APPENDIX E Stormwater Assessment

NZTA

BRYNDERWYNS HILLS RECOVERY WORKS

BRYNDERWYNS RP11.46 TO 13.79 STORMWATER DESIGN REPORT

27 JUNE 2024

PUBLIC

BRYNDERWYNS HILLS RECOVERY WORKS

BRYNDERWYNS SPANNING FROM RP11.46 TO 13.79 STORMWATER DESIGN REPORT

NZTA

WSP
Whangarei
Mansfield Terrace Service Lane
125A Bank Street, Whangarei,0110, New Zealand
+64 93048078 wsp.com/nz

REV	DATE	DESIGN GATE	DETAILS
A	27/06/2024	90%	Issued to client – awaiting final fish passage assessment appendix

	NAME	DATE	SIGNATURE
Prepared by:	Vani Liu, Suma Rudrappa	27/06/2024	V.L
Reviewed by:	Mat Chiaroni	27/06/2024	
Approved by:	Friso Roest	27/06/2024	

TABLE OF CONTENTS

1 PROJECT BACKGROUND

1.1 Introduction And Purpose

New Zealand Transport Agency Waka Kotahi (NZTA) engaged WSP New Zealand (WSP) to deliver a comprehensive design for recovery widening work on the south side of the Brynderwyn Hill spanning from RP 11.46 to 13.79. The scope of work encompasses geotechnical design of cut slopes, retaining wall design/retrofit, stormwater design, road design, and obtaining resource consent.

This document is the Design Report for stormwater design and improvement work.

1.2 SITE DESCRIPTION

The Brynderwyn Hill south section comprises approximately 2.5 km of typically two-lane road carriageway traversing steep terrain. The southbound lane (toward Auckland) is on the upslope side of the formation and the northbound lane (toward Whangarei) is on the downslope side.

The alignment is typically cut into the hillside with steep upslope batters. The alignment crosses several deep (filled) gullies. The slope of the terrain above the road is typically 2:1 with some areas as steep as 1.25:1. The ground cover is dense native bush with deep litter. The soil type typically comprises clayey silt residual soils overlying weathered greywacke.

Runoff from the larger upstream catchments is conveyed downslope over SH1 via culverts in the base of the filled gullies.

Those culvert inlets typically comprise projecting culvert ends (i.e. no headwall or inlet structure) and are prone to blockage.

The entire site is considered geotechnically 'at risk' – refer to the separate geotechnical report.

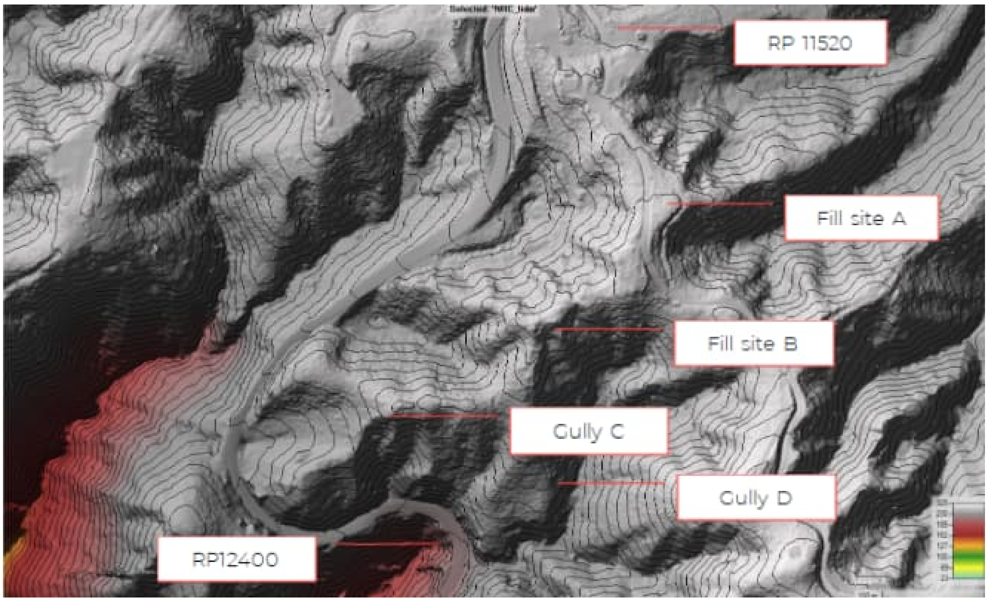


Figure 1-1: Gullies A–D, 5 m contours

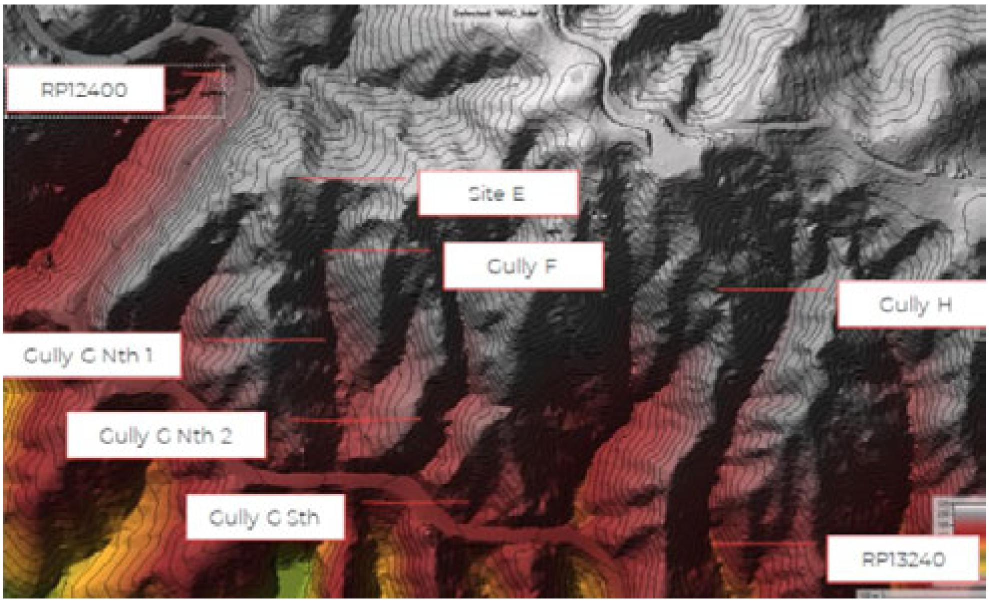


Figure 1-2: Gullies E–H, 5m contours

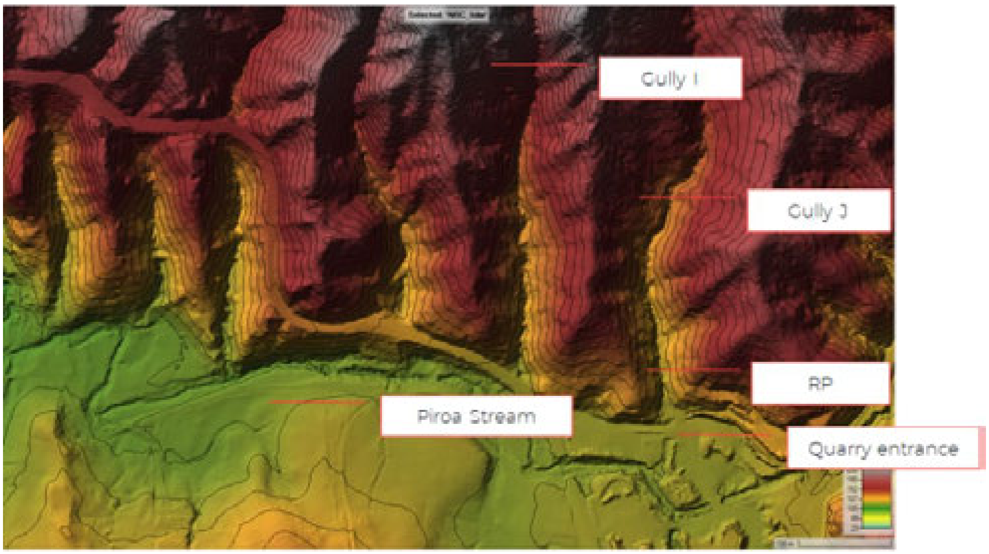


Figure 1-3: Gullies I, J, 5 m contours.

Depending on superelevation, road runoff is collected in concrete lined drains at the toe of the cut slopes and conveyed to the gullies or collected in kerb and channel and discharged downslope.

Some gully culvert outfalls discharge downslope a long way from the road. There is a lower geotechnical risk to the road, associated with those outfalls.

Minor culverts and road outfalls that discharge near the top of the slope pose a higher risk to the road from saturation or erosion of downslope fill embankment or in-situ material.

From Australian Rainfall & Runoff Blockage guidelines 2015, the site has HIGH debris availability (Table 1), HIGH debris mobility (Table 2) and MEDIUM debris transportability (Table 3), giving an overall debris potential of HIGH.

Access to upslope gullies and downslope outfalls is typically constrained by steep topography, bush cover, and ecology (species, fresh water).

2 STORMWATER DESIGN

2.1 GENERAL

The design philosophy for cross drainage servicing the upper catchments is to extend the existing cross culverts to accommodate the widened road formation. New inlets are to be constructed with improved resilience against blockage from debris. Existing road surface drainage cross culverts were be extended where practicable or renewed / replaced (e.g., where depth to cover under the widened road formation is compromised, or condition warrants replacement).

Additional capacity will be provided to align with current design standards, where this is practical (i.e. where the culvert is to be replaced). The design philosophy for road surface drainage is to minimise flow depths/flow encroachment into traffic lanes and increase resilience against blockage. Flows bypassing surface drainage inlets will be directed to the gully culverts.

Where headwater behind road fill embankments can affect stability, a secondary flow system (i.e. a high-flow bypass) will be installed in those locations. Stormwater discharges will be conveyed downslope in pipe flumes as far as practicable to minimise under slip risk (coordinating with geotechnical engineers). Runoff from slope batters will be collected in bench drains or toe drains and directed to the gully culverts, otherwise conveyed downslope via new or existing cross culverts. Road drainage and embankment runoff will be combined in concrete lined channels. New subsoil drains will be constructed within the widened road formation and will typically discharge to the downstream gullies.

2.2 DESIGN GUIDELINES, SPECIFICATIONS AND STANDARDS

The following design standards and guidelines are considered:

- NIWA, High Intensity Rainfall Design System (HIRDS), Version 4.
- NZTA P46 - Stormwater Specification.
- Hydraulic Engineering Circular No.11 (HEC-11), Use of Riprap for Bank Protection, FHWA
- HydroCAD Software for integrated hydrologic and hydraulic design.
- NZTA (2010), F3 Specification for Pipe Culvert Construction.
- Severe Weather Emergency Recovery (Waka Kotahi New Zealand Transport Agency) Order 2023 (WK-OiC).

2.3 DESIGN ELEMENTS

Table 2.1 Summary of required stormwater design elements

<table>
<tr><th>DESIGN ELEMENT</th><th>CRITERIA</th></tr>
<tr><td>Time of concentration</td><td>TC for impervious road surfaces=10 minutes

TC for bush catchments calculated using a combination of Kerby and Kirpich methodologies.</td></tr>
<tr><td>Runoff Coefficients</td><td>Per excerpt below (NZTA May 2010) – Coefficient varies with vegetation.

<table>
<tr><th colspan="2">Table 6-2
Rational Runoff Coefficients “C” Values</th></tr>
<tr><th>Description of area</th><th>Runoff Coefficient “C”</th></tr>
<tr><td>Lawns</td><td></td></tr>
<tr><td>Sandy soil, flat (<2% slope)</td><td>0.10</td></tr>
<tr><td>Sandy soil, average (2-7%)</td><td>0.15</td></tr>
<tr><td>Sandy soil, steep (>7%)</td><td>0.20</td></tr>
<tr><td>Clay soil, flat (<2%)</td><td>0.17</td></tr>
<tr><td>Clay soil, average (2-7%)</td><td>0.22</td></tr>
<tr><td>Clay soil, steep (>7%)</td><td>0.35</td></tr>
<tr><td>Impervious surfaces</td><td>0.95</td></tr>
<tr><td>Parks</td><td>0.25</td></tr>
<tr><td>Bush</td><td></td></tr>
<tr><td>Sandy soil, flat (<2%)</td><td>0.10</td></tr>
<tr><td>Sandy soil, average (2-7%)</td><td>0.15</td></tr>
<tr><td>Sandy soil, steep (>7%)</td><td>0.20</td></tr>
<tr><td>Clay soil, flat (<2%)</td><td>0.15</td></tr>
<tr><td>Clay soil, average (2-7%)</td><td>0.20</td></tr>
<tr><td>Clay soil, steep (>7%)</td><td>0.3</td></tr>
</table>
</td></tr>
<tr><td>Storm Frequency Factor</td><td>Per excerpt below

<table>
<tr><th colspan="2">Table 6-1
Rational Formula Runoff Coefficient Frequency Factors</th></tr>
<tr><th>Recurrence intermval (years)</th><th>Frequency factor (C_f)</th></tr>
<tr><td>20</td><td>1.1</td></tr>
<tr><td>50</td><td>1.2</td></tr>
<tr><td>100</td><td>1.25</td></tr>
<tr><td colspan="2">Note: the product of C_f times C shall not exceed 1</td></tr>
</table>
</td></tr>
<tr><td>Road drainage</td><td>The proposed road surface runoff collection system is kerb & channel/dish drain with recessed inlet (catchpits/scruffy dome/grated inlet/traversable wingwall).

100-year flows – 3.0 m clear width in live lane, maximum 100 mm depth in covered lane.

10-year flow (P46) shoulder flow must not encroach on traffic lanes.

Bypass flows (exceeding inlet capacity) will be conveyed (via the kerb & channel) to the existing cross culverts servicing the upstream bush</td></tr>
</table>

DESIGN ELEMENT	CRITERIA
	catchments (southbound lane), or to flume discharges downslope (northbound lane).
Batter/Slope drainage	Slope erosion protection by vegetation / geocomposite as dictated by geotechnical conditions, coordinated with slope stability consultant. Cutoff drains/diversion bunds above cut slopes where access permits. Benches to be positively graded, with and soft bunding Bench drains where practicable (i.e., where an access bench is being constructed, a drain will be included). Runoff collected at toe of slope in concrete lined drain (or similar) and discharged to gully culverts (separate from surface runoff).
Stormwater Treatment	There are no stormwater treatment devices along the existing alignment. Due to significant geotechnical & topographical constraints (very steep, unstable terrain), construction of stormwater treatment devices is impracticable. No new stormwater treatment devices are proposed.
Culvert sizing	The key requirements are: Typical cross-road culverts: • Convey the 10-year average recurrence interval (ARI) storm event flow without surcharge of the pipe, considering 2031-2050 climate change scenario. Gully Culverts • Convey the 100-year ARI storm event flow, whilst anticipating surcharge, with a minimum 500 mm freeboard to the outer edge line level considering 2031-2050 climate change scenario. • In discrete locations, include as an emergency bypass, an overflow pipe will be installed – see emergency bypass item below. Hydrology & Hydraulic calculations in HydroCAD(R) software using rational method.
Debris Screen	Will typically comprise scruffy dome inlets or proprietary debris screens for headwall structures. The inlets will be designed to allow the 10-year ARI design flow to enter the culvert a with 50% blockage of the open area. The inlets will be designed to allow the 100-year ARI design flow to enter the culvert a with 20% blockage of the inlet area
Emergency bypass	Due to high debris potential, gully culverts servicing upstream catchments will have two inlets (primary pipe inlet & scruffy dome manhole emergency inlet) to allow continued function if one inlet is completely blocked.

DESIGN ELEMENT	CRITERIA
Open Drain Outlets	Designed to ensure adequate energy dissipation and erosion protection measures to protect the integrity of the unreinforced downslopes in accordance with HEC14. Where practicable.
Flumes	Flumes (piped) to convey stormwater discharge away from under slip risk areas.
Secondary flow (road surface runoff)	Ensure that there is an acceptable flow path with a secondary flow (bypass flows from surface drainage inlets). This will be provided to meet existing performance and provide improvements where practicable.
Fish Passage	Environmental DNA analysis has been completed to confirm species –Fish passage retrofits are proposed were required; refer to the fish passage assessment.
Fill Sites	Incorporation of design activities with Southern Skies supplied sedimentation pond design. Ensure that there is an acceptable flow path with a secondary flow (bypass flows from surface drainage inlets)

2.4 DEPARTURES

Due to the constrained nature of the sites and the accelerated recovery works programme, the departures summarised in Table 2-1 were required, so the proposed work could be completed within the physical recovery works window.

Table 2.2 Summary of required stormwater departures

DISCIPLINE	EXPECTED DEPARTURE	DEPARTURE
General	Design Life	Replacement and/or a higher level of maintenance of deteriorating components may be required beyond 10 years. Lower adopted design events for seismic.
Stormwater	Design Life	Due to the nature of the works (emergency and short life); proposed solution deviations from design life standards will be discussed with NZTA and documented with reasoning.

DISCIPLINE	EXPECTED DEPARTURE	DEPARTURE
Stormwater	Headwater Depth	Existing gully culverts when analysed using RCP 8.5 rainfall scenarios may exceed the maximum allowable headwater depth.
Stormwater	Headwater Depth	Road reticulation inlets may exceed the maximum allowable headwater depth.
Stormwater	Waka Kotahi P46 – 3b	Considering the expected service life of the road (10 years) a climate change adjustment for high-range temperature increases for 2031-2050 is proposed.
Stormwater	Waka Kotahi State Highway Geometric Design Manual – 7	Roadside slopes may exceed the required front and back slope requirements to maximise the capacity of roadside open drains and provide allow for debris accumulation.
Stormwater	Waka Kotahi P46 - 4b	Existing table drains have insufficient capacity for primary flow due to site constraints. Providing new inlets / culverts to reduce length of flow paths is considered outside of the scope of this project.
Stormwater	Waka Kotahi P46 - 7.1c	Culverts will be allowed to surcharge to within 200 mm of the road surface for a 100-year ARI flow and surcharge up to 200 mm above the pipe soffit for a 10-year ARI flow, where required due to site constraints.
Stormwater	Waka Kotahi P46 – 5.5f	Manholes will be placed in the shoulder of the trafficable lane to facilitate scruffy dome inlets at the existing culverts. The manholes will be buried.

DISCIPLINE	EXPECTED DEPARTURE	DEPARTURE
Stormwater	Waka Kotahi P46 – 9.2b	Redundant infrastructure – Abandoned Culverts are to be filled with cement/grout and not excavated to minimise disruption and costs.

2.5 EXISTING STORMWATER INFRASTRUCTURE AND EXISTING CULVERT CONDITION

2.5.1 EXISTING STORMWTAER INFRASTRUCTURE

The existing stormwater infrastructure at each gully are shown in the Table 2-3 below.

Table 2-3 Existing Stormwater Cross Culverts by site

CULVERT NO.	SITE REFERENCE	LOCATION (RP)	ASSET	COMMENT
1	Gully A	11685	DN900	Sited within a proposed fill gully, there is a 112 meters Length, large diameter culvert constructed to a high standard circa 1990 mm, beneath an 8 m deep road fill embankment. Inlet headwall set back approximately 35 m from existing road edge. High capacity. Most of the pipe joints exhibit minor to medium cracking or spalling, indicating faults as per the CCTV inspection report on 16th of February 2024 done by WINCAN.
2	Gully B	11846	DN375	Sited within a proposed fill gully. 72 meters length culvert is constructed beneath a 15 m deep road fill embankment. There is an existing manhole without inlet / debris protection that is prone to blockage and set back approximately 25 m from the existing road edge. Most of the pipe joints exhibit significant cracking, spalling, and deformation, indicating faults as per the CCTV inspection report on 16th of February 2024 done by WINCAN. Existing inlet MH is sited within private property.

CULVERT NO.	SITE REFERENCE	LOCATION (RP)	ASSET	COMMENT
3	Gully C	12044	DN450	Projecting pipe inlet in hole prone to blockage. 32 meters existing pipeline was constructed beneath a 6 m deep road fill embankment Pipe assessed as poor condition in need of renewal/replacement. Most of the pipe joints exhibit minor to medium cracking or spalling, indicating faults as per the CCTV inspection report on 16th of February 2024 done by WINCAN. Existing inlet MH is sited within private property.
5	Gully D	12264	DN630	New twin-wall HDPE culvert, scruffy dome inlet MH, outlet MH, and culvert flume constructed post cyclone Gabrielle (Feb 2023)
6	Gully D (waterfall)	12365	DN900	The existing DN900 pipe will be extended along the current alignment. Additionally, the existing grated LID (manhole) will be demolished, due to road widening
9	Gully F South	12760	DN375	Existing 375 mm pipeline with new inlet MH constructed post cyclone Gabrielle to mitigate blockage.
		12760	DN800	Existing DN710 SDR17 HDPE pipe installed by HDD as emergency bypass constructed post-cyclone Gabrielle (Feb 2023)
11	Gully G North-1	12840	DN500	The damaged section needs to be replaced at least, due to the result of incomplete CCTV inspection result. Replace existing alignment with new traversable wingwall inlet, 1050 junction manhole, and DN500 Euroflo SN16 culvert crossing per typical detail.
12	Gully G North - 2	12920	DN375	Existing DN375mm pipeline with new 1050 junction manhole to be buried 260mm below FL, replace existing alignment with traversable headwall inlet.

CULVERT NO.	SITE REFERENCE	LOCATION (RP)	ASSET	COMMENT
13	Gully G North - 3	12980	DN600	Extending the existing DN600 pipeline, replacing the existing MH with DN1050 Scruffy dome.
14	Gully G North - 4	13060	DN600	Replacing the existing grated lid with scruffy dome.
15	Gully G South	13140	DN530	Abandon in place and grout fill existing culvert, replace with new DN630 cross culvert, DN1200 scruffy dome RCMH at inlet, and DN1200 junction manhole at outlet.
16	Gully H	13220	DN600	Awaiting results of CCTV inspection as at 2024/06/19 to confirm scope of repair.
18	Gully J North	13580	DN1200	The existing pipe is in good condition shown in the CCTV inspection report. Good capacity.
19	Gully J South	13700	DN600	The existing pipeline is at good condition and as per the CCTV inspection report. Out down bank on private property.

2.5.2 EXISTING CULVERTS CONDITION

A CCTV survey was conducted to assess the current condition of existing culverts. The condition of culverts is assessed in detailed in Appendix A.

2.6 ASSUMPTION AND CONSIDERATIONS

2.6.1 RAINFALL AND CLIMATE CHANGE

The calculation of rainfall runoff is using HIRDS V4 RCP8.5 for 2031-2050. Table 2-4 shows the adopted intensity/ duration/ frequency values.

Table 2-4: Design rainfall intensity (mm/hr) adjusted for climate change.

ARI	AEP	10 M	20 M	30 M	1 H
1.58	0.633	58.3	44.6	37.6	27.3
2	0.5	64.2	49.2	41.4	30.1
5	0.2	84.8	65	54.7	39.7
10	0.1	100	76.8	64.7	46.9
20	0.05	116	88.9	74.9	54.4
30	0.033	126	96.3	81.1	58.9
40	0.025	132	101	85.5	62.1
50	0.02	138	106	89	64.7
60	0.017	142	109	91.9	66.7
80	0.013	149	114	96.4	70
100	0.01	155	119	99.9	72.6

2.6.2 *TIME OF CONCENTRATION (Tc)*

The Tc used for impervious road surfaces = 10 minutes.

The Tc for bush catchments was calculated using a combination of Kerby and Kirpich methodologies and compared to the NZBC methodology. Gully banks in the upper areas are typically 100 m long with a slope of 50% with bush cover and deep litter. Gully reaches vary in length up to 500 m with slopes between 15% and 20%.

A 20-minute Tc was adopted for catchments with long reaches, and 15 minutes for catchments without significant reaches, based on the calculated Tc for the various catchments.

2.6.2.1 KERBY/KIRPICH FOR TC

1. Upper gully banks (Kerby method)

S=0.5

N=0.8

L=100

Kerby method Tt for upper gully reaches is typically **13 minutes**.

$$Tt = \left[\frac{0.67\ L\ N}{\mathrm{sqrt}(s)} \right]^{0.467}$$

where:

Tt=Travel time [minutes]
L=Flow length [feet]
N=Retardance coefficient (See table)
s=Land slope (along flow path) [ft/ft]

The Kerby method is frequently used in conjunction with the Kirpich method.

For further information see Rousell et al. 2005, p.6.

Figure 2-1 Kerby equation

2. Gully reaches (Kirpich method)

Using the parameters as shown below:

S = 20%

k =2.0 (general overland flow)

Table 2-5: Flow time for various reach lengths using Kirpich method.

CHANNEL LENGTH (M)	TC (MINUTES)
500	8.7 min
400	7.3 min
300	5.9 min
200	4.3 min
100	2.5 min

$$Tt = K\ k \left[\frac{L}{\mathrm{sqrt}(s)} \right]^{0.770} = K\ L^{0.770}\ S^{-0.385}$$

where:

Tt=Travel time [minutes]
K=Units conversion factor (0.0078 US, 0.0195 Metric)
k=Adjustment factor (See table)
L=Channel flow length [ft] or [m]
s=Land slope (along flow path) [ft/ft] of [m/m]

The Kirpich method is frequently used in conjunction with the Kerby method.

For further information see Rousell et al. 2005, p.7.

Figure 2-2: Kerby equation

2.6.2.2 NZBC E1 METHOD FOR TC

3. Upper gully banks using 2.3.2.

Using parameters

n = 0.1

L = 100

S = 50%

NZBC E1 calculation for overland flow time for the upper gully banks is typically 20 minutes.

i) the time of overland flow shall be determined by the formula:

$$t = 100\, nL^{0.33}/s^{0.2}$$

where

t = time (minutes).

L = length of overland flow (m).

Figure 2-3: NZBC overland flow calculation.

4. Gully reaches using 2.3.6 shown in Figure 2-4 below.

Table 2-6: Using NZBC (which does not account for reach roughness)

CHANNEL LENGTH (M)	TC (MINUTES)
500	4.3
400	3.7
300	2.9
200	2.1
100	1.3

This equates to an average velocity of approx. 2 m/sec which is considered excessive when taking into account the dense ground cover/debris potential within the gullies and meandering stream paths.

2.3.6 Alternative method to determine time of concentration

Where there are significant changes in gradient along the channel slope or where the open channel is in a rural area, the time of concentration t_c may be determined from:

$$t_c = 0.0195 \left(L^3 / H\right)^{0.385}$$

where

t_c = time of concentration (minutes).

L = length of catchment (m) measured along the flow path.

H = rise from bottom to top of catchment (m).

Figure 2-4: 2.3.6 Alternative method to determine time of concentration.

If using the NZBC method, the Tc for all catchments, regardless of reach length is approximately 20 minutes (i.e. dictated by the relatively slow overland flow time within the upper gully reaches).

Using the Kerby, Kirpich method, the Tc for catchments varies between 15-20 minutes, depending on reach length.

2.6.3 RUNOFF CO-EFFICIENT

The runoff coefficients and event frequency factors from NZTA report Stormwater Treatment for State Highway Infrastructure (May 2010) were adopted. The NZTA Runoff coefficients are shown in Figure 2-5.

The bush catchments have been assessed as 'clay soil, steep (>7%)'. The NZTA recommended runoff coefficient is 0.3. A more conversative coefficient of 0.35 has been adopted for design to account for the very steep topography.

Table 6-1
Rational Formula Runoff Coefficient Frequency Factors

Recurrence intermval (years)	Frequency factor (C_f)
20	1.1
50	1.2
100	1.25
Note: the product of C_f times C shall not exceed 1	

Table 6-2
Rational Runoff Coefficients "C" Values

Description of area	Runoff Coefficient "C"
Lawns	
Sandy soil, flat (<2% slope)	0.10
Sandy soil, average (2-7%)	0.15
Sandy soil, steep (>7%)	0.20
Clay soil, flat (<2%)	0.17
Clay soil, average (2-7%)	0.22
Clay soil, steep (>7%)	0.35
Impervious surfaces	0.95
Parks	0.25
Bush	
Sandy soil, flat (<2%)	0.10
Sandy soil, average (2-7%)	0.15
Sandy soil, steep (>7%)	0.20
Clay soil, flat (<2%)	0.15
Clay soil, average (2-7%)	0.20
Clay soil, steep (>7%)	0.3

Figure 2-5: Runoff coefficients (NZTA)

2.7 HYDROLOGY & HYDRAULIC ASSESSMENT

The following hydraulic criteria were adopted.

– Convey the 100-year ARI storm event flow without surcharge of the pipe more than 2 m above the pipe soffit, and a minimum 200 mm freeboard from the peak water level to the outer edge line level for the MPD scenario.

Hydrology & Hydraulic calculations in HydroCAD(R) software and the rational method is used for peak flow calculation and results are tabulated in Table 2-8 and calculations are in Appendix C.

2.7.1 CATCHMENT AREA

The catchment areas for all existing cross culverts have been calculated using LiDAR data and incorporating the widened road formation. The results are presented in Table 2-7.

Table 2-7: Catchment area

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA	
			ROAD (HA)	BUSH (HA)
1	Gully A	11685	0.50	3.3
2	Gully B	11846	0.10	2
3	Gully C North	12044	0.30	1.3
4	Gully C South	12160	0.15	0.05
5	Gully D North	12264	0.13	0.87
6	Gully D (Waterfall)	12365	0.00	9.1

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA	
			ROAD (HA)	BUSH (HA)
7	Gully E Roadside North	12420	0.00	0.3
8	Gully E Roadside South	12480	0.04	0.2
9	Gully F North	12560	0.04	0.3
10	Gully F Existing	12760	0.30	2.3
11	Gully G North - 1	12840	0.00	0.3
12	Gully G North - 2	12920	0.10	0.5
13	Gully G North - 3	12980	0.00	3.9
14	Gully G North -4	13060	0.00	3.6
15	Gully G South	13140	0.08	0.57
16	Gully H	13220	0.13	6
17	Gully I -RR	13400	0.05	0.6
18	Gully J North	13580	0.20	8.7
19	Gully J South	13700	0.00	8.6
20	Gully J New	13755	TBC	

Based on the existing culverts conditions and the calculation assessments, the hydraulic results are shown in table 2-8.

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA		CULVERT DIA (MM)		TOPO SURVEY			P46 REQUIREMENT		Q100 2031-2050 HYDROCAD OUTPUTS	
			ROAD (HA)	BUSH (HA	EXISTING CULVERT DIA (MM)	PROOSED CULVERT DIA (MM ID)	INLET INVERT (M)	ROAD LEVEL (M)	SLOPE	MAX. ALLOWED RL (HEADWATER DEPTH IN M)	MAX. ALLOWED RL (FREEBOARD IN M)	Q100 FLOW (M^3/SEC)	Q100 PEAK HEADWATER RL
1	Gully A	11685	0.50	3.3	900	900	262.478	274.3	31%	265.38	273.8	0.62	263.06
2	Gully B	11846	0.10	2	450	450	246.79	259.71	6%	249.24	259.21	0.29	247.49
3	Gully C North	12044	0.30	1.3	450	450	238.85	241.95	7%	241.30	241.45	0.32	239.66
4	Gully C South	12160	0.15	0.05	N/A	500 (420)	232.55	233.41	5%	234.97	232.91	0.07	232.79
5	Gully D North	12264	0.13	0.87	525	525	224.5	226.35	9.54%	227.03	225.85	0.22	225.28
6	Gully D (Waterfall)	12365	0.00	9.1	900	900	216.3	218.87	1%	219.20	218.37	1.32	218.52
7	Gully E Roadside North	12420	0.00	0.3	375	500 (420)	212.22	214.56	5%	214.64	214.06	0.08	212.44
8	Gully E Roadside South	12440	0.04	0.2	375	500 (420)	207.96	208.59	2%	210.38	208.09	0.06	208.08
9	Gully F North	12560	0.04	0.3	375	500 (420)	201.12	202.04	3%	203.54	201.54	0.07	201.35
10	Gully F Existing	12760	0.30	2.3	800	800	179.53	185.71	0%	182.33	185.21	0.39	180.19
11	Gully G North - 1	12840	0.00	0.3	375	500 (420)	179.11	179.81	4%	181.53	179.31	0.06	179.31
12	Gully G North - 2	12920	0.10	0.5	375	375	171.59	173.1	6%	173.97	172.6	0.13	171.99
13	Gully G North - 3	12980	0.00	3.9	600	600	167.74	169.29	3%	170.34	168.79	0.36	168.28
14	Gully G North -4	13060	0.00	3.6	600	600	163.01	164.39	6%	165.61	163.89	0.58	163.70
15	Gully G South	13140	0.08	0.57	630	630 (525)	155.91	157.52	2%	158.44	157.02	0.12	156.16
16	Gully H	13220	0.13	6	600	600	141.67	146.63	11%	144.27	146.13	0.86	141.67
17	Gully I -RR	13400	0.05	0.6	375	500 (420)	140.58	141.45	1%	143.00	140.95	0.13	140.92
18	Gully J North	13580	0.20	8.7	1200	1200	122.156	127.49	13%	125.36	126.99	1.32	123.004
19	Gully J South	13700	0.00	8.6	600	600	114.95	118.57	4%	117.48	118.07	1.24	116.62
20	Gully J New (last)	13755	0.00	0.1	N/A	500 (420)	115.11	116.74	9%	117.53	116.24	0.02	115.22

Table 2-8: Hydraulic calculations of gully culverts

2.7.2 RECOMMENDATION

Refer to Table 2-9 about the recommendations, based on the hydraulic calculation's outcomes of the existing pipelines.

Table 2-9: Recommendations

CULVERT NO.	CULVERT NAME / FLUME NAME	LOCATION	RECOMMENDATIONS	MEETS THE RMA DEFINITION OF A 'RIVER'/'STREAM' (YES/NO
N/A	Outfall A1	11620	Install inlet MH and ≈ 40 m flume discharging to stable area below fill embankment	No
N/A	Outfall A2	11760	Install inlet MH and ≈ 50 m flume discharging to stable area below fill embankment	No
1	Gully A	11685	Raise inlet level (fill gully), CIPP line the existing culvert, as the size meet the hydraulic requirement, but shows signs of joint separation, and recommended burial depths for Class 2 concrete pipe is significantly exceeded.	Yes
2	Gully B	11846	Raise inlet level (fill gully), CIPP line the existing culvert, as the size meet the hydraulic requirement, but the culvert is significantly degraded.	No
3	Gully C North	12044	CIPP line the existing culvert, as the size meet the hydraulic requirement, but the culvert is significantly degraded. Extend pipe 6 m upstream to accommodate road widening.	Yes
4	Gully C South	12160	Construct a new ≈ 25 m long DN500 (ID420) SN16 cross culvert with a traversable inlet.	No
N/A	Outfall at C south		Install 1050Ø inlet MH and ≈ 20 m flume discharging downslope	No
5	Gully D North	12264	Preserve and extend existing culvert by ≈ 8 m, install new junction MH and new inlet MH	Yes

CULVERT NO.	CULVERT NAME / FLUME NAME	LOCATION	RECOMMENDATIONS	MEETS THE RMA DEFINITION OF A 'RIVER'/'STREAM' (YES/NO
6	Gully D (Waterfall)	12365	Preserve and extend existing culvert, by ≈ 5 m. move inlet position upstream to accommodate road widening.	Yes
7	Gully E Roadside North	12420	Construct a new ≈ 20 m long DN500 (ID420) SN16 cross culvert with a traversable inlet.	No
N/A	Outfall at E roadside north	12420	Construct a ≈ 15 m flume discharging downslope	No
8	Gully E Roadside South	12480	Construct a new ≈ 20 m long DN500 (ID420) SN16 cross culvert with a traversable inlet.	No
N/A	Outfall at gully E roadside south	12480	Construct a ≈ 15 m flume discharging downslope	No
9	Gully F North	12560	Construct a new ≈ 20 m long DN500 (ID420) SN16 cross culvert with a traversable inlet.	No
N/A	Outfall at gully F north	12560	Construct a ≈ 15 m flume discharging downslope	No
10	Gully F north	12680	Abandon existing culvert in place and grout fill – discharge location is contributing to instability below 'F'.	N/A - Abandoned
11	Gully F Existing	12760	CIPP line the existing culvert, as the size meet the hydraulic requirement, but the culvert is significantly degraded. Extend pipe upstream to accommodate road widening.	Yes
12	Gully G North - 1	12840	Excavate and remove the existing culvert. Replace the existing culvert (like for like) – poor condition, with a new traversable wingwall inlet, DN500 Eroflo SN16 culvert crossing the road to remedy limited cover, cracks, & misalignments.	No

CULVERT NO.	CULVERT NAME / FLUME NAME	LOCATION	RECOMMENDATIONS	MEETS THE RMA DEFINITION OF A 'RIVER'/'STREAM' (YES/NO
N/A	Outfall at gully G north	12840	Construct a ≈ 10 m flume discharging downslope	No
13	Gully G North - 2	12920	Preserve the existing culvert, as the size meet the hydraulic and structural requirement.	No
N/A	Outfall at gully G north 2	12920	Construct a ≈ 20 m flume discharging downslope	No
14	Gully G North - 3	12980	Preserve and extend the existing culvert ≈ 3 m, as the size meet the hydraulic and structural requirement.	Yes
15	Gully G North - 4	13060	Preserve the existing culvert, as the size meet the hydraulic and structural requirement.	Yes
16	Gully G South	13140	Excavate and remove existing 15 m long, 600 mm Ø culvert Constrauct a new ≈ 30 m long 600 mm Ø culvert	No
N/A	Outfall at Gully G south	13140	Install 1050Ø inlet MH and ≈ 15 m flume discharging downslope	No
17	Gully H	13220	CIPP line the existing culvert, as the size meet the hydraulic requirement, but the culvert is significantly degraded. Extend culvert upstream ≈ 6 m to accommodate road widening.	Yes
N/A	Outfall at Gully H	13350	Install 1050Ø inlet MH and ≈ 15 m flume discharging downslope	No
18	Gully I -RR	13400	Construct a new ≈ 25 m long DN 500 (ID 420) SN16 cross culvert with a traversable inlet.	No
N/A	Outfall at Gully I		Install 1050Ø inlet MH and ≈ 15 m flume discharging downslope	
19	Gully J North	13580	Retain the existing culvert meets the structural requirement.	Yes

CULVERT NO.	CULVERT NAME / FLUME NAME	LOCATION	RECOMMENDATIONS	MEETS THE RMA DEFINITION OF A 'RIVER'/'STREAM' (YES/NO
20	Gully J Middle	13630	Construct a new double superpit on the southern side of the road and a ≈ 15 m flume to base of the slope.	No
21	Gully J South	13700	Install a new junction MH and extend the existing 600 mm culvert upstream Install a secondary overflow pipe.	Yes
22	Gully J Road reticulation	13755	Install ≈ 20 m long 420 mm ID cross culvert	No – road reticulation only

2.8 FISH PASSAGE

Fish Passage Assessment (Appendix B) has been prepared by the project ecologist. The purpose of the assessment is to determine the need to provide fish passage, based on ecological considerations.

For this project, fish passage retrofits are required for the following gully culverts based on ecological considerations:

- Culvert 6 (site D - waterfall CH 12365
- Culvert 14 (site G north CH 12980)
- Culvert 17 (site H CH 13220)
- Culvert 19 (Site J north CH 13580)

Details of the retrofits are provided in the fish passage assessment.

2.9 STRUCTURAL ASSESSMENT

The preferred pipe material for replacing the existing stormwater pipe is polyethylene (PE). During detailed design, a structural assessment was completed for the flexible pipes (e.g., PE pipes) as per AS/NZS 2566.1 1998. This checked deflection, strain, buckling and combined loading. The pipes had a stiffness rating of 8,000 N/m/m (SN8) and a minimum strength of 10 MPa (PE100).

Pipes installed beneath the road pavement are SN16. Note that the results for trafficked areas are conservative; pipes installed beneath the road were SN16 as required by NZTA standards.

2.10 OUTLET PROTECTION

Scour protection is required at the culvert outlets, outlets from bench drains, and where road runoff discharges into the gullies, based on discussion with NZTA during the design phase, the agreed scour protection measures were:

- Culvert outlets: full pipe, corrugated Euroflo flumes with a rip-rap apron at their termination. The design was based on what is practical to install on site, rather than a specific scour protection standard. These are considered a cost-effective solution which can be installed relatively quickly on a variety of downstream slope condition.
- Kerb or bund termination: Riprap lined to distribute concentrated flow as sheet flow and dissipate energy.
- Surface water channel: Riprap lined and be sized to accommodate a 20-year ARI event, as per P46 requirements.

Where site constraints required an alternative scour protection, site specific information has been included below.

2.11 ROAD DRAINAGE SYSTEM

Subsoil drains were required to protect the pavement layer and road embankment from possible seepage. Subsoil drains were installed Beneath the surface water channel at the toe of all cut embankments. The subsoil drain comprises a 110 mmØ perforated drain coil in a 300 mm W x 600 mm D (below subgrade) geotextile wrapped trench backfilled with gap-graded drainage aggregate (20/14, 40/20 or similar.

The proposed road surface runoff collection system is kerb & channel for the northbound (downslope) lane, and a parabolic concrete channel for the southbound (upslope) lane.

Secondary 100-year flows require – 3.0 m clear width in live lane, and a maximum 100 mm depth in the covered lane.

Shoulder flow must not encroach on traffic lanes in a 10-year event (P46). Bypass flows will be conveyed (via the kerb & channel) to the existing cross culverts servicing the upstream bush catchments.

2.11.1 UPSLOPE

To capture flows from cut embankments and road runoff (where superelevation slopes into the hillside) we designed a standard parabolic channel of size 110 mm depth and 700mm width. Its capacity is checked against peak flow for 1 in 10-year and 100-year rainfall for the year 2031-2050 using HydroCAD software and the results are tabulated in Table 2-10 and calculations are appended in Appendix B.

Table 2-10: HYDRAULIC CALCULATIONS OF ROAD CHANNELS

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA		CHANNEL SECTION			FROM HYDROCAD OUTPUT 10 YEARS			FROM HYDROCAD OUTPUT 100 YEARS		
			ROAD (HA)	CUT FACE (HA)	WIDTH (MM)	DEPTH (MM)	LENGTH (M)	PEAK FLOW (M³/SEC)	CHN CAPACITY (M³/SEC)	AVG. FLOW DEPTH (M³/SEC)	PEAK FLOW (M³/SEC)	CHN CAPACITY (M³/SEC)	AVG. FLOW DEPTH (M³/SEC)
1	Gully A	11685	0.50	0.4	700	110	160	0.16	0.13	0.12	0.32	0.13	0.18
2	Gully B	11846	0.10	0.1	700	110	63	0.03	0.2	0.05	0.067	0.2	0.06
3	Gully C North	12034	0.30	0.08	700	110	129	0.07	0.21	0.07	0.14	0.21	0.09
4	Gully C South	12160	0.15	0.05	700	110	81	0.04	0.1	0.07	0.07	0.1	0.1
5	Gully D North	12264	0.10	0.13	700	110	100	0.03	0.23	0.05	0.07	0.23	0.06
6	Gully D (waterfall)	12365	0.00	0.9	700	110	120	0.06	0.14	0.08	0.13	0.14	0.11
7	Site E North	12420	0.05	0.3	700	110	42	0.03	0.07	0.08	0.06	0.07	0.1
8	Site E South	12440	0.04	0.2	700	110	34	0.03	0.23	0.04	0.06	0.23	0.06
9	Site F North	12560	0.05	0.3	700	110	66	0.03	0.19	0.05	0.07	0.19	0.07

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA		CHANNEL SECTION			FROM HYDROCAD OUTPUT 10 YEARS			FROM HYDROCAD OUTPUT 100 YEARS		
			ROAD (HA)	CUT FACE (HA)	WIDTH (MM)	DEPTH (MM)	LENGTH (M)	PEAK FLOW (M^3/SEC)	CHN CAPACITY (M^3/SEC)	AVG. FLOW DEPTH (M^3/SEC)	PEAK FLOW (M^3/SEC)	CHN CAPACITY (M^3/SEC)	AVG. FLOW DEPTH (M^3/SEC)
10	Gully F Existing	12760	0.30	0.28	700	110	156	0.09	0.22	0.07	0.18	0.22	0.1
11	Gully G North-1	12840	0.00	0.3	700	110	76	0.03	0.16	0.05	0.05	0.16	0.06
12	Gully G North-2	12920	0.10	0.4	700	110	73	0.07	0.19	0.09	0.14	0.19	0.12
13	Gully G North-3	12980	0.00	0.1	700	110	51	0.05	0.24	0.02	0.01	0.24	0.02
14	Gully G North-4	13060	0.00	0.2	700	110	71	0.02	0.18	0.04	0.03	0.18	0.05
15	Gully G South	13140	0.08	0.24	700	110	90	0.05	0.16	0.06	0.07	0.16	0.08
16	Gully H	13220	0.00	0.06	700	110	64	0.01	0.16	0.02	0.01	0.16	0.03
17	Gully I - RR	13400	0.05	0.6	700	110	157	0.05	0.13	0.07	0.1	0.13	0.1
18	Gully J North	13580	0.20	0.1	700	110	N/A	0.05	0.19	0.06	0.08	0.19	0.08
19	Gully J South	13700	0.00	0.1	700	110	123	0.05	0.19	0.06	0.08	0.19	0.07

CULVERT NO.	CULVERT NAME	LOCATION	CATCHMENT AREA		CHANNEL SECTION			FROM HYDROCAD OUTPUT			FROM HYDROCAD OUTPUT		
								10 YEARS			100 YEARS		
			ROAD (HA)	CUT FACE (HA)	WIDTH (MM)	DEPTH (MM)	LENGTH (M)	PEAK FLOW (M^3/SEC)	CHN CAPACITY (M^3/SEC)	AVG. FLOW DEPTH (M^3/SEC)	PEAK FLOW (M^3/SEC)	CHN CAPACITY (M^3/SEC)	AVG. FLOW DEPTH (M^3/SEC)
20	Gully J New	13755	0.00	0.1	700	110	123	0.05	0.19	0.06	0.08	0.19	0.07

2.12 CULVERT ABANDONMENT

Existing culverts that were replaced or were no longer in service required abandonment. In these situations, existing pipes are either grout filled and abandoned in place or removed during construction as agreed with the Engineer.

Refer to Table 2-9 Recommendation.

2.13 SECONDARY FLOW PATHS

Failure of the slope below the road across the four slip sites has been associated with secondary flow paths overtopping the road and scouring the downstream slope. Therefore, additional emphasis during the design phase was placed on ensuring the resilience of the primary network and capacity of upgraded culverts.

In the event these stormwater assets are overwhelmed, an asphalt bund was constructed along the top of each wall to ensure that secondary flows are discharged at a controlled location.

2.14 GEOTECHNICAL CONDITIONS

The Brynderwyns Recovery Work Geotechnical Factual Report_Rev01 has been completed for the site. from the initial assessment, the following potential geotechnical risks have been identified with respect to the proposed concept options and these are considered and assessed in the detailed design:

- Potential for deep excavations in soils requiring temporary batter stabilisation. Shallower installation is preferable from a geotechnical risk perspective.

2.15 SITE DRAWINGS

The stormwater drawings are referenced for each site. These issued 'For Construction' drawings may differ from the details in this report, due to post-design amendments and stormwater infrastructure availability during the emergency works.

3 SITE SPECIFIC STORMWATER DESIGN

3.1 RMA CONSENTING REQUIREMENTS

3.1.1 PROPOSED REGIONAL PLAN FOR NORTHLAND

The Proposed Regional Plan for Northland (PRPN) sets out activities rules in relation to stormwater management and culverts. The following sets out the relevant rules that apply, including permitted activity provisions.

Proposed Regional Plan for Northland (PRPN)		
Activity Rules		Activity status
C.2.1.4	Replacement of a culvert in the bed of a river/ stream where the footprint is larger than the existing structure	Controlled
C.2.1.8	Placement or extension of a culvert in the bed of a river/ stream where the footprint is larger than the existing structure.	Controlled
C.6.4.2	**Other stormwater discharges** *Standards to be met for permitted activity status to apply:* The diversion and discharge of stormwater into water or onto or into land where it may enter water from an impervious area or by way of a stormwater collection system, is a permitted activity, provided: 1) The discharge or diversion is not form: a) A public stormwater network, or b) A high-risk industrial or trade premises, and 2) The diversion and discharge does not cause or increase flooding of land on another property in a storm event of up to and including a 10 percent annual exceedance probability, or flooding of buildings on another property in a storm event of up to and including a one percent annual exceedance probability, and 3) [Not applicable] 4) [Not applicable] 5) The diversion or discharge is not into potentially contaminated land, or not potentially contaminated land that is not covered by an impervious area, and 6) The diversion and discharge does not cause permanent scouring or erosion of the bed of a water body at the point of discharge, and 7) The discharge does not contain more than 15 milligrams per litre of total petroleum hydrocarbons, and 8) The discharge does not cause any of the following effects in the receiving waters beyond the zone for reasonable mixing: a) The production of conspicuous oil or grease films, scums or foams, of floatable or suspended materials, or b) A conspicuous change in the colour or visual clarity, or c) An emission of objectionable odour, or	Permitted

	d) The rendring of freshwater unsuitable for consumption by the farm animals, or e) The rendering of freshwater taken from a mapped priority drinking water abstraction point (refer I Maps | Nga mahere matawhenua) unsuitable for human consumption after existing treatment.	

For activities that require a consent, they will be sought from Northland Regional Council as part of a resource consent application for recovery works. The application will be prepared under the provisions of the WK-OiC.

3.1.2 WK-OIC REQUIREMENTS

The WK-OiC modifies the RMA to support recovery works along specific section of state highway. For resource consents granted under the provisions of the WK-OiC, the following conditional requirements will need to be complied with:

1. New land drains must be designed to accommodate the 20-year ARI flood flow event or other standard as applied to the specific drainage scheme affected and must include appropriate erosion control.
2. The consent holder must design nay new permanent culvert to ensure that any headwater ponding upstream of the culvert in the 100-year ARI rain event does not cause any significant adverse effect.

For this project, the above requirements will be...

3.2 FILL SITE A

3.2.1 GENERAL

The following drawings should be referred to for the Fill Site A stormwater detailed design:

1. 1-11264.01-WSP-SDDC-SA-DR-WA-4000

   1-11264.01-WSP-SDDC-SA-DR-WA-4001

   1-11264.01-WSP-SDDC-SA-DR-WA-4211

Groundwater levels at the Gully A are controlled by a drainage blanket (the existing drainage blanket below the road embankment was extended underneath the fill placed in the gully)

Fill site A is a 3.3 Ha bush catchment planted in pine which receives runoff from approximately 0.3 Ha of the outlet culvert is a DN900 mm RCRRJ culvert laid at approximately 23% gradient below the road embankment constructed circa 1990 with the inlet sited in the bottom of the gully. The inlet location was preserved with a 2050 inlet manhole & scruffy dome with additional risers placed as filling commenced >100,000 m^3 of fill material has been placed uphill of the road embankment. The existing culvert is the only drainage outlet from the gully (there are no emergency overflows).

The culvert inlet is approximately 8 m below the road edge.

Figure 3-1: *Gully A -5 m contours*

3.2.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.2.3 PIPE WORK AND SURFACE DRAINAGE

On the north-eastern side of the road from CH 11480 to CH 11670.the existing roadside drainage will be preserved and discharge into a new rock-lined drain/swale discharging to the inlet to the 900 culverts (as per the current drainage regime).

There is a DN900 culvert at CH 11716 beneath a deep road fill embankment noted as being in poor condition as per the CCTV inspection report done on 24th February,2024. The inlet headwall is sited within the fill gully approximately 8 m below road level. Construction photos show the culvert is Class 2 with concrete bedding. The recommended burial depth for a class 2 pipe is exceeded beneath the road fill embankment and within the fill site.

Considering the burial depth and the criticality of the culvert, CIPP lining is recommended.

3.2.4 OUTLET WORKS

No modifications are proposed to the outfall of the 900 culverts.

On the western side of the road at CH 11620, a new DN1050 junction inlet manhole with a scruffy dome will be constructed with a concrete inlet apron. approximately 40 m of DN400 Euroflo pipe flume will convey flows to the gut of the gully below any potentially unstable areas.

At western side of SiteA south near CH11760, replacing the existing double catchpit with new 1050 inlet manhole with scruffy dome and concrete inlet apron will be sited behind the new pile retaining wall. Approximately 50 m of DN400 SN8 Euroflo pipe flume will convey flows to the base of the gully (below the fill embankment).

Rock armouring will be provided at the flume outlets. Rock size will be limited by what can be ‘chuted’ through the new pipe flume.

3.2.5 INLET

The existing inlet headwall for the culvert has been replaced with a new DN2050 inlet manhole. The manhole is linked to subsoil drains, positioned with a drainage blanket (refer geotechnical report) on its southern side. As the fill progresses, additional manhole risers are incorporated.

On the northern side, a DN100 subsoil drain wrapped in geotextile Nova Flo is installed within a trench. To aid clean water diversion, a temporary DN300 drain coil is affixed to the ground and removed at completion of the works.

3.3 FILL SITE B

3.3.1 GENERAL

The following drawings should be referred to for the Fill Site B stormwater detailed design:

- 1-11264.01-WSP-SDDC-SB-DR-WA-4000
- 1-11264.01-WSP-EWGL-GB-DR-WA-4211
- 1-11264.01-WSP-EWGL-GB-DR-WA-4212

Groundwater levels at fill site B are governed by the installed drainage blanket on the underside of the fill.

Fill site B is a 2 Ha bush catchment planted in pine which receives runoff from approximately 0.26 Ha catchment. The outlet culvert is a DN375 RCRRJ culvert laid at approximately 6 % gradient below the road embankment constructed circa 1990.

The culvert inlet is approximately 11 m below the road edge.

Figure 3-2: Gully B - 5 m contours

3.3.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.3.3 NEW AND EXISTING PIPE WORK

There is an existing DN375 Culvert at CH11846 that warrants replacement because of its poor condition, and the existing inlet is in the new extension area. Given these circumstances, the following action is warranted:

1. Rehabilitate the existing DN375 culvert at CH11846 with CIPP liner (relaying the culvert is not practical through the deep road fill embankment.
2. Extending the existing DN900 inlet manhole to suit fill level during construction by placing 1050 risers as fill progresses.
3. Installation of subsoil drains within the drainage blanket and underfill drains in geotextile wrapped trenches where practicable to collect groundwater flow.

A new concrete line channel will be constructed to connect with the existing channel from CH11786. Towards to the gully extension area, the concrete lined channel runs out into rock-lined drain to suit site, and discharge water to the inlet manhole.

3.3.4 OUTLET WORKS

The existing outlet structure is being maintained. Although the outlet was not found, the inlet and culvert are clear and in good condition, we assume that the outlet is also in good condition (as mentioned in RAMM).

3.3.5 INLET

Extend the existing DN900 manhole to suit the new fill site and to capture flows from the catchment area. An additional DN100 perforated subsoil drain wrapped with Class C Geotextile is installed in a trench. Installation of new drainage blanket is necessary to remove water or control groundwater seepage from the fill.

3.4 GULLY C

3.4.1 GENERAL

The following drawings should be referred to for the Gully Site C stormwater detailed design:

1. 1-11264.01-WSP-SDDC-SC-DR-WA-4000

   1-11264.01-WSP-SDDC-SC-DR-WA-4211

   1-11264.01-WSP-EWGL-GC-DR-WA-4212

Groundwater levels at the Gully Site C appear to be seasonal. Geotechnical investigations completed on November 28th, 2023.

