Project.

The existing flood plains and overland flow paths are shown in Appendix D over the extent of the works. This shows that there is a number of places where the current culverts are under capacity and overtop the road.

2.5 Flood Risk to Road and Others

It is identified through review of the existing AC GeoMaps that there are many locations along the road or in adjacent private properties that could be inundated with stormwater during a large rainfall event. The key risk areas are identified in the table below.

Table 2-3: Flood Plains in adjacent properties

Property Address or Lot Description	Reference Chainage	Comment
179 SH16	190230	Residential properties
181 SH16	190250	Residential properties
222A, 238, 191, 239, 238A, 256 SH16	190620	Due to Brigham Creek Culvert (Ngongetepara Stream)
300 SH16	191280	Roadside drainage
312 SH16	191470	Roadside drainage with Road Sag location
324 SH16	191500	Natural depression
350 SH16	191780	Roadside drainage
366 SH18	191900	Roadside drainage/private pond
418 SH16	192420	Roadside drainage
407,429, 436 SH16	192570	Kumeū River Tributary
436 SH16	192570	Natural Wetland
475 and 465 SH16	193000	External Catchment to roadside drainage
464 SH16	192900	External Catchment
26 Old Railway Road	193250	External Catchment
482 and 472 SH16	193250	External Catchment
522 SH16	193480	Natural Wetland
507 SH16	193600	Private pond
538 and 550 SH16	193750	Kumeū River Flood Plain
7 Main Road	194060	Kumeū River Flood Plain

3 Design Requirements

This section sets out the design requirements for the Project.

3.1 Standards and Guidelines

The stormwater drainage design will be based on the following design standards and guidelines, as per the Design Philosophy Report listed in the order of precedence:

- NZTA, Stormwater Treatment Standard for State Highway Infrastructure, May 2010
- NZTA, P46 Stormwater Specification, April 2016
- Waka Kotahi, Stormwater Specification Manufactured Treatment Device Radial Media Filled Cartridge, Draft 1, May 2020
- NZTA TM 4006 Traversable and Mountable Grate for Precast Concrete Headwalls (2008)
- AUSTROADS, Guide to Road Design – Part 5: Drainage, 2013
- FHWA, HEC 22: Urban Drainage Design Manual, Third Edition, revised August 2013
- FHWA, HEC 14: Hydraulic Design of Energy Dissipaters for Culverts and Channels, Third Edition 2013
- NZTA, Bridge Manual (SP/M/022), Third Edition, May 2016
- NZTA, Fish Passage Guidance for State Highways, August 2013
- Auckland Council, Auckland Unitary Plan – Operative in Part (AUP), updated on 9 October 2020
- ARC, Design Guideline TP108: Guidelines for Stormwater Runoff Modelling in the Auckland Region, April 1999
- Auckland Transport, Auckland Transport Code of Practice – Section 17: Road Drainage, 2013
- Auckland Council, Code of Practice for Land Development and Subdivision - Chapter 4: Stormwater, reference to Version 3 issued in September 2021 and January 2022
- Auckland Council, Guideline Document GD01: Stormwater Management Devices in the Auckland Region, December 2017
- Auckland Council, Guideline Document GD04: Water Sensitive Design for Stormwater, March 2015
- Auckland Council, Technical Report 2013/035, Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements, August 2013
- ARC, Design Guideline TP10: Stormwater Management Devices, May 2003
- ARC, Technical Publication 131: Fish Passage for the Auckland Region, June 2003
- ARC, Technical Report 2009/084: Fish Passage in the Auckland Region – a synthesis of current research, June 2009
- AS/NZS 2566 Buried Flexible Pipelines, 1998
- AS/NZS 3500.3, Plumbing and Drainage Part 3: Stormwater Drainage, 2003
- AS/NZS 3725, Design for Installation of Buried Concrete Pipes, 2007

3.2 Project Requirements

The overall primary key design principles for stormwater drainage design are:

- Auckland Council requirements for climate change shall be allowed for in design rainfall
- The primary focus will be to use kerb and channel drainage conveyance systems that will discharge to piped networks or to swales
- Land aquisition requirements will be considered and kept to a minimum when designing stormwater conveyance and treatment systems. To aid with this, the runoff from the corridor may be treated by proprietary treatment devices
- Where land take opportunities are possible and assessed to be appropriate, this will be considered for the design and construction of stormwater swales

- New culverts, pipelines, manholes and other hydraulic structures beneath paved surfaces shall have a design and hydraulic performance life, and durability performance of not less than 100 years, considering the site ground conditions, potential settlement, and depth of cover, type of bedding and backfill and method of installation
- Access to pipelines, hydraulic structures, and treatment devices where possible will be located to provide safe and convenient inspection and maintenance. No new access structures shall be in the sealed carriageway unless it can be proven that there are no practical alternatives

The overarching objective for the project's stormwater design is to create a stormwater management system that can:

- Cater for the increase in stormwater runoff discharge without increasing flooding conditions to properties upstream or downstream of the road designation with respect to the pre-development condition
- Provide stormwater quality treatment to provide an overall betterment in the stormwater runoff quality from the existing condition; and
- Provide flow control in areas where hydrology mitigation is required as identified on the planning maps to protect and improve downstream stream health

As defined by the Unitary Plan under E8 Stormwater – Discharge and diversion, Hydrology mitigation is required where runoff from an impervious area is discharged to a stream environment, it must be managed by a stormwater management device to meet the hydrology mitigation requirements specified for Stormwater Management Area Control – Flow 1 (SMAF 1). These requirements for retention and detention are based on the additional impervious areas as outlined in E8.6.4.1.

3.3 Climate Change Allowance

Design Guideline Background

Over the duration of this project there have been three versions of the Auckland Code of Practice for Land development and subdivision Chapter 4: Stormwater (AC SW CoP):

- Version 2, November 2015
- Version 3, September 2021
- Version 3, January 2022

Version 3, September 2021 issue coincided with the commencement of Detailed Design in September 2021 and as a Project Requirement (Section 3.2) is for Auckland Council requirements for climate change to be allowed for in design rainfall, it was confirmed with Waka Kotahi that the changes in this revision would be included in the design. It was advised at this time (by AC), that it would be fully implemented and considered the operative version of the Auckland Council Code of Practice, on 18 January 2022. This revision contains significant changes from the previous Version 2 (published 2015) in terms of climate change allowance for rainfall depths and intensities

Subsequent to this, the Version 3 released in September 2021 has been retracted and a new Version 3 has been released, dated January 2022. The January 2022 Version 3 utilised the same design guidelines as Version 2 from Climate Change, 2.1-degree temperature increase by 2090.

Upon discussion with Auckland Council in January 2022, it was indicated that the allowance for climate change and intensities are being reviewed and it is expected that the current design guidelines will be increased in the near future. It was therefore decided to continue the design based on 3.8-degree temperature increase by 2110. Refer to Section 3.3.3 for the design approach adopted.

Climate Change allowance on rainfall

AC SW CoP Version 3 (Sept 2021), to allow for higher levels of climate change in the future, using a 3.8-degree temperature increase by 2110, rather than the 2.1-degree temperature increase by 2090. The normalised intensity distribution profile was also modified to reflect the increase in peak flow. The new profile increases the peak flows by about 11.5% alone, without taking into account the new rainfall depths with climate change.

The percentage increase on rainfall depth are shown below.

Table 3-1. Increase in 24-hour design rainfall depth due to future climate change

Rainfall Event (Average Recurrence Interval)	% Increase in 24-hour Design Rainfall Depth due to Future Climate Change	
	2.1-Degree Temperature Increase (Version 2, 2015 and Version 3, 2022)	3.8-Degree Temperature Increase (Version 3, September 2021)
2 year	9.0%	27.4%
5 year	11.3%	29.6%
10 year	13.2%	30.8%
20 year	15.1%	31.2%
50 year	16.8%	31.9%
100 year	16.8%	32.7%

These changes have had an impact on the stormwater design flows, pipe and culvert sizes, catchpit spacings, conveyance and treatment swales. The changes also have had an impact on the stormwater flood levels, and the flows through the main stream crossings.

The September 2021 Version 3 increase in climate change is in accordance with Table 7 of the Ministry for the Environment, 2018: Climate Change Projections for New Zealand (shown in Figure 3-1 below). This table shows the projected changes in seasonal and annual mean temperatures by region. This is based on the global Coupled Model Intercomparison Project 5 (CMIP5). Therefore, for an RCP 8.5 scenario of a 3.8-degree temperature increase to 2101-2120 is required.

Table 7: As Table 5, but for projected changes between 1986–2005 and 2101–2120

No results are shown for RCP6.0 because only two models in the NIWA CMIP5 archive have data available beyond 2100 for this RCP (see Table 2).

Region		Summer	Autumn	Winter	Spring	Annual
Northland						
	rcp 8.5	4.1 (2.9, 5.9)	4.0 (3.0, 5.5)	3.6 (2.7, 4.5)	3.4 (2.8, 4.2)	3.7 (2.9, 5.0)
	rcp 6.0					
	rcp 4.5	1.8 (1.1, 2.5)	1.8 (1.2, 2.3)	1.6 (1.0, 2.2)	1.5 (1.0, 2.2)	1.7 (1.2, 2.2)
	rcp 2.6	0.8 (0.2, 1.3)	0.8 (0.3, 1.3)	0.7 (0.5, 1.2)	0.7 (0.3, 1.2)	0.8 (0.4, 1.3)
Auckland						
	rcp 8.5	4.1 (2.9, 6.1)	4.0 (3.0, 5.6)	3.6 (2.8, 4.7)	3.4 (2.7, 4.3)	3.8 (2.9, 5.2)
	rcp 6.0					
	rcp 4.5	1.8 (1.1, 2.9)	1.8 (1.2, 2.3)	1.6 (1.0, 2.2)	1.5 (1.0, 2.2)	1.7 (1.2, 2.3)
	rcp 2.6	0.7 (0.0, 1.5)	0.8 (0.3, 1.4)	0.7 (0.4, 1.2)	0.7 (0.4, 1.2)	0.7 (0.4, 1.3)

Table 5: Projected changes in seasonal and annual mean temperature (in °C) between 1986–2005 and 2031–2050, by region, as derived from statistical downscaling. The changes are given for four RCPs (8.5, 6.0, 4.5 and 2.6), where the ensemble-average is taken over (41, 18, 37, 23) models respectively

The values in each column represent the ensemble average, and in brackets the range (5th percentile to 95th percentile) over all models within that ensemble. Projections for the Chatham Islands are a direct interpolation from the global CMIP5 models (ie, not statistically downscaled). Projections for the 'seven-station average' are taken from the seven VCSN grid-points co-located with the NIWA seven-station locations.

Figure 3-1: Table 7 from Ministry for the Environment, 2018: Climate Change Projections for New Zealand and description from Table 5.

The climate change effects under Version 2 and Version 3 January 2022 AC SW CoP were based on a forecast 2.1-degree temperature increase by 2090, in accordance with Table 5.2 of Climate Change Effects and Impact Assessment: A Guidance Manual for Local Government in New Zealand (Ministry for the Environment, 2008).

Climate Change Allowance Approach adopted in the design.

The following approach has been adopted for the design of SH16 Stage 2:

- Stormwater design is based on Version 3, September 2021 AC SW CoP guidelines, 3.8-degree temperature increase by 2110
- Stormwater design for Hydrology Mitigation and Quality does not include impact of Climate Change on rainfall depth
- Structures and cross culverts have been reviewed on a case by case bases and undertaken a sensitivity analysis to determine the Best Practical Option (BPO) approach. The sensitivity assessment utilises Version 3, September 2021 3.8-degree temperature increase and the Version 3, January 2022 2.1-degree temperature increase.

3.4 Basis of Design

The Table below sets out a summary of quantitative stormwater management design criteria applicable to the project.

Table 3-2: Summary of Stormwater Design Criteria

Item	Criteria	
Design event allowances		
Rainfall (TP108 no Climate Change) [1]	100-year ARI (1% AEP), 24-hour	190mm
	10-year ARI (10% AEP), 24-hour	130mm
	5-year ARI (20% AEP), 24-hour	110mm
	2-year ARI (50% AEP), 24-hour	83mm
Rainfall (incl. 3.8°C climate change increase to 2110) [2]	100-year ARI (1% AEP), 24-hour	252mm
	10-year ARI (10% AEP), 24-hour	170mm
	5-year ARI (20% AEP), 24-hour	143mm
	2-year ARI (50% AEP), 24-hour	102mm
Rainfall for Hydrologic Mitigation [3]	95th percentile rainfall	36mm
	90th percentile rainfall	25mm
Stormwater quality rainfall [4]	As per NZTA requirement (2 year, 1-hour, but not greater than 30mm).	28mm or 24.7mm → Therefore 25mnm has been adopted 10mm/hr has been adopted for design of the swales (GD01)
Catchment characteristics		

Item	Criteria	
SCS curve number	Impervious areas	98
	Pervious areas	74
Road catchment	Existing and proposed	100% impervious
Upper catchment [5]	Existing and proposed	Rural Zones: 10% impervious, 90% pervious Urban (Residential) Zones: 60% impervious, 40% pervious
Design criteria		
SMAF 1 - Retention when discharging to a stream environment above RL1.7m (NZVD2016)	Additional Impervious areas >5,000m^2	Retention (volume reduction) of 5mm runoff depth for the impervious area for which hydrology mitigation is required
	Additional Impervious areas <=5,000m^2	No retention required (Permitted under AUP E8)
SMAF 1 - Detention when discharging to a stream environment above RL1.7m (NZVD2016)	Additional Impervious areas >5,000m^2	Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24-hour rainfall event minus the 5mm retention volume, over the impervious area for which hydrology mitigation is required
	Additional Impervious areas <=5,000m^2	No detention required (Permitted under AUP E8)
Quality [4]	High Use Road > 5000 vehicles per day and new or redevelopment road area >5,000m^2	Treatment of runoff as per the following guidelines, in order of precedence: NZTA treatment guideline and GD01 guideline To be applied to existing and additional impervious area discharging to the same network (E9.7.1.2.f)
Conveyance	Primary	10% AEP
	Secondary	1% AEP less primary capacity.
Flood risk	Carriage way	Inundation of road is kept to as per the existing condition
	Offsite properties [6]	The diversion and discharge must not result in or increase the following: flooding of other properties in rainfall events up to the 10 per cent annual exceedance probability (AEP); inundation of buildings on other properties in events up to the 1 per cent annual exceedance probability (AEP).

Notes:

[1]Rainfall data from TP108 Appendix A.

[2]Climate Change increase from AC CoP for Land Development and Subdivisions assuming 3.8°C increase in temperature to 2110 (Version 3 dated September 2021)

Item	Criteria
[3]Interpolated from Figure 13 and 14 of Auckland Council Technical Report 2013/035	
[4]Stormwater quality rainfall varies depending on the referenced guideline (other values listed below). 28mm is adopted for the project as NZTA design guideline is preferred and is greater than GD01	
29mm as per TP10 (2 year, 24-hour, divide by 3)	
25mm as per GD01 (90th percentile rainfall)	
[5]Existing pervious area as defined from AC GIS and aerial photograph	
[6]As per Section E8.6.1 (3) of the Unitary Plan.	

3.5 Stormwater Quality Requirements

SH16 is classified as an existing high use road with more than 5000 vehicles per day. The Project involves redevelopment of a new or redevelopment of an existing high use road greater than 5,000m^2 under the Auckland Unitary Plan (AUP), E9 Stormwater quality. This requires stormwater runoff from the impervious area of the high use road to be treated by stormwater management devices before discharging to the receiving environment under, section E9.6.2.2. The stormwater runoff from the Shared Use Path (SUP) is considered 'clean water' and therefore does not require stormwater treatment.

For the extent of the Project, where the new or redeveloped area cannot be kept separate from the existing road discharge, it is proposed that all the road runoff is treated, where we are modifying the existing drainage network. Consideration will be given to the practicality to provide treatment, considering a number of factors outlined in E9.7.1.2 and E9.7.2.2, including the site and operational constraints, other utility services, topographic limitation and safety. Selection of the stormwater treatment device will also take into account effects on the environment, sized of device, durability, operation and maintenance, geotechnical and structural requirements.

The AUP requires that Stormwater Management Devices are to be sized and designed in accordance with Guidance Document 2017/001 Stormwater Management Devices in the Auckland Region (GD01). Or, if alternative devices or guidelines are used, it must be demonstrated that an equivalent level of contaminant or sediment removal performance to that of GD01.

Waka Kotahi has a stormwater specification for the design and construction of stormwater requirements on all State Highway improvements projects, referred to as NZTA P46 Stormwater Specification. This requires that all stormwater devices shall be designed in accordance with NZTA's *Stormwater Treatment Standard for State Highway Infrastructure (May 2010),* unless a regional standard prescribes a higher standard, in which case the regional standard shall apply.

The NZTA treatment standard has been compared with GD01. NZTA treatment designs to 75% TSS removal, while GD01 design is based on performance-based (with the understanding that properly sized, and design devices will meet certain aspects of removal requirements for pollutants). The design of the swales through the different guidelines achieves similar removal efficiency and hydraulic residence time. One different factor between the design guidelines is the Water Quality Flow, which is ~18mm/hr under the NZTA treatment standard and 10mm/hr under GD01. As GD01 has undergone an extensive review and reflects the lasts design philosophy and principles GD01 has been used in the design of the treatment swales.

Waka Kotahi has a specific design standard for propriety devices within State Highways, which has been used in the design. This is the Waka Kotahi, Stormwater Specification Manufactured Treatment Device Radial Media Filled Cartridge, Draft 1, May 2020.

The following approach has been adopted for stormwater treatment design:

- Natural green stormwater devices are preferred over proprietary devices. Proprietary treatment devices will be used if constrained by land availability or existing utilities

- If required, linear land take along the road corridor is preferred over large land take at discrete locations. Opportunity for such land take will be assessed for suitability of larger stormwater infrastructures
- All swales will be designed in accordance with appropriate guidelines and shall not pose a hazard to road users. All treatment swales are to be planted to minimise footprint
- All piped discharges to sensitive receiving environments (waterways and wetlands) shall have energy dissipaters and appropriately designed permanent erosion control.
- Detention and retention volume for hydrology mitigation (as required) are to be incorporated into with natural devices where practical to eliminate the need of constructing dedicated devices. These volumes can be provided for in swales with check dams, retention swales, wetlands and ponds, bioretention devices or infiltration trenches.
- The implementation of wetlands and ponds is largely dependent on the catchment areas draining to each device is larger than 4Ha. The stormwater catchment for this Project as less than 4Ha, therefore are not proposed.
- Clean stormwater runoff from permeable surfaces are diverted away from treatment devices where practicable to reduce the load through the device.

3.6 Hydrological Mitigation - Retention and Detention

Hydrologic Mitigation is provided where additional impervious area discharges to a stream environment, including permanent and intermittent streams above RL1.7 (NZVD2016) from the AUP E8 (E8.6.4.1). The stream receiving environment has been determined by the ecological assessment completed.

The Hydrology Mitigation requirements, where required on the project, are to meet the SMAF 1 requirements as outlined below from AUP E10, Stormwater management area – Flow 1 and Flow 2. This equates to 5mm runoff depth for retention and 18.5mm runoff depth for detention for the impervious area over which the hydrology mitigation is required. Hydrology mitigation is required for additional impervious surfaces greater than 5,000m^2 of road, therefore for this project this includes the additional road area and the SUP. It is noted that in AUP E8.6.2.3 for the diversion and discharge of stormwater runoff from impervious areas up to 5,000m^2 that no SMAF requirements are triggered.

In some areas there will be constraints to achieve the retention requirements due to existing utilities, ground conditions or topography. At these locations the retention volume can be taken up by the detention volume (refer to AUP E10 Table E10.6.3.11, (2) (c)).

Stormwater management area control	**Hydrology mitigation requirements**
(1) Except as provided for in (2) below the following applies:	
Stormwater management area – Flow 1	(a) provide retention (volume reduction) of at least 5mm runoff depth for the impervious area for which hydrology mitigation is required; and (b) provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24 hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved, over the impervious area for which hydrology mitigation is required.

Figure 3-2 Hydrology mitigation requirements

3.7 Carriageway Drainage Conveyance

The design capacity for all new primary systems shall generally be sufficient for the 10% AEP peak flows and shall meet NZTA guidelines and standards. Effects of climate change (3.8ºC temperature increase to 2110, Version 3 September 2021) shall be allowed for in the design. New inlets should be placed such that gutter flow will not encroach into the nearest traffic lane in a 10% AEP event.

The following design criteria shall be adopted for stormwater conveyance:

- A minimum pipe diameter of 300mm is adopted across the design for reduced risk of blockage, and minimum of 375mm pipe under live lanes
- Inlet and outlet structures shall be installed on all pipes, unless specified
- All outlet structures shall be specifically designed to ensure that adequate energy dissipation is designed and that the effects of the discharge do not cause scour/erosion within the immediate receiving environment
- Where piped networks are proposed, new inlets are spaced such that gutter flow will not encroach into the nearest traffic lane in a 10% AEP event
- Secondary flow should typically be contained within the road carriageway and designed such that one lane remains open for traffic each way during a 1% AEP storm event. However, it is worth to note that this may not always be practical to achieve in certain areas along the corridor due to existing flooding issues
- 150mm of freeboard is to be provided from the 10% AEP storm event flow depth within the open channel to the adjacent road surface
- Side culverts will be provided under vehicle access points along the network to convey runoff from open channels. These will have a minimum of diameter of 375mm.
- Where the finished road surface is proposed to be Open Graded Porous Asphalt (OGPA), recessed catchpits, splay pits or metropit are proposed. This is to retain a shoulder of min 1.5m across the Project and eliminate the risk of a surface level change due to the OGPA and catchpit apron for road cyclists.
- Manhole Infill lids are to be used on the SUP to eliminate risk of slip due to surface change.
- Access culverts under driveways / accessways will be fitted with mountable traversable grates. Where barriers are present, headwalls will be used.
- Scruffy domes and check dams are to be located behind barriers.

Asset Ownership

The SH16 road corridor is designated by Waka Kotahi. Most stormwater assets within the designation are owned by Waka Kotahi. The full extent of SH16 is gazetted under 1994-au6321 (page 2641). There are some existing assets that are currently owned by Auckland Council (AC) and Auckland Transport along the extent of the Project.

AC owns stormwater assets within the road corridor where the discharge comes from private properties. The stormwater pipe becomes public (i.e. AC owned) immediately downstream of the point when it crosses a boundary of a fee-simple lot (Section 4.2.4.1 AC SW CoP). Therefore, any modification to existing assets, or any new assets, is subject to Engineering Plan Approval (EPA) and are to be vested to AC.

The Project includes discharges to existing Auckland Transport (AT) assets as well as work on local roads including Kennedys Road, Coatesville Riverhead Highway, Old North Road, Old Railway Road and Main Road. At these locations all discharges to the kerb are subject to AT approval, however approval in principal for the proposed works has been accepted. Where the assets are to be owned by AT, the AT design standards have been used where practical. This has been agreed with AT through email confirmation from Auckland Transport:

- Asset Ownership Confirmation: from Katherine Dorofaeff (AT) with James Taylor and Peter Scott comments. (asset manager), email dated 26 August 2022
- Design agreeance in principle of design: from Katherine Dorofaeff (AT) with Moahmmed Sahim (Principal Engineer), email dated 20 September 2022

Maintenance of the assets is to be confirmed between Waka Kotahi, Auckland Council and Auckland Transport to ensure that maintenance can be carried out with little or no disturbance to the surroundings, as

well as safe operation and maintenance. This will be achieved through a maintenance agreement between Waka Kotahi, Auckland Council and Auckland Transport.

Discharge Locations

As discussed in Section 2.3 there are some existing stormwater discharge locations which discharge to private property. These are proposed to be rectified with the Project and the primary stormwater network will discharge to public land or a stream.

AC SW CoP Chapter 4, Stormwater, Section 4.3.7 outlines that the Watercourse maintenance (including natural intermittent streams, drainage channels and natural depressions) are the responsibility of the landowners, and there is an obligation on downstream landowners to accept these natural flows from upstream properties. In some locations Auckland Council has control over the watercourse via covenants or easements and in some locations, these are versed assets. Section 4.3.14.2 outlines that the 'developer' shall always discharge into the public stormwater network at the point approved by Council. If other public system is not possible, other site-specific discharge locations may be discussed with the council and submitted for specific approval. Water shall not be discharged to an adjacent property.

The Project has provided the opportunity to redirect the stormwater to a public stormwater network or stream. Each existing discharge has been assessed to understand the options and the BPO has been selected for modifying the discharge.

3.8 Cross Drainage and Flood Risk

Any new cross drainage will be designed as per NZTA guidelines to ensure adequate freeboard to the road surface can be provided.

All existing culverts will remain at their current levels with no changes to existing conditions. Small scale flood models have been developed for Ngongetepara Stream/Brigham Creek and Kumeū River, to inform the design of the new bridge structures for the SUP. No other flood modelling will has been undertaken as part of this project. A high level assessment of the proposed design option on all existing culverts has been completed to understand the flood risk effects of the Project. This is to confirm that the flood risks are not any worse for these existing structures under the proposed design, even though they currently do not meet current design standards.

The following design criteria shall be adopted for stormwater conveyance, where required:

- Existing culverts are to be extended to suit the new road geometry as a minimum.
- Additional culverts will be provided should the extension of culvert result in an adverse effect of flooding to others on the upstream side.
- All permanent and intermittent streams are to provide for Fish Passage where the structure is being modified and required under the National Environmental Standards - Freshwater.

3.9 Existing Wetlands

There are two existing wetlands within the extent of works. One at 436 SH16 and the other at 522 SH16. Refer to Ecology for details of wetlands.

4 Proposed Design

The SH16 design has been developed based on the required Standards and Guidelines, Project Requirements, Auckland Council Unitary Plan as well as consideration for the existing topography, site constraints and safety. As this is a safety improvements project, the design includes consideration for safety in construction, operations and maintenance, as well as the end users.

4.1 Change in impervious area

The proposed design for SH16 will result in an increase in impervious road area due to the widening works and the new SUP along the extent of works. The existing road is typically 11m wide along the corridor. The new works proposed typically results in a total road width of 17.7m at Section A and C and 11.1 at Section D. The SUP has a typical width of 3m throughout the Stage 2 Project.

Based on the existing road impervious area, the average increase in impervious area within this project is 27% as per shown in the Table 4-1. The table is split into the two catchment which the project extends over, Redhill's catchment and Taupaki and Kumeū-Huapai catchment.

Table 4-1: Existing and Proposed Impervious Area of SH16 Road

Road Catchment within	Existing Impervious Area (m^2)	Proposed Impervious Area			Proposed Total Impervious Area (m^2)	% Increase of Total Impervious Area
		Road (m^2)	Shared Path (m^2)	Total Additional (m^2)		
Redhills*	50399	16658	9144	25802	76201	51
Taupaki and Kumeū-Huapai	78619	6901	6659	13,560	92179	17
Total	117,780	16,025	13,165	29,190	146,970	27

4.2 Primary and Secondary Conveyance

Refer to drawings CD-2100 to CD-2127 for the detailed design stormwater drainage layout. New manholes and pipes will be typically located behind barriers, where possible. Catchpit spacing has been determined across the extent of the Project based on flow width requirements.

There are two critical services within the existing road corridor unable to be moved and have minimum required clearances for new infrastructure around these assets. These are the Spark International Cable (SIC) and a critical water main. The SIC is located on the northern side of the road corridor within the existing berm and extends the length of the Project. The 450Ø critical watermain is located on the northern side of the SH16, from Brigham Creek roundabout to Taupaki Road roundabout. In some locations stormwater assets have had to be installed in the road carriageway shoulder to comply with these clearances.

Secondary flow from the carriageway has been contained within the road carriageway between kerbs or within roadside conveyance channels and/or swales.

Clean water diversion drains on either side of the road corridor have been relocated or established, where required, and replicate the existing roadside open channels. These drains divert clean runoff from upstream external catchments, so it does not contribute the additional runoff on the road carriageway. This therefore keeps the pipe network and treatment devices to a minimum and not overloading with clean water runoff.

The catchpit depth has been set to drain the subsoil drainage in preliminary design and in most cases the catchpit depth is 1950mm from the kerb invert. This allows for a 1.2m ground cover on a 300mm lead pipe

and with a 450mm sump. The depth of ground cover is required for pavement and subsoil design. In some locations the cover is at a min 600mm, where the outfall level is constrained.

Pipe outlet structures for the pipe network have been designed for erosion and scour protection including suitable riprap and/or protection to the receiving environment. Open channels (including swales) have been designed to mitigate scour and erosion for the Project.

At the SH16 crossing over Ngongetepara Stream (CH190630) a kerb and channel is proposed. There is a sag point on the south-eastern side of the stream crossing on SH16 where a stormwater megapit has been sized for secondary flow to discharge to Ngongetepara Stream.

Side access culverts under vehicle access will be installed. These will be minimum 375Ø with typically 400mm cover. Where this minimum cover cannot be achieved a reinforced slab will be provided above the culvert. The culverts will be fitted with headwalls and wingwalls when located behind a barrier or a sufficient distance away from the carriageway. Where there is no barrier a mountable or traversable grate has been provided.

There is an existing stormwater pipe located outside 191 SH16. This pipe is located within the tree protection zone for the notable trees. This pipe is to remain in place and the contractor is to CCTV the stormwater pipe to confirm the existing condition of the pipe and to confirm if there are any lateral connections into the pipe. If the pipe is in poor condition, it will be made redundant and filled with flowable fill. There will be no earthworks in this area.

4.3 Stormwater Discharge and Diversion

The stormwater discharge points for the extent of the works are shown on the image below, as well as the outfall reference number, which is used in the drawings. Refer to drawings CD-2100 to CD-2127 for the new stormwater drainage layout for primary and secondary conveyance systems. A plan is also shown below

identifying all the discharge points (DP) and outfall references for the smaller contributing catchments.

Figure 4-1 Stormwater Discharge Points and Outfall reference

There are some existing locations where the SH16 primary stormwater network currently discharges to private properties adjacent to SH16. These outfalls have been modified, with the primary SH16 runoff redirected to discharge to public land or a stream environment. Table 4-2 below shows the change in pervious and impervious area at each discharge point to reflect the change in catchment and modifications along SH16. Significant changes in catchment and discharge points are noted in the Table below. In other locations minor changes of increased impervious from road widening and the SUP will be seen within the catchment.

Table 4-2: Changes in impervious areas at Discharge Points

Discharge Point	Outfall Ref	Existing Scenario		Proposed Development		Comment
		Pervious (m^2)	Impervious (m^2)	Pervious (m^2)	Impervious (m^2)	
DP 1	A	19548	9821	15549	23156	
	M Kennedy Road Properties and Road*	5436	4282	0	0	Moved from outfall M to outfall A
	B	5614	810	11035	2937	Increase due to redirection of Stormwater from DP2

Discharge Point	Outfall Ref	Existing Scenario		Proposed Development		Comment
		Pervious (m^2)	Impervious (m^2)	Pervious (m^2)	Impervious (m^2)	
	C	30153	8895	25594	11987	
DP 2 (Property 256)		6186	780	0	0	Redirected to Outfall B at DP1.
DP 3a (Property 324)		6741	4537	0	0	Redirected to Outfall N at DP4 East.
DP 3b (Property 315)		0	3503	0	0	Redirected to Outfall N at DP4 East.
DP4 East	NE	1013	1055	8165	12103	Increase due to redirection of Stormwater from DP3a and DP3b
DP4 West	NW	4613	5584	721	6896	Minor reduction due to new roundabout. Increase at DP4 East.
DP5	F	50163	13516	45306.2	17066	
DP6	H	78830	15252	88311	17066	
	I	1509	10144	3283	11997	
	J	7972	1291	6444.9	2100	
	G	533	812	1390	574	
DP7	K1	27310	8524	478	1876	Redirected from 464 SH16 pond to 472 SH16 through new swale and open channel to be owned by Waka Kotahi
	K2			1529	1522	
	K3			20861	8220	
	K4			0	1008	
	North Catchment	72622	5466	70279	7808	
DP8	L	37243	5571	35028	7624	
DP9	S	2752	1774	2610	1930	
DP10		0	965	0	965	
DP11	Q	915	3531	758	4373	
	R		757	728	1017	
DP12	P	123	1340	0	2069	

Stormwater discharge from SH16 at the following locations currently discharge to Auckland Transport local roads. At these locations flows will increase as a result of the SH16 Stage 2 Project. This includes: Coatesville Riverhead Highway (DP4), Old North Road (DP5) and Old Railway Road (DP9).

Modification to existing AT assets outside 7 Main Road and 550 Main Road will be modified as part of this work. These discharge to Kumeū River (DP11).

Stormwater runoff from the existing Auckland Council public network, which captures runoff from Kennedys Road and adjacent properties is located within SH16 designation. The stormwater runoff from this catchment is currently conveyed to Ngongetepara stream (DP1). A new stormwater pipe which services these properties will be combined with the SH16 road runoff. This pipe is to remain with Auckland Council and the network extension to DP1 will be vested to Auckland Council. Maintenance of the assets is to be confirmed by AC and Waka Kotahi.

Stormwater discharge to the streams

Discharge to the streams requires a riprap apron to manage the erosion and scour protection from the 10-year event. The following locations require works within the stream bed.

Ngongetepara Stream:

- DP1 Outfall A – Gabion baskets place within stream on bank edge – 4m wide along stream bank and ~1m high placed on stream bed. A reno mattress will extend into the stream ~1m.
- DP1 Outfall B – Gabion baskets place within stream on bank edge – 3m wide at stream bank and ~1m high placed on stream bed. A reno mattress will extend into the stream ~1m.
- DP1 Outfall C – Gabion baskets place within stream on bank edge – 3m wide at stream bank and ~1m high placed on stream bed. A reno mattress will extend into the stream ~1m.

Huruhuru Stream:

- DP4 Outfall NE – Rock rip rap placed on southern stream bank edge – 3m wide at stream bank and 0.6m deep. Does not extend into stream bed

Intermittent/ permanent stream at CH192580

- DP6 Outfall G - Rock rip rap placed on southern stream bank edge – 2.5m wide at stream bank and 0.3m deep. Does not extend into stream bed
- DP6 Outfall J - Rock rip rap placed on northern stream bank edge – 3m wide at stream bank and 0.3m deep. Does not extend into stream bed
- DP6 Outfall I Rock rip rap placed on northern stream bank edge – 3m wide at stream bank and 0.3m deep. Does not extend into stream bed

Kumeū River:

- DP11 Outfall Q – Rock rip rap placed on eastern stream bank edge – 3m wide at stream bank and 0.6m deep. Does not extend into stream bed
- DP11 Outfall R – Rock rip rap placed on southern stream on bank edge – 3m wide at stream bank and 0.6m deep. Does not extend into stream bed

Table 4-3 below identifies the discharge points and receiving environment for each sub catchment, along with the requirements for hydrology mitigation and stormwater treatment (details of these are set out in this section of the report).

Table 4-3: Proposed Stormwater Discharge Points and Conveyance Systems

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
DP 1	A	River or Stream (Ngongetepara Stream) at Brigham Creek Culvert	Y	N	Kerb and channel with pits and pipes and discharge into a retention swale prior to discharge to stream	Falls towards road. Collected in road pipe network	Vortcapture and SW360 ZPG Filter Cartridge	Vortcapture: VC70 SW360: 47x69cm Cartridge in 7.15m x 2.7m Vault GD01 requirements achieved and meets Waka Kotahi Propriety device guidelines Area of untreated road surface 1750m^2, of which 378m^2 is additional pavement area due to site constraints	Rock lined channel on stream embankment from stormwater outfall. Gabions required to be installed on stream bank within permanent water level
	Kennedy Road Properties A5. branch		N	N	Pipe and manhole to convey runoff from Kennedy Road and properties to discharge to stream	N/A	Combined System with outfall reference A	Discharge from local residential houses	N/A – as above
	B		Y (for 434m^2 only)	N	Majority of road fall away to Outfall C. Small section of road collected through Kerb and channel with pits and pipes prior to discharge to stream	Falls away from road. Conveyed in dish channel drain and collected in local catchpits prior to discharge to stream	No treatment provided	Area of untreated road surface 626m^2 of which 145m^2 is additional pavement area. This is due to constraints related to space, access for maintenance / safety and geotechnical requirements has precluded treatment for this area	New stormwater pipe and headwall installed on stream bank within permanent water level. Existing headwall to be removed.

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
	C		Y	N	Kerb and channel with pits and pipes and discharge into a treatment swale prior to discharge to stream	N/A	Treatment Swale with check dams Remaining collection: Vortcapture and SW360 ZPG Filter Cartridge	Planted Swale Details: Length 55m Longitudinal Slope 7.7% Bottom Width 1.5m Slide Slopes 1V:3H Depth Swale 0.6m Check dams: 17 x 3.25m spacing Treatment Achieved: 101% Vortcapture: VC40 SW360: 5x69cm Cartridge in a 1800ØMH GD01 requirements achieved and meets Waka Kotahi Propriety device guidelines Area of untreated road surface 302m^2 of which 202m^2 is new pavement. This is due to constraints related to space, access for maintenance / safety and geotechnical requirements has precluded treatment for this area which makes this area not practical for discharging to the treatment device	Rock lined channel on stream embankment from stormwater outfall. Gabions required to be installed on stream bank within permanent water level. Removal of tree required. Existing headwall to remain.

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
DP 2	Removed as a primary discharge point due to private property, Overland Flow path exists for large events								
DP 3a	Removed as a primary discharge point due to private property, Overland Flow path exists for large events. SH16 Primary discharge redirected to DP4 East								
DP 3b	Investigations did not provide enough evidence this discharge point was viable. SH16 Primary discharge redirected to DP4 East								
DP4 East	N	Auckland Transport Roadside drain	Y	Y	CH191200 to 191500 - East bound carriageways is collected in kerb and channel with pits and pipes to discharge into Road Drain - West bound carriageway is collected in kerb and channel withpit and pipes into treatment swale - Roundabout is collected in kerb and channel and discharged into Road drain	Falls towards road. Collected in road pipe network	Treatment Swale D – DP3 Retention Swale N(East)	Planted Swale Details: Swale D – DP3 Length 110m Longitudinal Slope 0.5% Bottom Width 1.0m Slide Slopes 1V:3H Depth Swale 0.3m 333% treatment achieved. Planted Retention Swale N(East) Length 39m Longitudinal Slope 4.6% Bottom Width 0.6m Slide Slopes 1V:5H Depth Swale 0.55m Check dams: 9 x 5.6m spacing @0 250mm high 87% treatment achieved Driven by scope of works and space.	Discharge to existing roadside swale. Discharge to permanent stream on Coatesville Riverhead highway stream. No works required – to be confirmed on Site during construction. No survey information available Upgrade of side culverts required along length of AT road to discharge location.

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
DP4 West	N	AT Roadside drain	Y	Y	Kerb and channel with pits and pipes and discharge into a swale prior to discharge to roadside drain Collection of Boric Carpark and Access roads	N/A	Retention Swale N(west)	Retention Swale N(West) Length 37m Longitudinal Slope 3% Bottom Width 2.0m Slide Slopes 1V:5H Depth Swale 0.45m Check dams: 7 x 5.80m spacing @250mm high Treatment Achieved: 117%	Discharge to roadside swale.
DP5	F	Roadside drain on Old North Road	Y	Y	Kerb and channel with pits and pipes and discharge into swale on the south side. Before being discharged to North Side and Old North Road Northside discharges to existing Roadside drain at Old North Road	Falls towards road. Collected in road pipe network	Swale F TBC Swale at Old North Road	Planted Retention Swale F Length 74m Longitudinal Slope 0.8% Bottom Width 1.5m Slide Slopes 1V:3H Depth Swale 0.75m Treatment Achieved: 242% Treatment Swale on Old North Road – to be confirmed with AT. Grassed Retention Swale $F_{\text{Old North Road}}$ Length 47m Longitudinal Slope 0.5% Bottom Width 1.0m Slide Slopes 1V:5H Depth Swale 0.45m Treatment Achieved: 157%	Discharge to roadside swale. No stream works at discharge.

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
DP6	H	River or Stream (Kumeū River Tributary)	N	Y	Swale from Taupaki Road	Falls away from road. Collected in relocated swale (south East) Falls away from road and collected in catch pit (South West)	Existing grass swale will be replicated	Grass Swale Details: Length 254m Longitudinal Slope 2.4% Bottom Width 1.0m Slide Slopes 1V:4H Q10 depth 0.25m Treatment Achieved: 436% Area of untreated existing road surface 315m^2 is removed from existing treatment due to overland flow and raised table.	Discharge point unchanged – in close proximity to natural wetland Conveyance for the 100 year from Taupaki Roundabout
	I		Y	Y	Roadside Drain and swale (minimal new impervious area)	N/A	Treatment Swale (Detention provided with a media with liner)	Planted Swale Details: Length 27m Longitudinal Slope 2.6% Bottom Width 1.2m Slide Slopes 1V:3H Q10 depth 0.5m Treatment Achieved: 54% Site constraints due to location of SIC cable.	Discharge to swale and rock lined channel to stream.
	J		Y	Y	Kerb and channel with pits and pipes and discharge into a bioretention swale to discharge to intermittent stream	N/A	Treatment Swale (Detention provided with a media with liner)	Planted Swale Details: Length 120m Longitudinal Slope 2.0% Bottom Width 0.6m Slide Slopes 1V:3H Q10 depth 0.6m	Discharge from stormwater pipe to rock lined channel to stream.

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
								Treatment Achieved: 340% Area of untreated road surface 945m^2 of which 415m^2 is additional pavement area. This section of road cannot discharge to the treatment devices due to site constraints and the existing SIC Cable.	
	G		Y	Y	Kerb and channel with pits and pipes and discharge into a bioretention swale to discharge to intermittent stream	Falls towards road. Collected in road pipe network	Retention Swale	Planted Swale Details: Length 35m Longitudinal Slope 5.0% Bottom Width 1.2m Slide Slopes 1V:3H Q10 depth 0.4m Check dams: 8 x 4.17m spacing Treatment Achieved: 439%	Discharge from stormwater pipe through swale to rock lined channel to stream.
DP7	K1	New open channel and discharge to Kumeū River	Y	N	Kerb and channel with pits and pipes and discharge into a proposed new treatment device at 472	Falls towards road. Collected in road pipe network		Planted Swale Details: Length 35m Longitudinal Slope 5.0% Bottom Width 1.2m Slide Slopes 1V:3H Q10 depth 0.4m Check dams: 8 x 4.17m spacing	Discharge from stormwater pipe through swale to stream. New rock lined channel required. Extent of Work to be confirmed on Site as no
	K2		Y	N					
	K3		Y	N		Falls towards road. Collected in road pipe network			
	K4		Y	N					

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
								Treatment Achieved: 100%	survey data is available.
DP8	L	River or Stream (Kumeū River)	Y	Y	Kerb and channel with pits and pipes and discharge into a bioretention swale to discharge in Kumeū River.	Falls towards road. Collected in road pipe network	Retention Swale	Grassed Swale Details: Length 110m Longitudinal Slope 0.5% Bottom Width 1.0m Slide Slopes 1V:3H Swale Depth 0.45m Treatment Achieved: 471% Area of untreated road surface 536m^2 of which 51m^2 is additional pavement. This section of road cannot discharge to the treatment devices due to site constraints	Discharge to existing outfall behind 538 SH16 (BP Petrol Station)
DP9	S	Roadside drain	Y	N	discharge directly into swale which discharges into Old Railway road	N/A	Treatment Swale (Detention provided with a media with liner)	Planted Swale Details: Length 30m Longitudinal Slope 0.5% Bottom Width 0.6m Slide Slopes 1V:3H Q10 depth 0.35m Treatment Achieved: 100%	Discharge to existing road side channel
DP10	Project works no longer required this discharge point								
DP11	Q	River or Stream (Kumeū River)			Kerb and channel with pits and pipes and discharge into a Kumeū River	Falls away from road conveyance drain – TBC upon survey	N/A	No treatment Provided for existing road, as no change to road pavement or drainage.	Discharge through pipe network into Kumeū River. Rock lined

Discharge Point	Outfall Ref	Receiving Environment	SW Quality Required	Hydro-logy Mitiga-tion required	Road Conveyance Systems	Shared Path Conveyance Systems	Treatment Device	Treatment Device Sizing / comment	Discharge Point / Outfall
									channel required. To be confirmed on Site during construction
	R	River or Stream (Kumeū River)			Kerb and channel with pits and pipes and discharge into a Kumeū River	Falls away from road conveyance drain – TBC upon survey	N/A	No treatment Provided for existing road, as no change to road pavement or drainage.	Discharge through pipe network into Kumeū River. Rock lined channel required. To be confirmed on Site during construction

4.4 Stormwater Quality Treatment

Based on the AUP requirements, stormwater runoff generated from the new or redeveloped high use road impervious area is proposed to be treated before discharge. This includes stormwater treatment of the new and existing road impervious area, where the discharge cannot be separated. This is achieved by collecting and treating the road surface runoff through a combination of natural green infrastructure and proprietary treatment devices proposed along the corridor, as shown on drawings.

Not all runoff from existing road surface can be captured and treated as there are some sections of the existing carriageway edge which are left unchanged at the western end of the Project. There are also some areas where it is not practical to achieve 100% of treatment due to site constraints. Approximately 90% (67,373m^2 of treated area out of 75,242m^2 total impervious area) of the total impervious road area is treated. This is a significant increase on the current 23% treatment achieved. Refer to the Table above for the treatment device, sizing and level of treatment achieved for each outfall.

A combination of treatment swales with varying base width are primarily used for treatment purposes. Where the site is constrained by land, other service or operational requirements proprietary treatment devices (such as Stormwater360) have been designed. Retention swales have been adopted where treatment and hydrology mitigation is required and where the topography and site constraints are suitable. Planted treatment swales and retention swales are designed to GD01 guideline to provide a residence time of 9 minutes or more to treatment of the road stormwater runoff. Preliminary sizing of propriety treatment devices has been completed by Stormwater360 using a water quality rainfall intensity of 10mm/hr as per GD01. The sizing is based on a treatment train approach with an upstream Gross Pollutant Trap (GPT) (Vortcapture) and ZPG media cartridges at full flow (Stormfilter), as recommended by Waka Kotahi Stormwater Assets Manager. The sizing is outlined in Table 4-3 above.

Maintenance areas have been provided at each location where proprietary stormwater treatment devices are proposed. This provides for a safe working area, clear of the shared path and carriageway.

The areas of SH16 which are not treated or provide limited treatment include:

- DP1 Outfall A: 1,750m^2 of new and existing impervious area which is not treated due to site constraints. This is at a sag point above Ngongetepara Stream due to topographical and geotechnical limitations, site access for maintenance and safety due to the location on SH16.
- DP5 Outfall J: 701m^2 of new and existing impervious area which is not treated due to site constraints.
- DP11 Outfall Q: 3,515m^2 of existing impervious area which is not treated due to site constraints (note: this does not require stormwater treatment as there is no new or redeveloped road at this location)
- DP11 Outfall R: 509m^2 of existing impervious area which is not treated due to site constraints (note: this does not require stormwater treatment as there is no new or redeveloped road at this location)
- DP12 Outfall P: 408m^2 of new impervious area. There is currently stormwater treatment provided for this area, however the size of the device is unknown. It is expected that it will be able to treat the stormwater runoff from the additional area.

As this is a small area, the overall the impact of not treating this area of road is negligible.

4.5 Hydrological Mitigation - Retention and Detention

Hydrologic mitigation is provided where additional impervious area discharges to a stream environment, including permanent and intermittent streams above RL1.7 (NZVD2016). This is to manage stream erosion and extend the flow release to the stream environment.

Hydrology mitigation is required at discharge points: DP4, DP6, DP7, DP8 and DP11 as we are discharging into a stream environment. At these locations we have additional impervious areas from both road widening and the SUP. In assessing the design options to achieve hydrology mitigation, consideration of the site constraints, topographical limitations, operational requirements, safety and existing service have been taken into account.

Hydrology mitigation volumes are provided using retention storage volume under the retention swale with check dams, the results are summarised in the table below. In some locations where existing utilities are located, primarily the Spark International Cable (SIC) and the 450Ø critical watermain, retention cannot be achieved. At these locations the detention requirements have been increased to allow the required retention volumes (refer to AUP E10 Table E10.6.3.11, (2) (c)), meeting the overall hydrology mitigation volumes where practical. This approach allows the overall hydrology mitigation to be achieved, protecting the stream environment.

Discharge Point 1 is Ngongetepara Stream (Brigham Creek). The base of the stream at this location is typically RL1.3m, however two of the discharge points from the pipe network are higher up the stream embankments due to the incised banks to the stream. The discharge from the SH16 stormwater network is also located at the downstream end of Redhills Catchment, immediately before it discharges to Brigham Creek, a tidal area. Due to the location within the catchment, level and proximity to the tidal area, hydrology mitigation (detention or retention) is not required at this location. However, as there are some swales in this area, a small amount of detention is achieved in this area and is detailed in the table below.

The SH16 Stage 2 Project achieves the following hydrology mitigation requirements based on the three main stream environments:

- Ngongetepara Stream: Hydrology mitigation not required, however 16m^3 of detention is achieved through swales
- Huruhuru Stream: 27% of the hydrology mitigation requirements are achieved. Achieved retention 10m^3 and detention 34m^3
- Kumeū River: 84% of the hydrology mitigation requirements are achieved. Achieved retention 50m^3 and detention 211m^3

Table 4-4 outlines hydrology mitigation requirements and volume which can be achieved on site.

Table 4-4: Hydrology Mitigation requirements when discharging to a Stream Environment

Discharge Point	Outfall Ref	Receiving Environment	Retention Volume required (m^3)	Detention Volume required (m^3)	Total Hydrology Mitigation required (m^3)	Total Hydrology Mitigation provided (m^3)	Comments
DP1	A	River or Stream (Ngongetepara Stream) at Brigham Creek Culvert. Invert of stream ~RL1.3m	N/A^ (27.3)	N/A^ (101.0)	N/A^ (128.3)	N/A^	Site Constraints (notable trees)
	B (includes DP2 diversion)		N/A^ (9.6)	N/A^ (35.5)	N/A^ (45.1)	N/A^	Site constraints (geotechnical)
	C		N/A^ (13.0)	N/A^ (48.1)	N/A^ (61.1)	N/A^ 25% (16m^3)	17% Achieved through check dams of the swale
DP4	NE	AT roadside drain then to River or Stream (Huruhuru stream)	26.8	99.0	125.8	18%	Achieved 28% of requirement for combined discharge at DP4.
	NW		4.7	17.4	22.1	85%	

Discharge Point	Outfall Ref	Receiving Environ-ment	Retention Volume required (m^3)	Detention Volume required (m^3)	Total Hydrology Mitigation required (m^3)	Total Hydrology Mitigation provided (m^3)	Comments
DP5	F	AT roadside drain then to Stream at DP6	70.6	19.1	89.7	64.0	Achieved 71% of requirement for combined discharge at DP5
DP6	H	River or Stream (Kumeū River Tributary)	7.9	29.1	36.9	100%	Retention swale
	I		4.3	15.8	20.0	46%	Swale: Detention only due to SIC location
	J		3.5	13.0	16.5	129%	Swale: Detention only due to SIC location
	G		1.7	6.3	8.0	161%	Retention swale,
	Total hydrology mitigation achieved for DP6 is 97%						
DP7	K	River or stream (Kumeū River)	17.7	65.60	83.30	118%	Retention swale
DP8	L	River or Stream (Kumeū River)	7	25.8	32.8	137%	Retention swale
DP9	S	AT roadside drain then River or Stream (Kumeū River)	0.57	2.11	2.68	241%	Swale: No retention due to SIC location
DP11	Q	River or Stream (Kumeū River)	3.6	13.2	16.8	116%	Retention swale
	R	River or Stream (Kumeū River)	1.6	5.8	7.4	0%	Stormwater conveyed through pipe

*Hydrology mitigation requirements are not required due to level of discharge (refer to E10.6.1). Retention and detention requirements provided are based on the additional impervious areas at the site for reference.

^DP A has no Hydrology Mitigation proposed due to realignment of SH16 to protect notable trees. The location of the treatment is constrained with structures, services, topography and limitations for operational requirements.

4.6 Cross Drainage

The existing stormwater network consists of cross culverts which capture or convey runoff from an external catchment that then connects into piped networks, as well as those that cross under SH16. These existing cross culverts within the works have been reviewed to determine what is required to be modified as a result of the road widening and shared path. Refer to the stormwater cross culvert plan 3235804-SK-2010 in Appendix D.

The cross culverts are detailed in Table 2-2Table 2-1 and Table 2-2 in the existing culvert and stream information. The majority of the cross culverts discharge into the existing or new stormwater pipe network and all other cross culverts remain as they are. Where the cross culverts discharge into the stormwater pipe network, these have been assessed for the 10 year event, as part of the stormwater conveyance network, and not treated as cross culvert. The pipes are 600Ø or smaller, therefore would be considered to be blocked in a 100 year event.

The existing culvert at CH193270 (DP6) will remain unchanged (downstream level, location and culvert condition is to be confirmed). At this location, there are properties within the upstream flood plain. As shown in the Auckland Council GIS flood maps, the 1% AEP storm event the flood water overtops the SH16 road corridor (refer to Section 4.7). The design crest level of the road at this location (CH192530 to 192610) remains the same at the existing. This is achieved in the design with a road edge beam rather than a kerb. There is a barrier at this location to provide safety from the SH16 road corridor to the SUP.

The culvert at CH192900 and CH192940 is a 300Ø and a 450Ø, respectively. Both connects into the pipe network at 464 SH16 and discharges to the existing pond on the property. The capacity of the existing cross culvert is currently undersized. The outfall to property 464 SH16 has been redirected to a new outlet at 472 SH16 which will require new culvert crossings under SH16.

As discussed previously, the existing culverts are under capacity and will overtop the road under the 10% AEP design rainfall event.

Table 4-5: Change in HWL at culverts with capacity for 10% AEP rainfall

Chainage	Size	Existing Length (m)	Change in length (m)	Existing 10% AEP HWL (RL m)	10% AEP HWL Project (RL m)	Change in HWL (m)	Comment
191900	600Ø[1]	52	0	New Stormwater Pipe as part of road stormwater network installed in addition to existing 600Ø therefore no change			
192430	375Ø	31	0	Replaced as part of Stormwater Pipe Network			
192570	600Ø	29.6	0	30.96[1]	31.05[1]	0.09[1]	Current edge of seal (high point) approx. RL29.5
192900	300Ø[2]	15	0	Replaced as part of Stormwater Pipe Network			
192940	450Ø	16.3	0	Replaced as part of Stormwater Pipe Network			
193260	375Ø	16.7	0	Replaced as part of Stormwater Pipe Network			
193510	375Ø	20.0	5	Culvert drains the existing wetland and not impacted by the Project.			

[1] Indicated only as the flood water will continue to overtop the SH16 road. Modelling has not been carried out.

[2]Culvert will be replaced with a 375Ø as part of the road drainage stormwater network

As the focus of the project is safety improvements, therefore it is not a Project Requirement to upgrade existing culverts to comply with the current design standards on hydraulic performance if the upstream water level is not worse as a result of the Project.

4.7 Flood Risk

The effects of the SH16 Stage 2 Project is assessed in four different areas below:

- Flood Risk to Road
- Flood Risk to Others – Downstream
- Flood Risk to Others – Upstream at Culverts
- Afflux at Major Stream Crossings

The assessment of the effects on the various areas of flood risk have been completed through desktop studies, based on information from AC GIS, existing RAMM data and survey information (where available). Assumptions have been made where there are gaps in the existing information, such as stream cross section profiles and invert levels of pipes and culverts.

Flood Risk to Road

The existing road vertical geometry is not intended to be modified significantly, and the effects of the proposed widening works on the overland flow path of the road is considered to be minor. This is due to the new conveyance channels and swales being designed for the new layout.

Flood Risk to Others – Downstream

The effect of the proposed SH16 Stage 2 Project works on downstream properties and buildings have been assessed at several locations. The flood water levels have been taken from the Auckland Council GIS viewer flood plains and contours.

- DP2- 256 SH16 and 238A SH16
  The existing properties at this location are within the existing flood plain for the 100 year event. This flooding is caused from Brigham Creek Culvert on Ngongetepara Stream, creating head water effects to approximately RL10m. The increase in impervious area for the 100 year event from the SH16 Stage 2 contributing to the tributary is 0.5% for the stream tributary and the effects are considered minor.
  The 10year event is collected through a pipe network and discharged to DP1 and DP4, therefore reducing flood effects at this location for the 10 year event. Refer to Afflux at Major Streams below.
- DP3a – 315 SH16
  There are no existing properties at this location within an existing flood plain for the 100 year event. The increase in impervious area for the 100 year event from the SH16 Stage 2 works is 30% of the catchment and the effects are considered minor due to the nature of the runoff shedding at these locations.
  The 10year event is collected through a pipe network and discharged to DP4, therefore reducing flood effects at this location for the 10 year event.
- DP4 – 1385 and 1367 Coatesville Riverhead Highway
  The existing property at this location is partly within an existing flood plain for the 100 year event which is generally within the Huruhuru Stream. The flow to the downstream properties is restricted by the existing culvert upstream on Coatesville Riverhead Highway. The increase in impervious area for the 100 year event from the SH16 Stage 2 works is 1.4% of the catchment and the effects are considered minor.
- DP5 – 1368 SH16
  The existing property at this location is within an existing flood plain for the 100 year event. The site is generally flat and the flood plain is widespread. The increase in impervious area for the 100 year event from the SH16 Stage 2 works is 3.91% of the catchment and the effects are considered minor.

The 10year event is collected through a pipe network and discharged to DP6, therefore reducing flood effects at this location for the 10 year event.

- DP6 – 436 SH16
  The existing property at this location is partly located within an existing flood plain for the 100 year event. This is due to the permanent stream tributary of the Kumeū River. The increase in impervious area for the 100 year event from the SH16 Stage 2 works is 0.6% of the catchment and the effects are considered minor.
- DP7 – 464 SH16
  The existing properties at this location is partly located within an existing flood plain for the 100 year event. The increase in impervious area for the 100 year event from the SH16 Stage 2 works is 2.6% of the catchment and the effects are considered minor. The overland flow is moved to the west to 472 SH16, which will reduced the flood plain at 464 SH16.
- DP8 – 538 SH16
  There are no existing properties at this location within an existing flood plain for the 100 year event, however the Kumeu River flood plain is located at the downstream end of the property. The increase in impervious area for the 100 year event, the SH16 Stage 2 works is 5% of the catchment and the effects are considered minor.
- 550 Main Road
  The existing building is partly located within an existing flood plain from Kumeū River. The cumulative effects of the SH16 Stage 2 project is considered minor at this location as the floodplain is impacted by Kumeū River. Refer to Afflux at Major Streams below.

Flood Risk to Others – Upstream at Culverts

The increase in impervious area of the project may influence the head water level (HWL) at each culvert and could therefore have an increase in potential flood risk effects to immediate upstream properties and buildings.

The majority of the culverts conveying upstream flow have been redesigned for the 10 year event and combine with the stormwater pipe network (refer to Table 4-5). These pipes are generally less than 600Ø and therefore assumed to be blocked in a 100 year event.

The culvert at CH192570 is an existing 600Ø culvert and there are existing buildings upstream partly within the existing floodplain at 429 SH16 and 407 SH16. The flood plain is approximately RL29.6m. This is expected to be related to the crest of the SH16 road at RL29.5m, showing the flood water overtops the road. The existing 600Ø culvert is undersized at this location under the existing scenario.

For the 10 year event, the total increase in impervious area at this location is 5,474m^2 which is 1.3% of the total upstream catchment. On review of AC Geo Maps aerial photograph of the surrounding areas of each culvert, the likelihood of the effects from the SH16 Project work having an adverse effect on the flood risk to these upstream properties is low as the flood water will continue to overtop the SH16 road, as the crest level remains the same.

For the 100 year event, the total increase in impervious area at this location is 2,868m^2, which is 0.66% of the total upstream catchment. The effects on the property are considered minor.

Afflux at Major Stream Crossings

The proposed works crosses two major streams at Kumeū River, referred to as Kumeū No. 1 Bridge and Ngongetepara Stream, referred to as Brigham's Creek Culvert. The works around these areas are outlined below. Refer to the attached Design Memos for Kumeū River and Ngongetepara Stream that were prepared to inform the structural design of the new bridge structures for the SUP.

a. Kumeū No. 1 Bridge – Kumeū River

The works proposed at Kumeū No.1 Bridge includes the construction of a new pedestrian bridge for the shared path facility on the southern side of the existing road. This pedestrian bridge is located on the upstream side of the Kumeū River. It is proposed that the cross-section area defined by the stream channel and bridge structure will not be changed as the new bridge superstructure spans longer and the soffit is at the same level as the existing structure. On this basis, the effects of afflux is negligible.

b. Brigham Creek Culvert – Ngongetepara Stream

The works proposed at the SH16 crossing of Ngongetepara Stream at Brigham Creek culvert include the construction of a new pedestrian bridge for the shared path facility on the southern side of the existing road. This bridge is located on the upstream side of the stream. It is proposed that the cross-section area defined by the stream channel and culvert structure will not be changed as the new bridge spans longer and is higher than the existing culvert (top of the bridge is set at the SH16 road level). On this basis, the effects of afflux is negligible.

Table 4-6: Estimated Water Level at the two major stream crossings

Stream Name	Bridge / Culvert Name	Catchment area (ha)	Q100 Flow (m^3/s)			Q100 Water Level (m)		
			Pre	Post	Change	Pre	Post	Change
Ngongetepara Stream	Brigham Creek Culvert	1104.7	90.5	91	0.5	10.7	10.9	2mm
Kumeū River	Kumeū #1 Bridge	4323.2	210	210.6	0.6	23.4	23.8	4mm

The increase in flood extent and depth to downstream buildings and properties due to the minor increase in peak flow are expected to be minimal at these key crossing points. Due to the minor change in flows erosion and scour protection is not required at this location for the Streams. Scour protection is included around the bridge abutments, beneath the SUP (where stormwater sheds off the edge) and at stormwater outfall structures at these locations.

4.8 Scour Protection for the new Bridge Structures

Scour protection is required for the new SUP bridge structures located on Ngongetepara Stream and Kumeū River. This is required as the structures do not have stormwater capture and the runoff is able to shed over the sides into the ground below it.

Under AUP E3.6.14(1)(b) any required erosion or scour management works must not exceed 5m in length, either side of the extended structure.

Kumeū River

The scour protection will extend 5m out from the edge of the structure on the south side and 3m on the northern side, on the banks of Kumeū River. There will be no works within the stream. The extent of the work is to be confirmed onside with the Engineer.

Ngongetepara Stream

There is existing rock scour protection located above and around the existing culvert structure. This is to remain in place where possible. The scour protection required for the SUP structure is to extend 5m out from the edge of the structure on the south side and approximately 2m to the northern side. There will be no works within the stream for this scour protection. The extent of the work is to be confirmed onside with the Engineer.

4.9 Fish Passage

Existing culverts within the extent of the work need to comply with the National Environmental Standards (NES) 2020 for Freshwater. This requires fish passage to be provided for any culvert which is being altered/extended or reconstructed as part of this work, which is located in a permanent or intermittent watercourse and greater than 30m in length. Within the SH16 Stage 2 extent of works, there are no culverts located within a permanent or intermittent watercourse which are greater than 30m in length or being altered/extended or reconstructed. Therefore fish passage construction is not required.

4.10 Discharge near Wetlands

There are two existing wetlands within the extent of works at 436 SH16 and the other at 522 SH16. Refer to ecology for details. Information below sets out the change in catchment or flow discharging to the wetlands.

Wetland at 436 SH16

The existing Wetland situated at 436 SH16 is located on the southern side of State Highway 16. The wetland has an area of approximately 360m^2. The contributing catchment is approximately 1.22 hectares which is predominantly pastural land and outside of the project extents (as shown in Figure 4-2 A below). The wetland and contributing catchment is zoned in the AUP as Lifestyle rural (90 percent pervious and 10 percent impervious).

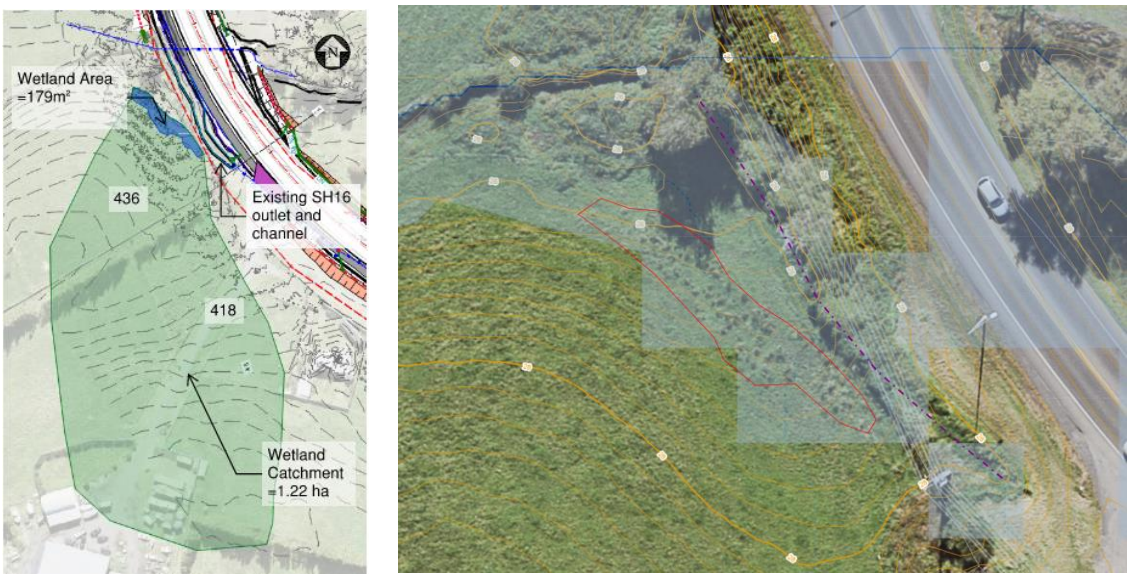


Figure 4-2: Left (A): Aerial of Catchment and wetland | Right (B): AC GIS Flood Map with indicative location of wetland in red and channel in purple

There is an existing open channel located on the north eastern side of the wetland (refer to image 4-2B), which conveys flow from the existing SH16 swale to the permanent tributary of Kumeū River. Auckland Council GeoMaps also shows the wetland to be located within the 100 year flood plain (Figure 4-2 B above).

A review has been undertaken to assess the existing swale outfall and the proposed works in relation to the wetland. The level of the wetland varies from ~RL27.5 to 26m. The existing channel is located approximately 5m east with an invert of RL27.09 at the upstream end, with a depth of 0.5m (refer to Figure 4-2C below). The water levels in the channel are expected to spill into the wetland for the 10 year and 100 year events in both the pre and post development.

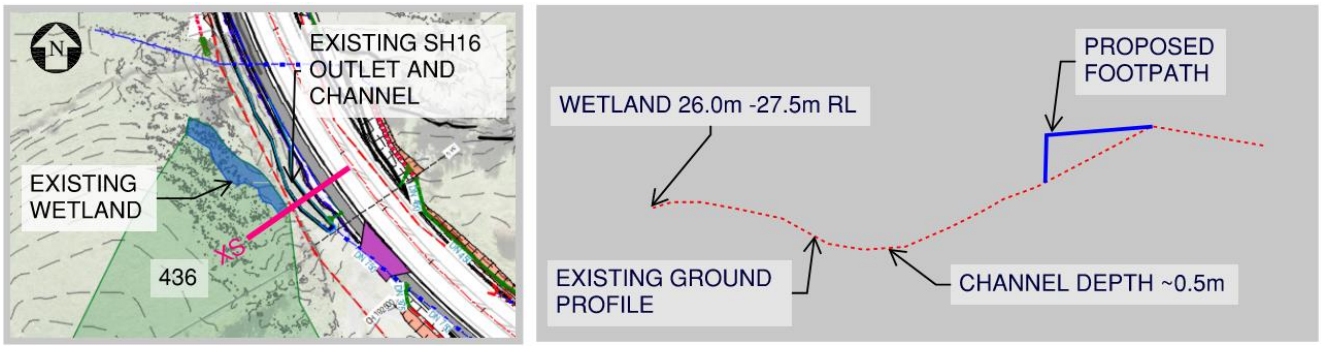


Figure 4-2C, Cross Section of Existing Channel with Existing Wetland

The levels have been sourced from Auckland Council GIS and have limitations due to vegetation.

It is proposed that the upgrades to SH16 will continue to use the existing channel and discharge into the existing permanent stream tributary north west of the wetland.

The area contributing to the wetland will be unchanged (1.22Ha), however as the design rainfall allows for Climate Change the peak flow at these locations increase, as shown in the Table below.

Table 4-7: Change in flow to wetland due to climate change allowance

Storm Event (ARI)	Pre Development flow to wetland (m^3/s)	Post Development flow to wetland (with Climate Change) (m^3/s)
10 year	0.18	0.3
100 year	0.3	0.5

The discharge from the existing outfall structure south of the wetland increases as a result of the Project, from increase in impervious area and the allowance for Climate Change. The impervious area increases by 1,265m^2 from the shared path and 58m^2 from SH16 road widening. This is an 8.5% increase in impervious area for this section of the Project.

Table 4-8: Change in impervious area on SH16 adjacent to the wetland

Scenario	Total Area (m2)	Pervious (m2)	Total Impervious (m2)	Existing Impervious	Cycleway Impervious (m2)	Additional Road Impervious (m2)	Additional access Impervious (m2)
Outlet H Pre Development	103958	88386	15572	15572	N/A	N/A	N/A
Outlet H Post Development	103958	87063	16895	15572	1265	58	0

The outfall discharges into an open channel, located to the east of the wetland. The stormwater flows and water depths in the open channel have been reviewed to assess the impact on the wetland. As shown in the table below, the 10 year and the 100 year event currently overtop the channel and extend into the wetland and this will continue to do so in the future.

Table 4-9: Change in the flows and water depth in the existing channel to the east of the wetland

Storm Event (ARI)	**Pre Development**		**Post Development**	
	Open Channel Flow (m^3/s)	**Water depth in channel (m)**	**Open Channel Flow (m^3/s)**	**Water depth in channel (m)**
10 year	0.1	0.52	0.3	0.63
100 year	0.3	0.61	0.5	0.71

Wetland at 522 SH16

There is an existing wetland at 522 SH16 which has an area of approximately 0.4Ha. The wetland is located on the southern side of SH16 and it is fed by pastural land on the southern side of the road, as well as a small length of road. The road currently discharges overland to an open channel on the southern side of the road towards the BP Petrol Station. This flows north through the eastern side of the wetland, and continues to flow parallel to the road. The catchment is largely pervious and is approximately 3.15Ha. The zoning under the AUP is Lifestyle rural (90% pervious and 10% impervious cover).

Currently the wetland primarily discharges north through a 450mmØ cross culvert at CH 193495. The culvert upstream invert is at RL25.18 and the downstream invert / outlet has not been located on the northern side of the road. The wetland also discharges north, utilising the existing open channel on the southern side of SH16 towards the BP petrol station. Flow will utilise this channel when the water level is greater than RL26.0

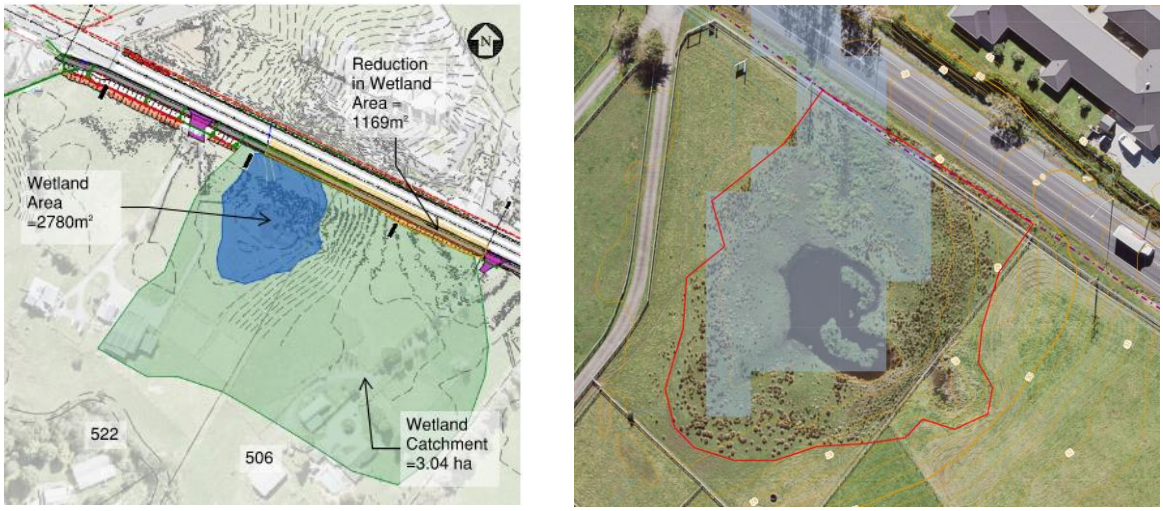


Figure 4-3: Left (A): Aerial of Catchment and wetland | Right (B): AC GIS Flood Map with indicative location of wetland in red and open channel in purple

The Projects proposed works reduces the catchment area that discharges to wetland through the following:

- SH16 road runoff is captured through catchpits and conveyed through a pipe network. This is discharged to a swale for stormwater treatment prior to discharge to Kumeū River (shown in yellow in Figure 4-3 A). Previously runoff discharged from the road directly into the wetland.
- The existing pervious strip of land between the SH16 and the wetland (existing channel) is developed into the SUP with a retaining wall. Stormwater runoff from the SUP is directed to the SH16 road and discharges to the road catchpits.

As outlined above the new shared path and minor road widening (~0.8m in width) will extend ~7m south from the current edge of seal, extending into the existing open channel and wetland. The existing wetland discharge culvert would be extended upstream by ~5m (into the wetland) with a new headwall structure prior to discharging through the new retaining wall and beneath the shared path and SH16. The culvert extension will have a new upstream invert level of RL25.23 (assuming at 1% fall). The level of the wetland adjacent to the new pipe invert is RL 25.68m.

A new open channel and swale will be constructed to the north of the wetland, parallel to the new retaining wall to convey the flow north towards the BP Petrol Station.

The total upstream catchment which discharges to the wetland is reduced by a total of 1,169m^2, which is a 3.7% reduction. This is a combination of pervious and impervious areas as shown in the table below.

Table 4-10: Change in upstream catchment to wetland 522 SH16

Wetland Catchment	Total area (m^2)	Previous Area (m^2)	Impervious Area (m^2)
Pre Development	31,583	28,425	3,158
Post Development	30,414	27,373	3,041

The catchment flows to the wetland increase, however this is due to allowance for Climate Change on the rainfall depth.

Table 4-11: Change in flows to wetland 522 SH16 (including allowance for climate change)

Scenario	Flow - 10 year (m^3/s)	Flow - 10 year (m^3/s)
Wetland Pre development	0.45	0.72
Wetland Post development	0.69	1.15

The Volume of water discharging to the wetland increases, as shown in the table below. This is also due to the allowance for Climate Change on the rainfall depth.

Table 4-12:Change in volume discharging to wetland (including allowance for climate change)

Scenario	Volume - 10 year (m^3)	Volume - 100 year (m^3)
Wetland Pre development	2,073	3,416
Wetland Post development	2,931	4,967
Increase	858	1551

5 Resource Consent Application Summary

The State Highway 16 safety improvements project is being undertaken by the New Zealand Government to save lives on roads. The Project works will create a small increase in runoff volume and increase pollution generating areas that flow to natural waterways in the Auckland Region. The methods of treatment, retention and detention proposed have been included within a space constrained corridor to mitigate the effects of the works before discharging runoff flows to the receiving stream.

The stormwater design has been completed to meet the best practical option, considering the limitations with existing utilities, properties and topography. The overall stormwater design achieves significant improvements to the environment, compared to the existing scenario.

Based on the current design, stormwater treatment for the Stage 2 project achieves 90% of the new and existing road impervious area. This is a significant increase of 25% of the existing SH16.

Hydrology mitigation requirements for the new impervious is achieved to 31% at the Huruhuru Stream and 84% of new impervious area discharging to the Kumeū River. The restrictions of not achieving all stormwater treatment and hydrology mitigation are due to site constraints and limitations, which is in line with the AUP. As discussed, due to the invert level of Ngongetepara Stream and proximity to the coastal marine area, hydrology mitigation is not required for the new impervious area discharging to this location.

Flood effects from the project are considered minor, as the increase in impervious area from the SH16 Stage 2 Project is insignificant in relation to the overall catchments.

APPENDIX A

DRAWINGS

GENERAL NOTES:

1. ALL MANHOLES SHALL BE 1050MM DIAMETER UNLESS NOTED OTHERWISE IN THE LONG SECTIONS.

2. ALL PIPES SHALL BE RCRRJ UNLESS NOTED OTHERWISE WITH MINIMUM OF:
   2.1. CLASS 4, (HS3 BEDDING), 375MM Ø FOR ALL VEHICLE CROSSING CULVERTS UNLESS NOTED OTHERWISE
   2.2. CLASS 4, 300MM FOR ALL OTHER STORMWATER PIPES UNLESS NOTED OTHERWISE
   2.3. ALL PIPES <400MM COVER TO HAVE CONCRETE ENCASEMENT OR REINFORCED THICKENED SLAB AS DETERMINED BY THE ENGINEER

3. ALL FRAME AND LID SYSTEMS SHALL BE:
   3.1. CLASS D LOAD RATING FOR TRAFFICABLE AREA
   3.2. INFILL MANHOLE LIDS IN SHARED PATHS (APPROVED BY ENGINEER)

4. ALL CATCHPIT GRATES SHALL BE STANDARD 675X450 CYCLE FRIENDLY TYPE CATCHPIT GRATE & FRAME, FITTED WITH APPROVED CONCRETE BACK ENTRY LINTEL UNITS UNLESS SPECIFIED

5. ALL VEHICLE CROSSING CULVERT HEADWALLS SHALL BE EXTENDED BEYOND THE BARRIER END TERMINALS. WHERE A BARRIER IS NOT PROVIDED, A MOUNTABLE GRATE (TM4006) SHALL BE PROVIDED. FINAL INSTALLATION TYPE AND LOCATION SHALL BE CONFIRMED WITH THE ENGINEER.

6. ALL RIP-RAP SHALL BE:
   6.1. CLASS 1 (D50=100MM) FOR RIP-RAP APRONS AT ALL DOWNSTREAM CULVERT HEADWALLS, UNLESS NOTED OTHERWISE.
   6.2. CLASS 2 (D50=200MM) FOR RIP-RAP CHUTES, WITH GEOTEXTILE FABRIC AS PER SPECIFICATIONS, UNLESS NOTED OTHERWISE.

7. ALL OPEN CHANNELS (SWALES AND DIVERSION DRAINS) SHALL BE PLANTED AND HAVE A SIDE SLOPE OF 3H:1V UNLESS NOTED OTHERWISE. REFER TO LANDSCAPE DRAWINGS FOR PLANTING DETAIL.

8. ALL CULVERT HEADWALLS SHALL BE PRECAST UNITS SUITABLE FOR THE DIAMETER OF PIPE SHOWN ON THE PLANS, UNLESS OTHERWISE NOTED.
   8.1. ALL EXISTING HEADWALL INVERTS AND CROSS CULVERT SIZES, LEVELS AND CONDITIONS SHALL BE CONFIRMED AND VERIFIED ON SITE PRIOR TO UNDERTAKING ANY PERMANENT WORKS.

9. THE CONTRACTOR SHALL SETOUT ALL STORMWATER DRAINAGE ELEMENTS USING DIGITAL 3D SETOUT INFORMATION PROVIDED. SETOUT OF ALL STRUCTURES SHALL BE COORDINATED WITH ALL GEOMETRIC STRINGS (E.G. EDGE OF SEAL, FACE OF KERB, EARTHWORK INTERFACE LINE) AND ROADSIDE CONSTRUCTION ELEMENTS (E.G. SAFETY BARRIERS, STREET LIGHT POLES, SIGNAGE SUPPORT POLES) PRIOR TO UNDERTAKING ANY PERMANENT WORKS.

10. THE CONTRACTOR SHALL VERIFY ALL LEVELS AND OPERATIONAL STATUS OF EXISTING STORMWATER STRUCTURES PRIOR TO UNDERTAKING ANY PERMANENT WORKS. ANY VARIATIONS TO WHAT IS SHOWN ON THE DRAWINGS SHALL BE NOTIFIED TO THE ENGINEER FOR REVIEW PRIOR TO PROCEEDING.
    10.1. ALL EXISTING STRUCTURES THAT WILL BE UTILISED ARE TO BE FLUSHED AND CONDITION CHECKED AND CONFIRMED PRIOR TO CONSTRUCTION. CONTRACTOR TO ALLOW FOR REPLACEMENT AS CONFIRMED BY THE ENGINEER.

11. STORMFILTERS AND ASSOCIATED VAULTS AND MANHOLES ARE A PERFORMANCE BASED DESIGN COMPONENT OF THE PROJECT. THE DETAILS SHOWN ON THE PLAN ARE PRELIMINARY ONLY AND ARE BASED ON TREATMENT AREAS AS PER TABLE 1 BELOW. THE DETAILS SHOWN ON THE PLANS AND TABLE BELOW ARE BASED ON DEVICES WITH BUILT-IN PEAK FLOW DIVERSION STRUCTURES.
    11.1. THE CONTRACTOR SHALL CONFIRM FINAL PRODUCT SELECTION AND DETAILS WITH THE MANUFACTURER AND INSTALL THEM AS PER MANUFACTURERS' RECOMMENDATIONS. SUBSTITUTION FOR ALTERNATIVE PRODUCTS ARE SUBJECT TO THE APPROVAL OF THE DESIGNER.
    11.2. THE VAULTS ARE TO FITTED WITH 900MM X 900MM CLASS D GRATED, HINGED AND LOCKABLE ACCESS COVERS AS PER WAKA KOTAHI SPECIFICATION. CONTRACTOR TO SUPPLY ADDITIONAL RISERS TO PROPRIETARY DEVICES TO SUIT FINISH LEVEL

12. SERVICE CLEARANCE REQUIREMENTS:
    12.1. EXACT LOCATION OF SPARK INTERNATIONAL CABLE AND CRITICAL WATERMAIN TO BE CONFIRMED ON SITE.
    12.2. ALL STORMWATER ASSETS TO HAVE 1.0M HORIZONTAL CLEARANCE TO THE SPARK INTERNATIONAL CABLE AND CRITICAL WATERMAIN
    12.3. ALL STORMWATER ASSETS TO HAVE 0.5M VERTICAL CLEARANCE TO THE SPARK INTERNATIONAL CABLE AND CRITICAL WATERMAIN
    12.4. EXACT LOCATION OF OTHER SERVICES ARE TO BE CONFIRMED ON SITE BY THE CONTRACTOR
    12.5. REFER TO UTILITY DRAWINGS FOR CLEARANCE REQUIREMENTS BETWEEN STORMWATER ASSETS AND OTHER UTILITY SERVICES

13. ALL STORMWATER ASSETS TO BE ABANDONED SHALL BE REMOVED OR FILLED WITH 5MPA FLOWABLE FILL IN ACCORDANCE WITH NZTA P46 STORMWATER SPECIFICATION.

14. EROSION AND SEDIMENT CONTROL IS THE CONTRACTORS RESPONSIBILITY AND SHALL BE IN ACCORDANCE WITH GD05

15. REFER TO 3235084-CA-1200 GENERAL ARRANGEMENT LEGEND AND NOTES FOR GENERAL NOTES AND SETTING OUT NOTES

16. THE SURVEY IS IN TERMS OF NZTM COORDINATES AND NZVD 2016 VERTICAL DATUM

17. UNLESS NOTED, ALL STORMWATER ASSETS ARE TO BE REMOVED. IF AGREED WITH THE ENGINEER TO REMAIN IN PLACE, THEN THE STORMWATER ASSET SHALL BE FILLED WITH 20MPA FLOWABLE FILL

18. WHERE ROCK CHANNELS AND SWALES PASS OVER RETAINED SERVICES, EXISTING MANHOLES ARE TO BE RAISED ABOVE THE LEVEL OF THE SURROUNDING GROUND AND LIDS TO BE INSPECTED FOR WATER TIGHTNESS AND REPLACED ACCORDINGLY - REFER TO UTILITY DRAWINGS 3235084-CU-2050 TO 2077 FOR LOCATIONS AND DETAILS.

19. FOR KERB TYPE AND LOCATION REFER TO KERB DRAWINGS CB-2900-2913

20. MANHOLES WHERE LOCATED WITHIN THE SUP CORRIDOR, SHALL BE INSTALLED WITH FLUSH INFILL LIDS MEETING CLASS D

21. ALL CONVEYENCE AND DIVERSION CHANNELS ARE TO HAVE A CONSTANT FALL WITH A MINIMUM OF 0.5% ANY DISCREPENCIES TO BE CONFIRMED WITH ENGINEER PRIOR TO CONSTRUCTION.

TABLE 1: TREATMENT DEVICE SIZING

PLAN SHEET NO.	CHAINAGE	IMPERVIOUS AREA (m^2)	PREVIOUS AREA (m^2)	VORTCAPTURE		STORMFILTER		STORMFILTER VAULT/MANHOLE
5	190600	18395	13910	SWVC-A1.4	V70 MANHOLE 2050Ø	SWTR-A1.3	47 x 69cm ZPG CARTRIDGES	VAULT 7.15m x 2.7m
6	190650	1797	0	SWVC-C1.3	VC40 MANHOLE 1200Ø	SWTR-C1.2	5 x 69cm ZPG CARTRIDGES	MANHOLE 1800Ø

STORMWATER LEGEND

EXISTING	NEW
SW — STORMWATER PIPE	STORMWATER PIPE
STORMWATER MANHOLE	STORMWATER MANHOLE (SWMH)
STORMWATER CATCHPIT	STORMWATER CATCHPIT (SWCP)
CATCHPIT MANHOLE	STORMWATER MEGAPIT (SWMP)
EXISTING HEADWALL WITH RIP RAP APRON	STORMWATER MOUNTABLE INLET/HEADWALL (SWMI)
SW — STORMWATER OUTLET	STORMWATER SPLAY PIT (SWSP) SINGLE
SW — SYSTEM TO BE ABANDONED / REMOVED	STORMWATER SPLAY PIT (SWSP) DOUBLE
OPEN CHANNEL / SWALE	SCRUFFY DOME (SWSD) / GRATED INLET
RIVER / STREAM	HEADWALL WITH RIP RAP APRON
	STORMWATER TREATMENT DEVICE (SWTD) (SEE NOTE 11)
	STORMWATER VORTCAPTURE (SWVC)
	STORMWATER DIVERSION WEIR (SWDW)
	RIP-RAP FLUME/CHUTE/APRON
	ACO KERB DRAIN
	ACO CHANNEL

SUBSOIL LEGEND AND NOTES

SUBSOIL DRAINAGE
FLUSHING POINT
DOUBLE FLUSHING POINT

1. REFER TO DRAWING 3235084-CP-3202 FOR SUBSOIL DETAILS.
2. ALL SUBSOIL DRAINS TO BE CONSTRUCTED AS PER NZTA F/2 SUBSOIL DRAINAGE WITH SMOOTH BORED PERFORATED SUBSOIL PIPE AND F2 FILTER MATERIAL (WITHOUT POST-CONSTRUCTION TRAFFICKING). ALL PIPES TO BE 110mm DIAMETER AND INSTALLED AT 1.2m BELOW ROAD SURFACE, UNLESS NOTED IN THE LAYOUT PLANS IN CD-2101 TO CD-2127.
3. CONTRACTOR TO CONFIRM SUBSOIL UPSTREAM OF PROPOSED SUBSOIL RUNS AND UNDERTAKE CCTV TO CONFIRM FUNCTIONALITY OF THE EXISTING NETWORK. IF THE EXISTING SUBSOIL IS FOUND TO BE DEEPER THAN 1.2m COVER, CONTRACTOR MUST LOWER THE PROPOSED NETWORK TO MAINTAIN POSITIVE DRAINAGE.
4. CONTRACTOR MUST CONFIRM EXACT LOCATION OF THE SPARK INTERNATIONAL CABLE (SIC), CRITICAL WATERMAIN SERVICES AND RETAINED SW PIPES PRIOR TO CONSTRUCTION. ALL SUBSOIL TRENCH TO BE CLEAR OF THESE SERVICES AT MINIMUM 0.5m CLEARANCE VERTICALLY AND 1.0m LATERALLY. WHERE THIS IS NOT ACHIEVED, THE CONTRACTOR MUST BRING TO ENGINEER'S ATTENTION
5. THE CONTRACTOR SHALL INSTALL 110mm DOA. NEXUS CULVERT TWIN WALL SMOOTH BORE NON-PERFORRATED HDPE CULVERT PIPE FOR ALL LATERAL OR DIAGONAL SUBSOIL CROSSINGS
6. MAXIMUM LENGTH OF ANY LONGITUDINAL PAVEMENT SUBSOIL DRAINAGE RUN SHALL NOT EXCEED 90m AND SUBSOIL PIPE SHALL BE DISCHARGED. AT A MINIMUM PIPE GRADIENT OF 0.5%, TO A DRAINAGE OUTLET STRUCTURE WHERE INDICATED ON THE LAYOUT PLANS. IF NO DRAINAGE STRUCTURE PRESENT WITHIN 90m, SUBSOIL FLUSHING EYE SHALL BE PROVIDED IN ACCORDANCE WITH THE LAYOUT PLANS.
7. CONTRACTOR TO CONFIRM ALL FLUSHING EYES AND SUBSOIL DRAINAGE DISCHARGE OUTLET POINTS PRIOR TO PAVEMENT CONSTRUCTION. LOCATION MAY BE ADJUSTED ON SITE TO AVOID LOCALISED CLASHES WITH OTHER ROAD ASSETS.
8. FLUSHING EYE SHALL BE INSTALLED AT THE START OF EVERY SUBSOIL RUNS AND AT A A MAXIMUM OF 90m INTERVALS WHERE THE SUBSOIL RUN IS > 90m.
9. THE DESIGN DOES NOT CONSIDER LATERAL OR LONGITUDINAL (TEMPORARY) SUBSOIL DRAINAGE REQUIRED DURING CONSTRUCTION. IT IS CONTRACTOR'S RESPONSIBILITY TO DESIGN AND INSTALL TEMPORARY SUBSOIL DRAINAGE WHERE REQUIRED DURING CONSTRUCTION.
10. WHERE THE SUBSOIL DRAINAGE LATERAL OUTLET uPVC PIPE CROSSES OVER STORMWATER OR UTILITY SERVICES TRENCHES, THE SUBSOIL DRAINAGE PIPE AND TRENCH SHALL BE LOWERED TO ALLOW FOR THE uPVC PIPE TO CROSS BELOW THE TRENCH WITH A MINIMUM CLEARANCE OF 100mm BETWEEN THE TWO TRENCHES.

GENERAL LEGEND

- PROPERTY BOUNDARY
- ROAD / RAIL DESIGNATION
- SIC — EXISTING INTERNATIONAL CABLE
- PEDESTRIAN FENCE
- TIMBER POST AND PANEL FENCE
- STANDARD POST AND WIRE FENCE
- RW — RETAINING WALL
- W — EXISTING WATERMAIN
- CH 196700 — CHAINAGE
- BRIDGE WIDENING
- SHARED USE PATH (SUP)
- WETLAND
- 016-0019-B/6.5 — ROUTE POSITION (RP)

CONTOURS LEGEND

NEW
- 17.00 — MAJOR CONTOURS (0.5m INTERVALS)
- 17.10 — MINOR CONTOURS (100mm INTERVALS)

EXISTING
- 17.00 — MAJOR CONTOURS (0.5m INTERVALS)

SWALE AND OPEN CHANNEL LEGEND

NEW CHANNEL AND ARROW
- PLANTED TREATMENT SWALE
- RETENTION SWALE
- CONVEYANCE AND DIVERSION CHANNEL
- CONCRETE SURFACE DRAIN

1. ALL SWALES AND OPEN CHANNELS SHALL BE CONSTRUCTED AS PER DIMENSIONED ON THE PLANS AND DETAILS.
2. THE CONTRACTOR SHALL ALLOW FOR LOCALISED EARTHWORK AND GRADING IN AREAS WITH UNDULATING TERRAINS SUCH THAT THE CHANNELS ARE FLOWING AS INTENDED BY THE PLANS.

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) NTS
Reduced Scale (A3) NTS

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER NOTES AND LEGEND

Discipline: CIVIL ENGINEERING
Drawing No.: 3235084-CD-2100
Rev.: C

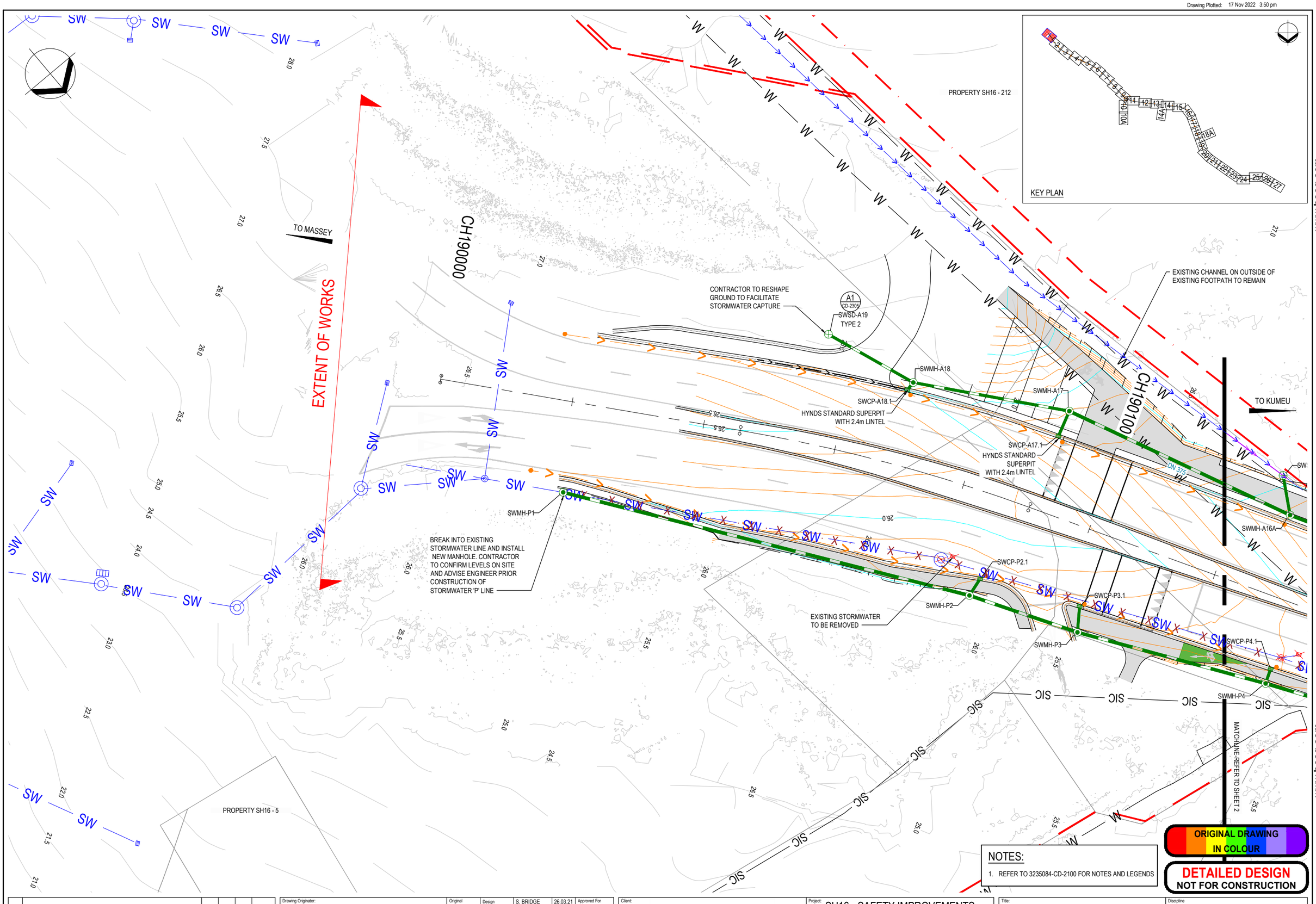
Document No. 3235084-CD-2100.DWG

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 17 Nov 2022 3:50 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2101

Rev.: C

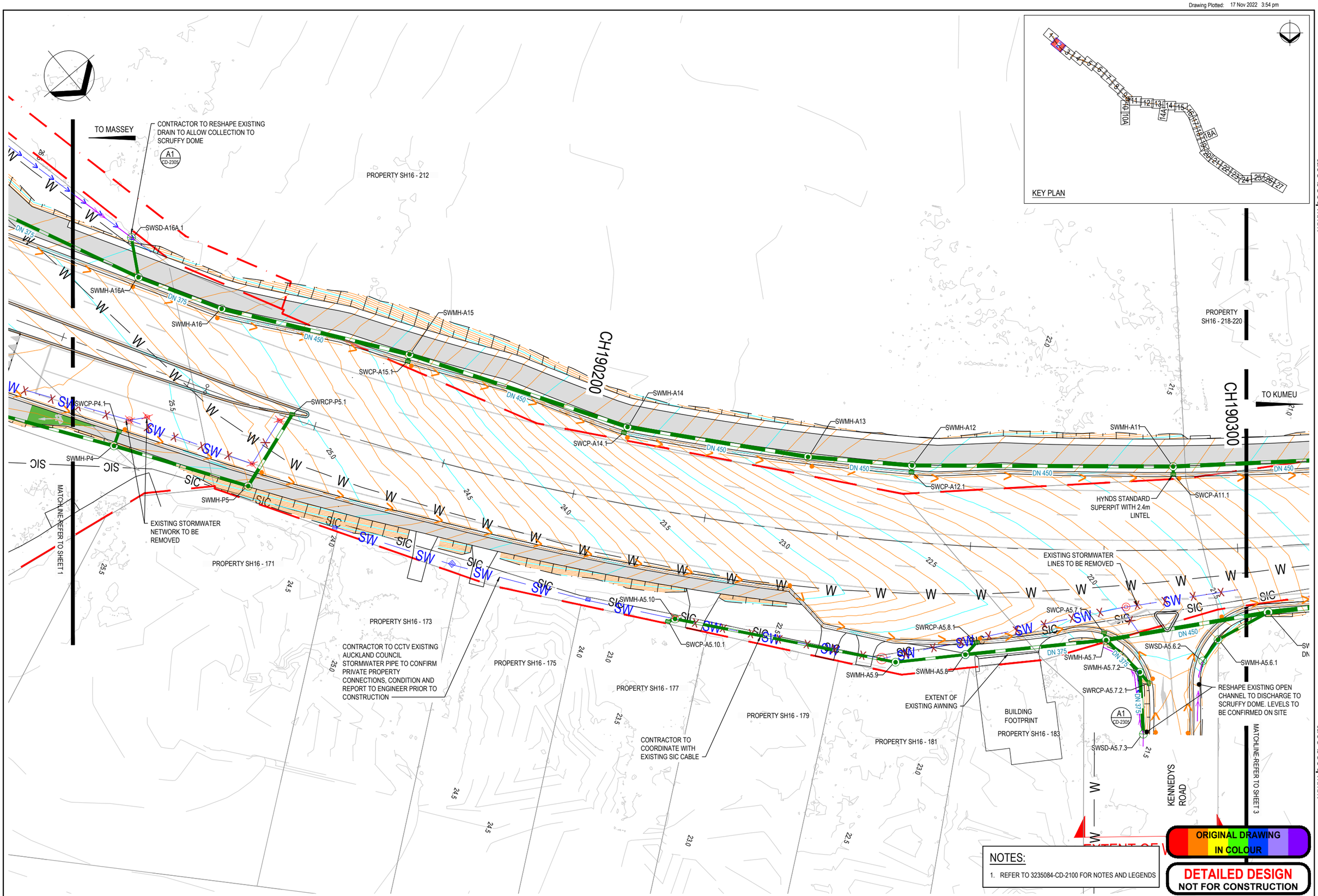
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 3:54 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250		
Reduced Scale (A3)	1:500		
Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 2

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2102

Rev.: C

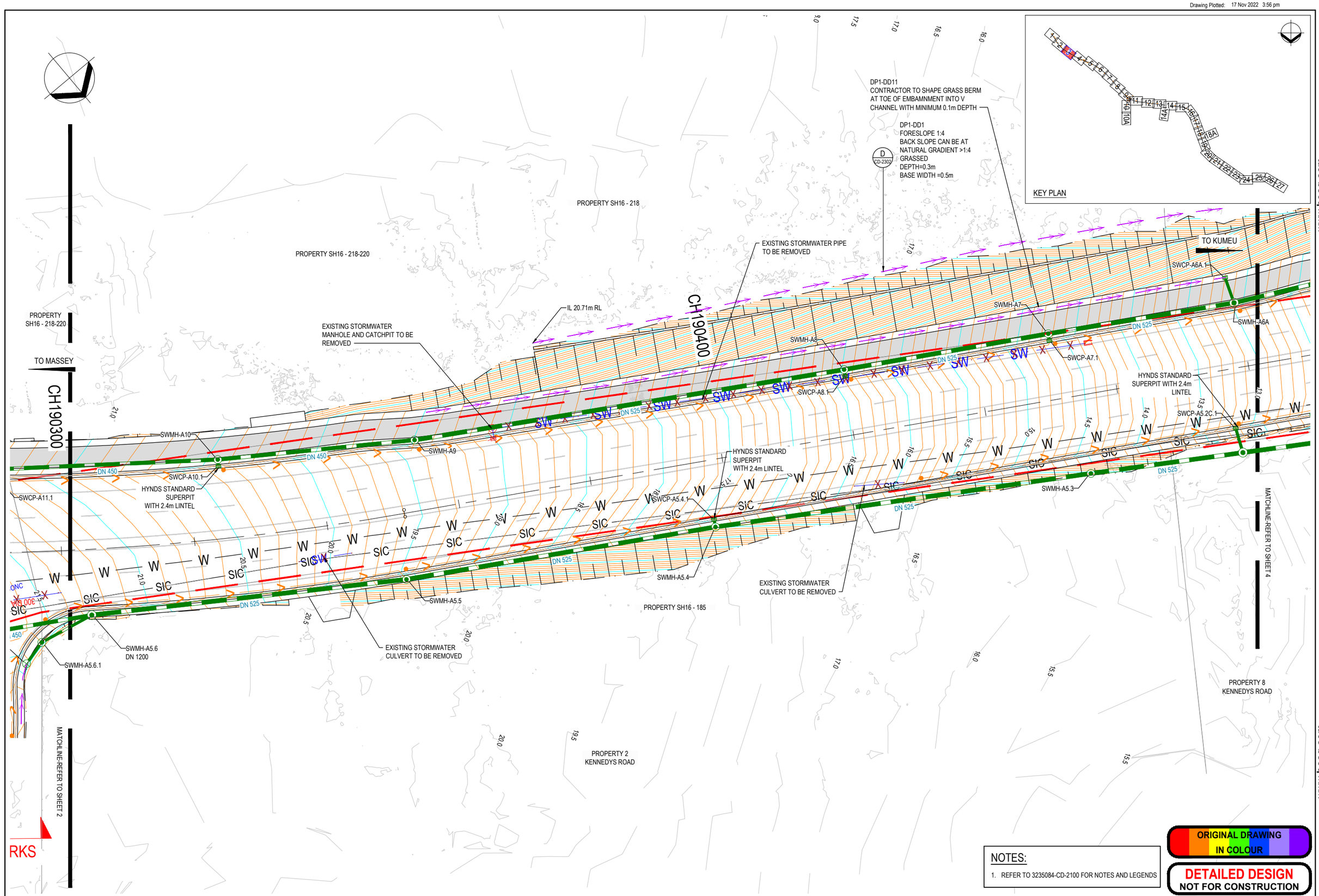
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 3:56 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21
No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 3

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2103

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 3:58 pm

PROPERTY SH16 - 222

NGONGETEPARA STREAM

NEW OUTFALL TO BE INSTALLED WITH RIPRAP APRON

PROPERTY SH16 - 238

EXISTING OUTFALL AND HEADWALL TO BE REMOVED. TO BE CONFIRMED ON SITE WITH ENGINEER.

DP1-RC1
ROCK SIZE D50=500mm
DEPTH=0.4m
BASE WIDTH =2m
CD-2321

DP1-RC2
ROCK SIZE D50=400
DEPTH=0.3m
BASE WIDTH =1m
B CD-2302

NEW OUTFALL TO BE INSTALLED WITH RIPRAP APRON

DP1-OUTFALL-A
IL 6.99m RL

DP1-OUTFALL-B
CD-2322

REFER TO KERB DRAWINGS CB-2900-2913

KEY PLAN

SWED-B1

SWMH-B2

DN 450

SWMH-B2.1

SWCP-B2.1.1

SWMH-B2.2

REFER TO BRIDGING DETAIL XXX
X XX

SWMH-B2.3

SWCP-B2.3.1

ACO S300K POWERDRAIN WITH AN IRON INTERCEPT GRATE HEELSAFE® ANTI-SLIP - CLASS D WITH AN INLINE SUMP OR SIMILAR APPROVED BY ENGINEER

SCOUR PROTECTION TO BE CONSTRUCTED BELOW SUP. EXTENT OF WORKS TO BE CONFIRMED ON SITE WITH ENGINEER.

HYNDS STANDARD SUPERPIT WITH 2.4m LINTEL

SWCP-C2.3

SWVC-A1.4
DN 2050

SWMH-A1.5
DN 1050

SWMH-A2
DN 1400

SWDW-A3
DN 1800

SWCP-A1.1

CH190600

DN 750

SWMH-A1
DN 1050

SWMH-A1.1
DN 1050

SWTR-A1.3

SWTR-A1.2

SWMP-A21

ACO INFRASTRUCTURE QK300SM KERBDRAIN OR SIMILAR APPROVED BY ENGINEER

MEGAPIT
CONTRACTOR TO PROCURE CUSTOM MEGAPIT WITH DEPTH OF 2.55m FOR LEAD TO PENETRATE UNDER LAGGING FROM RETAINING WALL AND RETAIN A 450mm SUMP

DP1-DD2
VEGETATED
DEPTH=0.3m
BASE WIDTH =0.5m
1:3 SIDE SLOPES
B CD-2302

FINAL LEVELS TO BE CONFIRMED ON SITE. INLET GROUND TO BE CONTOURED TO ENSURE CAPTURE AND CONTRACTOR TO ALLOW FOR RIPRAP DOWN CHANNEL SLOPE.
D CD-2317

IL 11.87m RL

DP1-AC1-1

PROPERTY SH16 - 222A

IL 10.77m RL

DP1-AC1-2

IL 13.03m RL

DP1-AC1

TO MASSEY

CH190500

DN 375

DN 600

SWMH-A5
DN 1800

V-DRAIN ACROSS VEHICLE ENTRANCE FROM CATCHPIT TO CONVEYENCE CHANNEL

SWMH-A6

SWCP-A6.1

SWMH-A6A

HYNDS STANDARD SUPERPIT WITH 2.4m LINTEL

SWCP-A1.5.1

HYNDS STANDARD SUPERPIT WITH 2.4m LINTEL

EXISTING OUTFALL AND STORMWATER TO BE REMOVED

SEE INSERT A - SHEET 2105

TO KUMEU

EXISTING WEIR STRUCTURE

BRIGHAM CREEK

PROPERTY SH16 - 239

CONTRACTOR TO CCTV AND CONFIRM CONDITION OF PIPE INVERT LEVELS AND CONNECTIONS AND REPORT TO ENGINEER BEFORE START OF WORKS

CONTRACTOR TO COORDINATE STORMWATER WITH EXISTING WATERMAIN

SWRCP-A5.1.1

SWMH-M1

SWSD-M1
DN 1050

DN 525

SWCP-A5.2B.1

SWMH-A5.1
DN 1200

SWMH-A5.2
DN 1800

EXISTING CHANNEL LEVELS TO RESHAPED WITH A BASE WIDTH OF 1m AND 1:4 SIDE SLOPES, DEPTH OF 0.5m MODIFY EXISTING CULVERT INLET WITH A LOW PROFILE SCRUFFY DOME

EXISTING CHANNEL TO BE FILLED AND REGRADED TO FINISHED SURFACE LEVELS

CONTRACTOR TO COORDINATE WITH EXISTING SIC CABLE

PROPERTY 8
KENNEDYS ROAD

PROPERTY SH16 - 191

EXTENT OF TREE PROTECTION ZONE

MATCHLINE-REFER TO SHEET 3

MATCHLINE-REFER TO SHEET 5

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 4

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2104

Rev. C

DO NOT SCALE

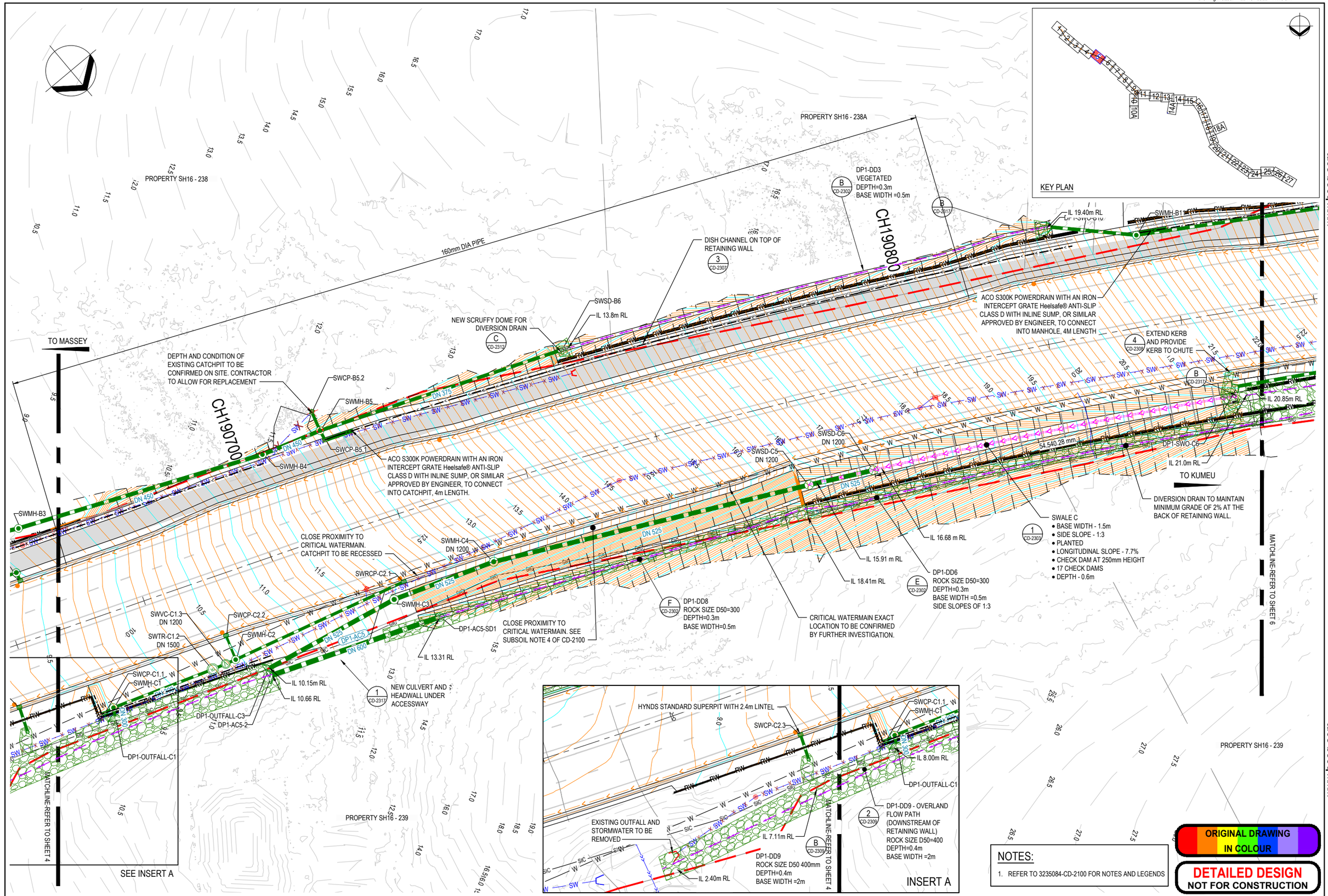
IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 22 Nov 2022 11:43 am

www.beca.com



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client:

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 5

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2105

Rev. C

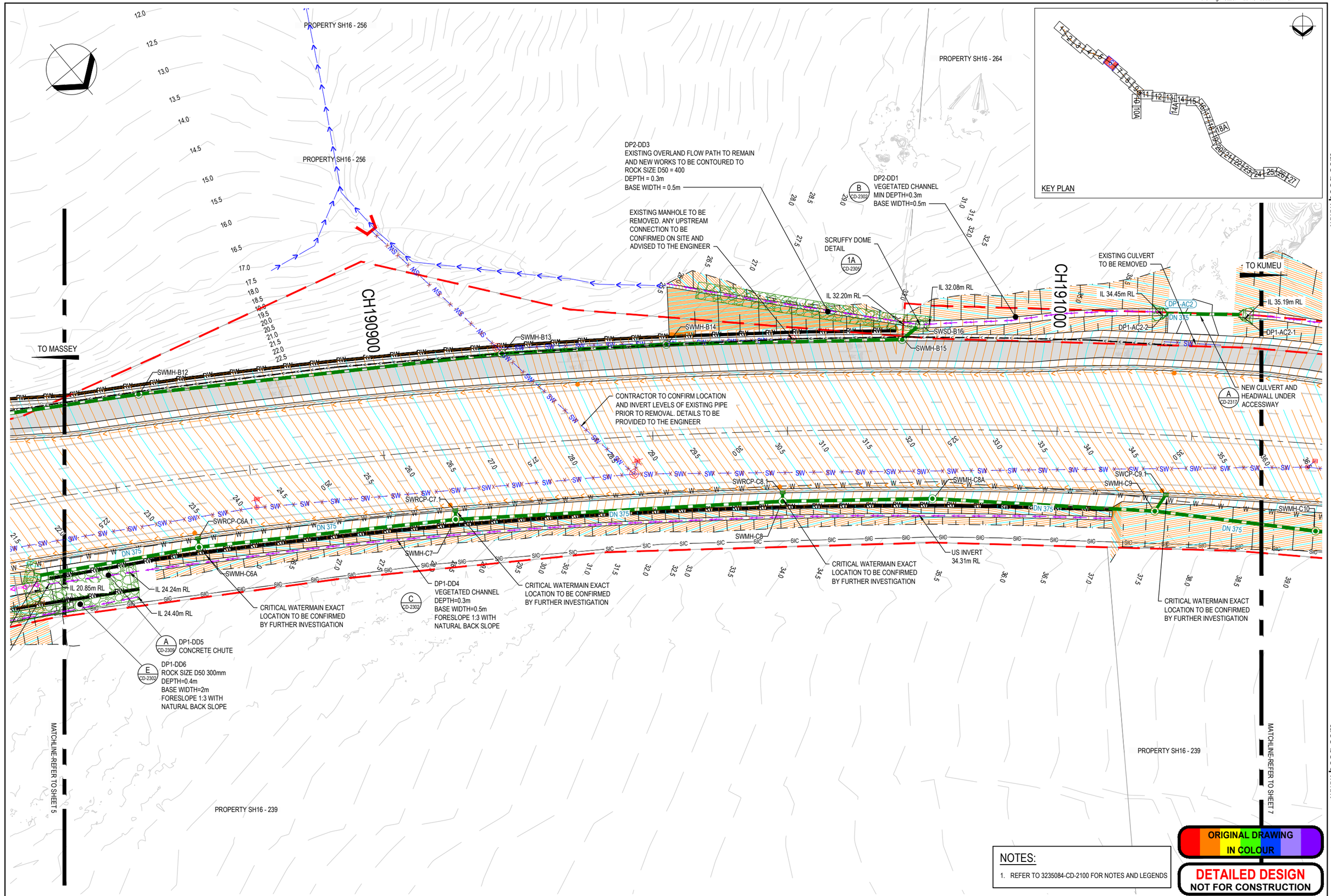
Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 22 Nov 2022 11:41 am



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client:

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 6

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2106

Rev.: C

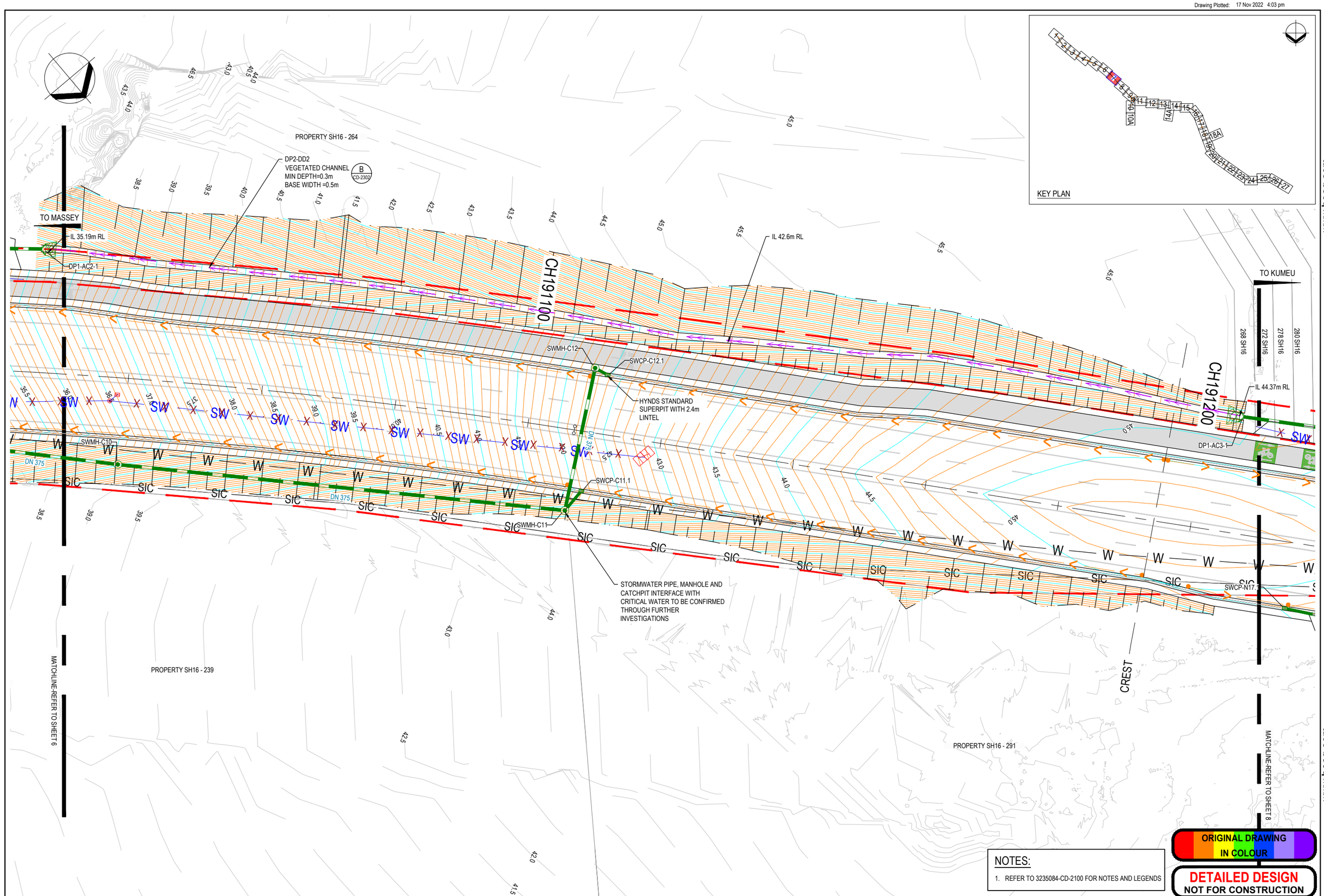
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:03 pm



ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 7

Discipline: CIVIL ENGINEERING

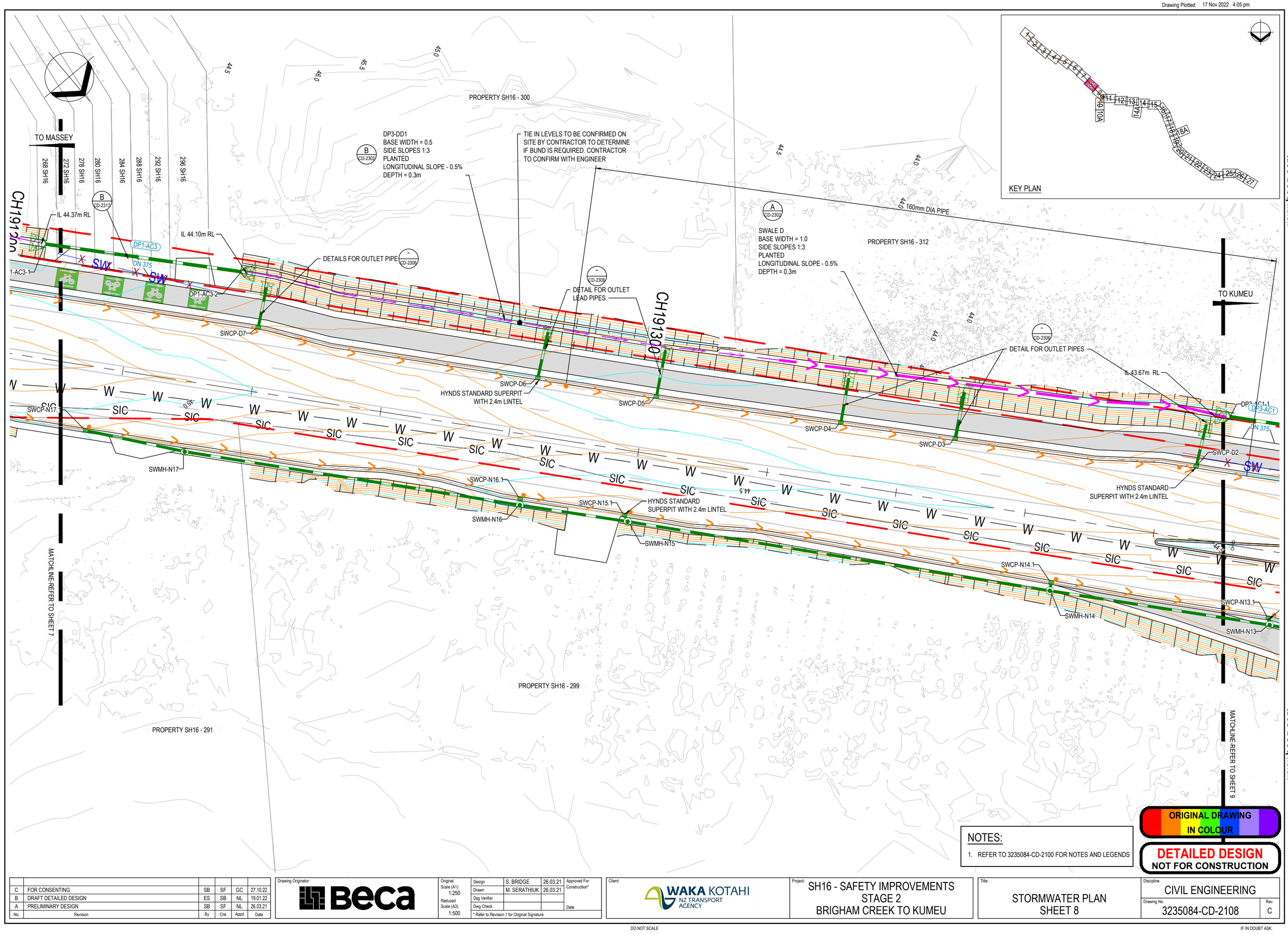
Drawing No.: 3235084-CD-2107

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:05 pm



www.beca.com

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250		
Reduced Scale (A3)	1:500		
Design	S. BRIDGE	26.03.21	Approved For Construction* Date
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 8

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2108

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

Document No. 3235084-CD-2101 TO 2127.DWG

www.beca.com

Drawing Plotted: 22 Nov 2022 2:02 am

www.beca.com

PROPERTY SH16 - 312

PROPERTY SH16 - 324

TO MASSEY

TO KUMEU

CH191400

CH191500

CH191540

CH0.000

CH60

CH80

CH100

CH120

CH140

CH160

160mm DIA PIPE

NEW CULVERT CROSSING UNDER ACCESSWAY WITH HEADWALLS

SWALE D
BASE WIDTH = 1.0
SIDE SLOPES 1:3
PLANTED
LONGITUDINAL SLOPE - 0.5%
DEPTH = 0.3m
MIN LENGTH =30
UNDERDRAINS REQUIRED

SCRUFFY DOME INLET
SWSD-N11.1.1
DN 1200

FOOTHPATH AND KERB TO BE LOCALLY SHAPED AND GRADED TO ALLOW FOR CONVEYENCE OF OVERLAND FLOW PATH REFER TO DETAIL

CONTRACTOR TO UNDERTAKE CHANNEL WORKS TO IMPROVE EXISTING DIVERSION DRAIN
DP3-DD1
GRASSED
SIDE SLOPES 1:4
DEPTH=0.3m
BASE WIDTH =0.5m

DP3-DD1
VEGETATED
SIDE SLOPES 1:3
DEPTH=0.3m
BASE WIDTH =0.5m

IL 42.65m RL

IL 43.31m RL

IL 43.1m RL

IL 43.3m RL

DP3-AC1-1

DP3-AC1-2

SWCP-D2

SWMH-N11.1
DN 1500

SWMH-N11.2

SWCP-N11.1.2.1

SWCP-N11.1.2.2

HYNDS STANDARD SUPERPIT WITH 2.4m LINTEL

SWMH-N11.3

SWMH-N11.4

SWSP-N11.5.1

SWCP-N11.3.1

SWCP-N11.4.1

SWCP-N13.1

SWMH-N13

SWCP-N12.1

SWMH-N12

SWCP-N10.1

SWMH-N11
DN 1800

SWMH-N10
DN 1200

SWFCP-N10.2

SWMH-N9
DN 1200

SWMH-N8
DN 1500

SWCP-N8.1

SWSP-N5.1.3.1

SWRCP-N5.1.2.1

SWMH-N5.3

SWMH-N5.1.2

SWMH-N6
DN 1200

SWCP-N5.2.1

SWFCP-N20.1

SWMH-N5.2

SWSP-N5.1.1

SWMH-N5.1

SWMH-N5

SWMH-N5

COLLECTION OF STORMWATER RUNOFF FROM PRIVATE LAND TO BE CONFIRMED WITH ONSITE WITH LAND OWNER AND ENGINEER

CATCHPIT MANHOLES TO BE REMOVED CONNECTION WITH BORIC CARPARK TO BE CONFIRMED ON SITE AND ADVISED TO THE ENGINEER

PROPERTY SH16 - 315

PROPERTY SH16 - 299

PROPERTY SH16 - 1411

SAG

CREST

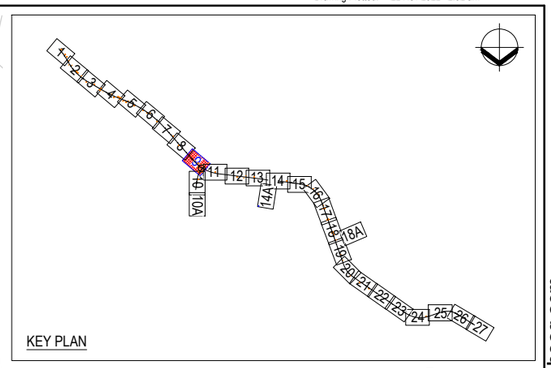
MATCHLINE-REFER TO SHEET 8

MATCHLINE-REFER TO SHEET 9

MATCHLINE-REFER TO SHEET 10

IL 40.890 RL

KEY PLAN



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 9

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2109

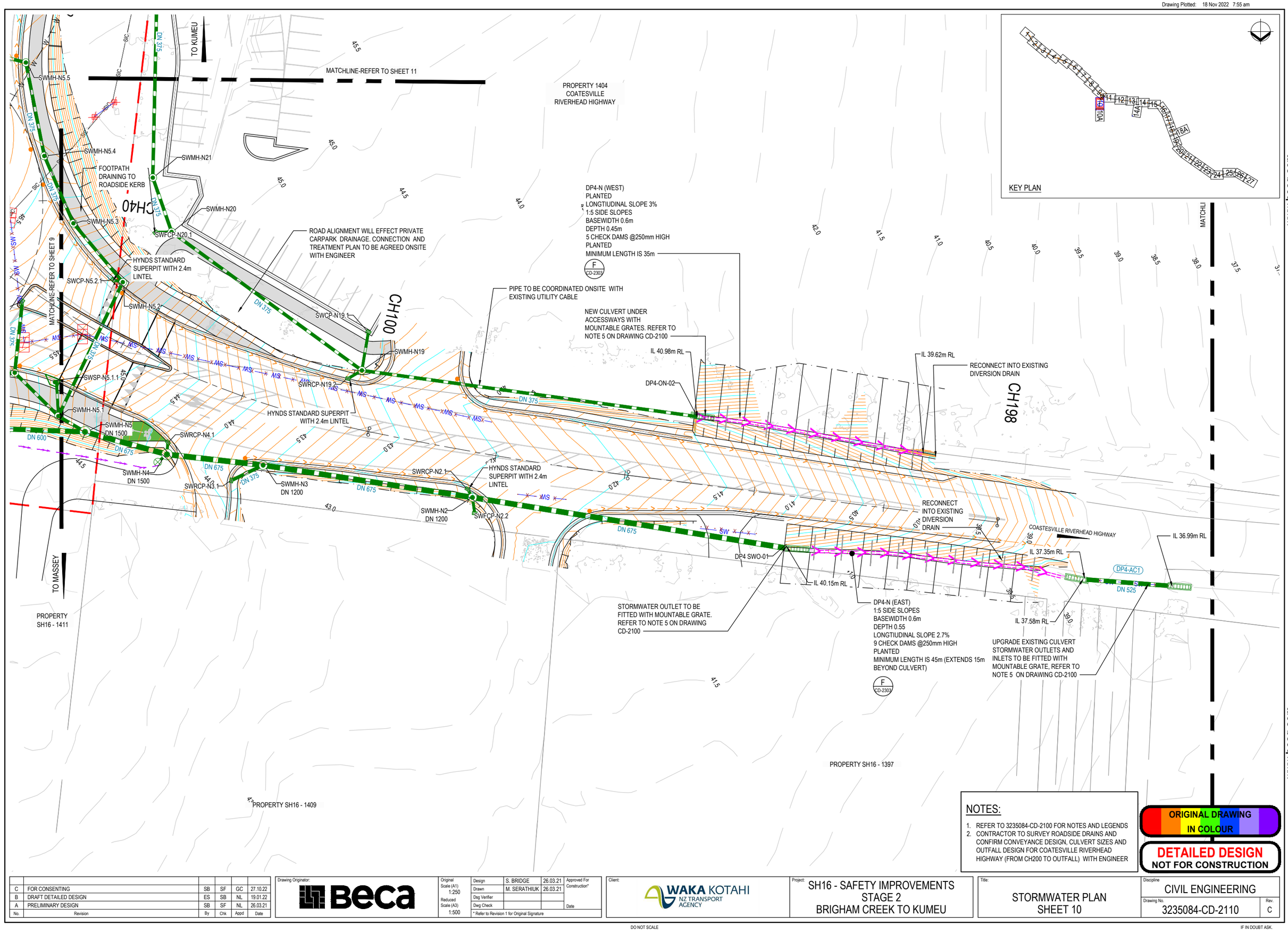
Rev. C

Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 18 Nov 2022 7:55 am



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS
2. CONTRACTOR TO SURVEY ROADSIDE DRAINS AND CONFIRM CONVEYANCE DESIGN, CULVERT SIZES AND OUTFALL DESIGN FOR COATESVILLE RIVERHEAD HIGHWAY (FROM CH200 TO OUTFALL) WITH ENGINEER