Gully Site C is a 1.3 Ha bush catchment planted in pine which receives runoff from approximately 0.3 Ha of the outlet culvert is a DN450 RCRRJ culvert laid at approximately 6.26 % gradient below the road embankment constructed circa 1990.

The culvert inlet is approximately 11 m below the road edge.

Figure 3-3: Gully C - 5 m contours.

3.4.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.4.3 PIPE WORK AND SURFACE DRAINAGE

An existing DN450 culvert at CH12034 needs to be replaced due to its poor condition. As the manhole clashes with the new road edge location, it will need to be extended. Given these circumstances, the following action is warranted:

1. Rehabilitate the existing DN450 culvert at CH12034 with CIPP liner.
2. Extending the existing DN900 manhole to suit fill level during construction, additionally, it will be connected to a new DN1050 inlet manhole with scruffy dome. This connection will be facilitated using a DN500 Euroflo pipe.
3. A rock lined drain will be built on site and connected to the proposed embankment toe drain in the bush area. It will be discharging directly into the new DN1050 inlet manhole.
4. The concrete drain will discharge into the rock lined drain area and using 25 MPa cast in-situ concrete splay to change flow direction to the proposed manhole.

Installation of a new Euroflo DN500 culvert at CH12170, the culvert is designed using a Traversable Inlet structure to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. And a new DN1050 inlet scruffy dome manhole with concrete inlet apron will be installed at downstream western side of the road. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, three 8 mmØ 316SS cables are fastened along the entire length of the flume at the pipe joints. The Contractor to confirm the alignment of flume on site with the Engineer.

3.5 GULLY D

3.5.1 GENERAL

The following drawings should be referred to for the Gully Site D stormwater detailed design:

1. 1-11264.01-WSP-SDDC-SD-DR-WA-4000

   1-11264.01-WSP-EWGL-GD-DR-WA-4212

Gully Extension D is a 2.1 Ha bush catchment planted in pine which receives runoff from approximately 0.5 Ha of the outlet culvert is a DN630 Euroflo laid at approximately 9.54 % gradient below the road embankment constructed circa 1990.

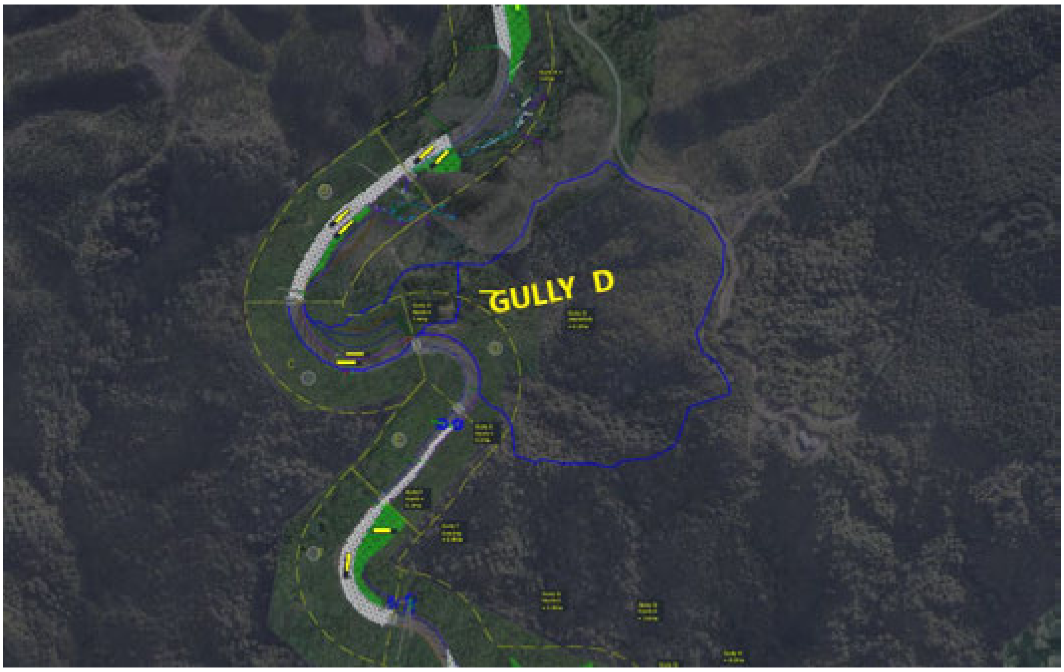


Figure 3-4: Gully D

3.5.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.5.3 NEW AND EXISITING PIPE WORK

There is an existing DN525 Euroflo culvert at CH12264 within the existing road, which has been replaced in November 2023, so the condition is acceptable, in order to suit the gully extension and road widen design, then it needs to be extended. It discharges immediately. So, the following action is warranted:

1. The existing DN18000 manhole is slated for removal at the current location due to the clash with the proposed road edge. Concurrently, the existing DN630 Euroflo will undergo an extension at a designated location. This elongated DN630 Euroflo will then be linked to a new DN1500 junction manhole. Furthermore, the fate of the existing DN1800 inlet manhole hinges on its condition: if deemed satisfactory, it will be relocated; otherwise, a new manhole of identical dimensions will take its place.

2. The proposed concrete drain will discharge into the new rock lined drain area.
3. Open upstream end on dish channel with cast in-situ erosion protection apron.

A new DN1050 inlet scruffy dome manhole with concrete inlet apron will be installed downstream on the opposite side of the road. Additionally, to ensure stability of the existing flume treatment, two 5 mm 316 stainless steel [whats?] will be securely fastened along the entire length of the pipe at 500 mm intervals. Two 32 mm Reinforcement bar anchors and saddle restraint is to suit at end of the existing flume.

The functionality of an another existing DN900 culvert at CH12358 in Site D is retained based on the provided CCTV report. To align with the new design of the road, it will need to reconnect back to the network system, the following action is warranted:

1. Demolish the existing grated lid manhole, extending waterfall culvert along existing alignment.
2. Run out concrete lined channel into the waterfall pool, cast in-situ concrete ramp.
3. Open upstream end on dish channel with cast in-situ erosion protection apron

3.5.4 OUTLET WORKS

Outlet protection is not included in this detail design. The pipe discharges onto a steep rock face. However, the current existing catchpit at CH12368 will undergo an upgrade to a Double Superpit arrangement at the outlet.

3.5.5 INLET

The existing inlet DN1800 manhole (SDMH3) has been relocated and connected with a new DN1500 junction manhole. The new inlet location on the new gully extension site will be the local low point. A new drainage blanket has been installed, which is a 500 mm thick layer of 65/40 drainage metal wrapped in strength Class C geotextile, filtration Class 2. It connected to the manhole with DN100 Euroflo or equivalent approved pipe above the manhole outlet.

3.6 SITE E

3.6.1 GENERAL

The following drawings should be referred to for the Gully Site E stormwater detailed design:

1. 1-11264.01-WSP-SDDC-SE-DR-WA-4000

   1-11264.01-WSP-SDDC-SE-DR-WA-4211

   1-11264.01-WSP-SDDC-SE-DR-WA-4212

Gully Extension E is a 0.5 Ha bush catchment planted in pine, which receives runoff from approximately 0.09 Ha of the outlet culverts are two DN500 Euroflo laid at approximately 5 % and 2% gradient below the road embankment.

Figure 3-5: Gully E

3.6.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.6.3 PIPE WORK AND SURFACE DRAINAGE

Two new DN500 culverts at CH12420 and CH12440 are designed using a traversable Inlet structure to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. The water will be discharged from the traversable inlet into a new DN1050 buried inlet manhole.

The current catchpit of Culvert 12420 will undergo an upgrade to a Double Superpit arrangement at the outlet. Additionally, the outlet will feature a DN500 SN16 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, two 32 mm RB anchors will be installed.

A Double Superpit is installed at Culvert 12480 outlet as well.

Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment with pipe clamps discharged onto rock, its bottom is at the designed outfall location. To ensure stability, three 8 mmØ 316SS cables are fastened along the entire length of the flume at the pipe joints. . The Contractor to confirm the alignment of flume on site with the Engineer.

Scour protection will be provided at the culvert extension outlets, with the rock size governed by pipe diameter.

3.7 GULLY F

3.7.1 GENERAL

The following drawings should be referred to for the Gully Site F stormwater detailed design:

1-11264.01-WSP-SDDC-SF-DR-WA-4000

1-11264.01-WSP-SDDC-SF-DR-WA-4211

Gully Extension F is a 2.6 Ha bush catchment planted in pine which receives runoff from approximately 0.35 Ha of the outlet culverts are two DN375 and DN800 laid at approximately 3% and 0% gradient below the road embankment.

Figure 3-6: Gully F

3.7.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C.

3.7.3 PIPE WORK AND SURFACE DRAINAGE

A new DN500 culvert at CH12560 is designed using a traversable Inlet structure to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. The water will be discharged from the traversable inlet into a new DN1050 buried inlet manhole The current catchpit of Culvert at CH12560 will undergo an upgrade to a Double Superpit arrangement at the outlet. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, three 8 mmØ 316SS cables are fastened along the entire length of the flume at the pipe joints and be fixed into retaining wall. Scour protection will be provided at the culvert extension outlets, with the rock size governed by pipe diameter.

Culvert 12760 needs to be constructed with precast wingwall in accordance with manufactures guidelines, and shape locally to form low point at new inlet. A stabilized earth bund is implemented at clean water diversion inlet, additionally the existing inlet pipe is to be abandoned in-place. The existing manhole is preserved and a new 1050 MH scruffy dome inlet manhole is utilized.

3.8 GULLY G

3.8.1 GENERAL

The following drawings should be referred to for the Gully Site G stormwater detailed design:

1. 1-11264.01-WSP-EWGL-GN-DR-WA-4211
   1-11264.01-WSP-EWGL-GN-DR-WA-4212
   1-11264.01-WSP-EWGL-GN-DR-WA-4213
   1-11264.01-WSP-EWGL-GN-DR-WA-4214
   1-11264.01-WSP-EWGL-GS-DR-WA-4211
   1-11264.01-WSP-EWGL-GS-DR-WA-4212
   1-11264.01-WSP-SDDC-SG-DR-WA-4000
   1-11264.01-WSP-SDDC-SG-DR-WA-4211

Gully Extension G is an 8.7 Ha bush catchment planted in pine which receives runoff from approximately 0.18 Ha of the outlet culverts are five pipes two DN375, two DN600 and DN630 laid at approximately 4%, 6%, 3% 7% and 2% gradient below the road embankment.

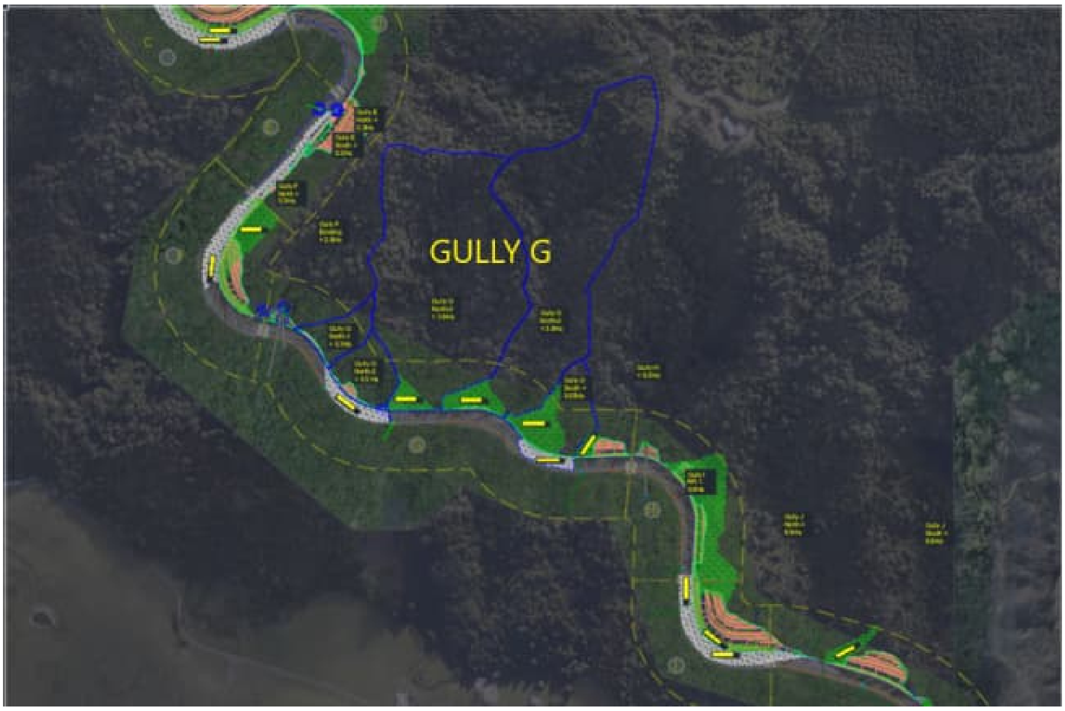


Figure 3-7: Gully G

3.8.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C

3.8.3 PIPE WORK AND SURFACE DRAINAGE

Relacing the existing alignment with new Traversable wingwall inlet at Culvert CH12840, including installation of 1050 buried junction manhole, and installation of DN500 Euroflo SN16 culvert crossing the road. to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. And a new DN1050 inlet scruffy dome manhole with concrete inlet apron will be installed at downstream western side of the road. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, two 32 mm RB anchors will be installed. The final alignment needs to be confirmed with the Engineer.

An existing DN375-DN450 culvert at CH12920 within the existing road is still functional, in order to suit the gully extension and road widen design, then it needs to be re-designed. It discharges immediately. So, the following action is warranted:

1. Removing the existing inlet manhole to make it out of the new kerb and channel area.

   Open upstream end on dish channel with cast in-situ erosion protection apron

   Relacing the existing alignment with new Traversable wingwall inlet at Culvert CH12840, including installation of 1050 buried junction manhole, and installation of DN500 Euroflo SN16 culvert crossing the road. to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. And a new DN1050 inlet scruffy dome manhole with concrete inlet apron will be installed at downstream western side of the road. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, two 32 mm RB anchors will be installed. The final alignment needs to be confirmed with the Engineer.

The existing DN600 culvert at CH12980 is still in good condition based on the CCTV report., in order to suit the road design, the following action is warranted:

2. Removing the existing manhole.

   Extending the existing pipeline with DN600 RCRRJ pipe and installing a new DN1050 inlet manhole with scruffy dome to make it out of the new kerb and channel area.

   Interrupt the proposed channel drain and construct in-situ concrete to help discharge to the inlet manhole.

   Open upstream end on dish channel with cast in-situ erosion protection apron

The existing DN600 culvert at CH13060 is still in good condition based on the CCTV report., to suit the road design, the following action is warranted:

3. Replacing the existing inlet manhole grated lid with scruffy dome.

   Running out the concrete dish drain into the existing inlet apron with 20 Mpa site concrete.

   Open upstream end on dish channel with cast in-situ erosion protection apron.

   Replacing the existing back entry manhole inlet lid with scruffy dome and 200 mm high concrete inlet apron all around.

   Preserving the existing flume alignment.

In Gully G south, the existing DN630 culver at CH13140 will be abandoned in place due to the poor condition. A new Culvert is designed for the site including:

4. Installation a new DN1200 Scruffy dome manhole at the lowest point and extend it with DN630 Euroflo culvert that crosses the road and connects to a new DN1200 JUNCTION MANHOLE Additionally, the outlet will feature a DN600 culvert for flume treatment, which will discharge at the designed outfall location. To ensure stability, two 32 mm RB anchors will be installed. At this stage, the outlet flume protection is to be confirmed, which will be updated at 100% design stage.

   A new rock lined drains is going to be constructed to drain the water from the new concrete lined drain.

3.9 GULLY H

3.9.1 GENERAL

The following drawings should be referred to for the Gully Site H stormwater detailed design:

1. 1-11264.01-WSP-EWGL-GH-DR-WA-4211

   1-11264.01-WSP-EWGL-GH-DR-WA-4212

Gully H is a 6 Ha bush catchment planted in pine which receives runoff from approximately 0.13 Ha of the outlet culvert is DN600 Euroflo laid at approximately 11% below the road embankment.

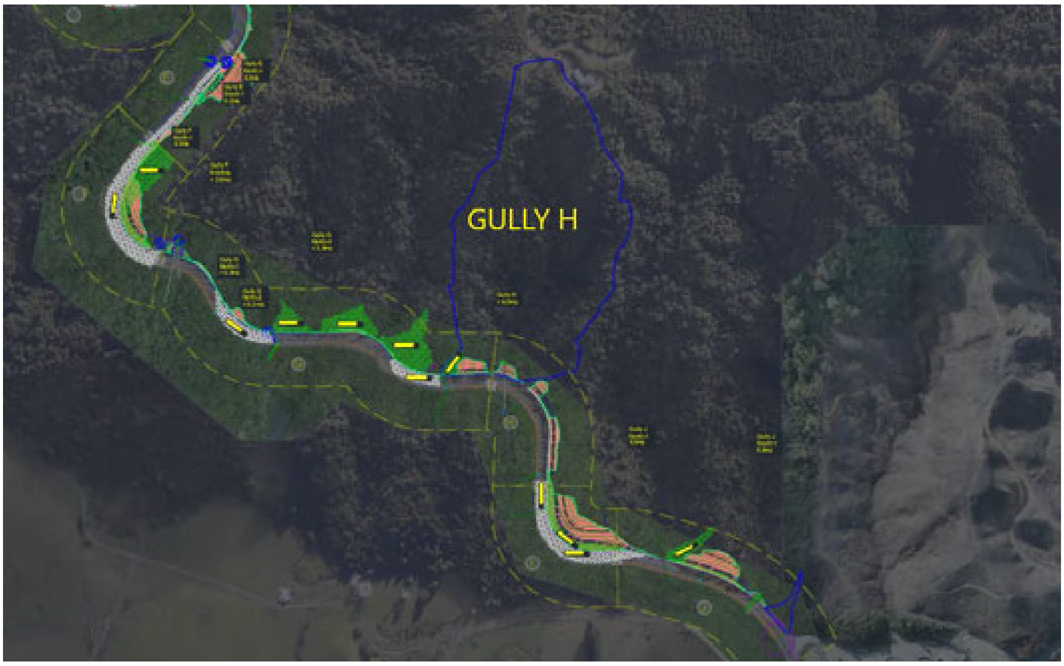


Figure 3-8: Gully H

3.9.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C

3.9.3 PIPE WORK AND SURFACE DRAINAGE

The existing pipeline at CH13220 has been assumed in a good condition based on the records in RAMM and we lack CCTV information. At the 80% design stage, the following action is warranted.

2. Extending the existing pipeline with D500 Euroflo SN8 pipe
3. Installation of an embankment toe drain in the bush area along the contour to do the excavation.
4. The concrete drain will discharge into the rock lined drain area and using 25 MPa cast in-situ concrete splay to change flow direction to the proposed manhole.

3.10 GULLY I

3.10.1 GENERAL

The following drawings should be referred to for the Gully Site I stormwater detailed design:

1. 1-11264.01-WSP-SDDC-SI-DR-WA-4000

   1-11264.01-WSP-SDDC-SI-DR-WA-4211

Gully I is a 0.6 Ha bush catchment planted in pine which receives runoff from approximately 0.05 Ha of the outlet culvert is DN500 Euroflo laid at approximately 1% below the road embankment.

Figure 3-9: Gully I

3.10.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C

3.10.3 NEW AND EXISTING PIPE WORK

Culvert CH13400 is at good condition based on the CCTV inspection report. However, in order to align with road design. The following actions will be taken:

2. A new DN500 culvert is designed using a traversable Inlet structure to accommodate site construction conditions, what's more this design allows water to flow from the road surface into stormwater system while ensuring safe passage for pedestrians and vehicles. The water will be discharged from the traversable inlet into a new DN1050 buried inlet manhole. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the proposed outfall location. To ensure stability three 8 mm Ø 316SS cables are fastened along the entire length of the flume at the pipe joints. Scour protection will be provided at the culvert extension outlets, with the rock size governed by pipe diameter.

   Two embankment toe drains are constructed along contour in the bush area to facilitate water drainage towards suitable points.

3.11 GULLY J

3.11.1 GENERAL

The following drawings should be referred to for the Gully Site J stormwater detailed design:

1. 1-11264.01-WSP-EWGL-GJ-DR-WA-4211

   1-11264.01-WSP-EWGL-GJ-DR-WA-4212

   1-11264.01-WSP-EWGL-GJ-DR-WA-4213

   1-11264.01-WSP-EWGL-GJ-DR-WA-4214

Gully J is a 15.3 Ha bush catchment planted in pine which receives runoff from approximately 0.2 Ha of the outlet culverts are two DN1200 and DN500 culverts laid at approximately 13% and 5% gradient below the road embankment.

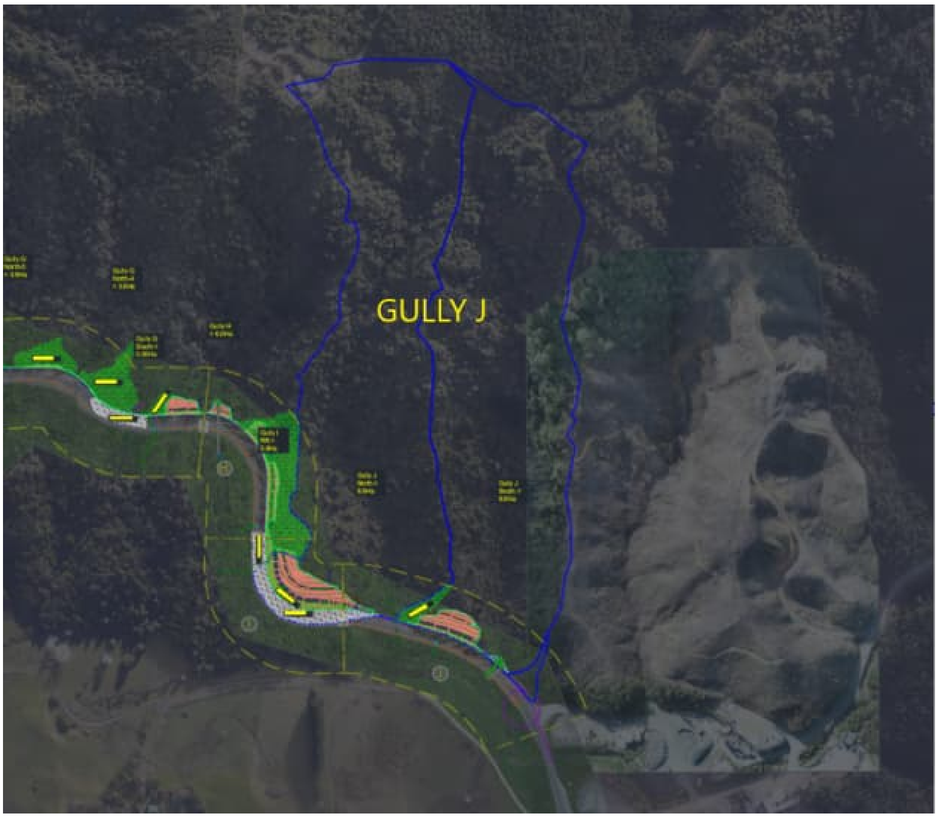


Figure 3-10: Gully J

3.11.2 HYDRAULIC ASSESSMENT

The details are shown in Appendix C

3.11.3 PIPE WORK AND SURFACE DRAINAGE

At Gully J North, there are no changes to the existing pipeline at CH13580. However, the proposed concrete drain extends into the existing rock-lined drain at CH13580.

At CH13633, a Double Superpit arrangement is designed at the southern side of the road. Additionally, the outlet will feature a DN500 SN8 Euroflo pipe for flume treatment, which will discharge at the existing outfall location. To ensure stability, three 8 mmØ 316SS cables are fastened along the entire length of the flume at the pipe joints. Scour protection will be provided at the culvert extension outlets, with the rock size governed by pipe diameter.

Based on the CCTV inspection report, the existing culvert at CH13700 is in a good condition, but does not have sufficient capacity for the catchment. The existing culvert will be extended and a new high flow culvert installed adjacent.

4 LIMITATIONS

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for Waka Kotahi ('Client') in relation to Brynderwyns Spanning from RP11.46 TO 13.79 Stormwater Design Report ('Purpose') and in accordance with the Contract Number PS -8897 SH1 Brynderwyn Hills -Design Services made on the 28th day of June 2023. The findings in this Report are based on and are subject to the assumptions specified in the Report and Design Philosophy Statement on 29th September 2023. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans, and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

APPENDIX A – EXISTING CULVERTS CONDITION ASSESSMENT MEMO

Memorandum

To	Mat Chiaroni / Chris Hardy
Copy	
From	Vani Liu
Office	Christchurch
Date	05 December 20235 December 2023
File/Ref	
Subject	Brynderwyns Recovery Work – SH1 RS 303 RP11.46 -13.79 – Existing Culverts Condition Assessment

1 Design Advice

Title: *Provide a concise description of the advice and which element of the*	Bringdowns Recovery Work – SH1 RS 303 RP11.46 -13.79 – Existing Culverts Condition Assessment		
Category:	Design		
Project Number	1-11264.01	**Zone:**	North
Prepared By:	Vani Liu	**Date:**	05/12/2023
Reviewed By:	Chris Hardy/Mat Chiaroni	**Date:**	05/12/2023
For Issue To – For Action *Specific name(s)*			
For Issue To – For Info Specific *name(s)*			
Attachments:	Asset CCTV Inspection Assessment Spreadsheet		

1.1 Purpose

Waka Kotahi has engaged WSP to provide a detailed design for recovery widening works on the south side of the Bringdowns from RP11.46 – 13.79. The works include stormwater design. Sixteen culverts located from RP11.46 – 13.79 were assessed using CCTV inspection footage to determine their existing condition and optional capacity.

Brynderwyns Recovery Work phase 1 Design Philosophy Statement aims to improve the resilience of the Brynderwyns in the short to medium term (10-30 years), with a minimum expected design life departure of 10 years.

WSP
Christchurch
52c Hayton Road
Wigram
Christchurch 8011, New Zealand
+64 3 343 0739
wsp.com/nz

This Design Advice outlines the approach adopted in determining each culvert's condition and operational capacity. The document also proposes high-level recommendations for remediation.

1.2 Asset Summary

Sixteen culverts were identified between road chainage RP11.46 -13.79. Table 1 outlines the size and numbers of culverts through the road corridor. And Appendix B_1-11264.01-WSP-EWGL-OA-DR-WA-4200 shows the locations of NZTA Culvert Assets.

Table 1 Existing Culverts Assets and Diameters

Culverts Requiring Maintenance	No. of Culverts
DN375	5
DN450	4
DN600	4
DN900	2
DN1200	1

1.3 Asset Assessment

Eleven of the 16 culverts have been CCTV inspected or visually inspected on site from upstream or downstream.

Attached to this report is a full list of all culverts and recommended actions.

The philosophy for repair or replacement was based on the identification of defects that could result in:

- Significant reduction in the hydraulic capacity.
- Failure due to structural damage.
- Pavement failure.

Culvert defects that fall outside the above threshold will be handed back to the maintenance Contractor as low risk defects that can be managed throughout that culvert remaining asset life.

Examples of damage to be handed back to maintenance Contractor are shown in the following it as follows:

- Minor damage such as localised spalling of concrete and exposed reinforcing at pipe ends.
- Minor cracking with no visible gap and not extending the full circumference or length of the pipe section.
- Minor joint and angular displacement with no possibility of material migrating into the pipe.

2 Design Recommendations

The following culverts have damage which is required to be addressed so that their continued functionality and extend the asset life or to prevent failure of the pavement.

2.1 Culvert 12034

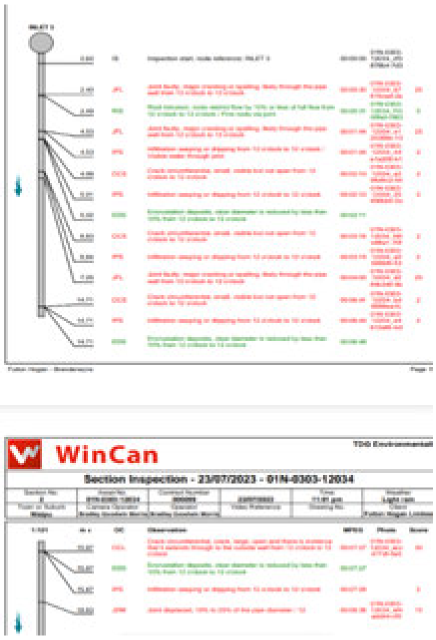


Figure 1 Culvert 12034

The pipeline was installed in 1995, which is quite old. There are three joints in the culvert where the cracking or spalling is observed on the pipe wall, accompanied by surface corrosion around the joints at distances of 4.54 m, 5.50 m, 7.24 m, 9.12 m, 10.09 m, 12.26 m, 14.71 m, 15.87 m, and 17.48 m. The final pipe joint has also shifted out of place, posing a high risk of pavement failure. It is strongly recommended that the entire culvert be replaced to address these issues.

2.2 Culvert 12747

Figure 2 Culvert 12747

The following was observed:

- There is a bend without a chamber at about 5 m.
- A small longitudinal crack has been identified along the pipeline, spanning from 7.91 m to 8.75 m.
- The joint at 8.84 m is displaced, and between 8.84 m and 10.07 m, two significant new longitudinal cracks have emerged.

- A longitudinal crack is evident in the pipe from 10.07 m to 11.46 m, accompanied by corrosion around the affected area.
- The section at 11.46 m pictured has full cracks at 9, 12 and 3 o'clock, so it has effectively failed without deforming or collapsing yet.
- Two large longitudinal cracks have been detected along the pipeline, extending from 11.46 m to 17.7 m.
- Corrosion is evident on the pipe surface surrounding these cracks with exposed steel. Many joints are displaced, and some are opened from 8.84 m to 17.7 m.

The concrete pipe has experienced significant longitudinal cracking, leading to compromised structural integrity, and it is probably being held up by bedding and its own residual strength. Additionally, the joints have been displaced, increasing the risk of pavement failure. Therefore, it is recommended to replace the entire pipeline.

2.3 Culvert 12829

Figure 3 Culvert 12829

The CCTV inspection was discontinued at 8.86 m. The clear diameter of the pipe has been reduced by approximately 30% due to accumulated debris and silt, necessitating thorough cleaning for the entire pipeline. Furthermore, some movement exists at some joints through the pipeline; however, conducting a definitive assessment proves challenging due to the limited visibility in the footage data.

Additionally, there is considerable damage near the joint at 4.34 m, allowing water to seep through, and two small longitudinal cracks along the pipe from 8.43 m to 8.86 m. At this stage, a recommendation for pipe replacement will be made at the damaged section.

2.4 Culvert 12900

Figure 4 Culvert 12900

The pipe size transitions to 450 mm toward the outlet. The CCTV inspection was halted at 13.18 m due to a drop, and an external photo at the outlet is required to assess the situation, as the footage does not clearly reveal an opening. This pipe might be a candidate for replacement, but more detailed information is necessary to determine if only the outlet requires fixing. The visible sections of the pipe appear to be in reasonable condition where there are no cracks, but it is likely that the cracks are situated beneath the live lanes, indicating a potential worsening of the situation over time.

2.5 Culvert 12961

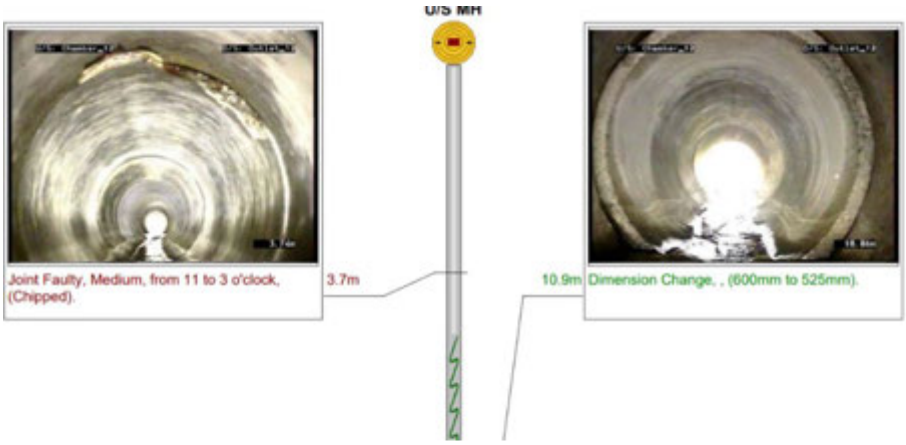


Figure 5 Culvert 12961

In general, the pipe is in a good condition. There is a significant crack near the joint at 3.74 m, exposing the steel shown in the CCTV pipeline Images Report. Action needs to be taken to prevent the crack being developed. Patches or mechanical seals can be used to seal the joints.

2.6 Culvert 13134

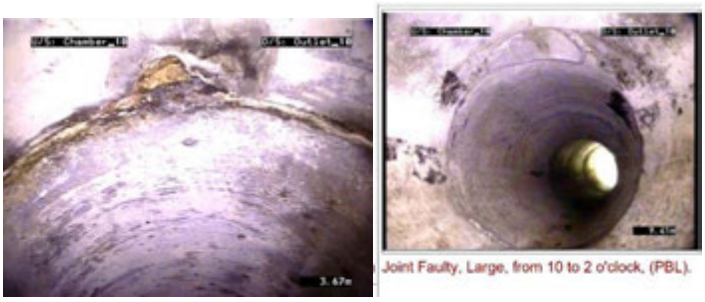


Figure 6 Culvert 13134

The joint at 3.8 m exhibits a significant crack, exposing the steel beneath. This situation poses a risk of water leakage from the joint. The seepage of water can erode the nearby soil, jeopardizing the stability of the ground above the pipe. With time, this erosion may escalate, potentially causing sinkholes and even structural damage to roads and nearby infrastructure. Immediate attention and repair are necessary to prevent these hazardous consequences. The last ~8m of the culvert needs to be replaced.

2.7 Other Culverts

There are two culverts that require maintenance works. The work required is generally cleaning and it is recommended that the cleaning works be carried out by the maintenance Contractor. Below is the list of the culverts:

- Culvert 12672

Figure 7 Culvert 12672 pipe has blockage (>30% Pipe Capacity)

Figure 7 above represents of blockage of >30% pipe capacity. This is a maintenance issue which is required to be addressed to ensure continued functionality of the culvert. And it also shows that there is a small cracking along a single pipe length through culvert 12672. The pipe is a concrete pipe, and it is in reasonable condition given its apparent age and would not require immediate replacement.

- Culvert 13390(installed in 1998)

The five culverts depicted below lack CCTV inspection information, according to the RAMM, Culverts 11685, 11846, and 13213 are reported to be in good condition, while Culverts 12264 and 12672 are noted as being in poor condition. It is worth noting that the conditions of Culverts might be similar to those of pipelines of the same age, which have CCTV data available.

- Culvert 11685 (installed in 1995)
- Culvert 11846 (installed in 1995)
- Culvert 12264 (installed in 1995)
- Culvert 12672 (installed in 1998)
- Culvert 13213 (installed in 1998)

3 Compliance

This section lists standards and documents to be complied with, and approved departures.

- AS/NZS 3725:2007 Design for Installation of Buried Concrete Pipes
- Design Philosophy Statement – Brynderwyns Recovery Work – SH1 RS 303 RP11.46 -13.79.
- NZTAP46 – Stormwater Specification
- NZTA (2010), F3 Specification for Pipe Culvert Construction

No departures are proposed.

4 APPENDIX A: Asset CCTV Inspection Assessment Spreadsheet

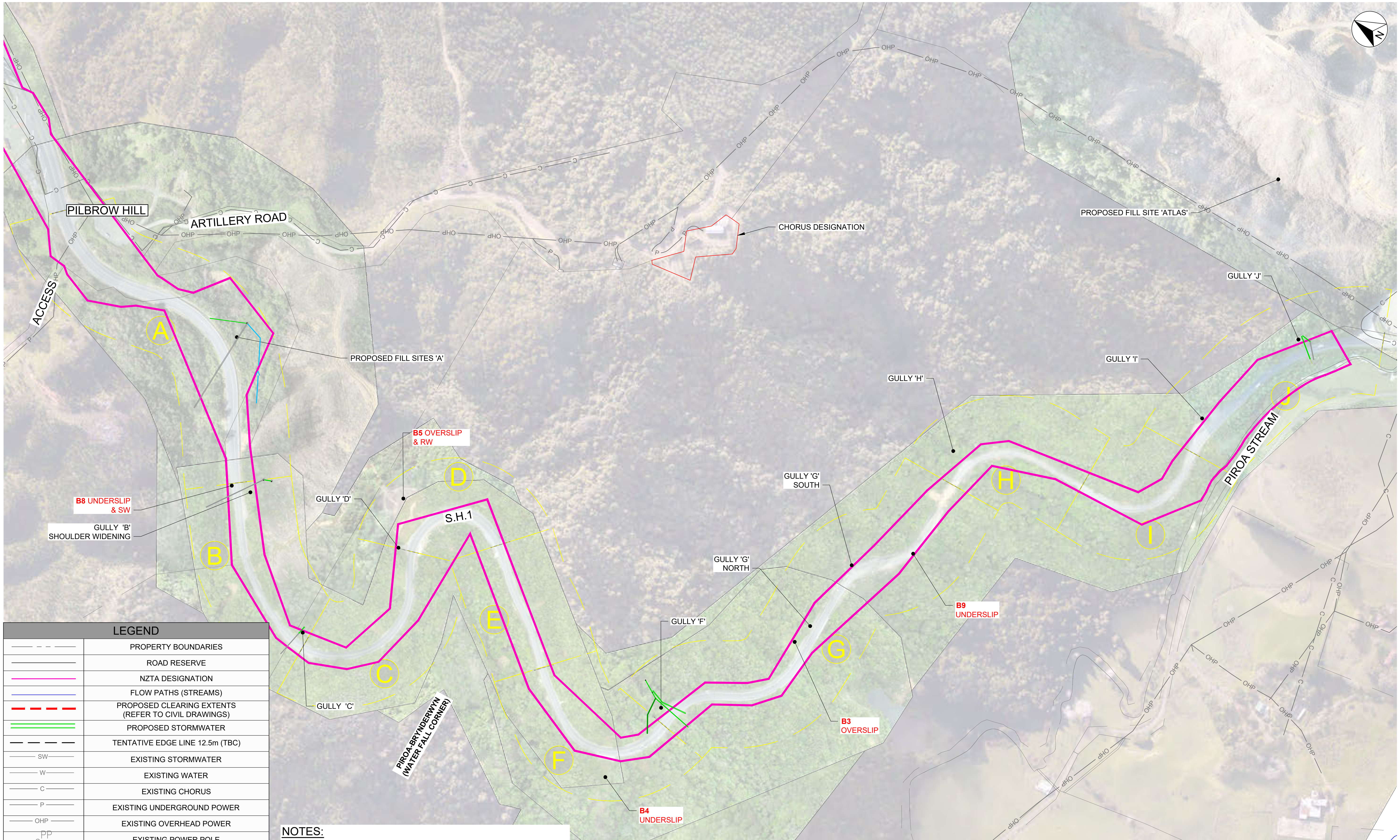
Culvert CCTV Requests

CCTV data missing (red)

CCTV data provided (green)

Project: 1-1264.01

Road	Name	Chainage (in RAMM)	Location (Shown in the sketch)	Location (Shown in the RAMM)	DN(Shown in the RAMM)	DN (Shown in Sketch)	Comments shown on the inspeted pdf sketch	Comments (Shown in RAMM)	Condition shown in RAMM	Condition Date shown in RAMM	Construction Date	Age	Action	CCTV Date	CCTV DAMAGE NOTED: Anything to affect Hydraulic Capacity? Barrel Settlement - suffcient to affect flow	Pipe Deformation in C/S	Structural Damage likely to result in failure in 5-10 years: Exposed reinf.	Cracking > 10mm	Joint Separation >40mm	Maintenance Issues? Blockage - needs cleaning (>30% c/s area)	Debris in Pipe (Temp obstruction) <30%	Notes (WSP assessment)	Other PM Comments	PM ACTION List	On Maintenance List
01N-0303	Fill Site A	15829	11685	11685	900	900	Missed location indicative	Inlet at bottom of deep, bush-covered gully. Difficult to access. Outlet was not found. Inlet clear. Culvert clear and good condition inside.	Good	28/09/2022	5/03/1995	28	Inspected									Needs to be inspected visually again or CCTV inspection. Pipe is haunched & bedded in mass concrete; condition is considered acceptable (MC 7/11/2023)	ACTIVE SLIP where diggers have previously been digging too unsafe to enter active slip area on nights further investigation required on days reffer to photos	Condition considered acceptable	
01N-0303	Gully Extension B	15826	11846	11846	450	450	Missed location indicative	Inlet in a deep drop chamber at the bottom of the gully. Inlet clear. Clear and good condition inside for as far as can be seen. Outlet in steep bush-covered gully was not found. Water was flowing through from the inlet OK, so outlet should be OK.	Good	28/09/2022	5/03/1995	28										Unble to located, need to be inspected visually or CCTV inspection	unable to locate due spent 30 minutes looking through bush unable to locate	Condition considered acceptable	
01N-0303	Gully Extension C	148229	12034	12034	450	450	Missed location indicative	Inlet in hole and prone to getting blocked. Culvert clear and in good condition inside. Outlet clear but in scoured-out hole and recessed under bank.	Good	28/09/2022	5/03/1995	28	Inspected /CCTV	23/07/2023			x	x	x			Three joints in the culvert where significant cracking or spalling is observed on the pipe wall. Pipewall corrosion around the joints at 4.54m, 5,50m,7.24m,9.12,10.09m, 12.26m, 14.71m, 15.87m, 17.48m, and minor cracking on the surface at 15.87m, joints separation at 4.53m is more than 40mm, the last joint is displaced. 85% of the pipeline needs to be replaced.	pipeline is in good condition, few joint faulty, , and one displacement at 18.8m	Replace	
01N-0303	Gully Extension D	15825	12264	12264	450	450	B5 repired, not required - location indicative	Inlet in drop chamber 148230 is completely blocked. Outlet is somewhere down steep. slumping bank covered in vegetation - culvert could be disjointed and blocked judging by the way the land is slumping.	Poor	28/09/2022	5/03/1995	28										Unble to located, need to be inspected visually or CCTV inspection THe old pipe has been replaced with twin wall HDPE 2023 (MC7/11/2023)	not required	THe old pipe has been replaced with twin wall HDPE 2023 (7/11/2023), so the condition considered acceptable	
01N-0303		15824	12358	12358	900	900	waterfall missed - Missed location indicative	Inlet clear outlet clear, flows ok	Good	26/07/2021	5/03/1995	28	CCTV	23/07/2023				x				2 cracks at 6.28m round the joint, no ingtress of metal, handback to Maintance Contractor, the culvert's functionality is retained.	Waterfall pipeline is in good condition no serious flaults found		Repair (defer)
01N-0303		15818	12672	12672	375	375	Missed location indicative	Inlet in catchpit 148225 is clear. Outlet across road is buried. Culvert 95% blocked inside.	Poor	28/09/2022	15/02/1998	25	CCTV	24/07/2023						x		CCTV inspection abandoned unable to pass at 2.38m. About the first 3m, and the pipe diameter reduceed more than 25% dut to the debris silt, and CCTV couldn't fully inspect , will need cleaning	opend cesspit to find it 100% full of debris vacume to clean and hydro out unable to complete pipeline we need downstream access via Southern Clousure		Cleaning
01N-0303	Gully Extension F	15816	12747	12747	375	375	Missed location indicative	and litter. Inlet is open. Outlet is down steep, bush-covered slope above a slip. Outlet is clear. Culvert is clear inside and in good condition. Deep hole over culvert on shoulder	Good	28/09/2022	15/02/1998	25	CCTV	29/08/2023			x	x	x			There are 2 longitudinal cracks observed along the pipeline, spanning from 11.46 meters to 17.7meters. Additionally, corrosion is apparent on the pipe surface surrounding these cracks, plus exposed steel. Many joints displaced from 8.84m to 17.7m.replace the entire pipeline.	Unable to flsuh or cctv aswell as confomation on which line were flushing due to new 800mm? pe pipeline	Replace	
01N-0303		15815	12829	12823	525	375	Abandoned due to silt/gravel in line >50% blocked near outlet abandoned at 8.9m	Inlet in drop chamber 148223 - partly blocked. Outlet pipe has larger diameter than the rest - 525 mm v. either 375 or 450. Outlet about 40% blocked. About 60% blocked further in. Pipes in good condition.	Average	29/09/2022	15/02/1998	25	CCTV	29/08/2023			x	x		x		The CCTV inspection was discontinued at 8.80 meters. The clear diameter of the pipe has been reduced by approximately 30% due to accumulated debris and silt, necessitating thorough cleaning for the entire pipeline. Furthermore, it is assumed that a joint displacement occurred at 3.53 meters; however, conducting a definitive assessment proves challenging due to the limited visibility in the footage data. Additionally, there is a significant crack near the joint at 4.34 meters, allowing water to seep through. And two small longitudinal cracks along the pipe from 8.43 meters to 8.86 meters. If the joint displaced is confirmed, a strong recommendation for pipe	Ran out of water and time to complete pipeline to attempt again on day 2	Replace	
01N-0303		15814	12900	12906	525	375	375 Diameter change near end of culver (13.6m), unable to complete inspection	Inlet in drop chamber 148236 - partly blocked. Outlet 10% blocked. Outlet pipe is 525 mm diameter - larger than the other pipes. Rest of culvert clear. Good condition.	Good	29/09/2022	15/02/1998	25	CCTV	29/08/2023			x		x	x		The pipe size transitions to 450mm toward the outlet. The CCTV inspection was halted at 13.18 meters due to a drop, and an external photo at the outlet is required to assess the situation, as the footage does not clearly reveal an opening. This pipe might be a candidate for replacement, but more detailed information is necessary to determine if only the outlet requires fixing. The visible	completed by previous operator	Replace	
01N-0303	Gully Extension G North	15813	12961	12963	600	600	600mm change to 525 at 10.9m outlet directly onto embankment	Scruffy dome drop chamber at inlet, with short side culvert draining into drop chamber. Inlet, outlet and inside clear and in good condition, apart from a rubber ring come out of one joint.	Good	29/09/2022	15/02/1998	25	CCTV	17/03/2023			x	x				There is a significant crack near the joint at 3.74m, exposing the steel,and the damaged section needs to be replaced or seal the cracks	completed by previous operator	Repair (defer)	or Seal the crack
01N-0303	Gully Extension G South	45816	13036	13036	450	600	extra MH (buried) at 21.7m, ponding within pipeline at buried MH junction	Inlet in drop chamber 47269. Outlet in manhole 45985. Culvert does not run straight to manhole - has a kink. All clear inside.	Good	29/09/2022	2/05/2006	17	CCTV	17/03/2023								There is no CCTV video available in the CCTV library. However, the report available provides limited information about the culvert. it shows in the report that pipe condition is good	completed by previous operator	No actions	
01N-0303		15810	13134	13144	600	450	Deteriorated,outfall directly onto bank	Inlet in drop chamber 148235. Clear and in good condition. Culvert bends slightly near outlet.	Good	29/09/2022	15/02/1998	25		17/03/2023				x				he joint at 3.8m exhibits a significant crack, exposing the steel beneath. This situation poses a risk of water leakage from the joint. The seepage of water can erode the nearby soil, jeopardizing the stability of the ground above the pipe. With time, this erosion may escalate, potentially causing sinkholes and even structural damage to roads and nearby infrastructure. Immediate attention and repair are necessary to prevent these hazardous consequences. The last ~8m of the culvert needs to be replaced.	completed by previous operator	The last ~8m of hte culvert needs to be replaced	
01N-0303	Gully Extention H South	15809	13213	13213	375	600	Missed location indicative	Inlet in bottom of gully. Outlet somewhere down very steep unstable bank. Inlet blocked with dead branches, but culvert clear and good condition inside.	Good	29/09/2022	15/02/1998	25										Needs to be inspected visually again or CCTV inspection	Unable to locate has steep revine either side more time required to locate on days		
01N-0303		15808	13390	13390	375	375	300/225 Blocked near outlet (3.5m) from end, unable to complete inspection, shaown as 375 in RAMM	Inlet in drop chamber 148237 - OK. Culvert about 30% blocked towards the outlet but otherwise clear and in good condition.	Good	29/09/2022	15/02/1998	25		17/03/2023						x		The pipeline is at good condation as per the CCTV inspection report. The clear diameter of the pipeline is reduced by approximately 30% due to accumulated debris and silt, heavy cleaning is required towards to the outle 11.92m	completed by previous operator		yes (Cleaning)
01N-0303	Gully Extension I	15806	13554	13557	1200	1200	Material change, grade change, socket separation at 34.6, outfall armoured and in good condition.	Inlet in bottom of gully and covered with a heavy iron grate. Outlet well down bank on private property. All clear and good condition inside.	Good	29/09/2022	15/02/1998	25		16/03/2023								The pipelin is at good condtaion as per the CCTV inspection report.	completed by previous operator	No actions	
01N-0303	Gully Extesion J	15805	13686	13697	600	600	stream	Outlet down bank on private property.	Good	29/09/2022	15/02/1998	25		16/03/2023								The pipelin is at good condtaion as per the CCTV inspection report.	completed by previous operator	No actions	



LEGEND

— — —	PROPERTY BOUNDARIES
———	ROAD RESERVE
———	NZTA DESIGNATION
———	FLOW PATHS (STREAMS)
— — —	PROPOSED CLEARING EXTENTS (REFER TO CIVIL DRAWINGS)
═══	PROPOSED STORMWATER
— — — —	TENTATIVE EDGE LINE 12.5m (TBC)
—— SW ——	EXISTING STORMWATER
—— W ——	EXISTING WATER
—— C ——	EXISTING CHORUS
—— P ——	EXISTING UNDERGROUND POWER
—— OHP ——	EXISTING OVERHEAD POWER
PP	EXISTING POWER POLE

1:2000 @ A1
1:4000 @ A3 0 20 40 60 80 100 120 140 160 180 200 m

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. REFER TO WATER DISCIPLINE DRAWINGS FOR ADDITIONAL INFORMATION.