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 10

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2110 Rev. C

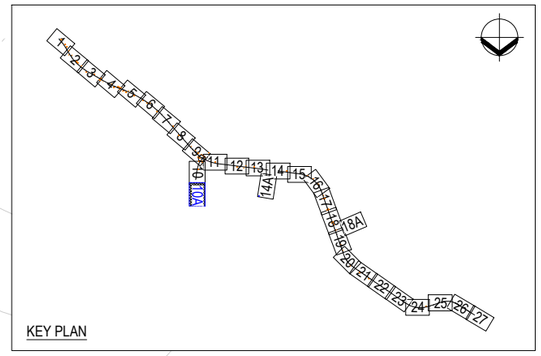
Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 17 Nov 2022 4:12 pm



MATCHLINE-REFER TO SHEET 10

38.5 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5 34.0 33.5 33.0 32.5 32.0 31.5 31.0 30.5 30.0 29.5 29.0

ESTIMATED ROAD EDGE

EXISTING ROCK LINED CHANNEL

DP4-AC2

DP4-AC3

SW

DN 525

PP

EXISTING CHANNEL TO BE IMPROVED AND CONFIRMED WITH ENGINEER ONSITE

EXISTING POWERPOLE TO BE RELOCATED

UPGRADE EXISTING 225 CULVERT STORMWATER OUTLETS AND INLETS TO BE FITTED WITH MOUNTABLE GRATE, REFER TO NOTE 5 ON DRAWING CD-2100

UPGRADE EXISTING 225Ø CULVERT STORMWATER OUTLETS AND INLETS TO BE FITTED WITH MOUNTABLE GRATE, REFER TO NOTE 5 ON DRAWING CD-2100

EXISTING CHANNEL TO BE IMPROVED AND CONFIRMED WITH ENGINEER ONSITE

EXISTING POWERPOLE TO BE RELOCATED

EXISTING CHANNEL TO BE IMPROVED AND CONFIRMED WITH ENGINEER ONSITE

RIP RAP AND NEW ROCK CHANNEL TO BE INSTALLED AND CONFIRMED ONSITE WITH ENGINEER

MS

30.0 29.5 29.0

EXTENT OF WORKS

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS
2. DRAWING 10A UTILITY INFORMATION HAS BEEN SOURCED FROM AERIALS AND SITE INSPECTION
3. CONTOURS SOURCED FROM AUCKLAND GIS
4. INFRASTRUCTURE LOCATIONS SOURCED FROM AERIAL INTERPRETATION.
5. CONTRACTOR TO SURVEY ROADSIDE DRAINS AND CONFIRM CONVEYANCE DESIGN AND CULVERT SIZES WITH ENGINEER
6. CONTRACTOR TO SURVEY AND DESIGN OUTFALL AS CONFIRMED WITH ENGINEER PRIOR TO COMMENCEMENT OF WORKS ON SITE

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250		
Reduced Scale (A3)	1:500		
Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 10A

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2110A

Rev.: C

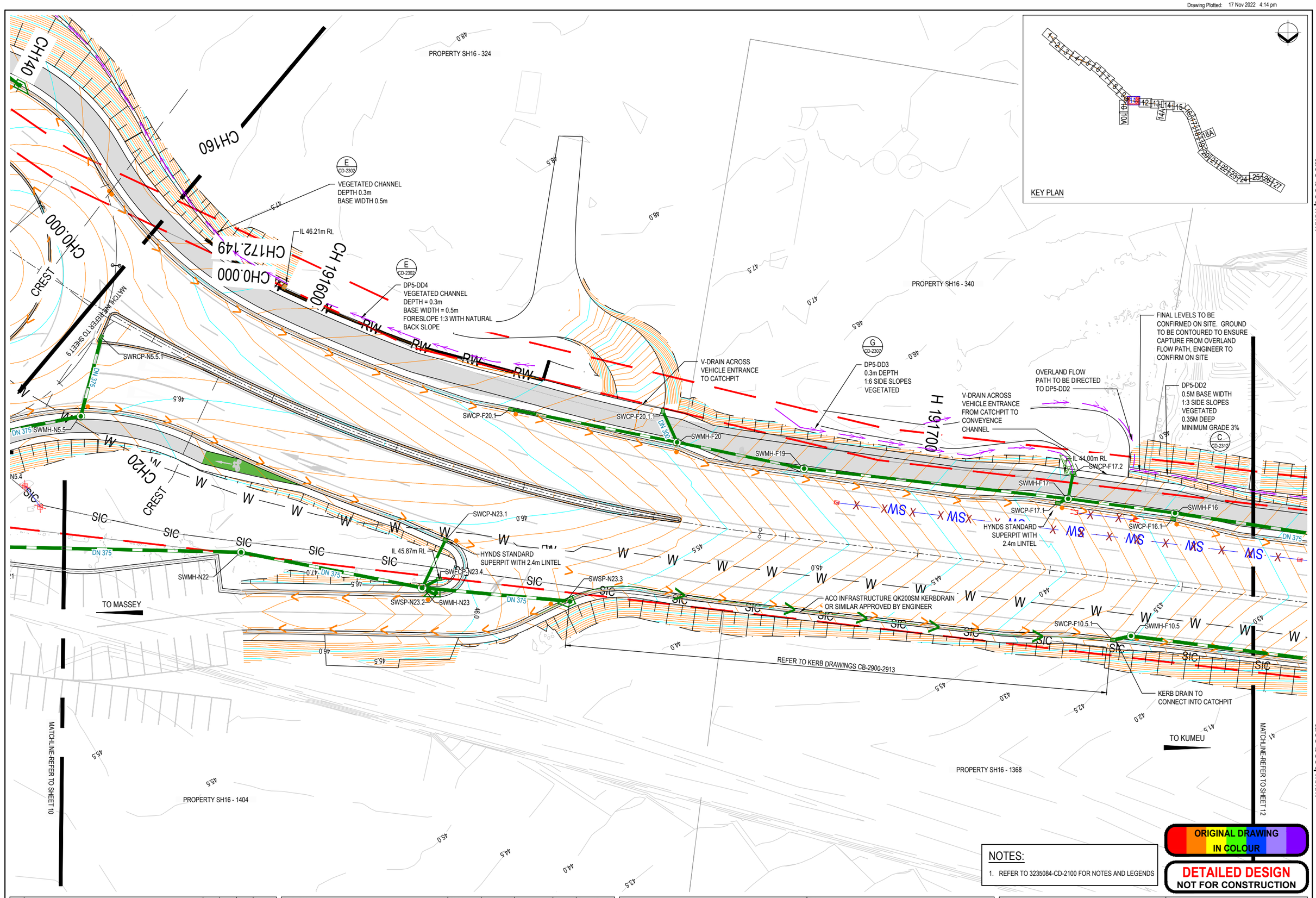
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:14 pm



www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 11

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2111

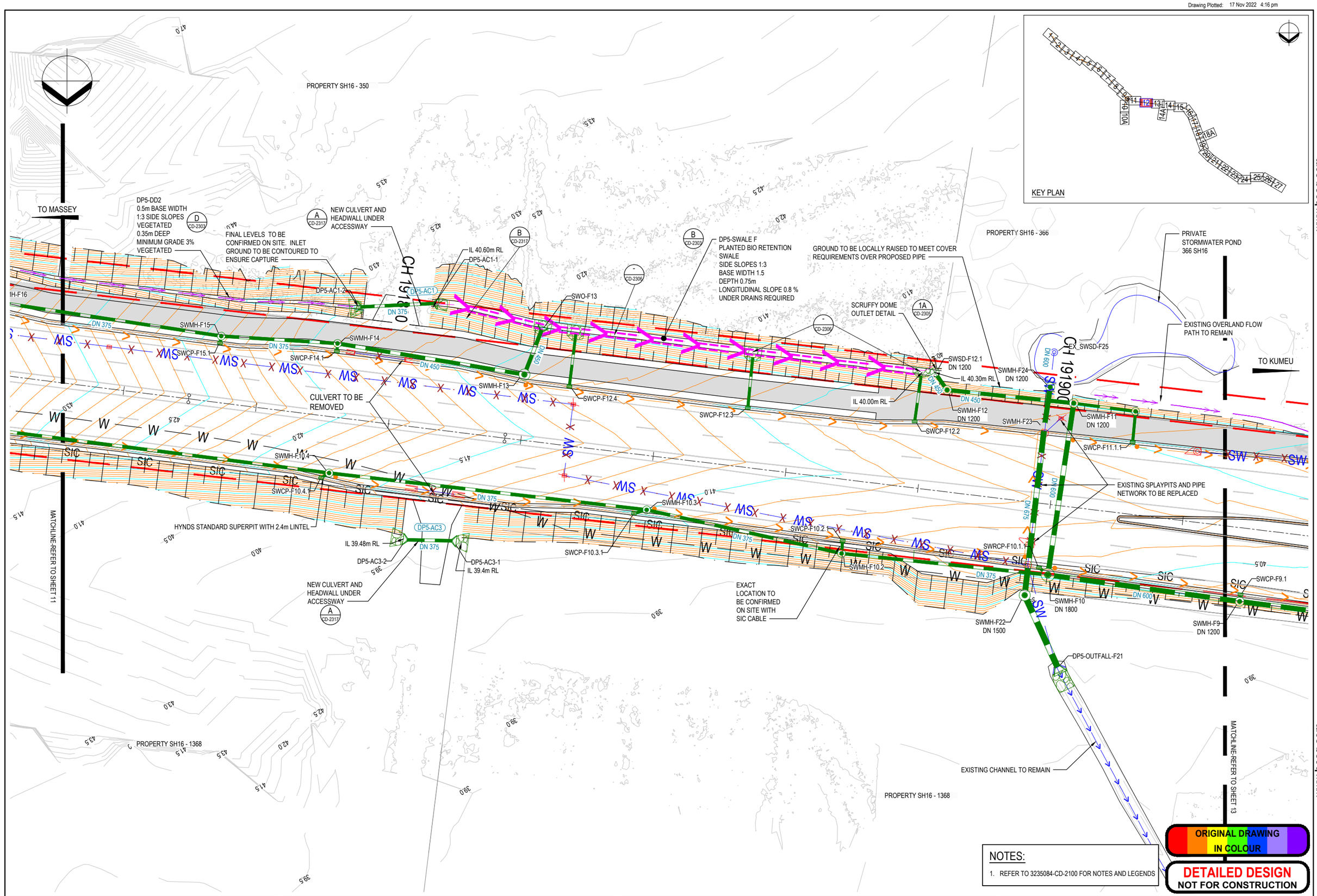
Rev. C

Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:16 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 12

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2112

Rev.: C

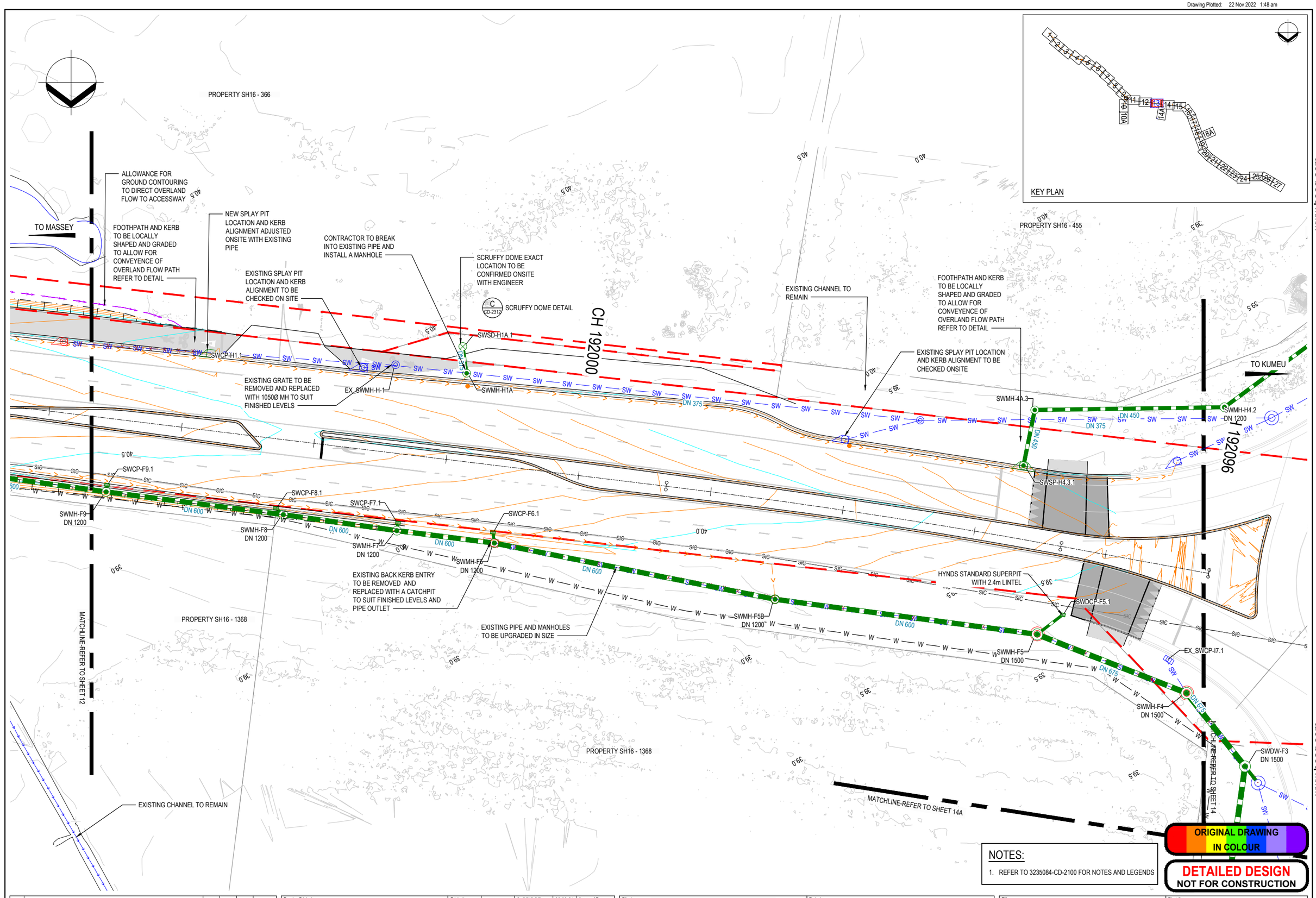
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 22 Nov 2022 1:48 am



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 13

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2113 Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 22 Nov 2022 1:49 am

www.beca.com

B CD-2320 MANHOLE DETAIL

PROPERTY 499 TAUPAKI ROAD

1500mm EXISTING MANHOLE WITH SCRUFFY DOME. UPGRADE EXISTING MANHOLE TO 1800mm DIAMETER

SWSD-H4 DN 1800

SWSP-H4.1

SWMH-H4.1 DN 1200

SWSP-H4.2

EXTENT OF WORKS APPROX. 100m SOUTH OF EXISTING ROUNDABOUT DUE TO STORMWATER

TAUPAKI ROAD

C CD-2320

EX_SWMH-H5 DN 1500

SWSP-H5.1

SWSP-H5.2

EXACT LOCATION OF GAS LINE TO BE REVIEWED PRIOR TO WORKS ADVISE TO THE ENGINEER

PROPERTY 466 TAUPAKI ROAD

TO MASSEY

CONTRACTOR TO CONFIRM EXACT LOCATION AND DEPTH OF GASLINE TO BE CONFIRMED ON SITE PRIOR TO WORKS

SWMH-H4.2 DN 1200

1.5m CHANNELS TO BE CUT INTO EXISTING ISLANDS ON BOTH ENDS OF RAISED TABLES TO CREATE CHANNELS FOR OVERLAND FLOW PATH WITH SAWTOOTH KERBS

CH192096

CH192180

CH192200

FOOTHPATH AND KERB TO BE LOCALLY SHAPED AND GRADED TO ALLOW FOR CONVEYENCE OF OVERLAND FLOW PATH REFER TO DETAIL

PROPOSED OUTFALL FROM 466 TAUPAKI ROAD DEVELOPMENT TO CONNECT TO EXISTING MANHOLE. CONTRACTOR TO CONFIRM LOCATION AND LEVEL OF PIPE AND REPORT TO ENGINEER PRIOR TO WORKS

TO KUMEU

H8 SW0

I.L 35.85m RL

B CD-2317

SWMH-H18

SWMH-H17

SWRCP-H18.1

EXISTING SCRUFFY DOME TO BE MODIFIED TO A MH LID AND RAISED TO SUIT FINISHED SURFACE LEVELS

EXISTING OUTLET AND HEADWALL TO BE REMOVED

EX_SWCP-I7.1

SWMH-F4 DN 1500

REFER TO DETAIL FOR INTERNAL DIVERSION WEIR D CD-2520

SWDW-F3 DN 1500

MATCHLINE-REFER TO SHEET 13

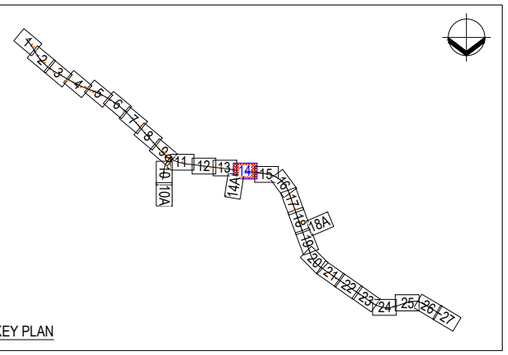
MATCHLINE-REFER TO SHEET 14A

MATCHLINE-REFER TO SHEET 15

PROPERTY SH16 - 393

OLD NORTH ROAD

KEY PLAN



ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 14

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2114

Rev. C

Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:21 pm

EXISTING OPEN CHANNEL FROM SH16 OUTFALL

EXISTING PRIVATE MANHOLE

EXISTING PRIVATE 825Ø STORMWATER PIPE

SW

TREATMENT SWALE
SLOPE = 1:5
DEPTH = 0.5m
BASE WIDTH OF 0.6
MINIMUM LENGTH 30m
GRASSED

EXISTING DISCHARGE LOCATION

EXISTING OUTLET AND CHANNEL FOR SH16 WATER

TREATMENT SWALE TO DISCHARGE TO EXISTING OPEN CHANNEL. EXACT LEVEL AND LOCATION TO BE CONFIRMED ON SITE

EXISTING GROUND LEVEL IS 37.25m
OUTFALL LEVEL IS 36.48
LEVELS TO BE CONFIRMED ON SITE BY CONTRACTOR

DP5-SWO-F

DN 675

SWMH-F1
DN 1200

CONTRACTOR TO REGRADE EXISTING SURFACE LEVELS TO ACHIEVE MINIMUM 0.6M COVER AND REINSTATE

CONTRACTOR TO CONFIRM EXACT LOCATION AND LEVEL OF GAS PIPE PRIOR TO WORKS COMMENCING AND ADVISE ENGINEER. STORMWATER LEVELS ARE TO BE CONFIRMED BY ENGINEER

SWMH-F2
DN 1200

DN 675

TO SHEET 13

TO SHEET 14

DN 375

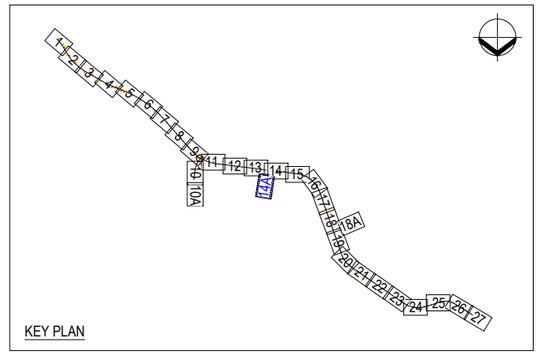
MATCHLINE-REFER TO SHEET 14

PROPERTY SH16 - 1368

PROPERTY SH16 - 393

PROPERTY 15
OLD NORTH ROAD

KEY PLAN



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS
2. CONTRACTOR TO SURVEY ROADSIDE DRAINS AND CONFIRM CONVEYANCE DESIGN AND CULVERT SIZES WITH ENGINEER

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) 1:500	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 14A

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2114A

Rev.: C

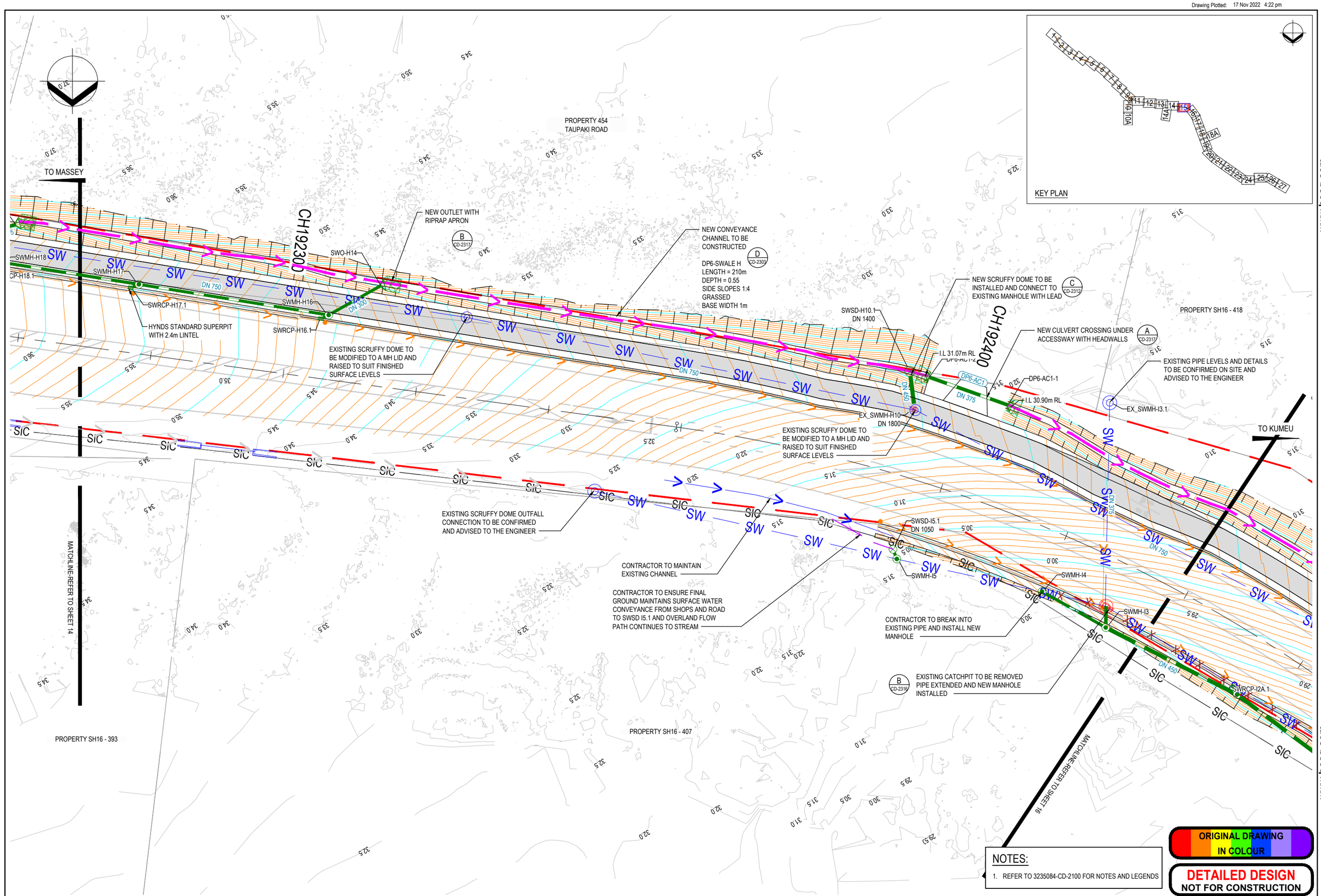
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:22 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 15

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2115

Rev.: C

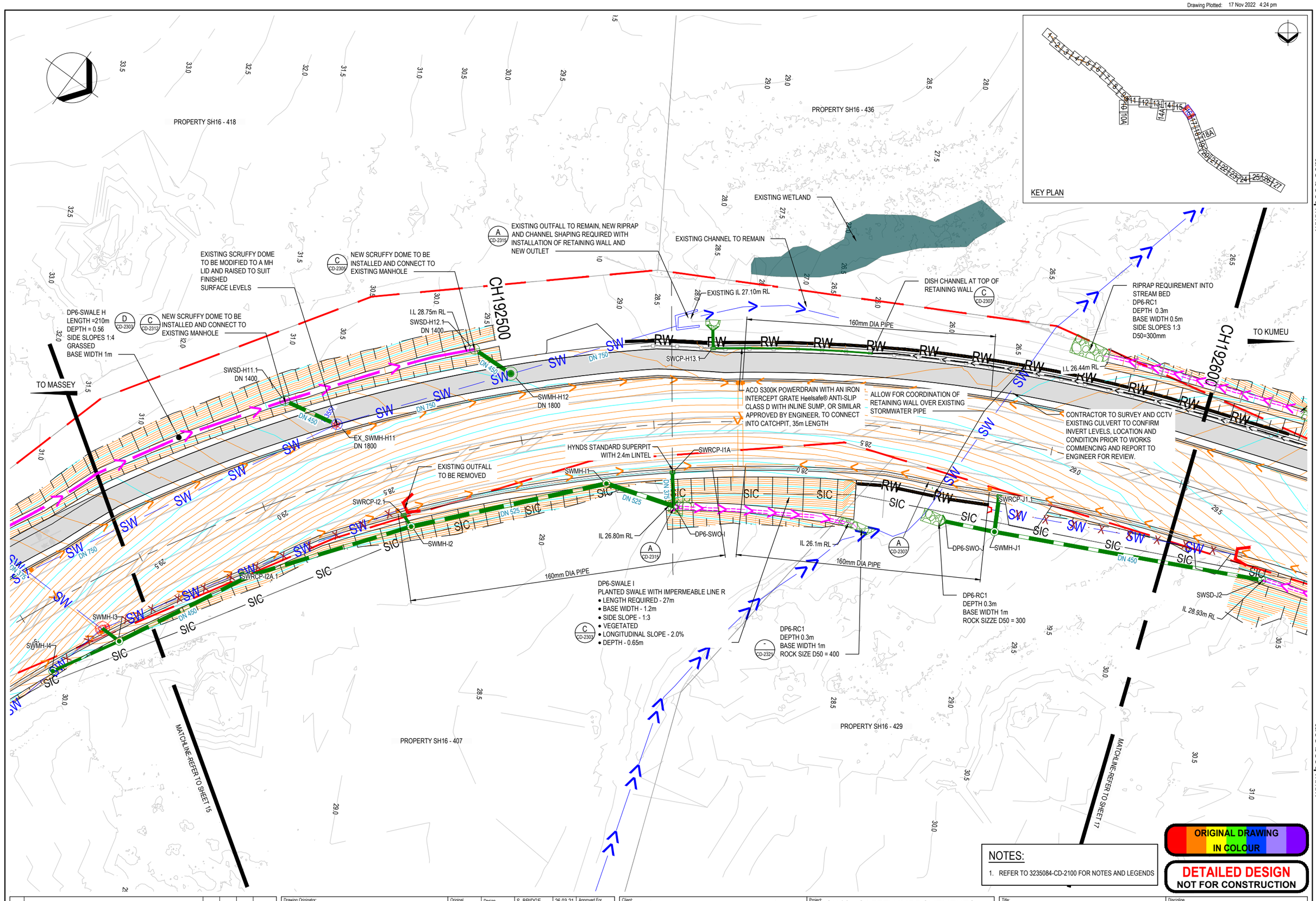
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:24 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 16

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2116

Rev. C

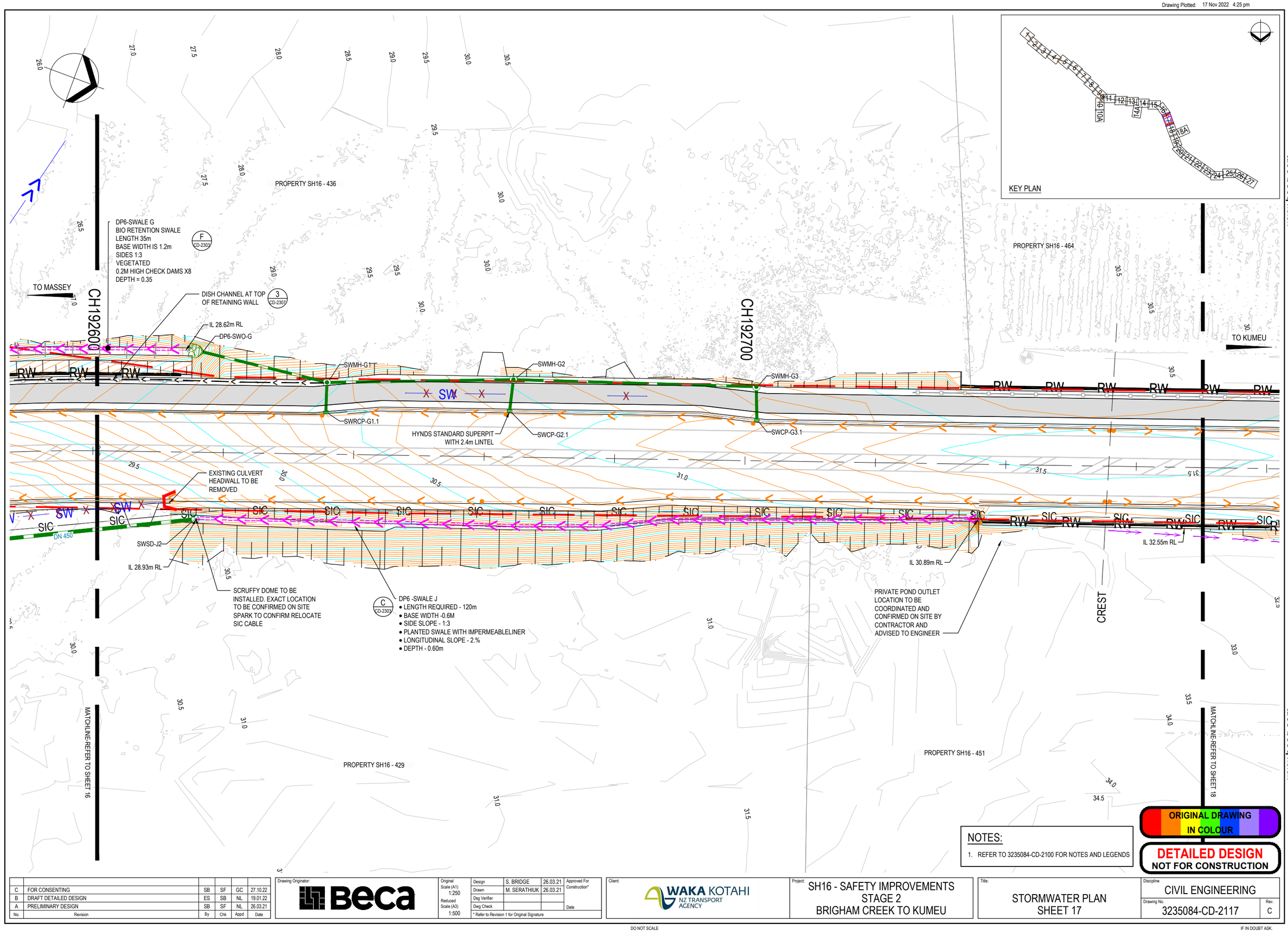
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:25 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 17

Discipline: CIVIL ENGINEERING

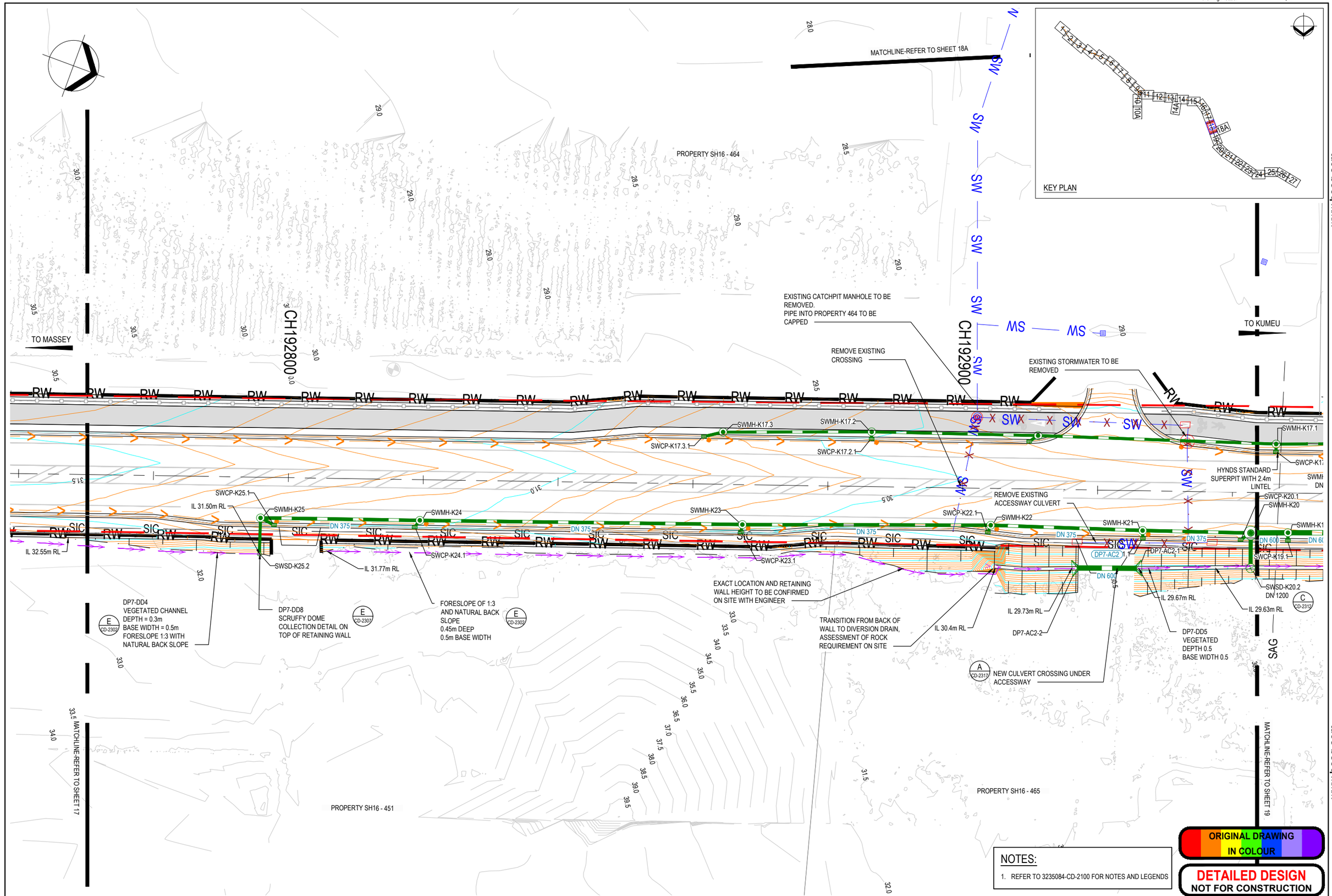
Drawing No.: 3235084-CD-2117

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:27 pm



ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 18

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2118

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:29 pm

MS MS MS

MATCHLINE-REFER TO SHEET 18

MATCHLINE-REFER TO SHEET 19

KEY PLAN

PROPERTY SH16 - 464

EXISTING 150Ø SW PIPE

PRIVATE STORMWATER POND

KUMEU RIVER

DP6- CHANNEL K2
- LENGTH REQUIRED - 25M
- BASE WIDTH - 2.0m
- SIDE SLOPE 1:4
- GRASSED CHANNEL
- LONGITUDINAL SLOPE - 1.45%
- DEPTH - 0.55M

DS INVERT 26.16m RL

DP6- CHANNEL K2
- LENGTH REQUIRED - 50M
- BASE WIDTH - 2.0m
- SIDE SLOPE 1:4
- GRASSED CHANNEL
- LONGITUDINAL SLOPE - 2%
- DEPTH - 0.51M

RIPRAP REQUIREMENT INTO STREAM BED
DP6-RC1
DEPTH
BASE WIDTH

PROPERTY SH16 - 472

CONTRACTOR TO SURVEY AND DESIGN OUTFALL AS CONFIRMED WITH THE ENGINEER PRIOR TO COMMENCING WORKS ON SITE

KUMEU RIVER

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) 1:500	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 18A

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2118A

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 22 Nov 2022 1:06 am

MATCHLINE-REFER TO SHEET 18A

DP6- RETENTION SWALE K1
- LENGTH REQUIRED - 60M
- LONGITUDINAL SLOPE - 1.5%

INNER CHANNEL:
- BASE WIDTH - 1.0m
- SIDE SLOPE 1:3
- PLANTED SWALE
- DEPTH - 0.15m

OUTER CHANNEL:-
- BASE WIDTH - 2.0m
- SIDE SLOPE 1:4
- GRASSED CHANNEL
- DEPTH - 0.45m

FOOTHPATH AND KERB TO BE LOCALLY SHAPED AND GRADED TO ALLOW FOR CONVEYENCE OF OVERLAND FLOW PATH REFER TO DETAIL

IL 28.05m RL

TO MASSEY

PROPERTY SH16 - 472

PROPERTY SH16 - 482

CH193000

CH193100

A CD-2317 NEW CULVERT CROSSING AND HEADWALLS UNDER ACCESSWAY. EXACT LOCATION TO BE CONFIRMED ON SITE WITH ENGINEER.

CONTRACTOR TO REMOVE EXISTING ACCESSWAY CULVERT

A CD-2317 NEW CULVERT CROSSING AND HEADWALLS UNDER ACCESSWAY. EXACT LOCATION TO BE CONFIRMED ON SITE WITH ENGINEER.

CONTRACTOR TO REMOVE EXISTING ACCESSWAY CULVERT

TO KUMEU

KEY PLAN

SWMH-K17.1
SWCP-K17.1.1
SWMH-K17 DN 1800
SWCP-K1.1
SWMH-K1 DN 1800
SWMH-K2 DN 1500
SWRCP-K2.1
SWMH-K3 DN 1500
SWCP-K3.1
SWMH-K4 DN 1500
SWRCP-K4.1
SWMH-K5 DN 1200
SWCP-K5.1
SWMH-K15 DN 1050
SWCP-K15.1
SWMH-K14 DN 1500
SWCP-K14.1
SWMH-K13 DN 1500
SWCP-K13.1
SWMH-K12 DN 1800
SWCP-K12.1
SWMH-K20
SWCP-K20.1
SWMH-K19
SWCP-K19.1

DP7-AC3-1
DP7-AC3
DP7-AC3-2
DP7-AC5-1
DP7-AC5
DP7-AC5-2
DP7-AC4-1
DP7-AC4
DP7-AC4-2

DN 1800 DN 675 DN 750 DN 600 DN 525 DN 450 DN 375

HYNDS STANDARD SUPERPIT WITH 2.4m LINTEL

SWSD-K20.2 DN 1200
SWSD-K12.1 DN 1200
SWSD-K13.2 DN 1200
SWSD-K14.2 DN 1200

IL 29.63m RL
IL 29.60m RL
IL 29.70m RL
IL 30.28m RL
IL 30.53m RL
IL 32.01m RL

SAG

B CD-2302 DP7-DD2 PLANTED DEPTH=0.75m BASE WIDTH =0.5m

A CD-2317 NEW CULVERT CROSSING UNDER ACCESSWAY

B CD-2302 DP7-DD1 PLANTED DEPTH=0.5m BASE WIDTH=0.5m

PROPERTY SH16 - 465

PROPERTY SH16 - 475

MATCHLINE-REFER TO SHEET 18

MATCHLINE-REFER TO SHEET 20

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 19

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2119

Rev. C

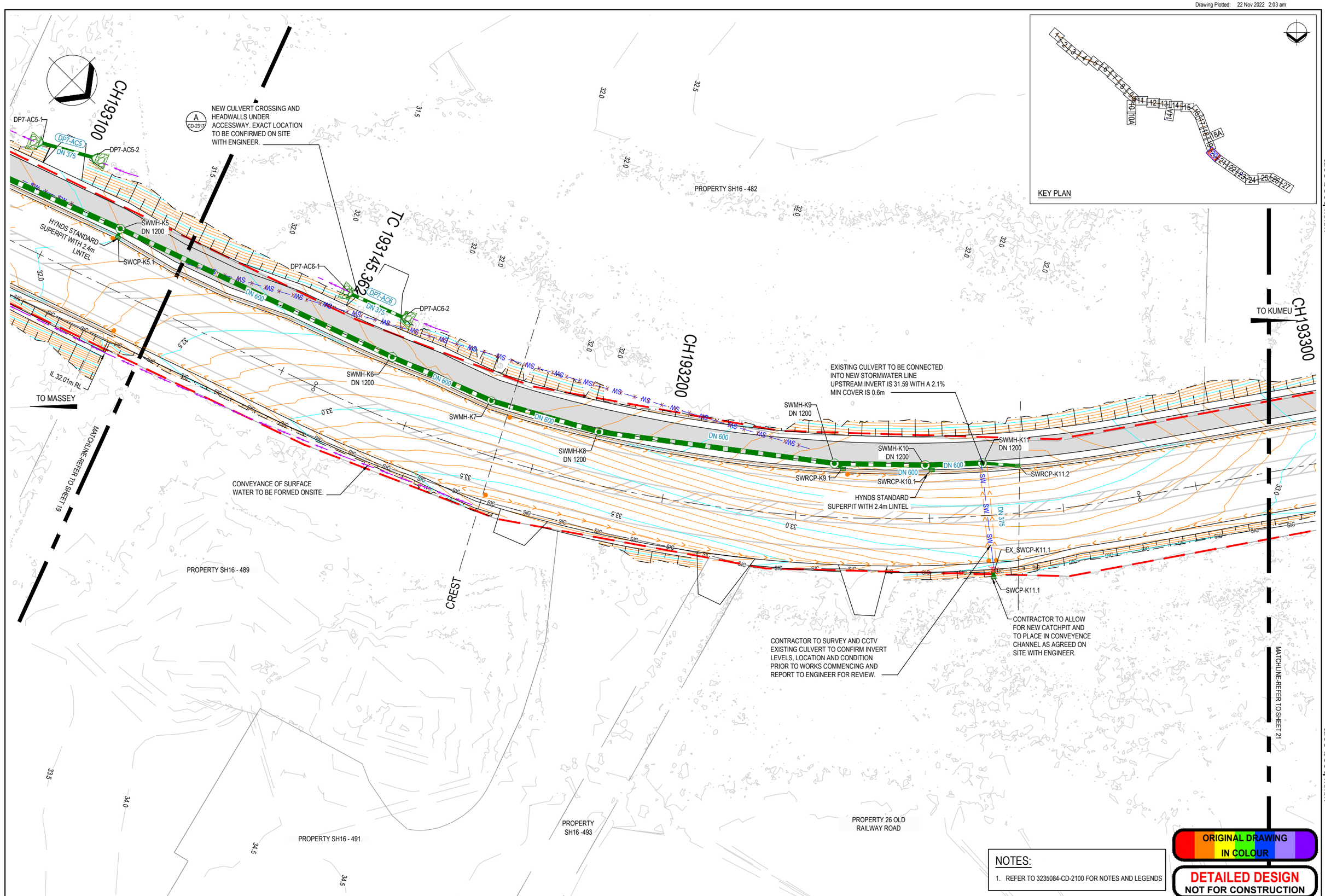
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 22 Nov 2022 2:03 am



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 20

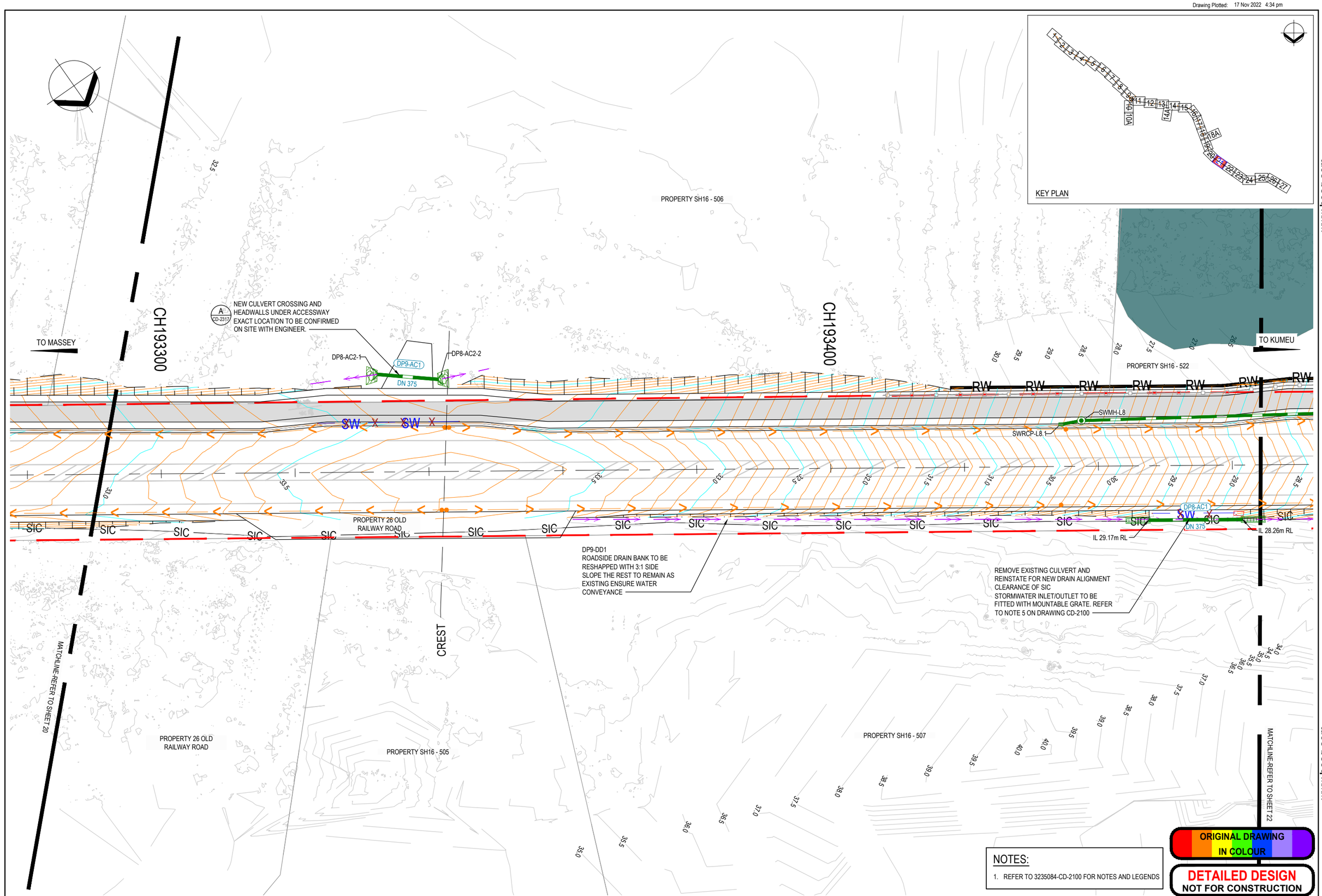
Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2120 Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:34 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) 1:500	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 21

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2121

Rev.: C

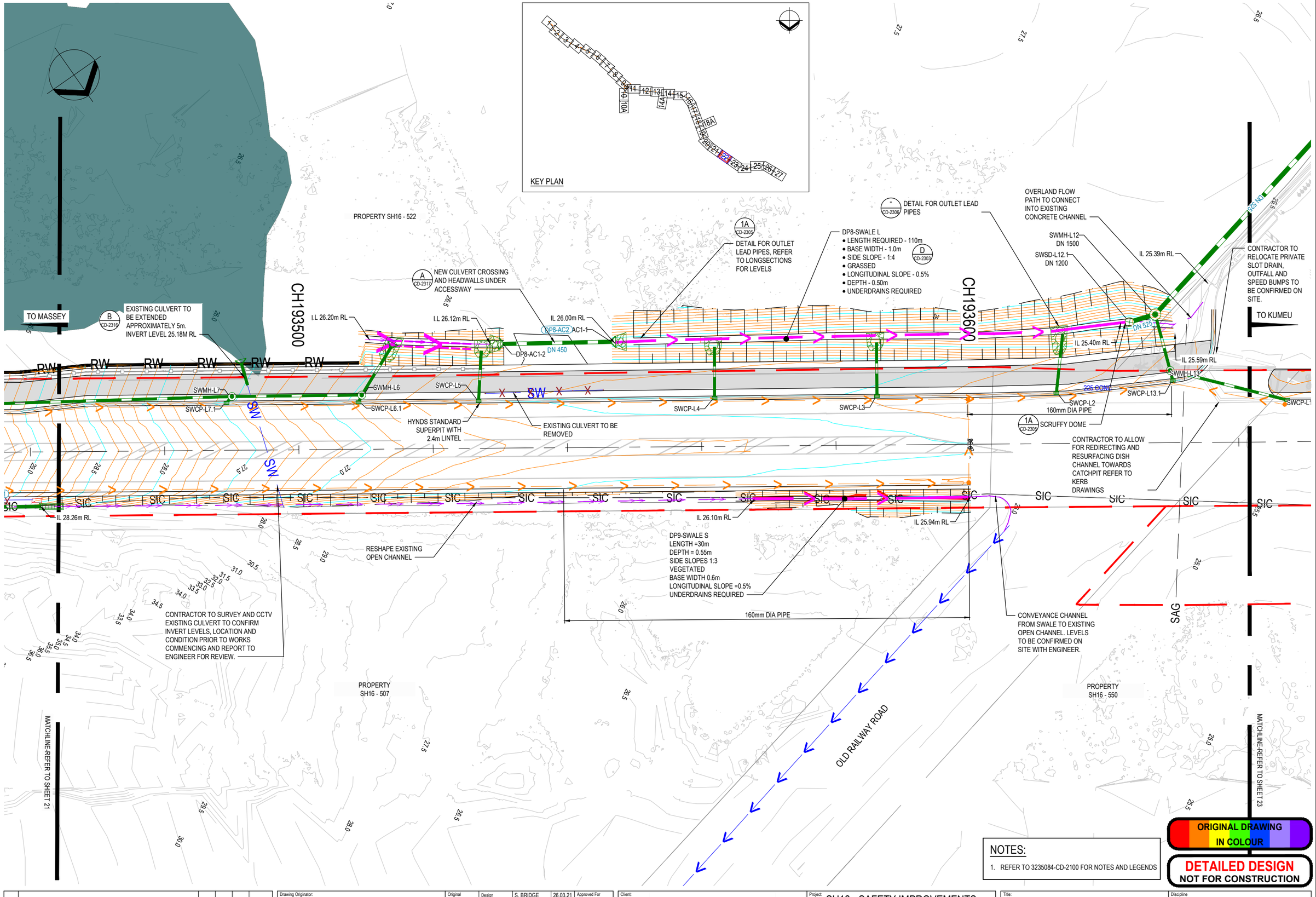
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:35 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 22

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2122

Rev. C

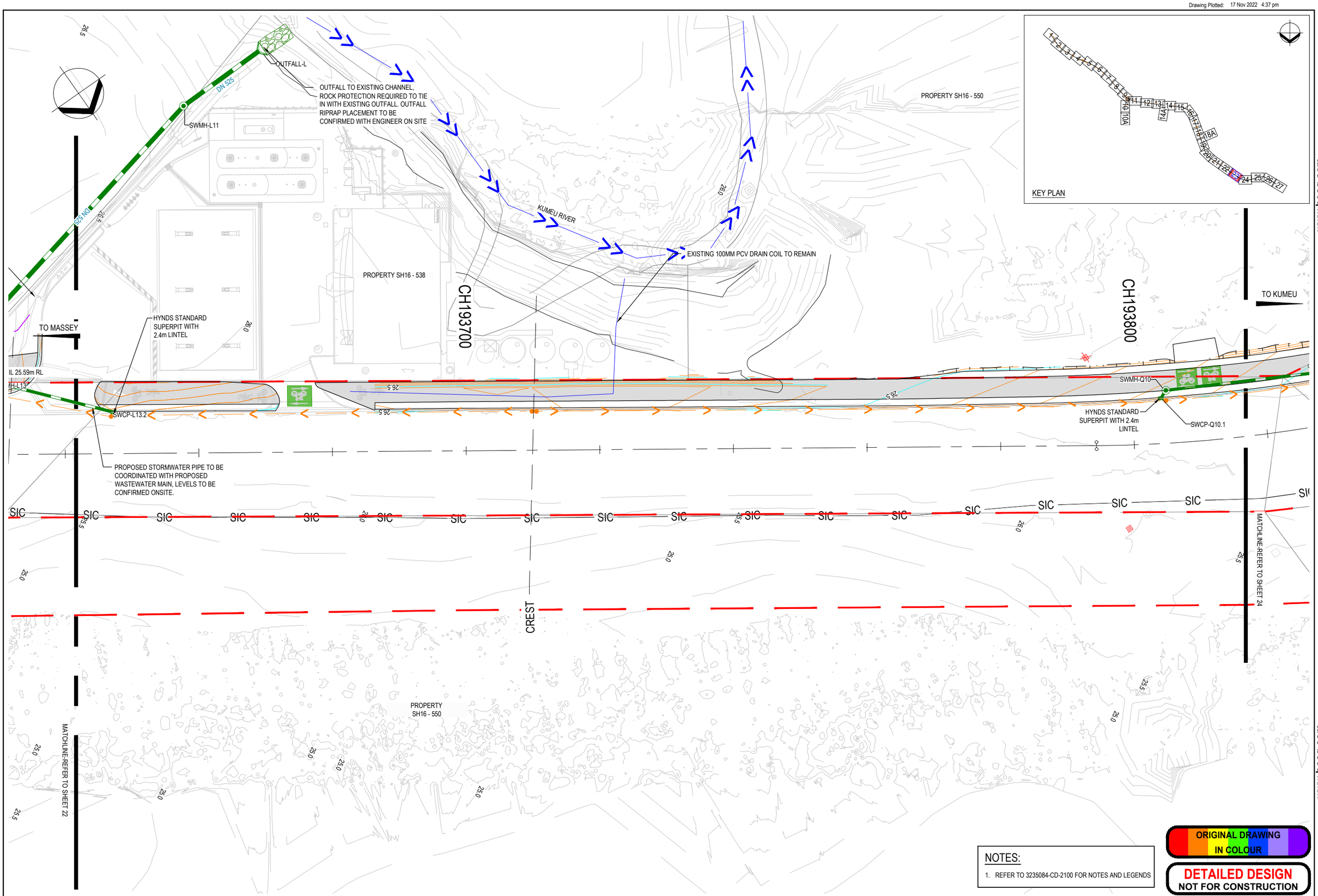
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:37 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 23

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2123

Rev.: C

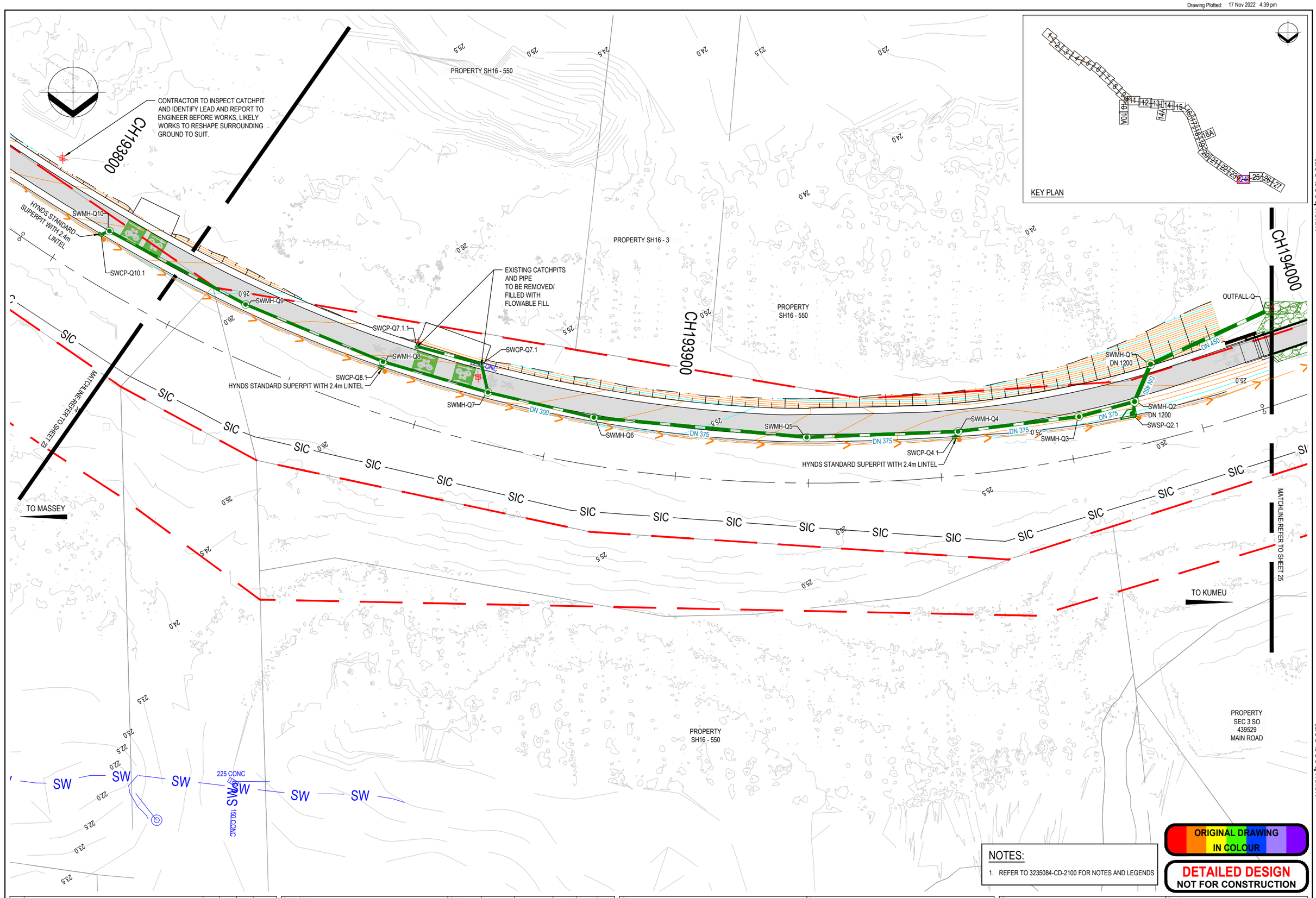
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

Drawing Plotted: 17 Nov 2022 4:39 pm



www.beca.com

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250		
Reduced Scale (A3)	1:500		
Design	S. BRIDGE	26.03.21	Approved For Construction* Date
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 24

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2124

Rev.: C

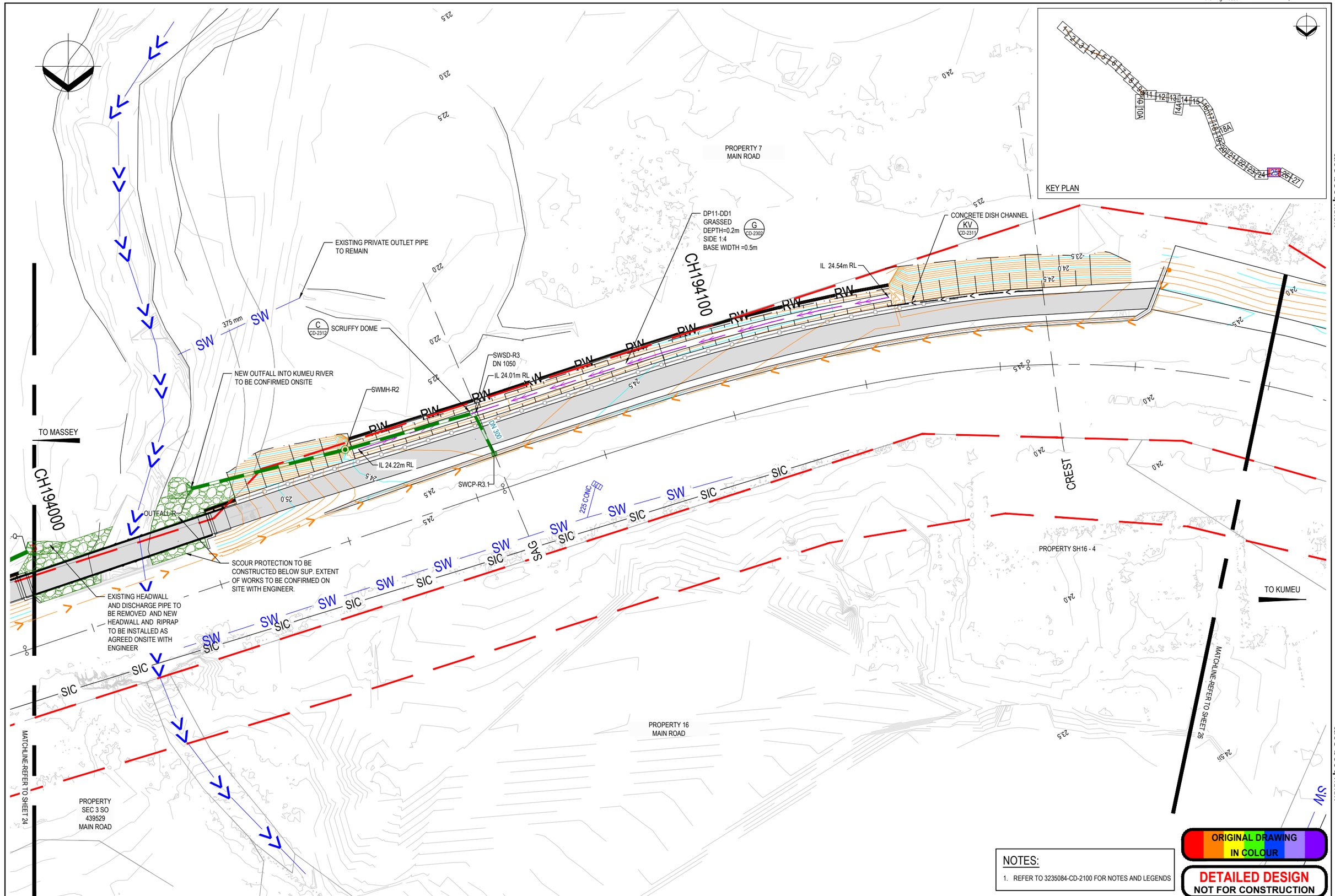
Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 17 Nov 2022 4:42 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

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

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 25

Discipline: CIVIL ENGINEERING

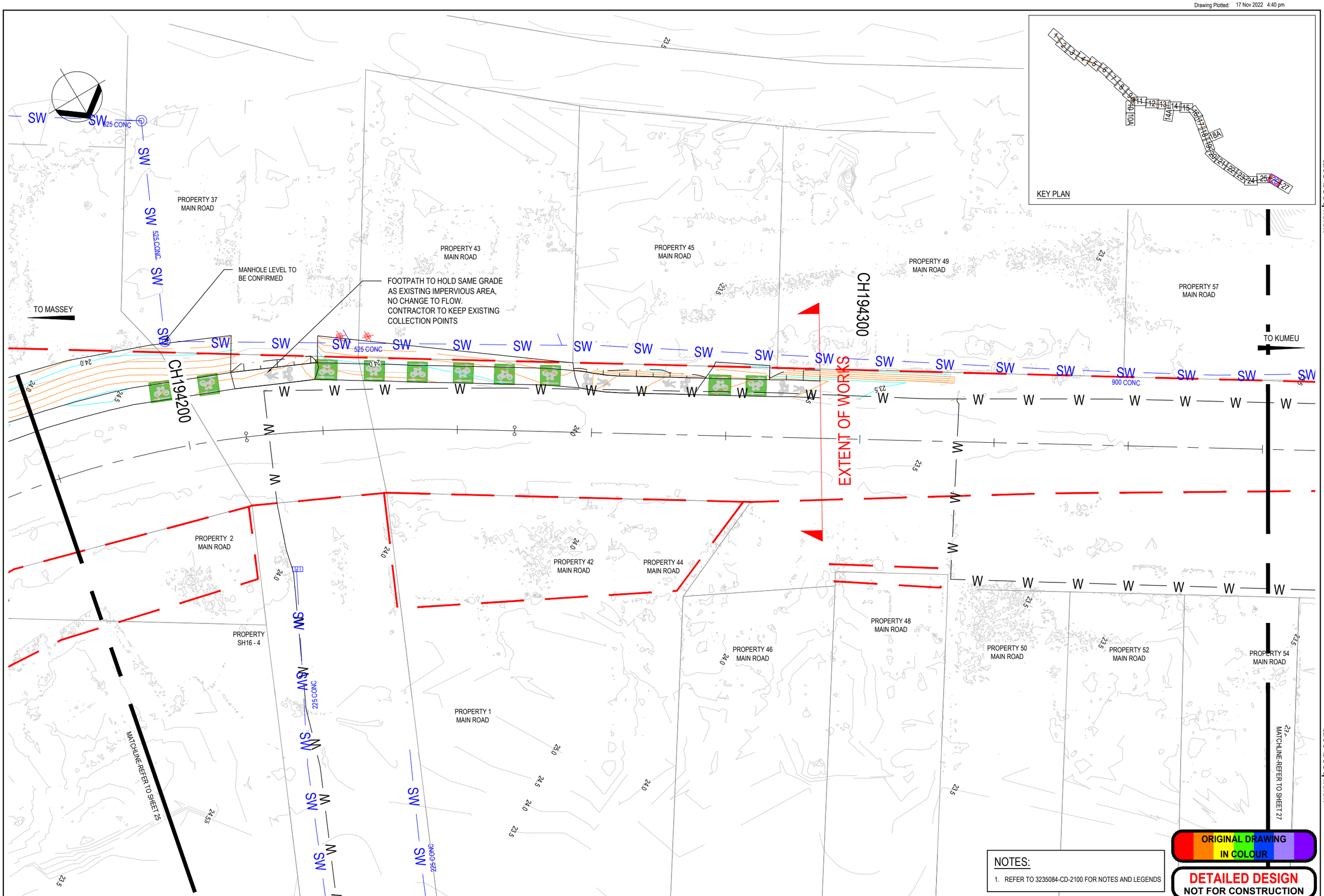
Drawing No. 3235084-CD-2125

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

Drawing Plotted: 17 Nov 2022 4:40 pm



www.beca.com

NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	1:250	Design	S. BRIDGE 26.03.21
Reduced Scale (A3)	1:500	Drawn	M. SERATHIUK 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 26

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2126

Rev.: C

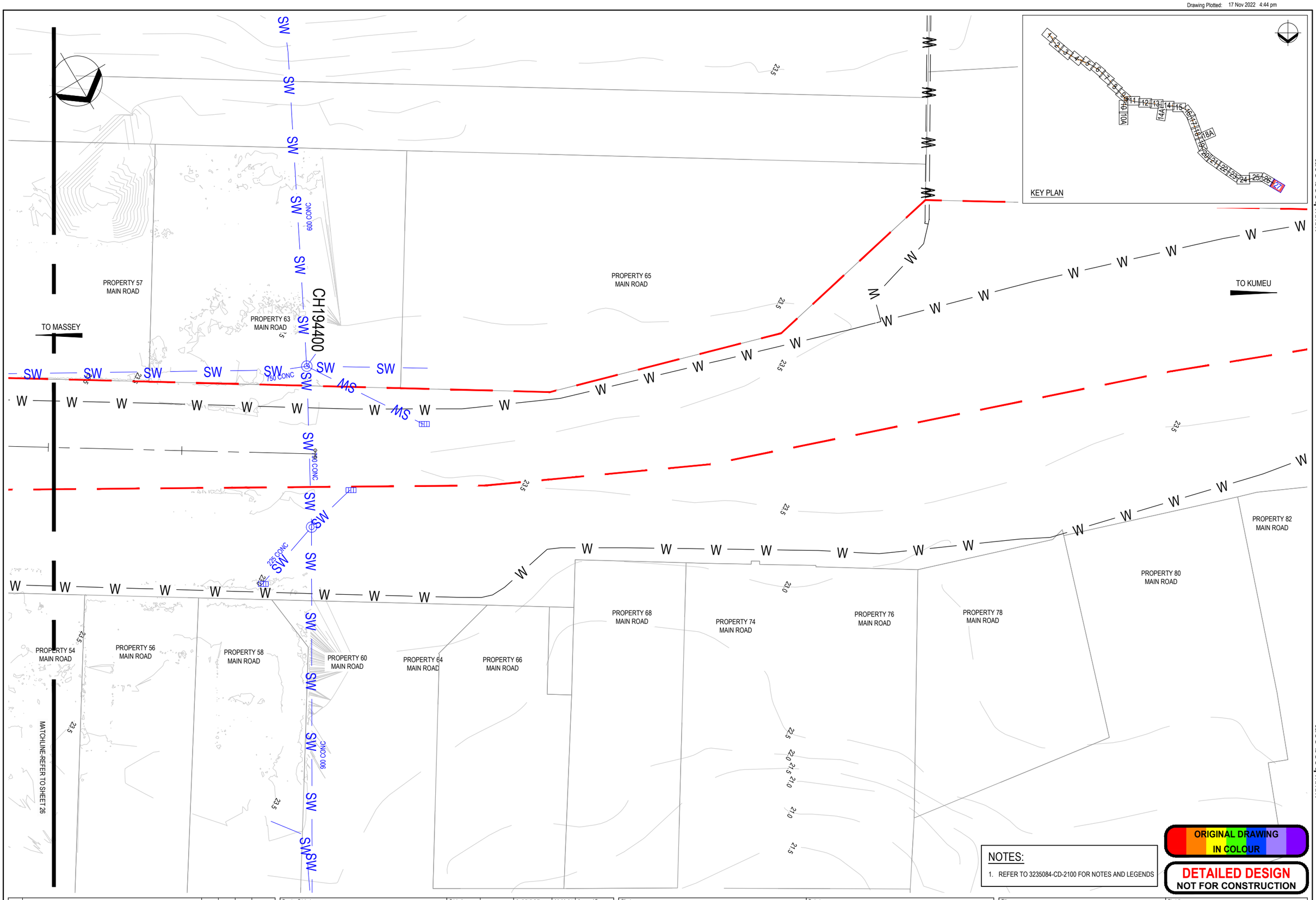
Document No. 3235084-CD-2101 TO 2127.DWG

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 17 Nov 2022 4:44 pm



NOTES:

1. REFER TO 3235084-CD-2100 FOR NOTES AND LEGENDS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	27.10.22
B	DRAFT DETAILED DESIGN	ES	SB	NL	19.01.23
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.22

Drawing Originator: Beca

Original Scale (A1) 1:250	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) 1:500	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER PLAN SHEET 27

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2127

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2101 TO 2127.DWG

www.beca.com

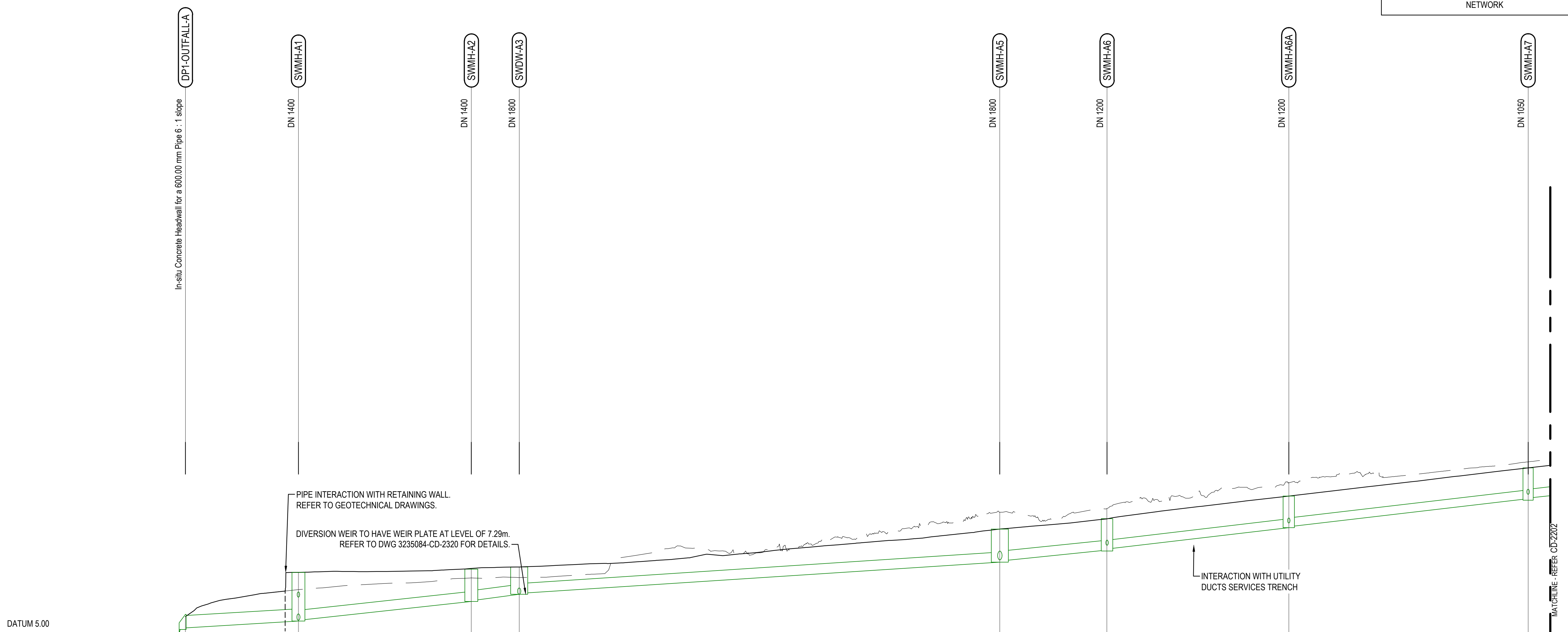
Drawing Plotted: 03 Nov 2022 12:11 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



LID LEVEL	6.11		8.58		8.77		8.90		11.14		11.74		13.08		14.74
PIPE INVERT LEVEL	5.31		5.71 / 5.76		6.87 / 6.92		7.29 / 7.34		9.19 / 9.25		9.90 / 9.96		11.22 / 11.27		12.92 / 12.97
DEPTH TO PIPE INVERT	0.60		2.81 / 2.76		1.89 / 1.85		1.56 / 1.51		1.89 / 1.84		1.79		1.76		1.77
PIPE SIZE AND CLASS		DN 750 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4	
PIPE GRADE		1:33 (3.00%)		1:18 (5.44%)		1:15 (6.64%)		1:31 (3.27%)		1:19 (5.16%)		1:17 (5.87%)		1:17 (5.85%)	
DISTANCE AND CHAINAGE	0.00	13.31	13.31	20.38	20.52	5.63	39.32	56.61	95.93	12.63	108.57	21.40	129.97	28.19	158.17

LONGITUDINAL SECTION: DP1-OUTFALL-A - SWSD-A19

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction*

Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 1

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2201

Rev.: C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

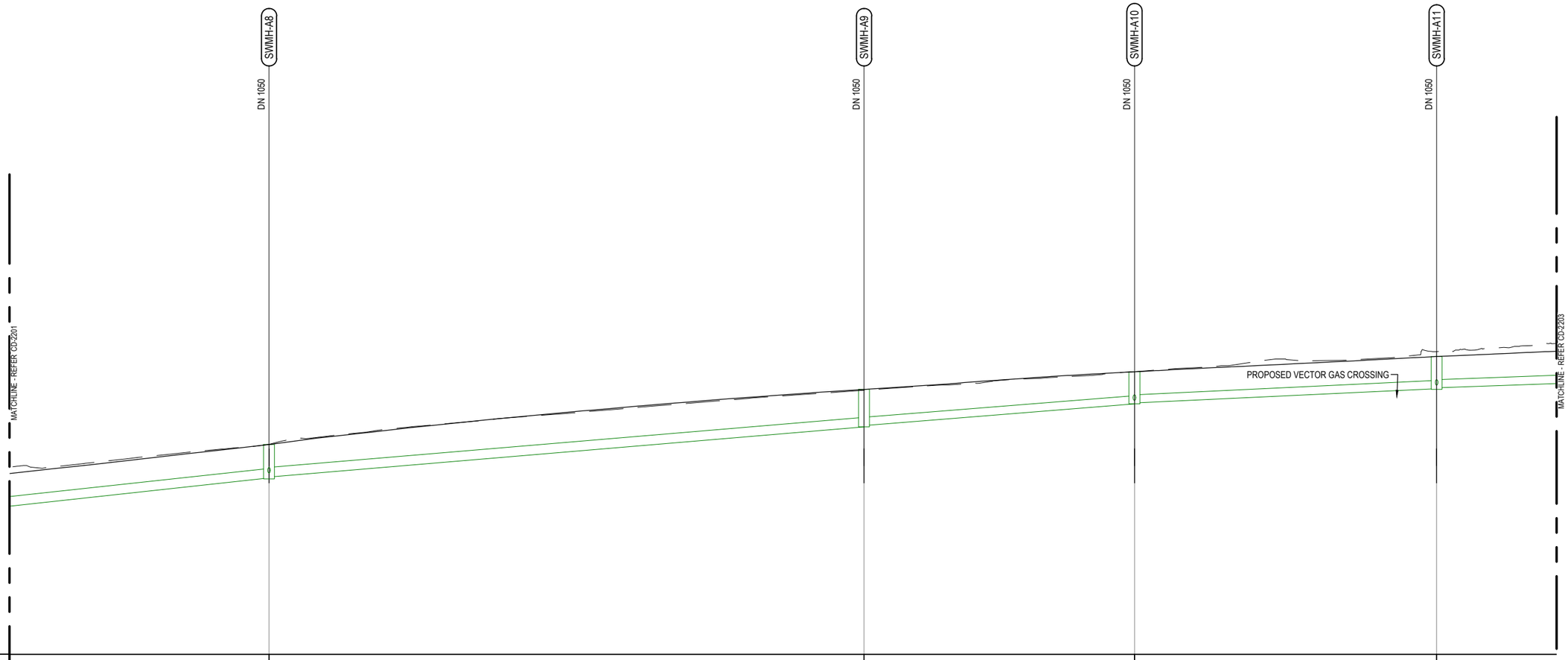
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 5.00

LID LEVEL		16.48					19.49					20.45					21.29						
PIPE INVERT LEVEL		14.65	14.70				17.45	17.52				18.70	18.75				19.53	19.58				
DEPTH TO PIPE INVERT			1.73				2.00	1.94				1.71	1.67				1.72	1.67				
PIPE SIZE AND CLASS	DN 525 RCRRJ CLASS 4					DN 525 RCRRJ CLASS 4							DN 450 RCRRJ CLASS 4						DN 450 RCRRJ CLASS 4				
PIPE GRADE	1:18 (5.43%)					1:24 (4.21%)							1:25 (4.00%)						1:42 (2.37%)				
DISTANCE AND CHAINAGE	31.04	189.21				65.17	254.38					29.62	283.99				33.10	317.09					

LONGITUDINAL SECTION: DP1-OUTFALL-A - SWSD-A19

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 2

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2202

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2201 TO 2219.DWG

Drawing Plotted: 03 Nov 2022 12:14 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

DATUM 5.00

		SWMH-A12		SWMH-A13		SWMH-A14		SWMH-A15		SWMH-A16		SWMH-A16A	
LID LEVEL		22.05		22.31		23.14		24.39		25.15		25.38	
PIPE INVERT LEVEL		20.29 / 20.34		20.69 / 20.74		21.40 / 21.45		22.61 / 22.66		23.58 / 23.66		23.79 / 23.84	
DEPTH TO PIPE INVERT		1.72 / 1.67		1.57 / 1.52		1.70 / 1.65		1.73 / 1.68		1.52 / 1.45		1.55 / 1.50	
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4
PIPE GRADE	1:55 (1.82%)		1:45 (2.24%)		1:42 (2.40%)		1:30 (3.38%)		1:31 (3.18%)		1:100 (1.00%)		1:100 (1.00%)
DISTANCE AND CHAINAGE	39.07	356.16	15.62	371.78	27.38	399.16	34.38	433.54	28.94	462.48	13.30	475.78	36.58

LONGITUDINAL SECTION: DP1-OUTFALL-A - SWSD-A19

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 3

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2203 Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

www.beca.com

DO NOT SCALE

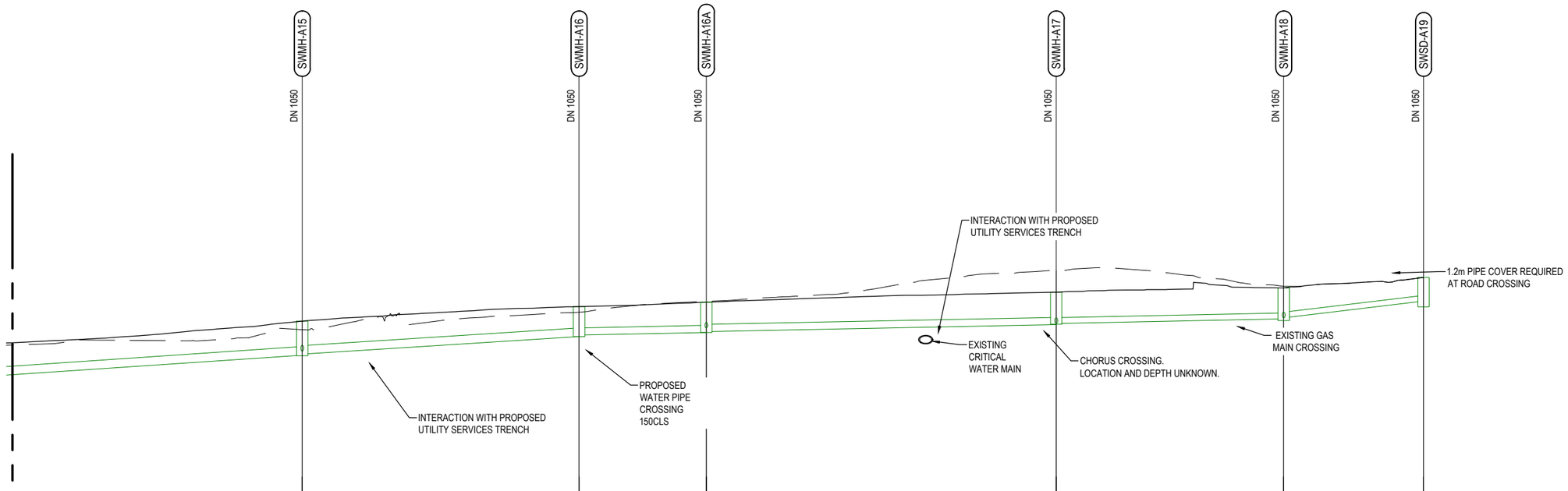
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 5.00

LID LEVEL	24.39		25.15		25.38		25.90		26.12		26.67		
PIPE INVERT LEVEL	22.61	22.66		23.58	23.66	23.79	23.84	24.21	24.26	24.51	24.56	25.44	
DEPTH TO PIPE INVERT	1.73	1.68		1.52	1.45	1.55	1.50	1.66	1.61	1.58	1.53	1.20	
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		
PIPE GRADE	1:30 (3.38%)		1:31 (3.18%)		1:100 (1.00%)		1:100 (1.00%)		1:97 (1.03%)		1:17 (5.98%)		
DISTANCE AND CHAINAGE	34.38	433.54	28.94	462.48	13.30	475.78	36.58	512.36	23.78	536.13	14.62	550.76	

LONGITUDINAL SECTION: DP1-OUTFALL-A - SWSD-A19

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 4

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2204

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

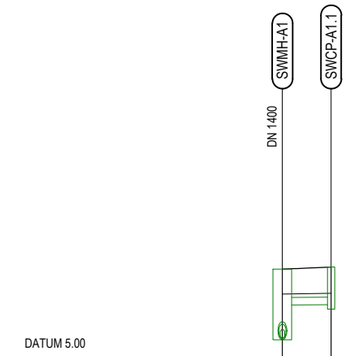
www.beca.com

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

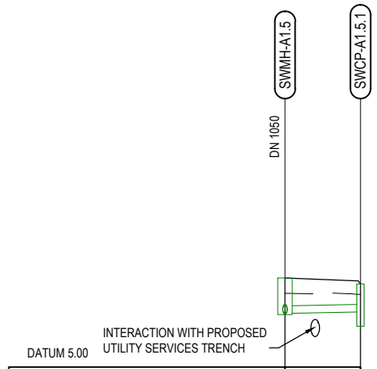
1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



LID LEVEL	8.58	8.68
PIPE INVERT LEVEL		7.12 / 7.14
DEPTH TO PIPE INVERT	1.43	1.50
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:223 (0.45%)	
DISTANCE AND CHAINAGE	0.00	3.97 / 3.97

LONGITUDINAL SECTION: SWMH-A1 - SWCP-A1.1

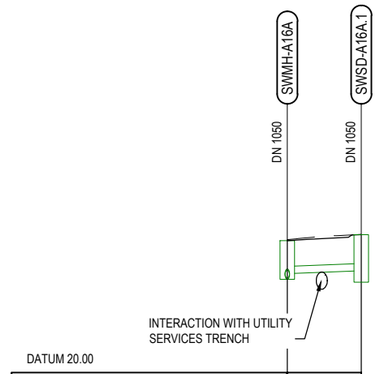
SCALE: HOR 1:250 VER 1:125



LID LEVEL	8.63	8.38
PIPE INVERT LEVEL	7.19	7.25
DEPTH TO PIPE INVERT	1.41	1.11
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	6.15 / 6.15

LONGITUDINAL SECTION: SWMH-A1.5 - SWCP-A1.5.1

SCALE: HOR 1:250 VER 1:125



LID LEVEL	25.38	25.62
PIPE INVERT LEVEL	24.02	24.15
DEPTH TO PIPE INVERT	1.32	1.44
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:50 (2.00%)	
DISTANCE AND CHAINAGE	0.00	6.04 / 6.04

LONGITUDINAL SECTION: SWMH-A16A - SWSD-A16A.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 5

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2205

Rev.: C

www.beca.com

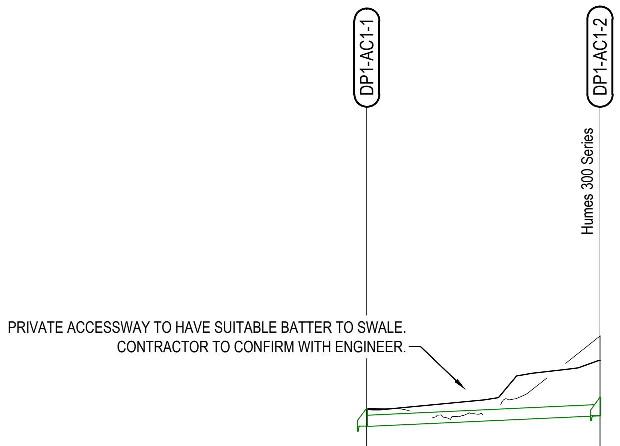
Drawing Plotted: 03 Nov 2022 12:18 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

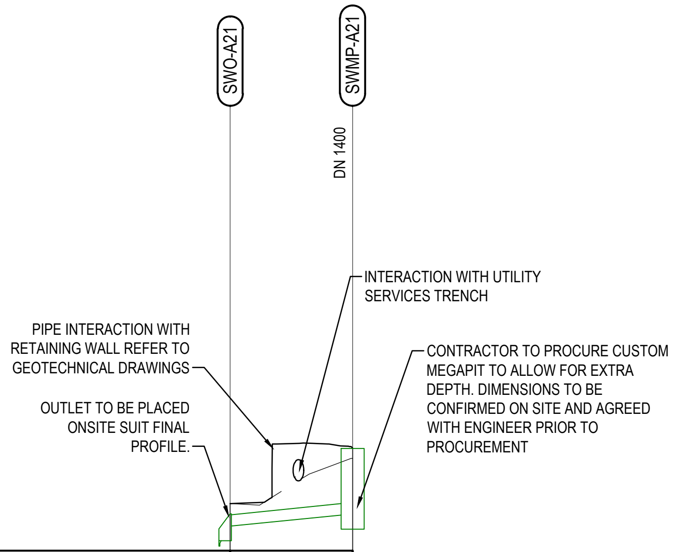


DATUM 10.00

LID LEVEL	12.22	12.58
PIPE INVERT LEVEL	11.61	11.97
DEPTH TO PIPE INVERT	0.53	1.80
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:44 (2.28%)	
DISTANCE AND CHAINAGE	0.00	15.42 / 15.42

LONGITUDINAL SECTION_ DP1-AC1

SCALE: HOR 1:250 VER 1:125

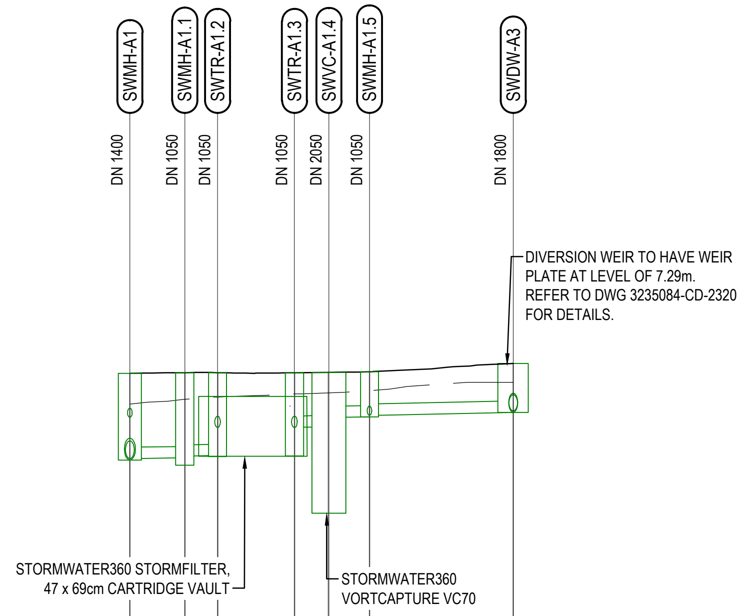


DATUM 5.00

LID LEVEL	6.22	8.38
PIPE INVERT LEVEL	5.81	6.21
DEPTH TO PIPE INVERT	0.71	2.13
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:20 (5.00%)	
DISTANCE AND CHAINAGE	0.00	8.09 / 8.09

LONGITUDINAL SECTION: SWO-A21 - SWMP-A21

SCALE: HOR 1:250 VER 1:125



DATUM 0.00

LID LEVEL	8.58	8.60	8.60	8.60	8.61	8.63	8.90
PIPE INVERT LEVEL	5.76	5.79	5.84 5.86	6.79 6.81	7.12 7.14	7.19	7.29
DEPTH TO PIPE INVERT	2.79	2.78	2.73 2.71	1.78 1.77	1.47 1.45	1.41	1.58
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	75 ASS 4		DN 375 RCRRJ CLASS 4	5 ASS 4	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:133 (0.75%)	1:100 1.00%)		1:100 (1.00%)	:100 .00%)	1:95 (1.05%)	
DISTANCE AND CHAINAGE	13.31	3.63 16.59	2.30 5.90	10.88	2.28 13.16	2.68 15.84	9.50 39.32

LONGITUDINAL SECTION: SWMH-A1 - SWDW-A3

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 6

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2206 Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

IF IN DOUBT ASK.

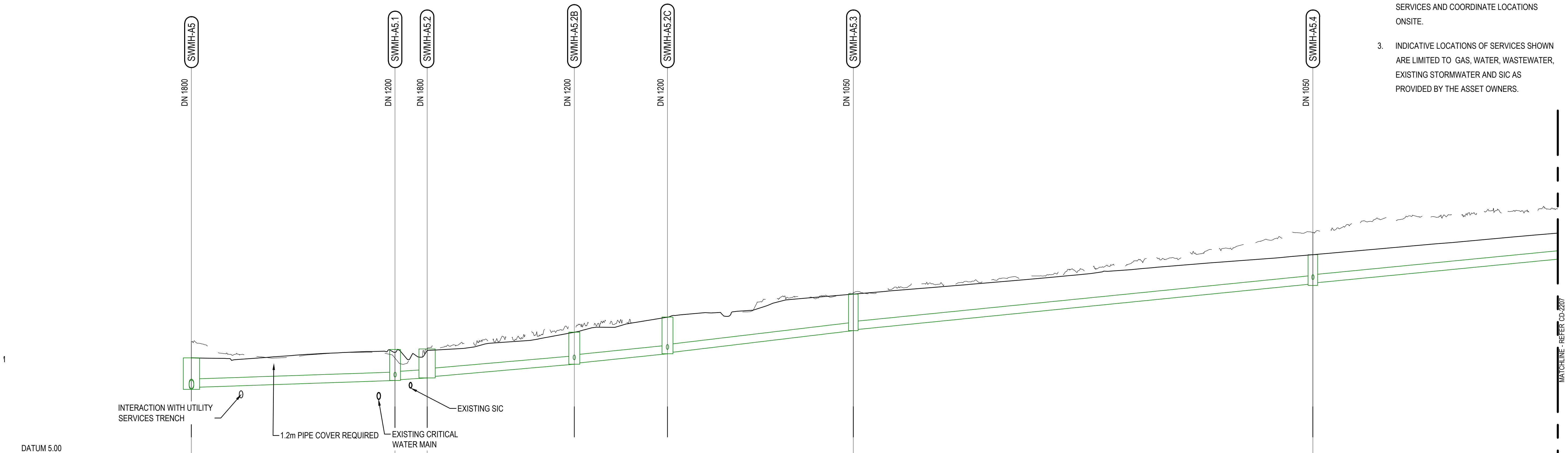
Drawing Plotted: 03 Nov 2022 12:19 pm

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



	SWMH-A5		SWMH-A5.1		SWMH-A5.2		SWMH-A5.2B		SWMH-A5.2C		SWMH-A5.3		SWMH-A5.4	
LID LEVEL	11.14		11.66		11.69		12.72		13.66		15.07		17.51	
PIPE INVERT LEVEL	9.32		9.74 / 9.78		9.90 / 9.95		10.75 / 10.80		11.40 / 11.45		12.82 / 12.87		15.71 / 15.76	
DEPTH TO PIPE INVERT	1.77		1.70 / 1.66		1.65 / 1.60		1.93 / 1.87		2.21 / 2.16		2.21 / 2.15		1.75 / 1.70	
PIPE SIZE AND CLASS		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4
PIPE GRADE		1:59 (1.69%)		1:33 (3.00%)		1:23 (4.40%)		1:19 (5.18%)		1:17 (5.97%)		1:20 (5.00%)		1:20 (4.88%)
DISTANCE AND CHAINAGE	0.00	25.16	25.16	3.96	29.12	18.18	47.31	11.51	58.82	22.97	81.79	56.78	138.57	46.93

LONGITUDINAL SECTION: SWMH-A5 - SWCP-A5.10.1.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dwg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 7

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2207 Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

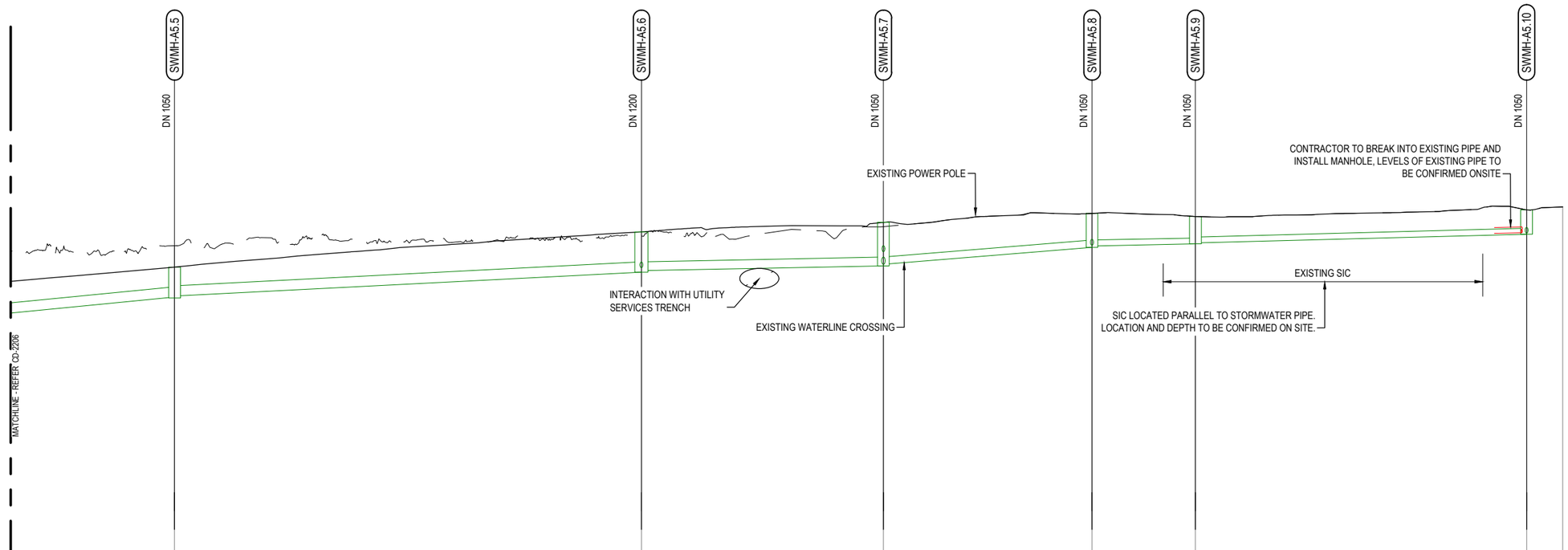
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 5.00

LID LEVEL	19.57		21.36		21.84		22.30		22.14		22.48			
PIPE INVERT LEVEL	18.05	18.10	19.32	19.39	19.63	19.71	20.57	20.64	20.75	20.80	21.24			
DEPTH TO PIPE INVERT	1.47	1.42	2.00	1.93	2.17	2.10	1.69	1.62	1.35	1.30	1.20			
PIPE SIZE AND CLASS		DN 525 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4				
PIPE GRADE		1:39 (2.56%)		1:100 (1.00%)		1:25 (4.07%)		1:100 (1.00%)		1:76 (1.32%)				
DISTANCE AND CHAINAGE	185.50	47.41	232.92	24.58	257.50	21.18	278.68	10.51	289.19	33.63	322.82			

LONGITUDINAL SECTION: SWMH-A5 - SWCP-A5.10.1.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 8

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2208

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

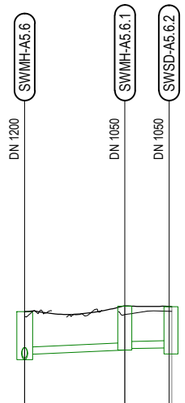
www.beca.com

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

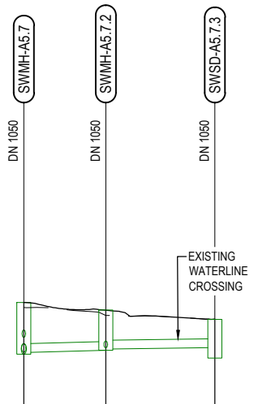


DATUM 15.00

LID LEVEL	21.36	21.59	21.57
PIPE INVERT LEVEL	19.53	19.73	19.78 / 19.82
DEPTH TO PIPE INVERT	1.80	1.84	1.79 / 1.71
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	DN 300 RRJ CLASS 4
PIPE GRADE		1:43 (2.32%)	1:100 (1.00%)
DISTANCE AND CHAINAGE	0.00	8.54	8.54 / 3.93 / 12.47

LONGITUDINAL SECTION: SWMH-A5.6 - SWSD-A5.6.2

SCALE: HOR 1:250 VER 1:125

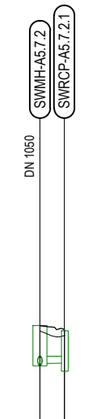


DATUM 15.00

LID LEVEL	21.84	21.51	21.12
PIPE INVERT LEVEL	19.71	19.80 / 19.85	19.92
DEPTH TO PIPE INVERT	2.10	1.67 / 1.62	1.17
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	DN 375 RCRRJ CLASS 4
PIPE GRADE		1:76 (1.32%)	1:141 (0.71%)
DISTANCE AND CHAINAGE	0.00	6.98 / 6.98	9.28 / 16.25

LONGITUDINAL SECTION: SWMH-A5.7 - SWSD-A5.7.3

SCALE: HOR 1:250 VER 1:125



DATUM 15.00

LID LEVEL	21.51	21.29	
PIPE INVERT LEVEL			19.90 / 19.91
DEPTH TO PIPE INVERT	1.57	1.35	
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:157 (0.64%)	
DISTANCE AND CHAINAGE	0.00	2.12	2.12

LONGITUDINAL SECTION: SWMH-A5.7.2 - SWCP-A5.7.2.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 9

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2209

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-CD-2201 TO 2219.DWG

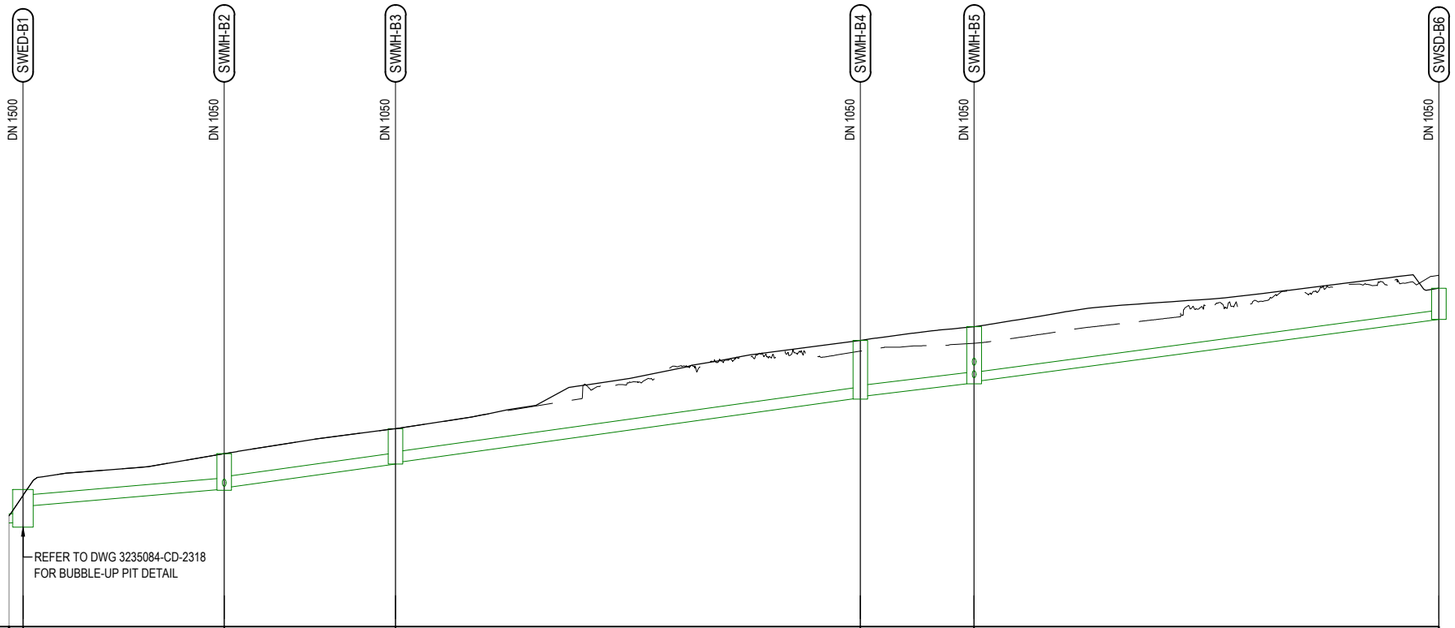
Drawing Plotted: 03 Nov 2022 12:23 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

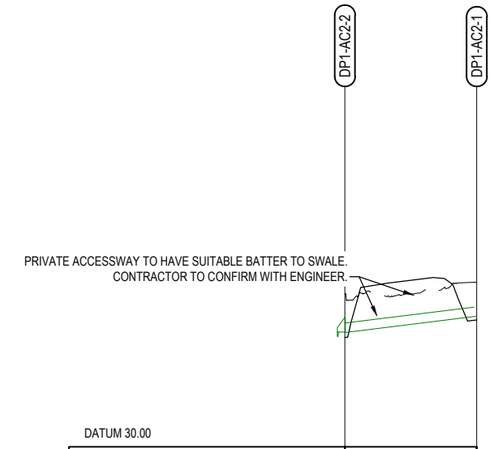


DATUM 0.00

LID LEVEL	5.38		7.04		8.06			11.66		12.22		13.78					
PIPE INVERT LEVEL	4.46	4.89	5.60	5.65	6.62	6.67		9.32	9.37	9.93	9.98	12.52					
DEPTH TO PIPE INVERT	0.88	0.41	1.40	1.35	1.40	1.35		2.30	2.25	2.25	2.20	1.23					
PIPE SIZE AND CLASS	DN 375 PVC-U PN9		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4			DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4					
PIPE GRADE	1:96 (1.04%)		1:23 (4.31%)		1:14 (6.96%)			1:14 (6.98%)		1:17 (6.00%)		1:15 (6.70%)					
DISTANCE AND CHAINAGE	0.00	1.13	16.41	17.53	13.97	31.50		37.91	69.41	9.27	78.69	37.90	116.58				

LONGITUDINAL SECTION: DP1-OUTFALL-B - SWSD-B6

SCALE: HOR 1:250 VER 1:125



DATUM 30.00

LID LEVEL	35.28		35.94
PIPE INVERT LEVEL	34.66		35.33
DEPTH TO PIPE INVERT	-0.24		-0.18
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:16 (6.17%)	
DISTANCE AND CHAINAGE	0.00	10.75	10.75

LONGITUDINAL SECTION_ DP1-AC2

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 10

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2210

Rev.: C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

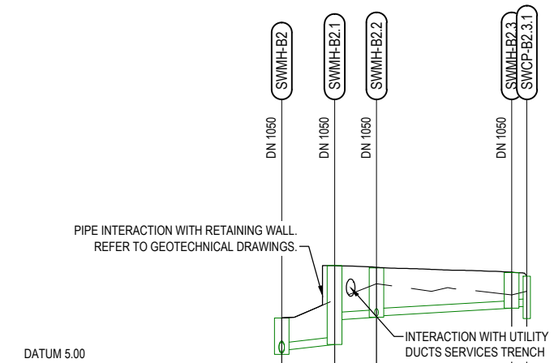
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

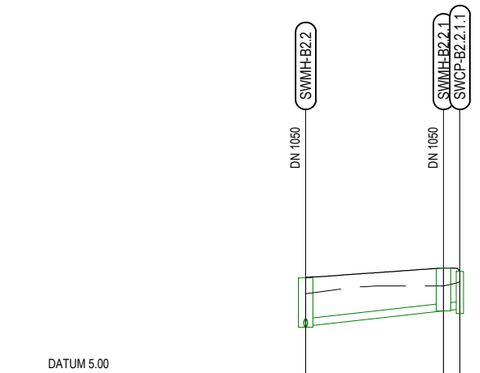


DATUM 5.00

LID LEVEL	7.04		9.17		9.08			8.89	8.74	
PIPE INVERT LEVEL		5.71	5.95	6.95	7.06	7.11		7.44	7.43	7.49 / 7.50
DEPTH TO PIPE INVERT		1.30	3.18	2.19	2.01	1.96		1.43	1.38	1.21
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		
PIPE GRADE		1:17 (5.76%)		1:30 (3.31%)		1:33 (2.99%)		1:100 (1.00%)		
DISTANCE AND CHAINAGE	0.00	4.31	4.31	3.42	7.73	11.02		18.75	19.99	1.24

LONGITUDINAL SECTION: SWMH-B2 - SWCP-B2.3.1

SCALE: HOR 1:250 VER 1:125

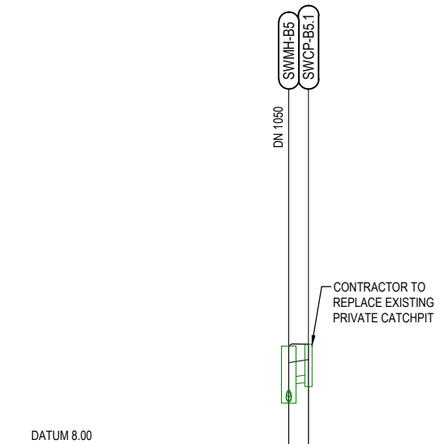


DATUM 5.00

LID LEVEL	9.08		9.48	9.34
PIPE INVERT LEVEL		7.11	7.73	7.83
DEPTH TO PIPE INVERT				1.51
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:18 (5.54%)	1:18 (5.55%)	
DISTANCE AND CHAINAGE	7.73	11.23	11.23	12.87

LONGITUDINAL SECTION: SWMH-B2.2 - SWCP-B2.2.1.1

SCALE: HOR 1:250 VER 1:125



DATUM 8.00

LID LEVEL	12.22		12.29
PIPE INVERT LEVEL			10.64 / 10.75
DEPTH TO PIPE INVERT			1.55 / 1.51
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:14 (7.00%)	
DISTANCE AND CHAINAGE	0.00	1.60	1.60

LONGITUDINAL SECTION: SWMH-B5 - SWCP-B5.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21	
	Dsg Verifier			
	Dwg Check			Date
	* Refer to Revision 1 for Original Signature			

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 11

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2211

Rev.: C

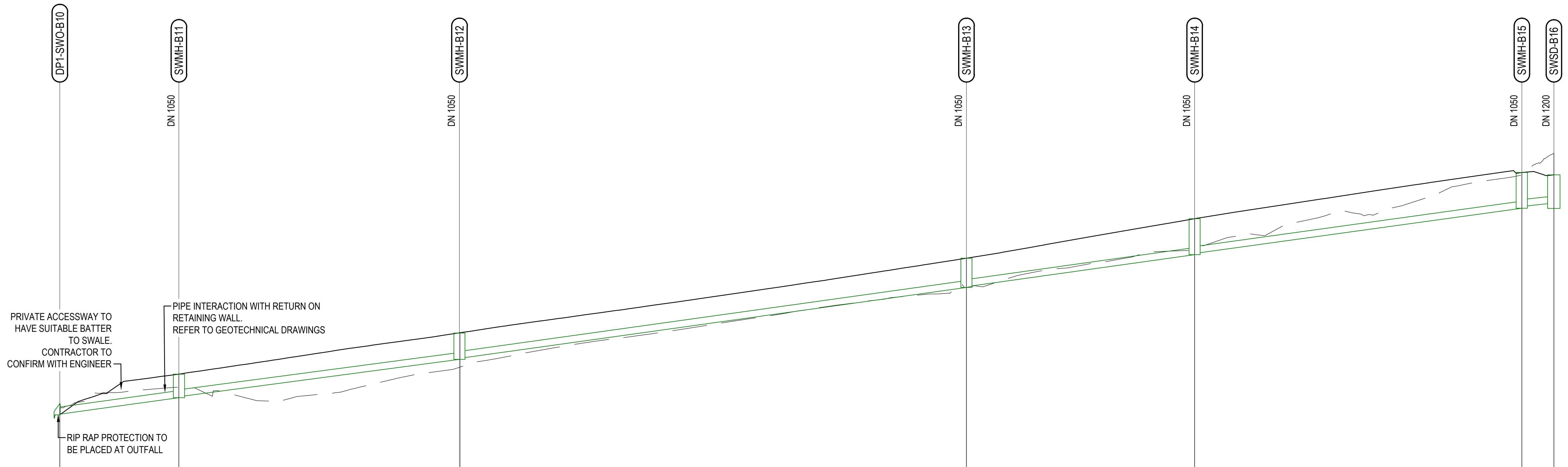
Drawing Plotted: 03 Nov 2022 12:25 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 15.00

	DP1-SWO-B10		SWMH-B11		SWMH-B12		SWMH-B13		SWMH-B14		SWMH-B15		SWSD-B16
LID LEVEL	19.96		21.54		23.74		27.75		29.87		32.34		32.21
PIPE INVERT LEVEL	19.40		20.28 20.33		22.33 22.38		26.18 26.23		27.94 28.00		30.43 30.52		30.71
DEPTH TO PIPE INVERT	-0.03		1.23 1.18		1.39 1.33		1.54 1.49		1.90 1.83		1.88 1.78		1.47
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:15 (6.88%)		1:15 (6.65%)		1:14 (7.00%)		1:14 (7.00%)		1:14 (6.93%)		1:18 (5.43%)	
DISTANCE AND CHAINAGE	0.00	12.75	12.75	30.03	42.78	54.26	97.04	24.43	121.47	35.02	156.49	3.43	159.92

LONGITUDINAL SECTION: DP1-SWO-B10 - SWSD-B16

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) HALF SHOWN	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 12

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2212 Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

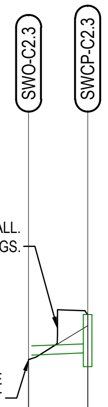
IF IN DOUBT ASK.

LEGEND

— — — —	EXISTING GROUND
———	PROPOSED FINISHED SURFACE
═══	EXISTING STORMWATER NETWORK
═══ (green)	PROPOSED STORMWATER NETWORK
═══ (red)	TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

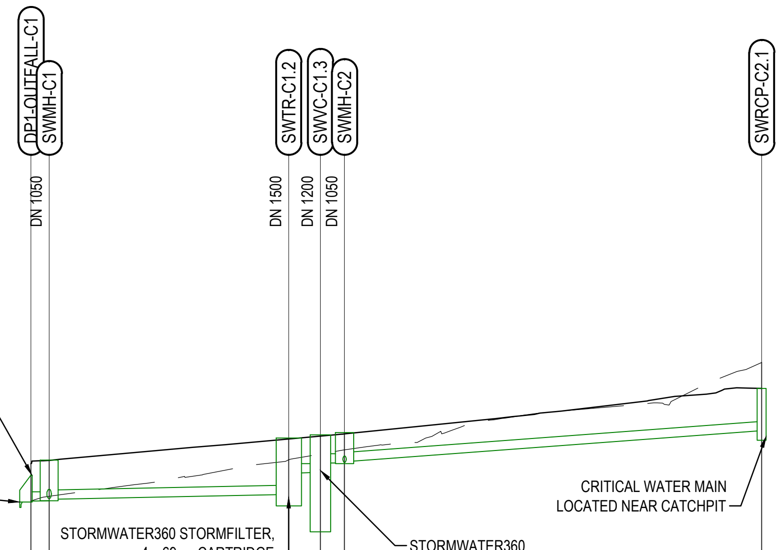


DATUM 5.00

	SWO-C2.3		SWCP-C2.3
LID LEVEL	8.21		9.22
PIPE INVERT LEVEL	7.88		7.96
DEPTH TO PIPE INVERT	-0.17		1.23
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:49 (2.06%)	
DISTANCE AND CHAINAGE	0.00	3.92	3.92

LONGITUDINAL SECTION: DP1-OUTFALL-C2 - SWCP-C2.3

SCALE: HOR 1:250 VER 1:125

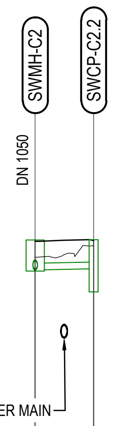


DATUM 5.00

	DP1-OUTFALL-C1	SWMH-C1		SWTR-C1.2	SWVC-C1.3	SWMH-C2		SWRCP-C2.1
LID LEVEL	9.10	9.59		10.33	10.42	10.50		11.96
PIPE INVERT LEVEL	8.23 / 8.24	8.30		8.46	9.16 / 9.18	9.49 / 9.51 / 9.54		10.56
DEPTH TO PIPE INVERT	1.21	1.31 / 1.25		1.80	1.19 / 1.17	0.96 / 0.92 / 0.88		1.37
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)		1:100 (1.00%)	1:100 (1.00%)	1:100 (1.00%)		1:27 (3.71%)	
DISTANCE AND CHAINAGE	0.00	1.19 / 1.19	15.84	17.03	19.12 / 2.09	20.72 / 1.60	27.57	48.29

LONGITUDINAL SECTION: DP1-OUTFALL-C1 - SWRCP-C2.1

SCALE: HOR 1:250 VER 1:125

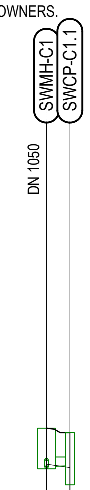


DATUM 0.00

	SWMH-C2		SWCP-C2.2
LID LEVEL	10.50		10.51
PIPE INVERT LEVEL	9.51		9.55
DEPTH TO PIPE INVERT	0.92		0.90
PIPE SIZE AND CLASS		DN 225 RCRRJ CLASS 3	
PIPE GRADE		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	3.87	3.87

LONGITUDINAL SECTION: SWMH-C2 - SWCP-C2.2

SCALE: HOR 1:250 VER 1:125



DATUM 5.00

	SWMH-C1		SWCP-C1.1
LID LEVEL	9.59		9.44
PIPE INVERT LEVEL	8.32		8.33
DEPTH TO PIPE INVERT	1.23		1.07
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	1.55	1.55

LONGITUDINAL SECTION: SWMH-C1 - SWCP-C1.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
	Drawn	M. SERATHIUK	26.03.21	
Reduced Scale (A3) HALF SHOWN	Dsg Verifier			
	Dwg Check			Date
	* Refer to Revision 1 for Original Signature			

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 13

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2213 Rev.: C

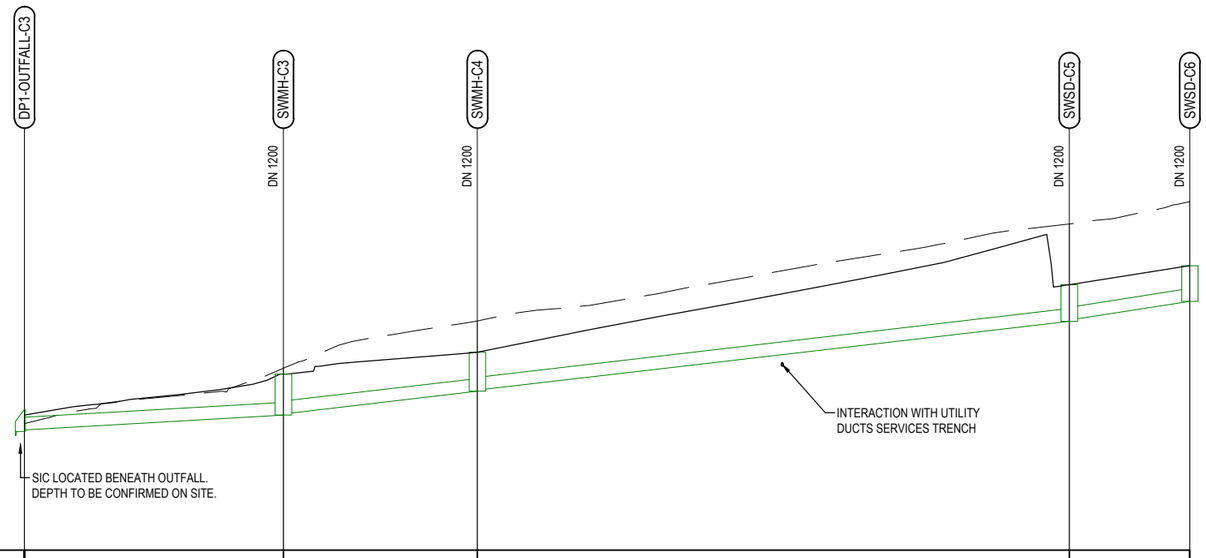
Document No. 3235084-CD-2201 TO 2219.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

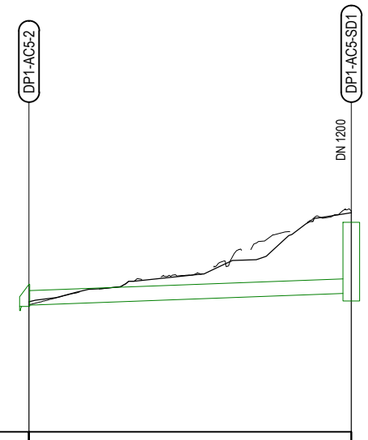


DATUM 5.00

LID LEVEL	10.73		12.17		13.06		15.82		16.59			
PIPE INVERT LEVEL	9.89		10.50	10.55		11.47	11.52		14.32	14.37		15.14
DEPTH TO PIPE INVERT	0.56		1.62	1.57		1.51	1.46		1.45	1.40		1.40
PIPE SIZE AND CLASS	DN 525 RCRRJ CLASS 4			DN 525 RCRRJ CLASS 4			DN 525 RCRRJ CLASS 4			DN 525 RCRRJ CLASS 4		
PIPE GRADE	1:35 (2.88%)			1:17 (5.80%)			1:17 (5.80%)			1:13 (7.81%)		
DISTANCE AND CHAINAGE	0.00	21.11	21.11	15.83	36.94		48.26	85.20		9.83	95.03	

LONGITUDINAL SECTION: DP1-OUTFALL-C3 - SWSD-C6

SCALE: HOR 1:250 VER 1:125



DATUM 5.00

LID LEVEL	11.01		13.54
PIPE INVERT LEVEL	10.17		10.66
DEPTH TO PIPE INVERT	0.09		3.22
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4		
PIPE GRADE	1:54 (1.87%)		
DISTANCE AND CHAINAGE	0.00	26.28	26.28

LONGITUDINAL SECTION_ DP1-AC5

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 14

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2214

Rev.: C

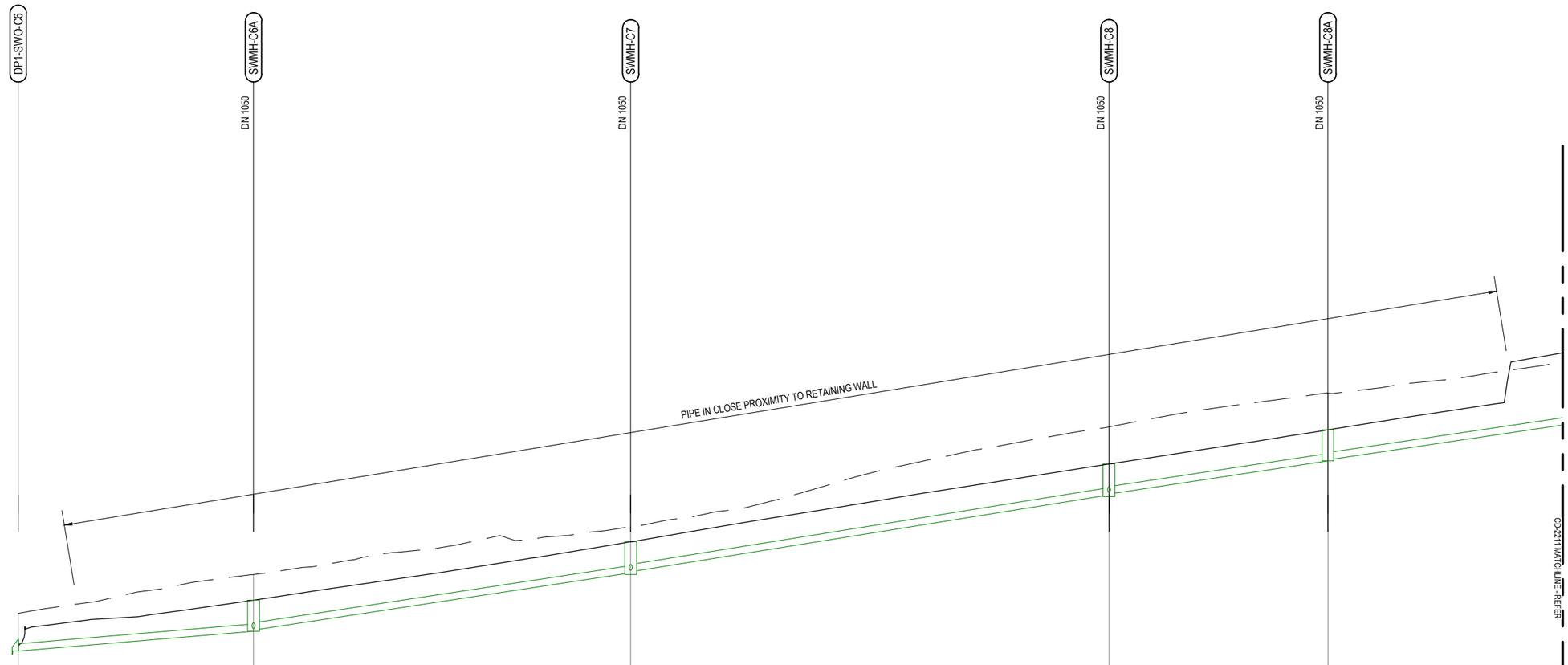
Document No. 3235084-CD-2201 TO 2219.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 20.00

LID LEVEL	21.43		23.40		26.36		30.31		32.04				
PIPE INVERT LEVEL	20.82		21.83	21.88		24.79	24.84		28.74	28.79		30.47	30.52
DEPTH TO PIPE INVERT	0.25		1.54	1.48		1.54	1.48		1.53	1.48		1.54	1.49
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4			DN 375 RCRRJ CLASS 4			DN 375 RCRRJ CLASS 4			DN 375 RCRRJ CLASS 4			DN 375 RCRRJ CLASS 4
PIPE GRADE	1:24 (4.24%)			1:13 (7.58%)			1:12 (8.02%)			1:13 (7.55%)			1:13 (7.42%)
DISTANCE AND CHAINAGE	0.00	23.91	23.91	38.31		62.21	48.58		110.79	22.23		133.02	33.05

LONGITUDINAL SECTION: DP1-SWO-C6 - SWCP-C12.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 15

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2215

Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

IF IN DOUBT ASK.