WORK IN PROGRESS
PRINTED 30/11/2023 11:44:42 am

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES	ORIGINAL SIZE
1:XXX AT A1	A1

DRAWN	DESIGNED	APPROVED
-	-	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR INFORMATION

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

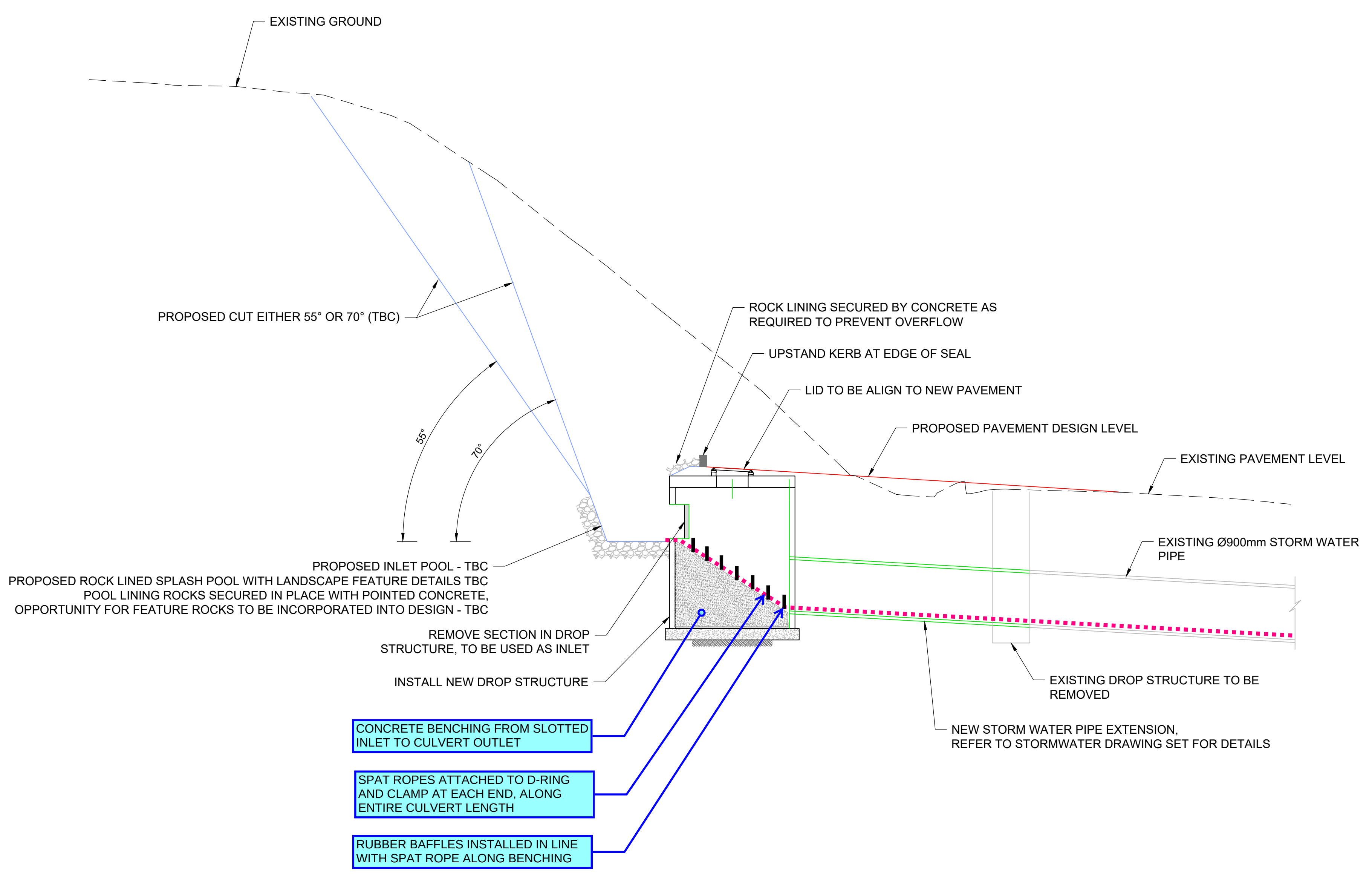
TITLE
OVERALL SITE
DRAINAGE PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA-4200	A

APPENDIX B – ECOLOGY REPORT (FISH PASSAGE)

DRAFT FOR DISCUSSION ONLY

FINAL DESIGN OF WATERFALL CORNER IS PENDING. ENGAGEMENT IS WITH HĀPU ABOUT WAHI TAPU VALUES



A - TYPICAL CROSS SECTION - SITE D WATERFALL CORNER

SCALE: 1:50

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES

1:50 @ A1 / 1:100 @ A3 — 0 1 2 3 4 5 m

WORK IN PROGRESS

PRINTED 18/04/2024 7:44:46 am

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION - 50%	CLH	2024-03-08

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp — Whangarei Office, +64 9 430 1700, Private Bag 9017, Whangarei 0148, New Zealand

CIVIL

SCALES: 1:50 AT A1 — ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
S.GAUTAM	R.MCKNIGHT	C.HAMILTON
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
V.GILES	C.BROWN	2024-03-08

FOR INFORMATION - 50%

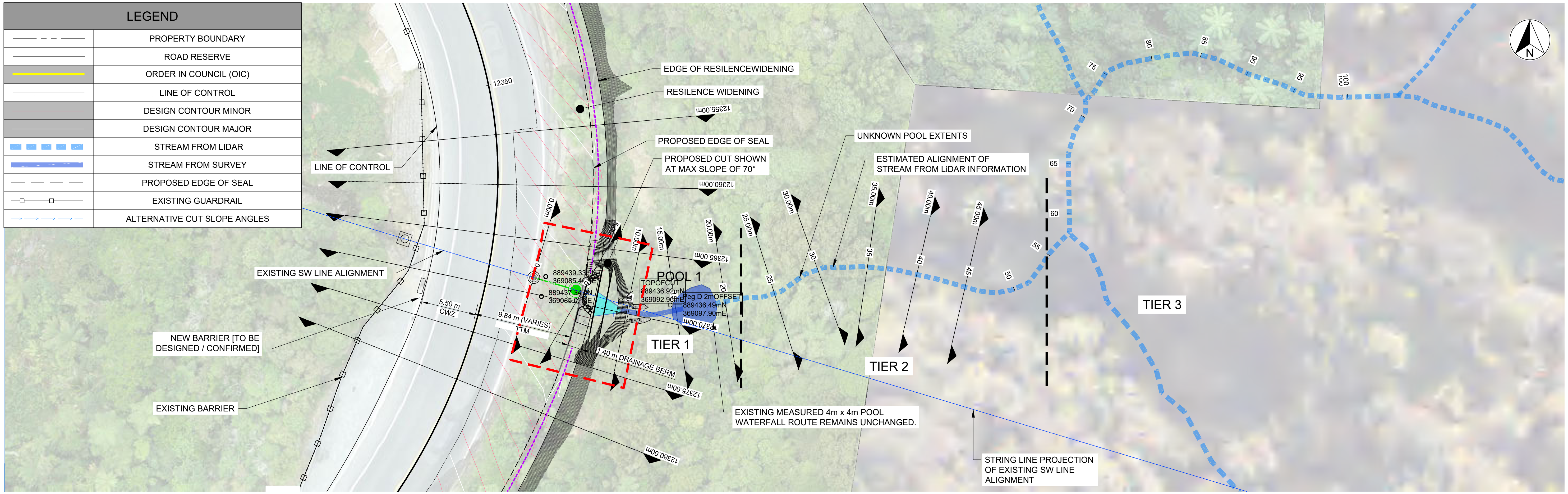
PROJECT: WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE: SITE D - WATERFALL CORNER
TYPICAL SECTION

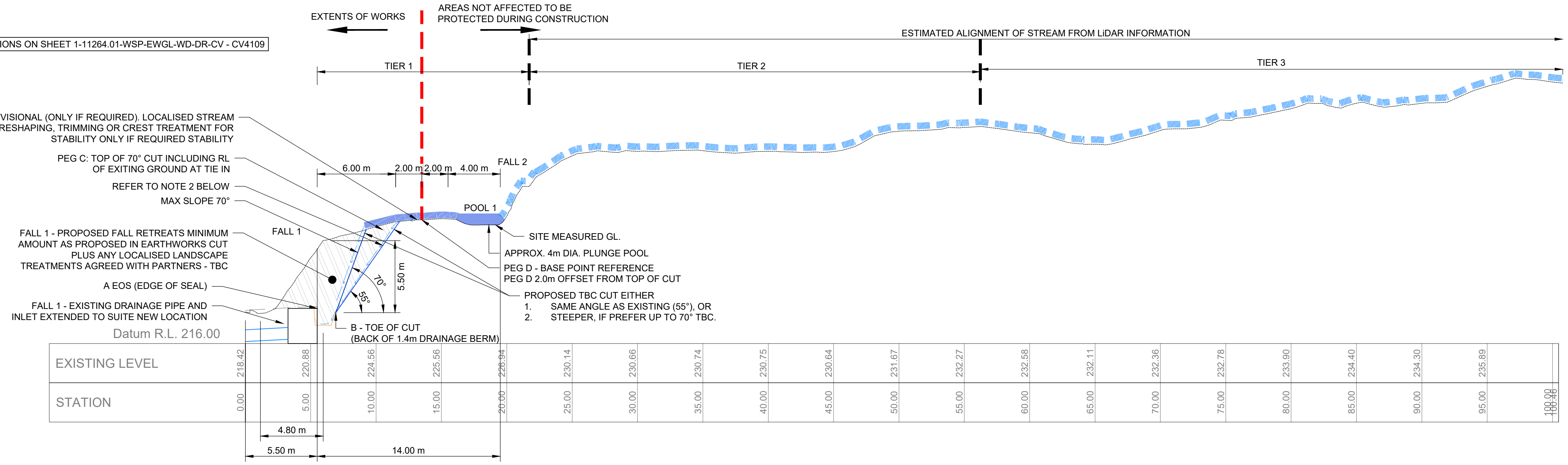
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-WD-DR-CV	CV4105	A

Original sheet size A1 (841x594) Plot Date 2024-04-18 at 7:44:46 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\CV\Sheets\1-11264.01-WSP-EWGL-WD-DR-CV_CV4105.dwg CV4105

LEGEND	
	PROPERTY BOUNDARY
	ROAD RESERVE
	ORDER IN COUNCIL (OIC)
	LINE OF CONTROL
	DESIGN CONTOUR MINOR
	DESIGN CONTOUR MAJOR
	STREAM FROM LIDAR
	STREAM FROM SURVEY
	PROPOSED EDGE OF SEAL
	EXISTING GUARDRAIL
	ALTERNATIVE CUT SLOPE ANGLES



NOTE: REFER TO CROSS SECTIONS ON SHEET 1-11264.01-WSP-EWGL-WD-DR-CV - CV4109



NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES
2. APPEARANCE OF SLOPE FACE ROCK WALL TO BE NATURALISED. NO OBVIOUS MECHANICAL MARKINGS ON ROCK FACE TO BE SEEN AROUND WATERFALL. DESIRED OUTCOME IS NATURAL SPLIT FACE ROCK WITH NATURALLY FORMING ROCKS AND CREVICES

1:200 @ A1 1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 18/04/2024 7:45:19 am

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION - 50%	CLH	2024-03-08
B	ISSUED FOR INFORMATION - 50% (SETOUT POINTS ADDED)		

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES	ORIGINAL SIZE
1:200 AT A1	A1

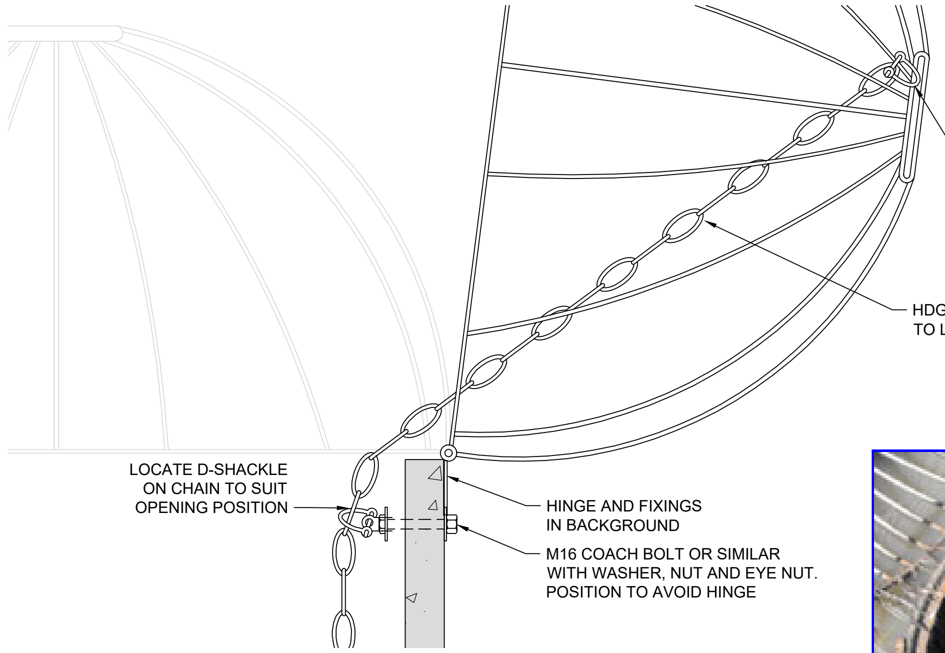
DRAWN	DESIGNED	APPROVED
S.GAUTAM	R.MCKNIGHT	C.HAMILTON
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
V.GILES	C.BROWN	2024-03-08

FOR INFORMATION - 50%

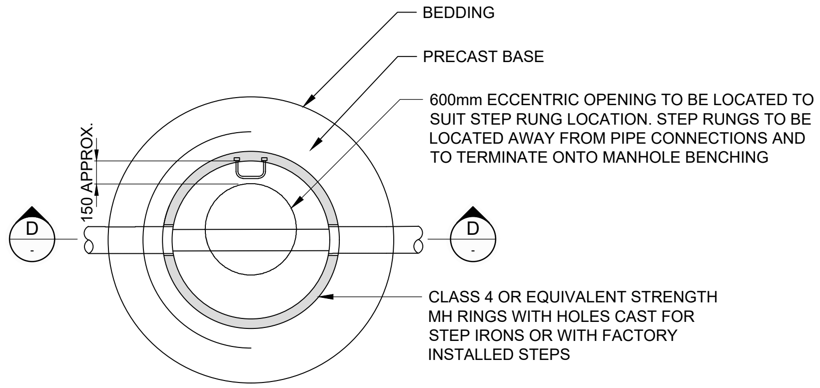
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE D - WATERFALL CORNER
PLAN AND LONG SECTION - DESIGN EW CUT AND STREAM

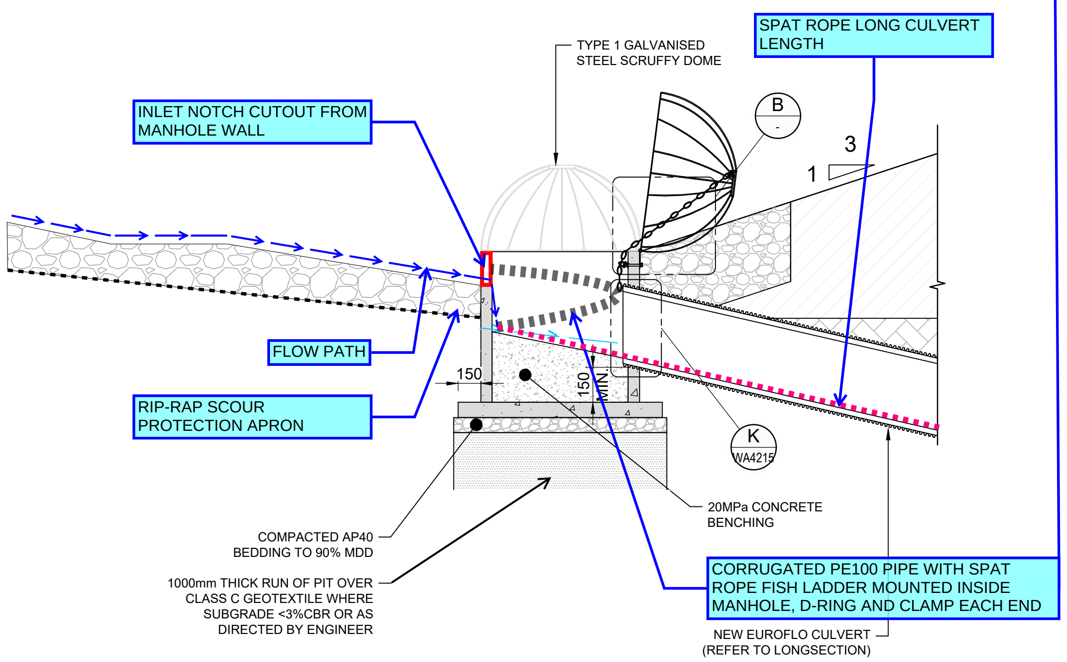
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-WD-DR-CV	CV4106	B



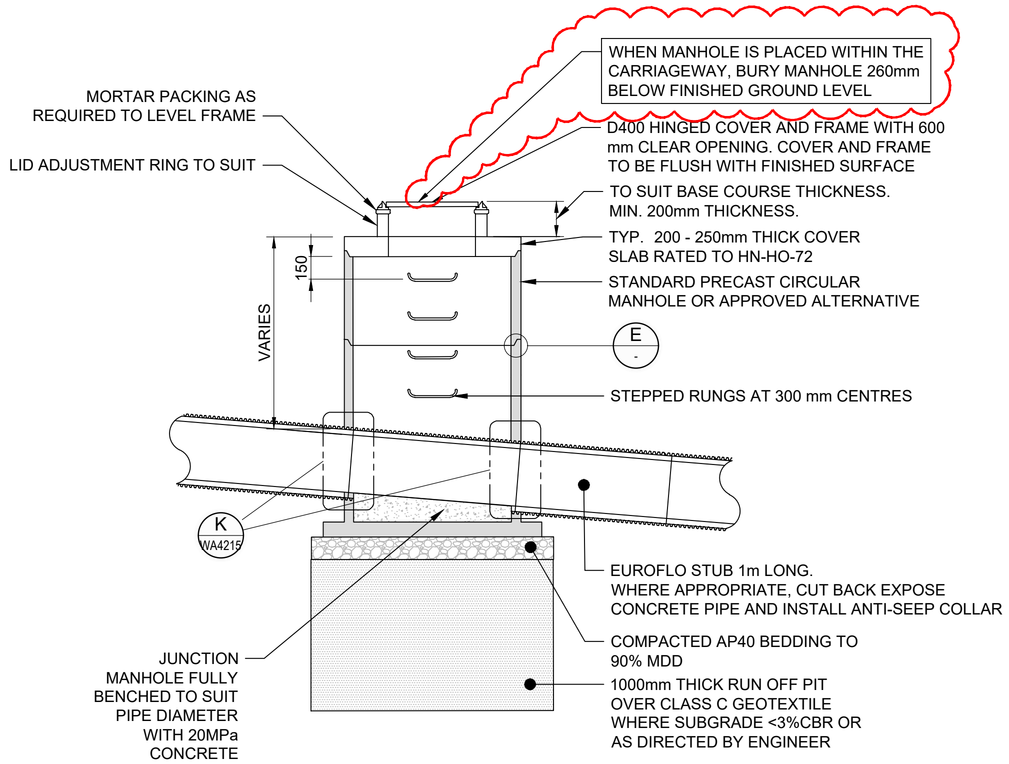
B - TYPICAL DETAIL - CHAIN ATTACHMENT
SCALE: 1:5



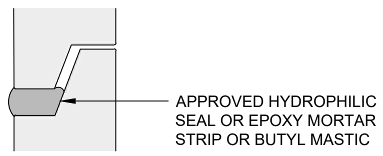
C - TYPICAL PLAN - GULLY JUNCTION MANHOLE
SCALE: 1:25



A - TYPICAL DETAIL - GULLY INLET SCRUFFY DOME MANHOLE
SCALE: 1:25



D - TYPICAL DETAIL - GULLY JUNCTION MANHOLE
SCALE: 1:25



E - DETAIL - JOINT
NTS

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.
2. REFER TO STORMWATER PLAN AND LONGSECTIONS FOR SCRUFFY DOME, OUTFALL AND PIPE INVERT INFORMATION.

1:25 @ A1 / 1:50 @ A3 — 0 400 800 1200 1600 2000 2400 mm

1:5 @ A1 / 1:10 @ A3 — 0 50 100 150 200 250 300 350 400 450 500 mm

WORK IN PROGRESS
PRINTED 4/04/2024 10:33:54 am

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	2023-12-14
2	ISSUED FOR CONSTRUCTION - 80% DRAFT	FMR	2024-02-27
3	ISSUED FOR CONSTRUCTION - 80% DRAFT	FMR	2024-03-22
4	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:5, 1:25 AT A1		ORIGINAL SIZE: A1
DRAWN: V. GILES	DESIGNED: M. CHIARONI	APPROVED: F. ROEST
DRAWING VERIFIED: K. MEIN	DESIGN VERIFIED: C. BROWN	APPROVED DATE: 2024-02-27

FOR CONSTRUCTION - 80% DRAFT

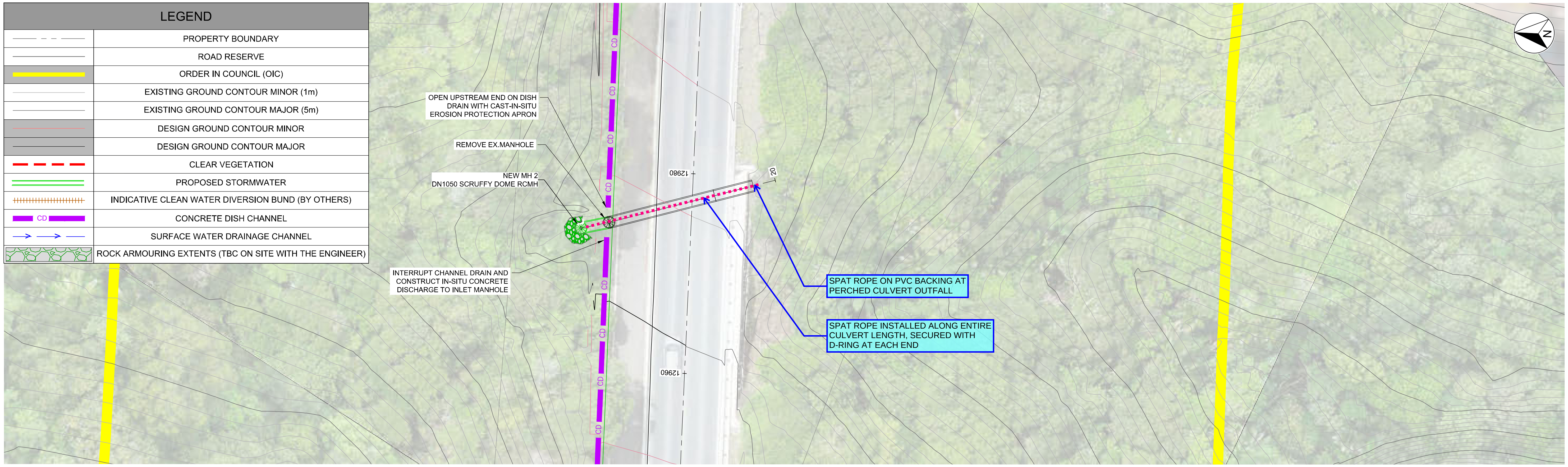
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

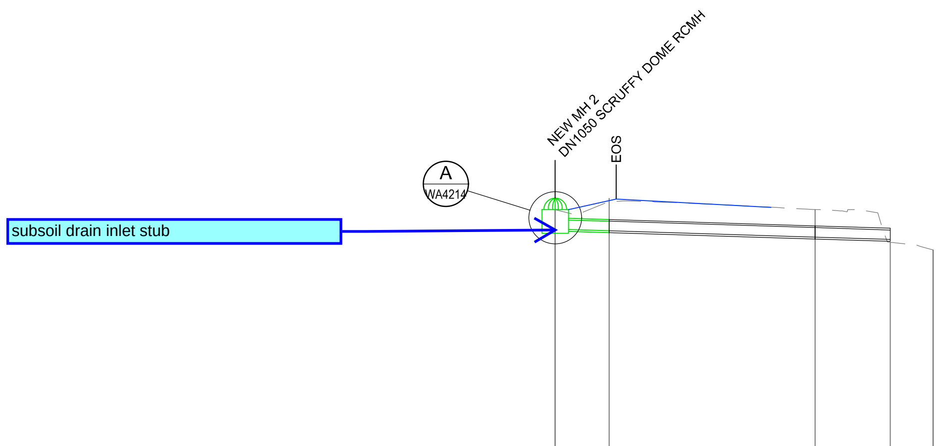
TITLE
OVERALL SITE
TYPICAL DETAILS - SHEET 1

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA4214	4

LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	ORDER IN COUNCIL (OIC)
	EXISTING GROUND CONTOUR MINOR (1m)
	EXISTING GROUND CONTOUR MAJOR (5m)
	DESIGN GROUND CONTOUR MINOR
	DESIGN GROUND CONTOUR MAJOR
	CLEAR VEGETATION
	PROPOSED STORMWATER
	INDICATIVE CLEAN WATER DIVERSION BUND (BY OTHERS)
CD	CONCRETE DISH CHANNEL
	SURFACE WATER DRAINAGE CHANNEL
	ROCK ARMOURING EXTENTS (TBC ON SITE WITH THE ENGINEER)





DATUM R.L. 155.00

GROUND LEVEL (m)	168.77	169.19	168.78	167.79
DEPTH TO INVERT (m) AT PIPE ENDS	1.03	1.54		1.30
PIPE INVERT LEVEL (m) AT PIPE ENDS	167.74	167.65 167.65	167.31 167.31	167.19
DISTANCE (m)	0.0	2.9	13.8	17.7
GRADIENT	3.10% (1:32)	3.10% (1:32)	3.10% (1:32)	
PIPE SIZE AND MATERIAL	CLASS 4 RCRRJ 600mm Ø	EX. DN600 RRJ	EX. DN525	

3.70 REPAIR PIPE DEFECT WITH CURE-IN-PLACE PIPE LINING (POST CONSTRUCTION)

COMPLETE CCTV INSPECTION OF CULVERT CONDITION FOLLOWING CONSTRUCTION WORKS

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES

1:200 @ A1 / 1:400 @ A3 — 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 12/02/2024 9:22:46 AM

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - DRAFT 80%	FMR	2024-02-09

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:200 AT A1 — ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
S.GAUTAM	V.LIU	F.ROEST
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
V.GILES	M.CHIARONI	2024-02-09

FOR CONSTRUCTION - 80% DRAFT

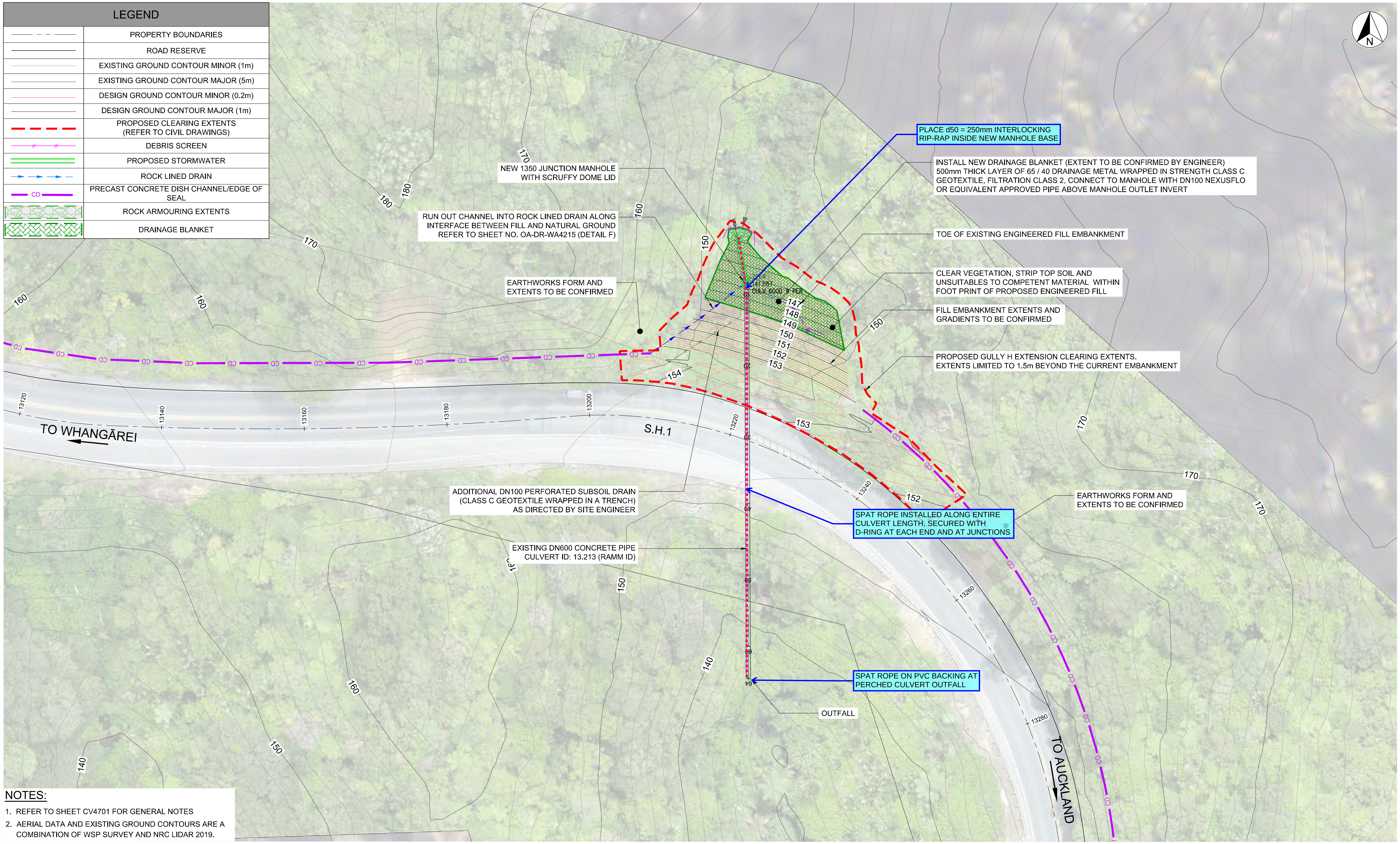
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
GULLY SITE G NORTH
DRAINAGE PLAN AND LONGSECTION 2

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-DR-CV — SHEET NO.: WA4213 — REVISION: 1

LEGEND

— - - —	PROPERTY BOUNDARIES
——	ROAD RESERVE
——	EXISTING GROUND CONTOUR MINOR (1m)
——	EXISTING GROUND CONTOUR MAJOR (5m)
——	DESIGN GROUND CONTOUR MINOR (0.2m)
——	DESIGN GROUND CONTOUR MAJOR (1m)
— — —	PROPOSED CLEARING EXTENTS (REFER TO CIVIL DRAWINGS)
—//—//—	DEBRIS SCREEN
═══	PROPOSED STORMWATER
- -▸- -▸-	ROCK LINED DRAIN
— CD —	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
(hatch)	ROCK ARMOURING EXTENTS
(hatch)	DRAINAGE BLANKET



NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. AERIAL DATA AND EXISTING GROUND CONTOURS ARE A COMBINATION OF WSP SURVEY AND NRC LIDAR 2019.

1:250 @ A1
1:500 @ A3
0 4 8 12 16 20 24 m

WORK IN PROGRESS
PRINTED 15/02/2024 4:11:42 pm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - DRAFT 80%	FMR	2024-02-15

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:250 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	V. LIU	F. ROEST
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
R. MCKNIGHT	M. CHIARONI	2024-02-15

FOR CONSTRUCTION - DRAFT 80%

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

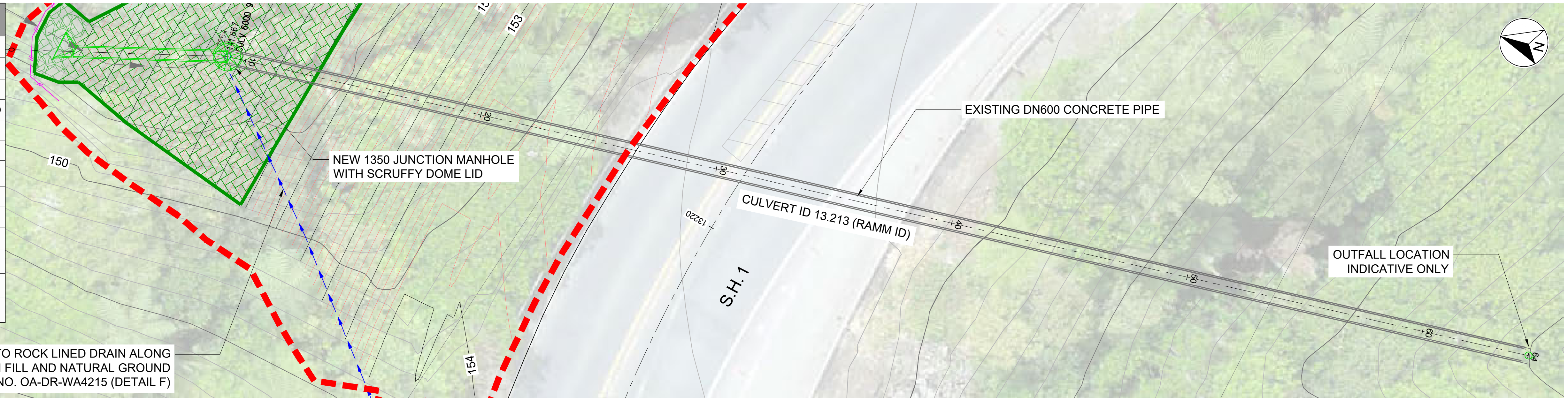
TITLE
GULLY SITE H
DRAINAGE PLAN

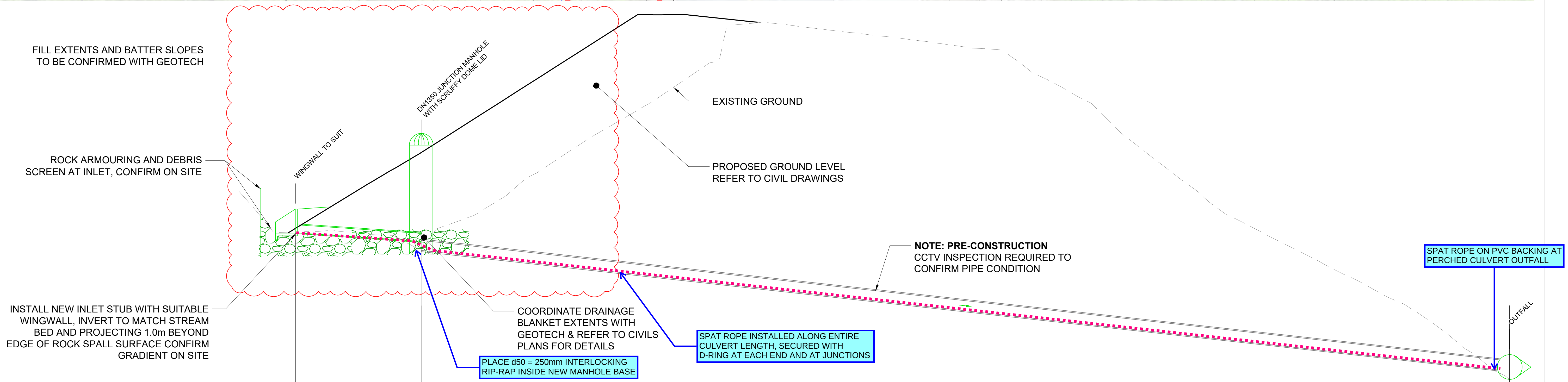
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-GH-DR-WA	WA4211	1

Original sheet size A1 (841x594) Plot Date 2024-02-15 at 4:11:42 pm C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-EWGL-GH-DR-WA-4211.dwg WA4211

LEGEND

— - —	PROPERTY BOUNDARIES
——	ROAD RESERVE
——	EXISTING GROUND CONTOUR MINOR (1m)
——	EXISTING GROUND CONTOUR MAJOR (5m)
——	DESIGN GROUND CONTOUR MINOR (0.2m)
——	DESIGN GROUND CONTOUR MAJOR (1m)
— — —	PROPOSED CLEARING EXTENTS (REFER TO CIVIL DRAWINGS)
—#—#—	DEBRIS SCREEN
══	PROPOSED STORMWATER
→ → →	ROCK LINED DRAIN
— CD —	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET





DATUM R.L. 134.00

GROUND LEVEL (m)		142.78	146.63 146.63	135.10
DEPTH TO INVERT (m)		0.21	4.50 4.96	-0.43
PIPE INVERT LEVEL (m)		142.57	142.13 141.67	135.54
DISTANCE (m)		2.8	9.2 9.2	64.5
GRADIENT		6.91% (1:14)	11.10% (1:9)	
PIPE SIZE AND MATERIAL		EUROFLO DN800 (630ID)	EXISTING DN600 CONCRETE PIPE (CULVERT ID 13.213 - RAMM ID)	

LONGITUDINAL PROFILE 0.0 m TO 64.5 m

HORIZONTAL SCALE 1:100 @ A1
VERTICAL SCALE 1:100 @ A1

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. AERIAL DATA AND EXISTING GROUND CONTOURS ARE A COMBINATION OF WSP SURVEY AND NRC LIDAR 2019.

1:100 @ A1 / 1:200 @ A3 — 0 1 2 3 4 5 6 7 8 9 10 m

WORK IN PROGRESS
PRINTED 15/02/2024 1:01:42 pm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - DRAFT 80%	FMR	2024-02-15

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp Whangarei Office +64 9 430 1700 Private Bag 9017 Whangarei 0148 New Zealand

CIVIL

SCALES: 1:100 AT A1 — ORIGINAL SIZE: A1
DRAWN: V.GILES — DESIGNED: V. LIU — APPROVED: F. ROEST
DRAWING VERIFIED: R. MCKNIGHT — DESIGN VERIFIED: M. CHIARONI — APPROVED DATE: 2024-02-15

FOR CONSTRUCTION - DRAFT 80%

PROJECT: WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

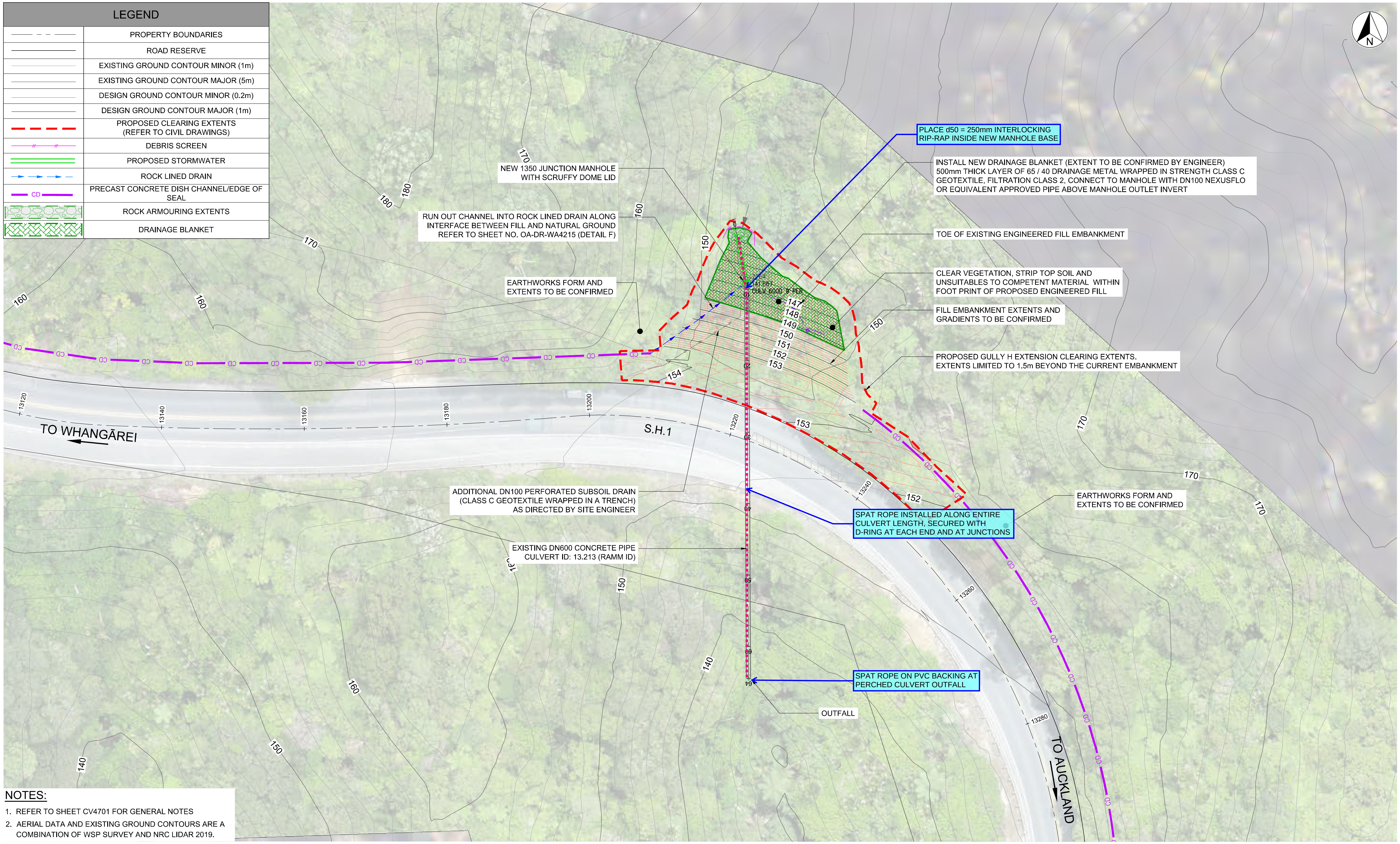
TITLE: GULLY SITE H
DRAINAGE PLAN AND LONG SECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-GH-DR-WA — SHEET NO. WA4212 — REVISION 1

Original sheet size A1 (841x594) Plot Date 2024-02-15 at 1:01:42 pm C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-EWGL-GH-DR-WA-4212.dwg WA4212

LEGEND

	PROPERTY BOUNDARIES
	ROAD RESERVE
	EXISTING GROUND CONTOUR MINOR (1m)
	EXISTING GROUND CONTOUR MAJOR (5m)
	DESIGN GROUND CONTOUR MINOR (0.2m)
	DESIGN GROUND CONTOUR MAJOR (1m)
	PROPOSED CLEARING EXTENTS (REFER TO CIVIL DRAWINGS)
	DEBRIS SCREEN
	PROPOSED STORMWATER
	ROCK LINED DRAIN
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET



NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. AERIAL DATA AND EXISTING GROUND CONTOURS ARE A COMBINATION OF WSP SURVEY AND NRC LIDAR 2019.

1:250 @ A1 / 1:500 @ A3 — 0 4 8 12 16 20 24 m

WORK IN PROGRESS
PRINTED 15/02/2024 4:11:42 pm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - DRAFT 80%	FMR	2024-02-15

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp Whangarei Office +64 9 430 1700 Private Bag 9017 Whangarei 0148 New Zealand

CIVIL

SCALES 1:250 AT A1		ORIGINAL SIZE A1
DRAWN V. GILES	DESIGNED V. LIU	APPROVED F. ROEST
DRAWING VERIFIED R. MCKNIGHT	DESIGN VERIFIED M. CHIARONI	APPROVED DATE 2024-02-15

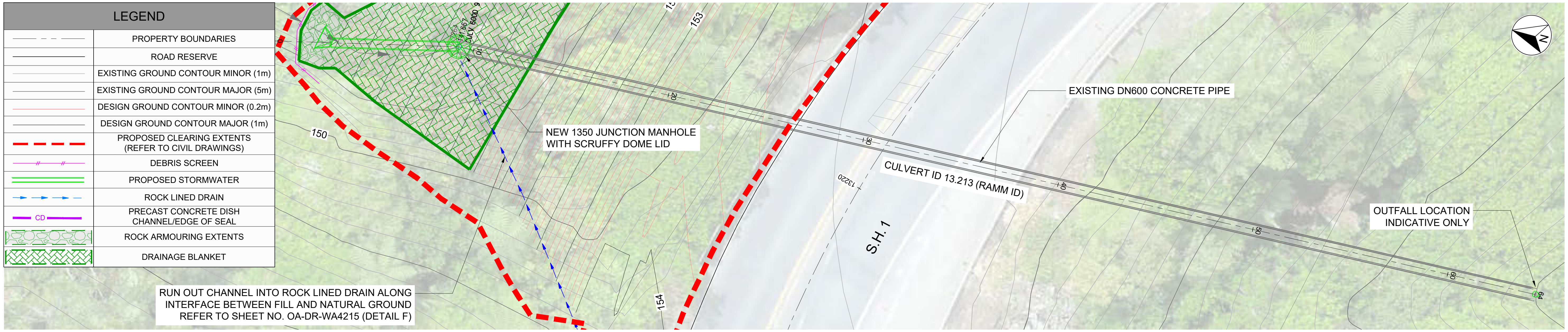
FOR CONSTRUCTION - DRAFT 80%

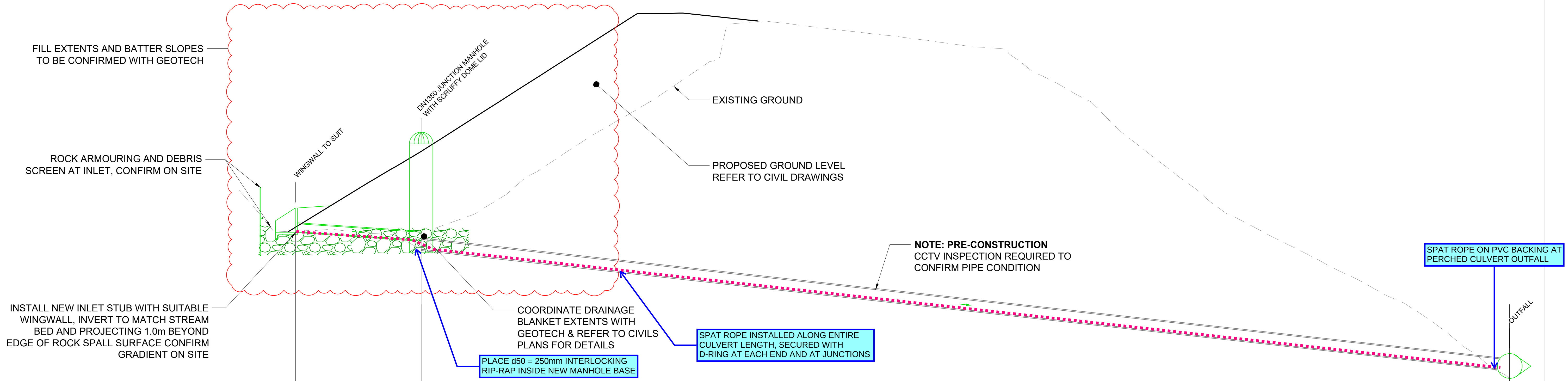
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
GULLY SITE H
DRAINAGE PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-GH-DR-WA
SHEET NO.: WA4211
REVISION: 1

Original sheet size A1 (841x594) Plot Date 2024-02-15 at 4:11:42 pm C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-EWGL-GH-DR-WA-4211.dwg WA4211





DATUM R.L. 134.00

GROUND LEVEL (m)	142.78	146.63 146.63	135.10
DEPTH TO INVERT (m)	0.21	4.50 4.96	-0.43
PIPE INVERT LEVEL (m)	142.57	142.13 141.67	135.54
DISTANCE (m)	2.8	9.2 9.2	64.5
GRADIENT	6.91% (1:14)	11.10% (1:9)	
PIPE SIZE AND MATERIAL	EUROFLO DN800 (630ID)	EXISTING DN600 CONCRETE PIPE (CULVERT ID 13.213 - RAMM ID)	

LONGITUDINAL PROFILE 0.0 m TO 64.5 m

HORIZONTAL SCALE 1:100 @ A1
VERTICAL SCALE 1:100 @ A1

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. AERIAL DATA AND EXISTING GROUND CONTOURS ARE A COMBINATION OF WSP SURVEY AND NRC LIDAR 2019.

1:100 @ A1 / 1:200 @ A3 — 0 1 2 3 4 5 6 7 8 9 10 m

WORK IN PROGRESS
PRINTED 15/02/2024 1:01:42 pm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - DRAFT 80%	FMR	2024-02-15

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

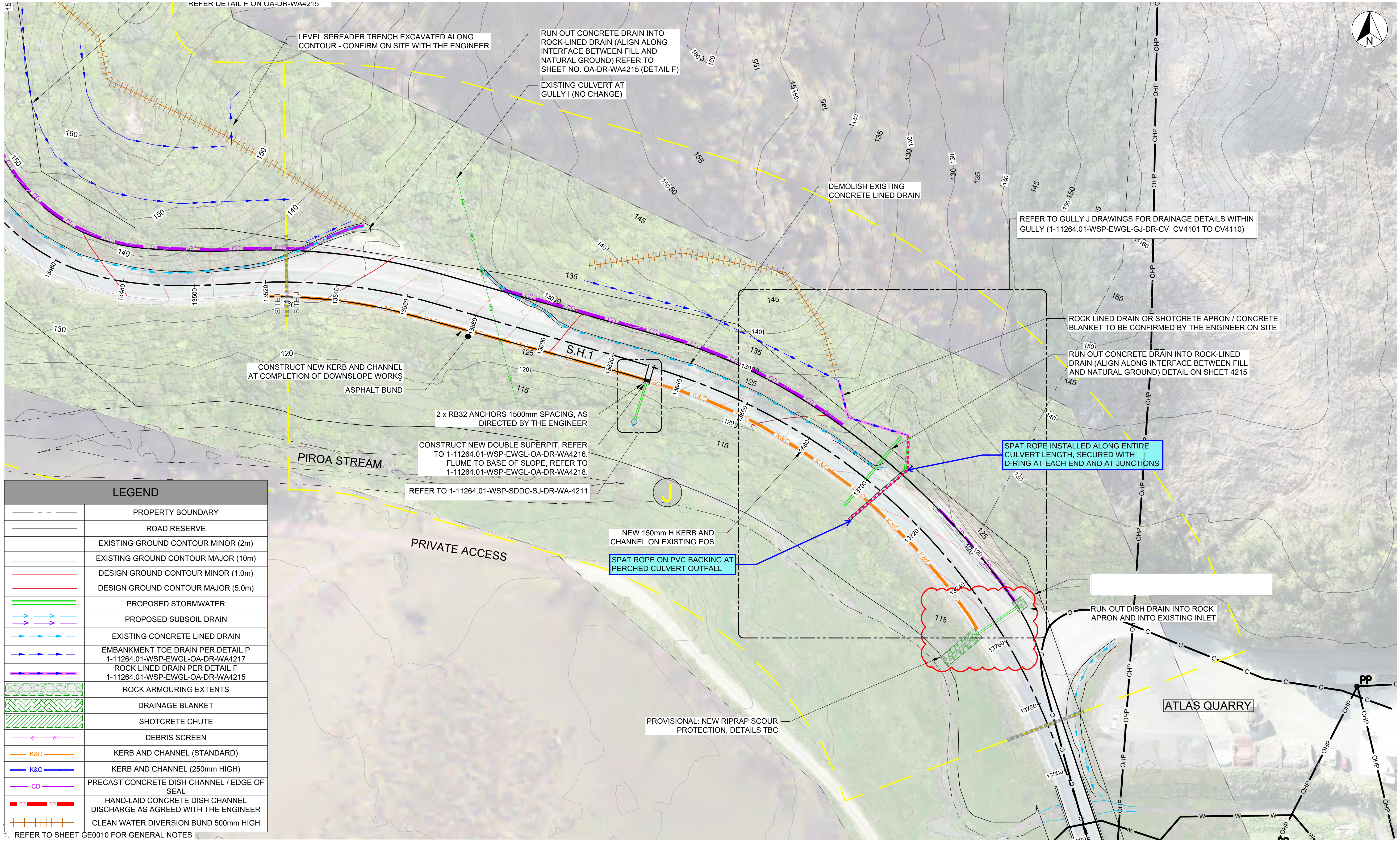
SCALES: 1:100 AT A1 — ORIGINAL SIZE: A1
DRAWN: V.GILES — DESIGNED: V. LIU — APPROVED: F. ROEST
DRAWING VERIFIED: R. MCKNIGHT — DESIGN VERIFIED: M. CHIARONI — APPROVED DATE: 2024-02-15

FOR CONSTRUCTION - DRAFT 80%

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
GULLY SITE H
DRAINAGE PLAN AND LONG SECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-GH-DR-WA — SHEET NO.: WA4212 — REVISION: 1



1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

WORK IN PROGRESS

PRINTED 5/04/2024 2:02:25 pm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	FMR	2024-02-27
2	ISSUED FOR CONSTRUCTION - 80% DRAFT	FMR	2024-04-05

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:500 AT A1 — ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	F. ROEST
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
K. MEIN	C. BROWN	2024-04-05

FOR CONSTRUCTION - 80% DRAFT

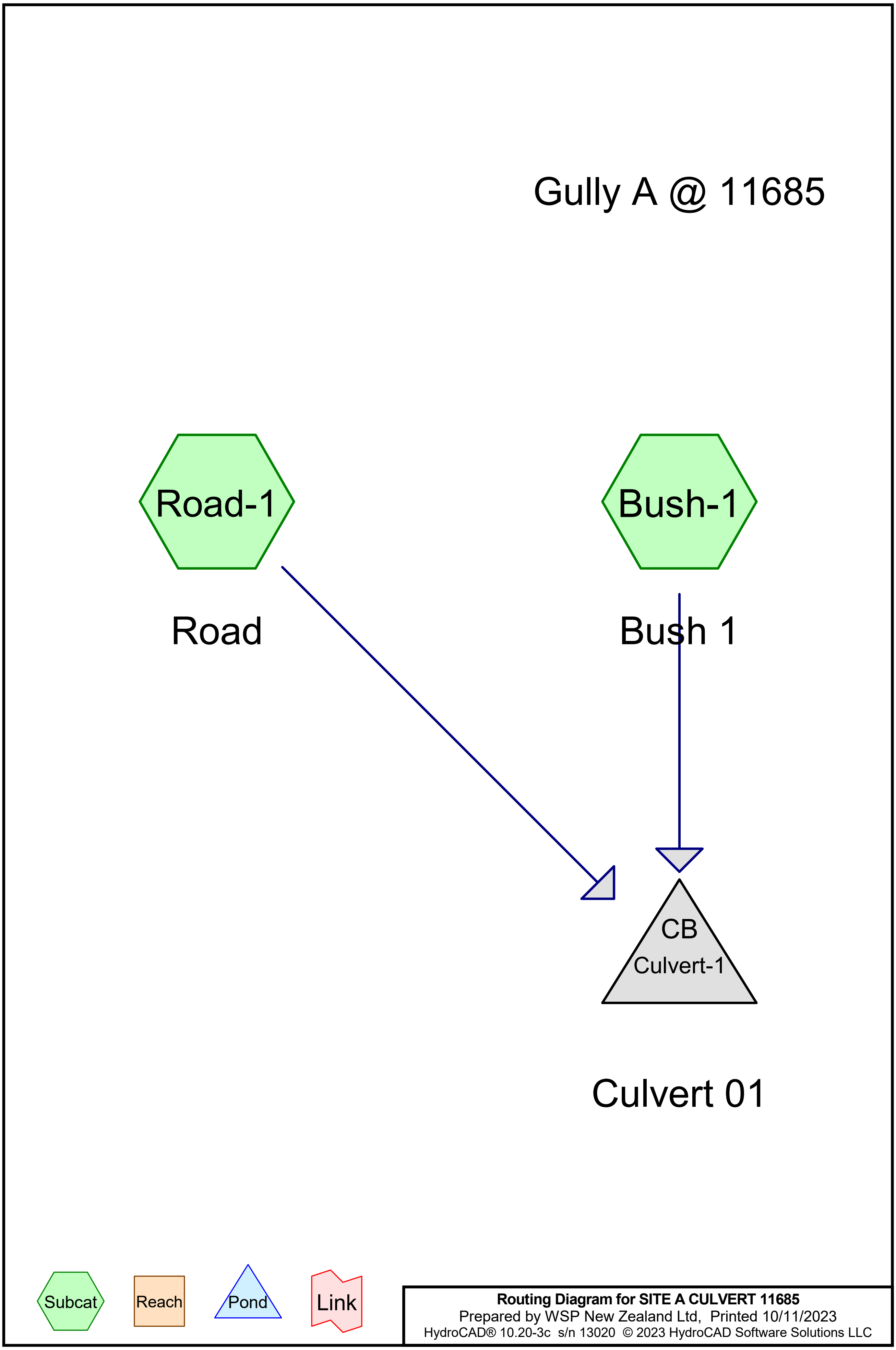
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
WATER - DRAINAGE PLANS
SITE J - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SJ-DR-WA
SHEET NO.: SHEET 10
REVISION: 2

Original sheet size A1 (841x594) Plot Date 2024-04-05 at 2:02:25 pm C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SJ-DR-WA-4000.dwg WA4000

APPENDIX C – HYDROLOGY AND HYDRAULIC CALCULATIONS



Routing Diagram for SITE A CULVERT 11685
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment Bush-1: Bush 1

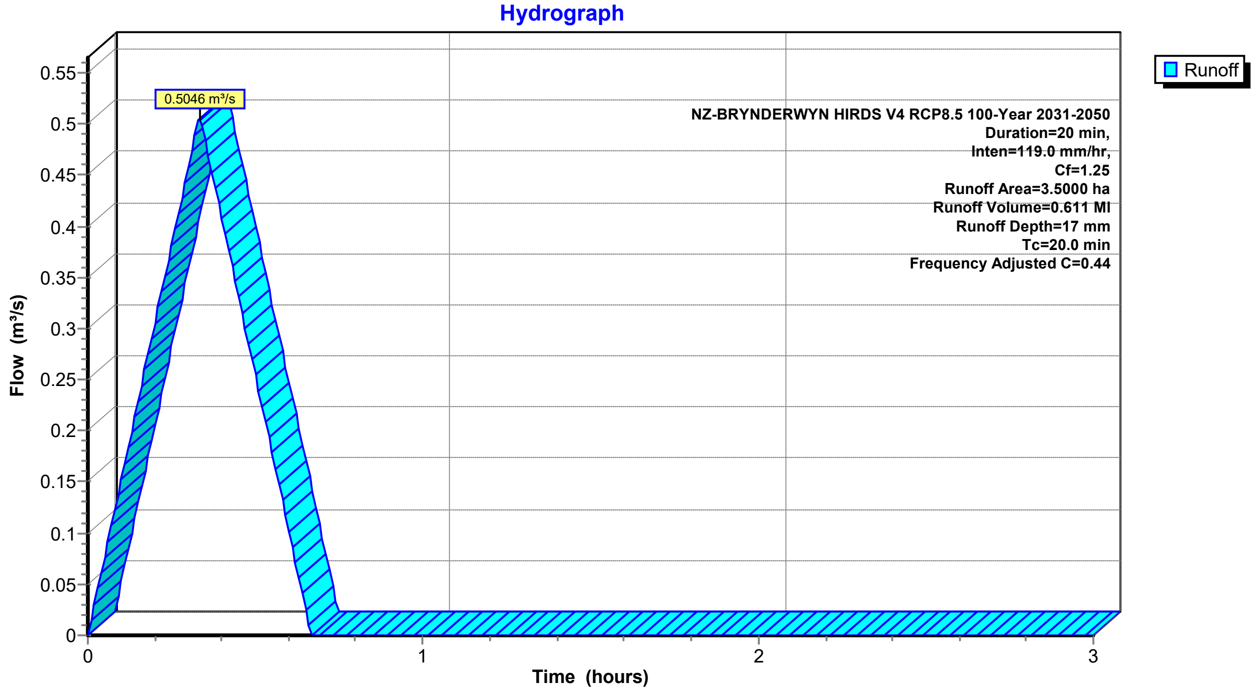
Runoff = 0.5046 m³/s @ 0.33 hrs, Volume= 0.611 Ml, Depth= 17 mm
Routed to Pond Culvert-1 : Culvert 01

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
3.5000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
3.5000	0.35	0.44	Weighted Average, Frequency Adjusted
3.5000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry,**