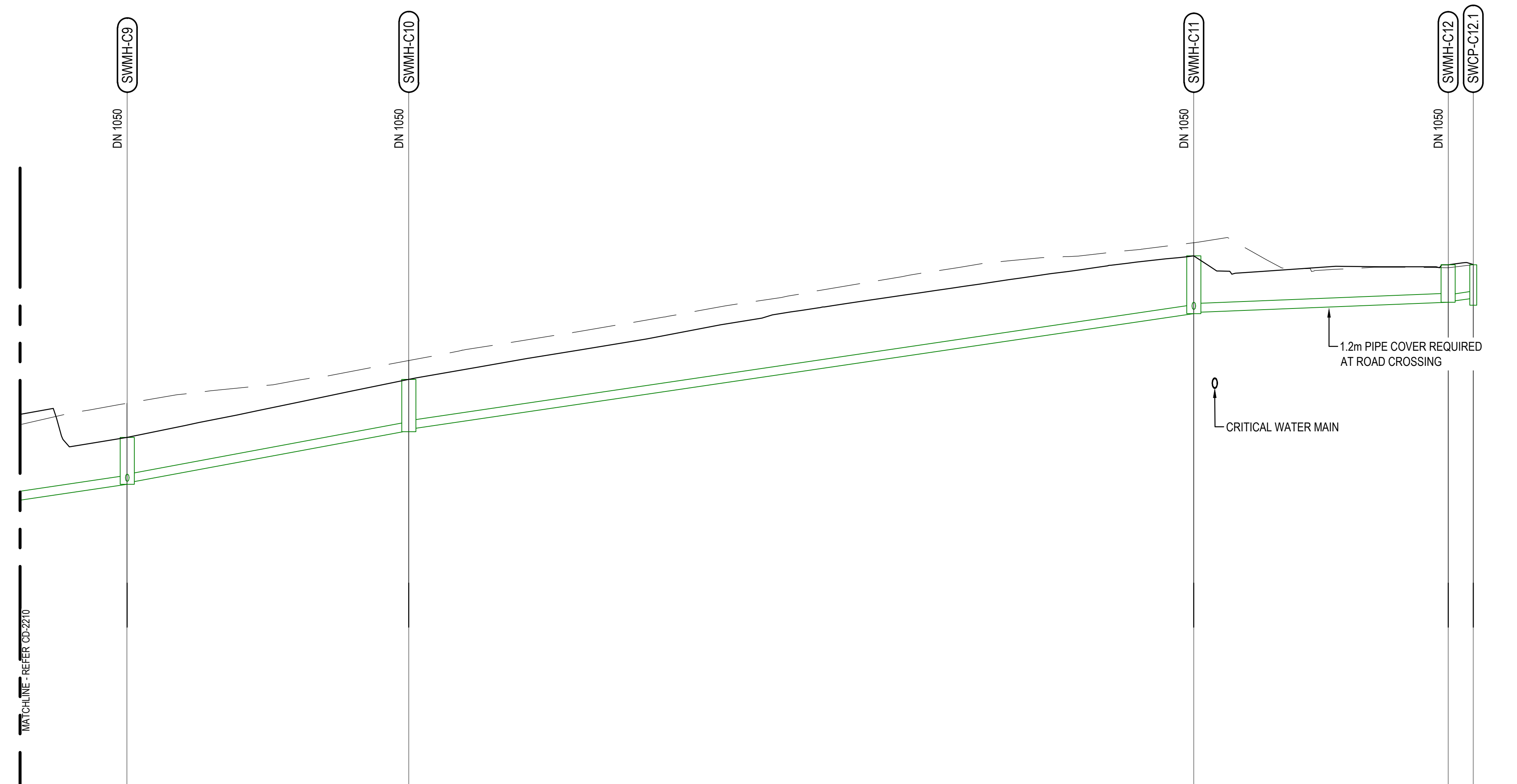
Drawing Plotted: 03 Nov 2022 12:30 pm

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

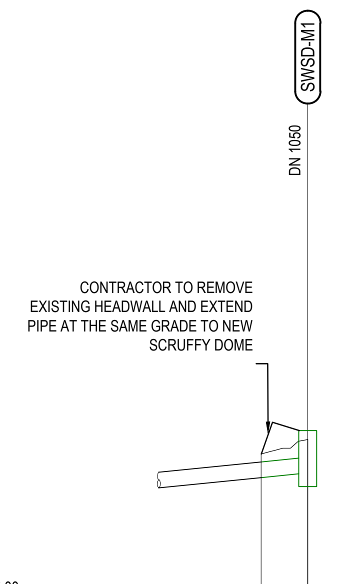


DATUM 20.00

	SWMH-C9		SWMH-C10		SWMH-C11		SWMH-C12 / SWCP-C12.1
LID LEVEL	34.97		37.45		42.71		42.33 / 42.33
PIPE INVERT LEVEL	32.97 / 33.02		35.26 / 35.31		40.25 / 40.30		40.74 / 40.75 / 40.90
DEPTH TO PIPE INVERT	1.95 / 1.90		2.15 / 2.10		2.43 / 2.38		1.56
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE		1:11 (9.29%)		1:14 (7.37%)		1:50 (2.00%)	1:14 (7.00%)
DISTANCE AND CHAINAGE	166.07	24.04	190.11	67.03	257.14	21.72	278.86 / 281.00

LONGITUDINAL SECTION: DP1-SWO-C6 - SWCP-C12.1

SCALE: HOR 1:250 VER 1:125



DATUM 5.00

LID LEVEL		10.74
PIPE INVERT LEVEL	9.19	9.34
PIPE SIZE AND CLASS	DN 525 RCRRJ CLASS 4	
PIPE GRADE	1:20 (5.00%)	
DISTANCE AND CHAINAGE	3.06	3.06

LONGTIDUINAL SECTION : EXISTING M1 - SWS

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 16

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2216 Rev. C

Document No. 3235084-CD-2201 TO 2219.DWG

DO NOT SCALE

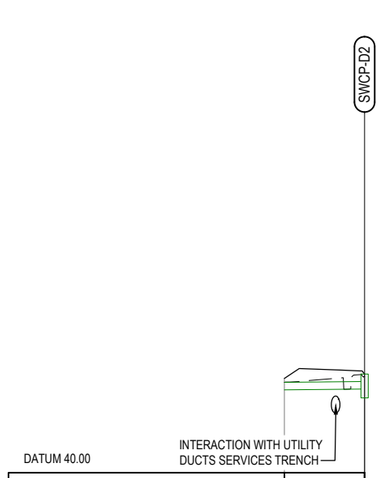
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

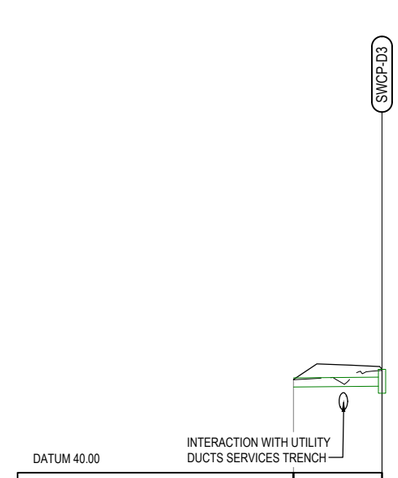
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



LID LEVEL		44.02
PIPE INVERT LEVEL	43.37	43.41
DEPTH TO PIPE INVERT	0.44	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	6.52	6.52

LONGITUDINAL SECTION: DP3-OD-2 - SWCP-D2

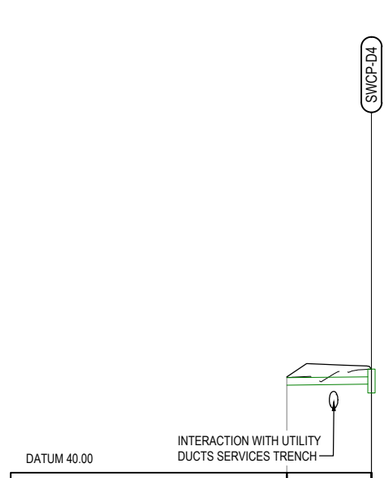
SCALE: HOR 1:250 VER 1:125



LID LEVEL		44.21
PIPE INVERT LEVEL	43.48	43.52
DEPTH TO PIPE INVERT	0.28	0.65
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.20	7.20

LONGITUDINAL SECTION: DP3-OD-3 - SWCP-D3

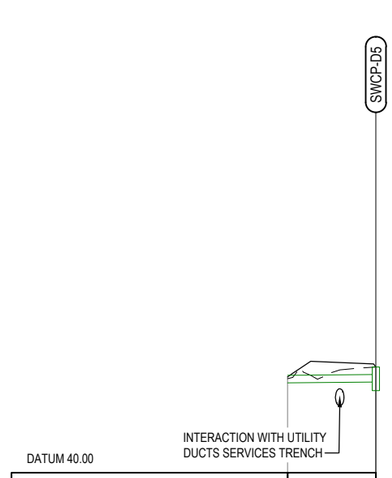
SCALE: HOR 1:250 VER 1:125



LID LEVEL		44.22
PIPE INVERT LEVEL	43.58	43.61
DEPTH TO PIPE INVERT	0.31	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	6.91	6.91

LONGITUDINAL SECTION: DP3-OD-4 - SWCP-D4

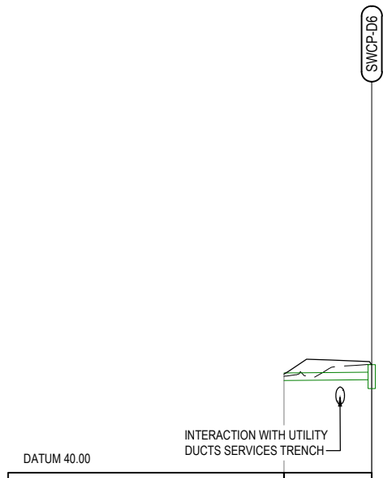
SCALE: HOR 1:250 VER 1:125



LID LEVEL		44.32
PIPE INVERT LEVEL	43.67	43.70
DEPTH TO PIPE INVERT	0.21	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.19	7.19

LONGITUDINAL SECTION: DP3-OD-5 - SWCP-D5

SCALE: HOR 1:250 VER 1:125



LID LEVEL		44.41
PIPE INVERT LEVEL	43.76	43.80
DEPTH TO PIPE INVERT	0.23	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.14	7.14

LONGITUDINAL SECTION: DP3-OD-6 - SWCP-D6

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 17

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2220

Rev.: C

www.beca.com

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

DATUM 40.00

LID LEVEL		44.41
PIPE INVERT LEVEL	43.76	43.80
DEPTH TO PIPE INVERT	0.23	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.14	7.14

LONGITUDINAL SECTION: DP3-OD-6 - SWCP-D6

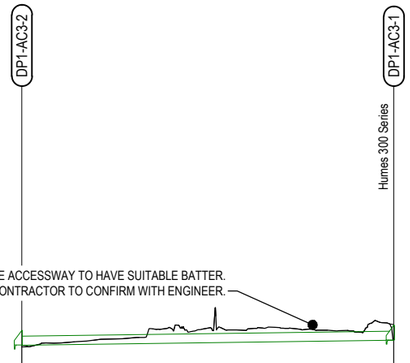
SCALE: HOR 1:250 VER 1:125

DATUM 40.00

LID LEVEL		44.69
PIPE INVERT LEVEL	44.04	44.08
DEPTH TO PIPE INVERT	0.53	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	6.22	6.22

LONGITUDINAL SECTION: DP3-OD-7 - SWCP-D7

SCALE: HOR 1:250 VER 1:125

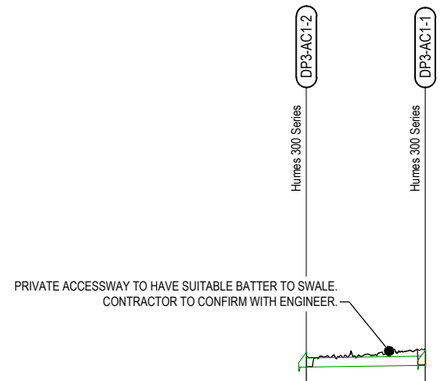


DATUM 40.00

LID LEVEL	44.74		44.94
PIPE INVERT LEVEL	44.13		44.33
DEPTH TO PIPE INVERT	-0.04		0.00
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:147 (0.68%)	
DISTANCE AND CHAINAGE	0.00	30.33	30.33

LONGITUDINAL SECTION: DP1-AC3

SCALE: HOR 1:250 VER 1:125



DATUM 40.00

LID LEVEL	43.90		43.97
PIPE INVERT LEVEL	43.29		43.36
DEPTH TO PIPE INVERT	-0.01		-0.01
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:131 (0.76%)	
DISTANCE AND CHAINAGE	0.00	9.68	9.68

LONGITUDINAL SECTION: DP3-AC1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
	Drawn	M. SERATHIUK	26.03.21	
Reduced Scale (A3) HALF SHOWN	Dsg Verifier			Date
	Dwg Check			

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 18

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2221 Rev.: C

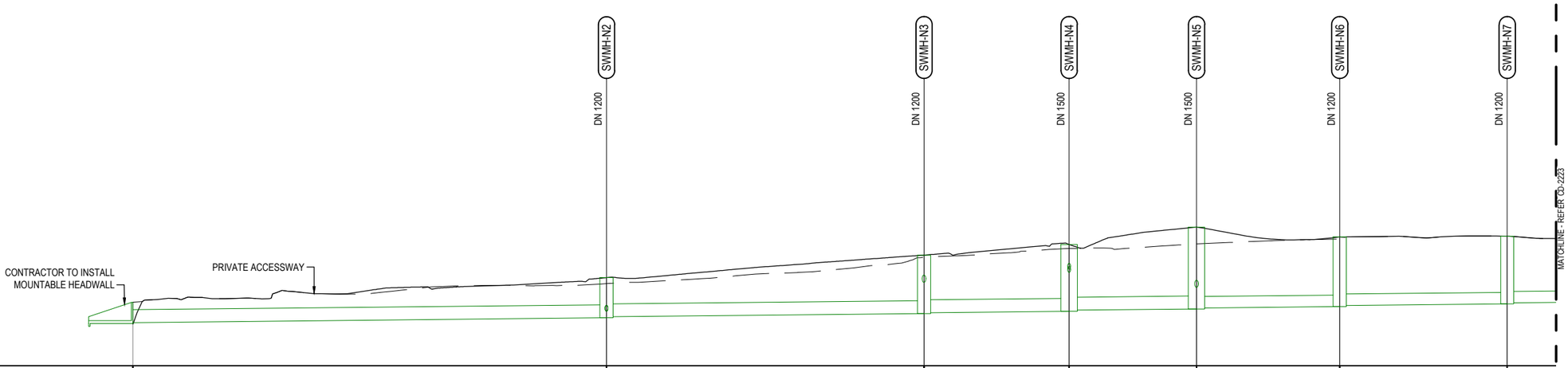
Document No. 3235084-CD-2220 TO 2239.DWG

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



DATUM 38.00

LID LEVEL	42.50	43.65	44.20	45.08	44.58	44.62	
PIPE INVERT LEVEL	40.20 / 40.45	40.50 / 40.66	40.71 / 40.78	40.83 / 40.90	40.95 / 41.02	41.07 / 41.16	41.21
DEPTH TO PIPE INVERT	-0.13 / 1.99	1.94 / 2.93	2.89 / 3.36	3.31 / 4.13	**4.09** / **3.51**	3.45 / 3.41	**3.36**
PIPE SIZE AND CLASS	DN 675 RCRRJ CLASS 4	DN 675 RCRRJ CLASS 4	DN 675 RCRRJ CLASS 4	DN 675 RCRRJ CLASS 4	DN 600 RCRRJ CLASS 4	DN 600 RCRRJ CLASS 4	
PIPE GRADE	1:195 (0.51%)	1:200 (0.50%)	1:200 (0.50%)	1:200 (0.50%)	1:200 (0.50%)	1:200 (0.50%)	
DISTANCE AND CHAINAGE	48.44 / 48.44	32.48 / 80.92	14.84 / 95.76	13.03 / 108.79	14.65 / 123.44	17.13 / 140.57	

LONGITUDINAL SECTION: DP4-ON(EAST)-01 - SWCP-N17.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 19

Discipline: CIVIL ENGINEERING
Drawing No.: 3235084-CD-2222
Rev.: C

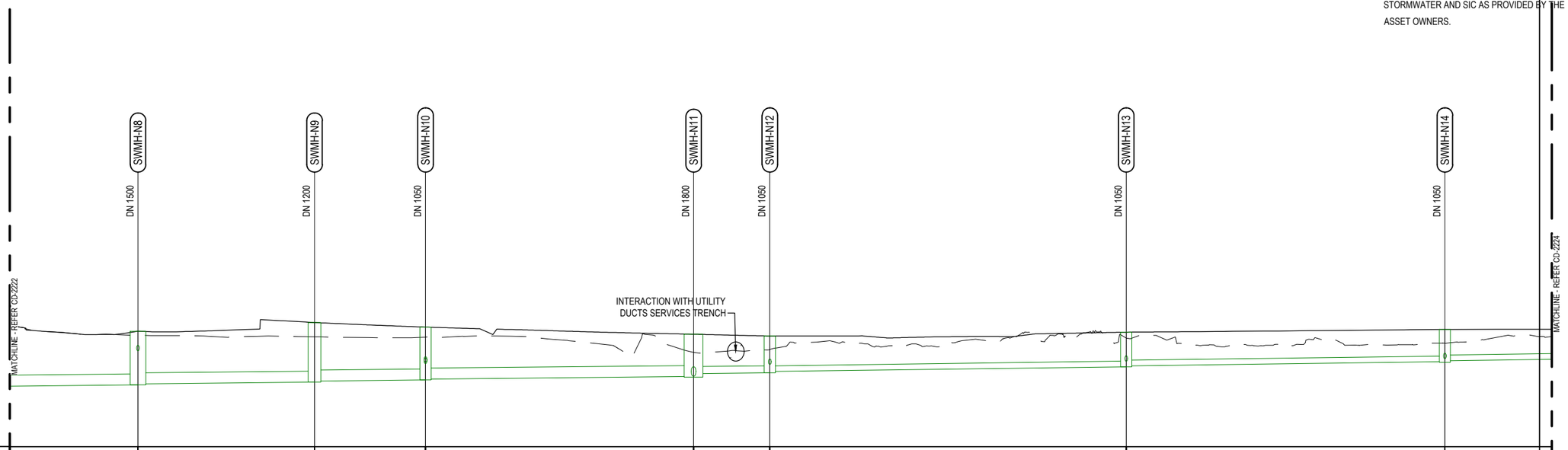
Drawing Plotted: 03 Nov 2022 12:51 pm

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



DATUM 38.00

LID LEVEL		44.18		44.65		44.40		44.02		43.92		44.13		44.27									
PIPE INVERT LEVEL		41.31	41.36		41.46	41.51		41.57	41.62		41.76	41.91		41.95	42.02		42.27	42.32		42.55	42.60		
DEPTH TO PIPE INVERT		2.81	2.76		3.13	3.08		2.77	2.73		2.21	2.08		1.94	1.87		1.82	1.78		1.69	1.64		
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4										
PIPE GRADE	1:200 (0.50%)		1:200 (0.50%)		1:198 (0.51%)		1:200 (0.50%)		1:200 (0.50%)		1:151 (0.66%)		1:150 (0.67%)										
DISTANCE AND CHAINAGE	20.09	160.66	18.90	179.56	11.88	191.44	28.69	220.12	8.16	228.28	38.14	266.42	34.10	300.52									

LONGITUDINAL SECTION: DP4-ON(EAST)-01 - SWCP-N17.1

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) HALF SHOWN	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 20

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2223

Rev.: C

Document No. 3235084-CD-2220 TO 2239.DWG

DO NOT SCALE

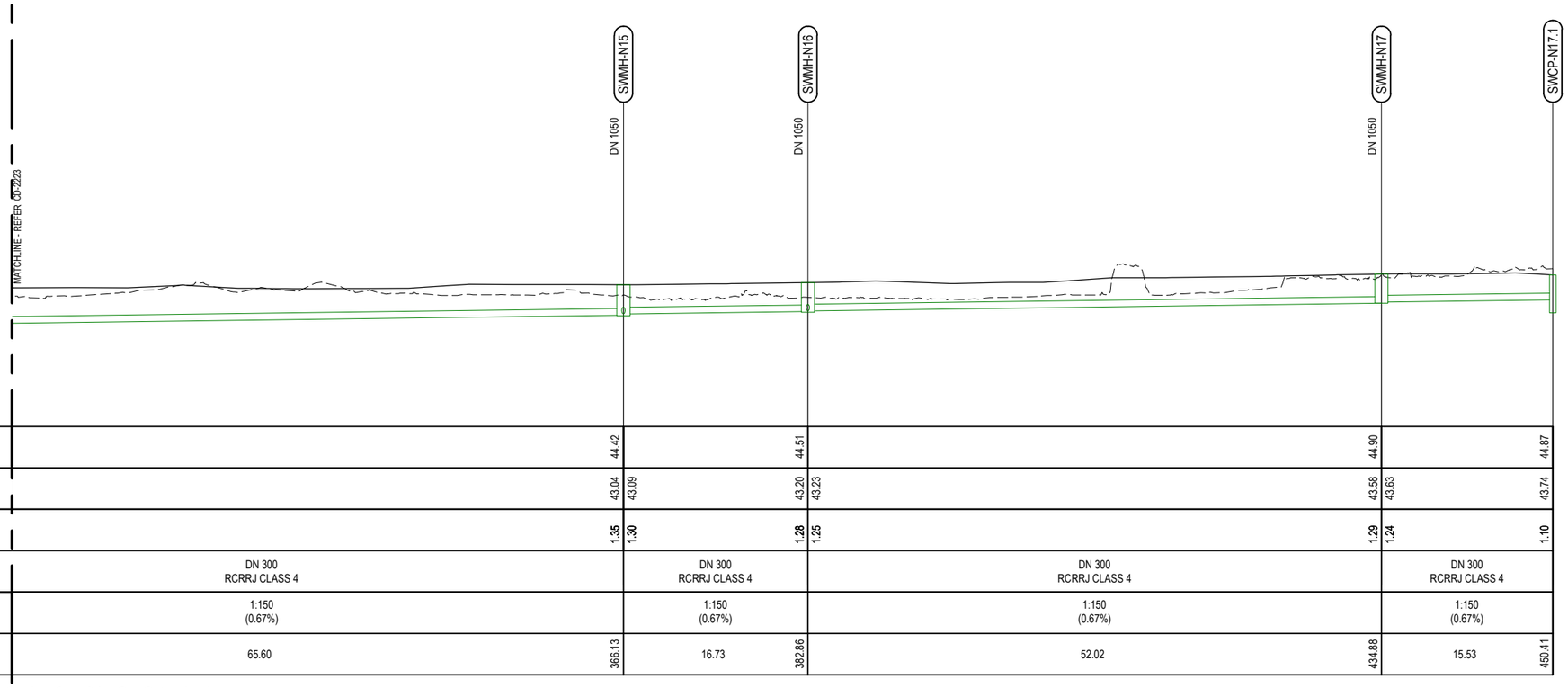
IF IN DOUBT ASK.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



DATUM 38.00

LID LEVEL	44.42	44.51	44.90	44.87
PIPE INVERT LEVEL	43.04 / 43.09	43.20	43.23 / 43.58	43.63 / 43.74
DEPTH TO PIPE INVERT	1.35 / 1.30	1.28	1.25 / 1.29	1.24 / 1.10
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE	1:150 (0.67%)	1:150 (0.67%)	1:150 (0.67%)	1:150 (0.67%)
DISTANCE AND CHAINAGE	65.60 — 366.13	16.73 — 382.86	52.02 — 434.88	15.53 — 450.41

LONGITUDINAL SECTION: DP4-ON(EAST)-01 - SWCP-N17.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 21

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2224

Rev.: C

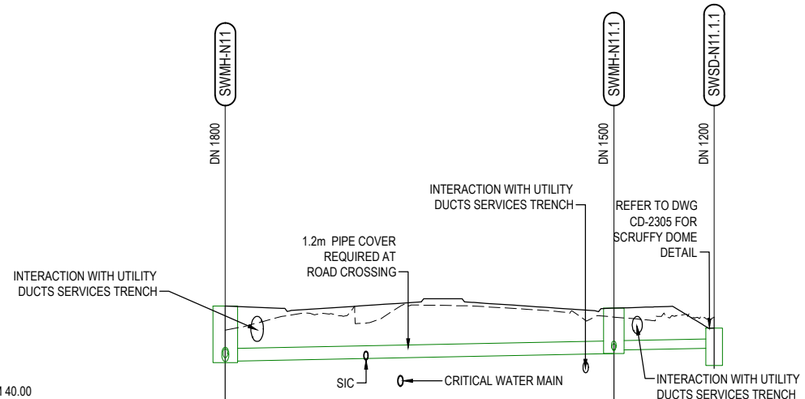
Document No. 3235084-CD-2220 TO 2239.DWG

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

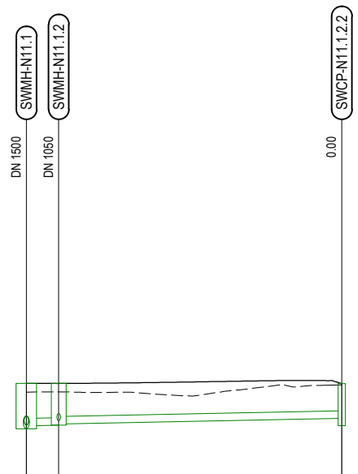


DATUM 40.00

LID LEVEL	44.02	43.94		43.12
PIPE INVERT LEVEL	41.77	42.08	42.23	42.31
DEPTH TO PIPE INVERT	2.21	1.81	1.67	0.77
PIPE SIZE AND CLASS	DN 525 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	31.68	31.68	8.17 39.85

LONGITUDINAL SECTION: SWMH-N11 - SWSD-N11.1.1

SCALE: HOR 1:250 VER 1:125



DATUM 40.00

LID LEVEL	43.94	43.93		43.93
PIPE INVERT LEVEL	42.20	42.23	42.28	42.51
DEPTH TO PIPE INVERT			1.62	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	2.64	2.64	23.08 25.72

LONGITUDINAL SECTION: SWMH N11.1 - SWCP-N11.1.3.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 22

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2225

Rev.: C

DO NOT SCALE

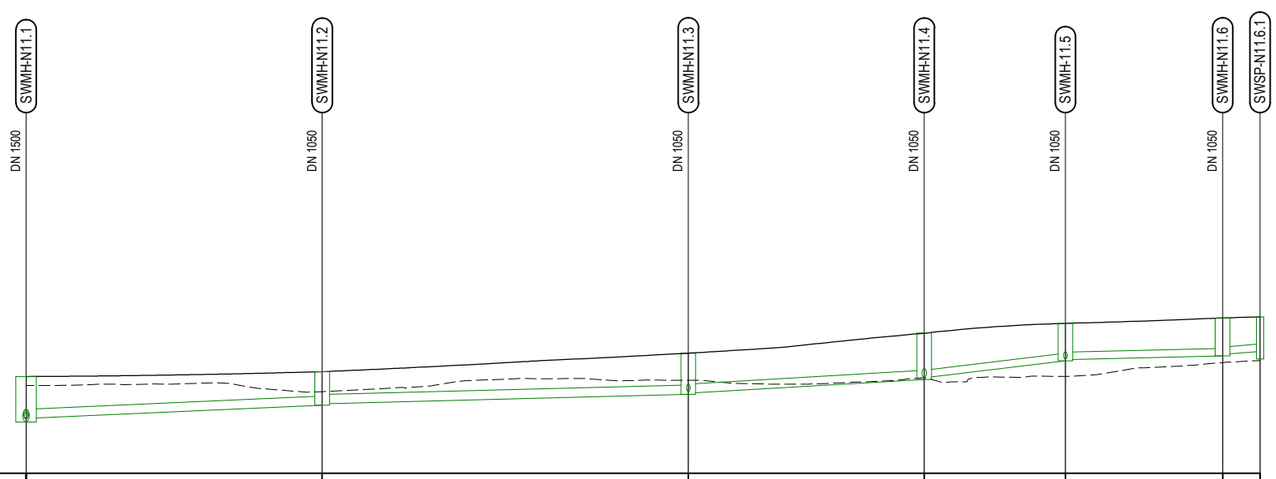
IF IN DOUBT ASK.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.

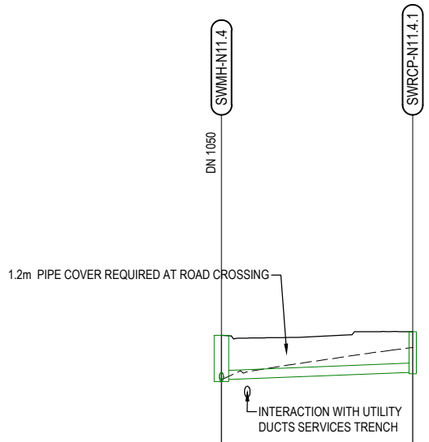


DATUM 40.00

LID LEVEL	43.94	44.13		44.88		45.71		46.10		46.32		46.37	
PIPE INVERT LEVEL	42.23	42.77	42.82	43.21	43.26	43.82	43.89	44.58	44.63	44.78	44.83	44.96	
DEPTH TO PIPE INVERT	1.67	1.33	1.27	1.64	1.59	1.85							
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		
PIPE GRADE	1:45 (2.24%)		1:78 (1.29%)		1:34 (2.92%)		1:17 (6.01%)		1:83 (1.21%)		1:25 (4.00%)		
DISTANCE AND CHAINAGE	0.00	24.15	24.15	29.85	54.00	19.24	73.24	11.51	84.74	12.82	97.57	3.04	100.61

LONGITUDINAL SECTION: SWMH-N11.1 - SWSP-N11.6.1

SCALE: HOR 1:250 VER 1:125



DATUM 40.00

LID LEVEL	45.71	45.85	
PIPE INVERT LEVEL	43.89	44.20	
DEPTH TO PIPE INVERT	1.78	1.62	
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		
PIPE GRADE	1:50 (2.00%)		
DISTANCE AND CHAINAGE	0.00	15.59	15.59

LONGITUDINAL SECTION: SWMH-N11.4 - SWRCP-N11.4.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 23

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2226

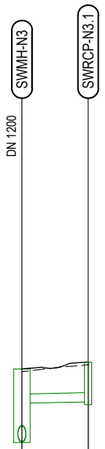
Rev.: C

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.

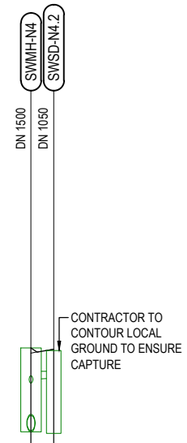


DATUM 40.00

LID LEVEL	43.65	43.93
PIPE INVERT LEVEL	42.26	42.32
DEPTH TO PIPE INVERT	1.36	1.57
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:95 (1.05%)	
DISTANCE AND CHAINAGE	0.00	5.40 5.40

LONGITUDINAL SECTION: SWMH-N3 - SWRCP-N3.1

SCALE: HOR 1:250 VER 1:125

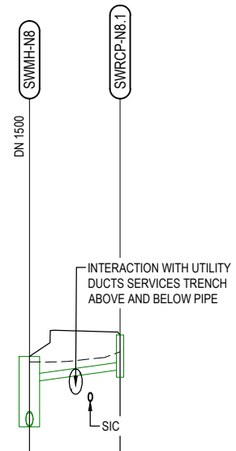


DATUM 40.00

LID LEVEL	44.20	44.10
PIPE INVERT LEVEL		42.93 42.96
DEPTH TO PIPE INVERT	1.23	1.16
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:85 (1.17%)	
DISTANCE AND CHAINAGE	0.00	1.85 1.85

LONGITUDINAL SECTION: SWMH-N4 - SWSD-N4.2

SCALE: HOR 1:250 VER 1:125



DATUM 40.00

LID LEVEL	44.18	45.06
PIPE INVERT LEVEL	43.13	43.64
DEPTH TO PIPE INVERT	1.02	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:14 (7.00%)	
DISTANCE AND CHAINAGE	0.00	7.39 7.39

LONGITUDINAL SECTION: SWMH-N8 - SWRCP-N8.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 24

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2227

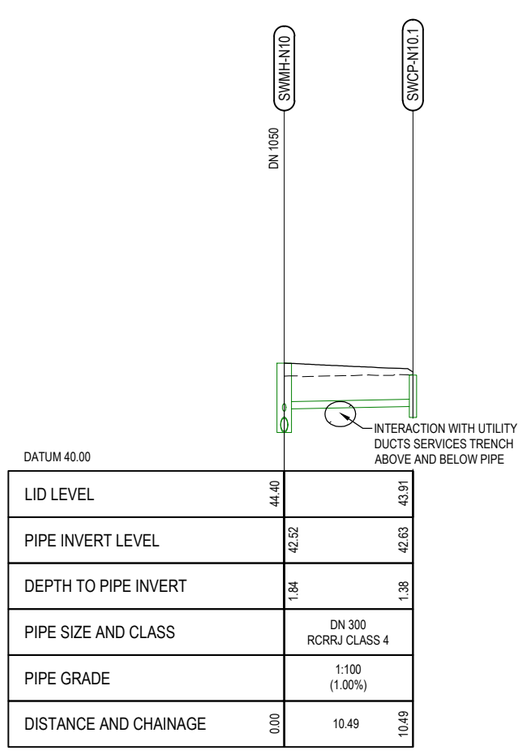
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

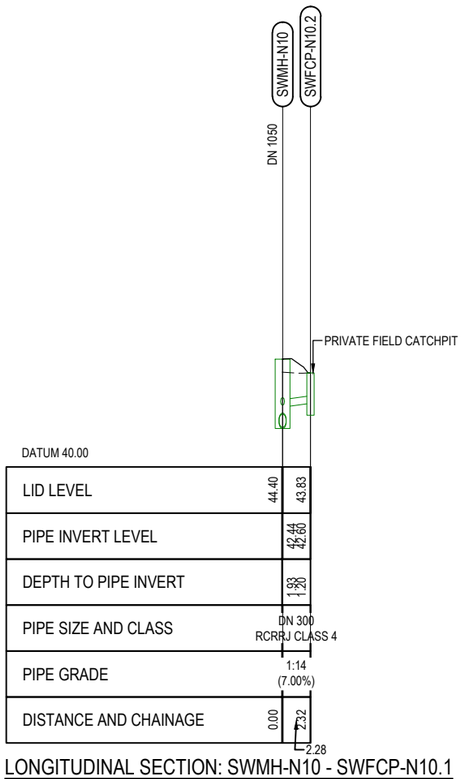
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



LID LEVEL	44.40	43.91
PIPE INVERT LEVEL	42.52	42.63
DEPTH TO PIPE INVERT	1.84	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	10.49

LONGITUDINAL SECTION: SWMH-N10 - SWCP-N10.1

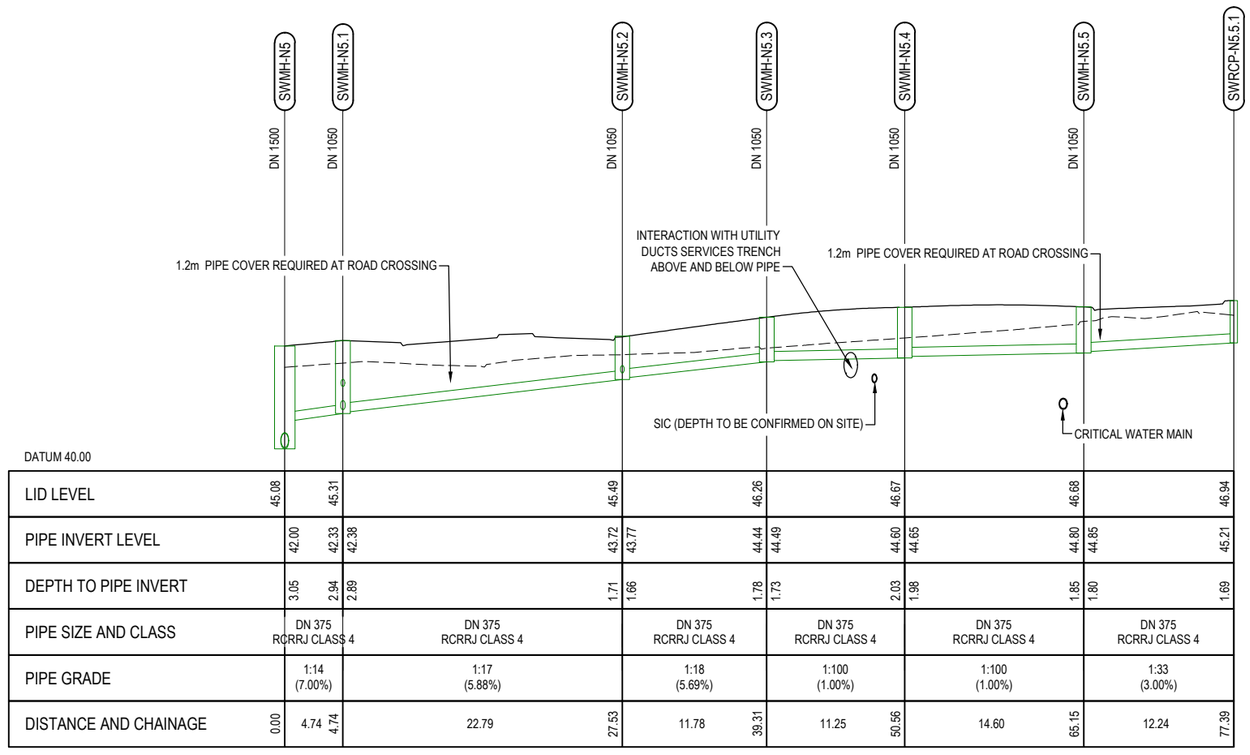
SCALE: HOR 1:250 VER 1:125



LID LEVEL	44.40	43.83
PIPE INVERT LEVEL	42.44	42.60
DEPTH TO PIPE INVERT	1.93	1.20
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:14 (7.00%)	
DISTANCE AND CHAINAGE	0.00	2.32

LONGITUDINAL SECTION: SWMH-N10 - SWFCP-N10.1

SCALE: HOR 1:250 VER 1:125



LID LEVEL	45.08	45.31	45.49	46.26	46.67	46.68	46.94	
PIPE INVERT LEVEL	42.00	42.33	42.38	43.72	43.77	44.44	44.49	44.60	44.65	44.80	44.85	45.21
DEPTH TO PIPE INVERT	3.05	2.94	2.89	1.71	1.66	1.78	1.73	2.03	1.98	1.85	1.80	1.69
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4			
PIPE GRADE	1:14 (7.00%)		1:17 (5.88%)		1:18 (5.69%)		1:100 (1.00%)		1:100 (1.00%)		1:33 (3.00%)	
DISTANCE AND CHAINAGE	0.00	4.74	4.74	22.79	27.53	11.78	39.31	11.25	50.56	14.60	65.15	12.24	77.39	

LONGITUDINAL SECTION: SWMH-N5 - SWRCP-N5.5.1

SCALE: HOR 1:250 VER 1:125

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 25

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2228

Rev. C

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

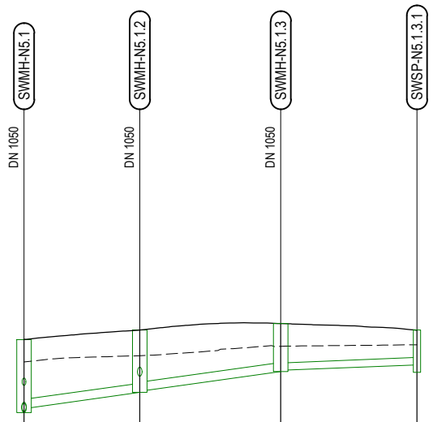
Document No. 3235084-CD-2220 TO 2239.DWG

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.

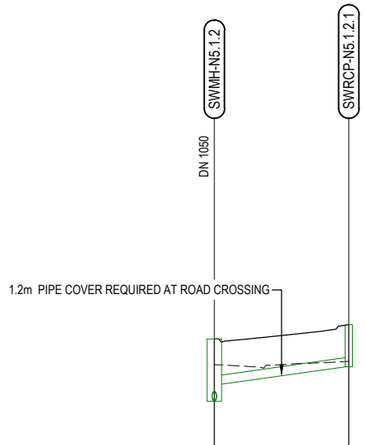


DATUM 40.00

LID LEVEL	45.31	45.69	45.96	45.69
PIPE INVERT LEVEL	42.49	43.15 / 43.20	44.00 / 44.05	44.27
DEPTH TO PIPE INVERT	2.78	2.51 / 2.46	1.92 / 1.88	1.38
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	DN 375 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE		1:14 (7.00%)	1:14 (7.00%)	1:50 (2.00%)
DISTANCE AND CHAINAGE	0.00	9.44 / 9.44	11.49 / 20.93	11.11 / 32.04

LONGITUDINAL SECTION: SWMH-N5.1 - SWSP-N5.1.3.1

SCALE: HOR 1:250 VER 1:125



DATUM 40.00

LID LEVEL	45.69	46.28	
PIPE INVERT LEVEL	43.81	44.57	
DEPTH TO PIPE INVERT	1.85	1.67	
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:14 (7.00%)	
DISTANCE AND CHAINAGE	0.00	10.96	10.96

LONGITUDINAL SECTION: SWMH-N5.1.2 - SWRCP-N5.1.2.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 26

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2229

Rev.: C

Document No. 3235084-CD-2220 TO 2239.DWG

www.beca.com

DO NOT SCALE

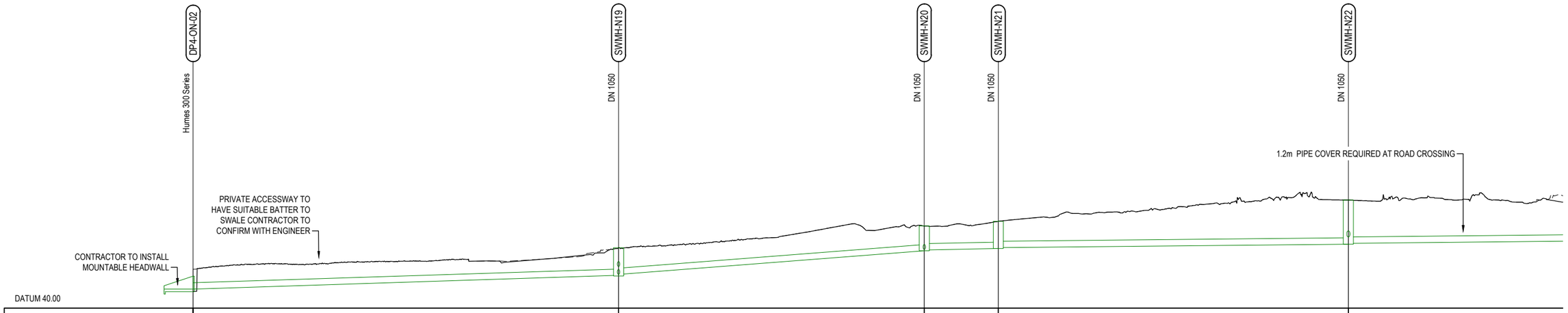
IF IN DOUBT ASK.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.



LID LEVEL	40.99	43.59	44.90	45.16	46.44	
PIPE INVERT LEVEL	41.13	41.95	42.00	43.41	43.46	43.55	43.60	43.81	43.86
DEPTH TO PIPE INVERT	-0.18	1.60	1.55	1.45	1.40	1.58	1.53	2.59	2.54
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4
PIPE GRADE	1:62 (1.62%)		1:26 (3.87%)		1:100 (1.00%)		1:200 (0.50%)		1:200 (0.50%)
DISTANCE AND CHAINAGE	0.00	50.69	50.69	36.42	87.12	8.81	95.93	41.71	137.64	27.70

LONGITUDINAL SECTION: DP4-ON(WEST)-02 - SWSP-N23.3

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 27

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2230

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

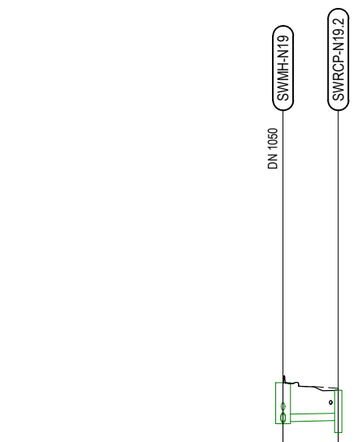
www.beca.com

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO Gas, Water, wastewater, existing stormwater and SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

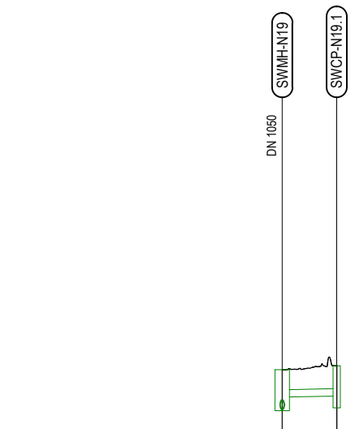
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



LID LEVEL	43.59	43.28
PIPE INVERT LEVEL	42.00	42.04
DEPTH TO PIPE INVERT	1.56	1.21
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	4.50

LONGITUDINAL SECTION: SWMH-N19 - SWCP-N19.2

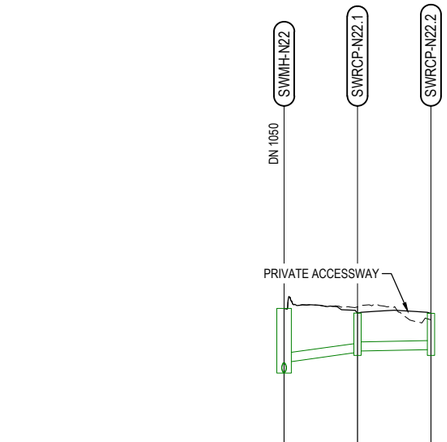
SCALE: HOR 1:250 VER 1:125



LID LEVEL	43.59	43.75
PIPE INVERT LEVEL	42.47	42.51
DEPTH TO PIPE INVERT	1.09	1.21
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	4.44

LONGITUDINAL SECTION: SWMH-N19 - SWCP-N19.1

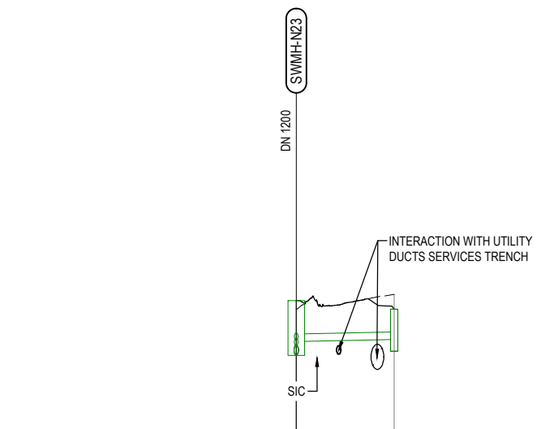
SCALE: HOR 1:250 VER 1:125



LID LEVEL	46.44	46.25	46.24
PIPE INVERT LEVEL	44.23	44.65	44.70	44.76
DEPTH TO PIPE INVERT	2.17	1.56	1.51	1.45
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:14 (7.00%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	5.98	5.99	11.98

LONGITUDINAL SECTION: SWMH-N22 - SWCP-N22.2

SCALE: HOR 1:250 VER 1:125



LID LEVEL	46.22	
PIPE INVERT LEVEL	44.57	44.64
DEPTH TO PIPE INVERT	1.63	1.21
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	165.34	7.98

LONGITUDINAL SECTION: SWMH-N23 - SWCP-N23.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 28

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2231

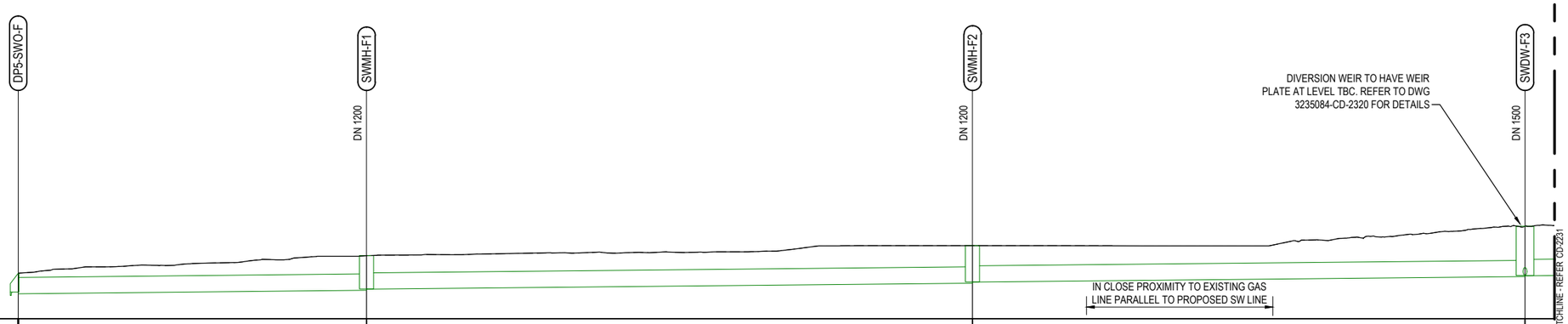
Rev.: C

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



DATUM 35.00

LID LEVEL	37.18							38.03										38.51					
PIPE INVERT LEVEL		36.26						36.43	36.48									36.77	36.82				
DEPTH TO PIPE INVERT		0.86						1.54	1.49									1.68	1.63				
PIPE SIZE AND CLASS		DN 675 RCRRJ CLASS 4							DN 675 RCRRJ CLASS 4										DN 675 RCRRJ CLASS 4				
PIPE GRADE		1:200 (0.50%)							1:200 (0.50%)										1:200 (0.50%)				
DISTANCE AND CHAINAGE	0.00							33.43	33.43									91.57					144.58

LONGITUDINAL SECTION: DP5-SWO-F - SWSD-F12.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd.	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 29

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2240 | Rev. C

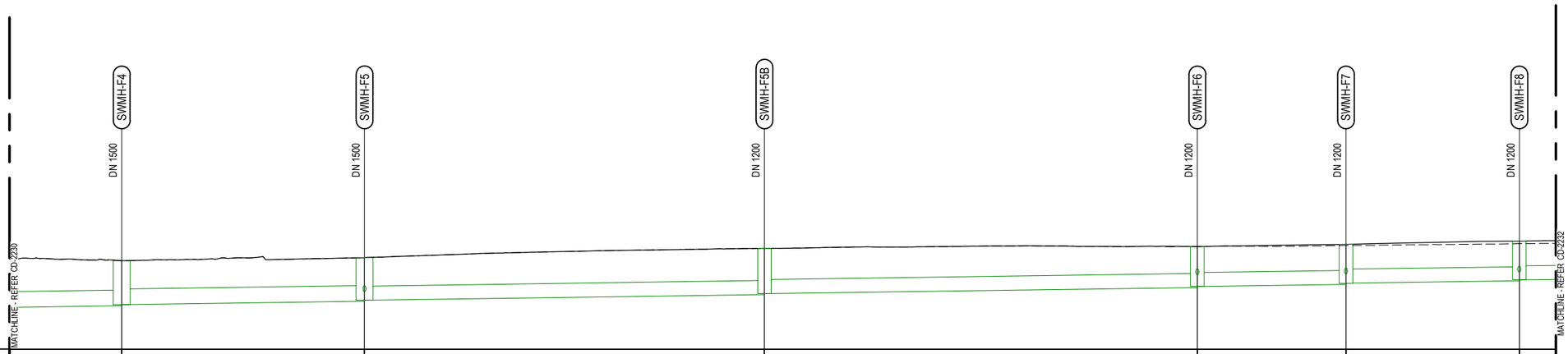
Document No. 3235084-CD-2240 TO 2259.DWG

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



DATUM 35.00

LID LEVEL	39.39	39.55		40.01		40.10		40.21		40.37			
PIPE INVERT LEVEL	37.22	37.27	37.44	37.49	37.77	37.82	38.12	38.17	38.27	38.33	38.45	38.50	
DEPTH TO PIPE INVERT	2.11	2.06	2.05	2.00	2.19	2.13	1.92	1.67	1.88	1.82	1.86	1.61	
PIPE SIZE AND CLASS	DN 675 RCRRJ CLASS 4		DN 675 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		
PIPE GRADE	1:143 (0.70%)		1:143 (0.70%)		1:143 (0.70%)		1:143 (0.70%)		1:143 (0.70%)		1:143 (0.70%)		
DISTANCE AND CHAINAGE	14.08	158.67	24.09	182.76	39.69	222.45	42.96	265.41	14.75	280.15	17.21	297.36	

LONGITUDINAL SECTION: DP5-SWO-F - SWSD-F12.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 30

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2241

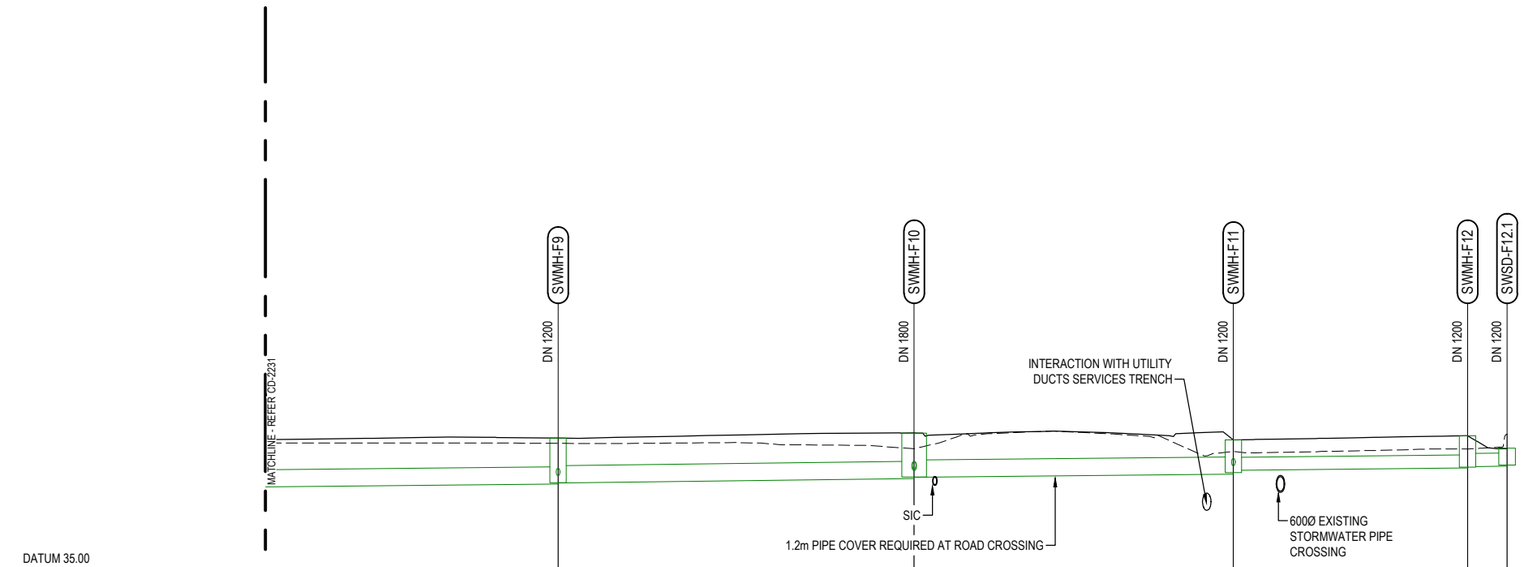
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

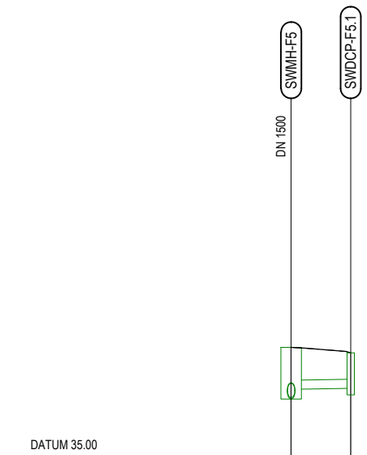
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 35.00					
LID LEVEL	40.45	40.66	40.38	40.55	40.04
PIPE INVERT LEVEL	38.63 / 38.68	38.86 / 38.91	39.04 / 39.18	39.27 / 39.33	39.35
DEPTH TO PIPE INVERT	1.76 / 1.71	1.75 / 1.69	1.28 / 1.16	1.23 / 1.18	0.63
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4	DN 600 RCRRJ CLASS 4	DN 600 RCRRJ CLASS 4	DN 450 RCRRJ CLASS 4	DN 450 RCRRJ CLASS 4
PIPE GRADE	1:200 (0.50%)	1:161 (0.62%)	1:200 (0.50%)	1:200 (0.50%)	1:200 (0.50%)
DISTANCE AND CHAINAGE	26.80 / 324.16	29.04 / 353.20	26.03 / 379.23	19.09 / 398.32	3.23 / 407.55

LONGITUDINAL SECTION: DP5-SWO-F - SWSD-F12.1

SCALE: HOR 1:250 VER 1:125



DATUM 35.00		
LID LEVEL	39.55	39.32
PIPE INVERT LEVEL	37.86	37.91
DEPTH TO PIPE INVERT	1.65	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00 / 4.85	4.85

LONGITUDINAL SECTION: SWMH-F5 - SWCP-F5.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 31

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2242

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

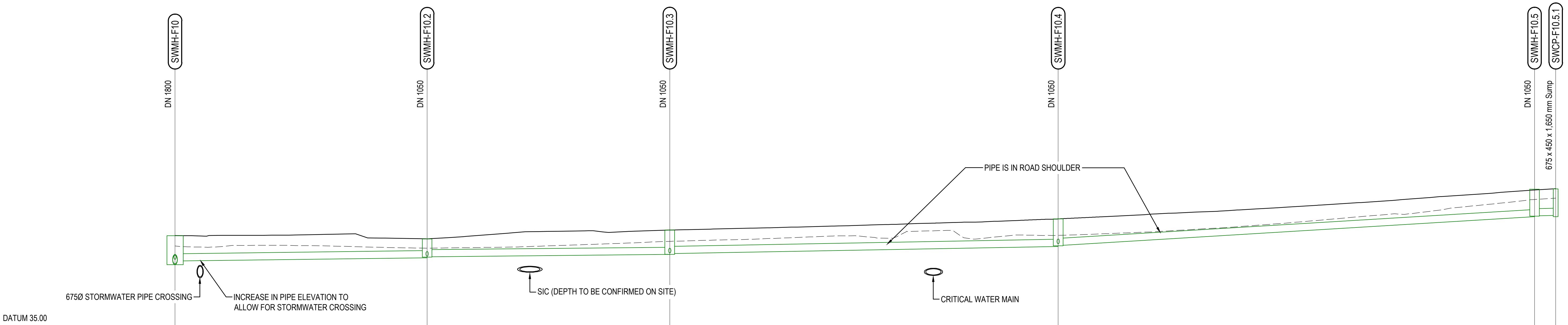
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 35.00

	SWMH-F10		SWMH-F10.2		SWMH-F10.3		SWMH-F10.4		SWMH-F10.5		SWCP-F10.5.1
LID LEVEL	40.66		40.46		41.00		41.69		43.52		43.55
PIPE INVERT LEVEL	39.12		39.33 / 39.38		39.53 / 39.58		40.03 / 40.08		41.86 / 41.91		41.94
DEPTH TO PIPE INVERT	1.50		1.09 / 1.04		1.43 / 1.38		1.63 / 1.58		1.63 / 1.58		1.58
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:151 (0.66%)		1:200 (0.50%)		1:107 (0.93%)		1:33 (3.03%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	353.20	31.11	31.11	29.94	61.05	47.93	108.98	58.79	167.76	2.77	170.38

LONGITUDINAL SECTION: SWMH-F10 - SWCP-F10.5.1

SCALE: HOR 1:250 VER 1:125

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 32

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2243 Rev. C

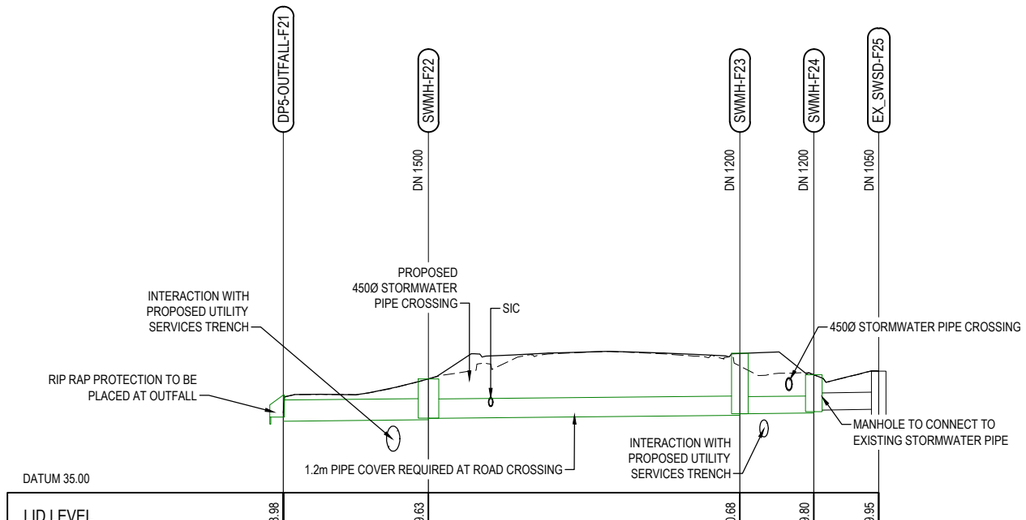
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

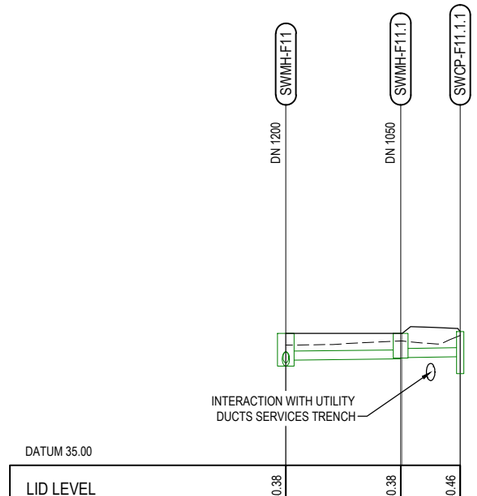
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 35.00										
LID LEVEL	38.98		39.63		40.68		39.80		39.95	
PIPE INVERT LEVEL	37.98	38.04	38.09	38.22	38.27	38.30	38.41	38.46		
DEPTH TO PIPE INVERT	0.21	1.52	1.48	2.39	2.35	1.45	1.34	1.43		
PIPE SIZE AND CLASS	DN 750 RCRRJ CLASS 4		DN 675 RCRRJ CLASS 4			DN 600 RCRRJ CLASS 4		DN 600 RRJ CLASS 4		
PIPE GRADE	1:200 (0.50%)		1:200 (0.50%)			1:200 (0.50%)		1:100 (1.00%)		
DISTANCE AND CHAINAGE	0.00	11.83	11.83	25.40	37.23	6.03	43.26	5.29	48.55	

LONGITUDINAL SECTION: DP5-OUTFALL-F21 - EX_SWSD-F26

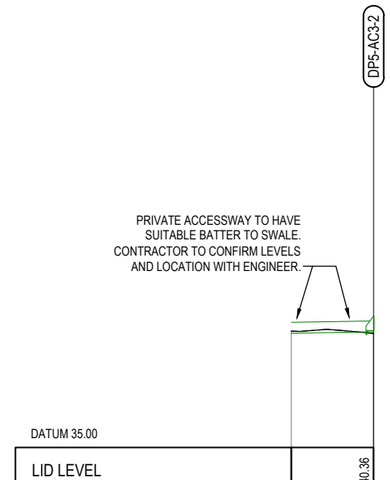
SCALE: HOR 1:250 VER 1:125



DATUM 35.00						
LID LEVEL	40.38		40.38		40.46	
PIPE INVERT LEVEL	39.32	39.37	39.42	39.47		
DEPTH TO PIPE INVERT			0.96	0.96		
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4			
PIPE GRADE	1:200 (0.50%)		1:100 (1.00%)			
DISTANCE AND CHAINAGE	0.00	9.36	379.23	4.64	14.20	

LONGITUDINAL SECTION: SWMH-F11 - SWCP-F11.1.1

SCALE: HOR 1:250 VER 1:125



DATUM 35.00			
LID LEVEL		40.36	
PIPE INVERT LEVEL	39.69	39.75	
DEPTH TO PIPE INVERT	0.02	-0.14	
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4		
PIPE GRADE	1:113 (0.89%)		
DISTANCE AND CHAINAGE	6.76	6.71	

LONGITUDINAL SECTION_ DP5-AC3

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 33

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2244

Rev.: C

Document No. 3235084-CD-2240 TO 2259.DWG

DO NOT SCALE

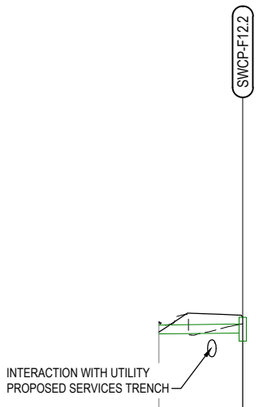
IF IN DOUBT ASK.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

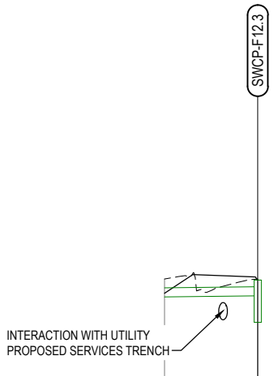


DATUM 35.00

LID LEVEL		40.72
PIPE INVERT LEVEL	40.08	40.11
DEPTH TO PIPE INVERT	0.01	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	6.84	6.84

LONGITUDINAL SECTION: SWO-F12.2 - SWCP-F12.2

SCALE: HOR 1:250 VER 1:125

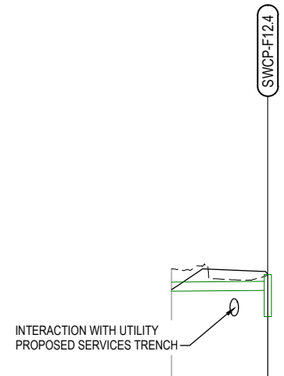


DATUM 35.00

LID LEVEL		40.95
PIPE INVERT LEVEL	40.30	40.34
DEPTH TO PIPE INVERT	0.08	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.60	7.60

LONGITUDINAL SECTION: SWO-F12.3 - SWCP-F12.3

SCALE: HOR 1:250 VER 1:125



DATUM 35.00

LID LEVEL		41.18
PIPE INVERT LEVEL	40.53	40.57
DEPTH TO PIPE INVERT	0.00	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.84	7.84

LONGITUDINAL SECTION: SWO-F12.4 - SWCP-F12.4

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 34

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2245

Rev.: C

Document No. 3235084-CD-2240 TO 2259.DWG

www.beca.com

DO NOT SCALE

IF IN DOUBT ASK.

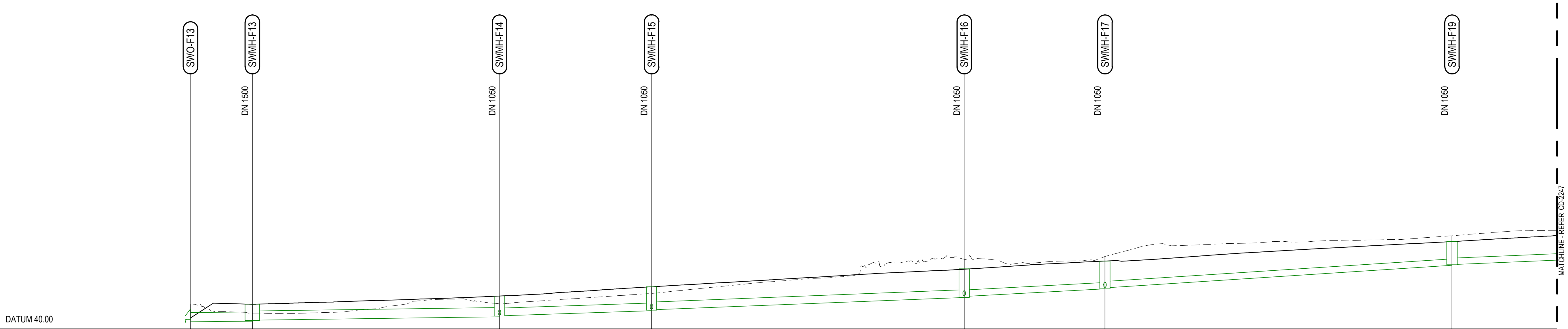
Drawing Plotted: 03 Nov 2022 1:47 pm

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.



	SWO-F13		SWMH-F13		SWMH-F14		SWMH-F15		SWMH-F16		SWMH-F17		SWMH-F19	
LID LEVEL	41.16		41.43		41.90		42.43		43.47		43.92		45.04	
PIPE INVERT LEVEL	40.46		40.50 40.55		40.75 40.80		41.09 41.14		41.86 41.91		42.35 42.40		43.70 43.75	
DEPTH TO PIPE INVERT	0.13		0.89 0.84		1.11 1.07		1.31 1.25		1.55 1.50		1.53 1.48		1.31 1.26	
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLAS
PIPE GRADE		1:200 (0.50%)		1:139 (0.72%)		1:60 (1.66%)		1:50 (1.99%)		1:37 (2.71%)		1:31 (3.26%)		1:48 (2.07%)
DISTANCE AND CHAINAGE	0.00	7.12	7.12	28.41	35.52	17.47	52.99	35.94	88.94	16.17	105.11	39.88	144.99	19.47

LONGITUDINAL SECTION: SWO-F13 - SWCP-F20.1

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 35

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2246 Rev. C

Document No. 3235084-CD-2240 TO 2259.DWG

DO NOT SCALE

IF IN DOUBT ASK.

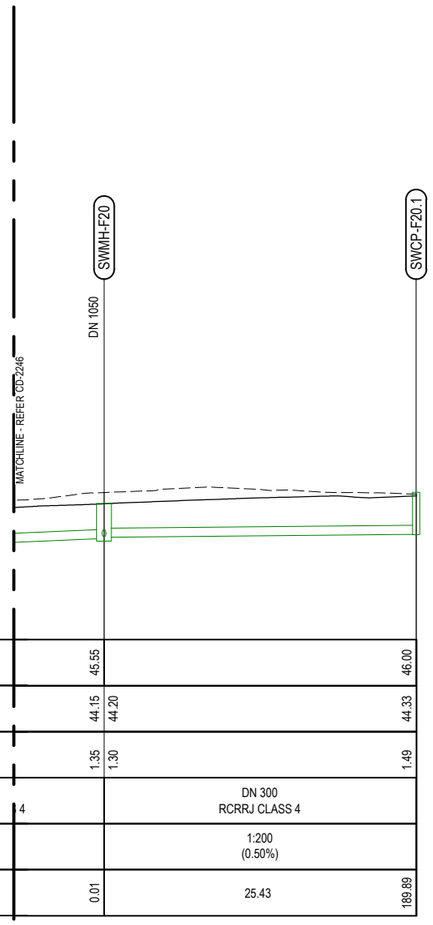
Drawing Plotted: 03 Nov 2022 1:51 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 40.00				
LID LEVEL	45.55			46.00
PIPE INVERT LEVEL	44.15	44.20		44.33
DEPTH TO PIPE INVERT	1.35	1.30		1.49
PIPE SIZE AND CLASS	4	DN 300 RCRRJ CLASS 4		
PIPE GRADE		1:200 (0.50%)		
DISTANCE AND CHAINAGE	0.01	25.43		189.89

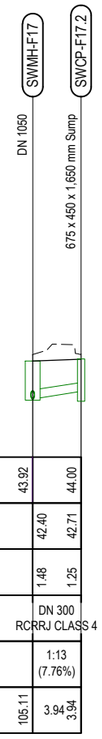
LONGITUDINAL SECTION: SWO-F13 - SWCP-F20.1

SCALE: HOR 1:250 VER 1:125

DATUM 40.00				
LID LEVEL	41.90	41.76		
PIPE INVERT LEVEL	40.80	40.81		
DEPTH TO PIPE INVERT	1.07	0.92		
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4			
PIPE GRADE	1:100 (1.00%)			
DISTANCE AND CHAINAGE	0.00	1.30	1.17	

LONGITUDINAL SECTION: SWMH-F14 - SWCP-F14.1

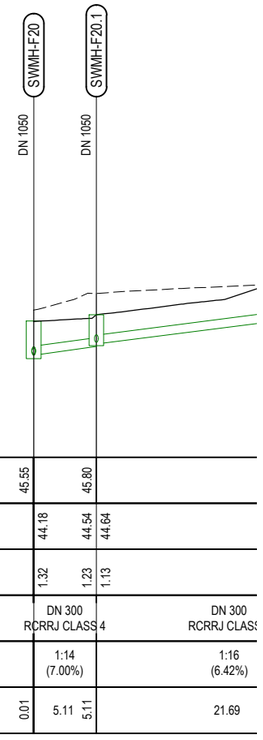
SCALE: HOR 1:250 VER 1:125



DATUM 40.00			
LID LEVEL	43.92		44.00
PIPE INVERT LEVEL		42.40	42.71
DEPTH TO PIPE INVERT		1.48	1.25
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:13 (7.76%)	
DISTANCE AND CHAINAGE	105.11	3.94	3.94

LONGITUDINAL SECTION: SWMH-F17 - SWSD-F17.2

SCALE: HOR 1:250 VER 1:125



DATUM 40.00				
LID LEVEL	45.55		45.80	
PIPE INVERT LEVEL		44.18	44.54	44.64
DEPTH TO PIPE INVERT		1.32	1.23	1.13
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS
PIPE GRADE		1:14 (7.00%)		1:16 (6.42%)
DISTANCE AND CHAINAGE	0.01	5.11	5.11	21.69

LONGITUDINAL SECTION: SWMH-F20 - SWSD-F20.2.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 36

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2247

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

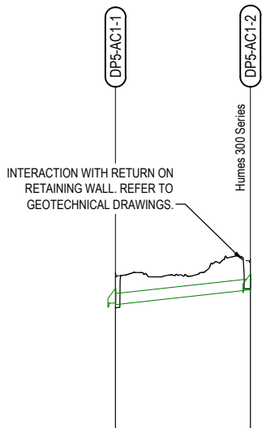
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

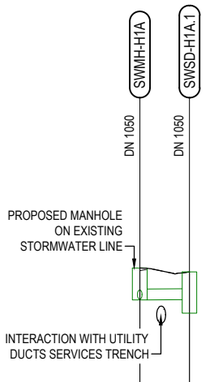
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 35.00		
LID LEVEL	41.48	42.07
PIPE INVERT LEVEL	40.86	41.46
DEPTH TO PIPE INVERT	-0.21	-0.02
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:18 (5.50%)	
DISTANCE AND CHAINAGE	0.00	10.99

LONGITUDINAL SECTION_ DP5-AC1

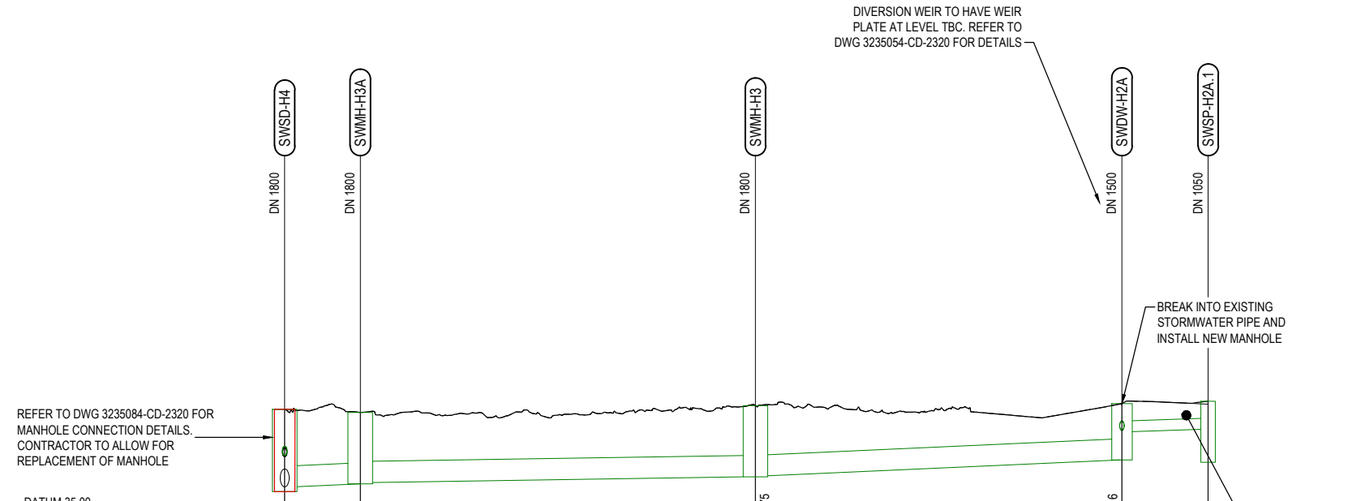
SCALE: HOR 1:250 VER 1:125



DATUM 35.00		
LID LEVEL	40.25	40.09
PIPE INVERT LEVEL	38.58	39.00
DEPTH TO PIPE INVERT	1.23	1.06
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:267 (0.37%)	
DISTANCE AND CHAINAGE	0.00	4.05

LONGITUDINAL SECTION: SWMH-H1A - SWSD-H1A.1

SCALE: HOR 1:250 VER 1:125



DATUM 35.00					
LID LEVEL	39.35	39.22	39.50	39.58	39.67
PIPE INVERT LEVEL	36.24	36.38	36.43	36.68	37.35	38.46	38.58
DEPTH TO PIPE INVERT	3.04	2.77	2.72	2.76	2.75	2.16	1.09	1.06
PIPE SIZE AND CLASS	DN 750 RCRRJ CLASS 4		DN 750 RCRRJ CLASS 4		DN 750 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:45 (2.22%)		1:130 (0.77%)		1:44 (2.25%)		1:57 (1.75%)	
DISTANCE AND CHAINAGE	0.00	6.16	6.16	38.39	38.39	68.28	68.28	75.31

LONGITUDINAL SECTION: SWSD-H4 - SWCP-H2A.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21	
	Dsg Verifier			
	Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 37

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2248

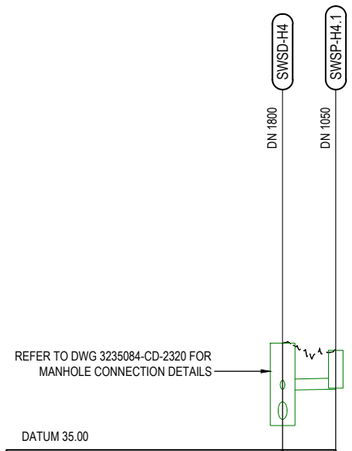
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

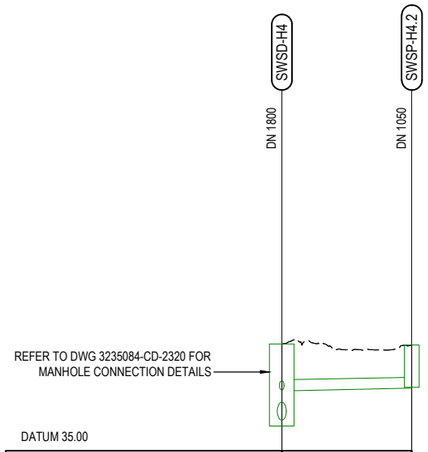


DATUM 35.00

LID LEVEL	39.35	39.07
PIPE INVERT LEVEL	37.47	37.52
DEPTH TO PIPE INVERT	1.84	1.52
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:93 (1.08%)	
DISTANCE AND CHAINAGE	0.00	4.33 4.33

LONGITUDINAL SECTION: SWSD-H4 - SWSP-H4.1

SCALE: HOR 1:250 VER 1:125

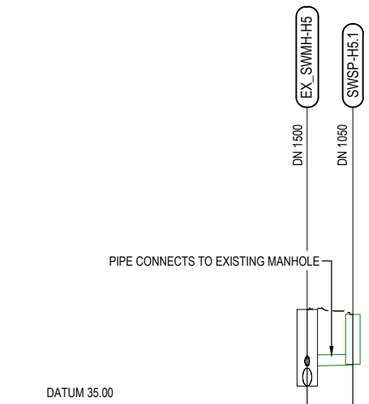


DATUM 35.00

LID LEVEL	39.35	39.30
PIPE INVERT LEVEL	37.47	37.58
DEPTH TO PIPE INVERT	1.84	1.69
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	10.60 10.60

LONGITUDINAL SECTION: SWSD-H4 - SWSP-H4.2

SCALE: HOR 1:250 VER 1:125

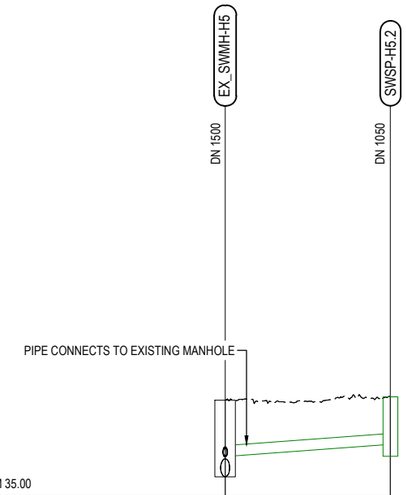


DATUM 35.00

LID LEVEL	38.94	38.74
PIPE INVERT LEVEL	36.68	36.72
DEPTH TO PIPE INVERT	2.23	1.99
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	3.72 3.72

LONGITUDINAL SECTION: EX_SWMH-H5 - SWSP-H5.1

SCALE: HOR 1:250 VER 1:125



DATUM 35.00

LID LEVEL	38.94	39.08
PIPE INVERT LEVEL	36.68	37.19
DEPTH TO PIPE INVERT	2.22	1.86
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:27 (3.75%)	
DISTANCE AND CHAINAGE	0.00	13.47 13.47

LONGITUDINAL SECTION: EX_SWMH-H5 - SWSP-H5.2

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 38

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2249

Rev.: C

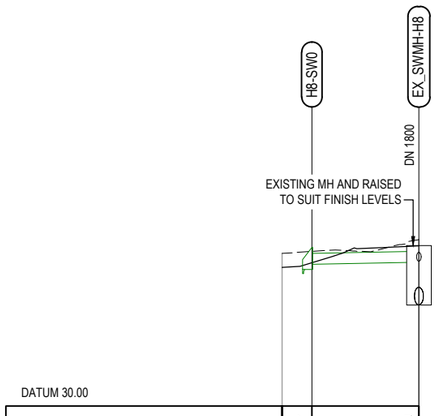
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

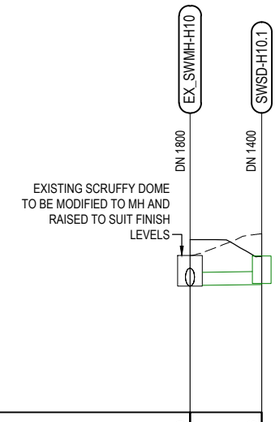
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 30.00				
LID LEVEL	36.47			36.54
PIPE INVERT LEVEL		35.81		35.90
DEPTH TO PIPE INVERT		0.00		0.59
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4		
PIPE GRADE		1:100 (1.00%)		
DISTANCE AND CHAINAGE	0.00	8.73		8.73

LONGITUDINAL SECTION: SWO-H8 - EX_SWMH-H8

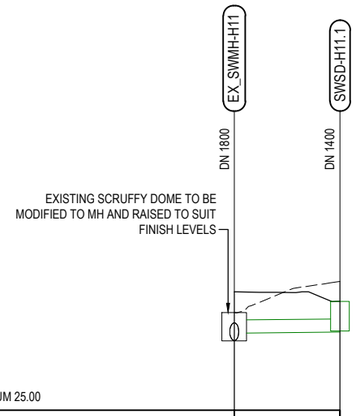
SCALE: HOR 1:250 VER 1:125



DATUM 25.00				
LID LEVEL	31.39			31.36
PIPE INVERT LEVEL		30.20		30.24
DEPTH TO PIPE INVERT		1.80		1.06
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4		
PIPE GRADE		1:132 (0.76%)		
DISTANCE AND CHAINAGE	0.00	5.84		5.84

LONGITUDINAL SECTION: EX_SWMH-H10 - SWSD-H10.1

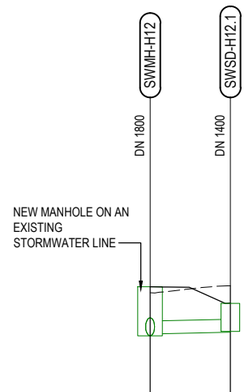
SCALE: HOR 1:250 VER 1:125



DATUM 25.00				
LID LEVEL	28.98			29.43
PIPE INVERT LEVEL		28.19		28.23
DEPTH TO PIPE INVERT		1.60		1.17
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4		
PIPE GRADE		1:215 (0.46%)		
DISTANCE AND CHAINAGE	0.00	8.62		8.62

LONGITUDINAL SECTION: EX-SWMH-H11 - SWSD-H11.1

SCALE: HOR 1:250 VER 1:125



DATUM 25.00				
LID LEVEL	29.48			28.80
PIPE INVERT LEVEL		27.59		27.66
DEPTH TO PIPE INVERT		1.85		1.10
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4		
PIPE GRADE		1:93 (1.07%)		
DISTANCE AND CHAINAGE	0.00	6.54		6.54

LONGITUDINAL SECTION: SWMH-H12 - SWSD-H12.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 39

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2250 Rev.: C

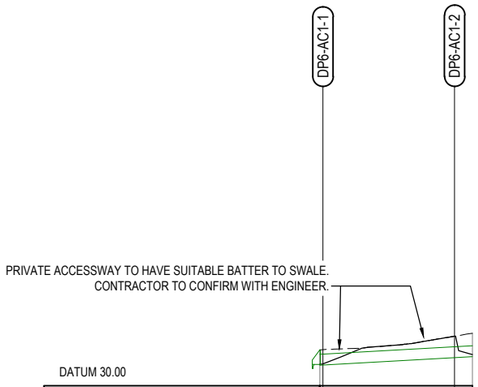
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

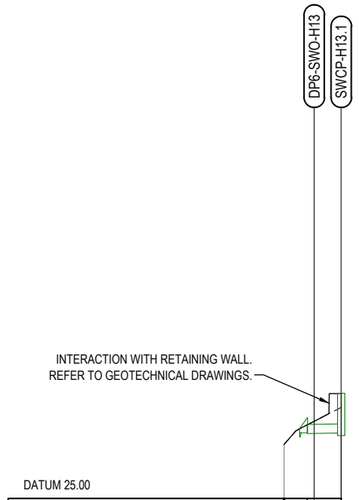


DATUM 30.00

LID LEVEL	31.46	31.79
PIPE INVERT LEVEL	30.87	31.22
DEPTH TO PIPE INVERT		
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:36 (2.81%)	
DISTANCE AND CHAINAGE 0.00	12.45	12.45

LONGITUDINAL SECTION_ DP6-AC1

SCALE: HOR 1:250 VER 1:125

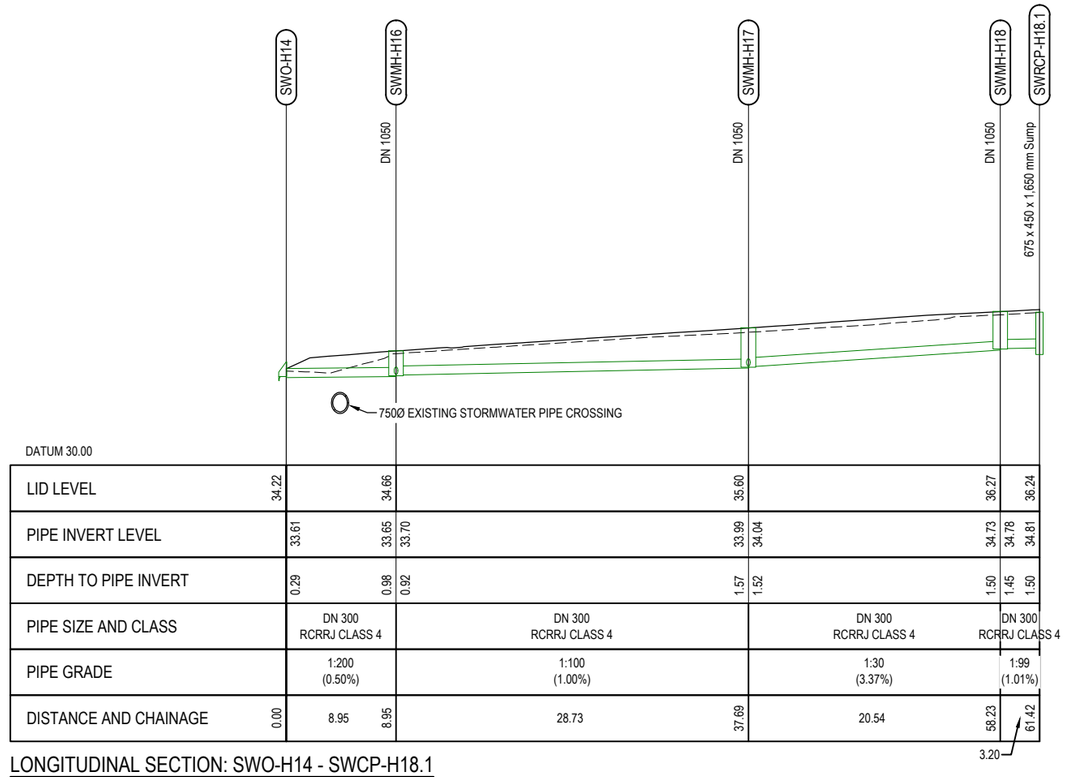


DATUM 25.00

LID LEVEL	28.28	29.28
PIPE INVERT LEVEL	27.68	27.70
DEPTH TO PIPE INVERT	0.29	1.55
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE 1.88	4.64	2.77

LONGITUDINAL SECTION: DP6-SWO-H13.1 - SWCP-H13.1

SCALE: HOR 1:250 VER 1:125



DATUM 30.00

LID LEVEL	34.22	34.66	35.60	36.27	36.24
PIPE INVERT LEVEL	33.61	33.65	33.70 / 33.99	34.04 / 34.73	34.78 / 34.81
DEPTH TO PIPE INVERT	0.29	0.98	0.92 / 1.57	1.52 / 1.50	1.45 / 1.50
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE	1:200 (0.50%)		1:100 (1.00%)	1:30 (3.37%)	1:99 (1.01%)
DISTANCE AND CHAINAGE 0.00	8.95	8.95	28.73 / 37.69	20.54	58.23 / 61.42

3.20

LONGITUDINAL SECTION: SWO-H14 - SWCP-H18.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 40

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2251 Rev. C

Document No. 3235084-CD-2240 TO 2259.DWG

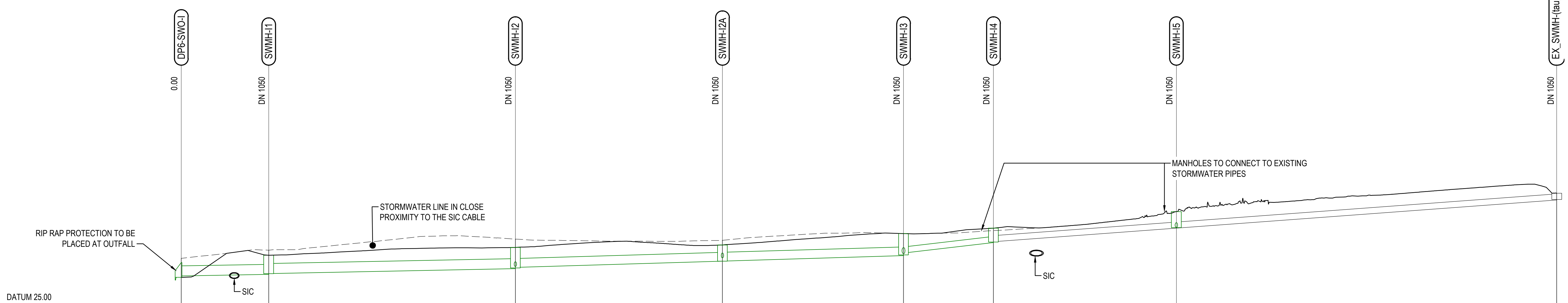
Drawing Plotted: 03 Nov 2022 2:07 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



	DP6-SWO-I		SWMH-I1		SWMH-I2		SWMH-I2A		SWMH-I3		SWMH-I4		SWMH-I5		EX_SWMH-(taupaki)-17B
LID LEVEL	27.67		28.11		28.59		28.74		29.43		29.76		30.77		31.89
PIPE INVERT LEVEL	26.90		26.99 / 27.04		27.34 / 27.42		27.80 / 27.80		28.13 / 28.28		28.92 / 28.97		29.80 / 29.80		31.51
DEPTH TO PIPE INVERT	-0.19		1.07 / 1.02		1.20 / 1.13		0.90 / 0.90		1.26 / 1.12		0.81		0.94		0.35
PIPE SIZE AND CLASS		DN 525 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 450 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:114 (0.88%)		1:100 (1.00%)		1:66 (1.51%)		1:67 (1.50%)		1:17 (5.87%)		1:27 (3.70%)		1:27 (3.70%)	
DISTANCE AND CHAINAGE	0.00	10.64	10.64	30.01	40.65	25.19	65.85	22.04	87.88	10.94	98.82	22.26	121.08	46.28	167.36

LONGITUDINAL SECTION: DP6-SWO-I1 - EX_SWMH(taupaki)-17B

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dwg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 41

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2252 Rev.: C

Document No. 3235084-CD-2240 TO 2259.DWG

DO NOT SCALE

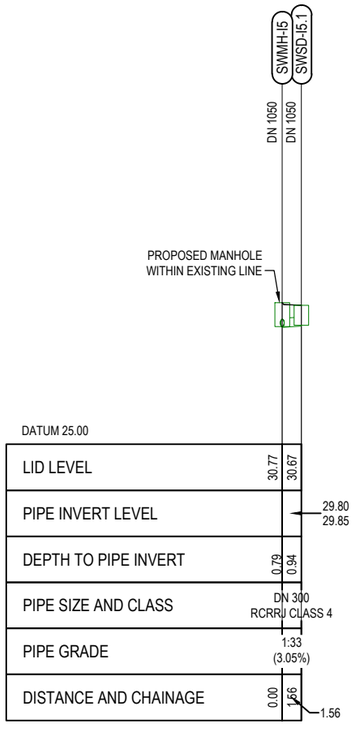
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

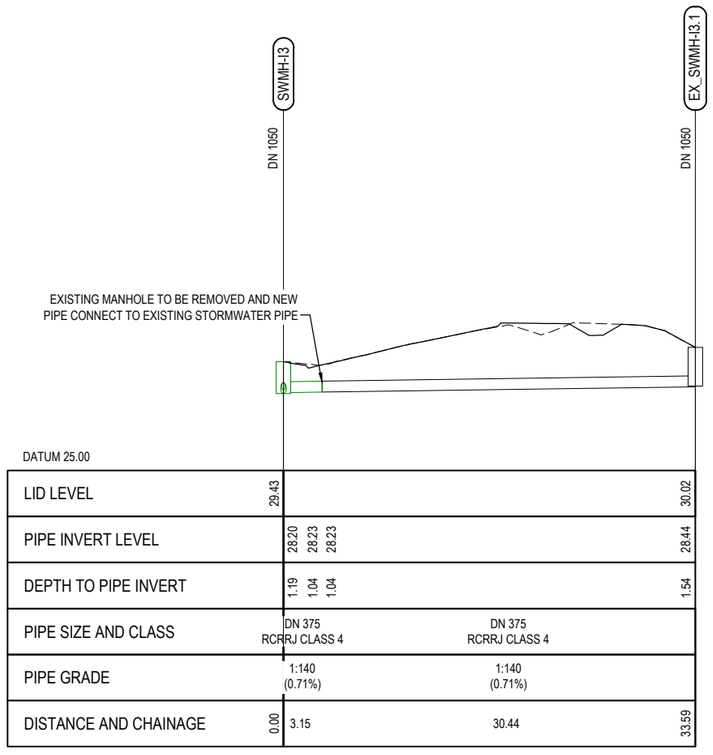
LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



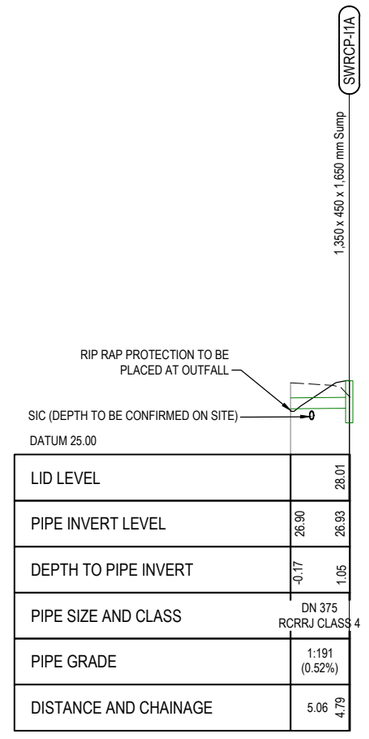
LONGITUDINAL SECTION: SWMH-I5 - SWSD-I5.1

SCALE: HOR 1:250 VER 1:125



LONGITUDINAL SECTION: SWMH-I3 - EX_SWMH-I3.1

SCALE: HOR 1:250 VER 1:125



LONGITUDINAL SECTION: DP6-OUTFALL-I - SWCP-I1A

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 42

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2253

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

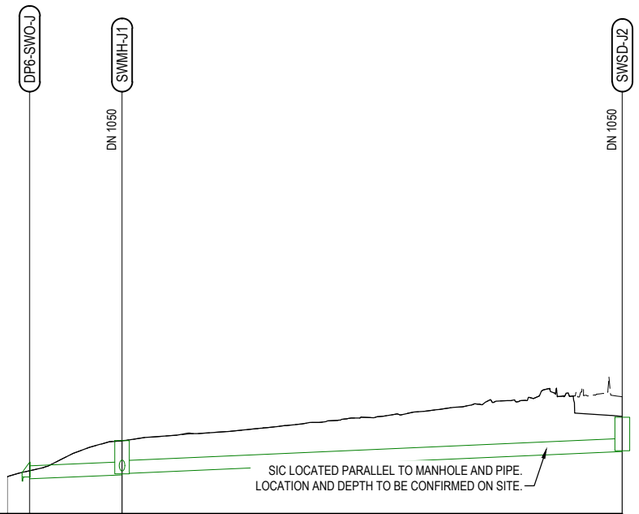
Document No. 3235084-CD-2240 TO 2259.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

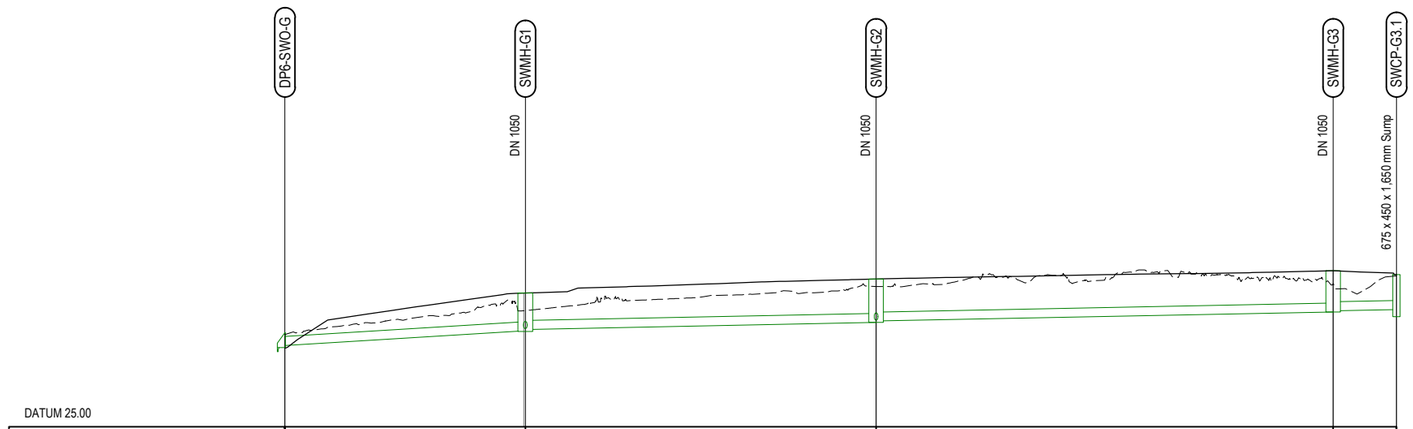
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00				
LID LEVEL	27.10	27.97	28.93	
PIPE INVERT LEVEL	26.45	26.62	26.67	27.56
DEPTH TO PIPE INVERT			1.26	1.35
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4	DN 450 RCRRJ CLASS 4	
PIPE GRADE		1:45 (2.20%)	1:45 (2.21%)	
DISTANCE AND CHAINAGE	1.79	7.54 9.33	40.78	50.11

LONGITUDINAL SECTION: DP6-SWO-J - SWSD-J2

SCALE: HOR 1:250 VER 1:125



DATUM 25.00					
LID LEVEL	28.83	30.45	31.03	31.36	31.21
PIPE INVERT LEVEL	28.35	28.95	29.00 29.29	29.34 29.71	29.76 29.81
DEPTH TO PIPE INVERT	-0.18	1.47	1.42 1.70	1.65 1.62	1.57 1.38
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE		1:33 (3.08%)	1:100 (1.00%)	1:102 (0.98%)	1:100 (1.00%)
DISTANCE AND CHAINAGE	0.00	19.62 19.60	28.60 48.20	37.27 85.47	5.16 90.63

LONGITUDINAL SECTION: DP6-SWO-G - SWCP-G3.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
	Drawn	M. SERATHIUK	26.03.21
Reduced Scale (A3) HALF SHOWN	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 43

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2254

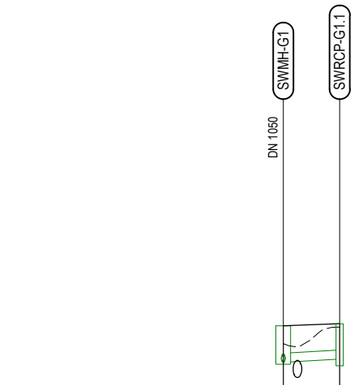
Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

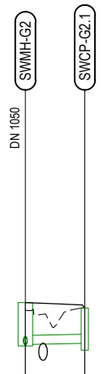
Document No. 3235084-CD-2240 TO 2259.DWG



DATUM 25.00		
LID LEVEL	30.45	30.54
PIPE INVERT LEVEL	29.00	29.13
DEPTH TO PIPE INVERT	1.42	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:35 (2.87%)	
DISTANCE AND CHAINAGE	0.00	4.59 4.59

LONGTTUDINAL SECTION: SWMH-G1 - SWCP-G1.1

SCALE: HOR 1:250 VER 1:125



DATUM 25.00		
LID LEVEL	31.03	30.80
PIPE INVERT LEVEL	29.34	29.39
DEPTH TO PIPE INVERT	1.65	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	4.85 4.85

LONGITUDINAL SECTION: SWMH-G2 - SWCP-G.2.1

SCALE: HOR 1:250 VER 1:125

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 44

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2255

Rev.: C

Document No. 3235084-CD-2240 TO 2259.DWG

DO NOT SCALE

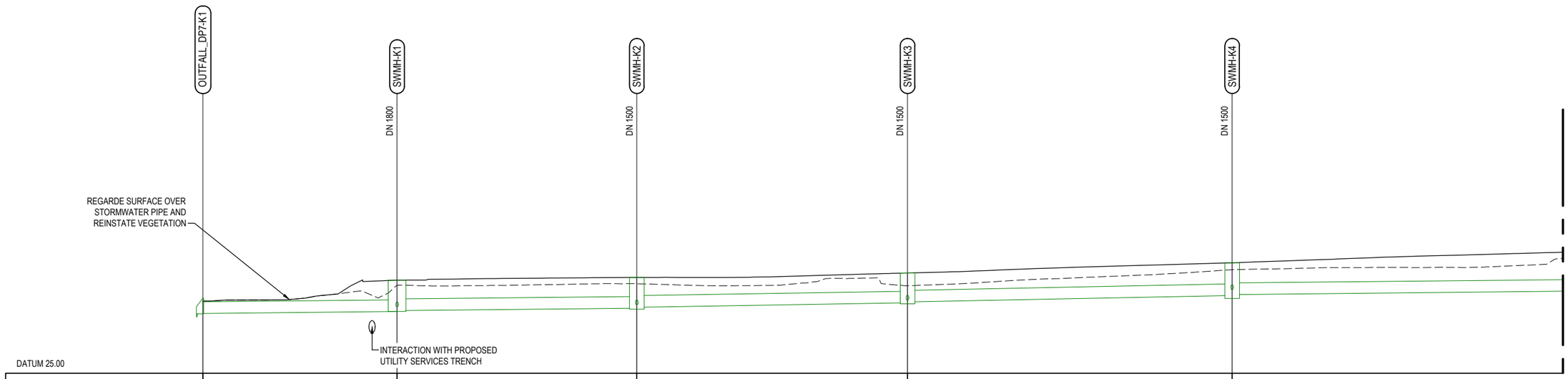
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00

LID LEVEL	29.28		30.30		30.46		30.71		31.30												
PIPE INVERT LEVEL	28.41		28.52	28.57		28.71	28.76		29.01	29.06		29.43	29.48								
DEPTH TO PIPE INVERT	0.64		1.73	1.67		1.69	1.63		1.64	1.59		1.81	1.75								
PIPE SIZE AND CLASS	DN 675 RCRRJ CLASS 4			DN 675 RCRRJ CLASS 4			DN 675 RCRRJ CLASS 4			DN 675 RCRRJ CLASS 4				DN 675 RCRRJ CLASS 4							
PIPE GRADE	1:200 (0.50%)			1:200 (0.50%)			1:125 (0.80%)			1:100 (1.00%)				1:200 (0.50%)							
DISTANCE AND CHAINAGE	0.00	22.14		22.14	27.34		49.48	30.87		80.35	37.02		117.37	51.23							

LONGITUDINAL SECTION: OUTFALL_DP7-K1 - SWCP-K11.2

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 45

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2260 Rev.: C

Document No. 3235084-CD-2260 TO 2279.DWG

DO NOT SCALE

IF IN DOUBT ASK.

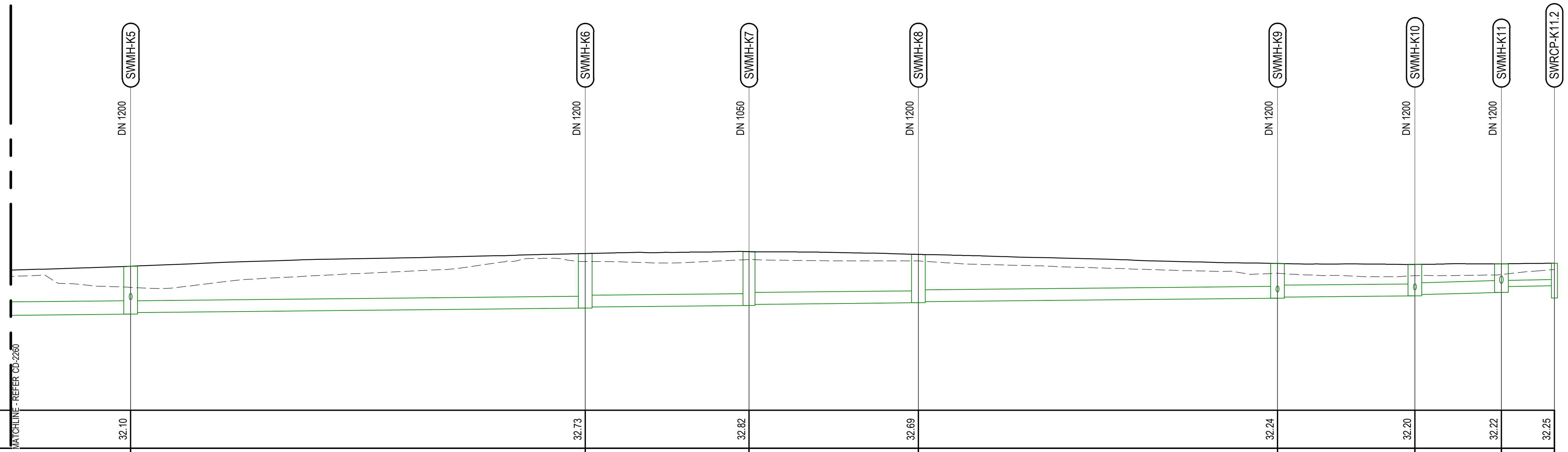
Drawing Plotted: 03 Nov 2022 3:22 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00

	SWMH-K5		SWMH-K6		SWMH-K7		SWMH-K8		SWMH-K9		SWMH-K10		SWMH-K11		SWRCP-K11.2
LID LEVEL	32.10		32.73		32.82		32.69		32.24		32.20		32.22		32.25
PIPE INVERT LEVEL	29.74 29.82		30.04 30.09		30.17 30.22		30.30 30.35		30.53 30.58		30.65 30.70		30.81 31.10		31.15
DEPTH TO PIPE INVERT	2.30 2.23		2.64 2.59		2.60 2.54		2.33 2.28		1.65 1.60		1.50 1.45		1.35 1.09		1.07
PIPE SIZE AND CLASS		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:202 (0.50%)		1:200 (0.50%)		1:200 (0.50%)		1:200 (0.50%)		1:200 (0.50%)		1:73 (1.37%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	168.60	44.82	213.42	16.15	229.57	16.70	246.27	35.40	281.67	13.55	295.22	8.52	303.74	5.22	308.96

LONGITUDINAL SECTION: OUTFALL_DP7-K1 - SWCP-K11.2

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction*
Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 46

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2261 Rev. C

Document No. 3235084-CD-2260 TO 2279.DWG

DO NOT SCALE

IF IN DOUBT ASK.

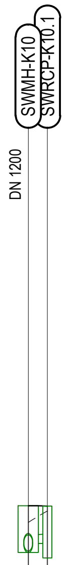
Drawing Plotted: 03 Nov 2022 3:23 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

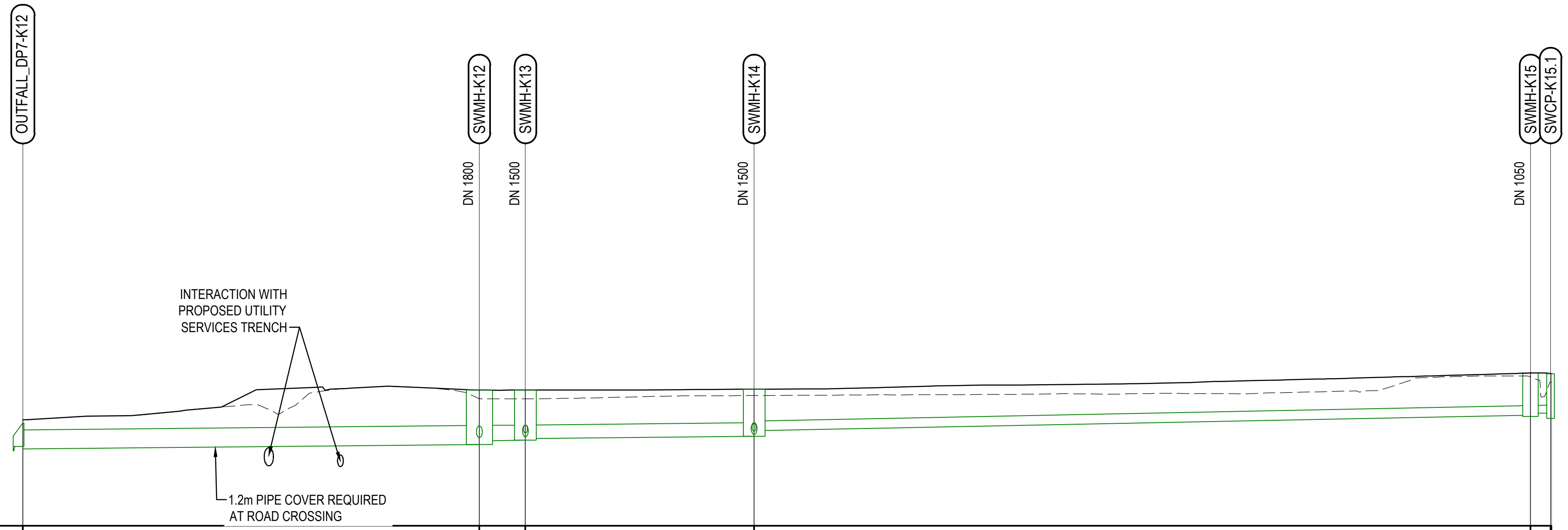


DATUM 30.00

	SWMH-K10	SWCP-K10.1	
LID LEVEL	32.20	32.19	
PIPE INVERT LEVEL			30.94 / 30.95
DEPTH TO PIPE INVERT	1.23	1.21	
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4		
PIPE GRADE	1:121 (0.82%)		
DISTANCE AND CHAINAGE	0.00	1.26	1.26

LONGITUDINAL SECTION: SWMH-K10 - SWCP-K10.1

SCALE: HOR 1:250 VER 1:125



DATUM 25.00

	OUTFALL_DP7-K12		SWMH-K12		SWMH-K13		SWMH-K14		SWMH-K15		SWCP-K15.1
LID LEVEL	28.94		30.21		30.21		30.25		30.87		30.84
PIPE INVERT LEVEL	27.95		28.12 / 28.27		28.28 / 28.35		28.44 / 28.65		29.25		29.32 / 29.33
DEPTH TO PIPE INVERT	1.06		2.02 / 1.89		1.87 / 1.81		1.76 / 1.56		1.59 / 1.52		1.49
PIPE SIZE AND CLASS		DN 750 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 525 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:200 (0.50%)		1:200 (0.50%)		1:199 (0.50%)		1:100 (1.00%)		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	35.09	35.09	3.54	38.63	17.58	56.21	59.68	115.89	1.55	117.43

LONGITUDINAL SECTION: OUTFALL_DP7-K12 - SWCP-K15.1

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1): AS SHOWN
Reduced Scale (A3): HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction*
Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 47

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2262 Rev. C

Document No. 3235084-CD-2260 TO 2279.DWG

DO NOT SCALE

IF IN DOUBT ASK.

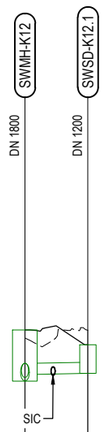
Drawing Plotted: 03 Nov 2022 3:25 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

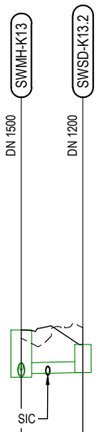
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00		
LID LEVEL	30.21	29.60
PIPE INVERT LEVEL	28.39	28.44
DEPTH TO PIPE INVERT	1.78	1.12
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	5.13 5.13

LONGITUDINAL SECTION: SWMH-K12 - SWSD-K12.1

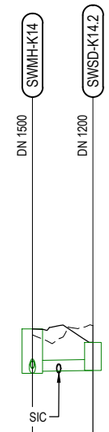
SCALE: HOR 1:250 VER 1:125



DATUM 25.00		
LID LEVEL	30.21	29.62
PIPE INVERT LEVEL	28.42	28.47
DEPTH TO PIPE INVERT	1.75	1.11
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	5.03 5.03

LONGITUDINAL SECTION: SWMH-K13 - SWSD-K13.2

SCALE: HOR 1:250 VER 1:125



DATUM 25.00		
LID LEVEL	30.25	29.69
PIPE INVERT LEVEL	28.51	28.56
DEPTH TO PIPE INVERT	1.70	1.10
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	4.93 4.93

LONGITUDINAL SECTION: SWMH-K14 - SWSD-K14.2

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 48

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2263

Rev. C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

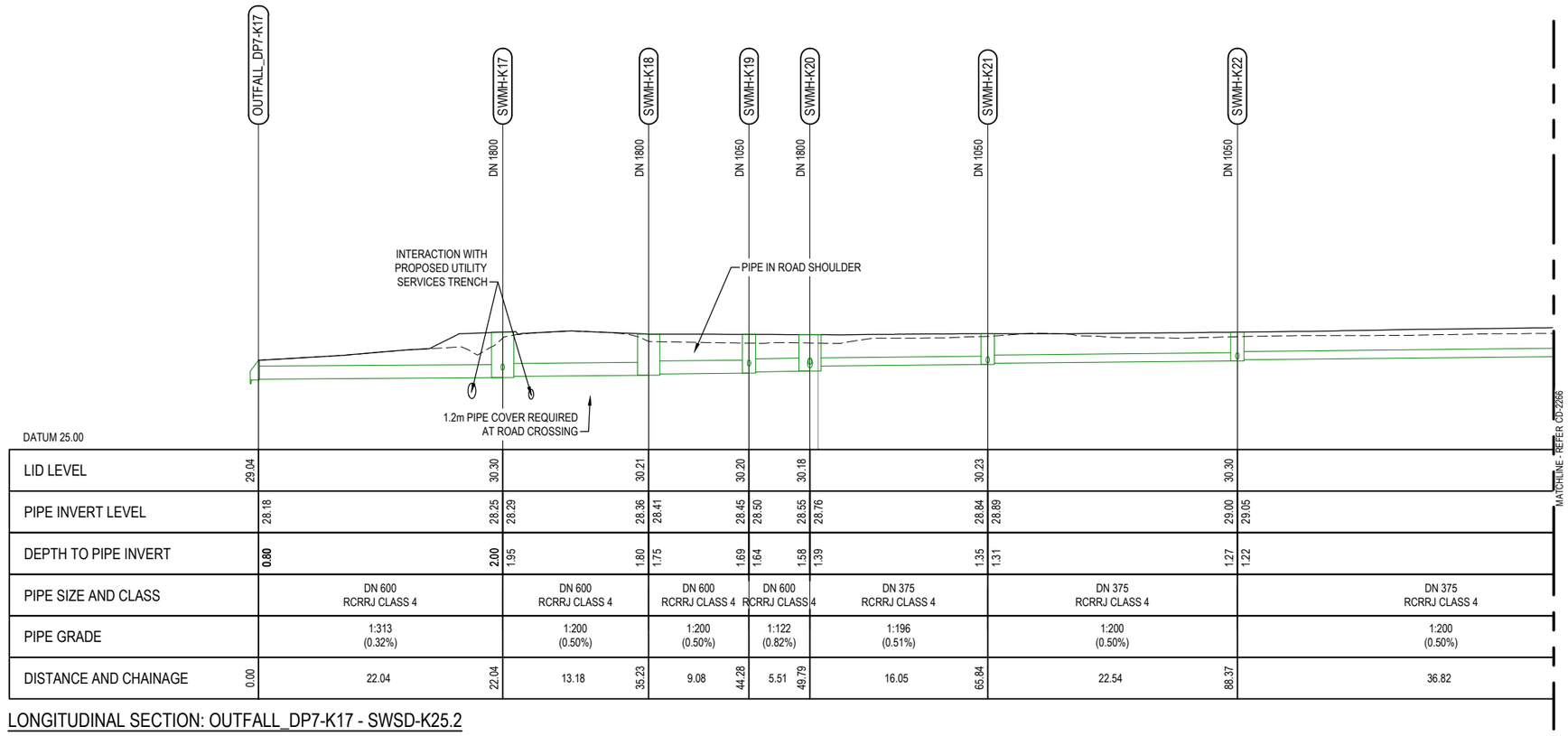
Document No. 3235084-CD-2260 TO 2279.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00

LID LEVEL	29.04	30.30		30.21		30.20		30.18		30.23		30.30											
PIPE INVERT LEVEL	28.18	28.25	28.29	28.36	28.41	28.45	28.50	28.55	28.76	28.84	28.89	29.00	29.05										
DEPTH TO PIPE INVERT	**0.80**	**2.00**	1.95	1.80	1.75	1.69	1.64	1.58	1.39	1.35	1.31	1.27	1.22										
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 600 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4										
PIPE GRADE	1:313 (0.32%)		1:200 (0.50%)		1:200 (0.50%)		1:122 (0.82%)		1:196 (0.51%)		1:200 (0.50%)		1:200 (0.50%)										
DISTANCE AND CHAINAGE	0.00	22.04	22.04	13.18	35.23	9.08	44.28	5.51	49.79	16.05	65.84	22.54	88.37	36.82									

LONGITUDINAL SECTION: OUTFALL_DP7-K17 - SWSD-K25.2

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 49

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2264

Rev.: C

Document No. 3235084-CD-2260 TO 2279.DWG

DO NOT SCALE

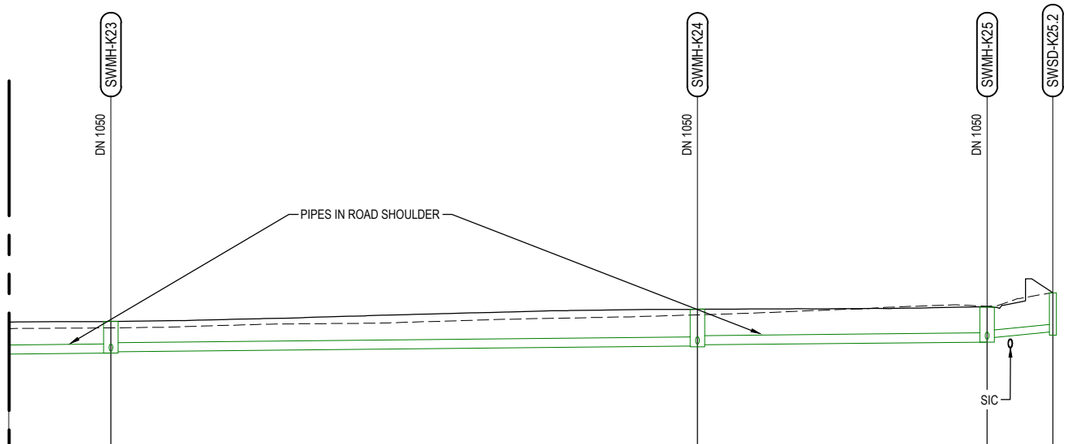
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

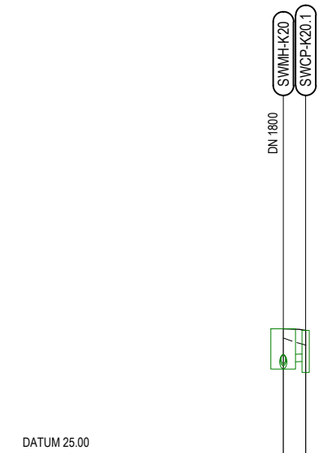


DATUM 25.00									
LID LEVEL	29.04	30.53		31.02		31.11		31.69	
PIPE INVERT LEVEL		29.23	29.28	29.52	29.57	29.69	29.84	30.11	
DEPTH TO PIPE INVERT		1.26	1.21	1.46	1.41	1.40	1.25	1.54	
PIPE SIZE AND CLASS			DN 375 RCRRJ CLASS 4			DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE			1:200 (0.50%)			1:210 (0.48%)		1:20 (5.10%)	
DISTANCE AND CHAINAGE	0.00	125.19	47.83	173.02		23.62	196.64	5.36	202.01

MATCHLINE - REFER CD-2265

LONGITUDINAL SECTION: OUTFALL_DP7-K17 - SWSD-K25.2

SCALE: HOR 1:250 VER 1:125



DATUM 25.00			
LID LEVEL	30.18	30.12	
PIPE INVERT LEVEL			28.83 28.85
DEPTH TO PIPE INVERT	1.32	1.24	
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:88 (1.13%)	
DISTANCE AND CHAINAGE	0.00	1.83	1.83

LONGITUDINAL SECTION: SWMH-K20 - SWCP-K20.1

SCALE: HOR 1:250 VER 1:125

DATUM 25.00			
LID LEVEL	30.18		29.52
PIPE INVERT LEVEL	28.68	28.73	
DEPTH TO PIPE INVERT	1.46	0.74	
PIPE SIZE AND CLASS		DN 450 RCRRJ CLASS 4	
PIPE GRADE		1:109 (0.92%)	
DISTANCE AND CHAINAGE	0.00	5.20	5.20

LONGITUDINALSECTION: SWMH-K20 - SWSD-K20.2

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1)	Design	S. BRIDGE	26.03.21	Approved For Construction*
AS SHOWN	Drawn	M. SERATHIUK	26.03.21	
Reduced Scale (A3)	Dsg Verifier			
HALF SHOWN	Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 50

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2265 Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

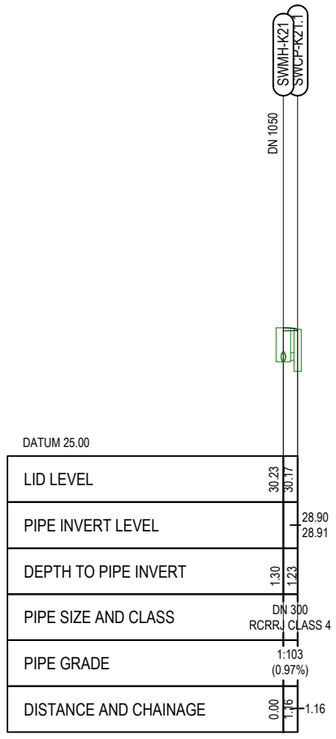
Document No. 3235084-CD-2260 TO 2279.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

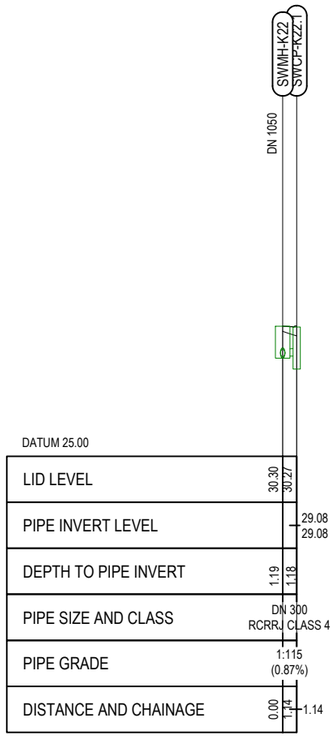
LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



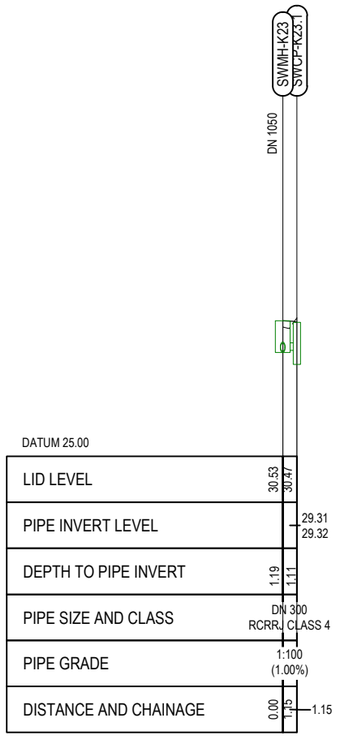
LONGITUDINAL SECTION: SWMH-K21 - SWCP-K21.1

SCALE: HOR 1:250 VER 1:125



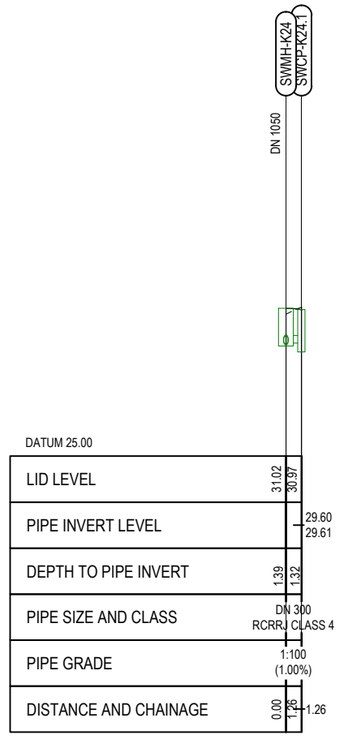
LONGITUDINAL SECTION: SWMH-K22 - SWCP-K22.1

SCALE: HOR 1:250 VER 1:125



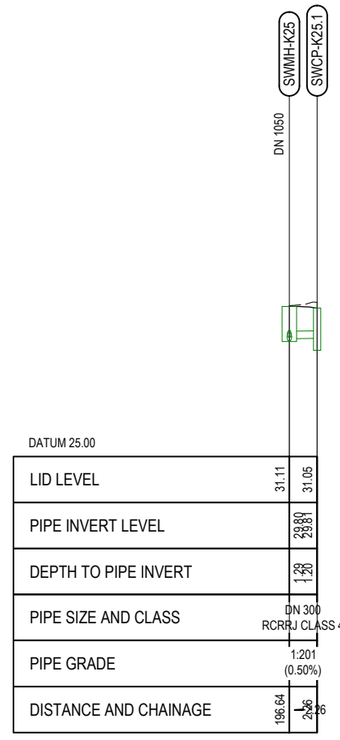
LONGITUDINAL SECTION: SWMH-K23 - SWCP-K23.1

SCALE: HOR 1:250 VER 1:125



LONGITUDINAL SECTION: SWMH-K24 - SWCP-K24.1

SCALE: HOR 1:250 VER 1:125



LONGITUDINAL SECTION: SWMH-K25 - SWCP-K25.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 51

Discipline: CIVIL ENGINEERING
Drawing No.: 3235084-CD-2266
Rev.: C

Document No. 3235084-CD-2260 TO 2279.DWG

DO NOT SCALE

IF IN DOUBT ASK.