Subcatchment Bush-1: Bush 1



Summary for Subcatchment Road-1: Road

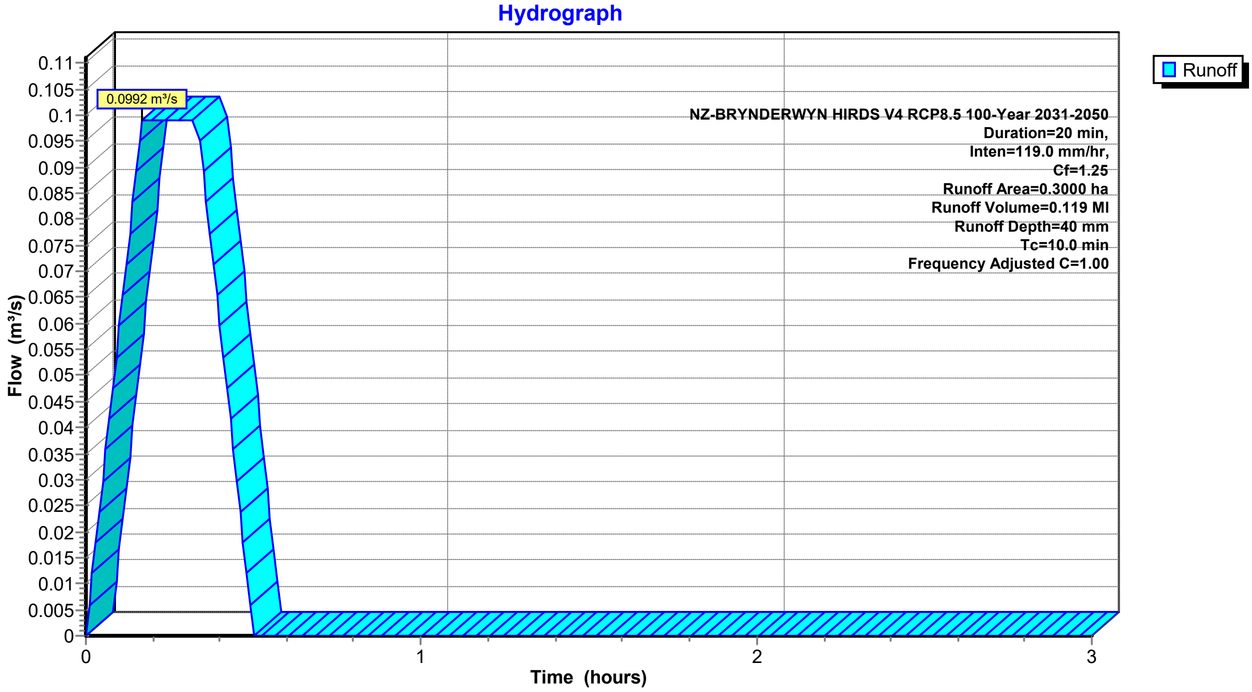
Runoff = 0.0992 m³/s @ 0.17 hrs, Volume= 0.119 Ml, Depth= 40 mm
Routed to Pond Culvert-1 : Culvert 01

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.3000	0.95		
0.3000	0.95	1.00	Weighted Average, Frequency Adjusted
0.3000			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road-1: Road



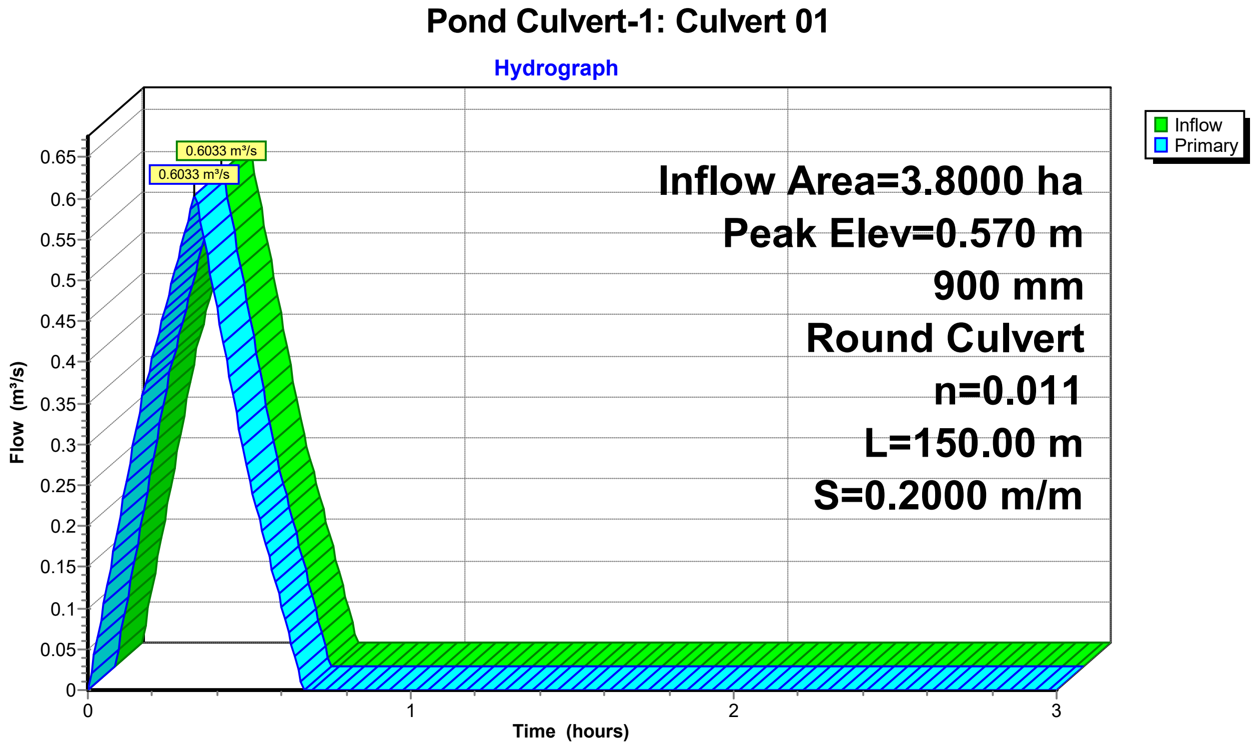
Summary for Pond Culvert-1: Culvert 01

Inflow Area = 3.8000 ha, 7.89% Impervious, Inflow Depth = 19 mm for 100-Year 2031-2050 event
Inflow = 0.6033 m³/s @ 0.33 hrs, Volume= 0.730 Ml
Outflow = 0.6033 m³/s @ 0.33 hrs, Volume= 0.730 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.6033 m³/s @ 0.33 hrs, Volume= 0.730 Ml

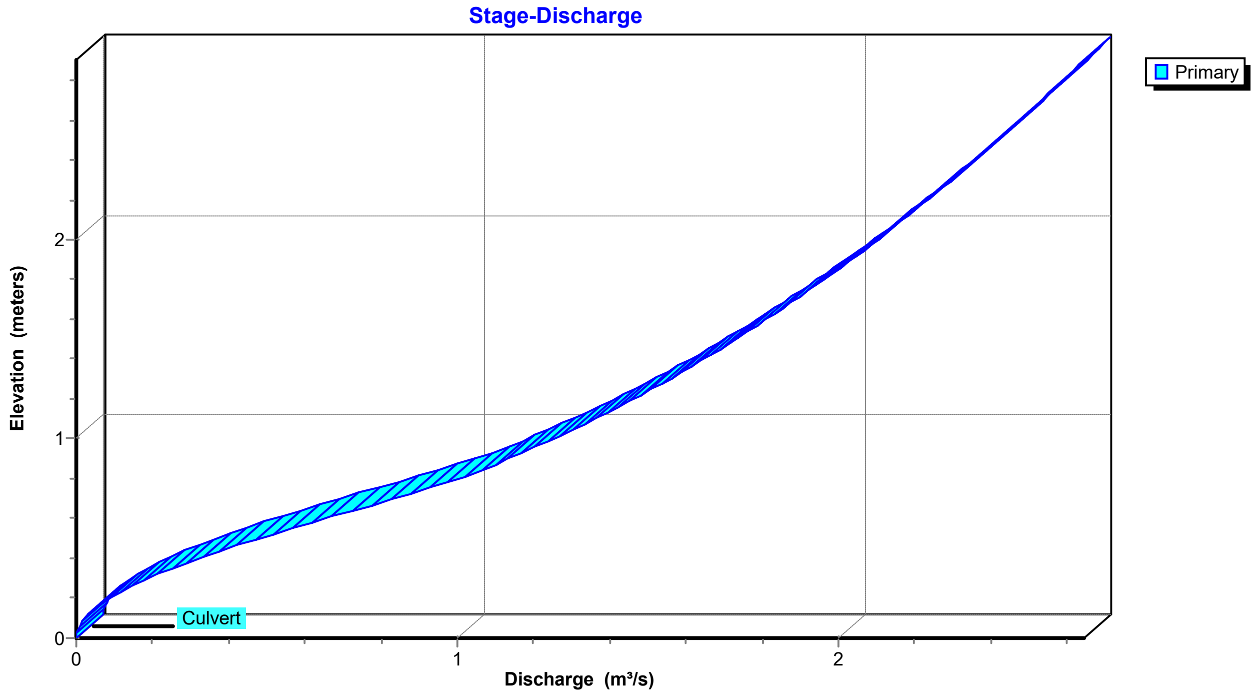
Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 0.570 m @ 0.33 hrs
Flood Elev= 2.900 m

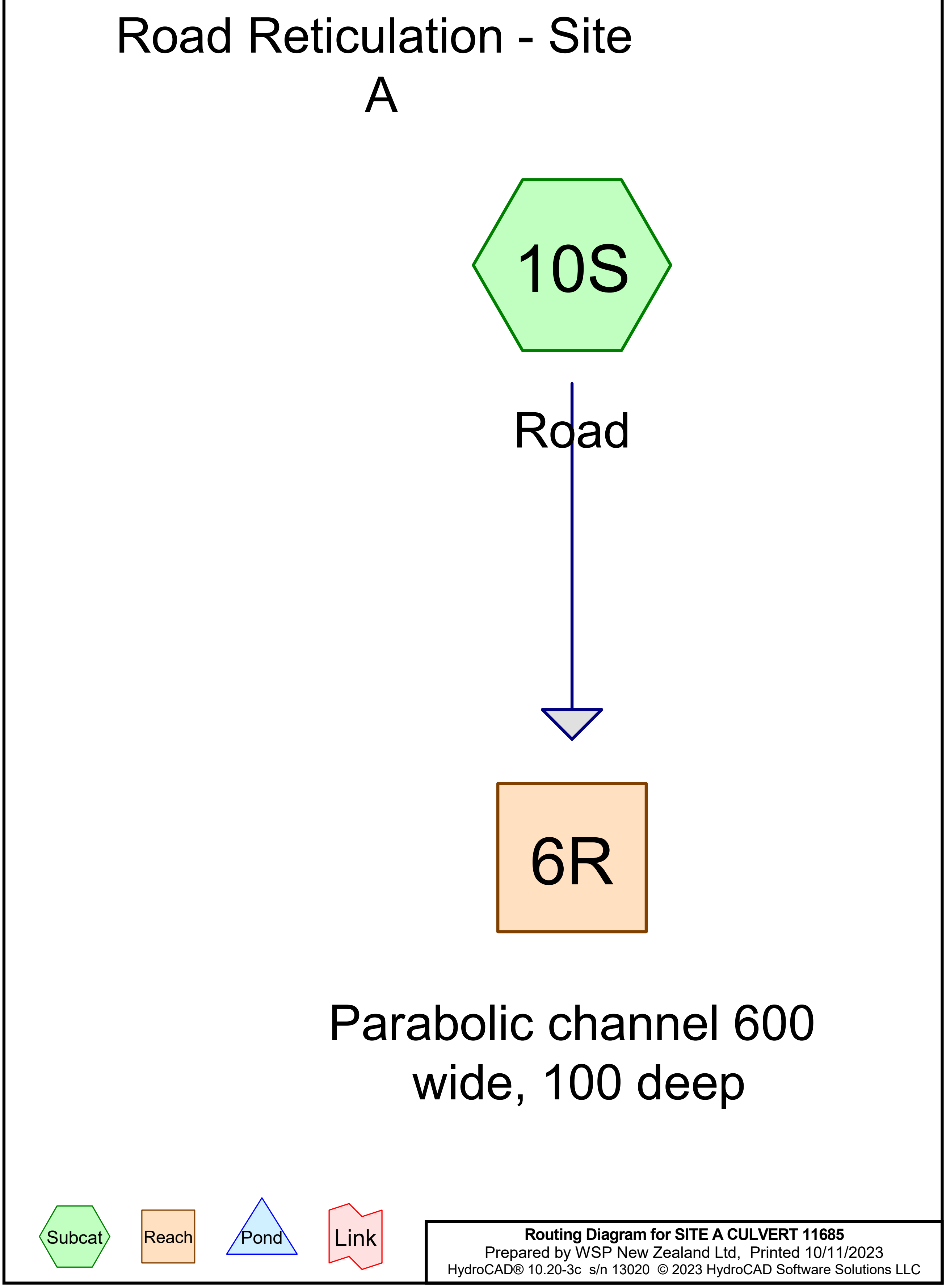
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**900 mm Round Culvert** L= 150.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -30.000 m S= 0.2000 m/m Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.636 m²

Primary OutFlow Max=0.6019 m³/s @ 0.33 hrs HW=0.570 m (Free Discharge)
└**1=Culvert** (Inlet Controls 0.6019 m³/s @ 1.42 m/s)



Pond Culvert-1: Culvert 01





Routing Diagram for SITE A CULVERT 11685
Prepared by WSP New Zealand Ltd, Printed 10/11/2023

Summary for Subcatchment 10S: Road

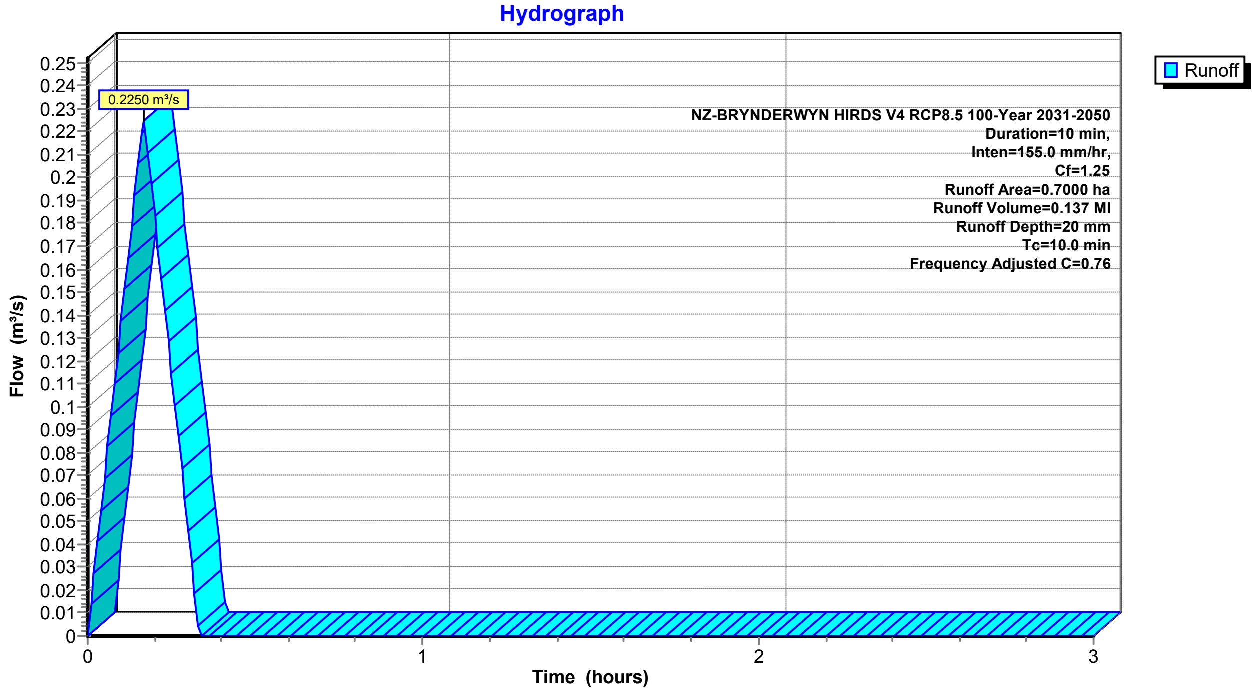
Runoff = 0.2250 m³/s @ 0.17 hrs, Volume= 0.137 Ml, Depth= 20 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.3000	0.95		road catchment
0.4000	0.35		cut face
0.7000	0.61	0.76	Weighted Average, Frequency Adjusted
0.4000			57.14% Pervious Area
0.3000			42.86% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 10S: Road



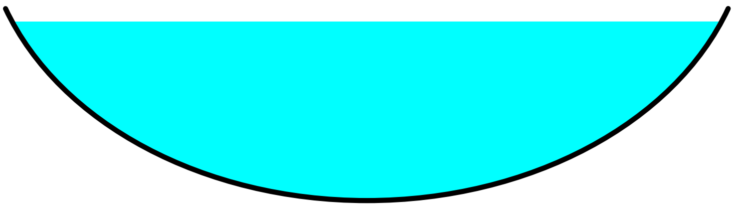
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

Inflow Area = 0.7000 ha, 42.86% Impervious, Inflow Depth = 20 mm for 100-Year 2031-2050 event
Inflow = 0.2250 m³/s @ 0.17 hrs, Volume= 0.137 Ml
Outflow = 0.2201 m³/s @ 0.18 hrs, Volume= 0.137 Ml, Atten= 2%, Lag= 0.7 min

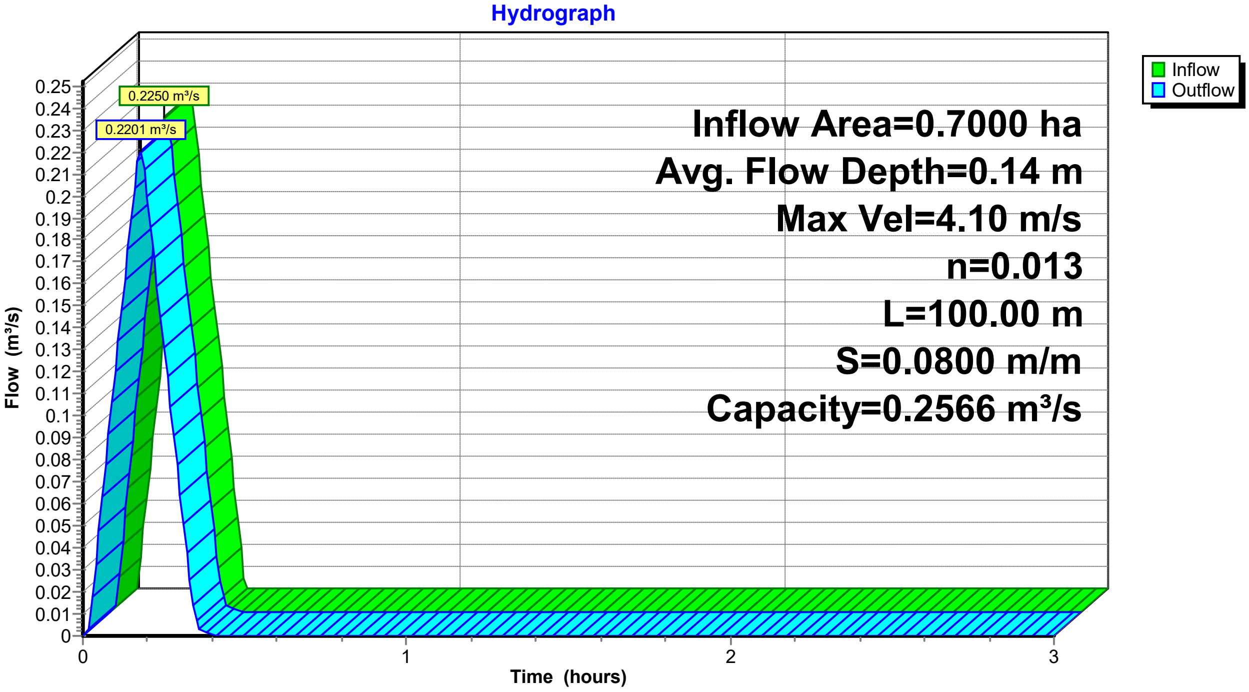
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 4.10 m/s, Min. Travel Time= 0.4 min
Avg. Velocity = 2.27 m/s, Avg. Travel Time= 0.7 min

Peak Storage= 5.4 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.14 m , Surface Width= 0.58 m
Bank-Full Depth= 0.15 m Flow Area= 0.06 m², Capacity= 0.2566 m³/s

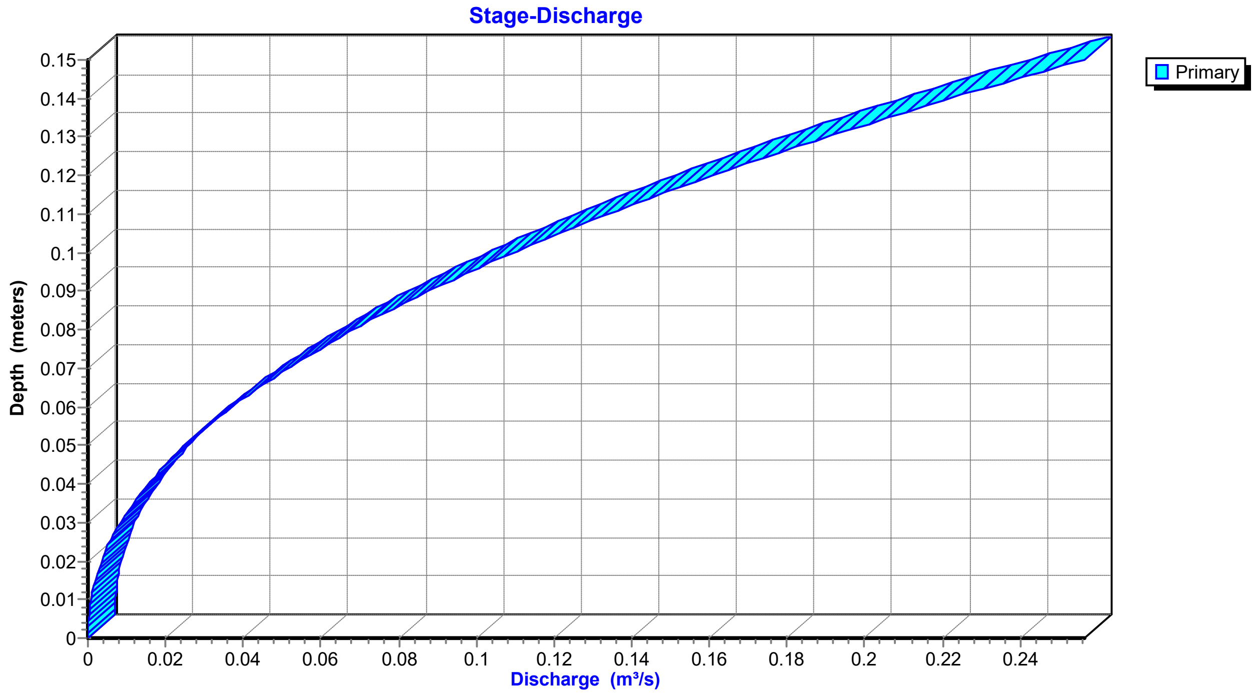
0.60 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m

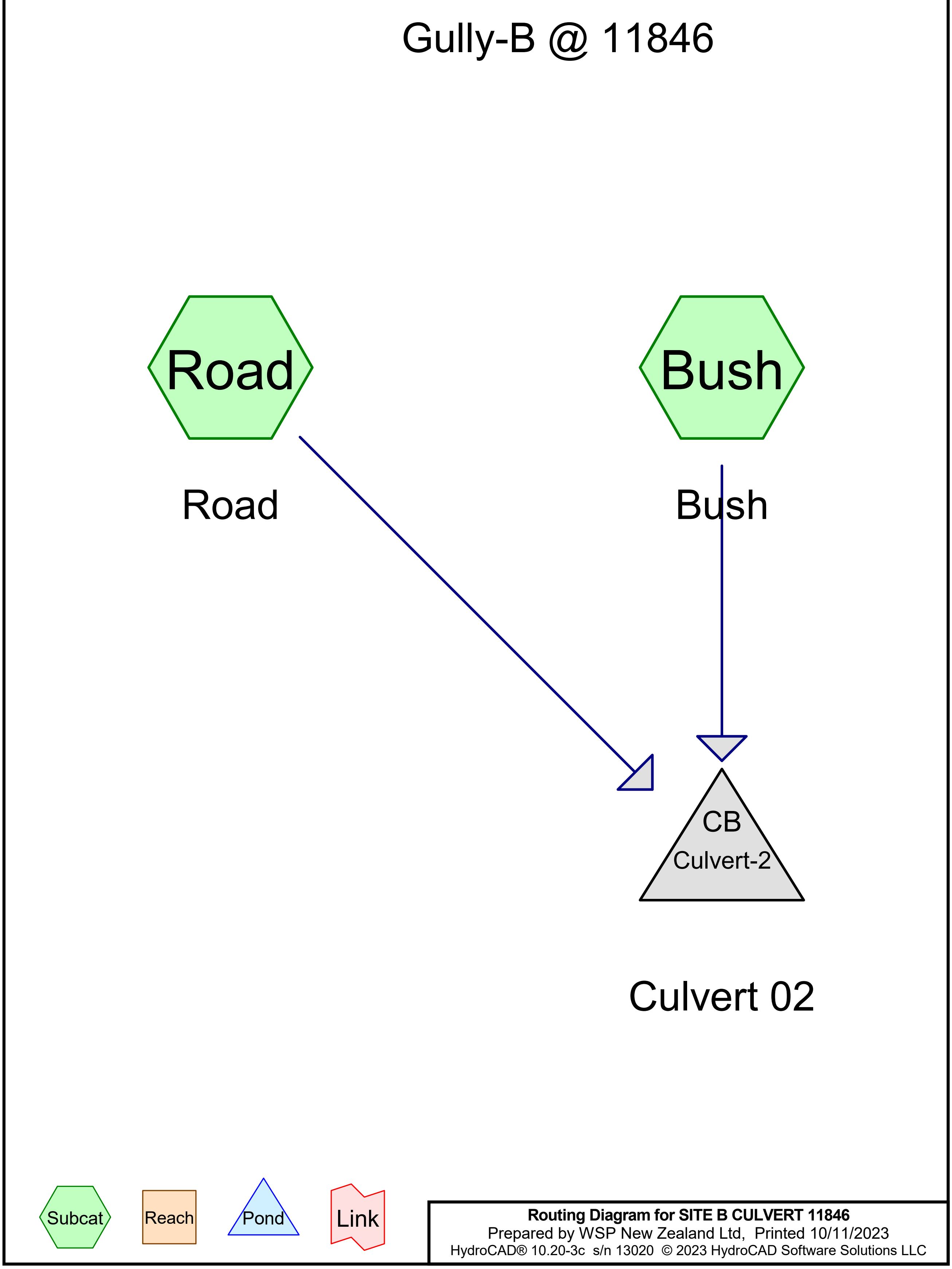


Reach 6R: Parabolic channel 600 wide, 100 deep



Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE B CULVERT 11846
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment Bush: Bush

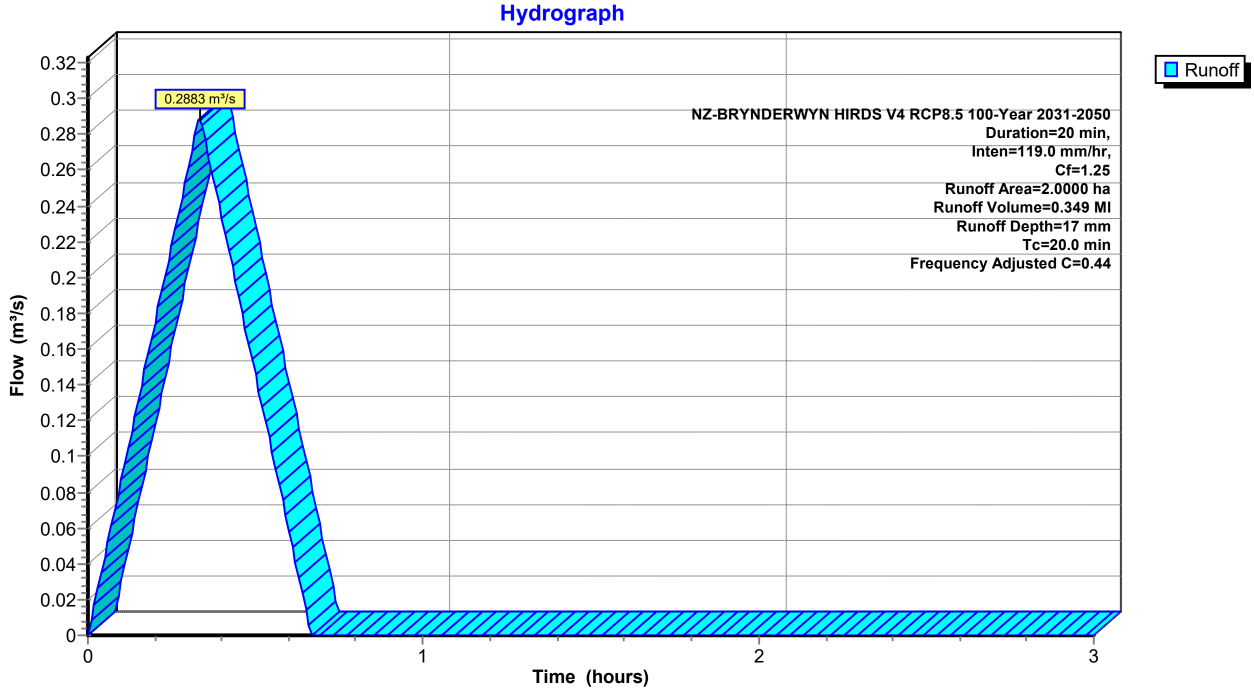
Runoff = 0.2883 m³/s @ 0.33 hrs, Volume= 0.349 Ml, Depth= 17 mm
Routed to Pond Culvert-2 : Culvert 02

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
2.0000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
2.0000	0.35	0.44	Weighted Average, Frequency Adjusted
2.0000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry,**

Subcatchment Bush: Bush



Summary for Subcatchment Road: Road

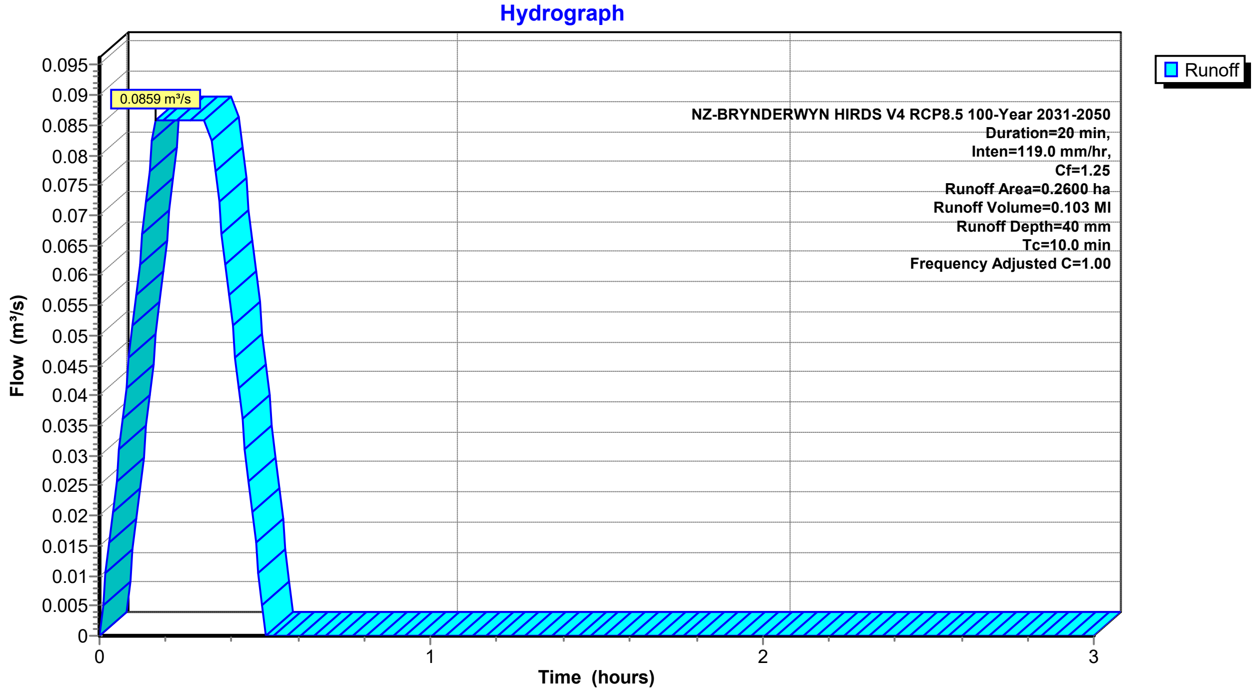
Runoff = 0.0859 m³/s @ 0.17 hrs, Volume= 0.103 Ml, Depth= 40 mm
Routed to Pond Culvert-2 : Culvert 02

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.2600	0.95		
0.2600	0.95	1.00	Weighted Average, Frequency Adjusted
0.2600			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road: Road



Summary for Pond Culvert-2: Culvert 02

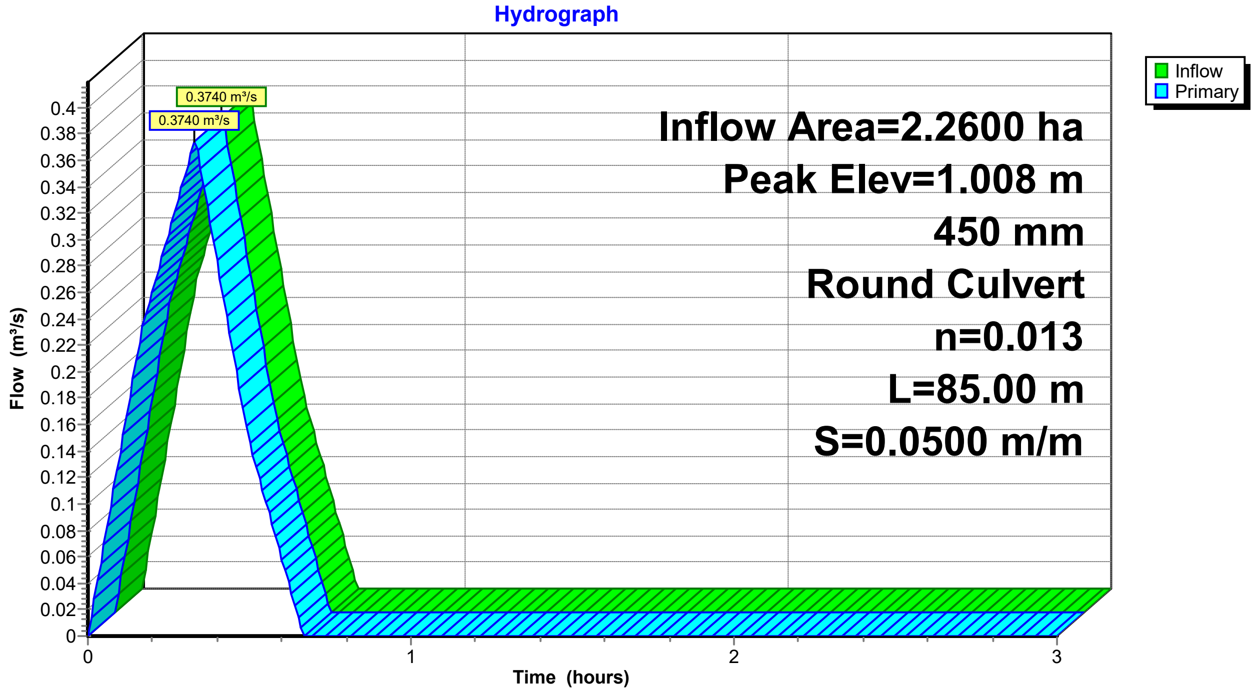
Inflow Area =	2.2600 ha,	11.50% Impervious,	Inflow Depth = 20 mm	for 100-Year 2031-2050 event
Inflow =	0.3740 m³/s @	0.33 hrs,	Volume=	0.452 Ml
Outflow =	0.3740 m³/s @	0.33 hrs,	Volume=	0.452 Ml, Atten= 0%, Lag= 0.0 min
Primary =	0.3740 m³/s @	0.33 hrs,	Volume=	0.452 Ml

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 1.008 m @ 0.33 hrs
Flood Elev= 2.900 m

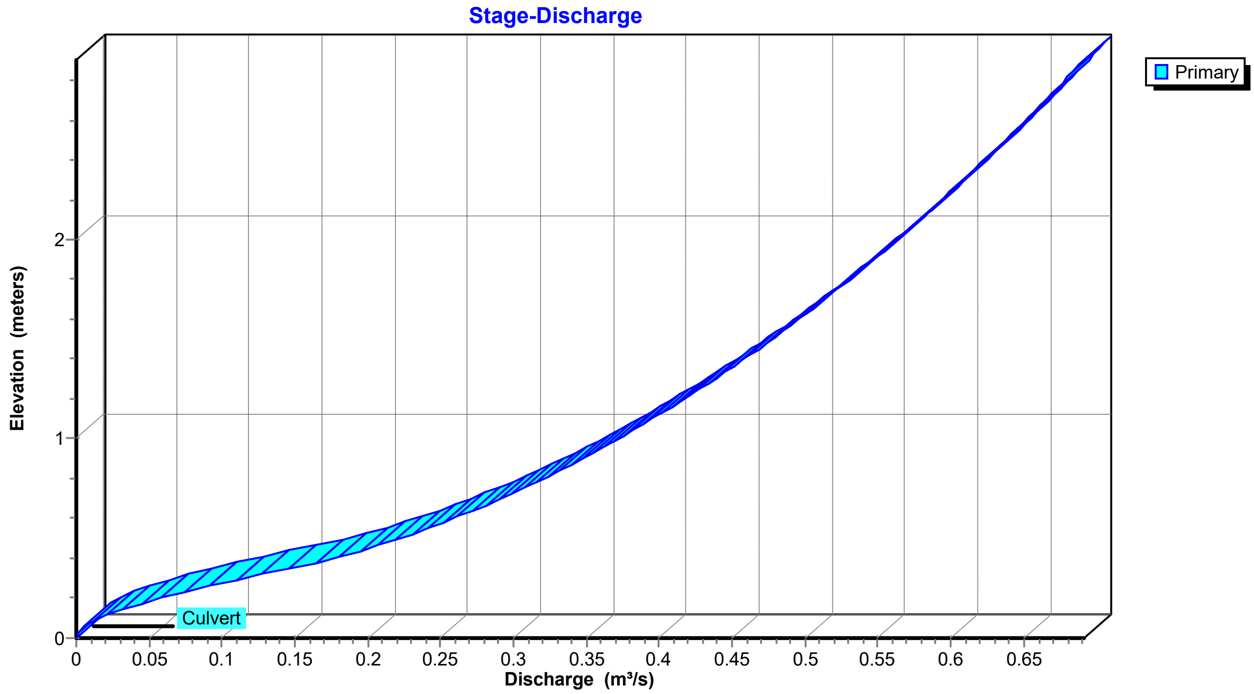
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**450 mm Round Culvert** L= 85.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -4.250 m S= 0.0500 m/m Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.159 m²

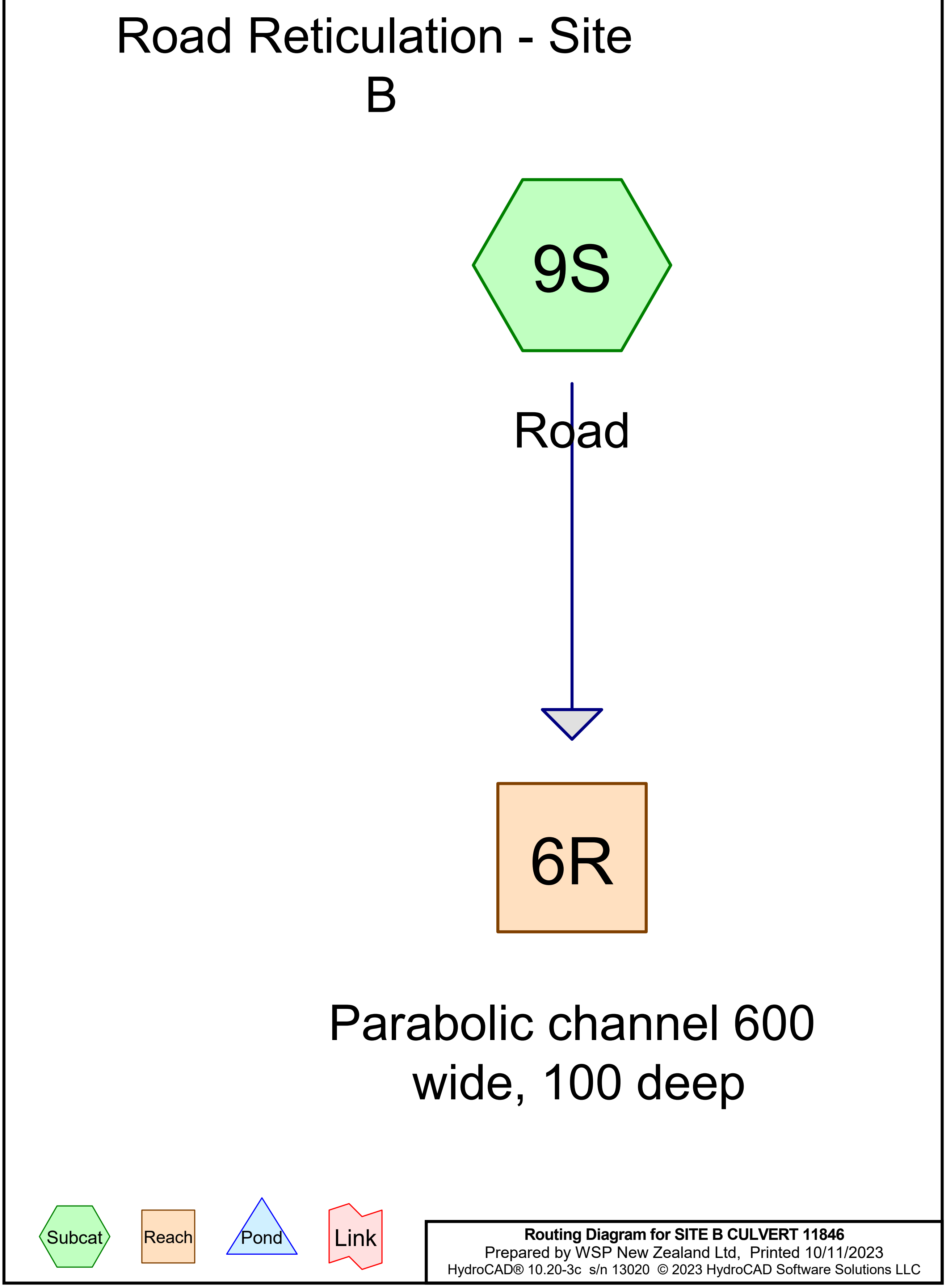
Primary OutFlow Max=0.3734 m³/s @ 0.33 hrs HW=1.006 m (Free Discharge)
└**1=Culvert** (Inlet Controls 0.3734 m³/s @ 2.35 m/s)

Pond Culvert-2: Culvert 02



Pond Culvert-2: Culvert 02




Road Reticulation - Site B
9S
Road
6R
Parabolic channel 600 wide, 100 deep
Subcat
Reach
Pond
Link

Summary for Subcatchment 9S: Road

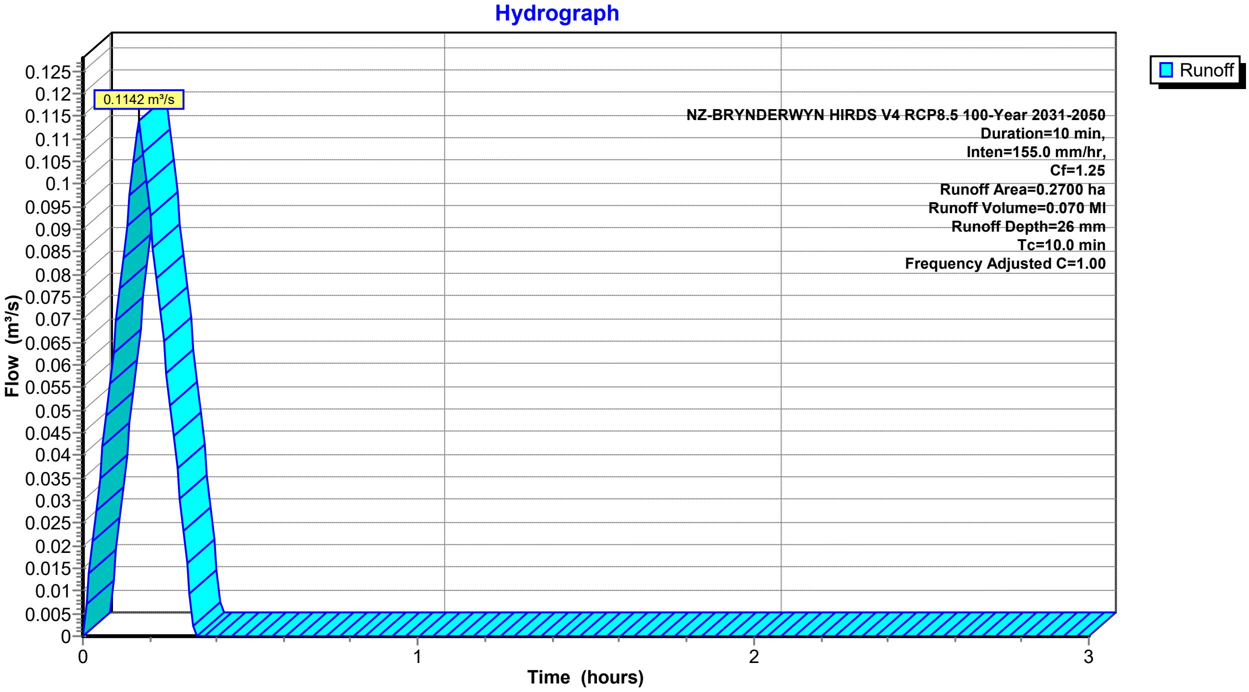
Runoff = 0.1142 m³/s @ 0.17 hrs, Volume= 0.070 Ml, Depth= 26 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.2600	0.95		road catchment
0.0100	0.35		cut face
0.2700	0.93	1.00	Weighted Average, Frequency Adjusted
0.0100			3.70% Pervious Area
0.2600			96.30% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



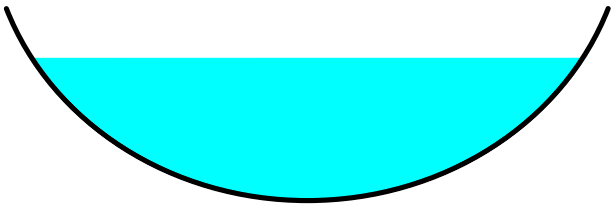
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

Inflow Area = 0.2700 ha, 96.30% Impervious, Inflow Depth = 26 mm for 100-Year 2031-2050 event
Inflow = 0.1142 m³/s @ 0.17 hrs, Volume= 0.070 Ml
Outflow = 0.1117 m³/s @ 0.18 hrs, Volume= 0.070 Ml, Atten= 2%, Lag= 0.8 min

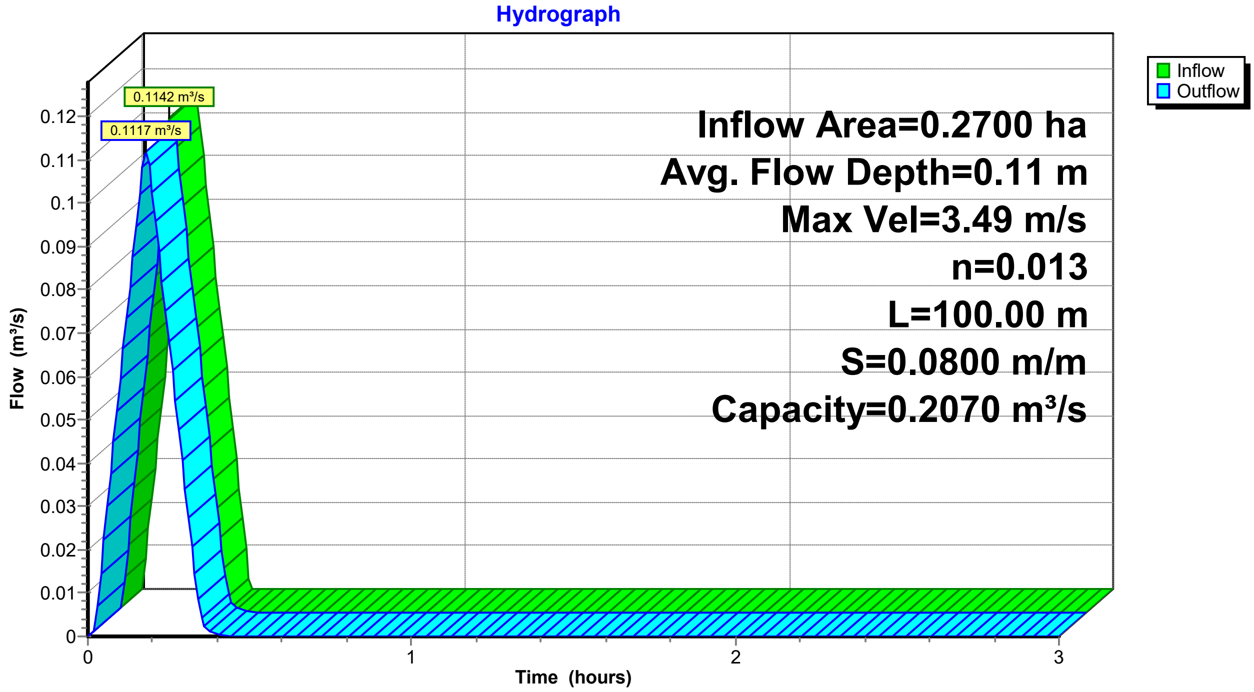
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.49 m/s, Min. Travel Time= 0.5 min
Avg. Velocity = 2.02 m/s, Avg. Travel Time= 0.8 min

Peak Storage= 3.2 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.11 m , Surface Width= 0.43 m
Bank-Full Depth= 0.15 m Flow Area= 0.05 m², Capacity= 0.2070 m³/s

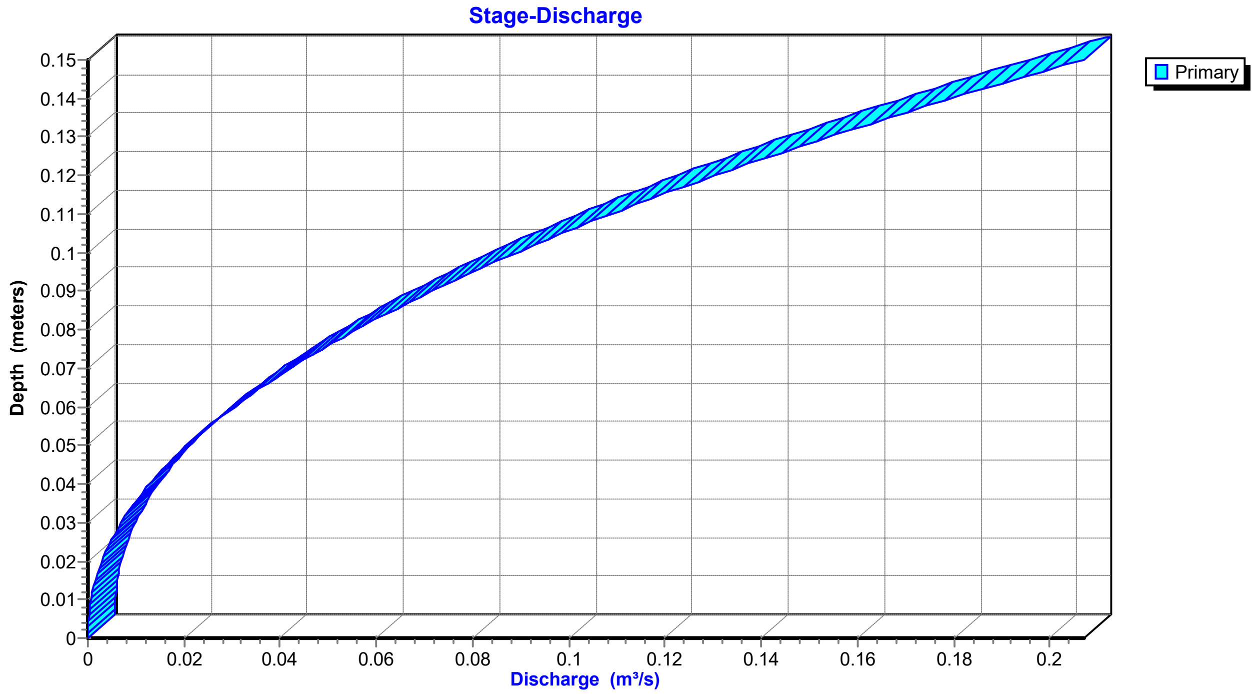
0.50 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m

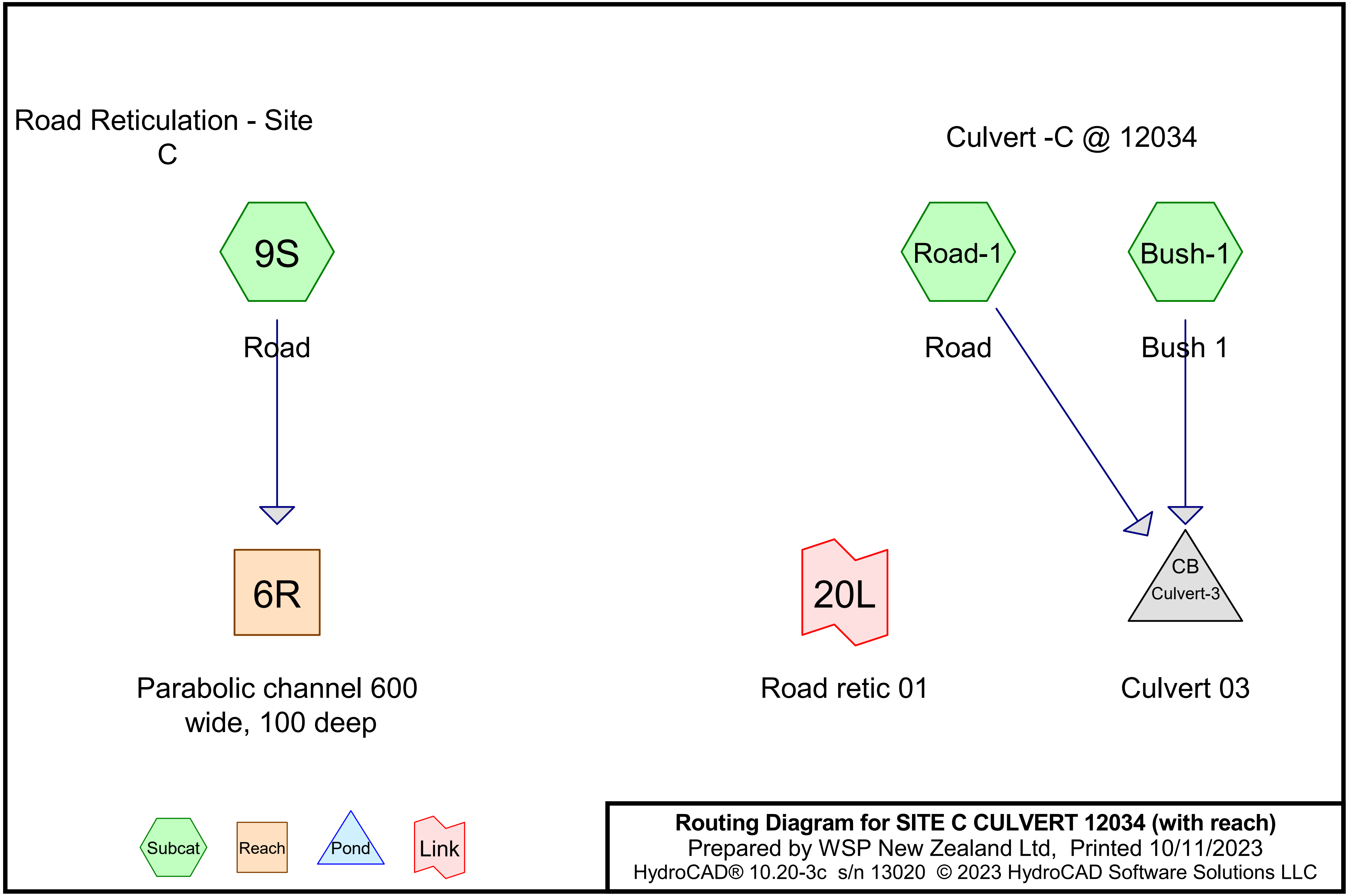


Reach 6R: Parabolic channel 600 wide, 100 deep

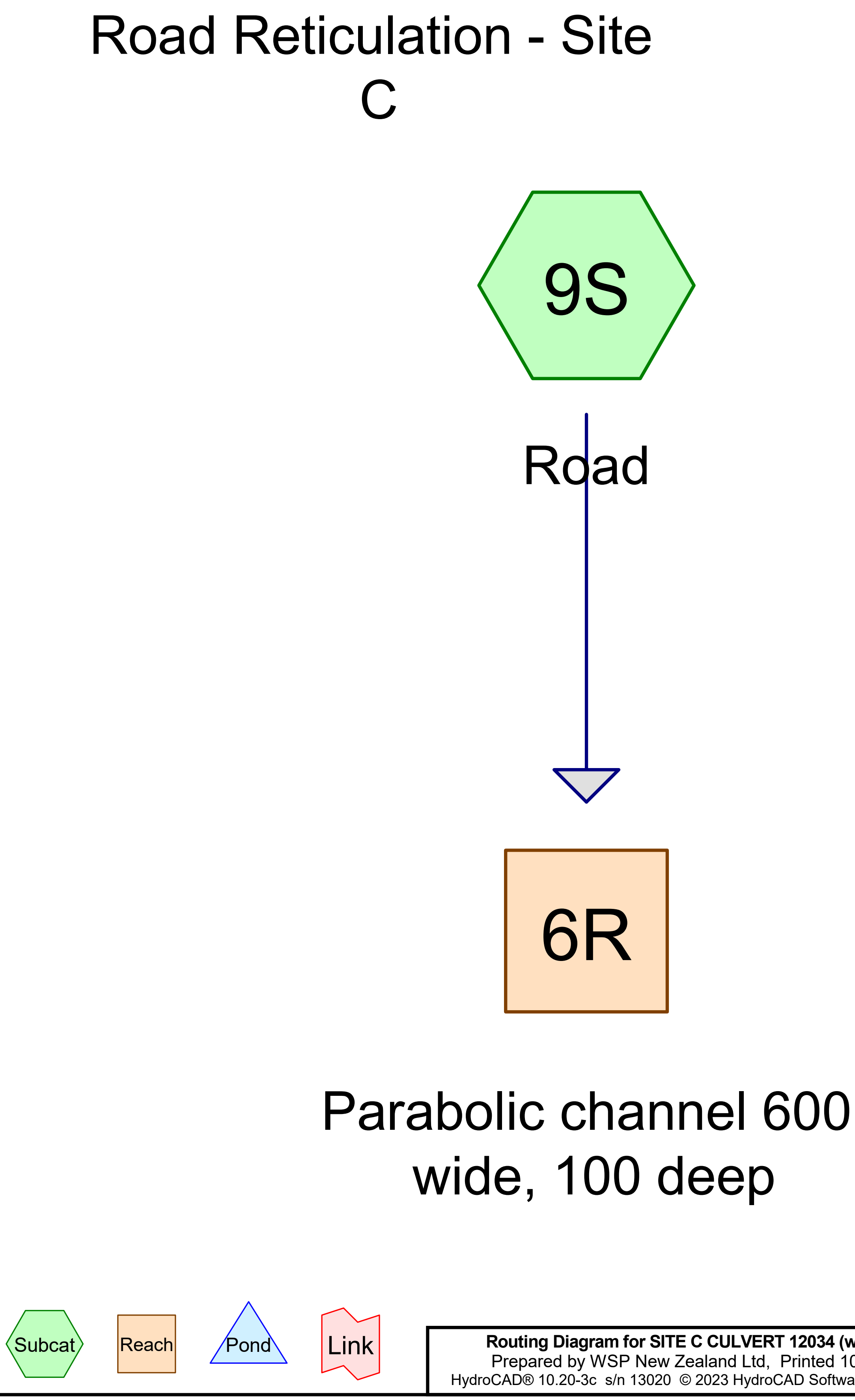


Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE C CULVERT 12034 (with reach)
Prepared by WSP New Zealand Ltd, Printed 10/11/2023



Routing Diagram for SITE C CULVERT 12034 (with reach)
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

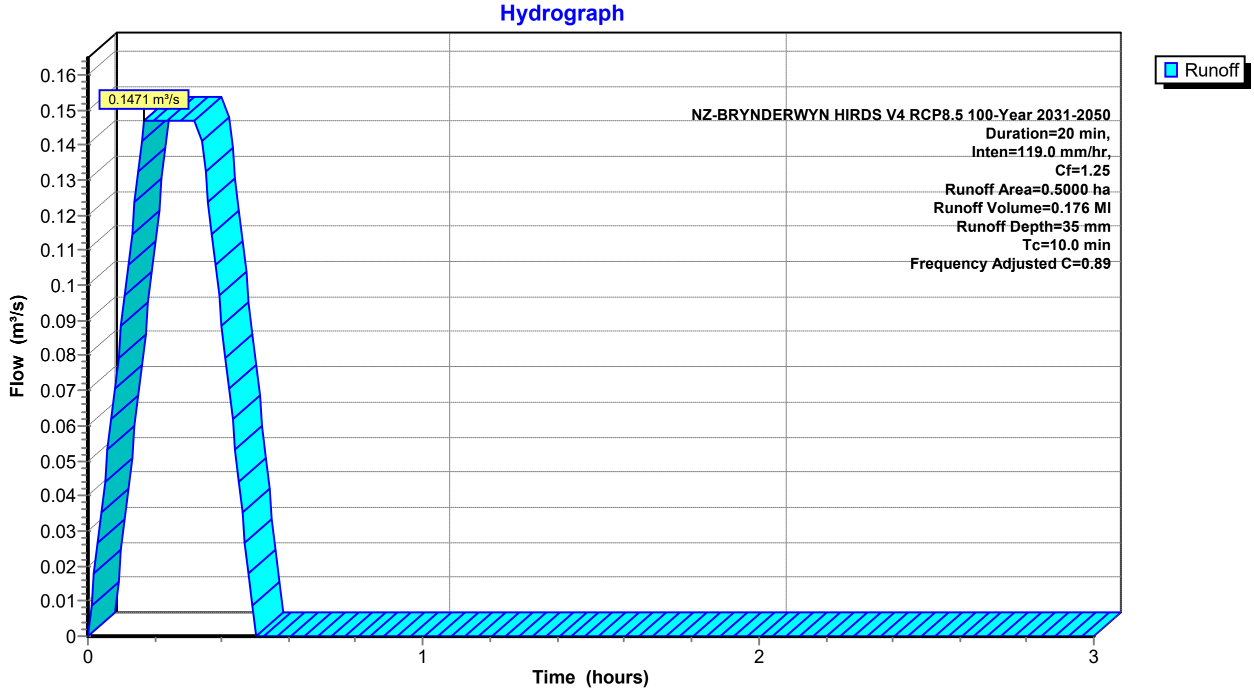
Runoff = 0.1471 m³/s @ 0.17 hrs, Volume= 0.176 Ml, Depth= 35 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.3000	0.95		road catchment
0.2000	0.35		cut face
0.5000	0.71	0.89	Weighted Average, Frequency Adjusted
0.2000			40.00% Pervious Area
0.3000			60.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



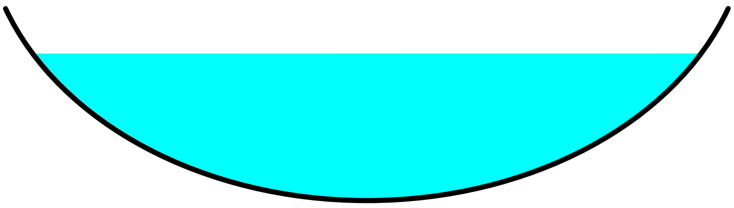
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

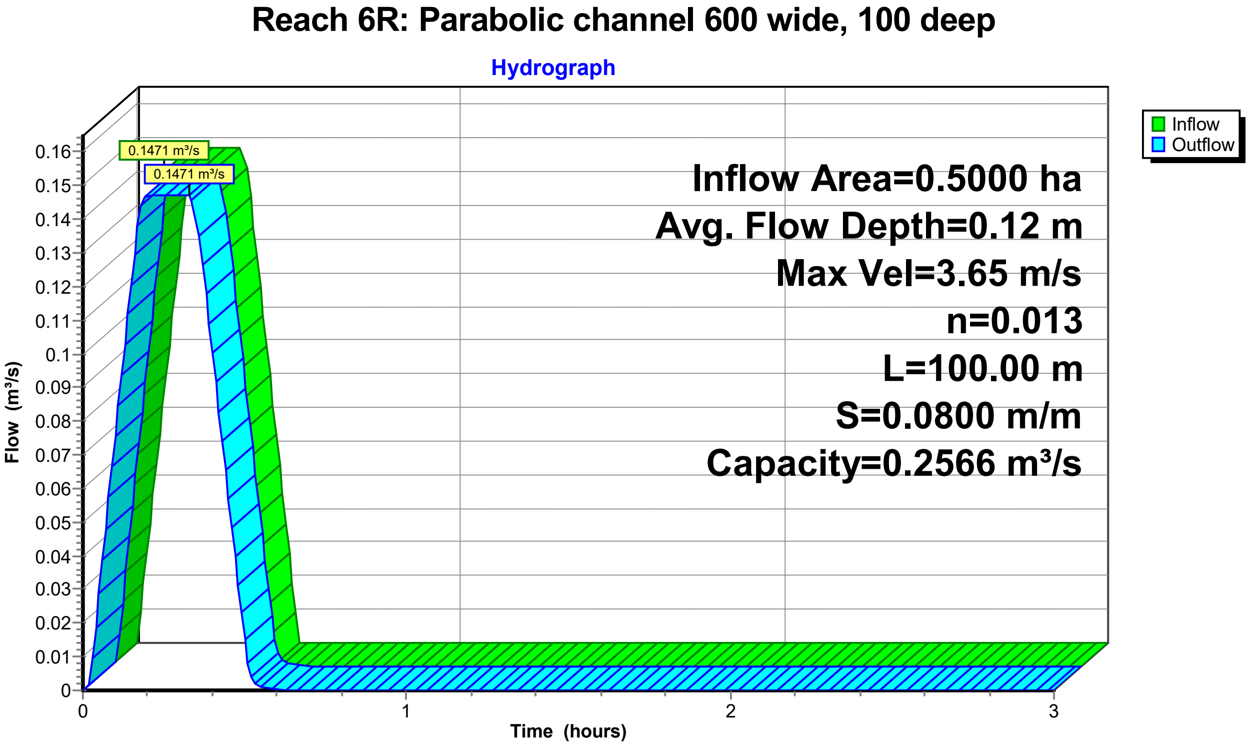
Inflow Area = 0.5000 ha, 60.00% Impervious, Inflow Depth = 35 mm for 100-Year 2031-2050 event
Inflow = 0.1471 m³/s @ 0.17 hrs, Volume= 0.176 Ml
Outflow = 0.1471 m³/s @ 0.33 hrs, Volume= 0.176 Ml, Atten= 0%, Lag= 9.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.65 m/s, Min. Travel Time= 0.5 min
Avg. Velocity = 2.43 m/s, Avg. Travel Time= 0.7 min

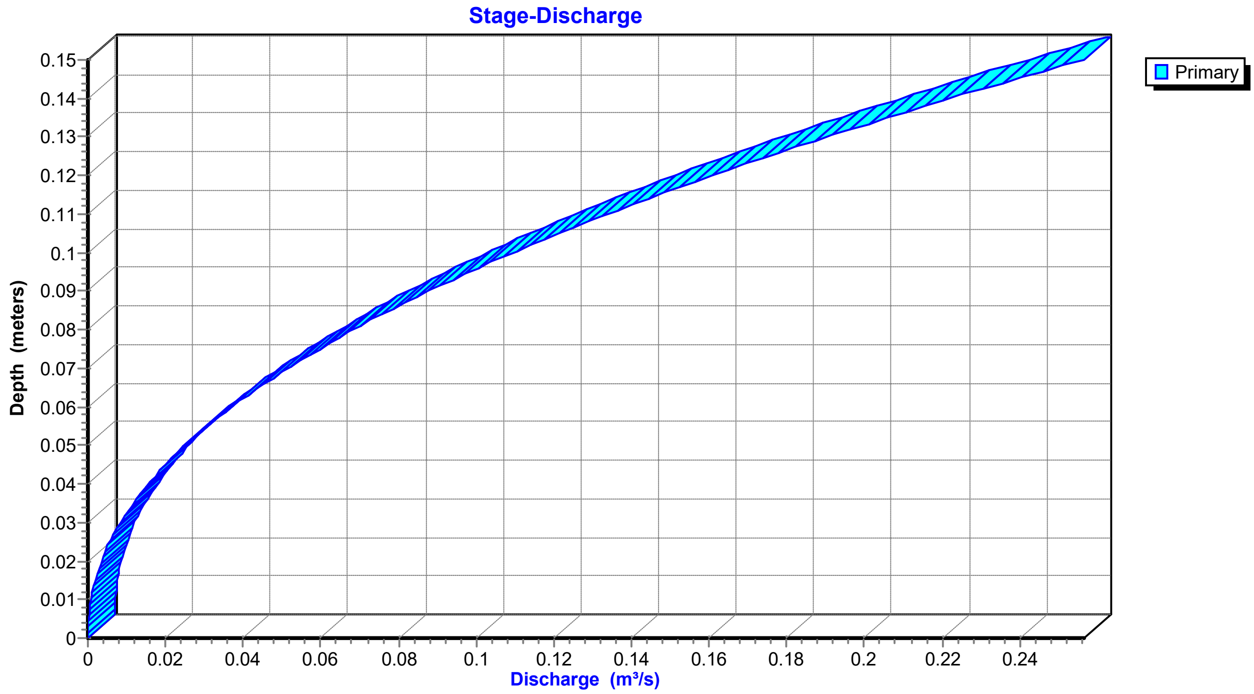
Peak Storage= 4.0 m³ @ 0.33 hrs
Average Depth at Peak Storage= 0.12 m , Surface Width= 0.53 m
Bank-Full Depth= 0.15 m Flow Area= 0.06 m², Capacity= 0.2566 m³/s

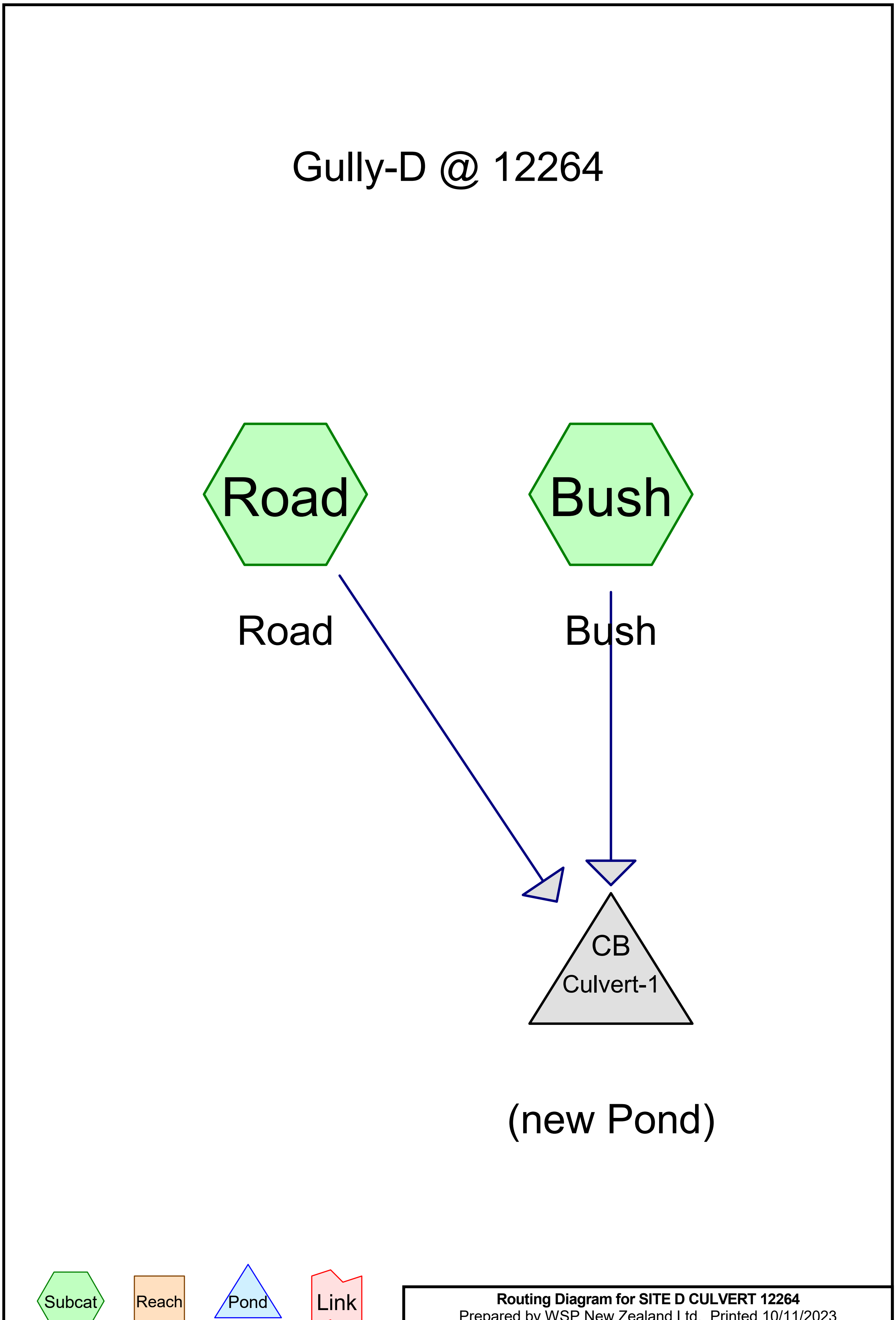
0.60 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m





Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE D CULVERT 12264
Prepared by WSP New Zealand Ltd, Printed 10/11/2023

Summary for Subcatchment Bush: Bush

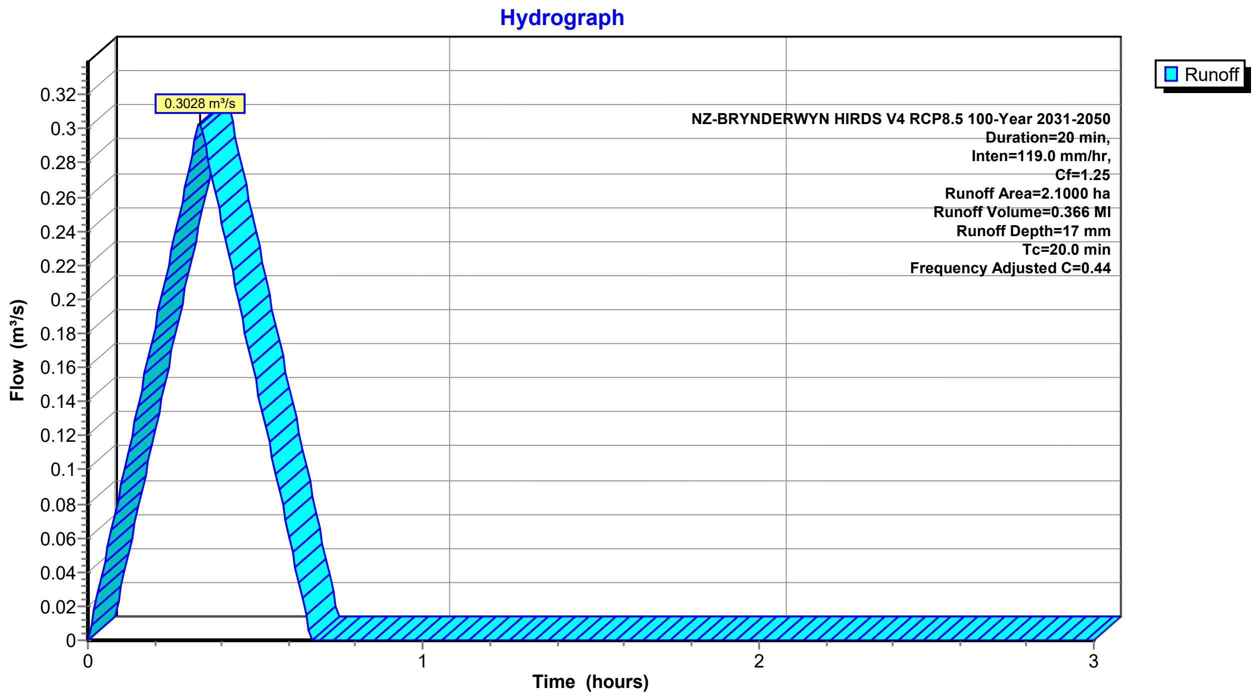
Runoff = 0.3028 m³/s @ 0.33 hrs, Volume= 0.366 Ml, Depth= 17 mm
Routed to Pond Culvert-1 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
2.1000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
2.1000	0.35	0.44	Weighted Average, Frequency Adjusted
2.1000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry,**

Subcatchment Bush: Bush



Summary for Subcatchment Road: Road

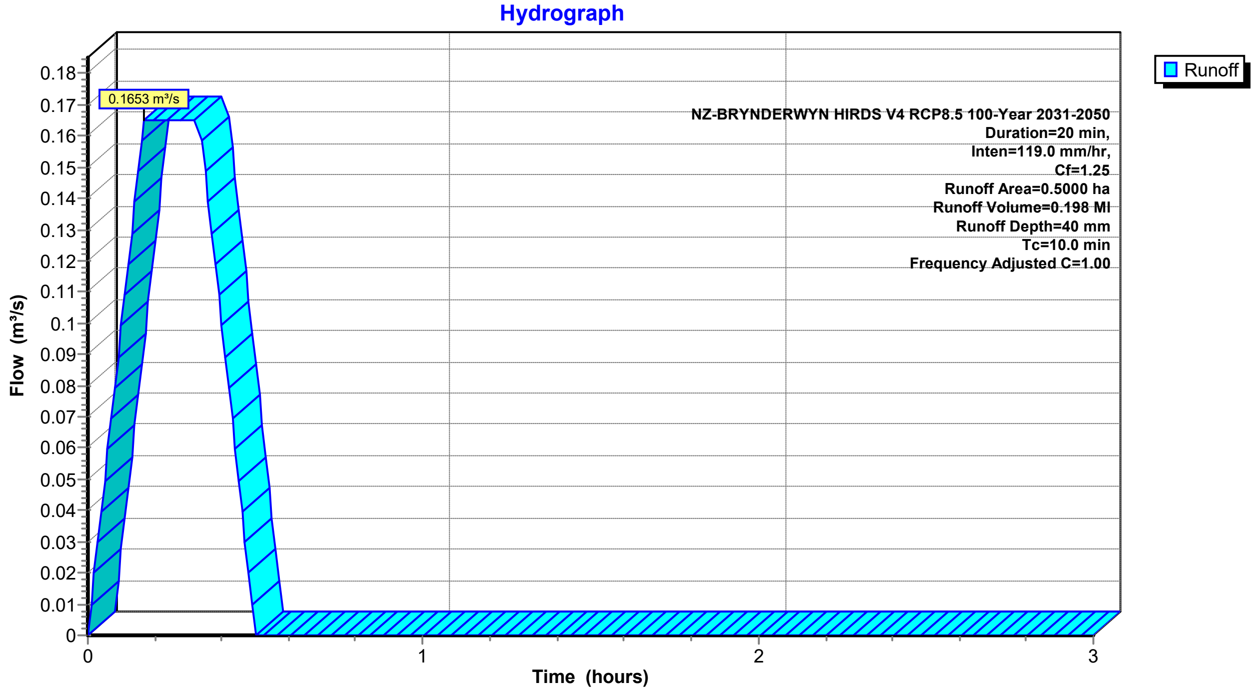
Runoff = 0.1653 m³/s @ 0.17 hrs, Volume= 0.198 Ml, Depth= 40 mm
Routed to Pond Culvert-1 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.5000	0.95		
0.5000	0.95	1.00	Weighted Average, Frequency Adjusted
0.5000			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road: Road



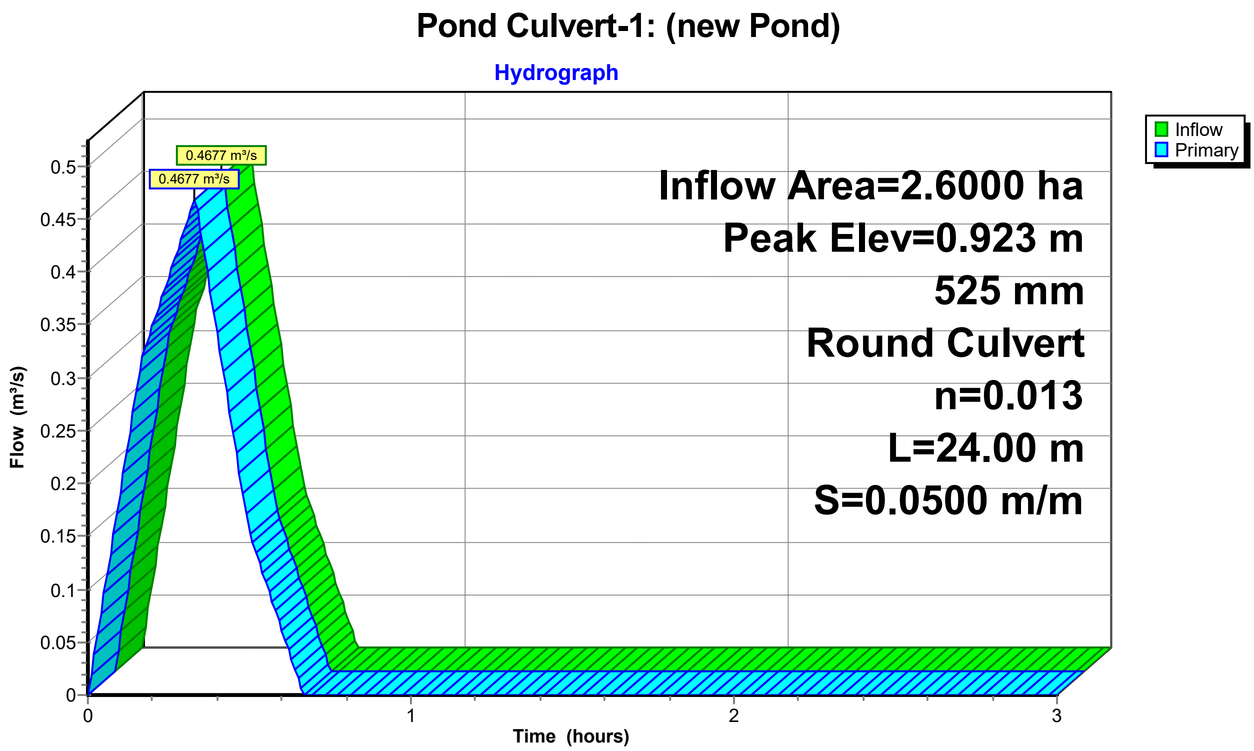
Summary for Pond Culvert-1: (new Pond)

Inflow Area = 2.6000 ha, 19.23% Impervious, Inflow Depth = 22 mm for 100-Year 2031-2050 event
Inflow = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml
Outflow = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml

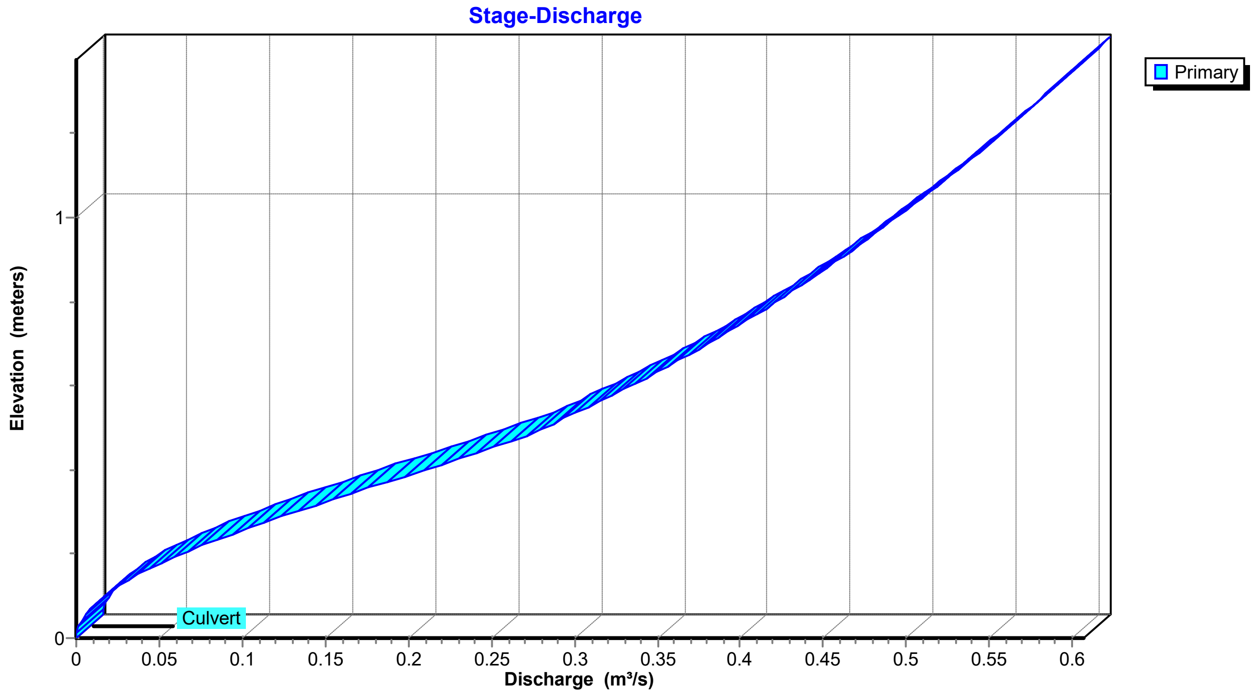
Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 0.923 m @ 0.33 hrs
Flood Elev= 1.375 m

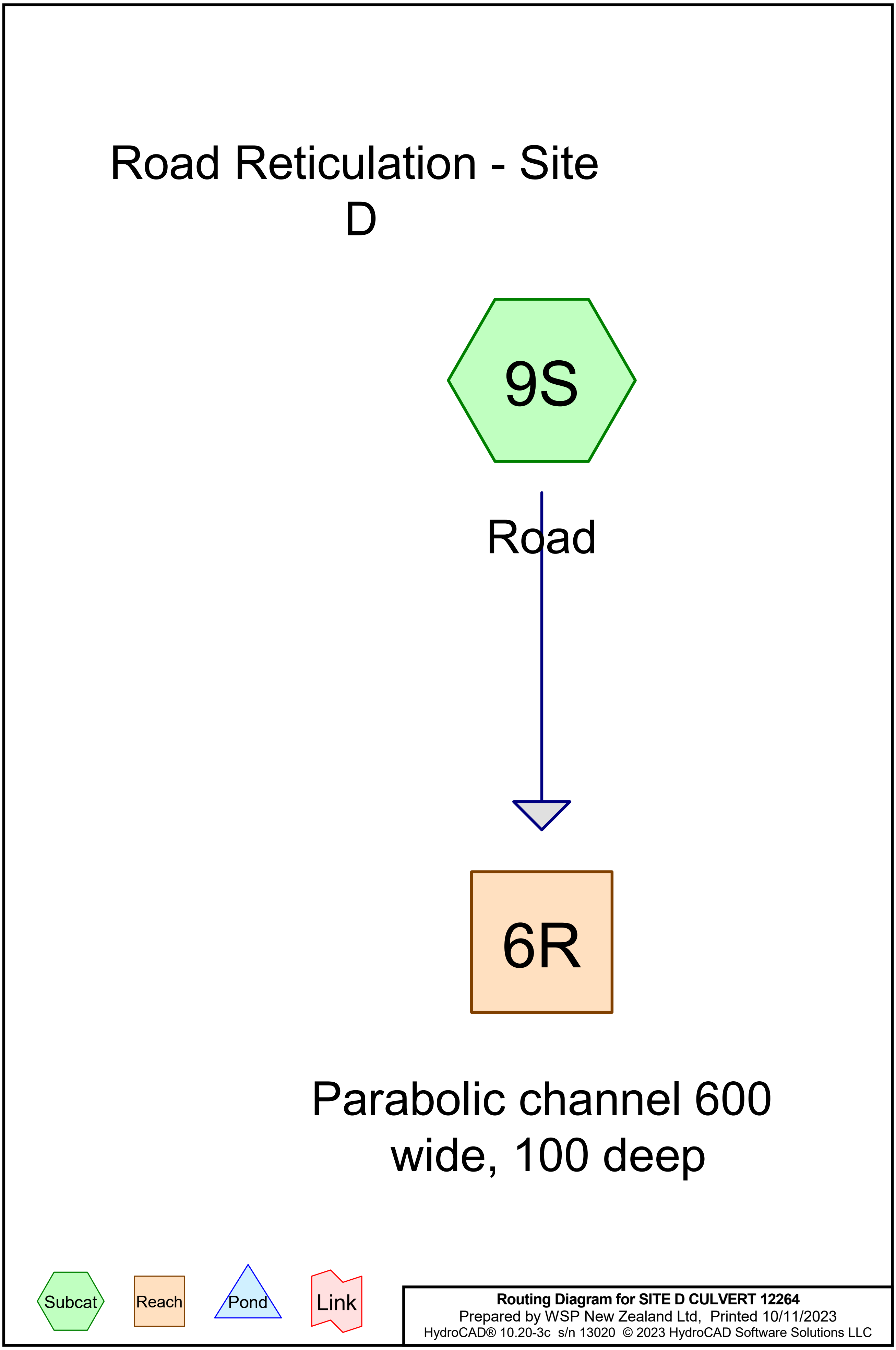
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**525 mm Round Culvert** L= 24.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -1.200 m S= 0.0500 m/m Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.216 m²

Primary OutFlow Max=0.4675 m³/s @ 0.33 hrs HW=0.923 m (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.4675 m³/s @ 2.16 m/s)



Pond Culvert-1: (new Pond)




Road Reticulation - Site D
9S
Road
6R
Parabolic channel 600 wide, 100 deep
Subcat
Reach
Pond
Link
Routing Diagram for SITE D CULVERT 12264
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

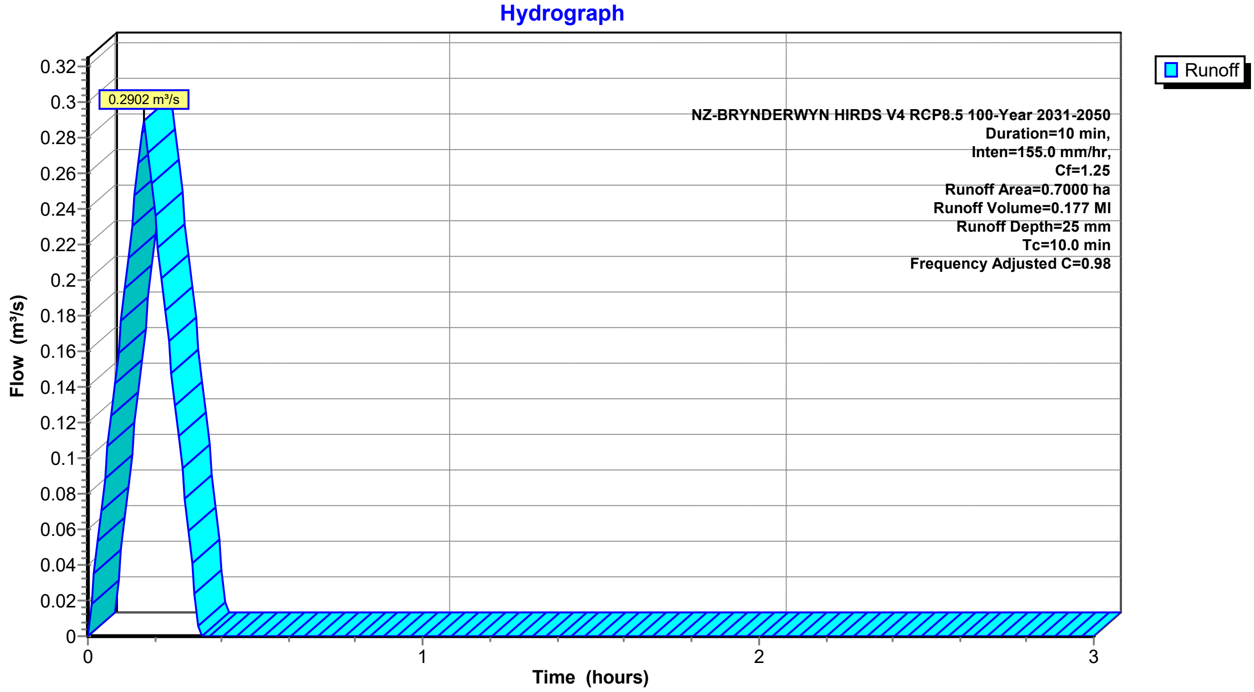
Runoff = 0.2902 m³/s @ 0.17 hrs, Volume= 0.177 Ml, Depth= 25 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.5000	0.95		road catchment
0.2000	0.35		cut face
0.7000	0.78	0.98	Weighted Average, Frequency Adjusted
0.2000			28.57% Pervious Area
0.5000			71.43% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



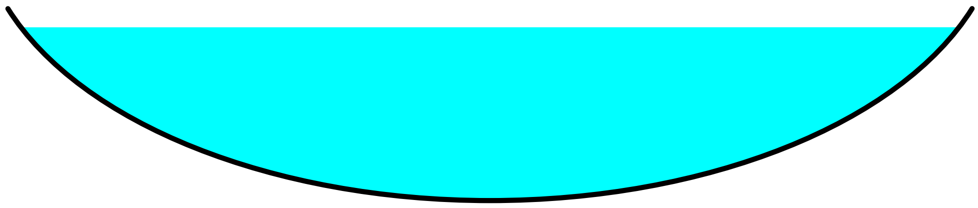
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

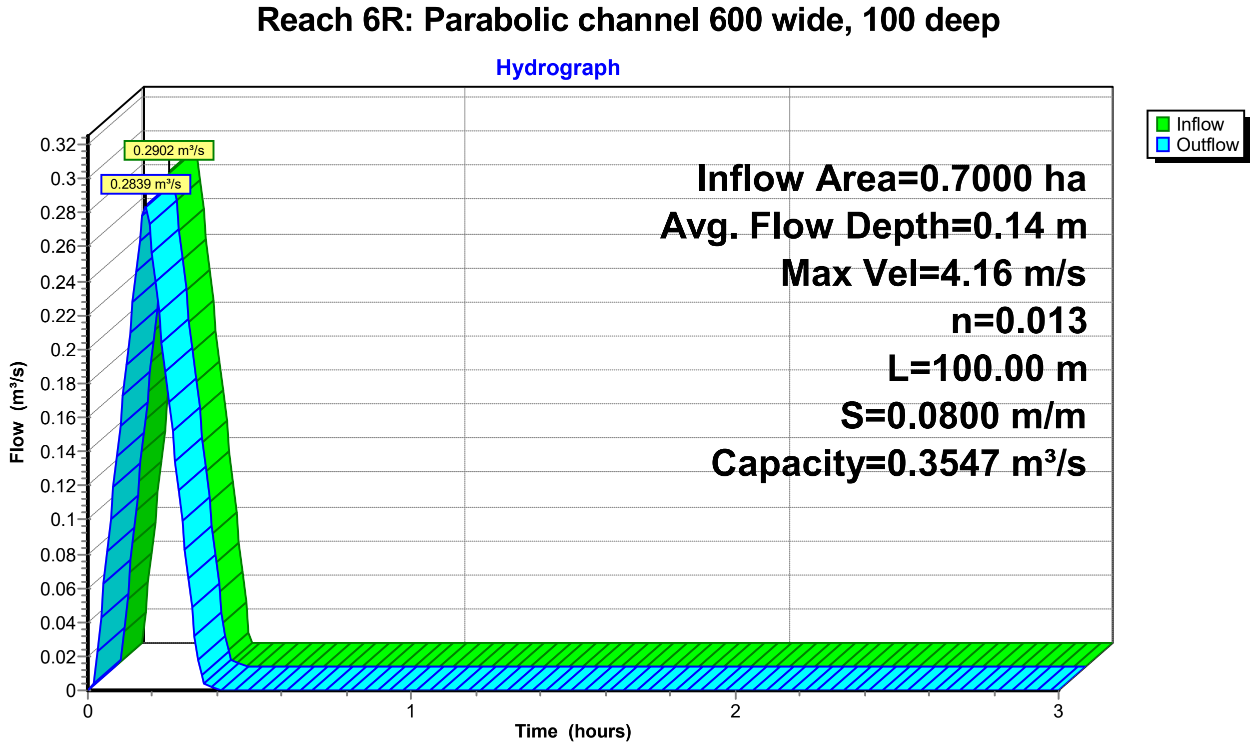
Inflow Area = 0.7000 ha, 71.43% Impervious, Inflow Depth = 25 mm for 100-Year 2031-2050 event
Inflow = 0.2902 m³/s @ 0.17 hrs, Volume= 0.177 Ml
Outflow = 0.2839 m³/s @ 0.18 hrs, Volume= 0.177 Ml, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 4.16 m/s, Min. Travel Time= 0.4 min
Avg. Velocity = 2.18 m/s, Avg. Travel Time= 0.8 min

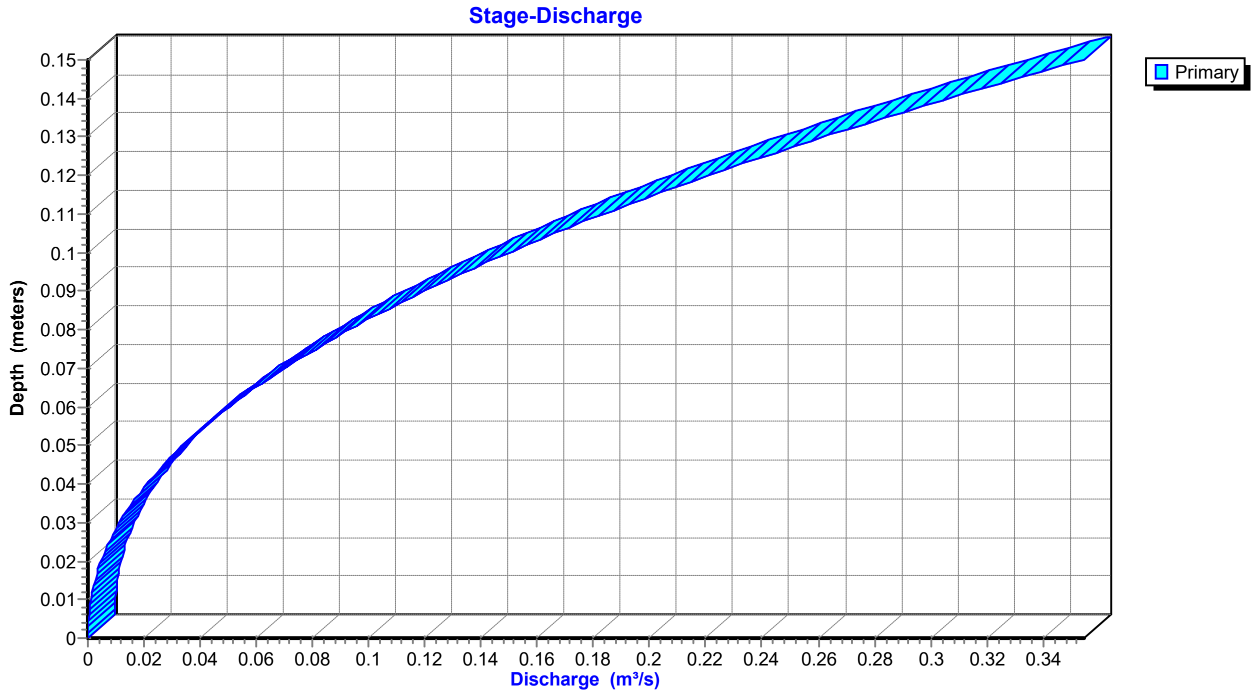
Peak Storage= 6.9 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.14 m , Surface Width= 0.76 m
Bank-Full Depth= 0.15 m Flow Area= 0.08 m², Capacity= 0.3547 m³/s

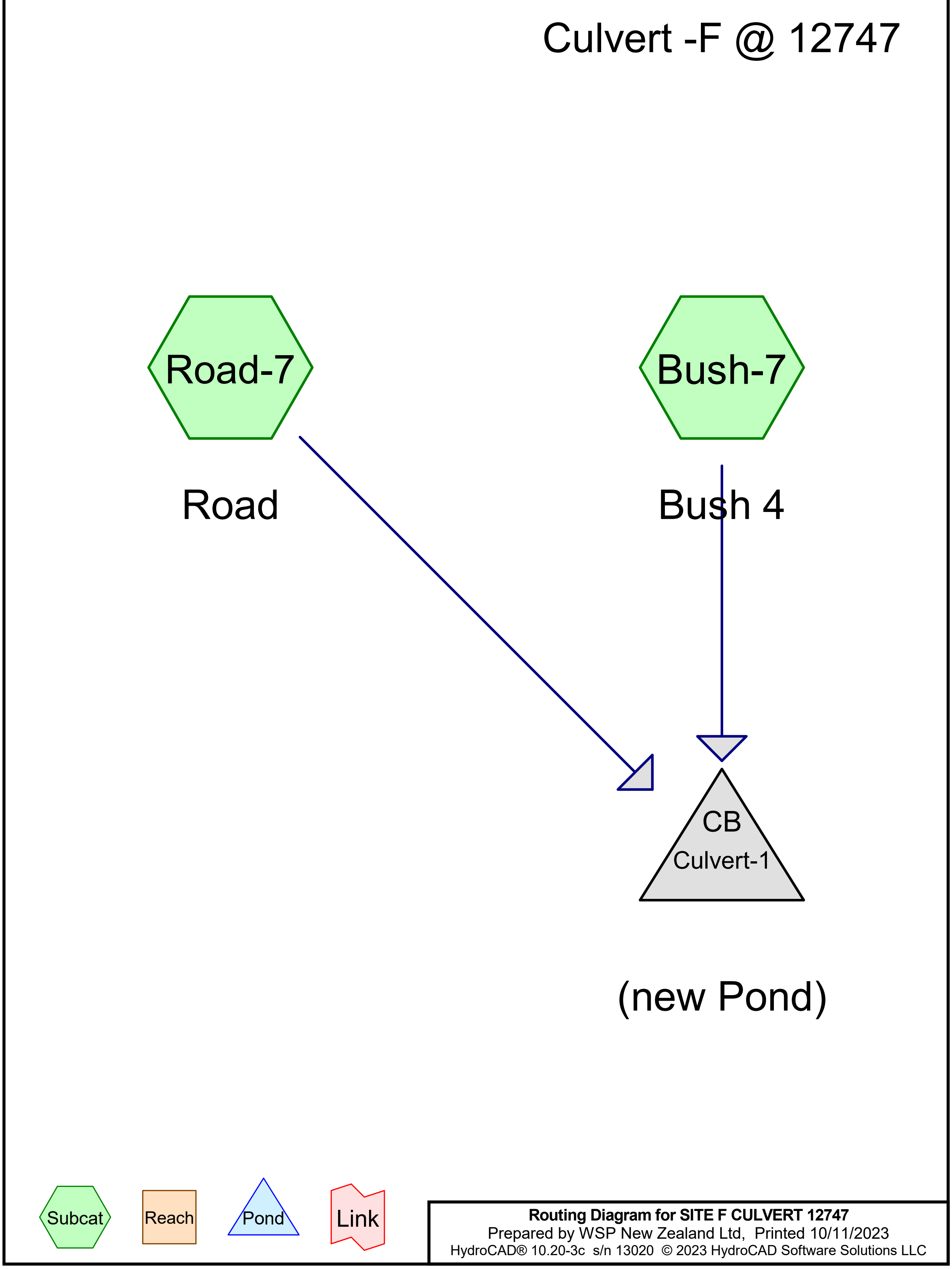
0.80 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m





Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE F CULVERT 12747
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment Bush-7: Bush 4

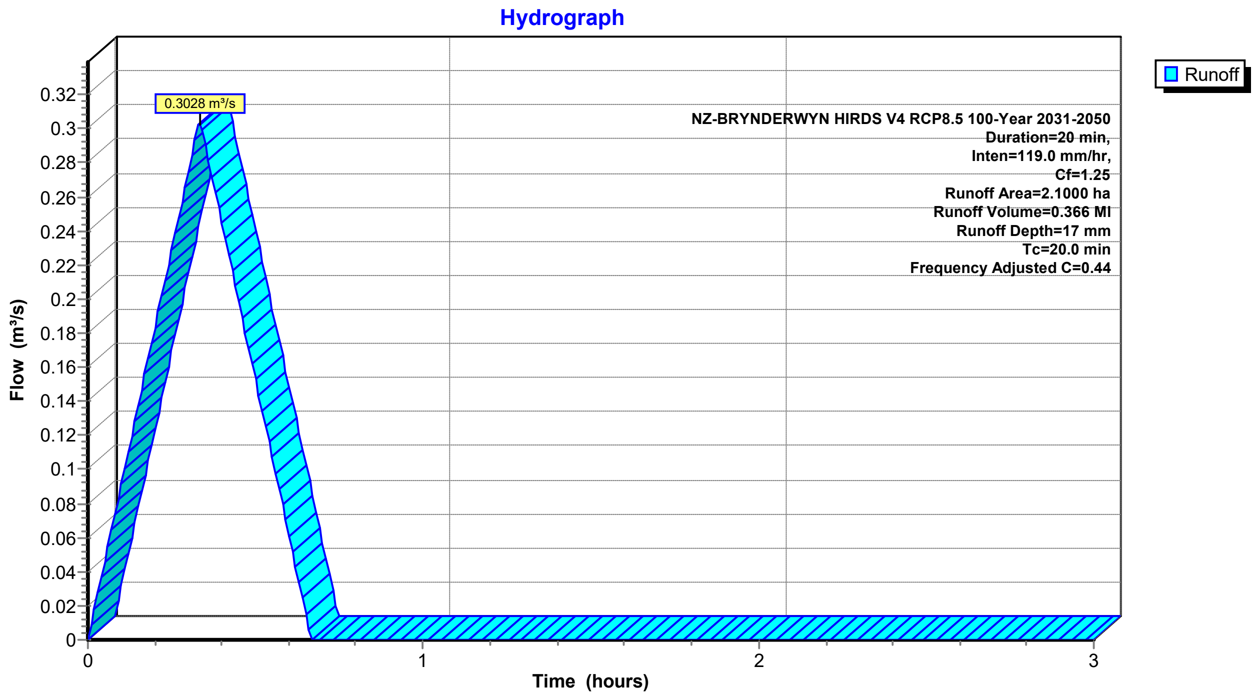
Runoff = 0.3028 m³/s @ 0.33 hrs, Volume= 0.366 Ml, Depth= 17 mm
Routed to Pond Culvert-1 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
2.1000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
2.1000	0.35	0.44	Weighted Average, Frequency Adjusted
2.1000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry,**

Subcatchment Bush-7: Bush 4



Summary for Subcatchment Road-7: Road

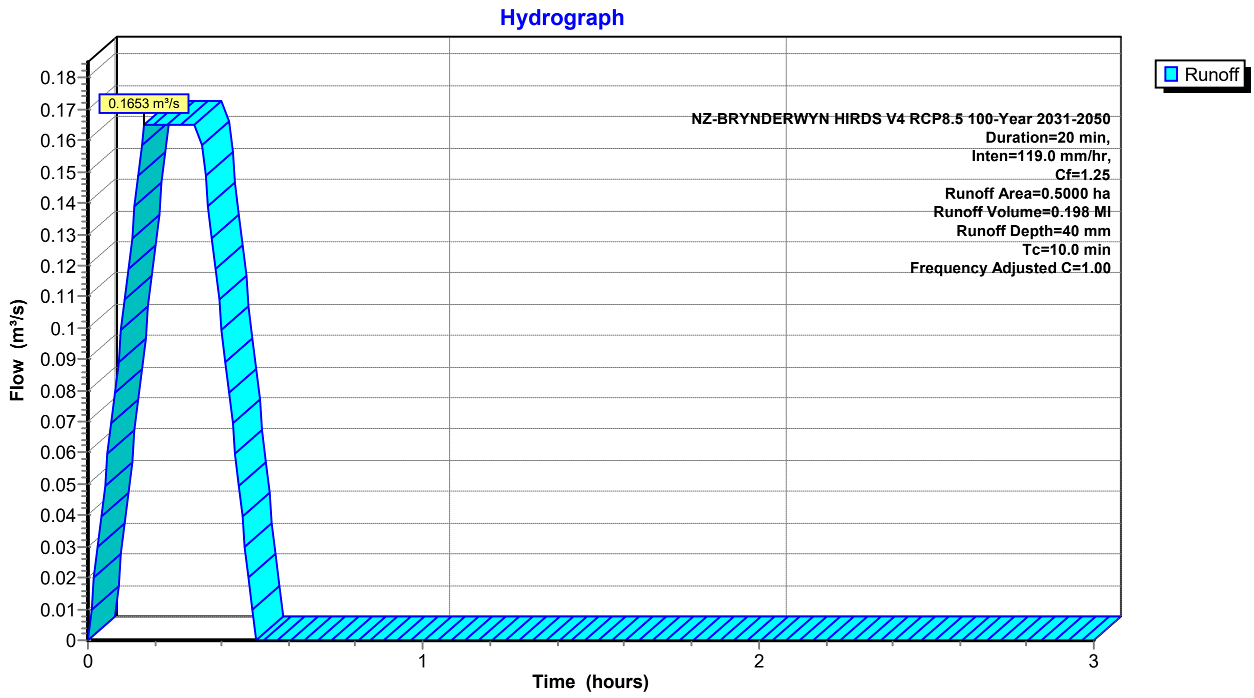
Runoff = 0.1653 m³/s @ 0.17 hrs, Volume= 0.198 Ml, Depth= 40 mm
Routed to Pond Culvert-1 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.5000	0.95		
0.5000	0.95	1.00	Weighted Average, Frequency Adjusted
0.5000			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road-7: Road