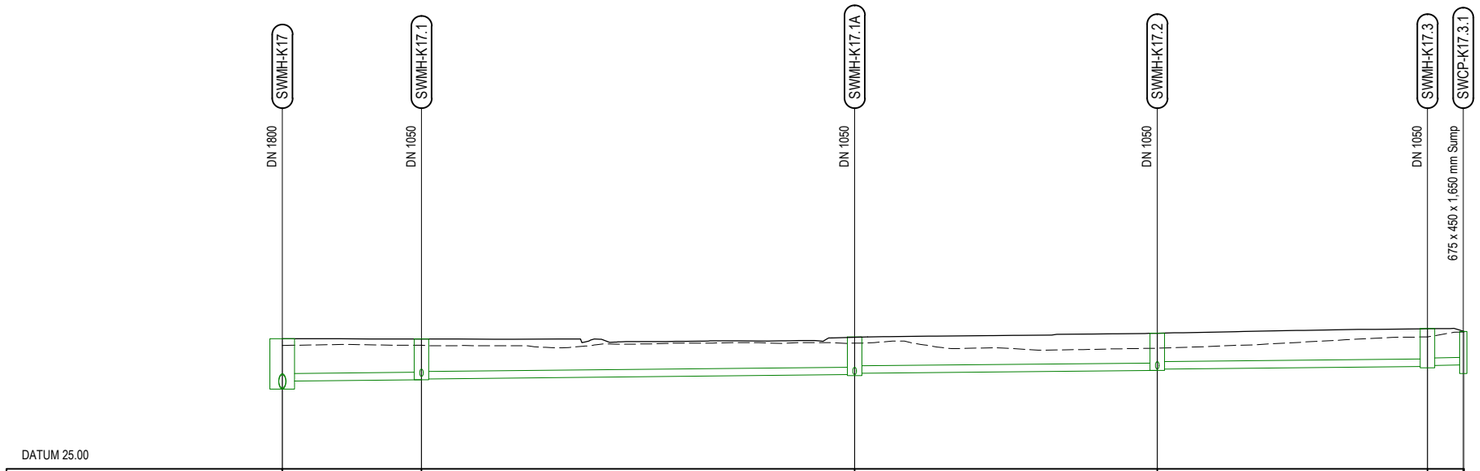
www.beca.com

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 25.00																							
LID LEVEL	30.30				30.29				30.37				30.52				30.71				30.60		
PIPE INVERT LEVEL		28.57			28.63		28.66		28.84		28.89		29.01	29.06			29.17	29.20			29.24		
DEPTH TO PIPE INVERT		1.70			1.63		1.60		1.53		1.48		1.49	1.43			1.51	1.48			1.33		
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4					DN 300 RCRRJ CLASS 4				DN 300 RCRRJ CLASS 4			DN 300 RCRRJ CLASS 4				DN 300 RCRRJ CLASS 4					
PIPE GRADE		1:200 (0.50%)					1:193 (0.52%)				1:210 (0.48%)			1:201 (0.50%)				1:82 (1.22%)					
DISTANCE AND CHAINAGE	0.00	11.35			11.35		35.32		46.67		24.68		71.35	22.03			93.38	96.29					
																	2.91						

LONGITUDINAL SECTION: SWMH-K17 - SWCP-K17.3.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 52

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2267

Rev.: C

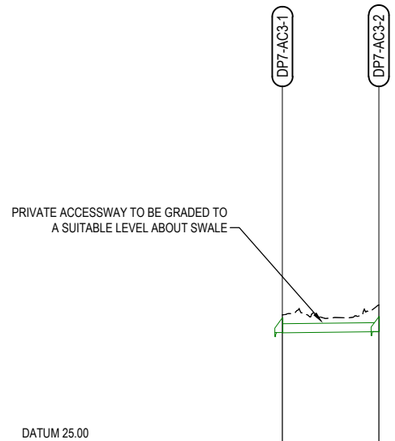
www.beca.com

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

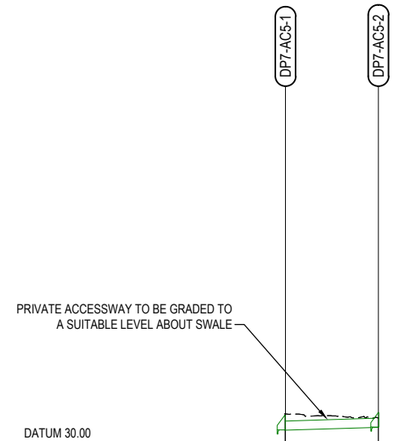


DATUM 25.00

LID LEVEL	30.25		30.30
PIPE INVERT LEVEL	29.64		29.69
DEPTH TO PIPE INVERT	0.69		1.05
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:185 (0.54%)	
DISTANCE AND CHAINAGE	0.00	7.86	7.86

LONGITUDINAL SECTION: DP7-AC3

SCALE: HOR 1:250 VER 1:125



DATUM 30.00

LID LEVEL	31.28		31.40
PIPE INVERT LEVEL	30.67		30.79
DEPTH TO PIPE INVERT	0.64		0.35
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	
PIPE GRADE		1:66 (1.51%)	
DISTANCE AND CHAINAGE	0.00	7.64	7.64

LONGITUDINAL SECTION: DP7-AC5

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 53

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2268

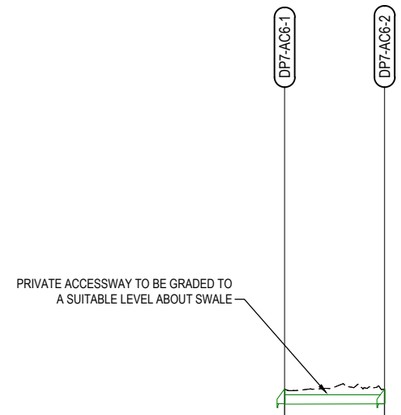
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

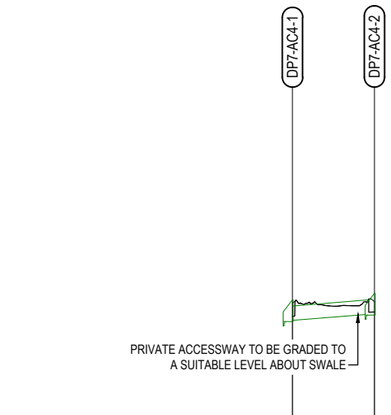
- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 30.00		
LID LEVEL	32.40	32.39
PIPE INVERT LEVEL	31.78	31.78
DEPTH TO PIPE INVERT	0.55	0.57
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:1558 (0.06%)	
DISTANCE AND CHAINAGE 204.08	8.14	212.22

LONGITUDINAL SECTION: DP7-AC6

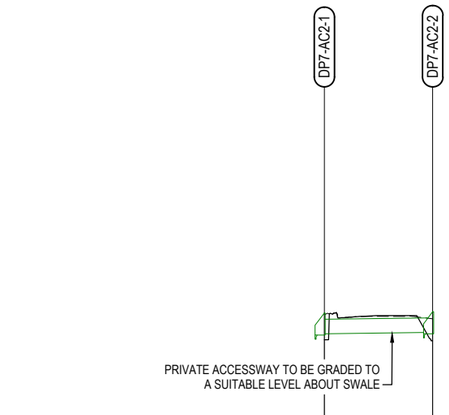
SCALE: HOR 1:250 VER 1:125



DATUM 25.00		
LID LEVEL	31.03	31.29
PIPE INVERT LEVEL	30.18	30.45
DEPTH TO PIPE INVERT	0.11	0.02
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4	
PIPE GRADE	1:25 (3.99%)	
DISTANCE AND CHAINAGE 0.00	6.68	6.68

LONGITUDINAL SECTION: DP7-AC4

SCALE: HOR 1:250 VER 1:125



DATUM 25.00		
LID LEVEL	30.47	30.52
PIPE INVERT LEVEL	29.63	29.68
DEPTH TO PIPE INVERT	-0.30	-0.40
PIPE SIZE AND CLASS	DN 600 RCRRJ CLASS 4	
PIPE GRADE	1:164 (0.61%)	
DISTANCE AND CHAINAGE 0.00	8.83	8.83

LONGITUDINAL SECTION: DP7-AC2

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 54

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2269

Rev.: C

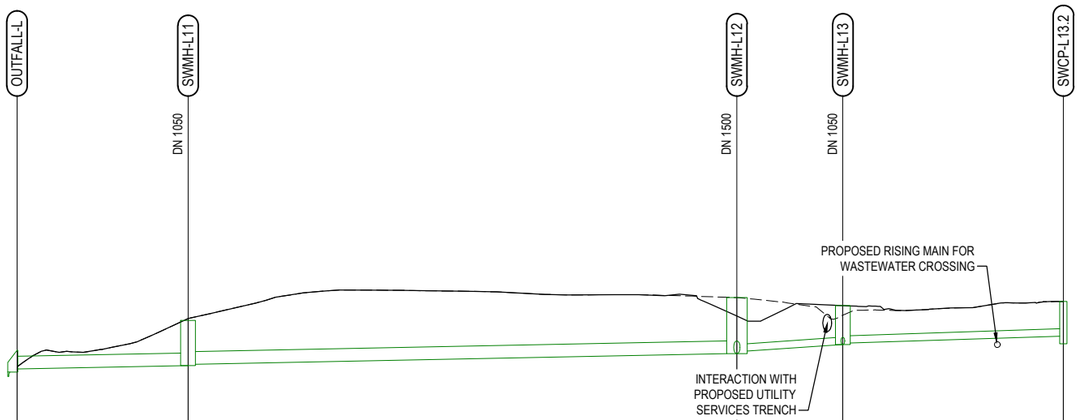
www.beca.com

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

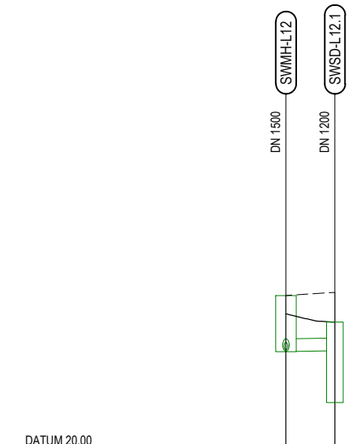


DATUM 20.00

LID LEVEL	24.33		25.55		26.48		26.15		26.31
PIPE INVERT LEVEL	23.56		23.70	23.75		24.20	24.26	24.56	24.61	24.90
DEPTH TO PIPE INVERT	0.04		1.87	1.82		1.48	1.43	1.56	1.50	1.38
PIPE SIZE AND CLASS		DN 525 RCRRJ CLASS 4			DN 525 RCRRJ CLASS 4			DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4
PIPE GRADE		1:100 (1.00%)			1:100 (1.00%)			1:29 (3.41%)		1:62 (1.62%)
DISTANCE AND CHAINAGE	0.00	13.95	13.95		44.75	58.70	8.64	67.34	17.98	85.31

LONGITUDINAL SECTION: OUTFALL-L - SWCP-L13.2

SCALE: HOR 1:250 VER 1:125

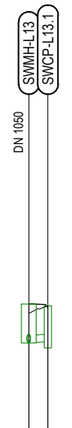


DATUM 20.00

LID LEVEL	26.48		25.40
PIPE INVERT LEVEL		24.19	24.22
DEPTH TO PIPE INVERT		1.49	1.13
PIPE SIZE AND CLASS		DN 525 RCRRJ CLASS 4	
PIPE GRADE		1:131 (0.76%)	
DISTANCE AND CHAINAGE	0.00	3.99	3.99

LONGTIDUINAL SECTION: SWMH-L12 - SWSD-L12.1

SCALE: HOR 1:250 VER 1:125



DATUM 20.00

LID LEVEL	26.15		26.07
PIPE INVERT LEVEL			24.56 24.61
DEPTH TO PIPE INVERT			1.55
PIPE SIZE AND CLASS			DN 300 RCRRJ CLASS 4
PIPE GRADE			1:29 (3.41%)
DISTANCE AND CHAINAGE	0.00		1.55

LONGITUDINAL SECTION: SWMH-L13 - SWCP-L13.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 55

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2280

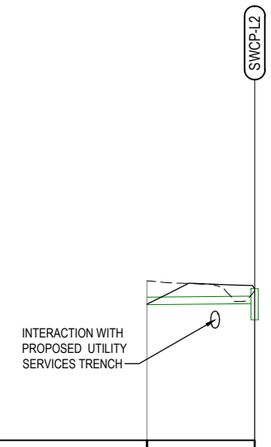
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

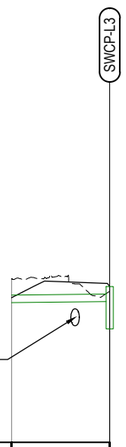


DATUM 20.00

LID LEVEL		26.18
PIPE INVERT LEVEL	25.52	25.56
DEPTH TO PIPE INVERT	-0.01	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	8.79	8.79

LONGITUDINAL SECTION: SWO-L2 - SWCP-L2

SCALE: HOR 1:250 VER 1:125



DATUM 20.00

LID LEVEL		26.35
PIPE INVERT LEVEL	25.70	25.74
DEPTH TO PIPE INVERT	0.17	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	8.00	8.00

LONGITDUINAL SECTION: SWO-L3 - SWCP-L3

SCALE: HOR 1:250 VER 1:125

DATUM 20.00

LID LEVEL		26.40
PIPE INVERT LEVEL	25.75	25.79
DEPTH TO PIPE INVERT	0.27	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.59	7.59

LONGITDUINAL SECTION: SWO-L4 - SWCP-L4

SCALE: HOR 1:250 VER 1:125

DATUM 20.00

LID LEVEL		26.51
PIPE INVERT LEVEL	25.86	25.90
DEPTH TO PIPE INVERT	0.30	0.58
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)	
DISTANCE AND CHAINAGE	7.46	7.46

LONGITUDINAL SECTION: SWO-L5 - SWCP-L5

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
	Drawn	M. SERATHIUK	26.03.21	
Reduced Scale (A3) HALF SHOWN	Dsg Verifier			
	Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 56

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2281

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

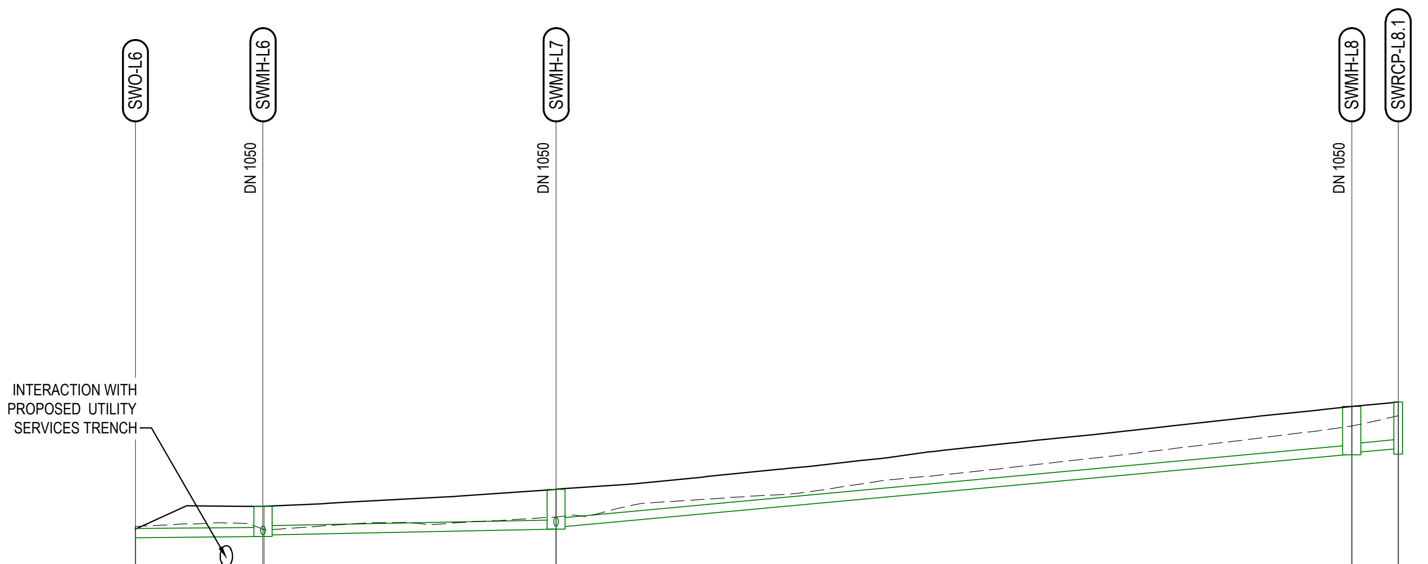
Drawing Plotted: 03 Nov 2022 3:41 pm

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

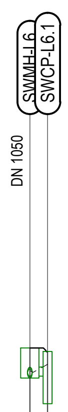


DATUM 25.00

	SWO-L6		SWMH-L6		SWMH-L7		SWMH-L8		SWRCP-L8.1
LID LEVEL	26.62		26.97		27.53		30.27		30.42
PIPE INVERT LEVEL	25.93		25.97 / 26.02		26.22 / 26.27		28.69 / 28.74		28.88
DEPTH TO PIPE INVERT	0.26		0.97 / 0.91		1.29 / 1.23		1.54 / 1.50		1.51
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:215 (0.46%)		1:100 (1.00%)		1:22 (4.60%)		1:22 (4.62%)	
DISTANCE AND CHAINAGE	0.00	8.44	8.44	19.33	27.81	52.60	80.41	3.0	83.47

LONGITUDINAL SECTION: SWO-L6 - SWCP-L8.1

SCALE: HOR 1:250 VER 1:125

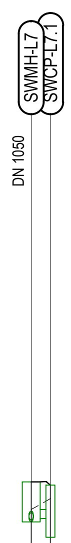


DATUM 20.00

	SWMH-L6		SWCP-L6.1
LID LEVEL	26.97		26.85
PIPE INVERT LEVEL	26.02		26.03
DEPTH TO PIPE INVERT	0.91		0.78
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	1.18	1.18

LONGITUDINAL SECTION: SWMH-L6 - SWCP-L6.1

SCALE: HOR 1:250 VER 1:125



DATUM 25.00

	SWMH-L7		SWCP-L7.1
LID LEVEL	27.53		27.42
PIPE INVERT LEVEL	26.31		26.33
DEPTH TO PIPE INVERT	1.19		1.06
PIPE SIZE AND CLASS		DN 300 RCRRJ CLASS 4	
PIPE GRADE		1:67 (1.49%)	
DISTANCE AND CHAINAGE	0.00	1.27	1.27

LONGITUDINAL SECTION: SWMH-L7 - SWCP-L7.1

SCALE: HOR 1:250 VER 1:125

www.beca.com

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21	Approved For Construction*
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21	
	Dwg Verifier			
	Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 57

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2282 Rev. C

Document No. 3235084-CD-2280 TO 2289.DWG

DO NOT SCALE

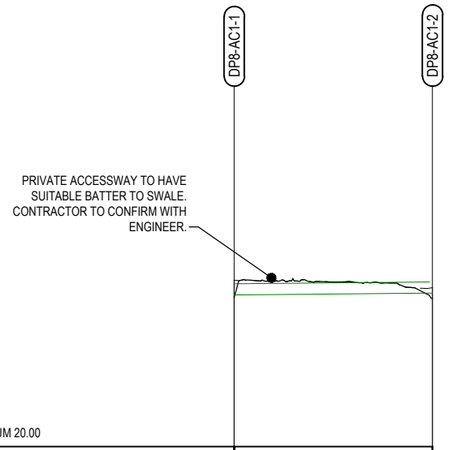
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

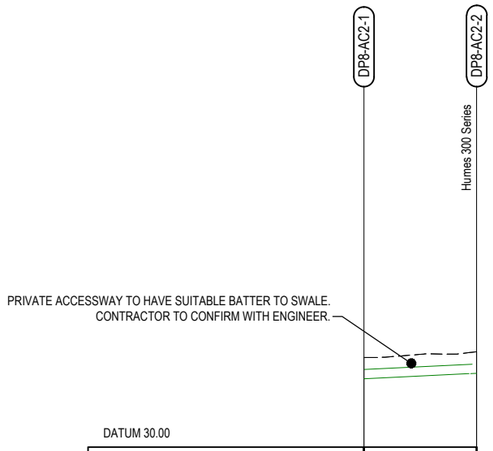


DATUM 20.00

LID LEVEL	26.79	26.87
PIPE INVERT LEVEL	26.18	26.26
DEPTH TO PIPE INVERT	-0.16	-0.25
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4	
PIPE GRADE	1:215 (0.47%)	
DISTANCE AND CHAINAGE	0.00	16.17

LONGITUDINAL SECTION_ DP8-AC1

SCALE: HOR 1:250 VER 1:125

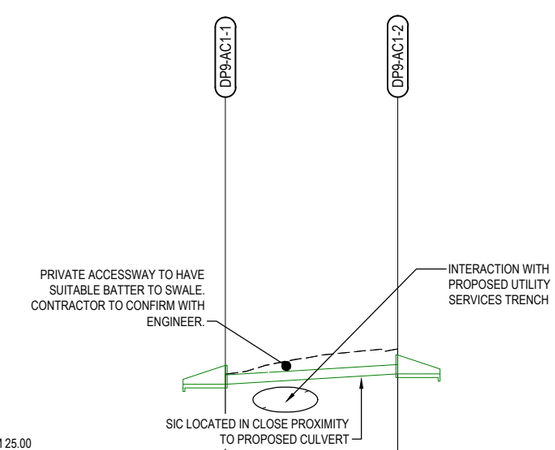


DATUM 30.00

LID LEVEL	33.40	33.62
PIPE INVERT LEVEL	32.79	33.01
DEPTH TO PIPE INVERT	0.84	0.82
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	-1:43 (-2.35%)	
DISTANCE AND CHAINAGE	0.00	9.19

LONGITUDINAL SECTION_ DP8-AC2

SCALE: HOR 1:250 VER 1:125



DATUM 25.00

LID LEVEL	28.60	29.02
PIPE INVERT LEVEL	27.99	28.41
DEPTH TO PIPE INVERT	0.37	0.98
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:33 (3.00%)	
DISTANCE AND CHAINAGE	0.00	14.05

LONGITUDINAL SECTION_ DP9-AC1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date
* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 58

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2283

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

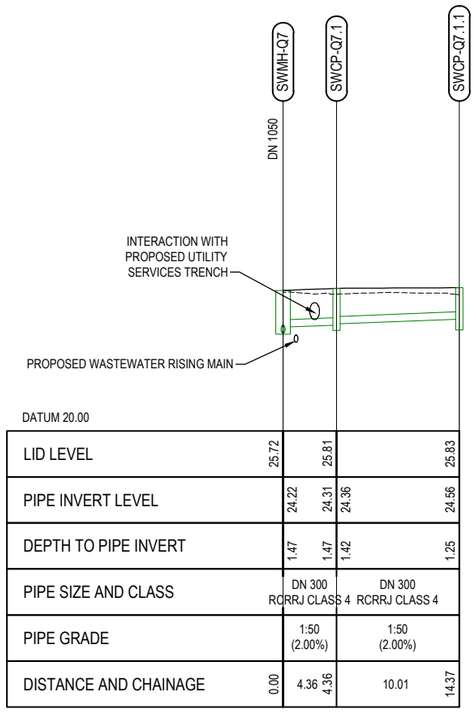
Document No. 3235084-CD-2280 TO 2289.DWG

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

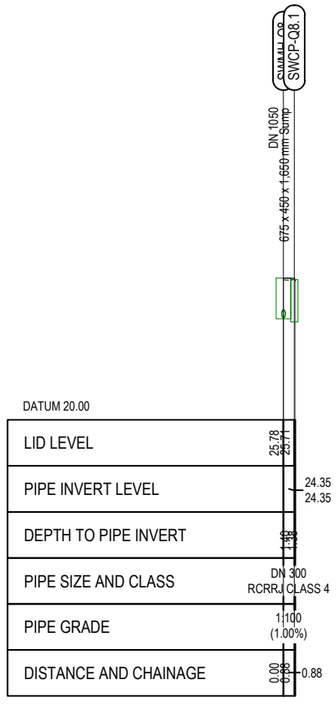
LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



LONGITUDINAL SECTION SWMH Q7 TO SWCP Q7.1.1

SCALE: HOR 1:250 VER 1:125



LONGITUDINAL SECTION SWCP-Q8.1 TO SWMH-Q8

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21
Drawn	M. SERATHIUK	26.03.21
Dsg Verifier		
Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 59

Discipline: CIVIL ENGINEERING

Drawing No. 3235084-CD-2290 Rev. C

DO NOT SCALE

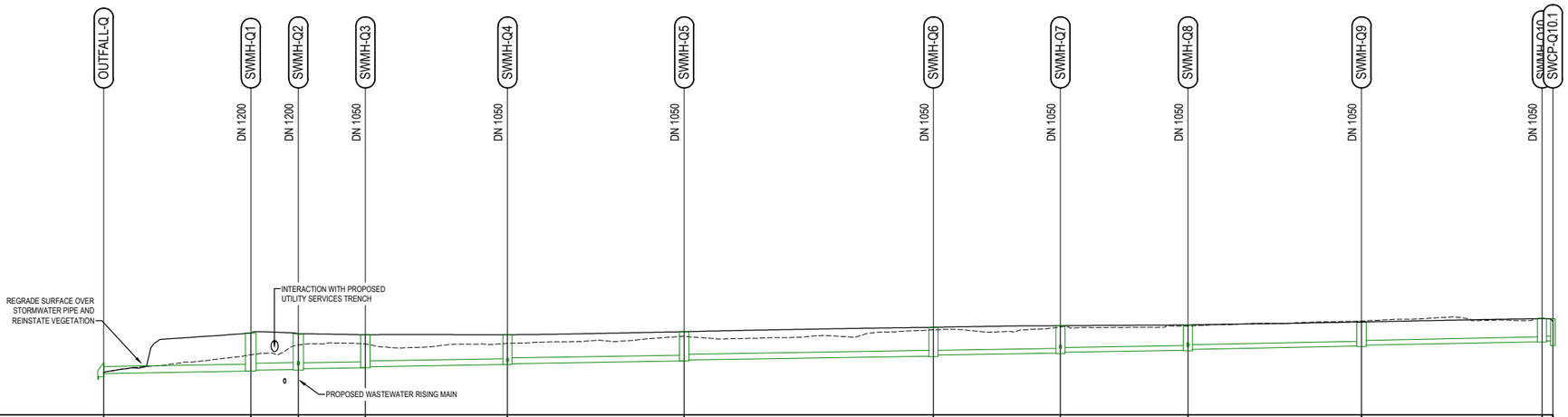
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 20.00

LID LEVEL	23.34		25.25		25.21		25.14		25.14		25.33		25.62		25.72		25.78		25.96		26.18	26.16
PIPE INVERT LEVEL	22.65		22.81	22.86	22.91	22.96	23.03	23.08	23.23	23.28	23.46	23.51	1.75 23.77	23.84	1.67 23.97	24.02 1.72	1.55 24.15	24.20 1.60	1.46 24.42	24.47 1.51	24.70	24.74 1.65
DEPTH TO PIPE INVERT																					1.41	1.38
PIPE SIZE AND CLASS	DN 450 RCRRJ CLASS 4			DN 450 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4		DN 300 RCRRJ CLASS 4
PIPE GRADE	1:118 (0.85%)			1:125 (0.80%)		1:125 (0.80%)		1:125 (0.80%)		1:125 (0.80%)		1:125 (0.80%)		1:125 (0.80%)		1:125 (0.80%)		1:100 (1.00%)		1:100 (1.00%)		1:100 (1.00%)
DISTANCE AND CHAINAGE	0.00	18.93	18.93	6.12	25.05	8.63	33.68	18.28	51.96	22.73	74.69	32.08	106.77	16.33	123.10	16.41	139.51	22.33	161.84	23.22	185.06	186.47 1.40

LONGITUDINAL SECTION: OUTLET-Q - SWCP-Q10.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 61

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2292

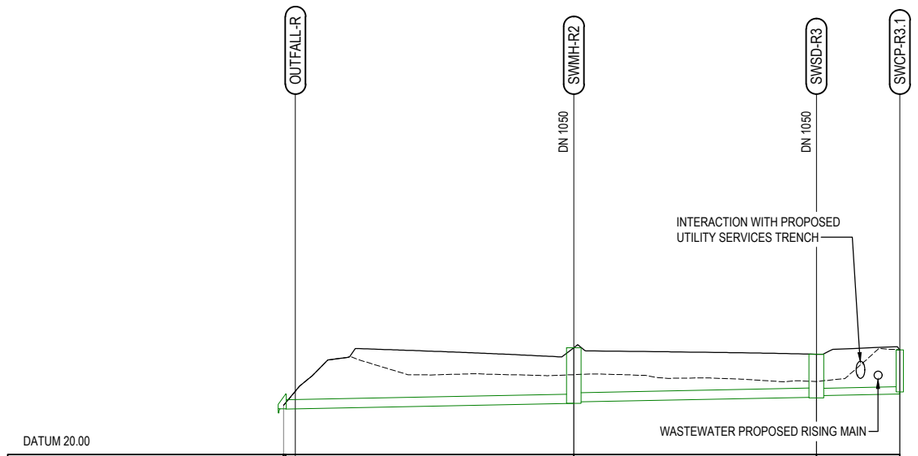
Rev.: C

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



	OUTFALL-R	SWMH-R2	SWSD-R3	SWCP-R3.1
LID LEVEL	22.47	24.35	24.09	24.27
PIPE INVERT LEVEL	21.86	22.09	22.14 22.34	22.39 22.46
DEPTH TO PIPE INVERT	0.22	2.23		1.66 1.77
PIPE SIZE AND CLASS		DN 375 RCRRJ CLASS 4	DN 375 RCRRJ CLASS 4	DN 300 RCRRJ CLASS 4
PIPE GRADE		1:100 (1.00%)	1:100 (1.00%)	1:100 (1.00%)
DISTANCE AND CHAINAGE	4.56	23.48 27.99	19.78 47.77	6.80 54.57

LONGITUDINAL SECTION: OUTFALL-R - SWCP-R3.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 62

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2293

Rev.: C

Document No. 3235084-CD-2290 TO 2294.DWG

DO NOT SCALE

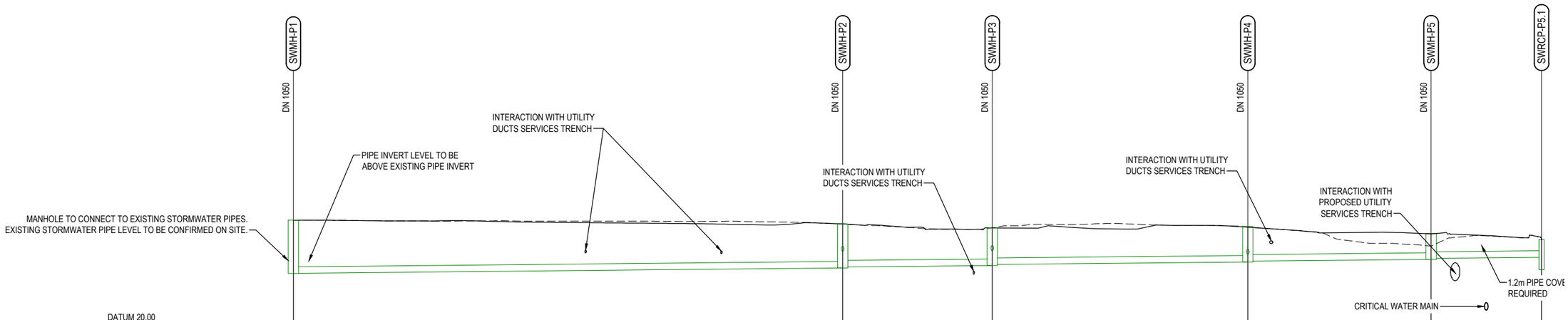
IF IN DOUBT ASK.

NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK



DATUM 20.00

LID LEVEL	26.13	25.92							25.68						25.77				25.37		25.02
PIPE INVERT LEVEL	23.09	23.40							23.54	23.45					23.74	23.59			23.89	23.79	24.01	23.94
DEPTH TO PIPE INVERT	3.01	2.48							2.11	2.43					1.95	2.05			1.42	1.91	1.01	1.37
PIPE SIZE AND CLASS	DN 375 RCRRJ CLASS 4								DN 375 RCRRJ CLASS 4						DN 375 RCRRJ CLASS 4				DN 375 RCRRJ CLASS 4		DN 375 RCRRJ CLASS 4	
PIPE GRADE	1:200 (0.50%)								1:200 (0.50%)						1:200 (0.50%)				1:202 (0.50%)		1:188 (0.53%)	
DISTANCE AND CHAINAGE	0.00	62.82							62.82	79.93					109.15	29.22			130.12	20.97	142.75	12.63

LONGITDUINAL SECTION: SWMH-P1 - SWRCP-P5.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN
Reduced Scale (A3) HALF SHOWN

Design	S. BRIDGE	26.03.21	Approved For Construction*
Drawn	M. SERATHIUK	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 63

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2295

Rev.: C

DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

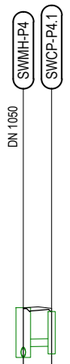
NOTES

1. REFER TO 3235084-CD-2100 FOR GENERAL NOTES.
2. STORMWATER LONGSECTIONS SHOW INDICATIVE CROSSING WITH PROPOSED AND EXISTING SERVICES. THE CONTRACTOR IS TO CONFIRM LOCATION AND DEPTH OF ALL SERVICES AND COORDINATE LOCATIONS ONSITE.
3. INDICATIVE LOCATIONS OF SERVICES SHOWN ARE LIMITED TO GAS, WATER, WASTEWATER, EXISTING STORMWATER AND SIC AS PROVIDED BY THE ASSET OWNERS.

LEGEND

- EXISTING GROUND
- PROPOSED FINISHED SURFACE
- EXISTING STORMWATER NETWORK
- PROPOSED STORMWATER NETWORK
- TO BE REMOVED STORMWATER NETWORK

R



DATUM 20.00		
LID LEVEL	25.77	25.61
PIPE INVERT LEVEL	24.18	24.20
DEPTH TO PIPE INVERT	1.52	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	2.31

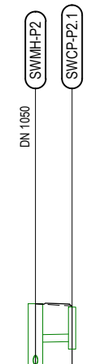
LONGITUDINAL SECTION: SWMH-P4 - SWCP-P4.1

SCALE: HOR 1:250 VER 1:125

DATUM 20.00		
LID LEVEL	25.68	25.85
PIPE INVERT LEVEL	24.38	24.42
DEPTH TO PIPE INVERT	1.27	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	3.90

LONGITUDINAL SECTION: SWMH-P3 - SWCP-P3.1

SCALE: HOR 1:250 VER 1:125



DATUM 20.00		
LID LEVEL	25.92	25.79
PIPE INVERT LEVEL	24.35	24.38
DEPTH TO PIPE INVERT	1.54	1.38
PIPE SIZE AND CLASS	DN 300 RCRRJ CLASS 4	
PIPE GRADE	1:100 (1.00%)	
DISTANCE AND CHAINAGE	0.00	2.98

LONGITUDINAL SECTION: SWMH-P2 - SWCP-P2.1

SCALE: HOR 1:250 VER 1:125

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF	GC	10.10.22
B	DRAFT DETAILED DESIGN	SJF	SF	NL	25.03.22
A	PRELIMINARY DESIGN	SB	SF	NL	26.03.21

Drawing Originator: Beca

Original Scale (A1) AS SHOWN	Design	S. BRIDGE	26.03.21
Reduced Scale (A3) HALF SHOWN	Drawn	M. SERATHIUK	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER LONG SECTIONS SHEET 64

Discipline: CIVIL ENGINEERING

Drawing No.: 3235084-CD-2296 Rev.: C

Document No. 3235084-CD-2295 TO 2299.DWG

DO NOT SCALE

IF IN DOUBT ASK.

APPENDIX B

1% AEP FLOOD MAP

SH16 Taupaki Road to Kumeu

0 50 100 150
Meters

Scale @ A4
= 1:8,000

Date Printed:
27/10/2020

Auckland Council
Te Kaunihera o Tāmaki Makaurau

SH16 Brigham Creek to Taupaki Road

0 50 100 150
Meters

Scale @ A4
= 1:8,000

Date Printed:
27/10/2020

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Rivers and Permanent Streams

- Open Watercourse
- Piped Watercourse
- Culvert
- Pond

Overland Flow Paths - 3ha and above

- Overland Flow Paths - 3ha and above

Overland Flow Paths - 4000m2 to 3ha

- Overland Flow Paths - 4000m2 to 3ha

Overland Flow Paths - 2000m2 to 4000m2

- Overland Flow Paths - 2000m2 to 4000m2

Overland Flow Paths

- Overland Flow Paths

Flood Plains

- Flood Plains

Address

- Address

Place Name (25,000)

- Place Name (25,000)

Rail Stations (8,000)

- Rail Stations (8,000)

Railway (25,000)

- Railway (25,000)

Auckland Council Boundary

- Auckland Council Boundary

Roads (8,000)

ROADCODE, STATUS

- Motorway
- Motorway Under Construction
- Secondary Arterial Road
- Secondary Arterial Road Under Construction
- Primary Arterial Road
- Primary Arterial Road Under Construction
- Collector Road
- Collector Road Under Construction
- Local Road
- Local Road Under Construction

Parcels

- Parcels

Legend

Date Printed:
27/10/2020

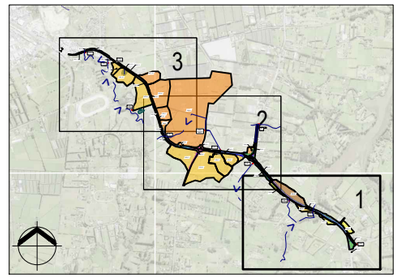
Auckland Council
Te Kaunihera o Tāmaki Makaurau

APPENDIX C

STORMWATER CATCHMENT PLAN

Drawing Plotted: 03 Nov 2022 2:07 PM

Catchment ID	Catchment Description	Total Area (m2)	Pervious (m2)	Impervious (m2)	Post development Flows		
					Qp 2 year +CC (m3/sec)	Qp 10 year +CC (m3/sec)	Qp 100 year +CC (m3/sec)
DP1-C1	DP1 - A - Diversion drain	6628	2651	3977	0.11	0.19	0.30
DP1-C2	DP1 - A pipe	22455	9755	12700	0.34	0.61	0.95
DP1-C3	DP1 - M Kennedy Road pipe	9622	3541	6081	0.16	0.28	0.43
DP1-C4	DP1- Outfall B	8802	6448	2355	0.12	0.23	0.37
DP1-C5	DP1 -- C Swale Outfall	20496	12027	8470	0.29	0.54	0.85
DP1-C6	DP1 - C SW360	2484	427	2057	0.05	0.08	0.12
DP2-C1	DP1 - DP2 Redirected to Outfall B	5171	4591	580	0.06	0.13	0.21
DP12-C1	DP12 - Brigham Creek Roundabout	2069	0	2069	0.04	0.07	0.10



LEGEND:

- SH16 ROAD
- SH16 FOOTPATH
- ADDITIONAL PAVEMENT
- SH16 PERVIOUS
- LOCAL ROADS WITHIN CATCHMENT
- EXTERNAL CATCHMENT - FUTURE URBAN ZONE
- EXTERNAL CATCHMENT - LIFESTYLE COUNTRY
- EXTERNAL CATCHMENT -MIXED RURAL
- PRIVATE ACCESSWAY
- CATCHMENT OUTLINE
- EXISTING AND PROPOSED DISCHARGE LOCATIONS WITH PROJECT CHAINAGE
- WATERCOURSE - PERMANENT AND INTERMITTENT STREAMS, FARM DRAINS AND ROADSIDE DRAINS (NOTED)
- WETLAND OR STORMWATER POND - (NOTED)
- 222 SH16 PROPERTY NUMBER

IDENTIFIER BREAKDOWN:

DP - DISCHARGE POINT
C - CATCHMENT

DP2-C1
DP1-C5
DP2 CH190900
INTERMITTENT STREAM
DP1-C6
NGONGATEPARA STREAM PERMANENT STREAM
DP1-C4
DP1 CH190600
PERMANENT STREAM
DP1-C1
DP1-C3
DP12-C1
DP12 CH190000
DP1-C2
EXTENT OF WORKS
MATCHLINE-REFER TO SHEET 2

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF		03.11.22
B	DETAILED DESIGN	ES	SB		
A	PRELIMINARY DESIGN	VZ			01.04.21

Drawing Originator: Beca

Original Scale (A1) NTS
Reduced Scale (A3) NTS

Design	S.BRIDGE	09.11.21	Approved For Construction*
Drawn	A. HOLT	26.03.21	
Dsg Verifier			
Dwg Check			Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: CATCHMENT PLANS POST DEVELOPMENT PLAN SHEET 1

Discipline: STORMWATER

Drawing No. 3235084-SK-2004

Rev. C

Document No. 3235084-SK-2004 TO 2006.DWG

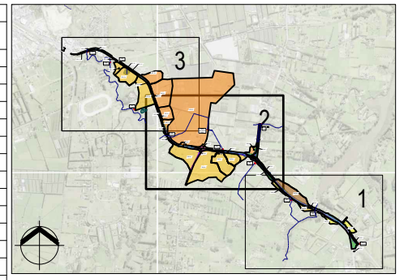
DO NOT SCALE

IF IN DOUBT ASK.

www.beca.com

Drawing Plotted: 03 Nov 2022 2:07 PM

Catchment ID	Catchment Description	Total Area (m2)	Pervious (m2)	Impervious (m2)	Post development Flows		
					Qp 2 year +CC (m3/sec)	Qp 10 year +CC (m3/sec)	Qp 100 year +CC (m3/sec)
DP4-C1	DP4- East of Roundabout - South	8431	5982	2449	0.11	0.22	0.36
DP4-C2	DP4 -South of Roundabout	3345	357	2988	0.06	0.11	0.16
DP4-C3	DP4 - East of Roundabout - North	4753	420	4333	0.09	0.15	0.22
DP4-C4	DP4 - N Swale (West)	7128	662	6466	0.13	0.22	0.34
DP4-C5	DP4 - N swale (East)	3029	1406	1623	0.05	0.09	0.14
DP4-C6	DP4 Local Road (west)	2280	1502	778	0.03	0.06	0.10
DP4-C7	DP4 local Road (East)	2202	1206	996	0.04	0.08	0.14
DP5-C1	DP5 -External Catchment - Pond (without Routing)	35886	27542	8344	0.46	0.91	1.47
DP5-C2	DP5 - External Catchment - Drain	17624	15862	1762	0.20	0.41	0.68
DP5-C3	DP5 - External Catchment into Network	3390	3051	339	0.04	0.08	0.14
DP6-C1	DP6- SH16 - East of Taupaki Roundabout to Boric	12253	4954	7299	0.20	0.36	0.56
DP6-C2	DP6 -Taupaki swale H	12200	4774	7426	0.17	0.30	0.46
DP6-C3	DP6- Cross Culvert at 192430	36925	3324	3693	0.05	0.44	0.91
DP6-C4	DP6 additional footpath	577	172	405	0.01	0.02	0.03
DP6-C5	DP6 - taupaki Roundabout (North) inflow into Swale I	7242	990	6252	0.12	0.21	0.31
DP6-C6	DP6-Sag (swale) I	5789	1479	4310	0.11	0.19	0.28
DP6-C7	DP6 J1(swale and Sag)	9246	6445	2801	0.11	0.22	0.36
DP6-C8	DP6 G (swale)	2453	1537	916	0.04	0.07	0.11
DP6-C9	DP6 -Tauaki Catchment 750mm pipe	91400	82260	9140	0.75	1.56	2.59



DP7-C8
DP7-C7
DP7-C1
DP7-C4
DP7-C5
DP6-C7
DP6-C8
DP6-C4
DP6-C6
DP6-C5
DP6-C2
DP6-C3
DP6-C9
DP5-C1
DP5-C2
DP4-C7
DP4-C6
DP4-C4
DP4-C5
DP4-C3
DP4-C1
DP6-C1
MATCHLINE REFER TO SHEET 3
MATCHLINE REFER TO SHEET1
DP6 CH192580
DP5A OLD NORTH ROAD
DP5 CH191900
DP4 CH198
DP3 CH191450
INTERMITTENT STREAM
PERMANENT STREAM
EXISTING WETLAND
AT CONVEYANCE CHANNEL
EXISTING PRIVATE CULVERT
PRIVATE FARM DRAIN
TRIBUTARY OF THE HURUHURU STREAM PERMANENT STREAM
ROAD SIDE DRAIN
EXTENSION WORKS
STORMWATER POND
CH192700
CH192600
CH192500
CH192400
CH192300
CH192200
CH192100
CH192000
CH191900
CH191800
CH191700
CH191600
CH191500
CH191400
CH198

IDENTIFIER BREAKDOWN:

DP - DISCHARGE POINT
C - CATCHMENT

LEGEND:

- SH16 ROAD
- SH16 FOOTPATH
- ADDITIONAL PAVEMENT
- SH16 PERVIOUS
- LOCAL ROADS WITHIN CATCHMENT
- EXTERNAL CATCHMENT - FUTURE URBAN ZONE
- EXTERNAL CATCHMENT - LIFESTYLE COUNTRY
- EXTERNAL CATCHMENT -MIXED RURAL
- PRIVATE ACCESSWAY
- CATCHMENT OUTLINE
- EXISTING AND PROPOSED DISCHARGE LOCATIONS WITH PROJECT CHAINAGE
- WATERCOURSE - PERMANENT AND INTERMITTENT STREAMS, FARM DRAINS AND ROADSIDE DRAINS (NOTED)
- WETLAND OR STORMWATER POND - (NOTED)
- 222 SH16 PROPERTY NUMBER

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF		03.11.22
B	DETAILED DESIGN	ES	SB		
A	PRELIMINARY DESIGN	OH			

Drawing Originator: Beca

Original Scale (A1) NTS	Design	S.BRIDGE	09.11.21
Reduced Scale (A3) NTS	Drawn	A. HOLT	26.03.21
	Dsg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: CATCHMENT PLAN POST DEVELOPMENT PLAN SHEET 2

Discipline: STORMWATER

Drawing No.: 3235084-SK-2005

Rev.: C

DO NOT SCALE

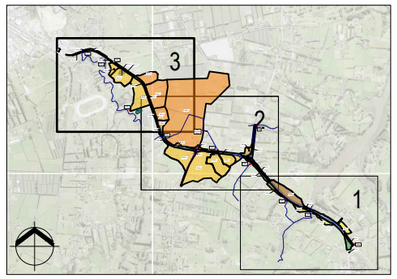
IF IN DOUBT ASK.

www.beca.com

Document No. 3235084-SK-2004 TO 2006.DWG

Drawing Plotted: 03 Nov 2022 2:07 PM

Catchment ID	Catchment Description	Total Area (m2)	Pervious (m2)	Impervious (m2)	Post development Flows		
					Qp 2 year +CC (m3/sec)	Qp 10 year +CC (m3/sec)	Qp 100 year +CC (m3/sec)
DP7-C1	DP7 - DD north East	16592	14933	1659	0.20	0.41	0.68
DP7-C2	DP7 - DD North West	61496	55346	6150	0.59	1.22	2.03
DP7-C3	DP7 - Outside Catchment O	22530	19897	2633	0.24	0.49	0.81
DP7-C4	DP7 K1(SE)	2354	478	1876	0.04	0.07	0.11
DP7-C5	DP7 K2 (NE)	3009	1486	1523	0.05	0.09	0.13
DP7-C6	DP7 K3 (SW)	6552	964	5588	0.11	0.19	0.29
DP7-C7	DP7 K4 (NW)	1008	0	1008	0.02	0.03	0.05
DP7-C8	DP7 Overland Flow into Swale	41759	37583	4176	0.39	0.81	1.35
DP8-C1	DP8 L - Swale	38141	34327	3814	0.43	0.89	1.47
DP8-C2	DP8 L- SH16	3568	847	2721	0.06	0.11	0.17
DP8-C3	DP8 L-SH16 (infront of BP)	943	28	915	0.02	0.03	0.05
DP9-C1	DP9 S Roadside Drain / Swale	4382	2611	1771	0.06	0.12	0.19
DP11-C1	DP11 - Q pipe	5131	758	4373	0.03	0.05	0.08
DP11-C3	DP11 - R pipe	1745	728	1017	0.03	0.05	0.08



LEGEND:

- SH16 ROAD
- SH16 FOOTPATH
- ADDITIONAL PAVEMENT
- SH16 PERVIOUS
- LOCAL ROADS WITHIN CATCHMENT
- EXTERNAL CATCHMENT - FUTURE URBAN ZONE
- EXTERNAL CATCHMENT - LIFESTYLE COUNTRY
- EXTERNAL CATCHMENT -MIXED RURAL
- PRIVATE ACCESSWAY
- CATCHMENT OUTLINE
- EXISTING AND PROPOSED DISCHARGE LOCATIONS WITH PROJECT CHAINAGE
- WATERCOURSE - PERMANENT AND INTERMITTENT STREAMS, FARM DRAINS AND ROADSIDE DRAINS (NOTED)
- WETLAND OR STORMWATER POND - (NOTED)
- 222 SH16 PROPERTY NUMBER

IDENTIFIER BREAKDOWN:

DP - DISCHARGE POINT
C - CATCHMENT

DP11-C2
DP11-C1
DP11 CH194000
DP11 - C3
DP8 - C3
DP9 CH193580
DP8 CH193640
DP8 - C2
DP9 - C1
DP8 - C1
DP8 - C4
EXISTING WETLAND
DP7 - C3
DP7-C6
DP7-C2
DP7-C7
DP7-C8
DP7 CH192900
DP6-C9
DP7-C1
DP7-C4
DP7-C5
DP6-C7
DP6-C8
EXISTING STORMWATER POND
MATCHLINE REFER TO SHEET 2
EXTENT OF WORKS

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
c	FOR CONSENTING	SB	SF		03.11.22
B	DETAILED DESIGN	ES	SB		
A	PRELIMINARY DESIGN	VZ			01.04.21

Drawing Originator: Beca

Original Scale (A1)	NTS	Design	S.BRIDGE 26.03.21
Reduced Scale (A3)	NTS	Drawn	A. HOLT 26.03.21
		Dsg Verifier	
		Dwg Check	

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: CATCHMENT PLANS POST DEVELOPMENT PLAN SHEET 3

Discipline: STORMWATER

Drawing No.: 3235084-SK-2006

Rev.: C

Document No. 3235084-SK-2004 TO 2006.DWG

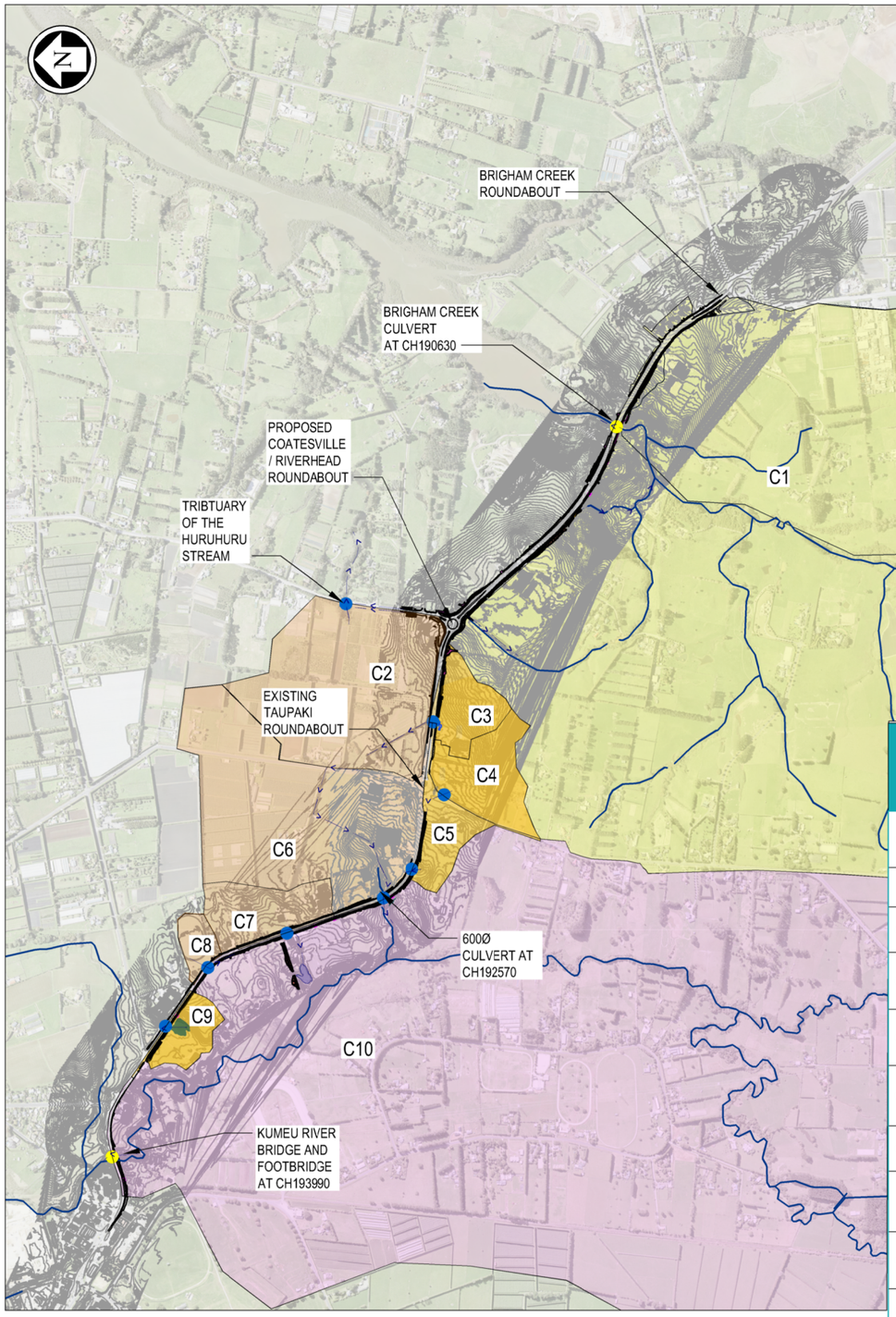
DO NOT SCALE

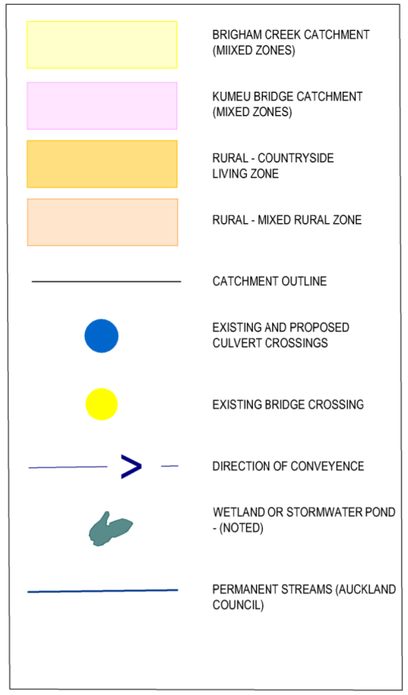
IF IN DOUBT ASK.

www.beca.com

APPENDIX D

CROSS CULVERT CATCHMENT PLAN





Catchment	Chainage	Description / address	Existing Peak Flows Q10 (m3/sec)	Existing Peak Flows Q100 (m3/sec)	Proposed Peak Flows (with Climate Change) Q10 (m3/sec)	Proposed Peak Flows (with Climate Change) Q100 (m3/sec)	Size
C1	CH. 190630	Ngongetepara Stream - Brighan Creek Culvert - BSN196	66.49	110.50	123.40	195.62	8.75m wide Arch Armco Culvert, 37.5m length
	CH. 190940	Outfall from pipe network not Cross Culvert (TBC on site)	Inlet could not be located or survey - assumed redundant				450Ø concrete culvert
C2	Coatesville Riverhead Highway	Tributary of the Huruhuru Stream,	3.31	4.56	4.5	7.51	600Ø concrete culvert
C3	CH. 191900	366 SH16 From existing stormwater pond at (Soljans Estate) flowing North (external Catchment).	0.92	1.46	0.86	1.15	600Ø concrete pipe (MH connections)
C4	CH. 192096	Taupaki Roundabout Road Crossing	1.07	1.54	1.56	2.59	750mm pipe and a 375mm stacked pipe under taupaki road
C5	CH. 192430	418A SH16 From external catchment crossing North. Discharge to headwall grate into roadside drain, Inlet to be confirmed on site	0.50	0.85	0.84	1.39	375Ø concrete culvert (connect to MH)
C6	CH. 192570	429 SH16 - 500m west of Tuapaki Roundabout	3.62	6.04	5.84	9.68	600Ø culvert
	CH. 192920	464 SH16 Roadside drain and external catchment.	Inlet could not be located or survey - assumed redundant				300Ø concrete culvert (Connect to pipe network)
C7	CH. 192940	464 SH16 Roadside drain and external catchment.	1.00	1.68	1.75	2.89	450Ø concrete culvert (Connect to pipe network)
C8	CH. 193260	429 Sh16 External Catchment Discharge to roadside drain	0.27	0.47	0.49	0.81	375Ø concrete culvert
C9	CH. 193510	522 Sh16 Wetland by Old Railway Road	0.42	0.70	0.70	1.09	375Ø concrete culvert, (outlet could not be located on survey, assumed furctional)
C10	CH. 193990	Kumeu No.1 Road Bridge - BSN230					Bridge
* values obtained from post development flows of resource consent 2010							

ORIGINAL DRAWING IN COLOUR

DETAILED DESIGN
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FOR CONSENTING	SB	SF		03.11.22
B	DRAFT DETAILED DESIGN	ES	SB		
A	PRELIMINARY DESIGN	VZ			17.12.20

Drawing Originator: Beca

Original Scale (A1) NTS	Design	S.BRIDGE	09.11.20
Reduced Scale (A3) NTS	Drawn	MC	01.06.18
	Dwg Verifier		
	Dwg Check		

Approved For Construction* Date

* Refer to Revision 1 for Original Signature

Client: WAKA KOTAHI NZ TRANSPORT AGENCY

Project: SH16 - SAFETY IMPROVEMENTS STAGE 2 BRIGHAM CREEK TO KUMEU

Title: STORMWATER CULVERT CROSSING CATCHMENT PLAN

Discipline: STORMWATER

Drawing No.: 3235084-SK-2010 Rev.: C

Document No.: 3235084-SK-2010 STORMWATER CULVERT CROSSINGS

DO NOT SCALE

IF IN DOUBT ASK.

APPENDIX E

KUMEŪ RIVER AND NGONGETEPARA STREAM DEISGN MEMO

Memorandum

To:	Terry Cheng	**Date:**	3 November 2021
From:	Samantha Fraser/Emma Bayfield	**Our Ref:**	3235084-1390048858-10962
Copy:	Gareth Clayton, Justin Kirkman		
Subject:	SH16 Stage 2 - Brigham Creek Flood level		

1 Introduction

1.1 Purpose

Beca are completing the design of the SH16 Stage 2 Road Safety Improvements Project for Waka Kotahi. This document has been prepared to provide hydraulic inputs for the structural design of a new pedestrian bridge structure over Ngongetepara Stream. The pedestrian bridge will service the Shared Use Path (SUP), which is being constructed on the southern side of SH16 for the extent of this Project, from Brigham Creek to Kumeu Township.

1.2 Location

The Site is located at the eastern extent of the SH16 Stage 2, to the West of Brigham Creek Roundabout. The bridge for the SUP will span over Ngongetepara Stream, which is an incised permanent stream within the Redhills Catchment. Refer to Figure 1 for the Site location.

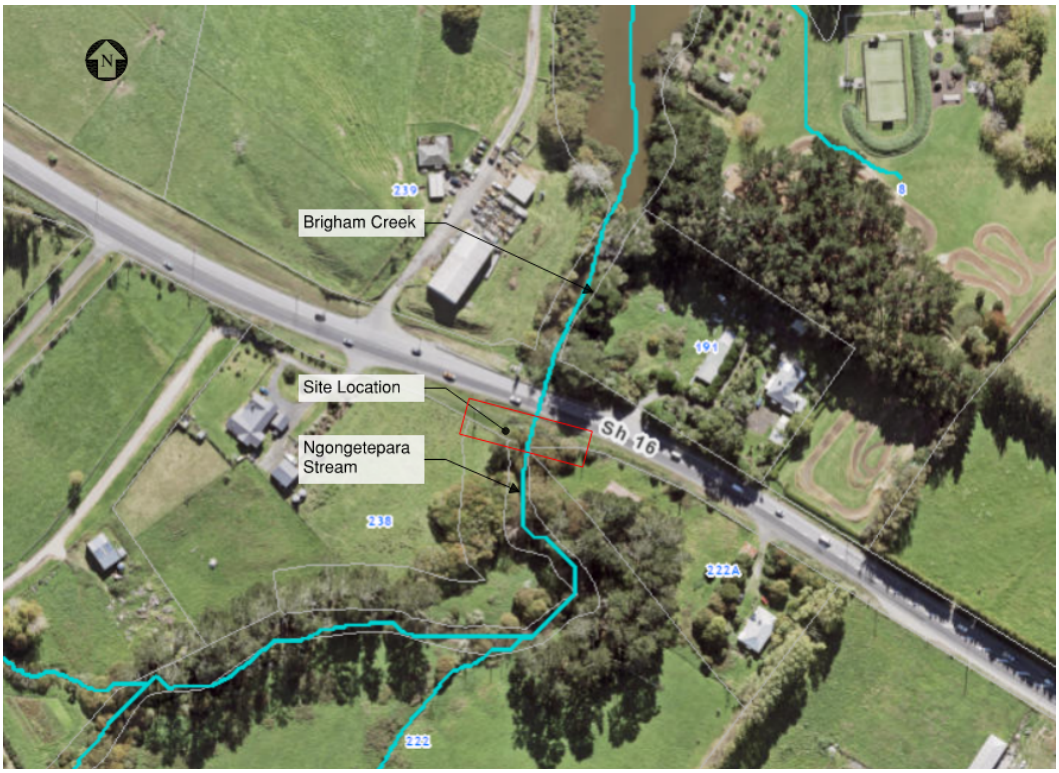


Figure 1: Aerial image showing location of new bridge structure, Ngongetepara Stream and Brigham Creek

The new SUP bridge structure will be located on the southern side of the SH16 , which is the upstream approach of Ngongetepara Stream. There is an existing arch culvert at this location, which is referred to as the Brigham Creek Culvert. Details are outlined in Table 1 below.

Table 1: Existing culvert structure and location chainage

Name Reference	Stream Name	Stream Classification	Size	Chainage	Comment
Brigham Creek Culvert	Ngongetepara Stream	Permanent River or Stream	8.75m wide Arch Armco Culvert, 37.5m length	CH. 190630	West of Kennedys Road BSN196

1.3 Scope

The scope of work will provide inputs for the design of the new pedestrian bridge structure. The NZTA Bridge Manual requires consideration of the following hydraulic inputs:

- Flood levels and velocities for the following events which correspond to Serviceability Limited State (SLS) and Ultimate Limit State (ULS) events for bridge design.
  - 1 in 25 year (SLS)
  - 1 in 50 year (SLS)
  - 1 in 500 year (ULS)
  - 1 in 1000 year (ULS)
- Description of catchment to assess the potential for trees (and therefore debris striking the structure or blocking the waterway) in the catchment.

This standard approach would see the new bridge structure set at a freeboard above the 100-year flood level (including allowance for climate change). The existing culvert at this location does not meet the freeboard requirements given in the manual and presently floodwaters are predicted to surcharge the top of the culvert in events as small as the 25-year event.

If the design of the new SUP followed the bridge manual freeboard recommendations, the new bridge structure would be set significantly higher than the existing culvert and SH16 road level. Instead, Departure Request 001 was sought from Waka Kotahi to set the bridge deck to match the existing road levels.

Because floodwaters have been predicted to exceed the top of the culvert and / or overtop the existing road level within the range of design events typically considered, a modified approach has been adopted. Rather than determining the design velocity at the bridge approach for the four design flows given in the manual, a range of flows have been modelled to determine the critical flow velocity for ULS design. These have been developed based on the design events above and two scenarios for the increase in Climate Change.

Memorandum

3 Design Criteria

3.1 Reference Documents

The following platforms have been reviewed for the assessment of Ngongetepara Stream at this location:

- Redhills Stormwater Management Plan (Auckland Council, Auckland 2016)
- Survey Data completed 2021 by Beca
- Auckland Council Geo Maps
- Brigham Creek Culvert original construction drawings dated 1983

3.2 Rainfall Depth

The rainfall depths presented in Table 2 and Figure 2 are based on the Guidelines for stormwater runoff in the Auckland Region (TP108) with allowances for Climate Change provided by versions of Auckland Council Stormwater Code of Practice (SWCoP) as wells as the NIWA HIRDS data set with a range of climate change projections .

Table 2: 24hr Rainfall Depths based on TP108

Rainfall Event	TP108	TP108 with 2.1° increase for Climate Change (version 2)	TP108 with 3.8° increase for Climate Change (version 3)
2-year ARI (50% AEP)	83mm	91mm	106mm
10-year ARI (10% AEP)	130mm	147mm	170mm
25-year ARI (4% AEP) [1]		177mm	205mm
50-year ARI (2% AEP)	170mm	199mm	227mm
100-year ARI (1% AEP)	190mm	221mm	252mm
500- year ARI[1]		281mm	315mm
1000- year ARI[1]		307mm	341mm

[1]Derived from a Log Relationship.

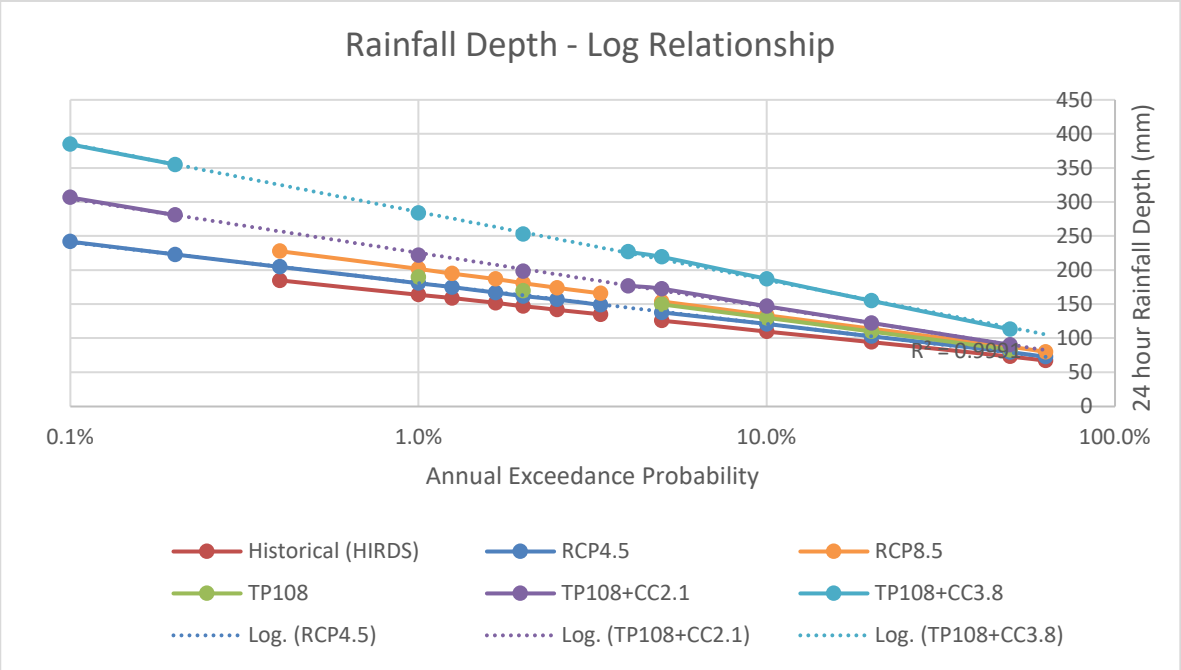


Figure 2: Graph showing log relationship for 24-hour rainfall depth (mm)

3.3 Climate Change

Auckland Council released an updated Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater to Version 3 in September 2021. The significant change in the documents relates to the impacts of climate change on the future rainfall depths and intensities to be used in stormwater design. At the time of release, it was proposed that this version will be considered the operative version of the Auckland Council's Code of Practice from 18 January 2022. The release of this document coincided with this assessment for SH16 Stage 2 Project.

The climate change effects under SWCoP Version 2, were based on a forecast temperature increase of 2.1 degrees increase by 2090, in accordance with Table 5.2 of Climate Change Effects and Impact Assessment: A Guidance Manual for Local Government in New Zealand (Ministry for the Environment, 2008). Forecasted changes in the climate have been included in the design of stormwater infrastructure for well over a decade.

Version 3 (September 2021) of the Auckland Council SWCoP had modified the increase in Climate Change to 3.8 degrees increase in temperature by 2110, based on the Ministry for the Environment, 2018: Climate Change Projections for New Zealand, and the NIWA, 2020: Auckland Region Climate Change Projections reports. The effect of this release increased rainfall depths, therefore increasing peak stormwater flows by an additional 30-35% (from the 2.1 degree increase in Climate Change). This change significantly increases stormwater design flows and predicted flooding levels.

Communications with Auckland Council advised that the flood models or the flood plains on the Auckland Council GeoMaps were not updated for the increase Climate Change. A meeting was held with Healthy Waters on 10/9/2021 to discuss the project. Comments from the meeting minutes state

"HW note that this modelling does not take into account the new recommended Climate Change increases and these should be taken into account when assessing the capacity of the culverts…. AC will not provide updated flood plains and catchment management plans" (Meeting Minutes, Oct 2021)

A new Version 3 was released in January 2021, which reduced the Climate Change increase back down to 2.1 degree increase. This assessment still includes the assessment of the 3.8 degree increase on Climate Change in the HEC-RAS model to understand the impact it will have on the development.

3.4 Freeboard

The following bridge freeboard is required under the NZ Bridge Manual for new structures. There is possibility that large trees may be carried down the waterway in this location, so the larger freeboard of 1.2m would apply. Neither the existing culvert nor the proposed new bridge at this location will meet any of these freeboard requirements.

Page 2-16

2.3.4 Hydraulics

a. Freeboard for level of serviceability to traffic

When considering the level of serviceability to traffic required by 2.3.2(d), the freeboards given in table 2.4 shall be used.

Table 2.4: Freeboard allowance for the level of serviceability to traffic

Waterway structure	Situation	Freeboard	
		Measurement points	Depth (m)
Bridge	Normal circumstances	From the predicted flood stage to the underside of the superstructure	0.6
	Where the possibility that large trees may be carried down the waterway exists		1.2
Culvert (including major culverts)	All situations	From the predicted flood stage to the road surface	0.5

Figure 3: NZ Bridge Manual Freeboard Requirements

4 Ngongetepara Stream and Brigham Creek Culvert

A new Shared Use Path bridge structure will be constructed as part of the SH16 Stage 2 project. It will span across Ngongetepara Stream on the southern side of State Highway 16. This bridge structure will be constructed adjacent to the existing Brigham Creek Culvert on the southern, upstream side.

4.1 Existing Environment and catchment

The location of the new SUP is located on the upstream side of SH16. This location is at the downstream end of the Ngongetepara Stream within the Red Hills catchment in Auckland. Ngongetepara Stream is culverted under SH16 road carriageway where is continues into Brigham Creek over an existing weir structure. The location of the weir, approximately 35m downstream, is the demarcation of the Coastal Marine Area (CMA). Due to the flat nature of the stream in this area, there is potential in the future for seawater ingress to the site, driven by the tide and future sea level rise.

The Redhills Catchment is 1366.12Ha (Auckland Council Geo Maps) of which 1104.7Ha is upstream of SH16. The catchment length is approximately 5.533Km with a slope of 0.6%. Refer to Figure 4 below for the Site location and catchment.

Under the Auckland Unitary Plan zoning, the upstream catchment area is largely Rural Countryside Living Zone to the west. The eastern side of the catchment is made up of Future Urban Zone and a variety of Residential Housing Zones. Refer to Section 4.2.1 for the upstream catchment impervious cover.