Summary for Pond Culvert-1: (new Pond)

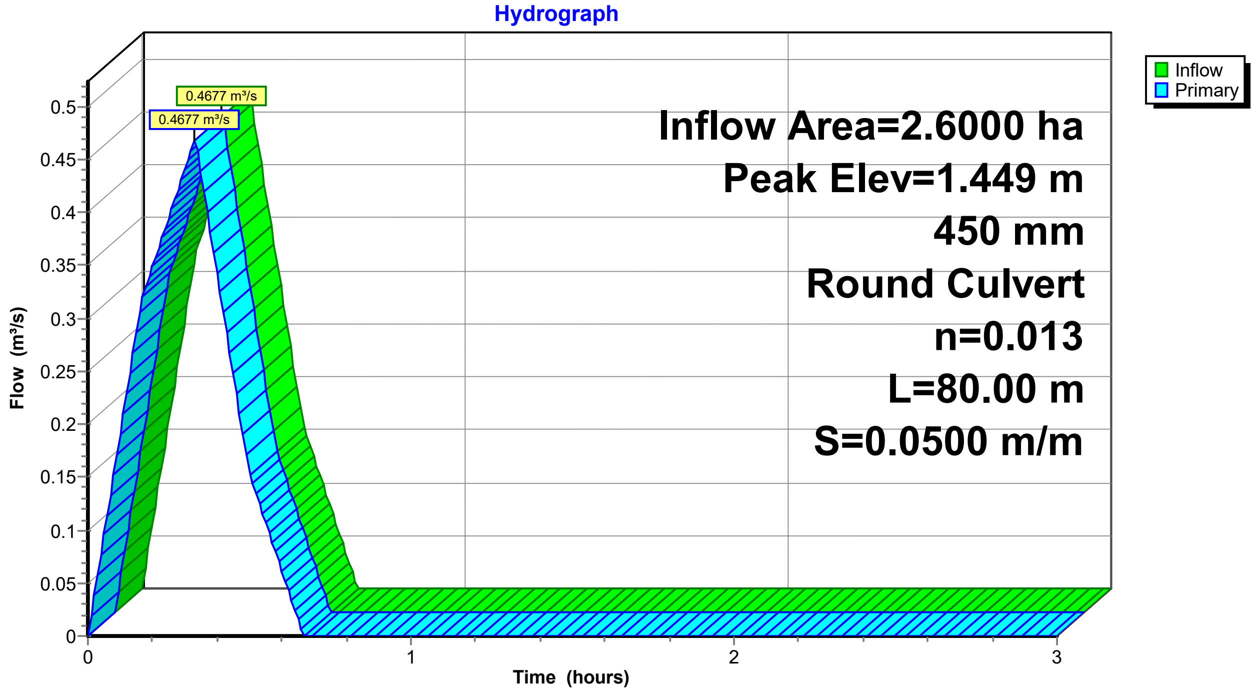
Inflow Area = 2.6000 ha, 19.23% Impervious, Inflow Depth = 22 mm for 100-Year 2031-2050 event
Inflow = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml
Outflow = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.4677 m³/s @ 0.33 hrs, Volume= 0.565 Ml

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 1.449 m @ 0.33 hrs
Flood Elev= 1.375 m

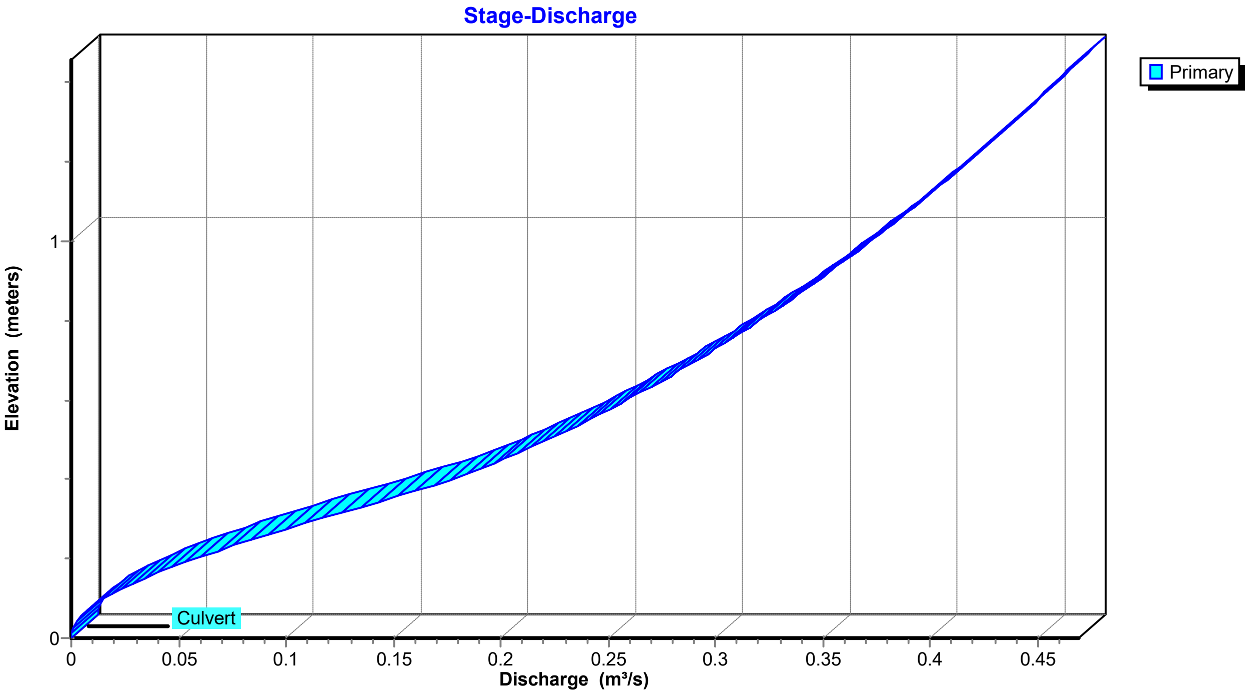
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**450 mm Round Culvert** L= 80.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -4.000 m S= 0.0500 m/m Cc= 0.900 n= 0.013, Flow Area= 0.159 m²

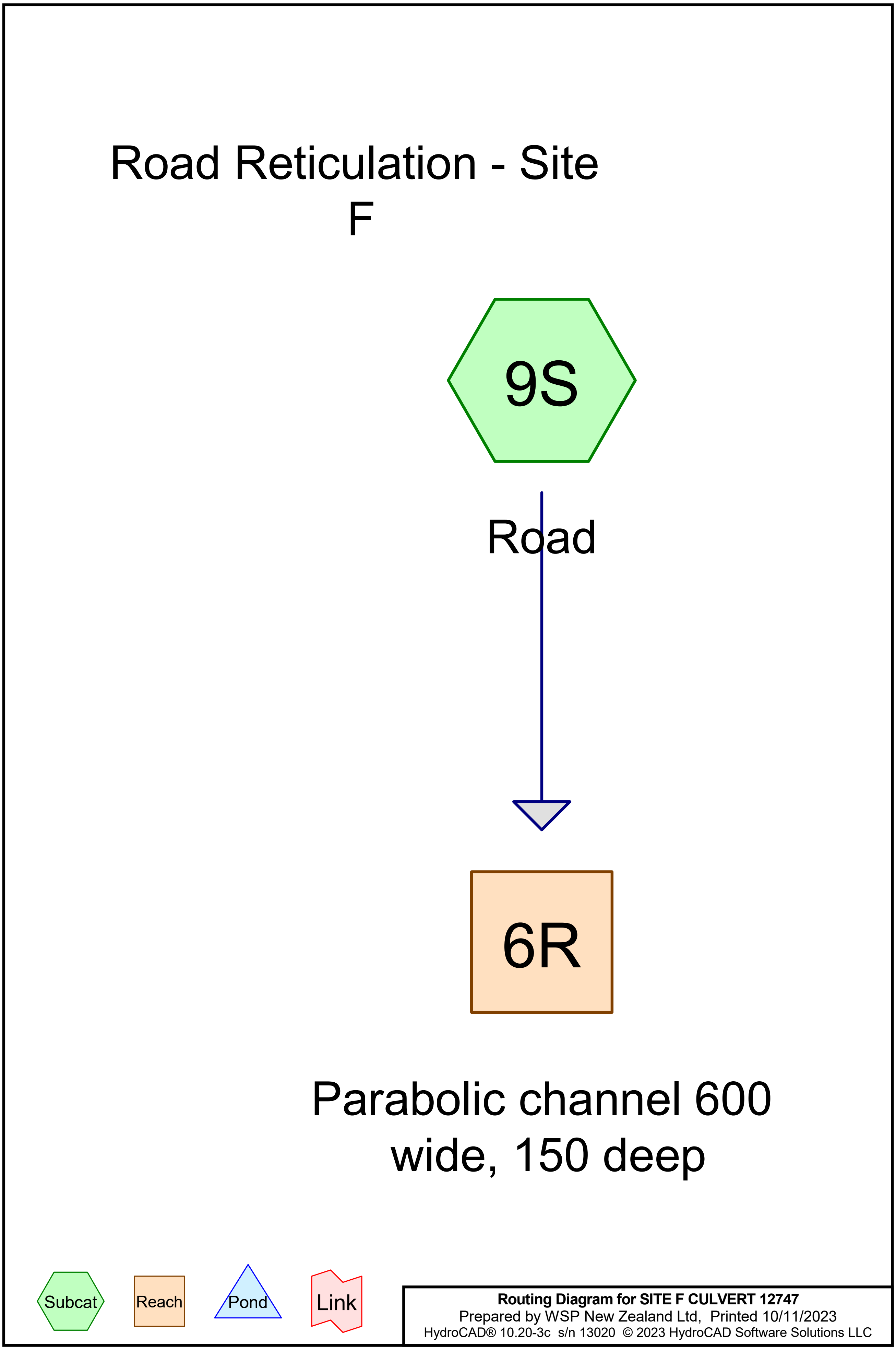
Primary OutFlow Max=0.4675 m³/s @ 0.33 hrs HW=1.448 m (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.4675 m³/s @ 2.94 m/s)

Pond Culvert-1: (new Pond)



Pond Culvert-1: (new Pond)




Road Reticulation - Site F
9S
Road
6R
Parabolic channel 600 wide, 150 deep
Subcat
Reach
Pond
Link
Routing Diagram for SITE F CULVERT 12747
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

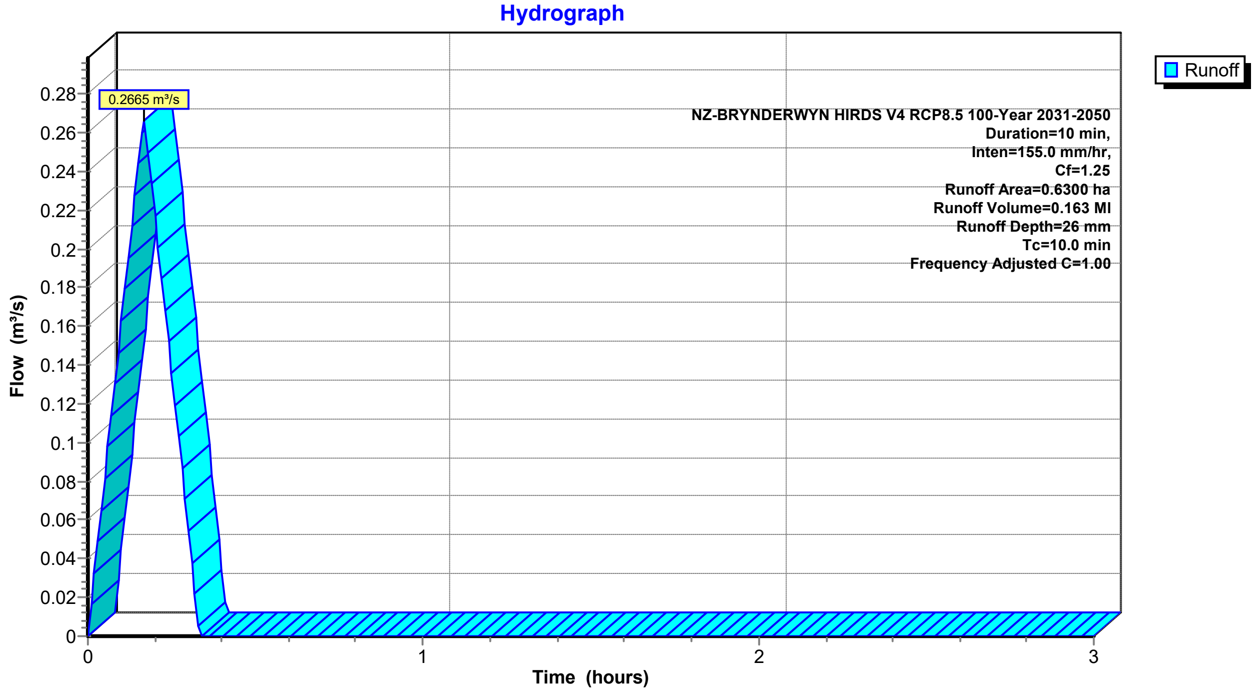
Runoff = 0.2665 m³/s @ 0.17 hrs, Volume= 0.163 Ml, Depth= 26 mm
Routed to Reach 6R : Parabolic channel 600 wide, 150 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.5000	0.95		road catchment
0.1300	0.35		cut face
0.6300	0.83	1.00	Weighted Average, Frequency Adjusted
0.1300			20.63% Pervious Area
0.5000			79.37% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



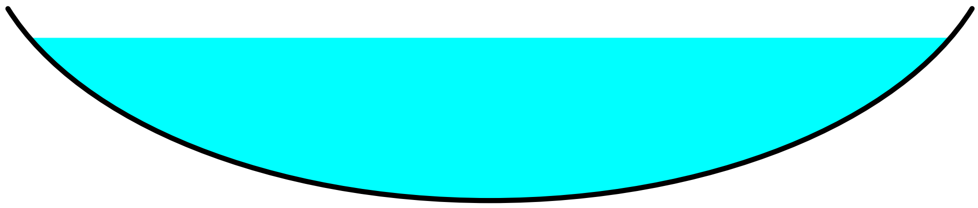
Summary for Reach 6R: Parabolic channel 600 wide, 150 deep

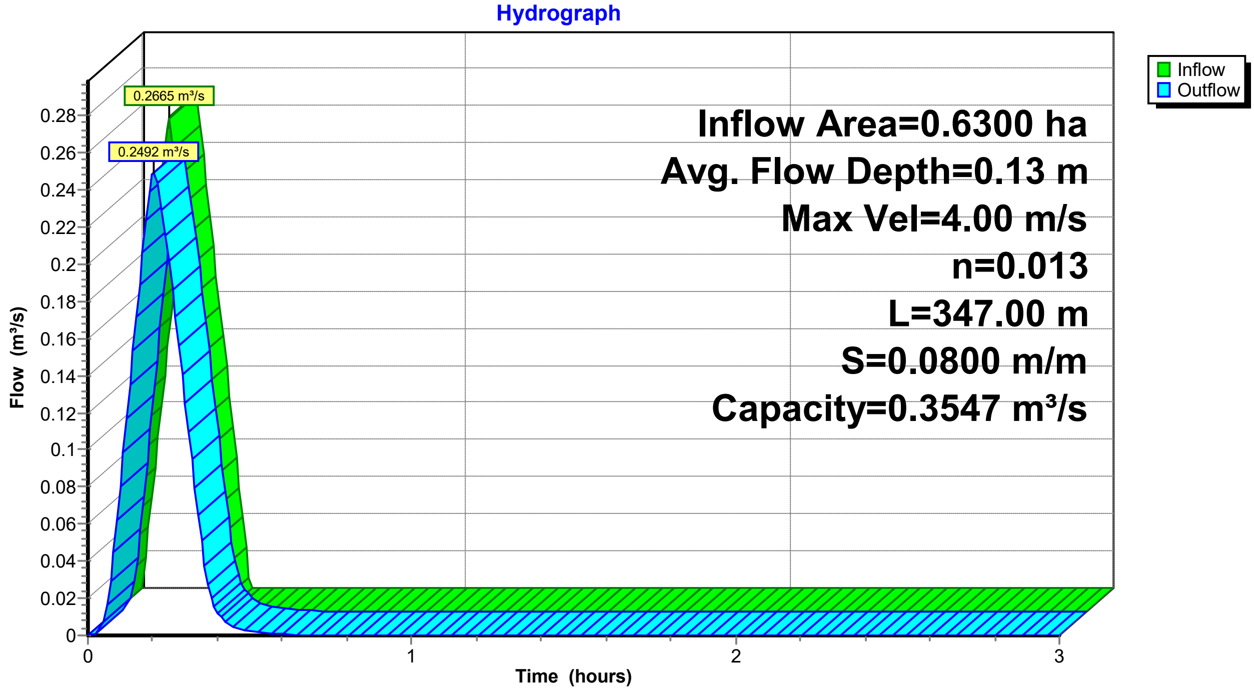
Inflow Area = 0.6300 ha, 79.37% Impervious, Inflow Depth = 26 mm for 100-Year 2031-2050 event
Inflow = 0.2665 m³/s @ 0.17 hrs, Volume= 0.163 Ml
Outflow = 0.2492 m³/s @ 0.20 hrs, Volume= 0.163 Ml, Atten= 7%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 4.00 m/s, Min. Travel Time= 1.4 min
Avg. Velocity = 1.35 m/s, Avg. Travel Time= 4.3 min

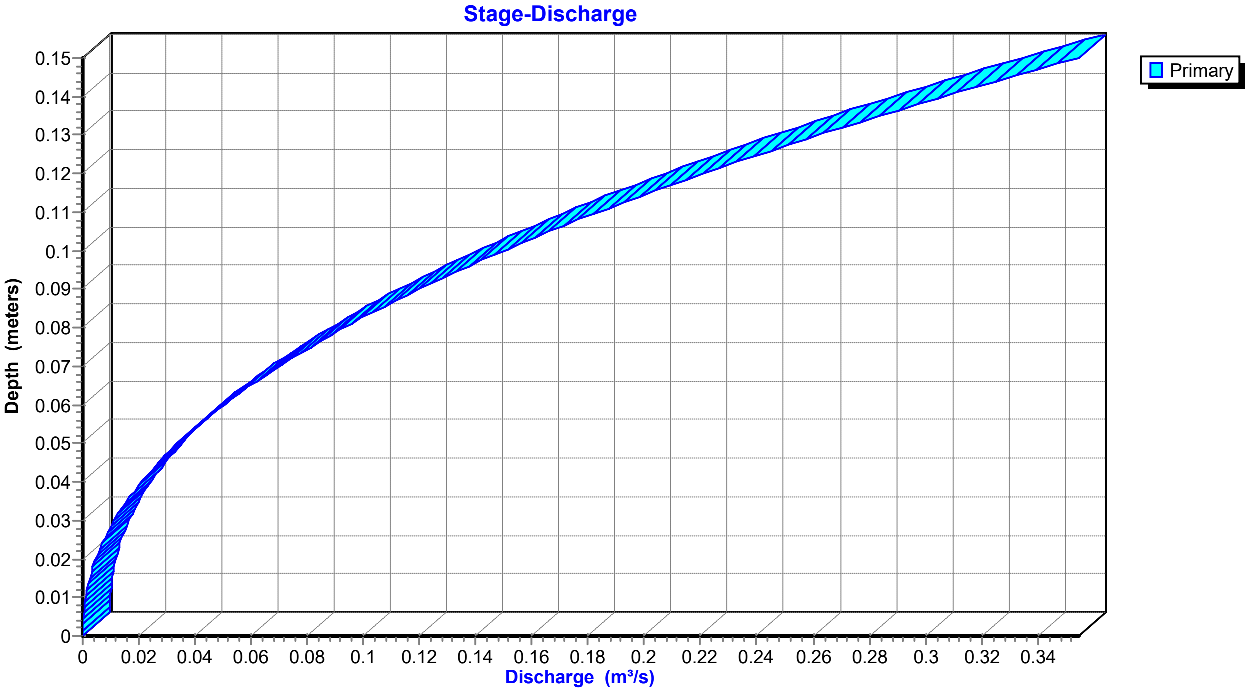
Peak Storage= 21.7 m³ @ 0.18 hrs
Average Depth at Peak Storage= 0.13 m , Surface Width= 0.74 m
Bank-Full Depth= 0.15 m Flow Area= 0.08 m², Capacity= 0.3547 m³/s

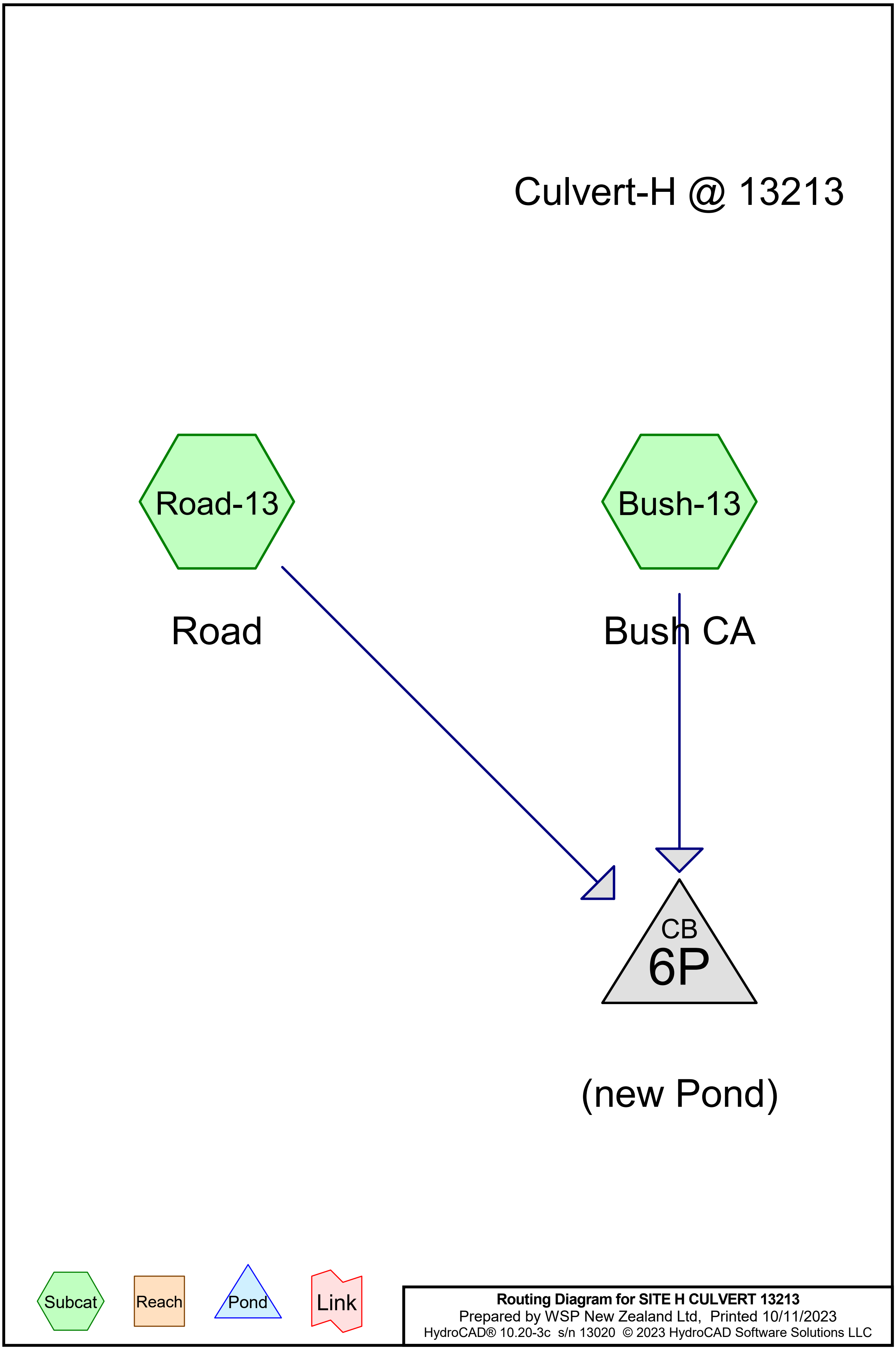
0.80 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 347.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 72.240 m





Reach 6R: Parabolic channel 600 wide, 150 deep





Routing Diagram for SITE H CULVERT 13213
Prepared by WSP New Zealand Ltd, Printed 10/11/2023

Summary for Subcatchment Bush-13: Bush CA

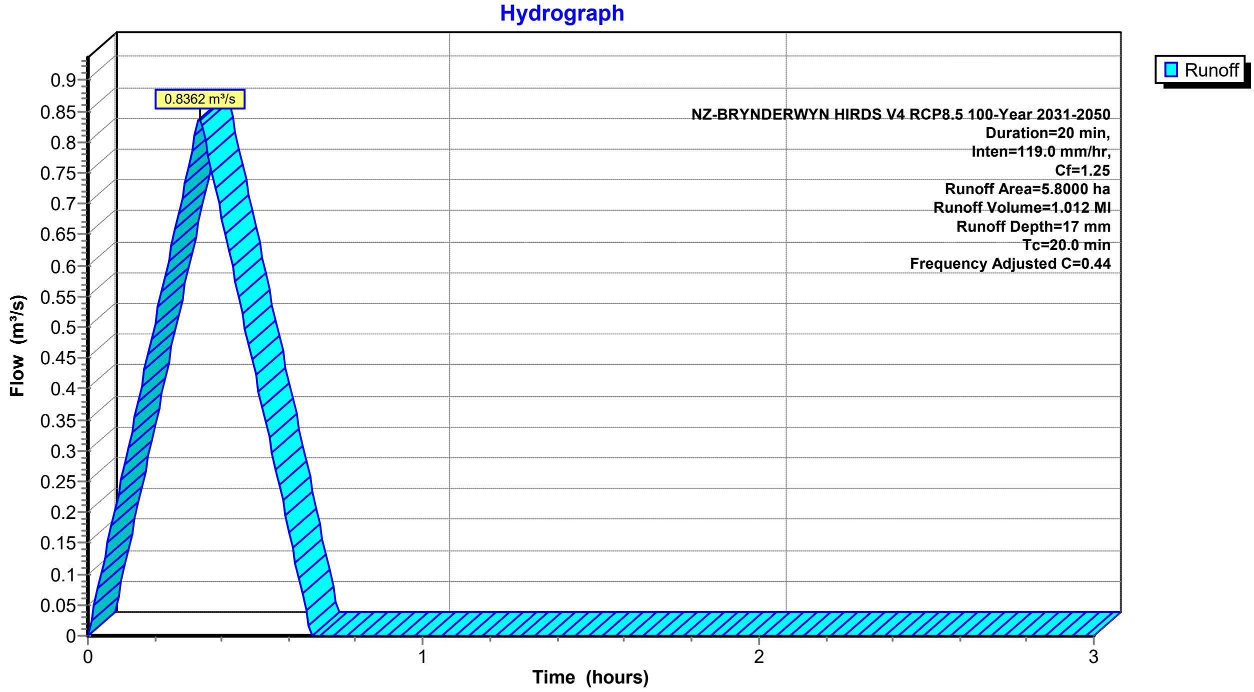
Runoff = 0.8362 m³/s @ 0.33 hrs, Volume= 1.012 Ml, Depth= 17 mm
Routed to Pond 6P : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
5.8000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
5.8000	0.35	0.44	Weighted Average, Frequency Adjusted
5.8000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry,**

Subcatchment Bush-13: Bush CA



Summary for Subcatchment Road-13: Road

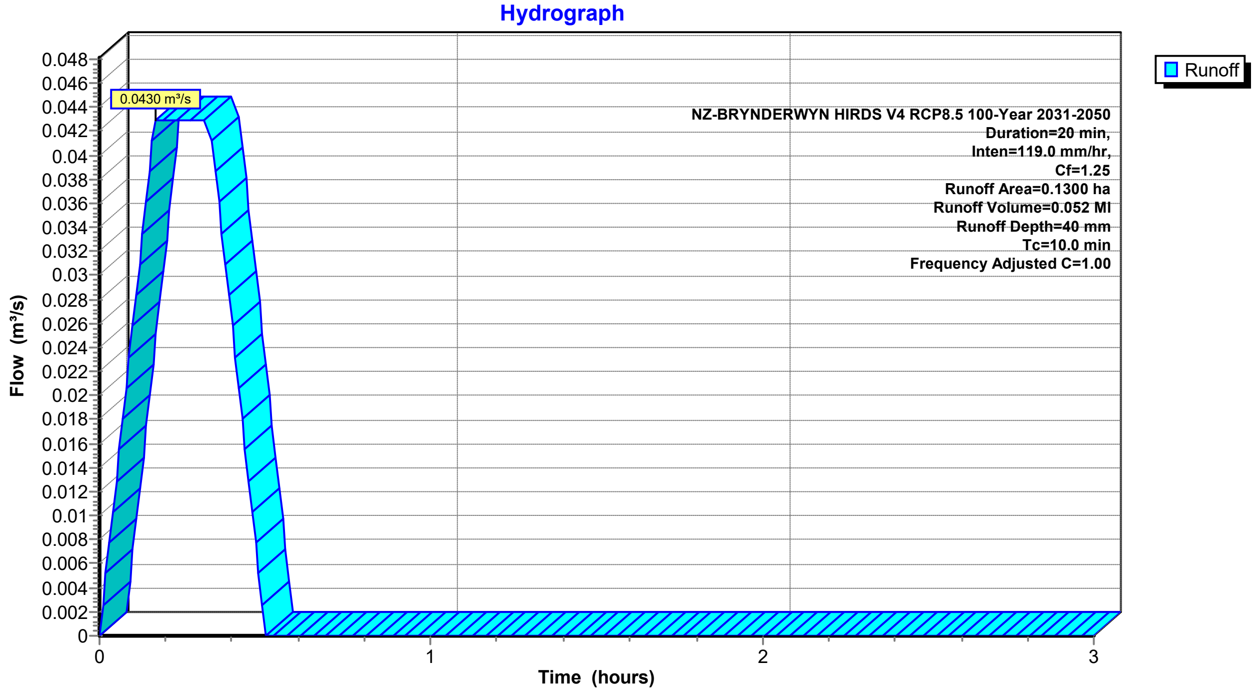
Runoff = 0.0430 m³/s @ 0.17 hrs, Volume= 0.052 Ml, Depth= 40 mm
Routed to Pond 6P : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.1300	0.95		
0.1300	0.95	1.00	Weighted Average, Frequency Adjusted
0.1300			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road-13: Road



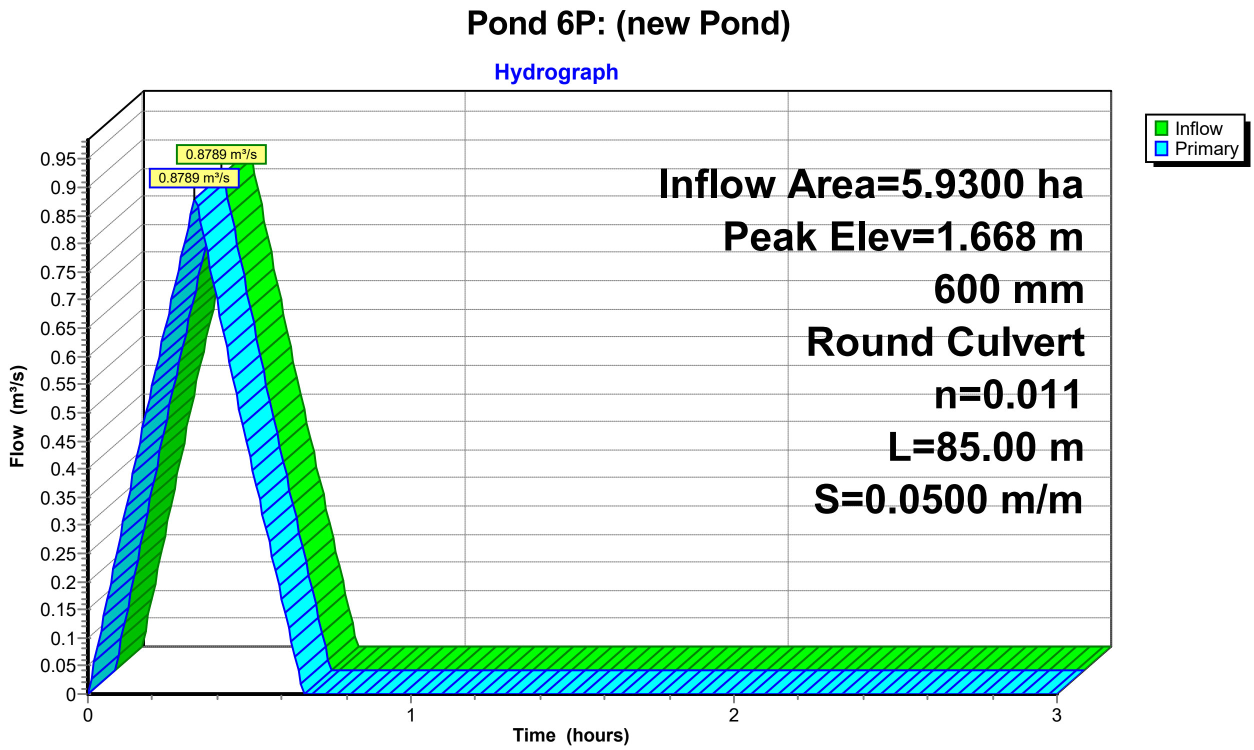
Summary for Pond 6P: (new Pond)

Inflow Area = 5.9300 ha, 2.19% Impervious, Inflow Depth = 18 mm for 100-Year 2031-2050 event
Inflow = 0.8789 m³/s @ 0.33 hrs, Volume= 1.064 Ml
Outflow = 0.8789 m³/s @ 0.33 hrs, Volume= 1.064 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.8789 m³/s @ 0.33 hrs, Volume= 1.064 Ml

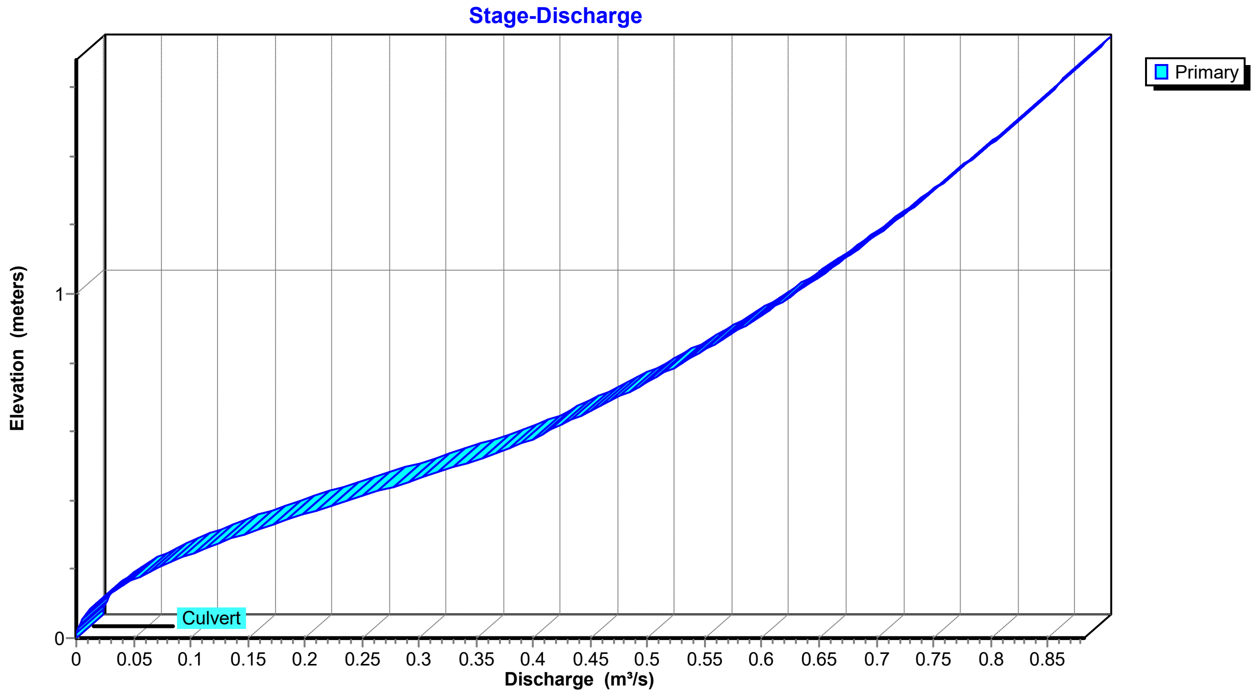
Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 1.668 m @ 0.33 hrs
Flood Elev= 1.375 m

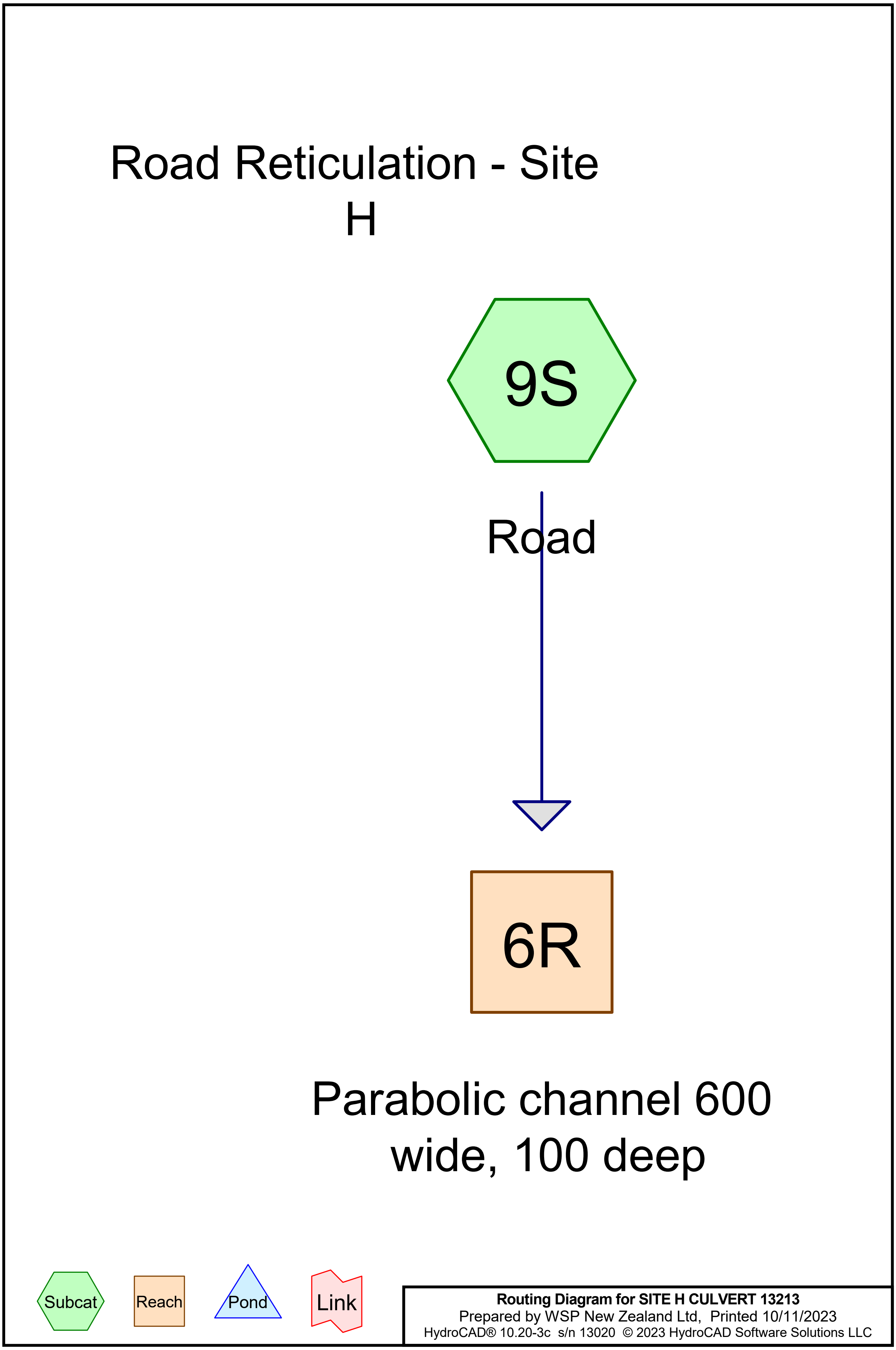
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**600 mm Round Culvert** L= 85.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -4.250 m S= 0.0500 m/m Cc= 0.900 n= 0.011, Flow Area= 0.283 m²

Primary OutFlow Max=0.8760 m³/s @ 0.33 hrs HW=1.659 m (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.8760 m³/s @ 3.10 m/s)



Pond 6P: (new Pond)




Road Reticulation - Site H
9S
Road
6R
Parabolic channel 600 wide, 100 deep
Subcat
Reach
Pond
Link
Routing Diagram for SITE H CULVERT 13213
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

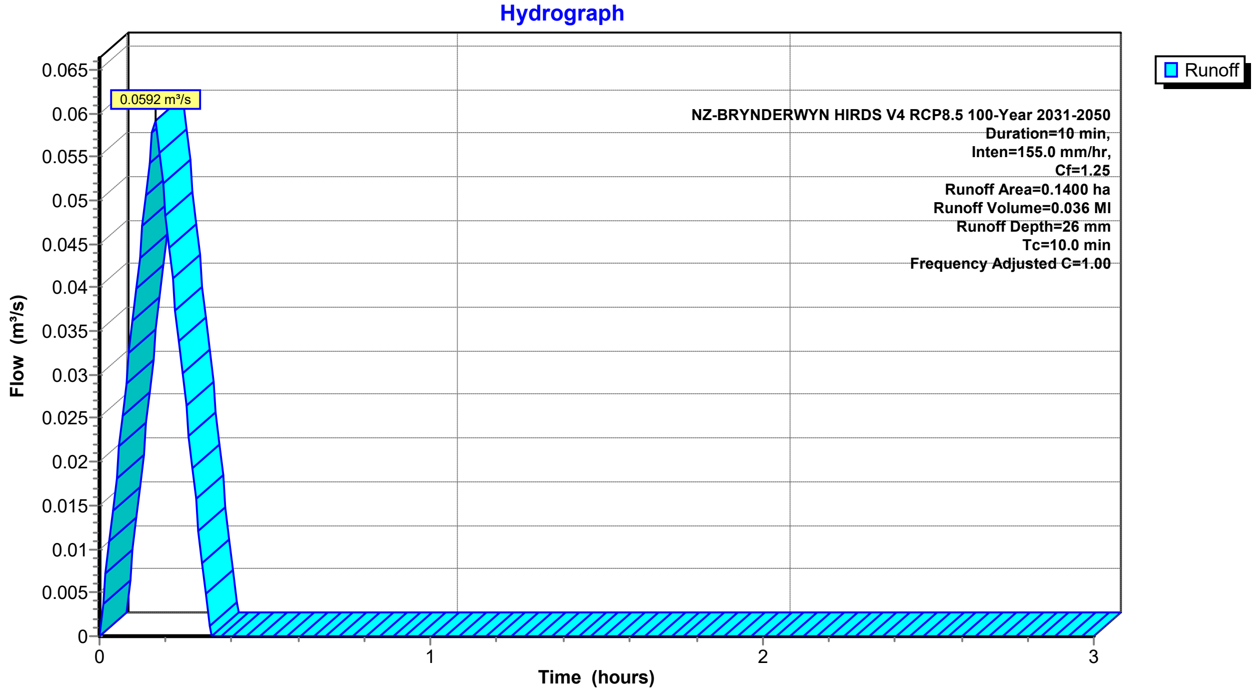
Runoff = 0.0592 m³/s @ 0.17 hrs, Volume= 0.036 Ml, Depth= 26 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.1300	0.95		road catchment
0.0100	0.35		cut face
0.1400	0.91	1.00	Weighted Average, Frequency Adjusted
0.0100			7.14% Pervious Area
0.1300			92.86% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



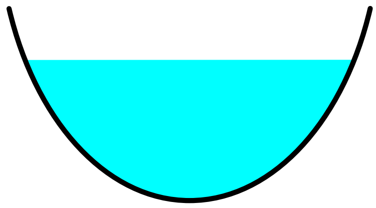
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

Inflow Area = 0.1400 ha, 92.86% Impervious, Inflow Depth = 26 mm for 100-Year 2031-2050 event
Inflow = 0.0592 m³/s @ 0.17 hrs, Volume= 0.036 Ml
Outflow = 0.0579 m³/s @ 0.18 hrs, Volume= 0.036 Ml, Atten= 2%, Lag= 0.9 min

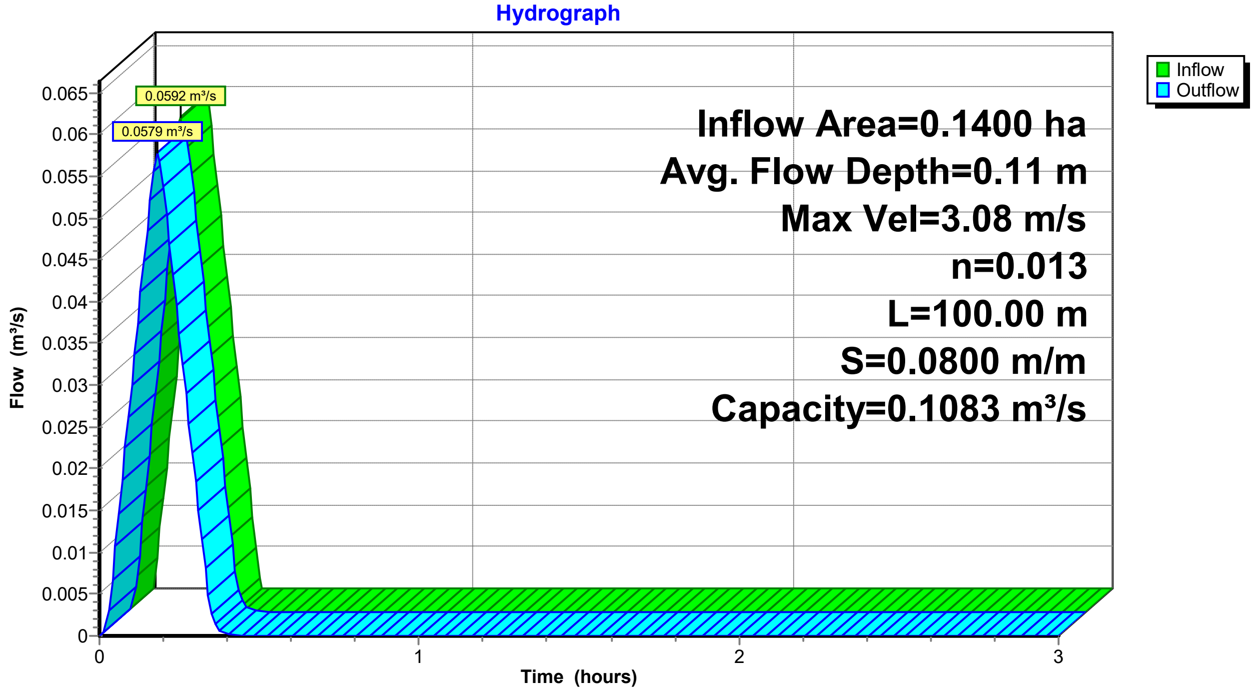
Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.08 m/s, Min. Travel Time= 0.5 min
Avg. Velocity = 1.96 m/s, Avg. Travel Time= 0.8 min

Peak Storage= 1.9 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.11 m , Surface Width= 0.26 m
Bank-Full Depth= 0.15 m Flow Area= 0.03 m², Capacity= 0.1083 m³/s

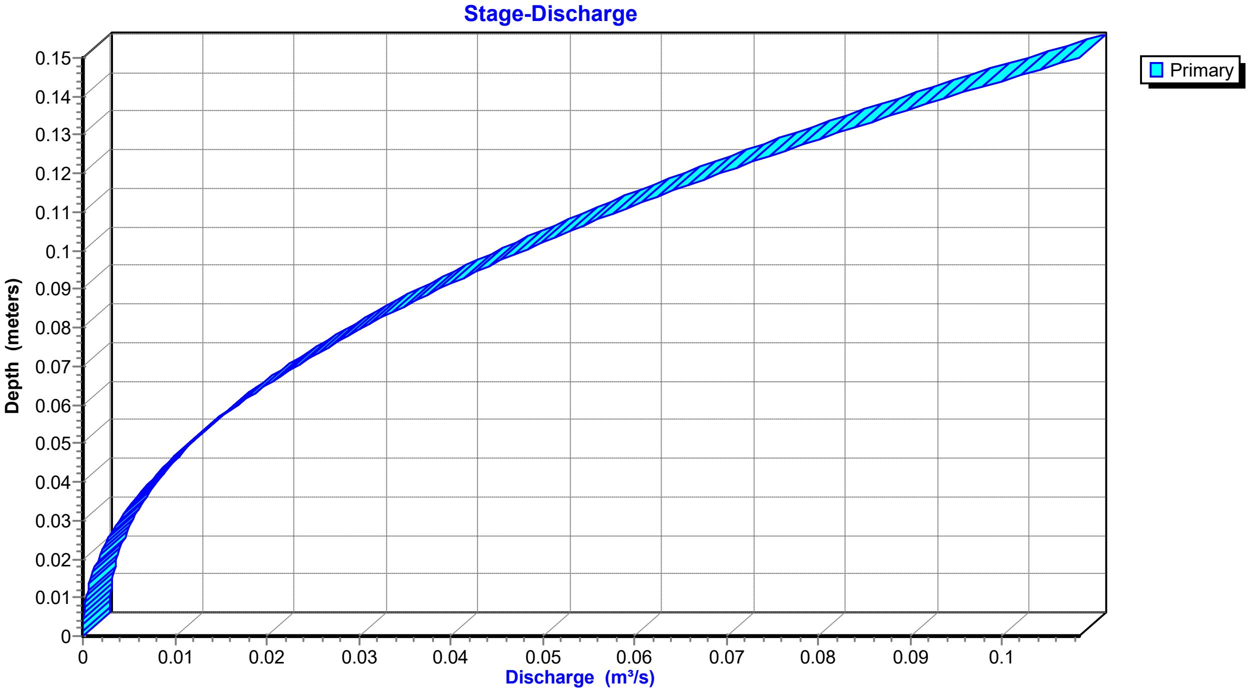
0.30 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m

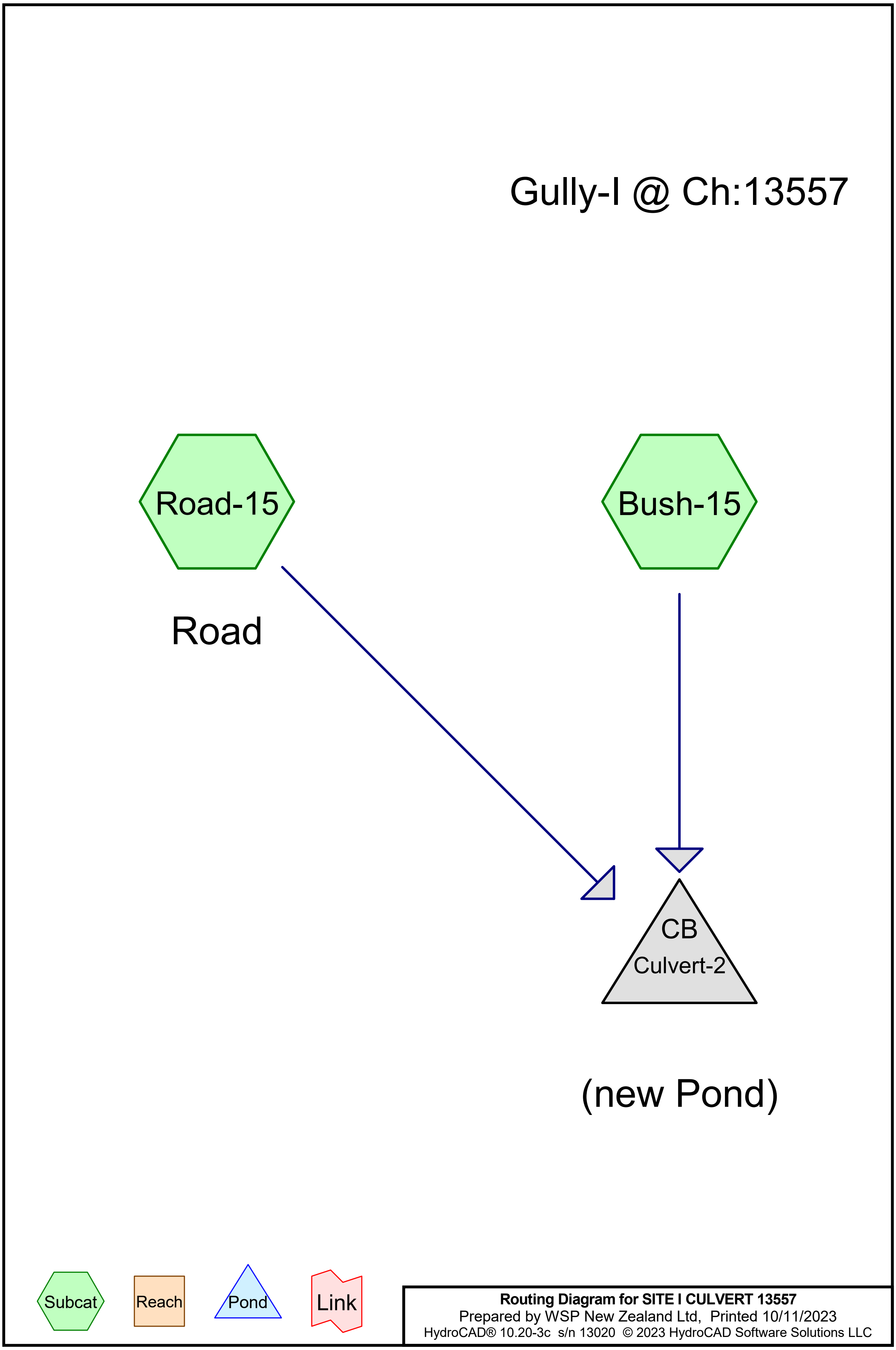


Reach 6R: Parabolic channel 600 wide, 100 deep



Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE I CULVERT 13557
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment Bush-15:

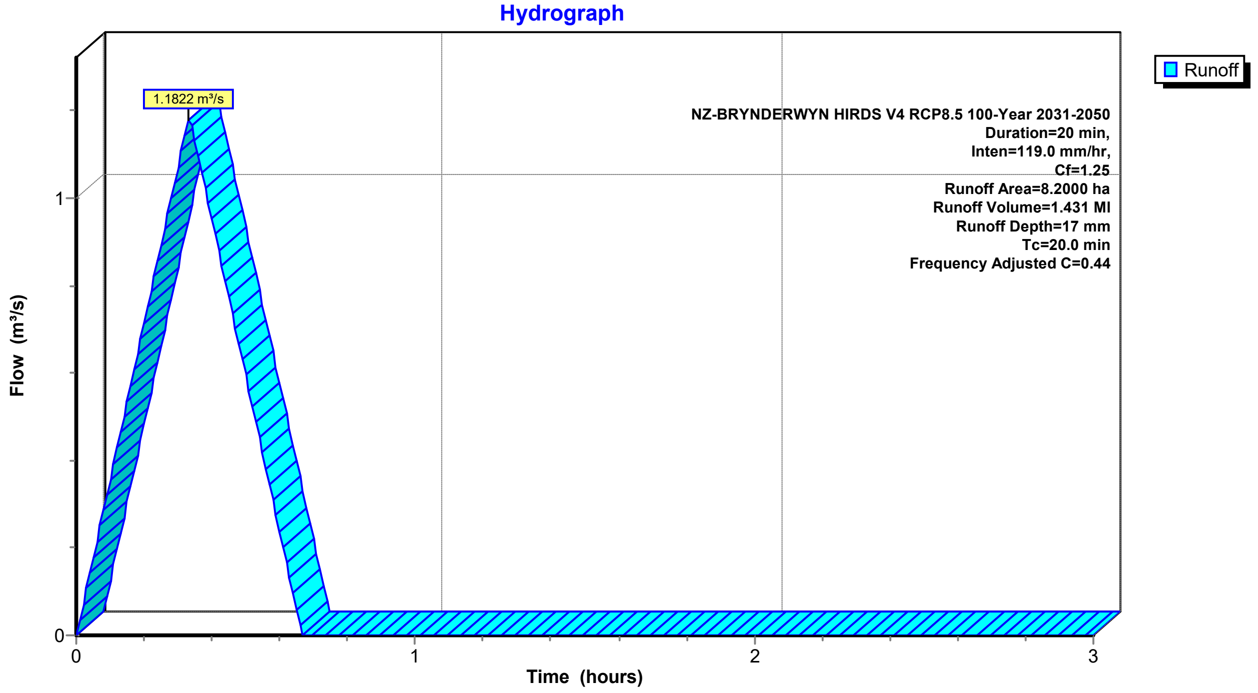
Runoff = 1.1822 m³/s @ 0.33 hrs, Volume= 1.431 Ml, Depth= 17 mm
Routed to Pond Culvert-2 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
8.2000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
8.2000	0.35	0.44	Weighted Average, Frequency Adjusted
8.2000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry, Kerby-23.5 and Kri-4.6**

Subcatchment Bush-15:



Summary for Subcatchment Road-15: Road

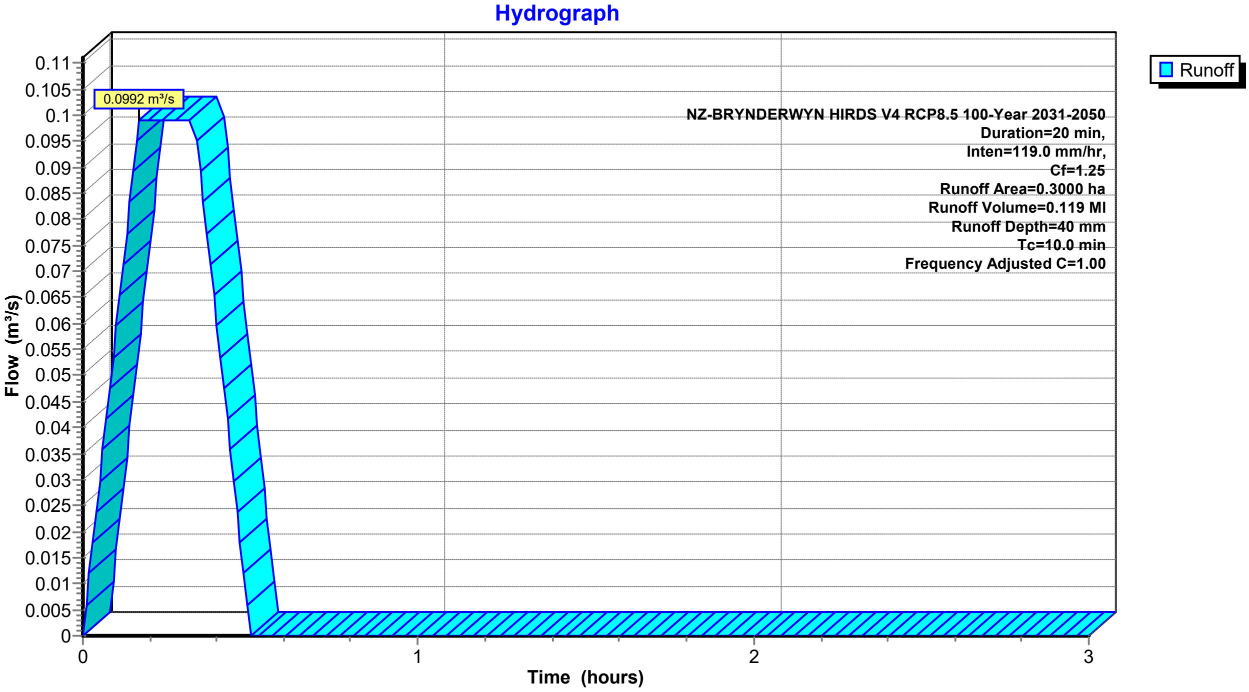
Runoff = 0.0092 m³/s @ 0.17 hrs, Volume= 0.119 Ml, Depth= 40 mm
Routed to Pond Culvert-2 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.3000	0.95		
0.3000	0.95	1.00	Weighted Average, Frequency Adjusted
0.3000			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road-15: Road



Summary for Pond Culvert-2: (new Pond)

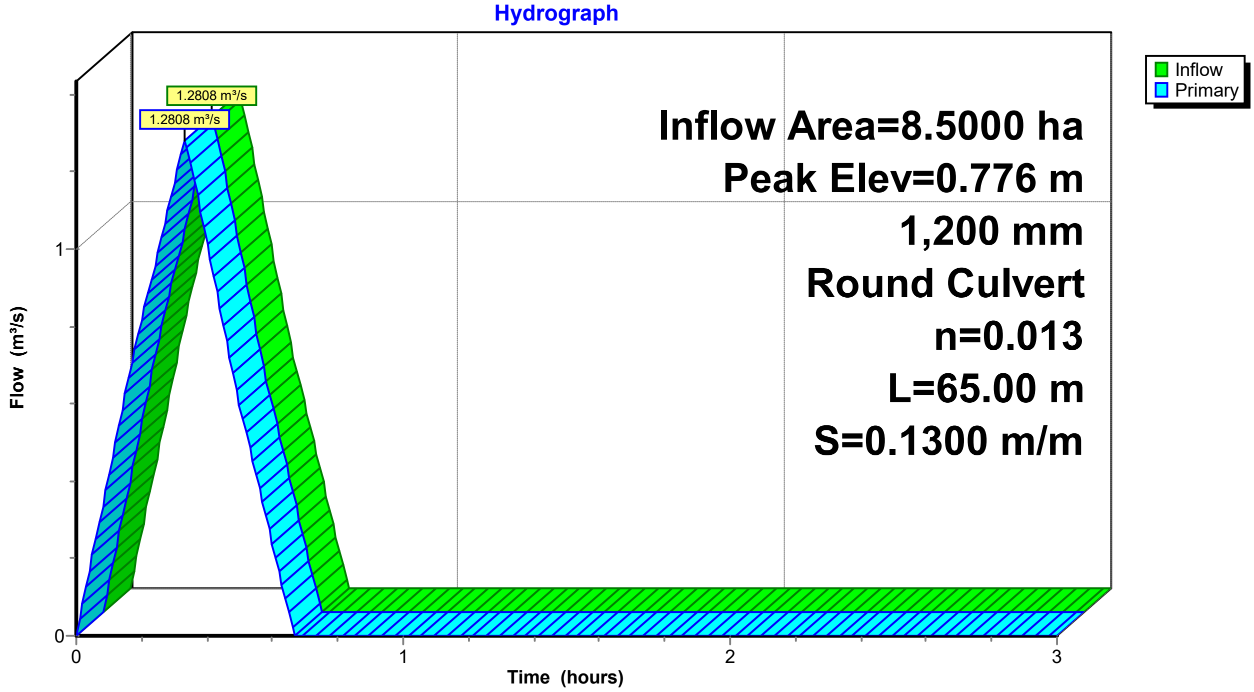
Inflow Area = 8.5000 ha, 3.53% Impervious, Inflow Depth = 18 mm for 100-Year 2031-2050 event
Inflow = 1.2808 m³/s @ 0.33 hrs, Volume= 1.550 Ml
Outflow = 1.2808 m³/s @ 0.33 hrs, Volume= 1.550 Ml, Atten= 0%, Lag= 0.0 min
Primary = 1.2808 m³/s @ 0.33 hrs, Volume= 1.550 Ml

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 0.776 m @ 0.33 hrs

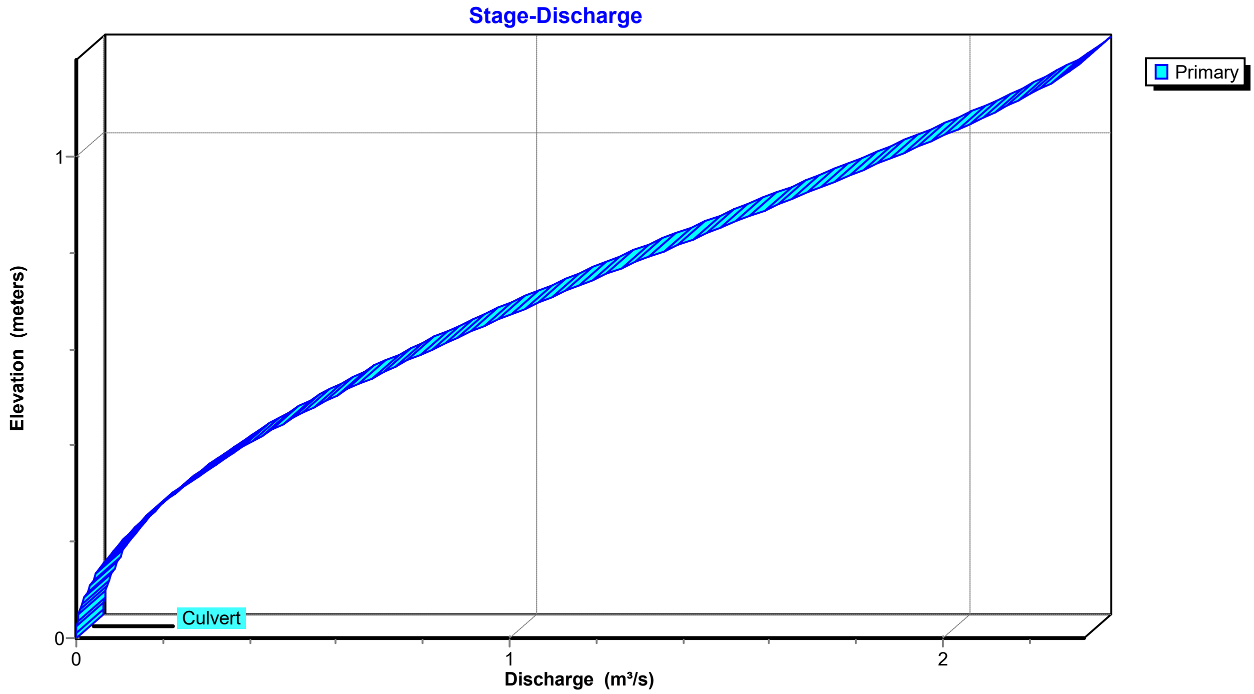
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**1,200 mm Round Culvert** L= 65.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -8.450 m S= 0.1300 m/m Cc= 0.900 n= 0.013, Flow Area= 1.131 m²

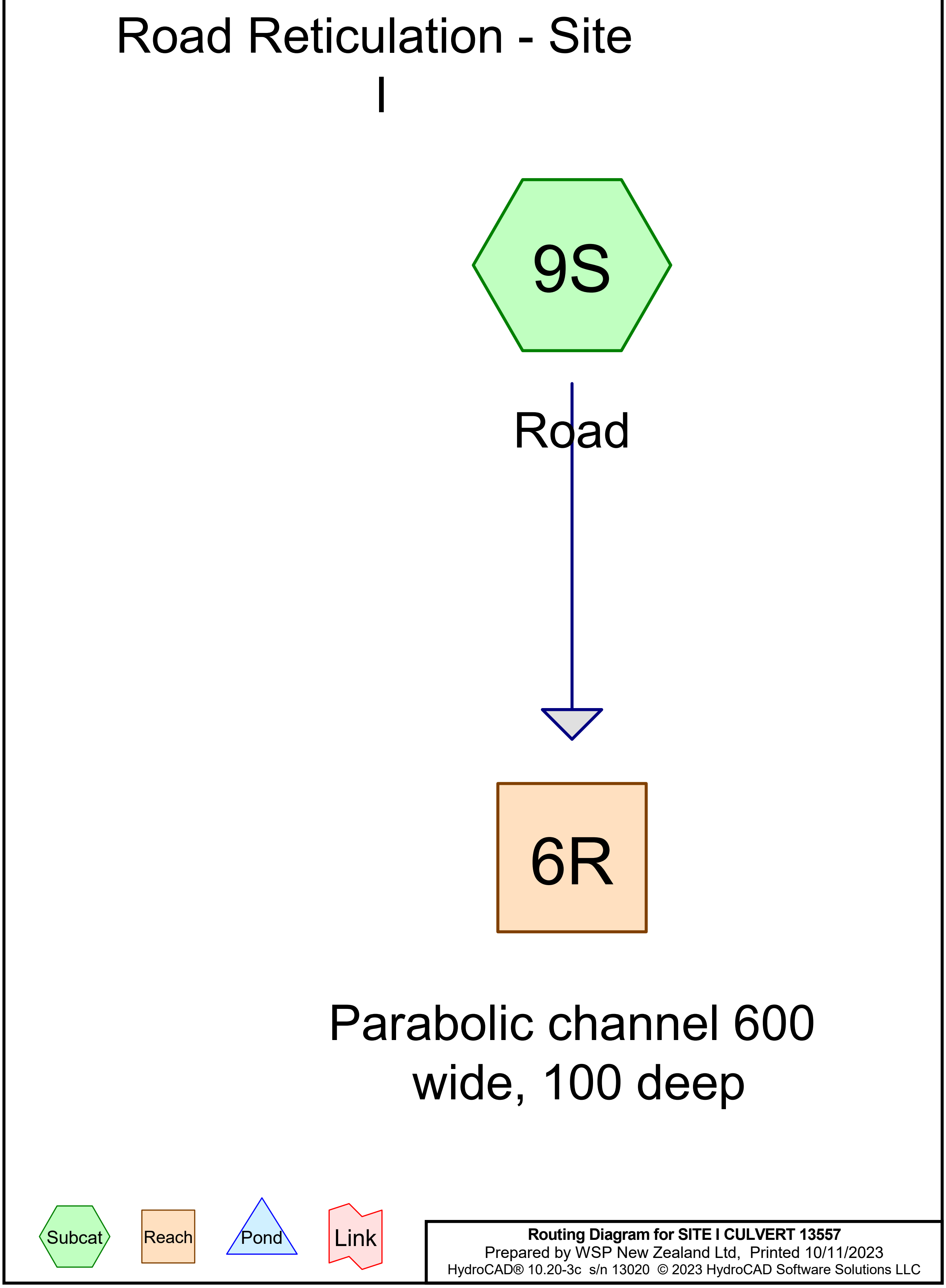
Primary OutFlow Max=1.2768 m³/s @ 0.33 hrs HW=0.775 m (Free Discharge)
└─1=Culvert (Inlet Controls 1.2768 m³/s @ 1.65 m/s)

Pond Culvert-2: (new Pond)



Pond Culvert-2: (new Pond)





Routing Diagram for SITE I CULVERT 13557
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

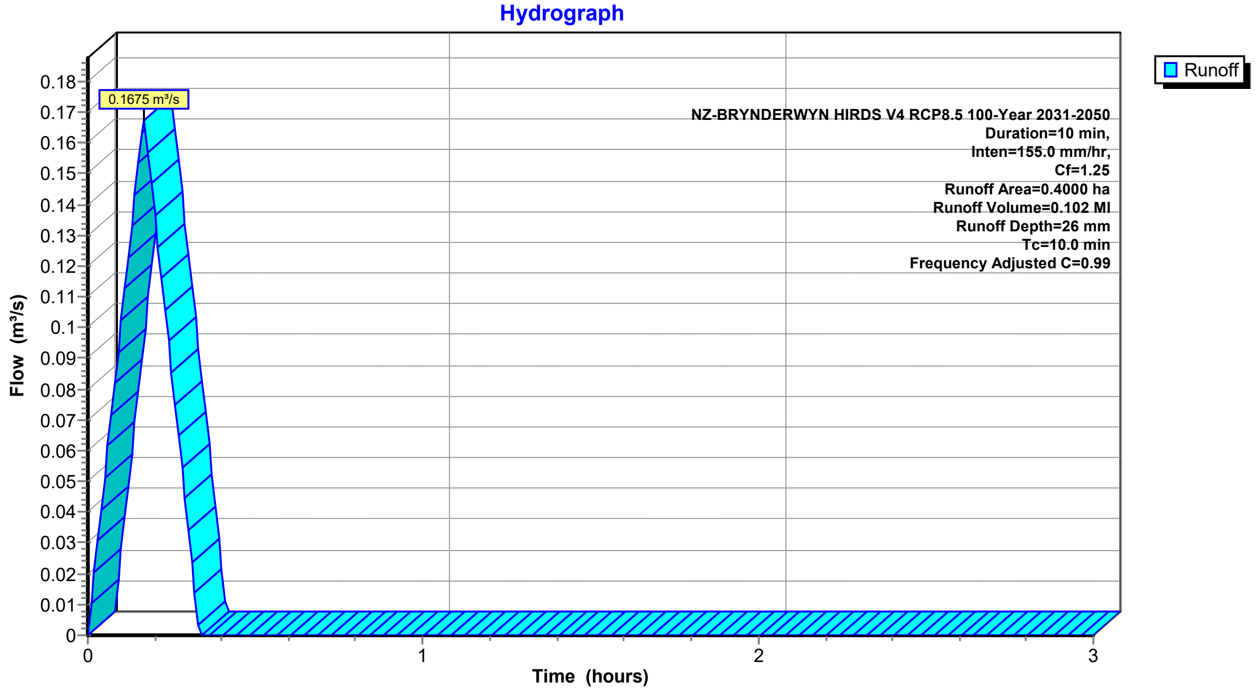
Runoff = 0.1675 m³/s @ 0.17 hrs, Volume= 0.102 Ml, Depth= 26 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.3000	0.95		road catchment
0.1000	0.30		cut face
0.4000	0.79	0.99	Weighted Average, Frequency Adjusted
0.1000			25.00% Pervious Area
0.3000			75.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



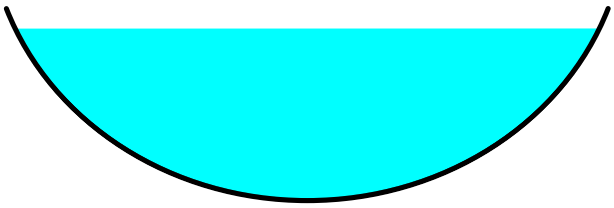
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

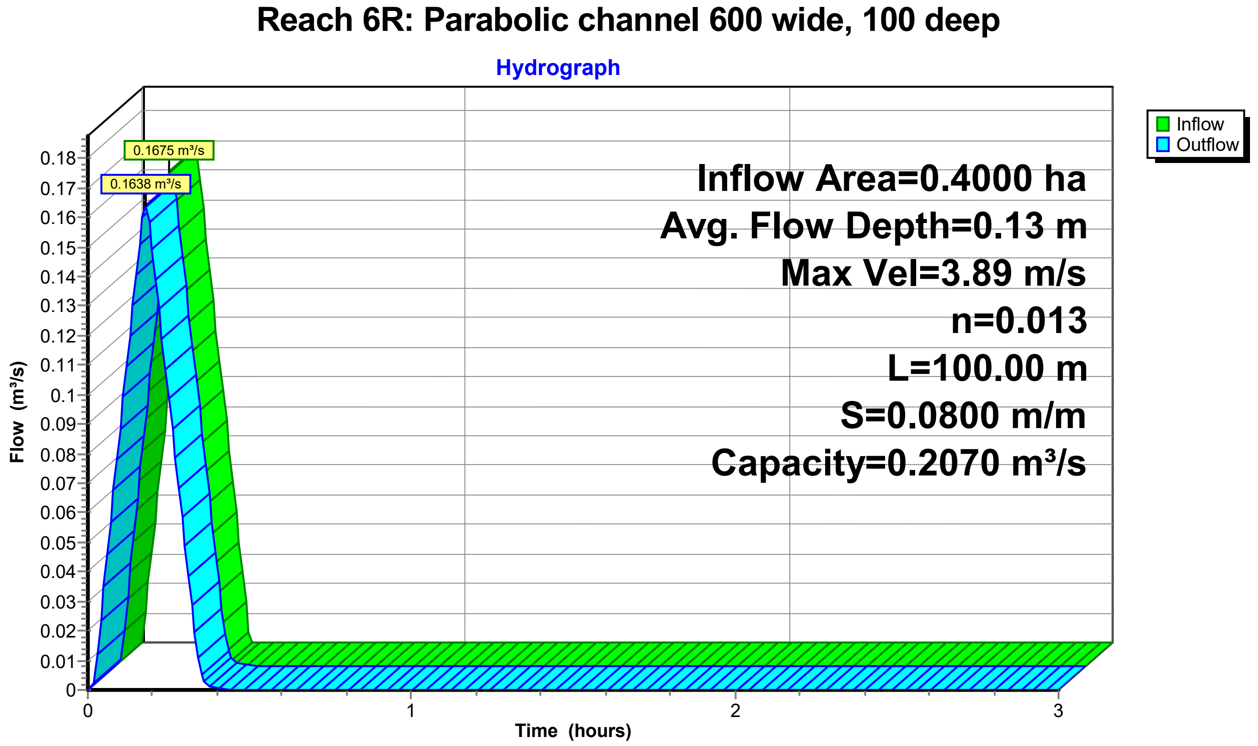
Inflow Area = 0.4000 ha, 75.00% Impervious, Inflow Depth = 26 mm for 100-Year 2031-2050 event
Inflow = 0.1675 m³/s @ 0.17 hrs, Volume= 0.102 Ml
Outflow = 0.1638 m³/s @ 0.18 hrs, Volume= 0.102 Ml, Atten= 2%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.89 m/s, Min. Travel Time= 0.4 min
Avg. Velocity = 2.24 m/s, Avg. Travel Time= 0.7 min

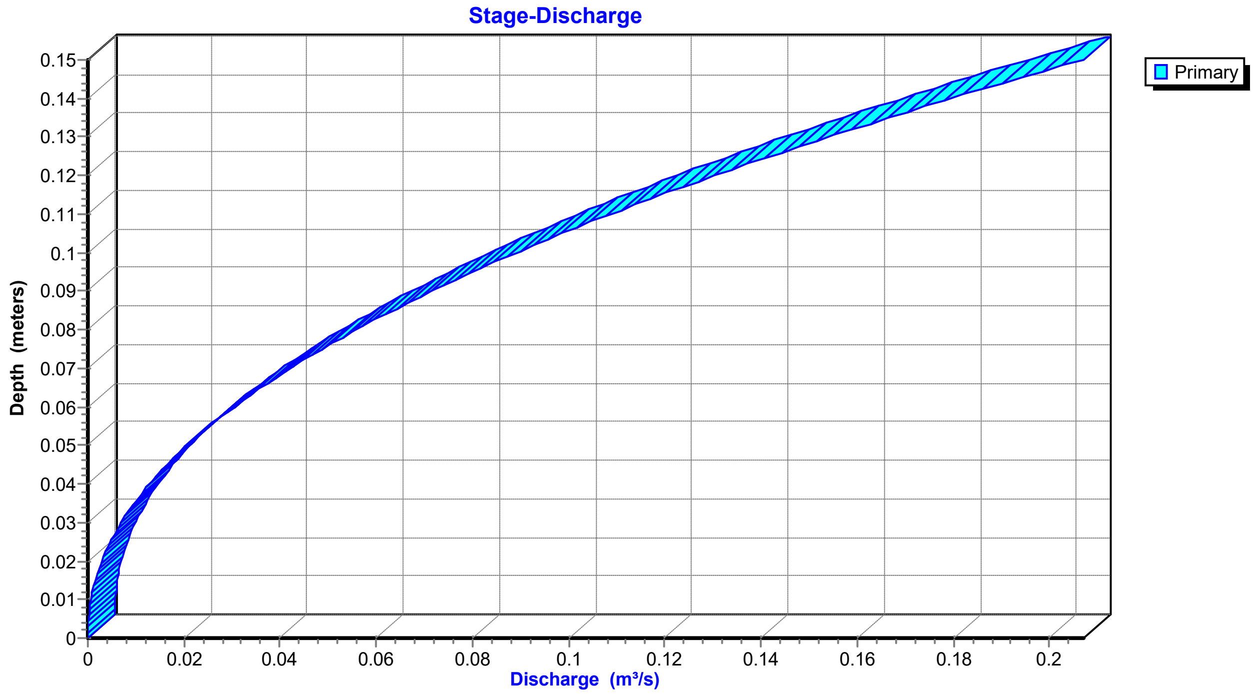
Peak Storage= 4.2 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.13 m , Surface Width= 0.47 m
Bank-Full Depth= 0.15 m Flow Area= 0.05 m², Capacity= 0.2070 m³/s

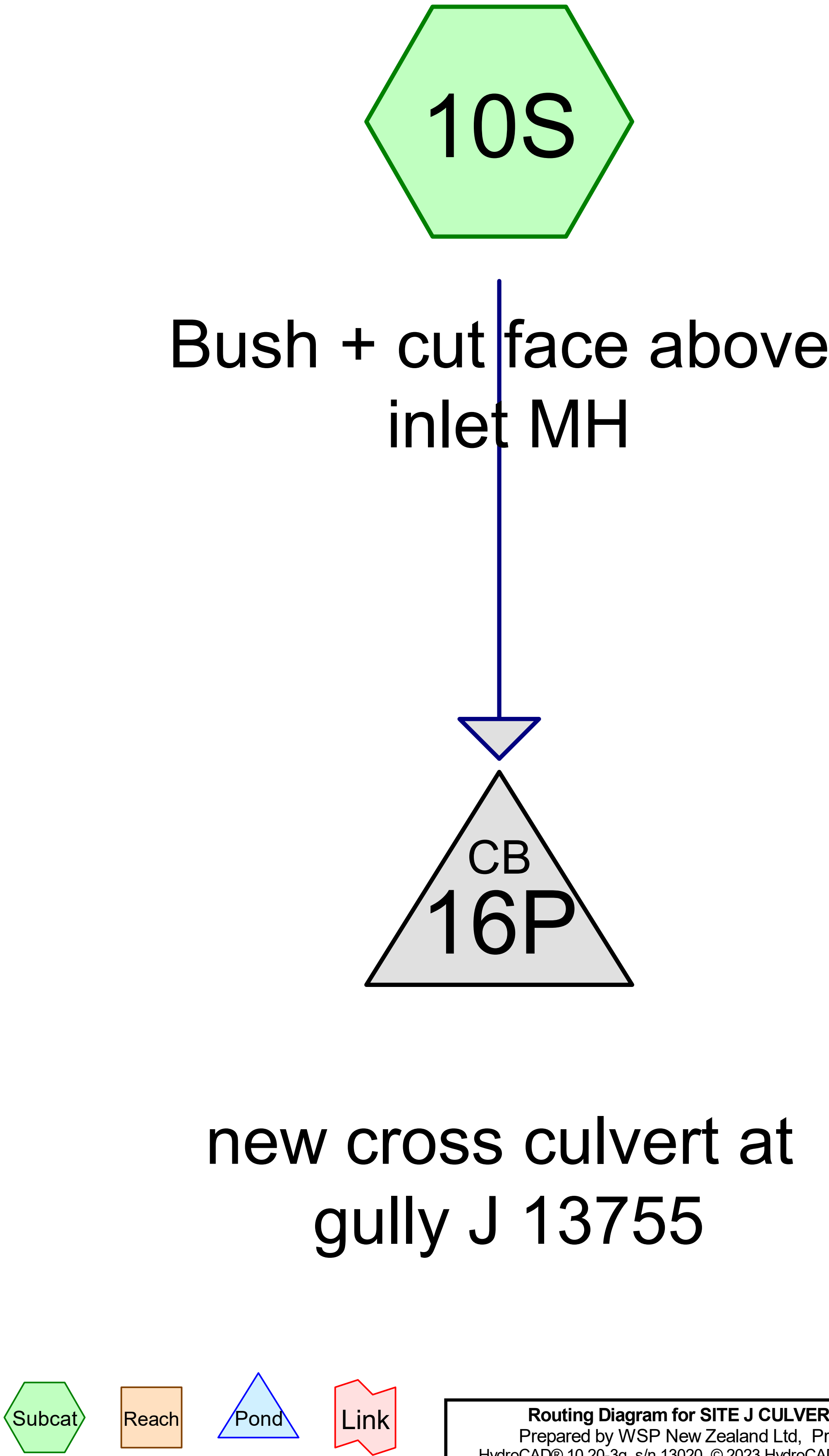
0.50 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m





Reach 6R: Parabolic channel 600 wide, 100 deep





Routing Diagram for SITE J CULVERT (the last one)
Prepared by WSP New Zealand Ltd, Printed 20/06/2024
HydroCAD® 10.20-3g s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 10S: Bush + cut face above inlet MH

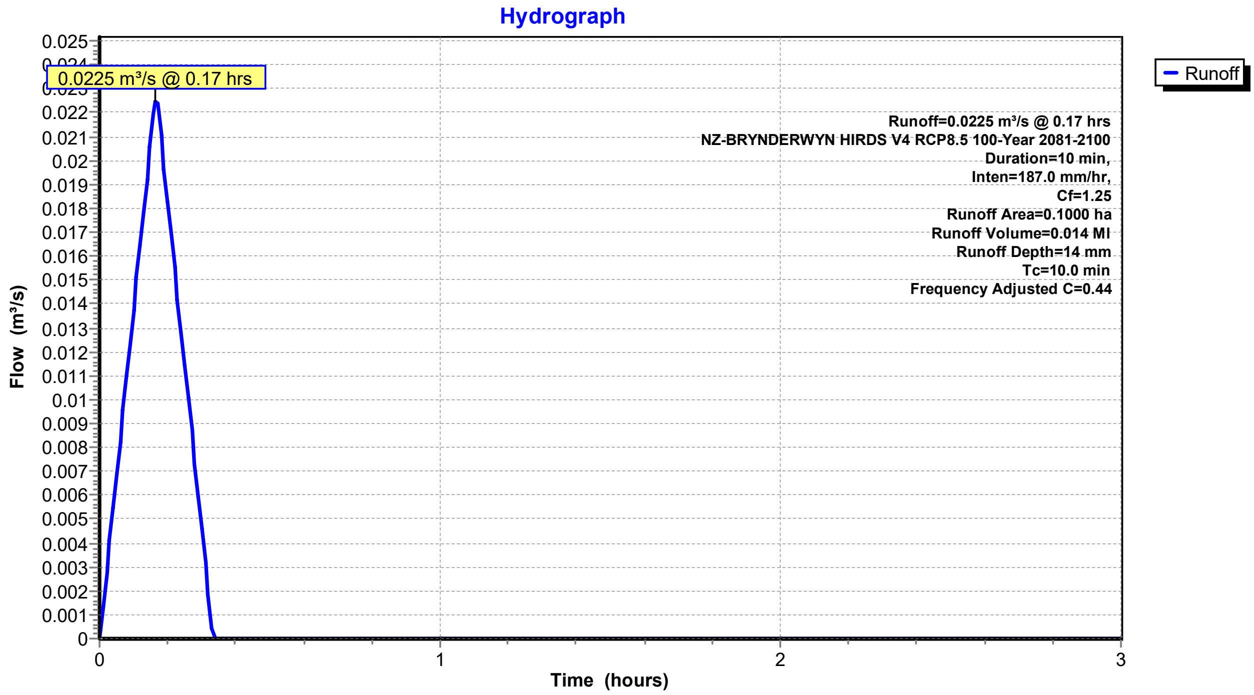
Runoff = 0.0225 m³/s @ 0.17 hrs, Volume= 0.014 Ml, Depth= 14 mm
Routed to Pond 16P : new cross culvert at gully J 13755

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2081-2100 Duration=10 min, Inten=187.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.1000	0.35		bush + cut face
0.1000	0.35	0.44	Weighted Average, Frequency Adjusted
0.1000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 10S: Bush + cut face above inlet MH



Summary for Pond 16P: new cross culvert at gully J 13755

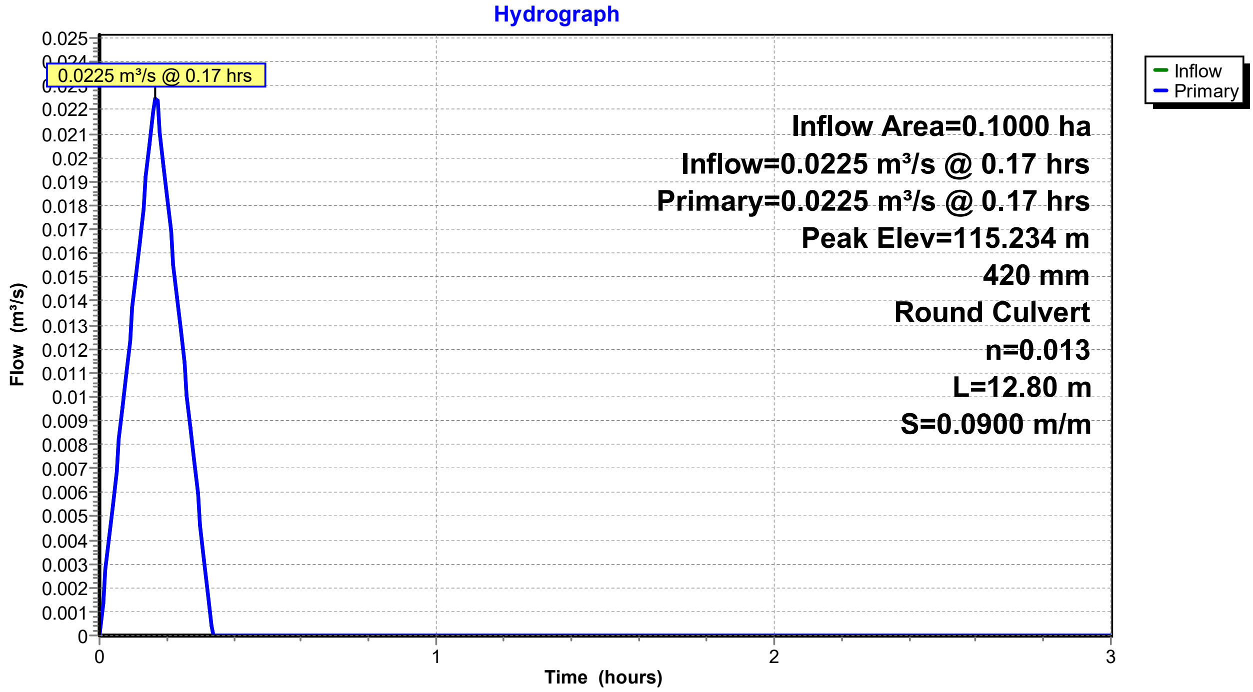
Inflow Area =	0.1000 ha,	0.00% Impervious, Inflow Depth =	14 mm	for 100-Year 2081-2100 event
Inflow =	0.0225 m³/s @	0.17 hrs, Volume=	0.014 Ml	
Outflow =	0.0225 m³/s @	0.17 hrs, Volume=	0.014 Ml, Atten= 0%, Lag= 0.0 min	
Primary =	0.0225 m³/s @	0.17 hrs, Volume=	0.014 Ml	

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 115.234 m @ 0.17 hrs

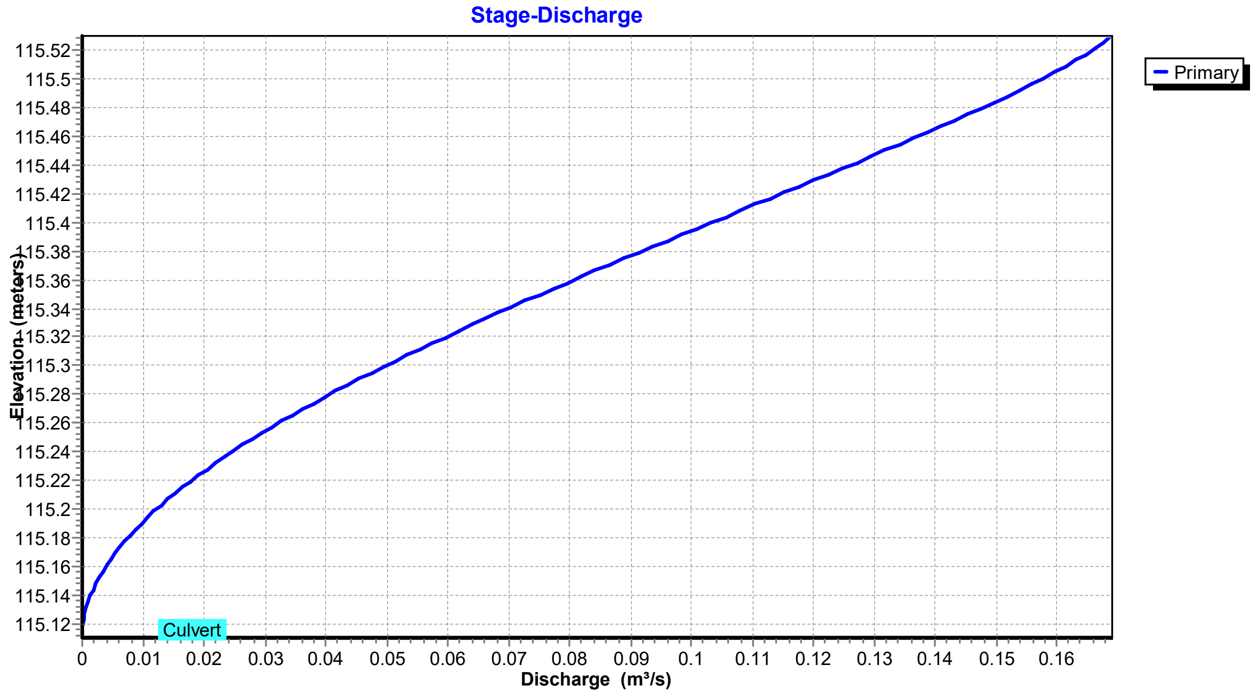
Device	Routing	Invert	Outlet Devices
#1	Primary	115.110 m	**420 mm Round Culvert** L= 12.80 m Ke= 0.500 Inlet / Outlet Invert= 115.110 m / 113.958 m S= 0.0900 m/m Cc= 0.900 n= 0.013, Flow Area= 0.139 m²

Primary OutFlow Max=0.0223 m³/s @ 0.17 hrs HW=115.233 m (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.0223 m³/s @ 0.66 m/s)

Pond 16P: new cross culvert at gully J 13755



Pond 16P: new cross culvert at gully J 13755



Summary for Subcatchment 10S: Bush + cut face above inlet MH

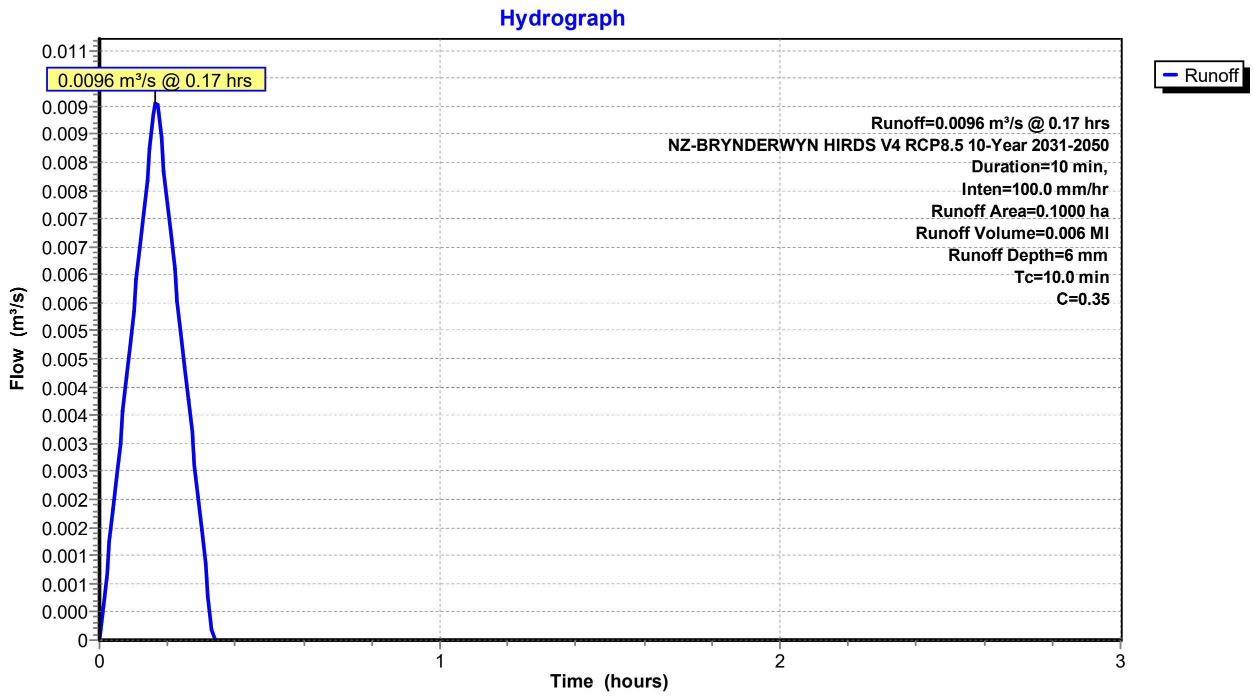
Runoff = 0.0096 m³/s @ 0.17 hrs, Volume= 0.006 Ml, Depth= 6 mm
Routed to Pond 16P : new cross culvert at gully J 13755

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 10-Year 2031-2050 Duration=10 min, Inten=100.0 mm/hr

Area (ha)	C	Description
0.1000	0.35	bush + cut face
0.1000		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 10S: Bush + cut face above inlet MH



Summary for Pond 16P: new cross culvert at gully J 13755

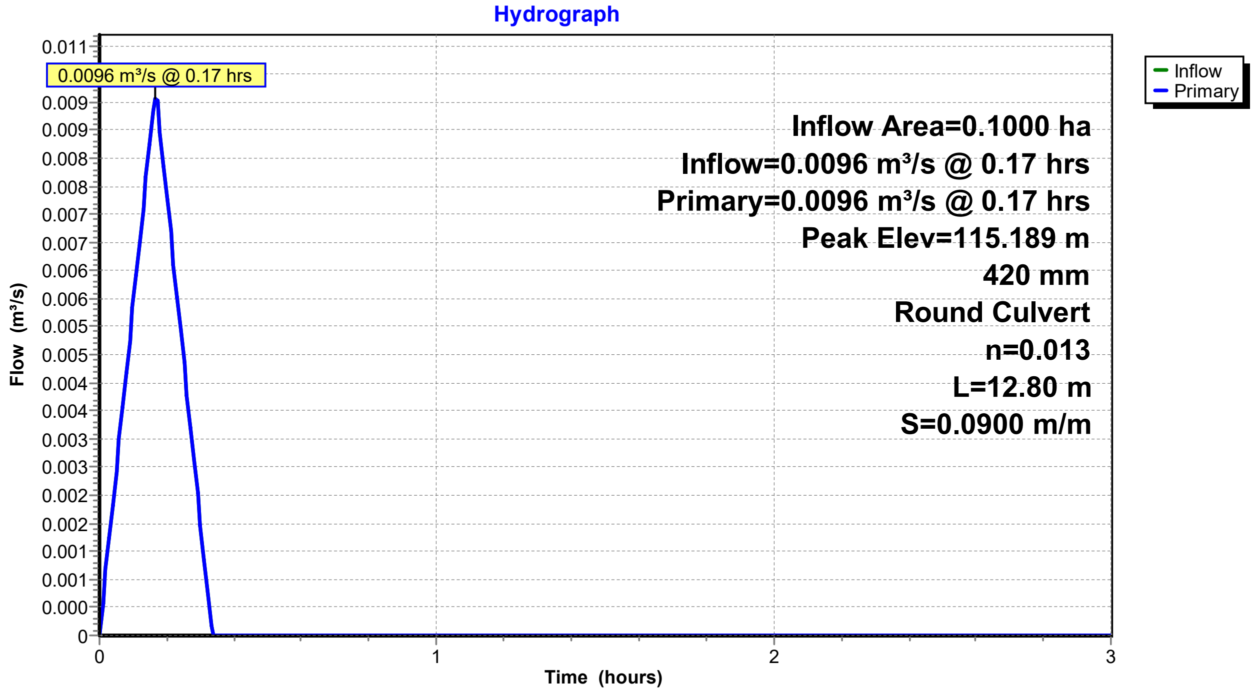
Inflow Area = 0.1000 ha, 0.00% Impervious, Inflow Depth = 6 mm for 10-Year 2031-2050 event
Inflow = 0.0096 m³/s @ 0.17 hrs, Volume= 0.006 Ml
Outflow = 0.0096 m³/s @ 0.17 hrs, Volume= 0.006 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.0096 m³/s @ 0.17 hrs, Volume= 0.006 Ml

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 115.189 m @ 0.17 hrs

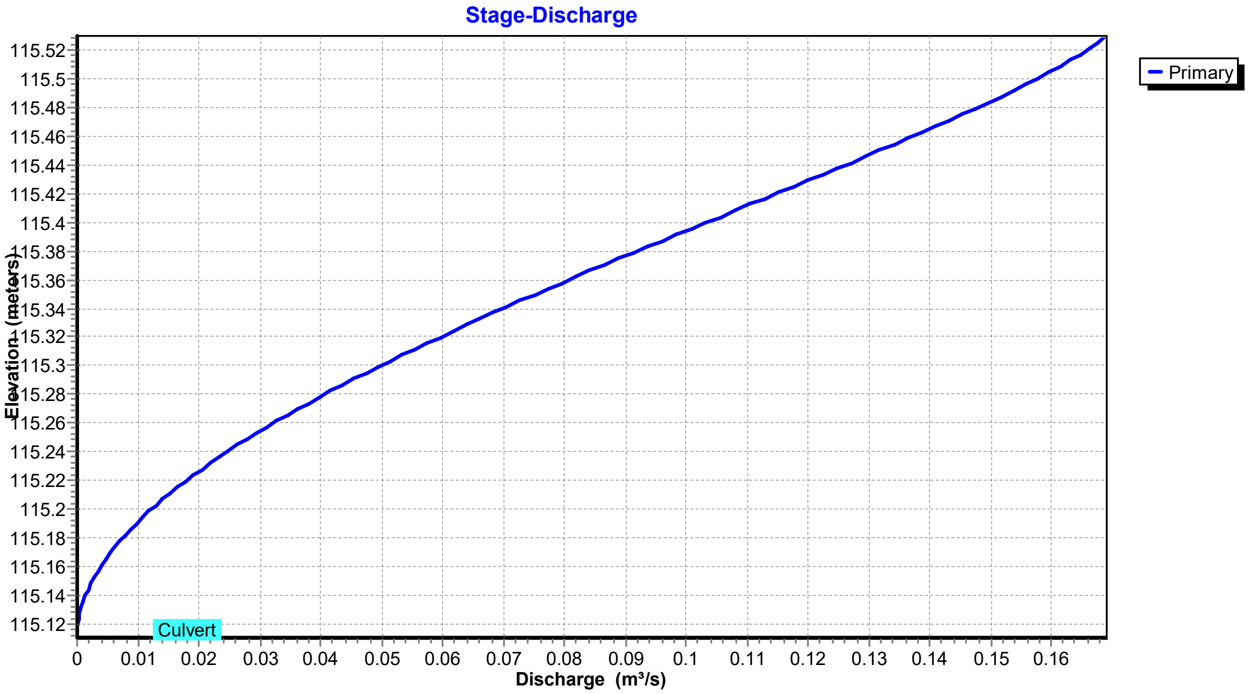
Device	Routing	Invert	Outlet Devices
#1	Primary	115.110 m	**420 mm Round Culvert** L= 12.80 m Ke= 0.500 Inlet / Outlet Invert= 115.110 m / 113.958 m S= 0.0900 m/m Cc= 0.900 n= 0.013, Flow Area= 0.139 m²

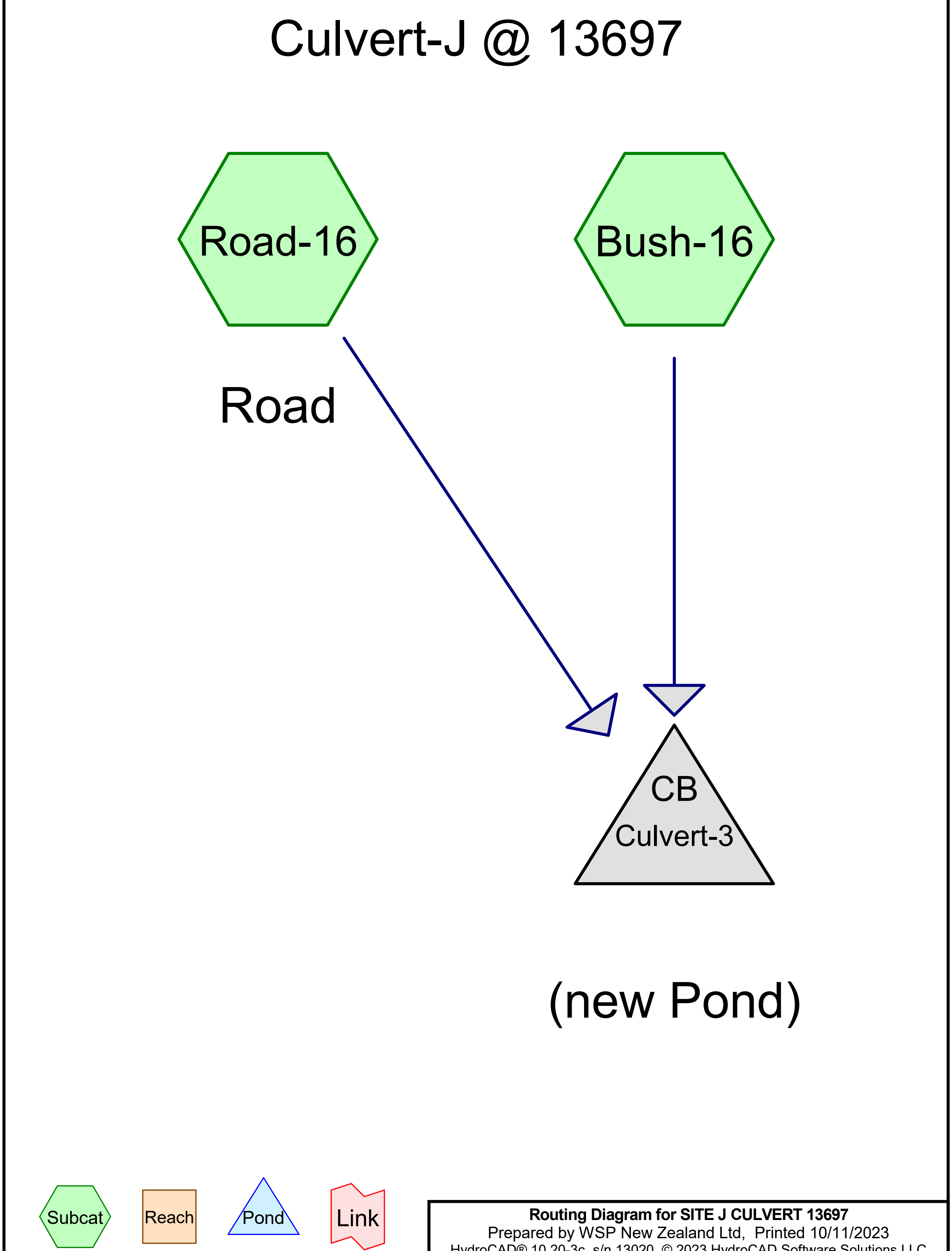
Primary OutFlow Max=0.0095 m³/s @ 0.17 hrs HW=115.189 m (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.0095 m³/s @ 0.53 m/s)

Pond 16P: new cross culvert at gully J 13755



Pond 16P: new cross culvert at gully J 13755





Routing Diagram for SITE J CULVERT 13697
Prepared by WSP New Zealand Ltd, Printed 10/11/2023

Summary for Subcatchment Bush-16:

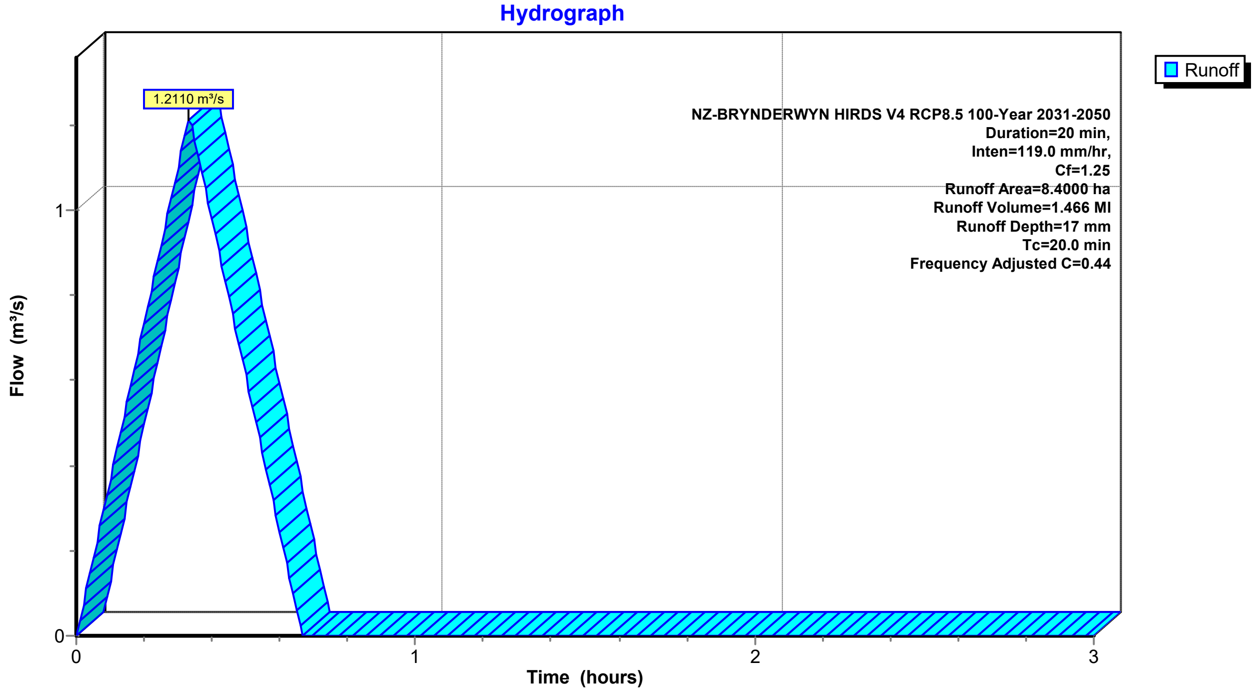
Runoff = 1.2110 m³/s @ 0.33 hrs, Volume= 1.466 Ml, Depth= 17 mm
Routed to Pond Culvert-3 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
8.4000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
8.4000	0.35	0.44	Weighted Average, Frequency Adjusted
8.4000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry, ker-23.3, kir-4.5**