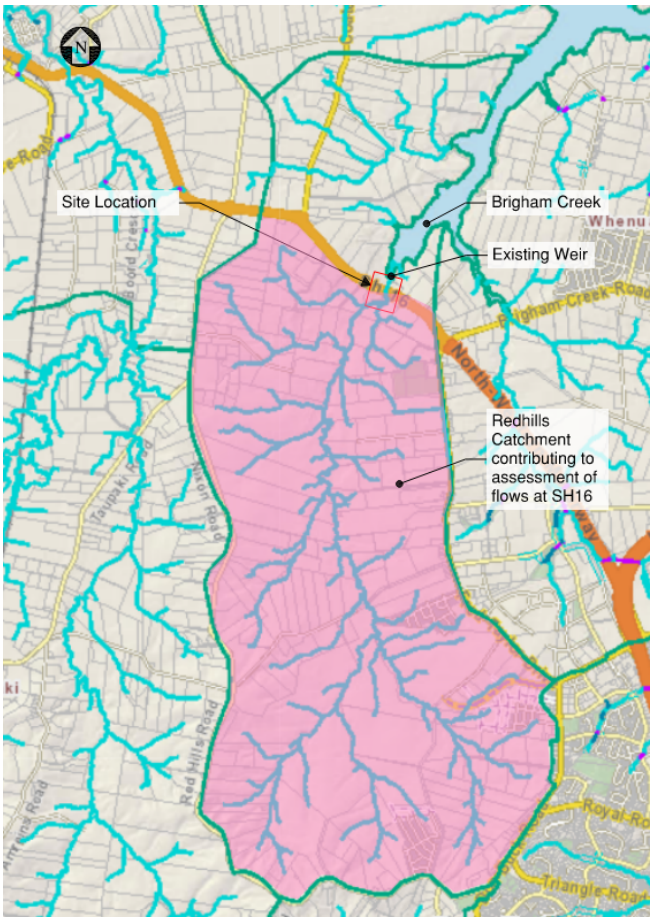


Figure 4: Auckland Council Geo Maps showing upstream Redhills Catchment

4.2 Existing Structure

The culvert under SH16 is referred to as Brigham Creek culvert (BSN196). It is a metal multi plate arch culvert constructed around 1983. The arch culvert is supported on reinforced concrete footings founded on bedrock. The culvert is 3.5m high from top of footing to top of culvert. It is 8.75m wide and the total length is approximately 38m. Concrete footing depths vary with bedrock levels along the length of the culvert. These details have been extracted from the Brigham Creek Bridge Replacement Contract Drawings, for the Ministry of Works and Development, dated 1983. The following levels have been surveyed by Beca. All levels are in NZVD2016

Table 3: Surveyed levels on SH16 and around the new SUP location

Location	Level (RL m)
SH16 Road - Southern Edge of Seal at low point	8.45
SH16 Road - Centreline at low point	8.58
SH16 Road - Northern Edge of Seal at low point	8.7
Upstream - Top of Culvert	6.1
Upstream - Left Bank Invert (east)	1
Upstream - Right Bank Invert (east)	2.1
Channel Invert (approximate)	0.3 – 1.3

The Stream is incised, with vegetation no the existing banks. There is evidence of scour located upstream of the existing culvert around the outfalls.

Figure 5: Existing Arch Culvert at Ngongetepara Stream. Left: Immediately upstream of the culvert looking at the true left bank with existing outfall | Right: Immediately upstream of the culvert looking at true right bank (image from October 2021).

4.3 Design Inputs

4.3.1 Stormwater Runoff Modelling Inputs

The information below set out the values used in the assessment of the stream flows at the site.

Design Criteria	Value	Comment
Total Catchment	1104.7Ha	Total Upstream Catchment to the Site
Existing Total Impervious	55.2Ha	5% Impervious cover
Existing Total Pervious	1049.4Ha	95% Pervious cover
MPD Total Impervious	484Ha	44% Impervious cover
MPD Total Pervious	620Ha	56% Pervious cover
Catchment Length	5.533Km	
Slope	0.6%	
Curve Number Pervious	74	
Curve Number Impervious	98	

4.3.2 Stormwater Flows

The following stormwater flows have been calculated at the Site using TP108.

The existing TP108 rainfall depths were adjusted for climate change based on the Auckland Council Code of Practice for Land Development and Subdivision – Stormwater Chapter 4.

Table 4: Existing and future flow at SH16

Storm Event (ARI)	Existing Scenario Stormwater Flow (m^3/s)	Future Scenario Stormwater Flow (m^3/s)	
		MPD and 2.1degree increase in rainfall	MPD and 3.8 degree increase in rainfall
10 year	44.1	66.1	78.5
25 year	-	-	97.9
50 year	-	-	110.2
100 year	74.9	107.3	124.2
500 year	-	140.5	159.8
1000 year	-	155.2	174.5

4.4 Proposed Design

The works proposed at Ngongetepara Stream includes the construction of a new pedestrian bridge for the Shared Use Path on the southern side of State Highway 16 and Brigham Creek Culvert.

A new single span Shared Use Path bridge is proposed on the upstream side of Ngongetepara Stream. The proposed abutments are expected to be set far enough from the riverbank with the intention to not disturb the existing culvert and the riverbank if possible. This will also minimise any change on Ngongetepara Stream cross-sectional area upstream of Brigham Creek Culvert. This approach will minimise any new potential scour of the riverbank and minimise any change in flood water levels after the SUP is constructed.

The top of existing culvert is at approximately RL 6.10m. At the centreline of existing culvert, the top of bridge deck is at approximately RL 8.70m and the bridge soffit is at approximately RL 7.27m.

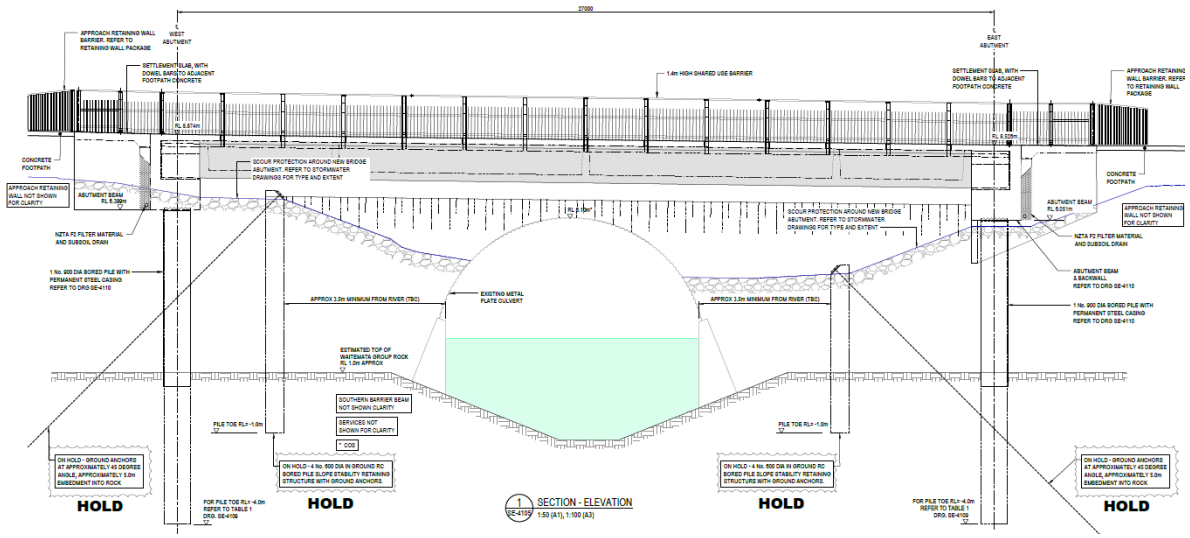


Figure 6: Image of existing culvert with indicative new bridge structure developed the structural team.

5 Flood Levels and Velocities

The flood levels and flows at the Site have been estimated utilising:

- Auckland Council Geo Maps floodplain layer
- Redhills Stormwater Management Plan (Auckland Council, Auckland 2016)
- A TP108 single catchment flow calculation and HEC-RAS Modelling – developed by Beca for this project.

The results from these have been reviewed and are summarised in the following sections.

5.1 Auckland Council Geo Maps Flood Plain Layer

The 1% AEP event flood levels have also been estimated using the Auckland Council Geo Maps “floodplain” layer and contour layers to provide a very rough estimate of flood levels near the existing culvert. This indicates that the 100-year flood plain is at RL10.5 and extends for a width of 153.3m. This flood plain extent shows significant overtopping of SH16.

Email Communications with Healthy Waters have indicated that the flood extents shown in the Geo Maps in not appropriate to use, as the culvert under SH16 has not been included in the model, therefore this flood water level can be disregarded. Refer to the email communications attached.

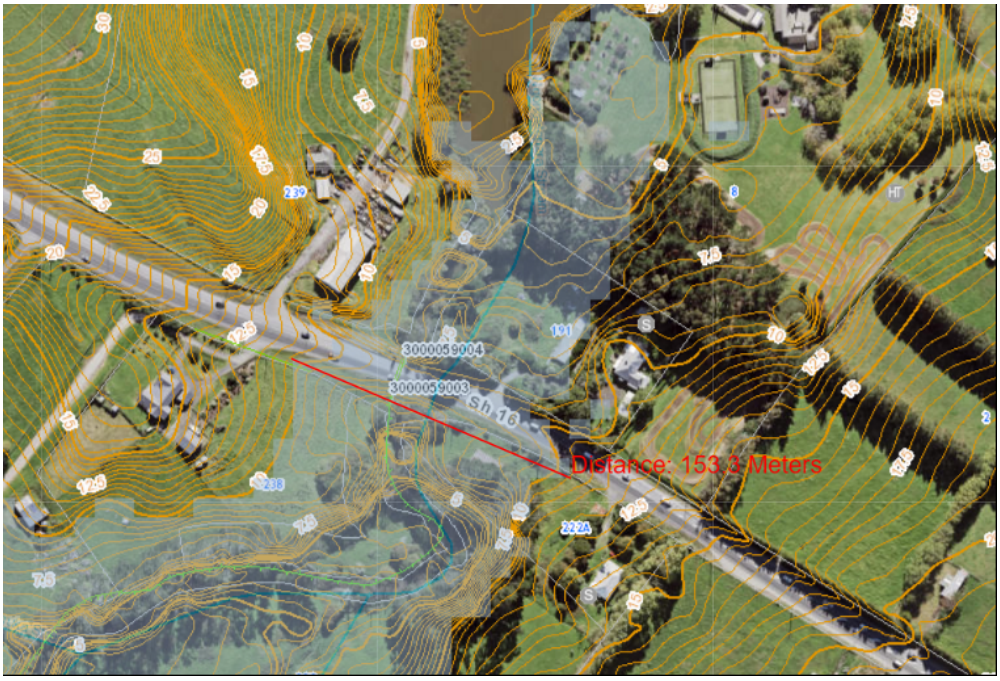


Figure 7: Auckland Council Geo Maps Flood Plain at SH16 and Brigham Creek Culvert

5.1.1 Redhills Catchment Stormwater Management Plan

The Redhills Catchment Stormwater Management Plan (SMP) report was prepared by Harrison Grierson for Auckland Council in August 2016. The document was produced to facilitate long-term sustainable development within the catchment to inform the Network Discharge Consent, which was being prepared at the time. It also includes the Redhills Rapid Flood Hazard Modelling Report, dated December 2015 by Harrison Grierson for the Redhills Landowner Consortium.

The model was developed using Infoworks ICM modelling software using rain on grid. TP108 10 year and 100 year design storms have been followed in the methodology, with allowance for Climate Change of 16.8% (consistent with 2.1degree increase on rainfall). The 100 year mapping showed minimal difference between the existing and maximum probable development (MPD) scenarios. The MPD is based on the Proposed Auckland Unitary Plan zoning.

Maps of the flood outline based on the ICM model results were provided in the Rapid Flood Hazard Modelling Report. These indicate that the flood levels do not overtop SH16 in the 100 year MPD scenario. It is estimated from these maps that the 100 year MPD flood water level is at approximately between RL7.5 - 8m.

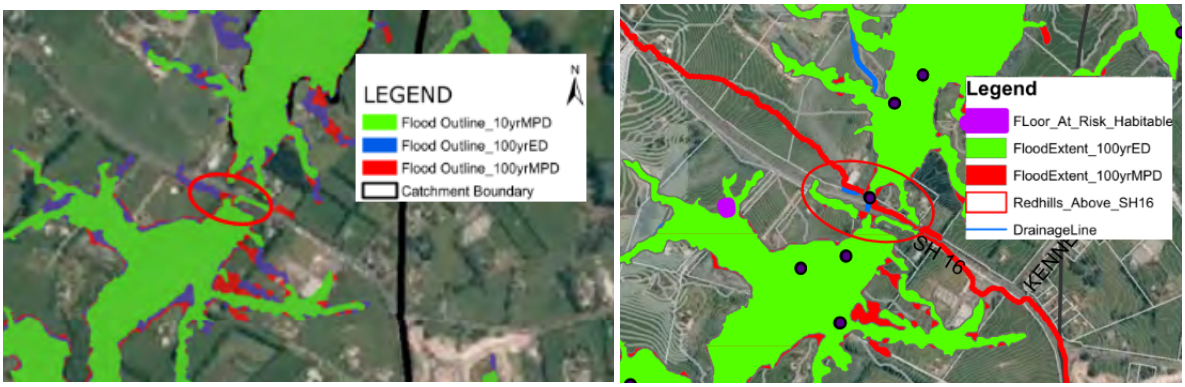


Figure 8: Images showing the 10 yr (left) and 100 yr right) flood water level from the Redhills Rapid Flood Hazard Modelling Report

5.1.2 HEC-RAS Model

HEC-RAS Version 6.0.0 has been used to model the existing and MPD events in a 1d model. Beca developed this model for the SH16 Stage 2 Project for this assessment only. The existing terrain used for the catchment was Auckland LiDAR 1m DEM (2013) in NZVD2009 vertical datum, but the final results are reported in NZD2016.

The survey points of the site from in September 2021 in NZVD 2016 were converted to NZVD 2009. The survey covered ~30m upstream and ~70m downstream of the culvert so this enabled the channel to be compared to the existing LiDAR. As the LiDAR is limited by vegetation and water surface, the invert of the channel and stream banks was adjusted lower to reflect the spot levels of the survey. From looking at aerial photographs the stream has always been surrounded by dense, tall trees hence the different levels.

The model extended 200m upstream and 50m downstream of the culvert. The difference found between the LiDAR and surveyed cross section at the culvert location was applied to all the cross sections within the model. Where survey information was available, this information was used. The invert of the channel within the culvert was assumed.

The downstream water level for the model is driven by the tide event. This was assessed for Mean Sea Level, Mean High Water Springs and Mean High Water Springs with 1m of Sea Level Rise.

The model is based on the existing topography and has not been modelled with the new bridge structure, as this is expected to be located out of the flood water level. The topography also includes the existing weir remains in place. If the weir is removed in the future, further assessments and investigation will need to be carried out.

Figure 9 below shows the model set out and the location of the cross sections used in reporting the results.

Memorandum

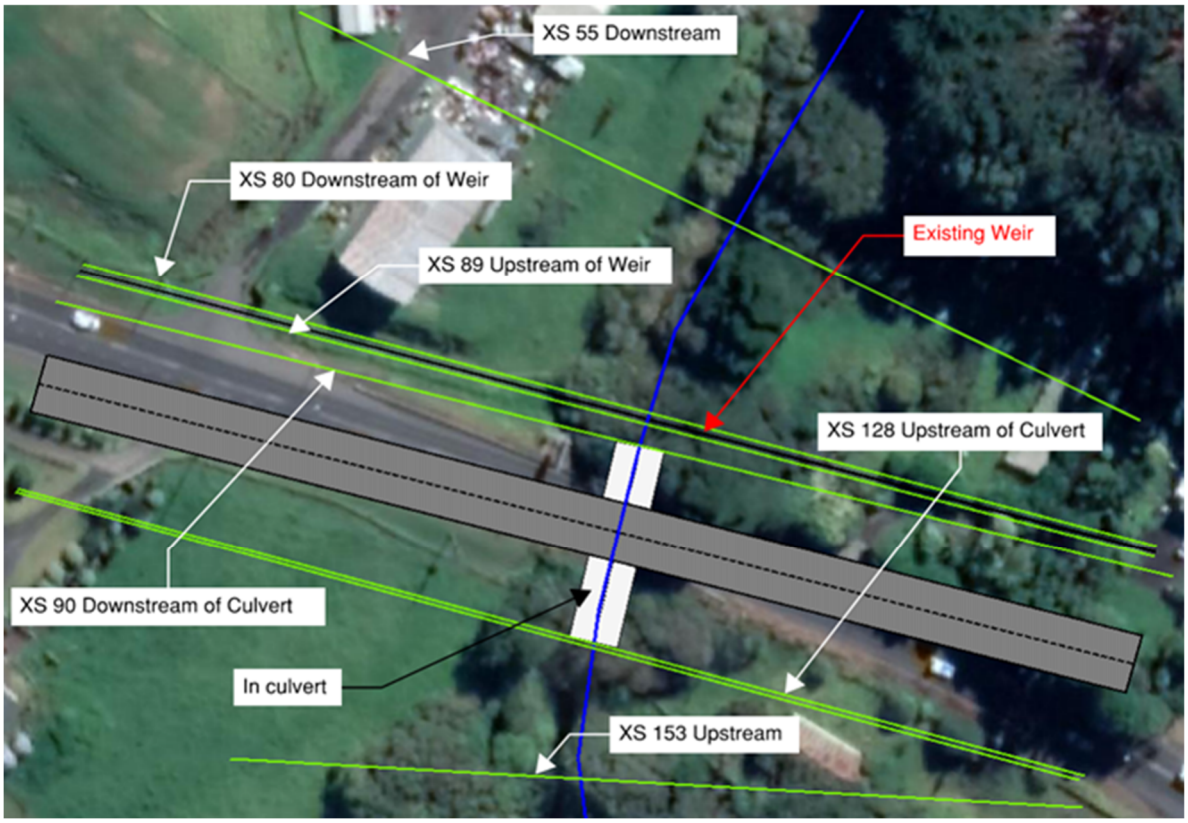


Figure 9: Image showing set out of HEC-RAS model and locations of the cross sections reported.

The model has been run using TP108 calculations based on a climate change increase of 3.8 degrees and 2.1d egrees, with the upstream MPD scenario as outline above in Section 4.3. The following table outlines the flow, velocity and water levels at two cross sections upstream of the existing culvert. The soffit of the new bridge is at RL7.27m at the centreline of existing culvert.

Table 5: Ngongetepara Stream results for 3.8 degree temperature increase and MPD (NZVD 2016)

Storm Event	Rainfall Depth (mm 24hr) – 3.8 degree	Flow Calculation (m3/s)	Cross Section 128		Cross Section 153	
			Average Velocity at culvert (m/s)	Upstream Water Surface Level culvert (RL m)	Average Velocity Upstream culvert m/s)	Upstream Water Surface Level culvert (RL m)
1/10	170	78.5	1.35	5.53	1.11	5.58
1/25	205	97.9	1.29	6.16	1.14	6.20
1/50	227	110.2	1.26	6.57	1.15	6.60
1/100	252	124.2	1.21	7.04	1.14	7.06
1/500	315	159.8	1.03	8.33	1.07	8.33
1/1000	341	174.5	0.97	8.76	1.04	8.76

Table 6: Ngongetepara Stream results for 2.1 degree temperature increase and MPD (NZVD 2016)

Storm Event	Rainfall Depth (mm 24hr) – 2.1 degree	Flow Calculation (m3/s)	Cross Section 128		Cross Section 153	
			Average Velocity at culvert (m/s)	Upstream Water Surface Level culvert (RL m)	Average Velocity Upstream culvert m/s)	Upstream Water Surface Level culvert (RL m)
1/10	147	51.6	1.36	5.40	1.07	5.18
1/100	221	107.3	1.27	6.75	1.15	6.50
1/500	281	140.5	1.14	7.89	1.12	7.62

The existing edge of seal on the southern side of SH16 at the low point is RL8.45m. This indicates that the water level will only encroach onto SH16 and overtop the road in the 1 in 1000 year event. As the new bridge structure has a soffit of R7.27m, which is above the top of the culvert at RL6.1m the cross-sectional area for the flow through the culvert will not be affected by the new structure.

The results for the 1 in 100 year event, with 2.1 degree and 3.8 degree increase in Climate Change, both have a maximum water level below the soffit of the new structure, with an expected water level of RL6.75m and RL7.04m respectively immediately upstream of the culvert. In events greater than the 1 in 100 year event, it is expected that the water level will encroach above the soffit the new structure and the velocity of the stream will need to be considered in the design.

5.2 Flow and Velocity Conclusion

Based on the assessment of the flow, velocity and water level at the Site location, it is recommended that the HEC-RAS model results should be utilised in the structural design of the SUP. Flow and velocity data was not provided in the flood plain mapping from Auckland Council GeoMaps Flood Plain or the Redhills SMP Rapid Flood Hazard Model. Auckland Council have also confirmed that the GeoMaps Flood Plain results should not be used and have therefore been disregarded. The Redhills SMP Rapid Flood Hazard Model can be used as an indicative comparison to the HEC-RAS model developed for this assessment, however this does not utilise any survey data at the Site. The HEC-RAS model includes the use of survey information at this location, it is expected that the water level results would be a better representation for design and are slightly lower than the Redhills SMP Rapid Flood Hazard Model results.

The HEC-RAS model has been based on two Climate Change scenarios of 2.1degrees increase and 3.8degree increase. As the water level, flows and velocities are driven by the existing structure, rather than the new structure, a range of flow conditions and velocities for the bridge structural design should be considered. These are outlined in Table 7 below.

Table 7: Ngongetepara Stream results and new structure levels

Storm Event (Climate Change Scenario)	Rainfall Depth (mm 24hr) – with Climate Change	Flow Calculation (m3/s)	Cross Section 128	
			Average Velocity at culvert (m/s)	Upstream Water Surface Level culvert (RL m)
Existing Culvert Top of Culvert RL6.10m				
1/100 (2.1°)	221	107.3	1.27	6.75
1/100 (3.8°)	252	124.2	1.21	7.04
New Structure: Soffit Level RL7.27m at centre line of culvert				
1/500 (2.1°)	281	140.5	1.14	7.89
1/500 (3.8°)	315	159.8	1.03	8.33
New Structure: Top of Bridge Deck Level RL 8.70m at centre line of culvert and existing road level				
1/1000 (3.8°)	341	174.5	0.97	8.76

6 Other Considerations

6.1 Debris and Log impact Risk

The upstream catchment is largely cleared catchment upstream (mainly farmland) and flat catchment. The downstream section of the catchment within the channel there are a large number of trees and there is a risk of logs being washed down the stream during flood event. This needs to be considered in the design of the structure and attached services, as well as for maintenance.

6.2 Scour

Scour protection through the existing channel is not proposed as part of the project as the increase in flows into Ngongetepara Stream is less than minor on the stream. Erosion protection for the existing channel is not within the scope of the project. Erosion and scour protection will be design at the stormwater outfalls.

Scour protection is recommended around the new abutments of the bridge structure. Due to the location of the abutments, with SH16 on the downstream side, it is expected that the velocities in this area will be minimal.

The size, location and depth of the rock required will be determined when the structural design has been completed. The rock sizing and detail will be added to the structural drawings.

It is expected that this will be D_{50} = 0.3m and with a depth of 0.5-1m.

Attachments

Email Communication from Healthy Waters – Culvert structure on SH16 has not been included in Auckland Council Geo Maps Flood Plains.

Samantha Fraser

From: Shannon Bridge
Sent: Friday, 27 August 2021 8:11 AM
To: Samantha Fraser
Subject: Fwd: Brigham Creek - Ngongetepara stream ref# 8702480727 26Aug21
Attachments: R001v4red-140295-01-SMP-dlc.pdf

Sam.

Geomaps doesn't include the SH16 structure.

Thanks
Shannon

Get Outlook for Android

From: Carmel O'Sullivan <carmel.osullivan@aucklandcouncil.govt.nz>
Sent: Thursday, 26 August 2021, 8:39 pm
To: Shannon Bridge
Cc: HWDevelopment; Gemma Chuah
Subject: FW: Brigham Creek - Ngongetepara stream ref# 8702480727 26Aug21

> You don't often get email from carmel.osullivan@aucklandcouncil.govt.nz. Learn why this is important

Dear Shannon

As Will noted the current floodplain shown on geomaps does not include a structure at that location. Hence, it appears overtops.

Please find attached a draft SMP for the catchment. Appendix 4 of the SMP contains a model report that was prepared for the Redhills Landowner Consortium.

Regards
Carmel

From: William Southorn <william.southorn@aucklandcouncil.govt.nz> **On Behalf Of** HWDevelopment
Sent: Thursday, 26 August 2021 8:52 am
To: Gemma Chuah <Gemma.Chuah@aucklandcouncil.govt.nz>; Carmel O'Sullivan <carmel.osullivan@aucklandcouncil.govt.nz>
Subject: FW: Brigham Creek - Ngongetepara stream ref# 8702480727

Morning Gemma and Carmel,

Would you be able to provide any relevant SMP and CMP info for this site?

Cheers,
Will

From: Shannon Bridge <Shannon.Bridge@beca.com>
Sent: Wednesday, 25 August 2021 8:42 PM
To: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Subject: Re: Brigham Creek - Ngongetepara stream ref# 8702480727

William

Thanks your for the reply.

Can we get a copy of the Redhills Stormwater Management Plan or any information wrt to the current model.

The GEOMAPS shows the culvert under SH16 being over topped. See image clipped above.

Thanks
Shannon

Get Outlook for Android

From: William Southorn <william.southorn@aucklandcouncil.govt.nz> on behalf of HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Sent: Wednesday, 25 August 2021, 2:47 pm
To: Shannon Bridge
Subject: RE: Brigham Creek - Ngongetepara stream ref# 8702480727

> You don't often get email from hwdevelopment@aucklandcouncil.govt.nz. Learn why this is important

Good afternoon Shannon,

Thank you for your enquiry,

Currently there aren't any specific development plans to look at the SH16 crossing, as the current modelling supporting the Redhills Stormwater Management Plan assumes MPD and does not indicate that the highway would flood in response to 100-year event.

The modelling on GeoMaps is still showing the 2009 DHI Regionwide model and the latest Regionwide modelling would not include the bridge.

Regards,

William Southorn
Customer Specialist
Healthy Waters I Infrastructure and Environmental Services

Congratulations to Healthy Waters on becoming a top 50 finalist in the 2021 Global Challenge "find out more"

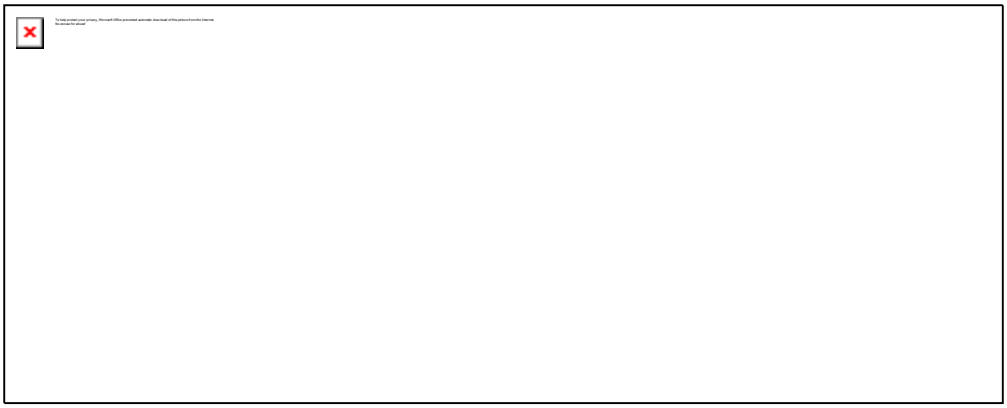
From: Shannon Bridge <Shannon.Bridge@beca.com>
Sent: Wednesday, 25 August 2021 10:48 AM
To: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Subject: Brigham Creek - Ngongetepara stream

Morena,

Hi my name is Shannon and I am working on the Sh16 stage 2 project Kumeu To Brigham Creek.

Is there any development plans to upgrade the capacity of the Ngongetepara stream culvert at Sh16 due to the development of the Redhills Catchment.

Thanks
Shannon Bridge
Civil Engineer
Beca
Phone: +64-9-300 9000
Mobile: +64-21-0566-643
Shannon.Bridge@beca.com
www.beca.com



Memorandum

To:	Terry Cheng	**Date:**	31 August 2022
From:	Dale Paice / Samantha Fraser	**Our Ref:**	3235084-1390048858-10962
Copy:	Gareth Clayton, Justin Kirkman		
Subject:	SH16 Stage 2 – Kumeu River Flood level		

1 Introduction

1.1 Purpose

Beca are completing the design of the SH16 Stage 2 Road Safety Improvements Project for Waka Kotahi. This document has been prepared to provide hydraulic inputs for the structural design of a new pedestrian bridge structure over Kumeu River. The pedestrian bridge will service the Shared Use Path (SUP), which is being constructed on the southern side of SH16 for the extent of this Project, from Brigham Creek to Kumeu Township.

1.2 Location

The Site is located at the western extent of the SH16 Stage 2 project at the entrance to Kumeu Township. The bridge for the SUP will span over Kumeu River, which is an incised permanent stream. Refer to Figure 1 for the Site location.

Figure 1: Aerial image showing location of new bridge structure and Kumeu River

The new SUP bridge structure will be located on the southern side of the existing road bridge, which is the upstream approach of Kumeu River. There is an existing footbridge on the northern side of the existing road bridge (downstream side of Kumeu River). The existing road bridge and footbridge structures at this location are outlined in Table 1 below.

Memorandum

Table 1: Existing bridge structure locations chainage

Name Reference	Stream Name Crossing	Stream Classification	Structure	SH16 Chainage	Comment
Kumeu No.1 Road Bridge	Kumeu River	Permanent River or Stream	Road Bridge	CH. 193990	Structure reference BSN230; Kumeu No.1 Bridge
Kumeu footbridge	Kumeu River	Permanent River or Stream	Footbridge	CH. 193990	Located on northern side of road bridge

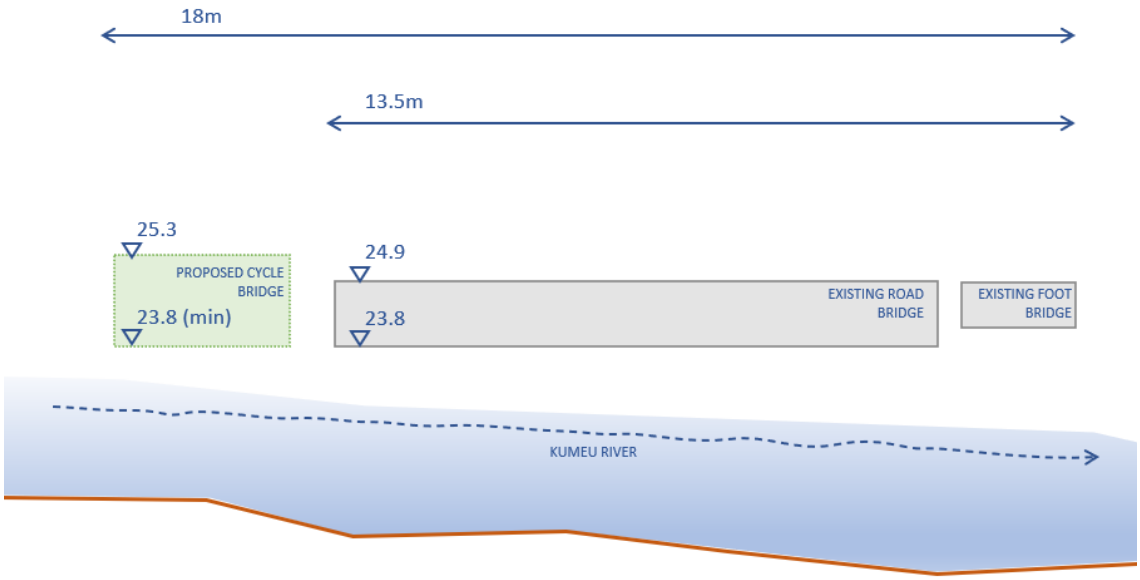


Figure 2: Indicative section through proposed and existing bridge structures

1.3 Scope

The scope of work will provide inputs for the design of the new pedestrian bridge structure. The NZTA Bridge Manual[1] requires consideration of the following hydraulic inputs:

- Flood levels and velocities for the following events which correspond to Serviceability Limited State (SLS) and Ultimate Limit State (ULS) events for bridge design.
  - 1 in 25 year (SLS)
  - 1 in 50 year (SLS)

[1] NZTA (2014). "Bridge Manual". NZTA Bridge Manual 3rd Edition, New Zealand Transport Agency (NZTA), NZ.

  - 1 in 500 year (ULS)
  - 1 in 1000 year (ULS)
- Description of catchment to assess the potential for trees (and therefore debris striking the structure or blocking the waterway) in the catchment.

This approach would see the new bridge structure set at a freeboard above the 100-year flood level (including allowance for climate change). The existing bridges at this location do not meet the freeboard requirements of the Bridge Manual given the floodwaters are predicted to reach the existing bridge soffits in the 100-year event with no freeboard allowance possible.

If the design of the new SUP followed the bridge manual freeboard recommendations, the new bridge structure would be set significantly higher than the existing bridges. Instead, it has been agreed between Beca and Waka Kotahi to set it the minimum bridge soffit to match the existing bridges as shown on Figure 2 (Departure Request 001).

Because floodwaters have been predicted to reach and / or overtop the bridge within the range of design events typically considered, a different approach has been adopted. Rather than determining the design velocity at the bridge approach for the four design flows given in the manual, a range of flows have been modelled to determine the critical flow velocity for ULS design.

2 Design Criteria

2.1 Reference documents

The following documents and platforms have been reviewed for the assessment of Kumeu River at this location:

- Kaipara-Kumeu Catchment Management Plan – Hydraulic Modelling, Rodney District Council, December 2009
- Kumeu Footbridge Construction Plans - Rodney District Council Kumeu Gateway Footbridge, by OPUS, dated between 2005 and 2006
- Survey Data completed 2021 by Beca
- Auckland Council Geo Maps.

2.2 Rainfall Depth

The rainfall depths presented in Table 2 and Figure 3 are based on the Guidelines for stormwater runoff in the Auckland Region (TP108) with allowances for Climate Change provided by versions of Auckland Council Stormwater Code of Practice (SWCoP) as wells as the NIWA HIRDS data set with a range of climate change projections .

Table 2: 24hr Rainfall Depths based on TP108

Rainfall Event	TP108 with 0.0° increase for Climate Change	TP108 with 2.1° increase for Climate Change	TP108 with 3.8° increase for Climate Change
2-year ARI (50% AEP)	83mm	91mm	106mm
10-year ARI (10% AEP)	130mm	147mm	170mm
25-year ARI (4% AEP) [1]		177mm	205mm
50-year ARI (2% AEP)	170mm	199mm	227mm
100-year ARI (1% AEP)	190mm	221mm	252mm
500- year ARI[1]		281mm	315mm
1000- year ARI[1]		307mm	341mm

[1]Derived/extrapolated using a Log-normal Relationship ploted using known data points.

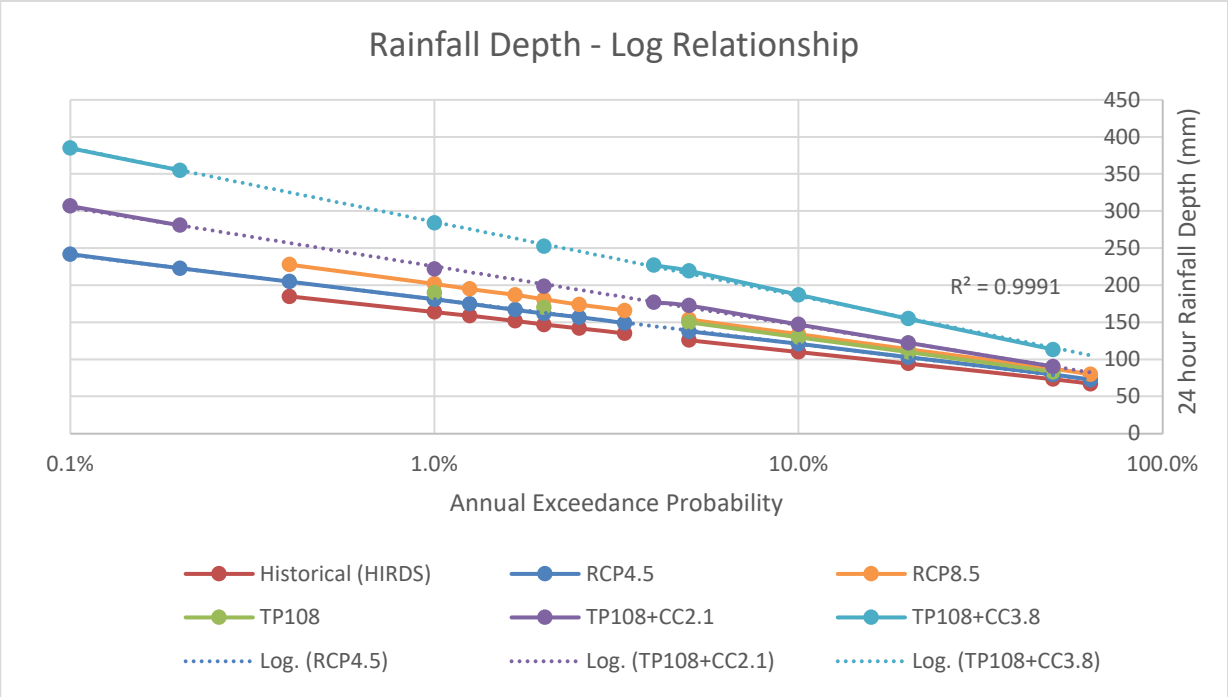


Figure 3: Graph showing log relationship for 24-hour rainfall depth (mm)

2.3 NZ Bridge Manual Freeboard requirements

The following bridge freeboard is required under the NZ Bridge Manual for new structures. There is possibility that large trees may be carried down the waterway in this location, so the larger freeboard of 1.2m would apply. Neither the existing nor the proposed new bridge at this location will meet any of these freeboard requirements.

Page 2-16

2.3.4 Hydraulics

a. Freeboard for level of serviceability to traffic

When considering the level of serviceability to traffic required by 2.3.2(d), the freeboards given in table 2.4 shall be used.

Table 2.4: Freeboard allowance for the level of serviceability to traffic

Waterway structure	Situation	Freeboard	
		Measurement points	Depth (m)
Bridge	Normal circumstances	From the predicted flood stage to the underside of the superstructure	0.6
	Where the possibility that large trees may be carried down the waterway exists		1.2
Culvert (including major culverts)	All situations	From the predicted flood stage to the road surface	0.5

Figure 4: NZ Bridge Manual Freeboard Requirements

3 Kumeu River and Bridge Structures

A new Shared Use Path bridge structure will be constructed as part of the SH16 Stage 2 project. It will span across Kumeu River on the southern side of State Highway 16. This bridge structure will be constructed adjacent to the existing Kumeu No.1 bridge (road bridge) on the southern side.

3.1 Existing Environment and catchment

The location of the new bridge structure is on the upstream side of the existing Kumeu No.1 bridge (road bridge), spanning across Kumeu River. The Site is located in the larger Kumeu- Kaipara Catchment which drains in a northerly direction to Kaipara Harbour. The sub-catchments which contribute to the watercourse is the Kumeu-Huapai sub-catchment and the Taupaki sub-catchment, refer to Figure 4 below.

The Kumeu- Huapai sub-catchment is 3864.91Ha (Auckland Council Geo Maps) of which 254.72Ha is upstream of the Kumeu Bridge. The Taupaki sub-catchment is 3977.47Ha (Auckland Council Geo Maps). This gives a total catchment area of 4232.2Ha to the existing road and footbridge within Kumeu River. Of this, approximately 410.5 Ha is impervious, and 3,821.7 Ha is pervious. The catchment length is approximately 11.684km with a slope of = 0.2%.

Under the Auckland Unitary Plan zoning, the upstream catchment area is a combination of Rural Countryside Living Zone and Waitakere Village and Foothills.

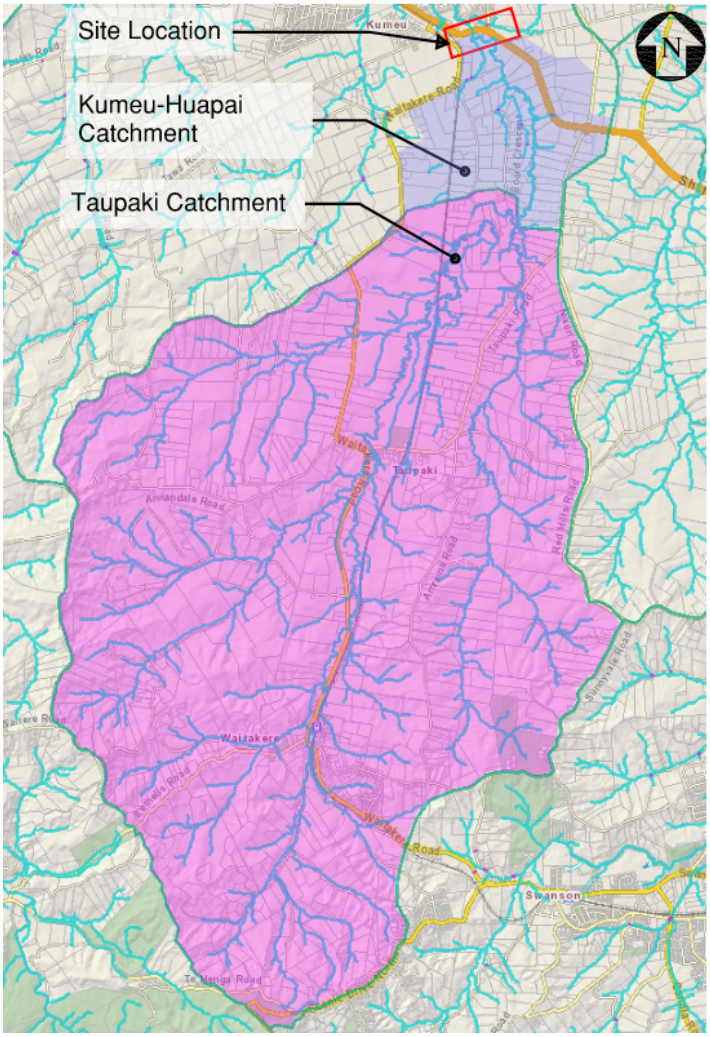


Figure 5: Auckland Council Geo Maps showing upstream catchments

3.2 Existing Structures

There are two existing structures at this location, the Kumeu No.1 Road bridge and a footbridge on the northern side.

Kumeu No. 1 Bridge is a single span road bridge. A survey was completed by Beca between 2020 to 2021 to get key levels, locations and dimensions. Below is a photo of Kumeu River and the existing road bridge looking north. This photo shows that the river is incised, with vegetation on the banks. There is no existing scour protection along this extent of the river.

Figure 6: Existing road bridge at Kumeu River. Left: Photo taken from upstream on the true right bank, looking north | Right: Photo taken from upstream on the true right bank, looking west (image from October 2020).

The existing footbridge structure was constructed in 2006 and is located on the downstream side of Kumeu River. The Construction Plans where provided to Beca by Waka Kotahi for this structure.

Figure 7: Existing footbridge at Kumeu River. Left: Photo of north-western bridge abutment | Right: Photo of underside of footbridge.

3.3 Proposed Design

The works proposed at Kumeu River includes the construction of a new pedestrian bridge for the Shared Use Path on the southern side of State Highway 16 (the existing Kumeu No. 1 Road Bridge).

A new single span Shared Use Path bridge is proposed on the upstream side of Kumeu River. The proposed abutments are expected to be set far enough from the riverbank with the intention to not disturb the existing stone wall, bridge structures and the riverbank if possible and the soffit of the new bridge is to be set at the existing bridge soffit level to avoid reducing hydraulic capacity beneath the bridges. This approach will minimise new potential scour of the riverbank and damage to the existing stone wall.

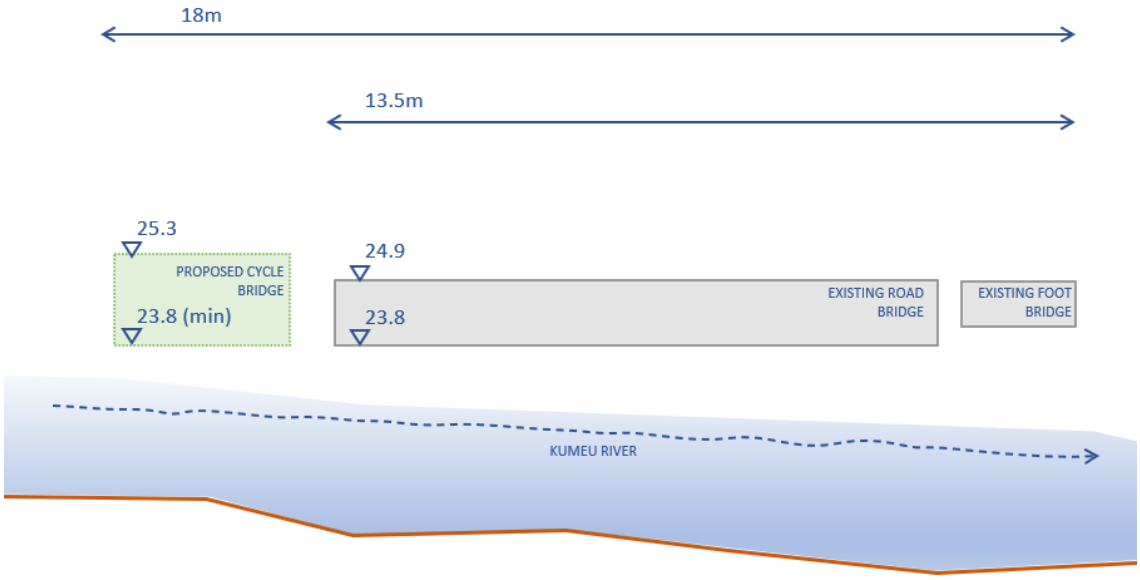


Figure 8: Indicative section and location of proposed and existing bridge structures (excludes handrails, foundations and details)

The image below shows the indicative new SUP structure, with the top of deck level at RL25.3 and a soffit level of minimum RL23.8.

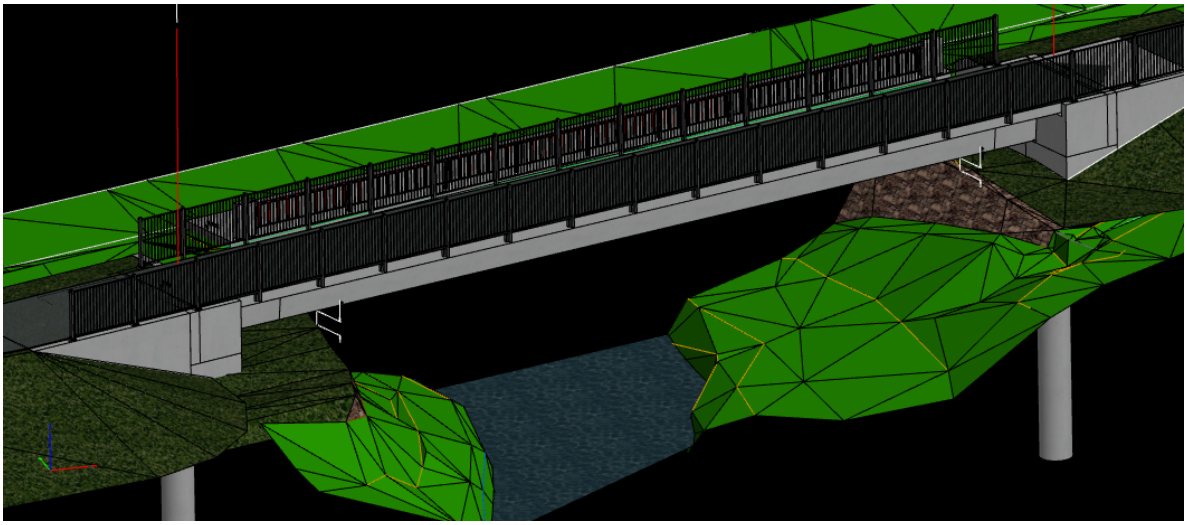


Figure 9: Graphic of the new SUP structure on the upstream of Kumeu River

4 Flood Levels and Flows

The flood levels and flows at the Site have been estimated utilising:

- Kaipara-Kumeu Catchment Management Plan – Hydraulic Modelling, Rodney District Council, December 2009 and previous studies referenced therein.
- Auckland Council Geo Maps floodplain layer
- Kumeu Floods – Predicted 12 years earlier (Auckland Council Stormwater Conference Paper 2022)
- A TP108 single catchment flow calculation
- HEC-RAS Modelling – developed by Beca for this project.

The results from these have been reviewed and are summarised in the following sections.

4.1 Kumeu-Kaipara Catchment Management Plan

The Kumeu-Kaipara Catchment Management Plan (CMP) report was prepared and updated between June 2004 and December 2009. This document includes the hydraulic model build, calibration and flood mapping of the Kaipara catchment.

The model was developed utilising MIKE 11 hydraulic and hydrodynamic modelling package and the hydrology model for each sub-catchment follows the TP-108 methodology. Rainfall has been based on historic rainfall events from daily and automatic rainfall gauges used to develop the hyetograph with adjustments on the catchment averaged storm depth. This historical analysis showed that rainfall within the catchment is highly variable, and the rainfall distributions are significantly affected by the local topography and elevation. The model was calibrated based on flow gauges within the catchment and floodwater levels observed in large events. The model did not allow for Climate Change implications in the future. Land uses were modelled based on Ministry of Environment Land Use Database II July 2004.

The CMP also referred to other studies in the past relating to this catchment. The results of some of these are included in the Kumeu-Kaipara CMP for comparison. The following image compares the

Memorandum

water level for the 1% AEP event and discharge for the previous Beca 1988 model at the approximate project location.

Table 8-4 Comparison of 1% AEP water levels and discharges (v2007 model) between present study and 1988 Flood Management Plan

Location	1% AEP Water Level and Discharge			
	TP108-MIKE 11		Beca 1988	
	Water Level (m)	Discharge (m^3/s)	Water Level (m)	Discharge (m^3/s)
Taupaki Bridge	41.46	123	41.15	125.0
Taupaki Railway Bridge	35.04	138	34.60	170.0
Kumeu SH Bridge	24.43	154	24.50	245.0
Weza Lane Bridge	24.03	155	23.90	245.0
Oraha Road Bridge	20.76	160	21.10	240.0
Pinotage Place	20.43	160	20.85	240.0
Tapu Bridge	17.66	159	17.65	260.0
Waimauku Bridge	13.41	339	13.10	385.0
Davidson Bridge	6.49	356	6.45	375.0
Kiwitahi Bridge	5.77	339	5.85	360.0

Figure 10: Table 8-4 of the CMP: 1% AEP water levels from the Catchment Management Plan Report

In addition, separate model results show flood levels on flood maps. Immediately upstream of the bridge locations, flood levels were predicted to be 23.0m and 23.7m for the 10 year and 100 year ARI respectively in the “existing” scenario and 22.7m and 23.4m in a “future” scenario” respectively on the maps. Reporting for these maps does not include an explanation of what assumptions make up the “existing” or “future” scenarios mapped.

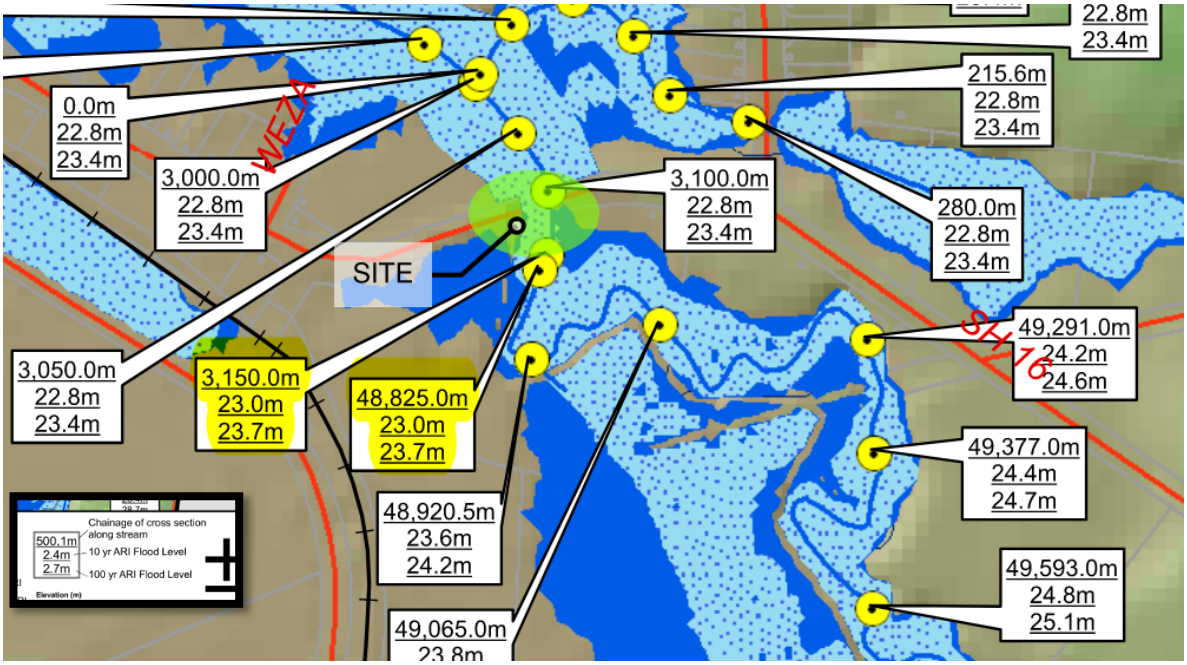


Figure 11: Future flood Levels at Kumeu Bridge No. 1 (10 and 100 year ARI Flood Levels) (reference: Kumeu-Kaipara Catchment Management Plan Map 1.7 Kumeu/Kaipara River Catchment Flood Extents (Existing)

Memorandum

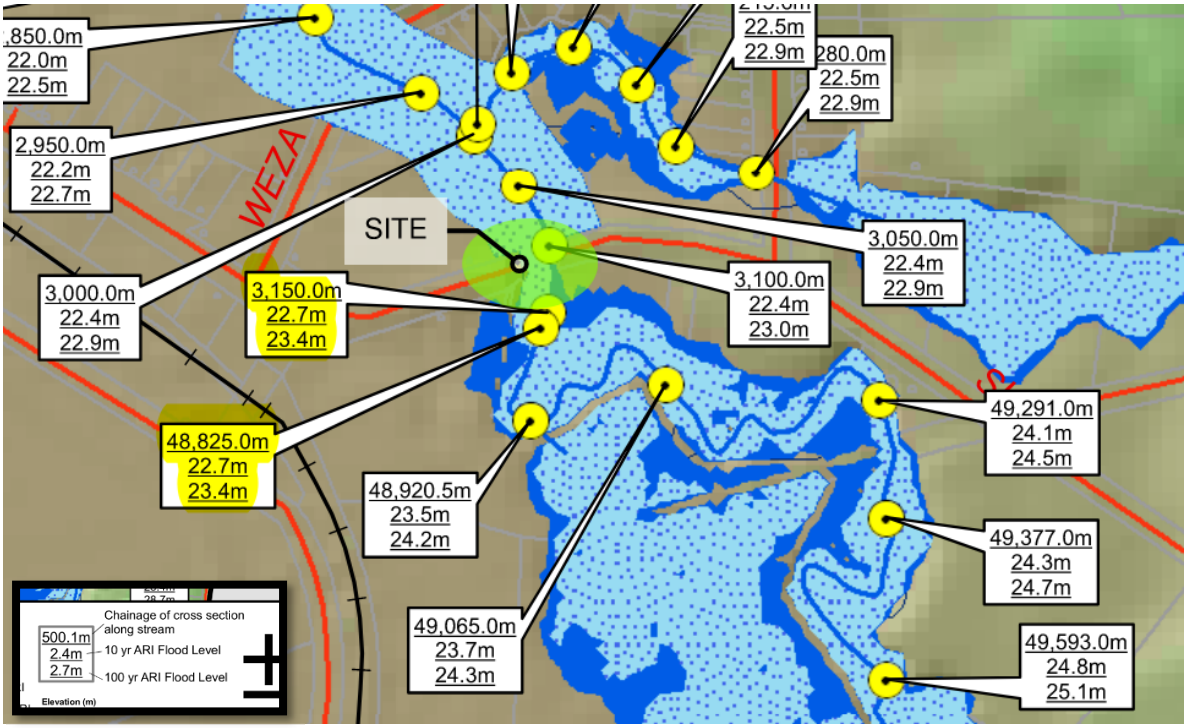


Figure 12: Future flood Levels at Kumeu Bridge No. 1 (10 and 100 year ARI Flood Levels) (reference: Kumeu-Kaipara Catchment Management Plan Map 2.7 Kumeu/Kaipara River Catchment Flood Extents (Future)

4.2 Auckland Council Geo Maps Floodplain Layer

The 1% AEP event flood levels have also been estimated using the Auckland Council Geo Maps "floodplain" layer and contour layers to provide a very rough estimate of flood levels near the bridge. This exercises indicates that the upstream 100-year flood plain is at RL23.75 on the west and RL24.75 (NZVD 2016) on the eastern side. The flood plain extends for a width of approximately 24m. While the Geomaps data lists the the Kaipara-Catchment Management Plan 2009 as the information source the floodplain extents vary from that mapping significantly, so it is assumed to be another source. The inputs and assumptions for that floodplain mapping are therefore unknown.

Figure 13: Images from Auckland Council Geo Maps Flood Plain at Kumeu Bridge

4.3 Kumeu Floods – Predicted 12 years earlier (Stormwater Conference Paper)

Auckland Council prepared a conference paper for the Stormwater Conference 2022 on the Kumeu Flooding which occurred on 30/31 August 2021. This paper collates the flood incident information, flood extents and water level, rerun of the existing 2009 DHI 1D MIIKE11 and development of a new

simplified 1D-2D coupled MIKEFLOOD model for the Kumeu Township area. The recorded 24 hour rainfall depth for this event was 208.4mm.

Auckland Council developed a new simplified 1D-2D coupled MIKEFLOOD model for the Kumeu Township area. The water level results of the new model provides good agreement between the model predictions and the observed flood extent and maximum flood levels, however there are significant differences between the model predicted and recorded peak flow at Waimauku gauge (further upstream). The new modelled water level at the existing Kumeu SH16 Bridge is RL24.12, while the observed water level for this event was RL24.24. The existing 2009 DHI 1D MIIKE11 flood model was also rerun using the rain radar 5-minute interval time series rainfall data which resulted in a water level of RL23.71 at this same location.

The new model show that the flood waters overtop the Kumeu River true left bank about 300m, upstream of the SH16 bridge, which flowed towards Main Road and into Kumeu Township.

Not recorded in the Conference Paper, but provided by Auckland Council (email 5/09/2022), the new model had a maximum flow through Kumeu River Bridge of 155m^3/s and velocity of 1.3m/s.

4.4 TP108 Flow (single catchment)

The information below set out the values used in an assessment of the stream flows at the Site using a simple TP108 single catchment calculation (that is, no consideration of routing / storage in the catchment).

Table 3: TP108 single catchment flow estimate inputs and results

Design Criteria	Value
Inputs	
Total Catchment	4,232Ha
Total Impervious	410Ha
Total Pervious	3,821Ha
Catchment Length	11.684Km
Slope	0.2%
Curve Number Pervious	74
Curve Number Impervious	98
Channelisation factor	1.0
Aerial reduction factor	0.93
Peak flow estimates (m^3/s)	
100-year ARI (0.0° climate change)	161
100-year ARI (2.1° climate change)	197
100-year ARI (3.8° climate change)	247

4.5 Comparison of flood flows and levels

Table 4 sets out a comparison of predicted 100-year ARI flood flows from the information sources and calculations outlined above. This comparison shows a wide range of flow estimates. Factors contributing to this large range will include:

- Variation in impervious coverage, land use, growth scenarios and the soil type estimate (not all clear in the reporting provided).
- Variation in future development scenarios considered
- Variation in rainfall depths.
- Different calculation methods and level of detail.

Table 4: Comparison of 100-year ARI flood flow estimates

Event	Climate Change	Peak flow estimate (m^3/s)		
		TP108	1988 model (CMP)	2009 model (CMP)
100-year ARI	0.0°	161	245	154
	2.1°	197	-	-
	3.8°	247	-	-

The 100-year flood levels form the information sources outlined above has also been considered. There is a very large range of levels and indications that some levels are either erroneous or presented in a different datum. In every case, however, the 100 year levels reach at least the soffit level of the existing bridges in the current climate scenarios.

4.6 HEC RAS Model

HEC-RAS Version 6.0.0 has been used to model the a range of flows in a 1d hydraulic model. Beca developed this model for the SH16 Stage 2 Project for this assessment only. The existing terrain used for the catchment was Auckland LiDAR 1m DEM (2013) in NZVD 2009m as well as survey completed by Beca in September 2021. The survey points were converted back to NZVD 2009 from NZVD 2016 to use with the LiDAR terrain. The survey covered ~100m upstream and does not extend downstream of SH16.

As the LiDAR is limited by vegetation and water surface, the invert levels of the channel and stream banks were adjusted lower to reflect the spot levels of the survey. From looking at aerial photographs the stream upstream of the Kumeu Bridge is surrounded by dense, tall trees hence the different levels.

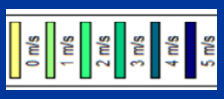
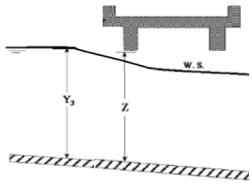
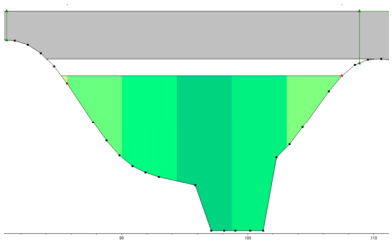
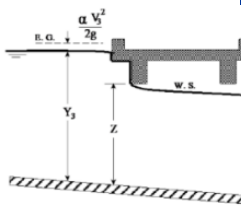
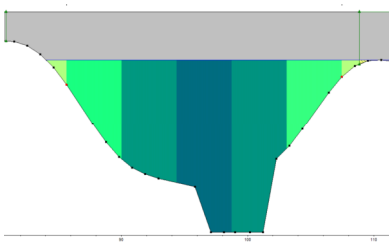
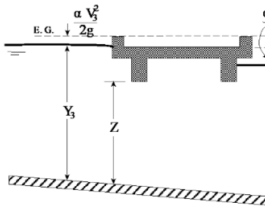
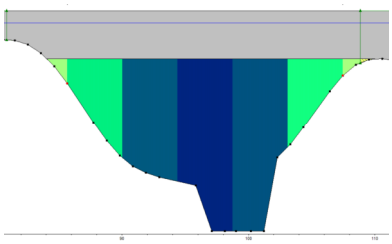
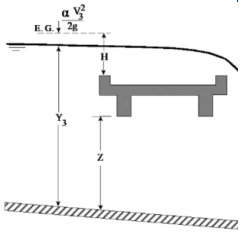
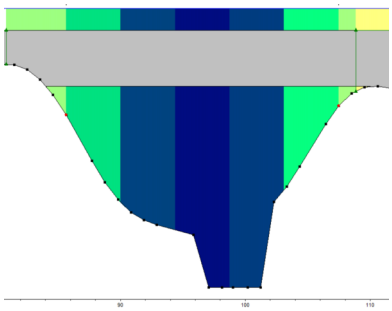
The model extended approximately 50m upstream and 30m downstream of the existing Kumeu No.1 Bridge. The difference found between the LiDAR and surveyed cross section at the culvert location was applied to all the cross sections within the model. Where survey information was available, this information was used. The invert of the channel within the culvert was assumed.

The HEC-RAS model run showed four different types of flow behaviour through / over the bridges. These are:

- Open channel flow - (flood levels below soffit)
- Pressure flow - sluice gate type - (flood levels above soffit on upstream side)
- Pressure flow - sluice gate submerged type - (flood levels above soffit on upstream and downstream sides)
- Pressure and weir flow - (bridges are overtopping).

Memorandum

Table 5: Flood levels and velocities

Flow type	Flow	Flood level	Total velocity (through bridge)	
Open channel flow (flood levels below soffit) 	60* - 130m^3/s	< 23.4m	3.32 m/s	
Pressure flow - sluice gate type. (flood levels above soffit on upstream side) 	140 - 210m^3/s	24.07 – 24.65m	3.50 m/s	
Pressure flow - sluice gate submerged type. (flood levels above soffit on upstream and downstream sides) 	220 - 260m^3/s	24.78 – 24.98m	4.30 m/s	
Pressure and weir flow (bridges are overtopping). 	270– 300*m^3/s	25.43 – 25.73* m	4.49 m/s	

5 Conclusions

The following table outlines a range of flow conditions and velocities for consideration for the bridge structural design. Note the recurrence intervals given assume 2.1 degrees of climate change.

Table 6: Recommended design velocities (and flow conditions) for bridge design

Approximate recurrence interval (2.1 climate change)	Flow (m^3/s)	Total velocity in bridge opening (m/s)	Total velocity at upstream section (m/s)	flood level (mRL)	Condition
10-year ARI	110	3.27	2.35	23.08	800mm freeboard to soffit.
25-year ARI	130	3.32	2.45	23.36	400mm freeboard to soffit.
100-year ARI	190	3.17	2.99	24.40	Flood level halfway up deck.
	250	4.17	3.94	24.78	Flood level more than halfway up deck
500- year ARI	300	4.52	2.21	25.61	More than 500mm depth of overtopping flow
1000- year ARI	330	2.72	1.75	25.80	More than 700mm depth of overtopping flow

Table 7 below demonstrates the impact the range of climate change scenarios considered could have on the peak flow through the bridge. Note the shading corresponds to the flow condition given in Table 6 above.

Table 7: Impact on climate change scenarios on peak flow estimate

ARI	Approximate peak flow estimate (m^3/s)		
	TP108+0°	TP108+2.1°	TP108+3.8°
2	49	56	79
10	96	114	155
25	122	145	196
100	161	197	258
500	263	315	411
1000	287	344	449

It is recommended that the velocities and flood water levels in Table 6 are utilised in the structural design of the new Shared Use Path bridge. It should be noted that the new bridge (because it has been designed to match adjacent existing bridges) has a lower-than-standard level of flood protection. That is, it is much more likely that flood waters will reach the bridge deck or overtop the structure than many other bridges on the State Highway network.