Subcatchment Bush-16:



Summary for Subcatchment Road-16: Road

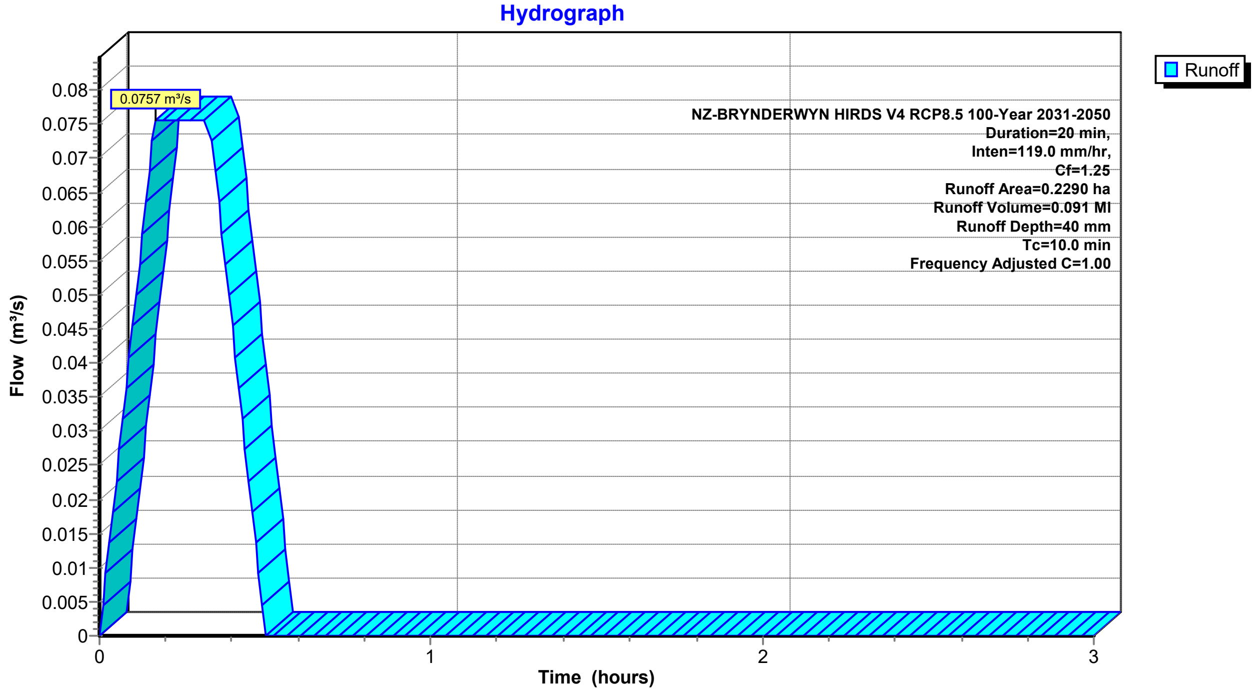
Runoff = 0.0757 m³/s @ 0.17 hrs, Volume= 0.091 Ml, Depth= 40 mm
Routed to Pond Culvert-3 : (new Pond)

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.2290	0.95		
0.2290	0.95	1.00	Weighted Average, Frequency Adjusted
0.2290			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment Road-16: Road



Summary for Pond Culvert-3: (new Pond)

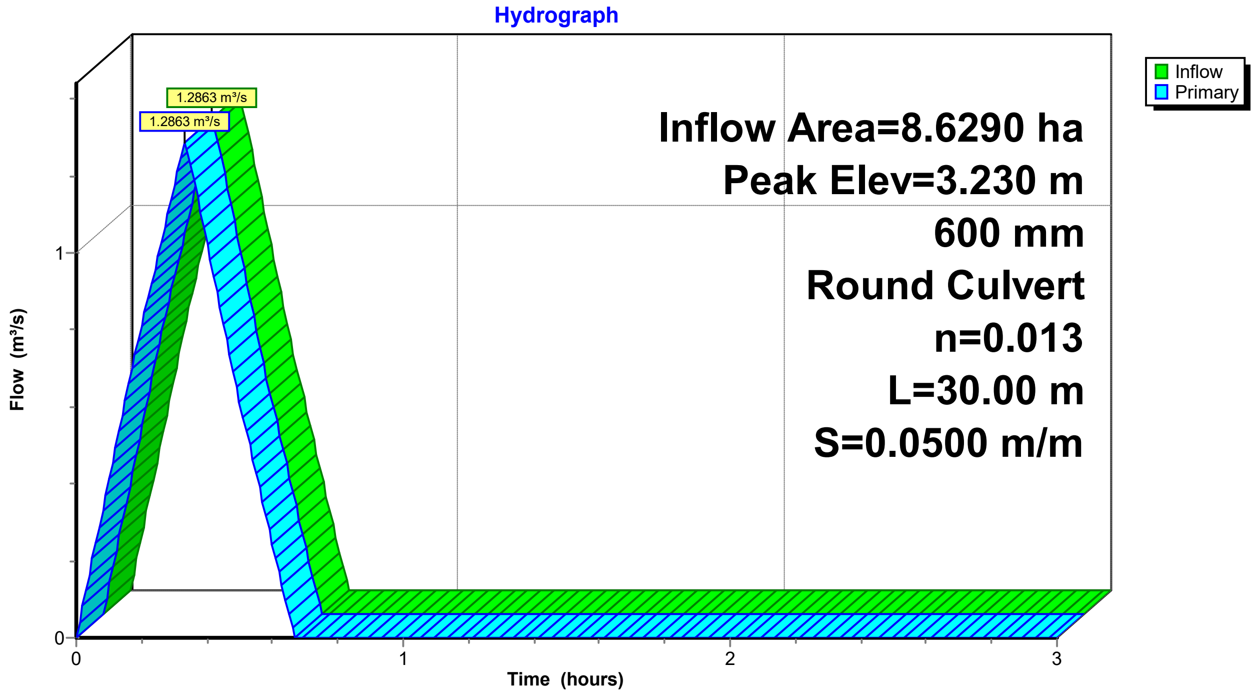
Inflow Area = 8.6290 ha, 2.65% Impervious, Inflow Depth = 18 mm for 100-Year 2031-2050 event
Inflow = 1.2863 m³/s @ 0.33 hrs, Volume= 1.557 Ml
Outflow = 1.2863 m³/s @ 0.33 hrs, Volume= 1.557 Ml, Atten= 0%, Lag= 0.0 min
Primary = 1.2863 m³/s @ 0.33 hrs, Volume= 1.557 Ml

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 3.230 m @ 0.33 hrs

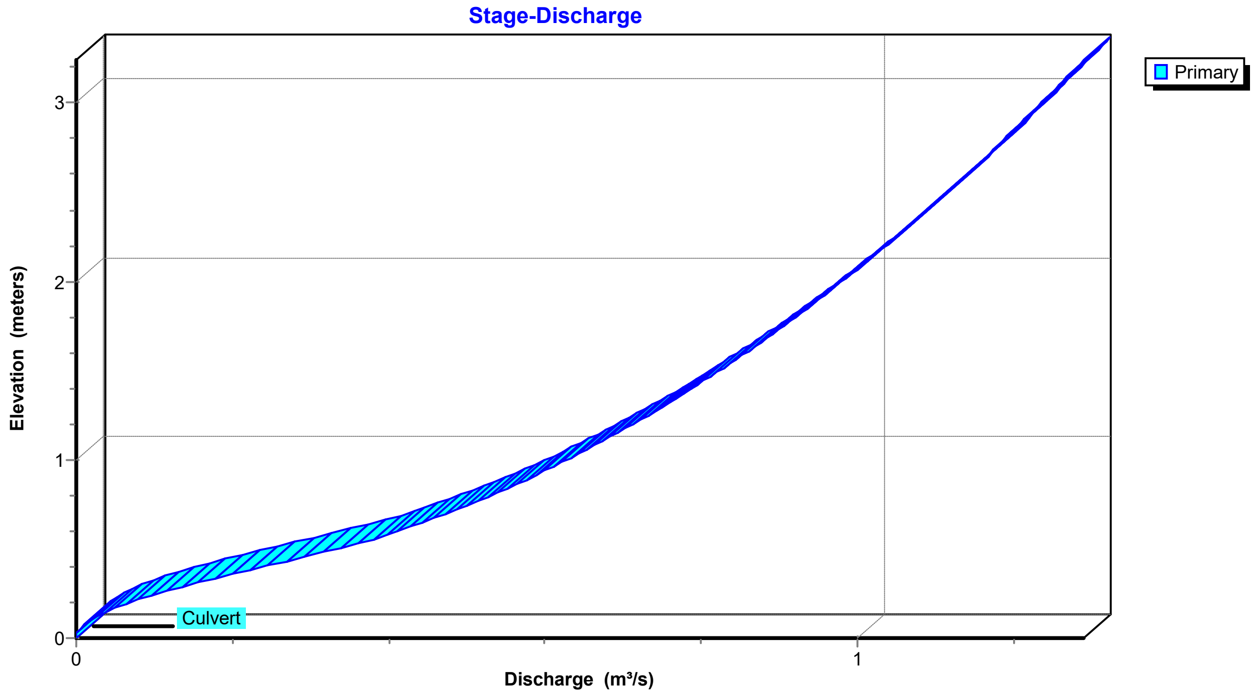
Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**600 mm Round Culvert** L= 30.00 m Ke= 0.500 Inlet / Outlet Invert= 0.000 m / -1.500 m S= 0.0500 m/m Cc= 0.900 n= 0.013, Flow Area= 0.283 m²

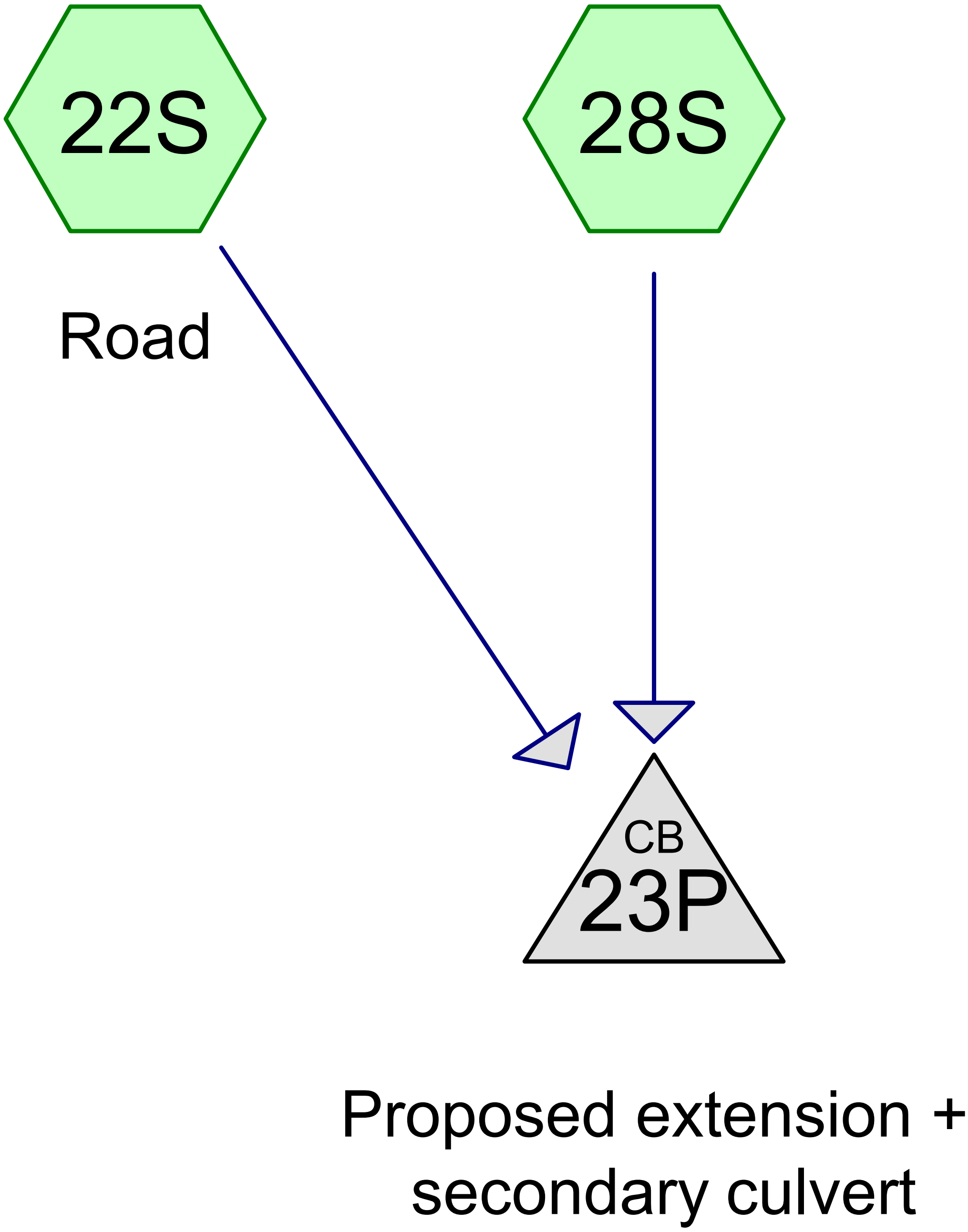
Primary OutFlow Max=1.2821 m³/s @ 0.33 hrs HW=3.211 m (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.2821 m³/s @ 4.53 m/s)

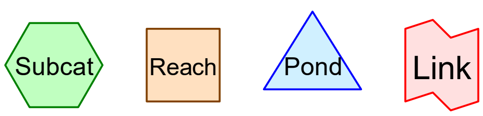
Pond Culvert-3: (new Pond)



Pond Culvert-3: (new Pond)







Routing Diagram for SITE J CULVERT twin culverts
Prepared by WSP New Zealand Ltd, Printed 20/06/2024

Summary for Subcatchment 22S: Road

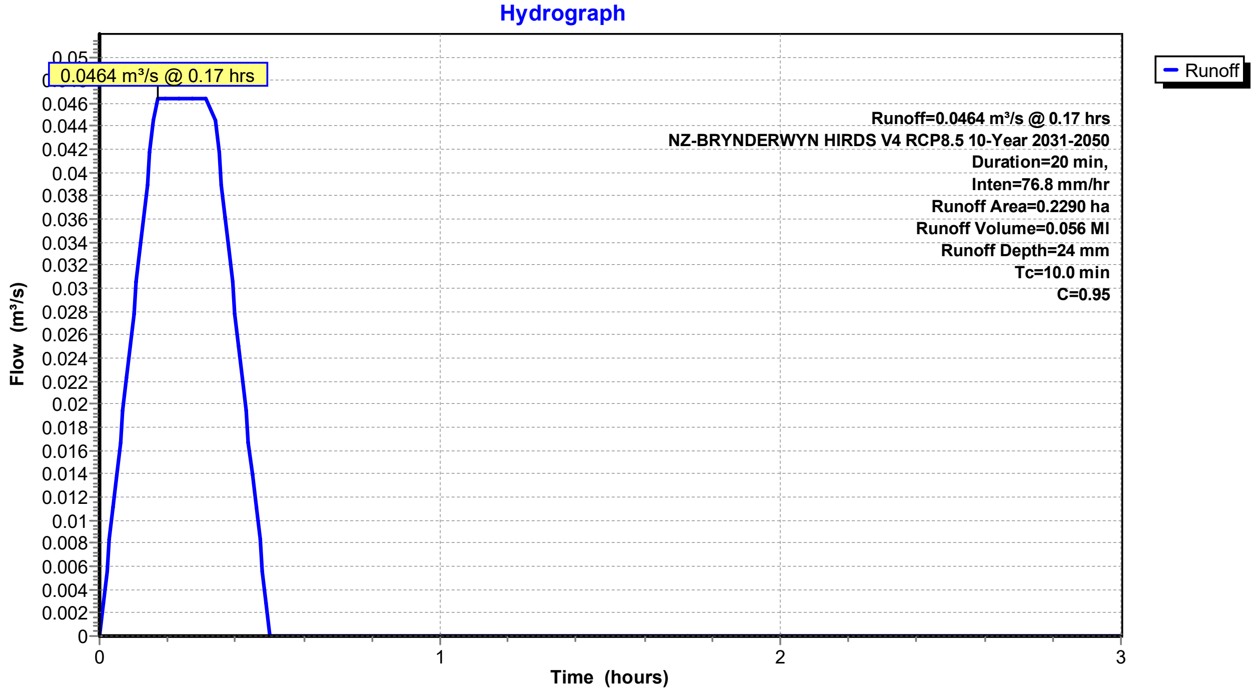
Runoff = 0.0464 m³/s @ 0.17 hrs, Volume= 0.056 Ml, Depth= 24 mm
Routed to Pond 23P : Proposed extension + secondary culvert

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 10-Year 2031-2050 Duration=20 min, Inten=76.8 mm/hr

Area (ha)	C	Description
0.2290	0.95	
0.2290		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 22S: Road



Summary for Subcatchment 28S:

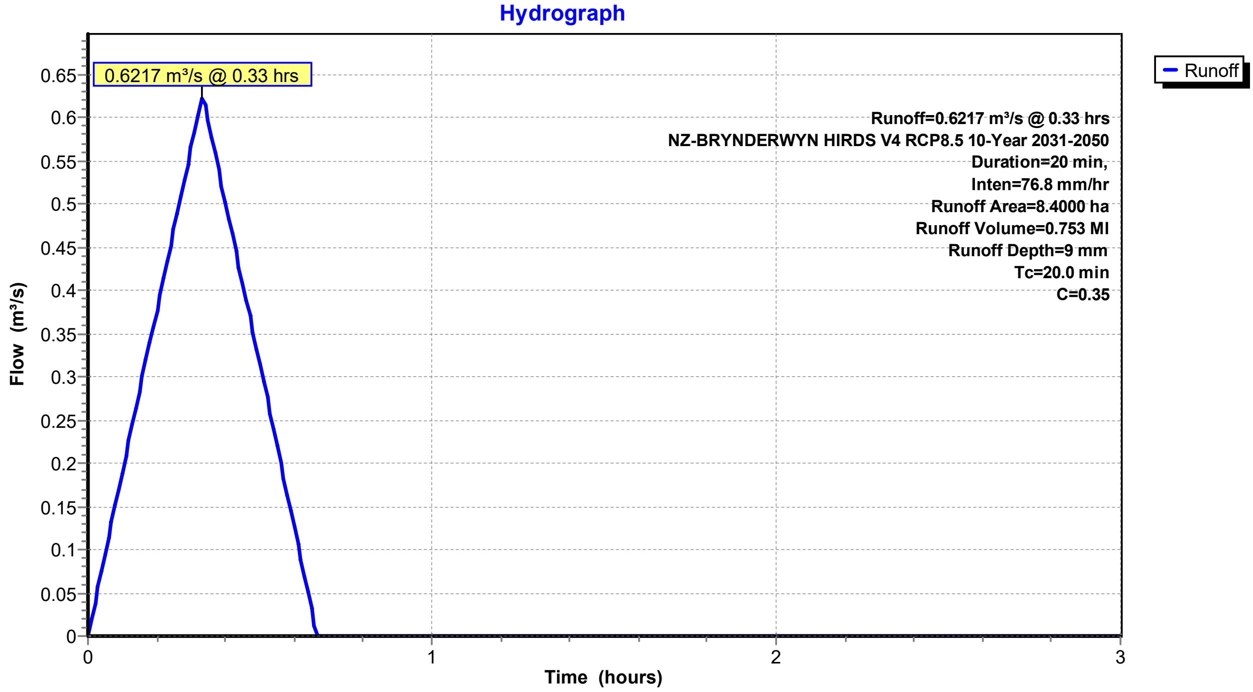
Runoff = 0.6217 m³/s @ 0.33 hrs, Volume= 0.753 Ml, Depth= 9 mm
Routed to Pond 23P : Proposed extension + secondary culvert

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 10-Year 2031-2050 Duration=20 min, Inten=76.8 mm/hr

Area (ha)	C	Description
8.4000	0.35	medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
8.4000		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry, direct entry**

Subcatchment 28S:



Summary for Pond 23P: Proposed extension + secondary culvert

Inflow Area = 8.6290 ha, 2.65% Impervious, Inflow Depth = 9 mm for 10-Year 2031-2050 event
Inflow = 0.6679 m³/s @ 0.33 hrs, Volume= 0.808 Ml
Outflow = 0.6679 m³/s @ 0.33 hrs, Volume= 0.808 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.6600 m³/s @ 0.33 hrs, Volume= 0.808 Ml
Secondary = 0.0078 m³/s @ 0.33 hrs, Volume= 0.001 Ml

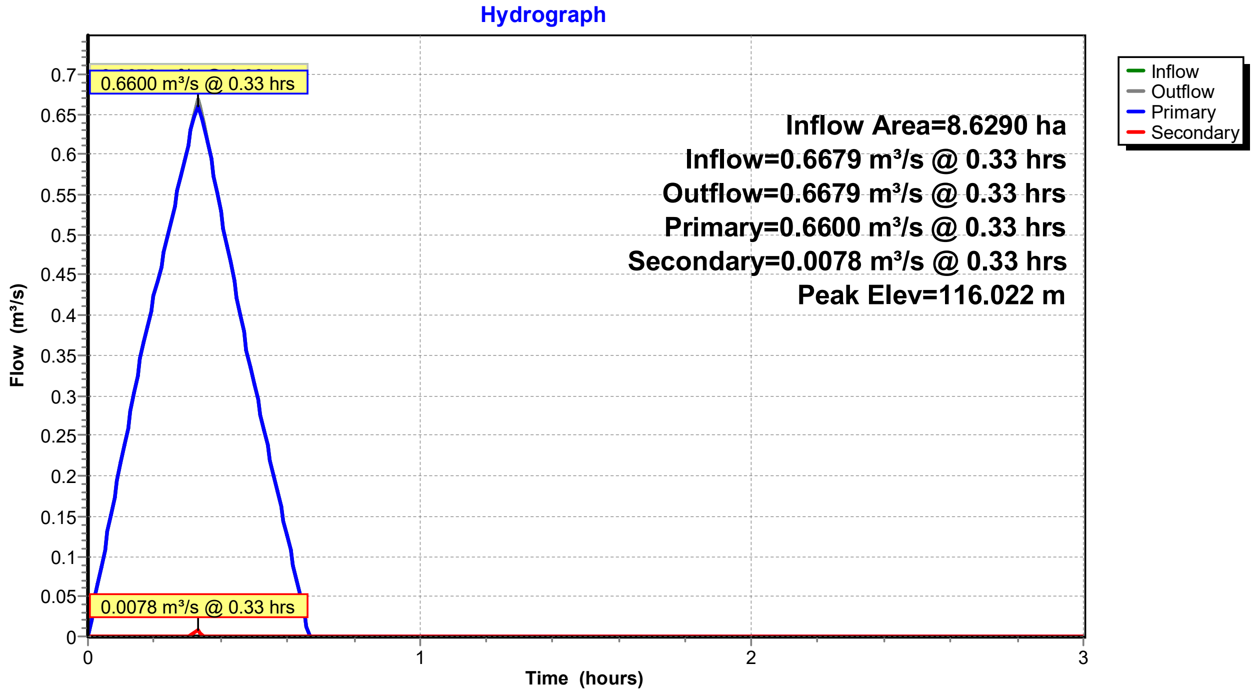
Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 116.022 m @ 0.33 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	115.950 m	**650 mm Round euroflo DN600 (530ID)** L= 30.00 m CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.950 m / 114.750 m S= 0.0400 m/m Cc= 0.900 n= 0.013, Flow Area= 0.332 m²
#2	Primary	114.950 m	**600 mm Round Culvert existing 600Ø RCP** L= 30.00 m RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 114.950 m / 113.450 m S= 0.0500 m/m Cc= 0.900 n= 0.013, Flow Area= 0.283 m²

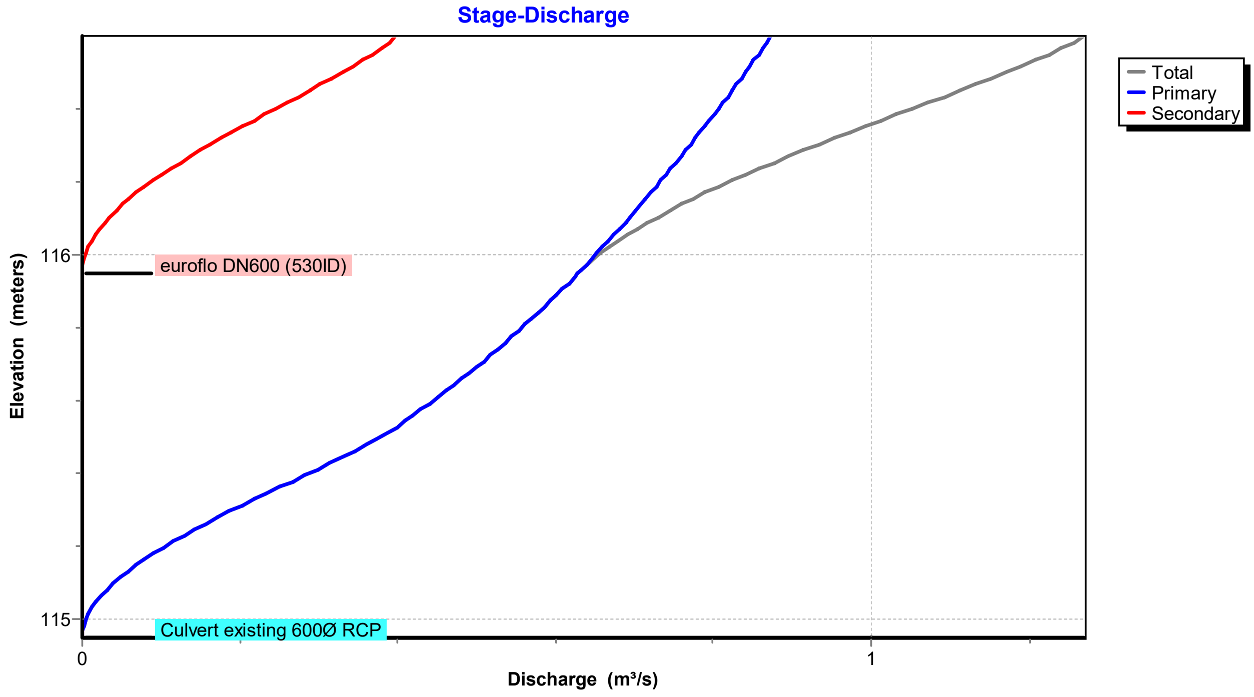
Primary OutFlow Max=0.6585 m³/s @ 0.33 hrs HW=116.018 m (Free Discharge)
└─**2=Culvert existing 600Ø RCP** (Inlet Controls 0.6585 m³/s @ 2.33 m/s)

Secondary OutFlow Max=0.0072 m³/s @ 0.33 hrs HW=116.018 m (Free Discharge)
└─**1=euroflo DN600 (530ID)** (Inlet Controls 0.0072 m³/s @ 0.39 m/s)

Pond 23P: Proposed extension + secondary culvert



Pond 23P: Proposed extension + secondary culvert



Summary for Subcatchment 22S: Road

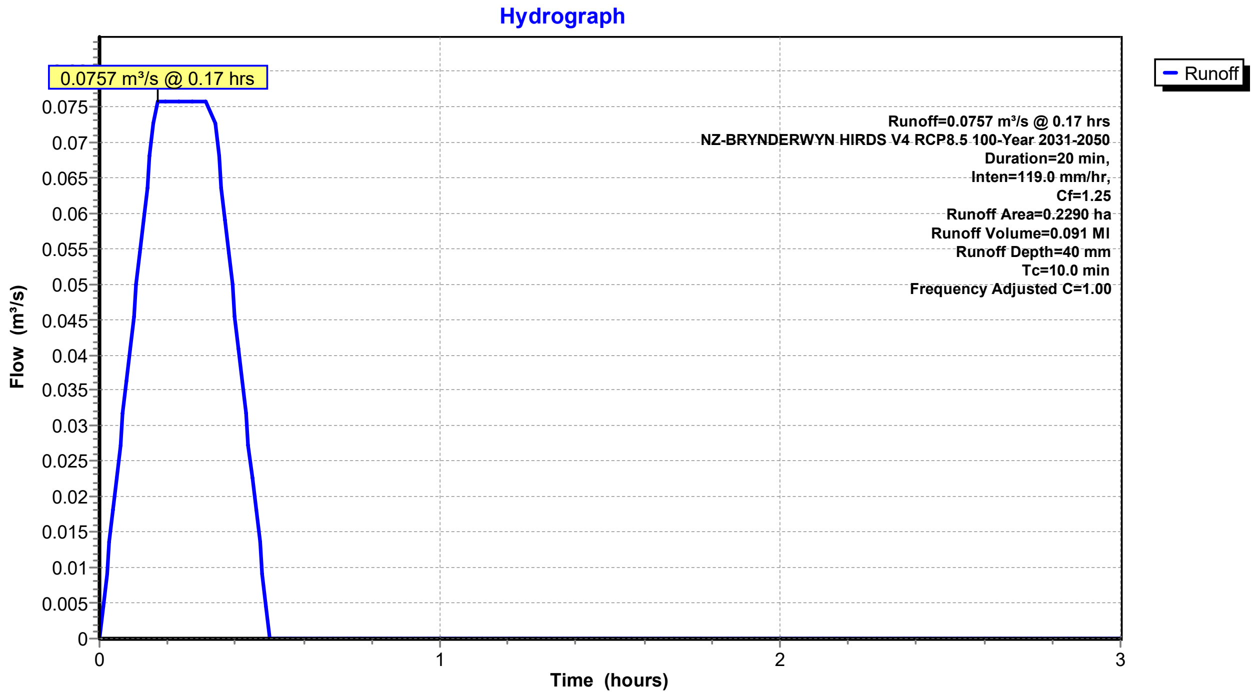
Runoff = 0.0757 m³/s @ 0.17 hrs, Volume= 0.091 Ml, Depth= 40 mm
Routed to Pond 23P : Proposed extension + secondary culvert

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.2290	0.95		
0.2290	0.95	1.00	Weighted Average, Frequency Adjusted
0.2290			100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 22S: Road



Summary for Subcatchment 28S:

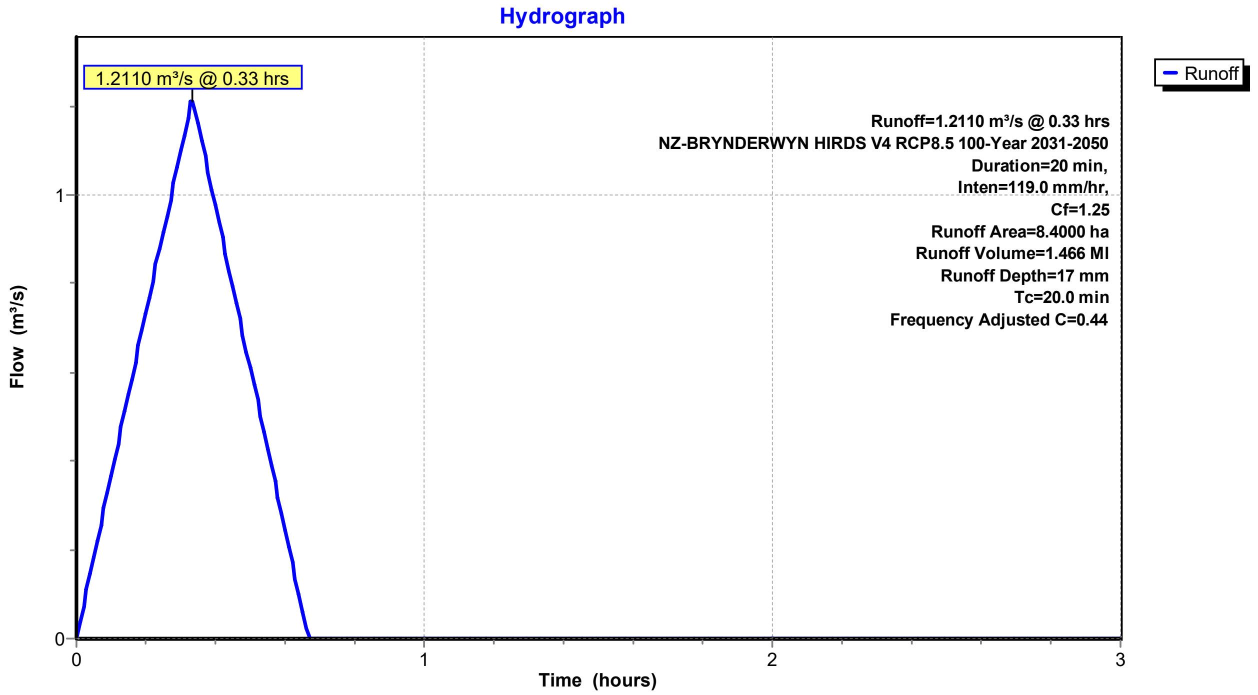
Runoff = 1.2110 m³/s @ 0.33 hrs, Volume= 1.466 Ml, Depth= 17 mm
Routed to Pond 23P : Proposed extension + secondary culvert

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=20 min, Inten=119.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
8.4000	0.35		medium soakage bush and scrub cover 0.25 + 0.1 for steep slope
8.4000	0.35	0.44	Weighted Average, Frequency Adjusted
8.4000			100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
20.0					**Direct Entry, direct entry**

Subcatchment 28S:



Summary for Pond 23P: Proposed extension + secondary culvert

Inflow Area = 8.6290 ha, 2.65% Impervious, Inflow Depth = 18 mm for 100-Year 2031-2050 event
Inflow = 1.2863 m³/s @ 0.33 hrs, Volume= 1.557 Ml
Outflow = 1.2863 m³/s @ 0.33 hrs, Volume= 1.557 Ml, Atten= 0%, Lag= 0.0 min
Primary = 0.8788 m³/s @ 0.33 hrs, Volume= 1.322 Ml
Secondary = 0.4075 m³/s @ 0.33 hrs, Volume= 0.235 Ml

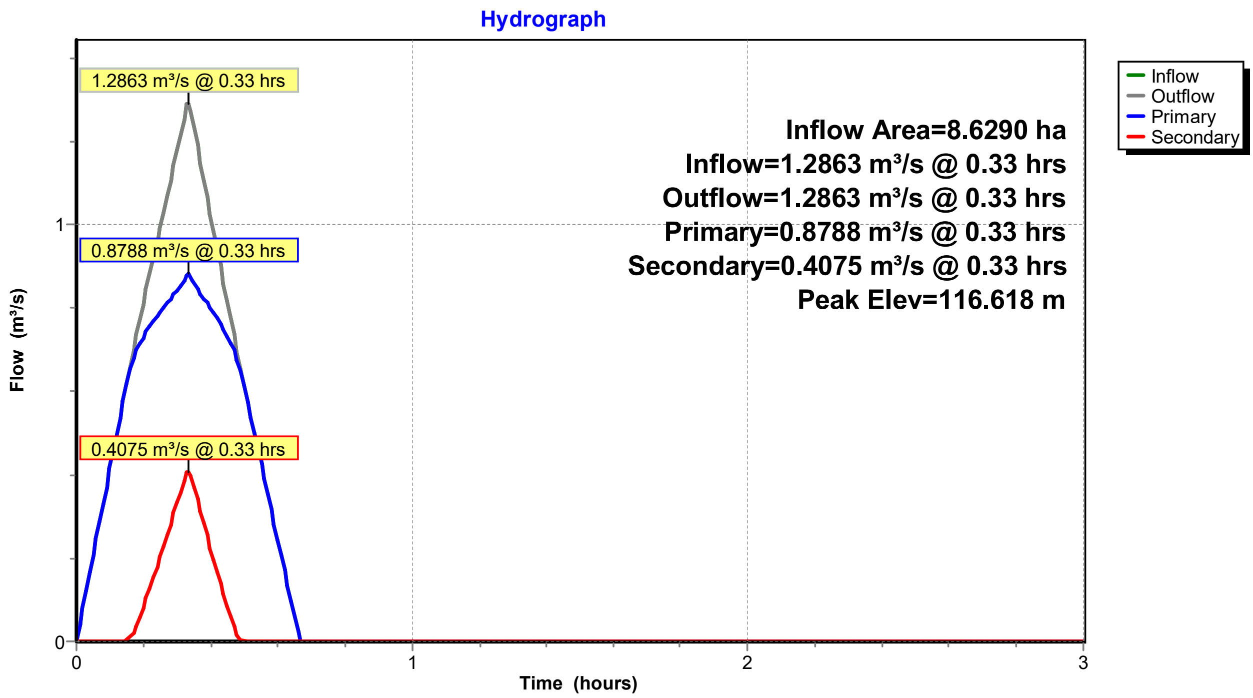
Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Peak Elev= 116.618 m @ 0.33 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	115.950 m	**650 mm Round euroflo DN600 (530ID)** L= 30.00 m CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 115.950 m / 114.750 m S= 0.0400 m/m Cc= 0.900 n= 0.013, Flow Area= 0.332 m²
#2	Primary	114.950 m	**600 mm Round Culvert existing 600Ø RCP** L= 30.00 m RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 114.950 m / 113.450 m S= 0.0500 m/m Cc= 0.900 n= 0.013, Flow Area= 0.283 m²

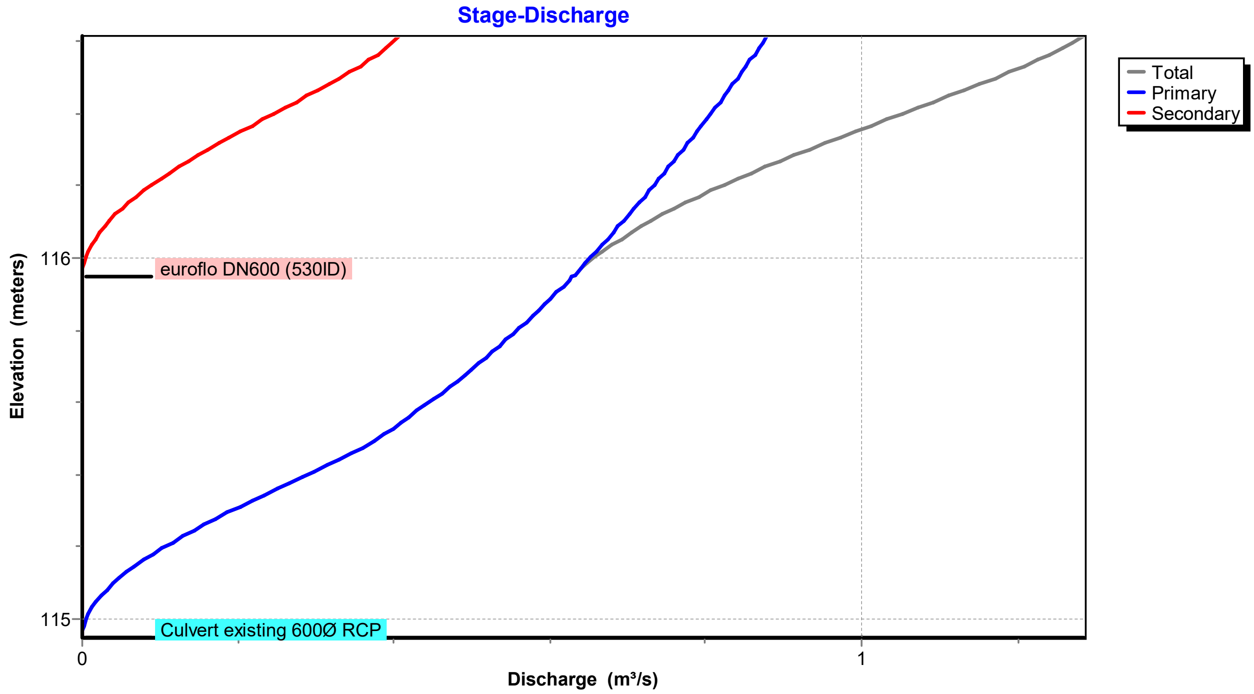
Primary OutFlow Max=0.8772 m³/s @ 0.33 hrs HW=116.613 m (Free Discharge)
↑**2=Culvert existing 600Ø RCP** (Inlet Controls 0.8772 m³/s @ 3.10 m/s)

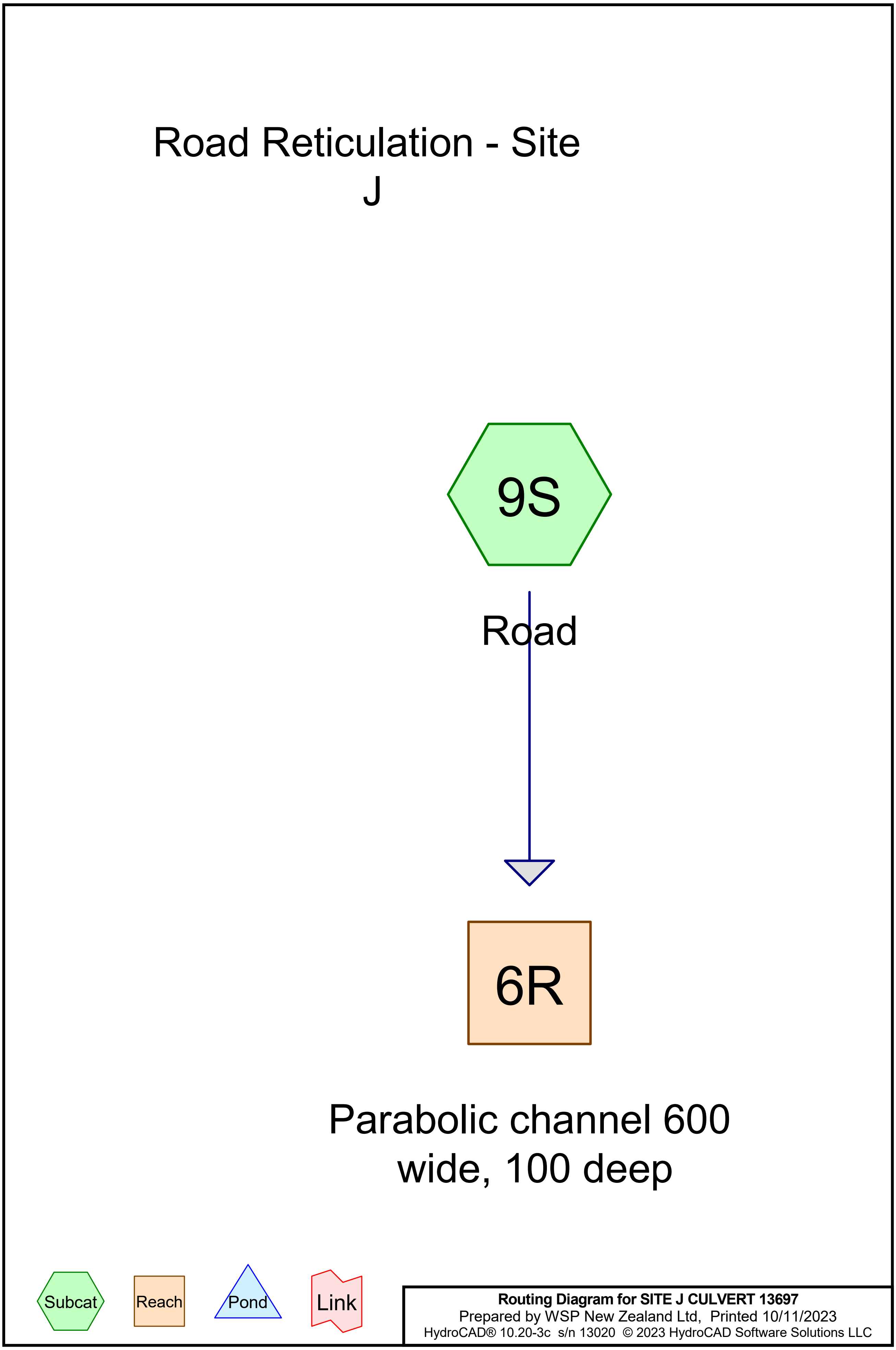
Secondary OutFlow Max=0.4049 m³/s @ 0.33 hrs HW=116.613 m (Free Discharge)
↑**1=euroflo DN600 (530ID)** (Inlet Controls 0.4049 m³/s @ 1.22 m/s)

Pond 23P: Proposed extension + secondary culvert



Pond 23P: Proposed extension + secondary culvert





Road Reticulation - Site J
9S
Road
6R
Parabolic channel 600 wide, 100 deep
Subcat
Reach
Pond
Link
Routing Diagram for SITE J CULVERT 13697
Prepared by WSP New Zealand Ltd, Printed 10/11/2023
HydroCAD® 10.20-3c s/n 13020 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 9S: Road

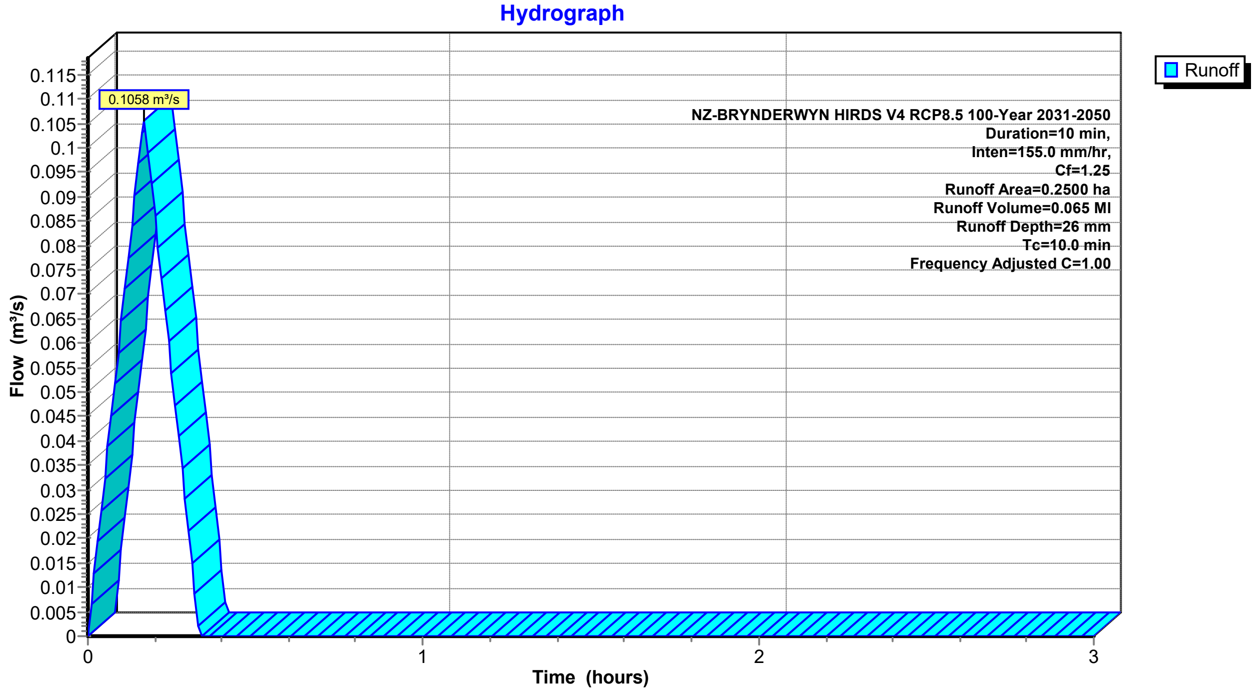
Runoff = 0.1058 m³/s @ 0.17 hrs, Volume= 0.065 Ml, Depth= 26 mm
Routed to Reach 6R : Parabolic channel 600 wide, 100 deep

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
NZ-BRYNDERWYN HIRDS V4 RCP8.5 100-Year 2031-2050 Duration=10 min, Inten=155.0 mm/hr, Cf=1.25

Area (ha)	C	Adj	Description
0.2300	0.95		road catchment
0.0200	0.30		cut face
0.2500	0.90	1.00	Weighted Average, Frequency Adjusted
0.0200			8.00% Pervious Area
0.2300			92.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 9S: Road



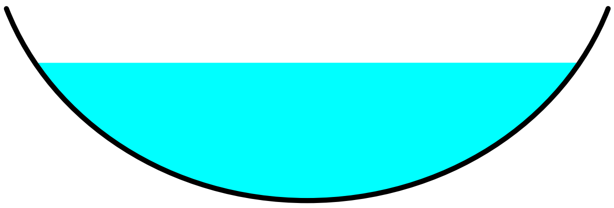
Summary for Reach 6R: Parabolic channel 600 wide, 100 deep

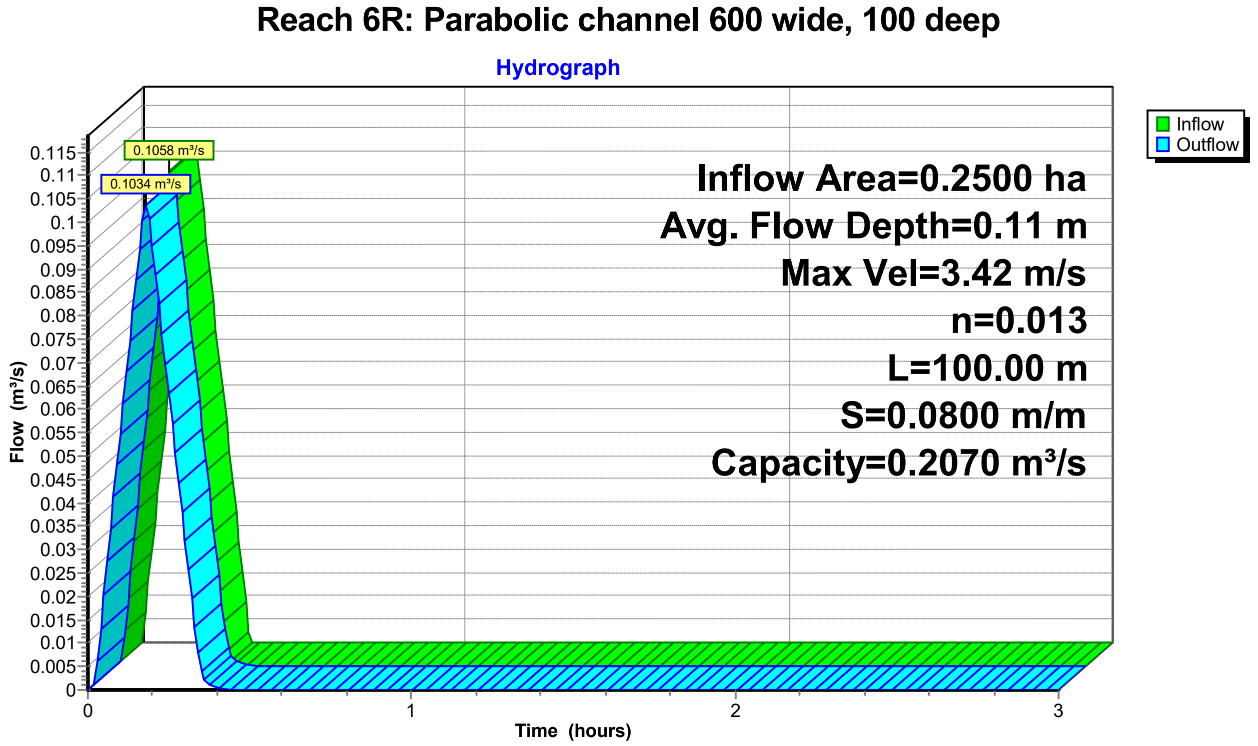
Inflow Area = 0.2500 ha, 92.00% Impervious, Inflow Depth = 26 mm for 100-Year 2031-2050 event
Inflow = 0.1058 m³/s @ 0.17 hrs, Volume= 0.065 Ml
Outflow = 0.1034 m³/s @ 0.18 hrs, Volume= 0.065 Ml, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.42 m/s, Min. Travel Time= 0.5 min
Avg. Velocity = 1.98 m/s, Avg. Travel Time= 0.8 min

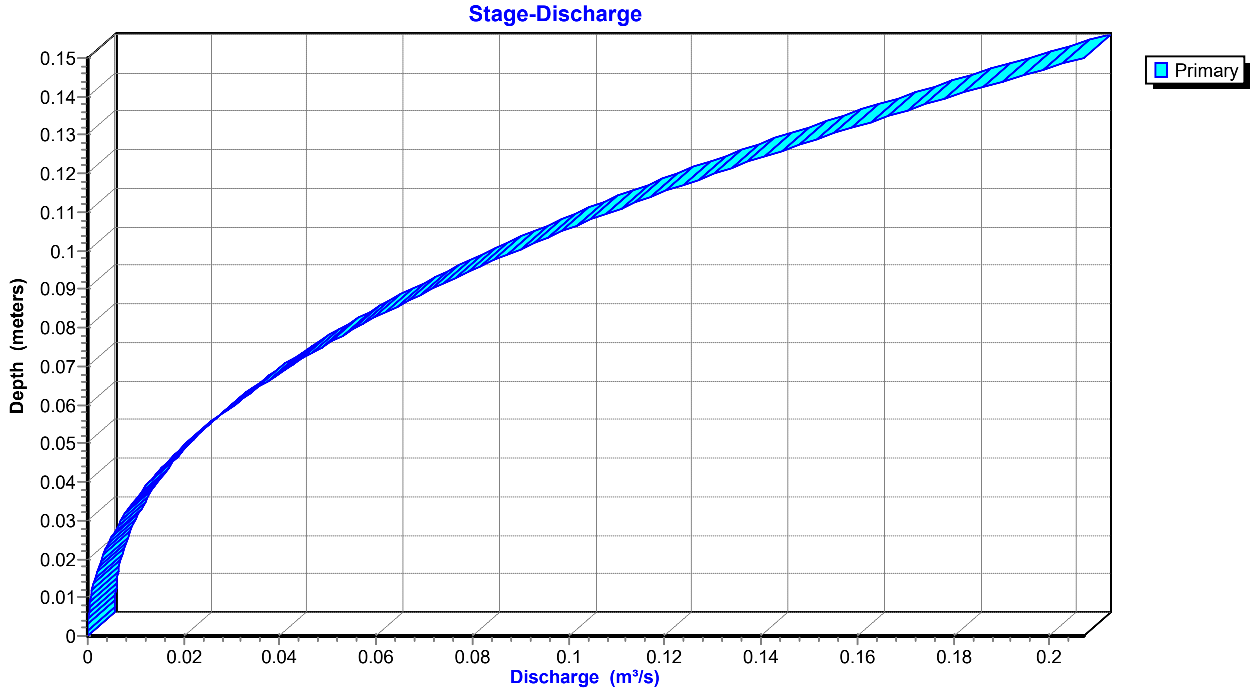
Peak Storage= 3.0 m³ @ 0.17 hrs
Average Depth at Peak Storage= 0.11 m , Surface Width= 0.42 m
Bank-Full Depth= 0.15 m Flow Area= 0.05 m², Capacity= 0.2070 m³/s

0.50 m x 0.15 m deep Parabolic Channel, n= 0.013
Length= 100.00 m Slope= 0.0800 m/m
Inlet Invert= 100.000 m, Outlet Invert= 92.000 m

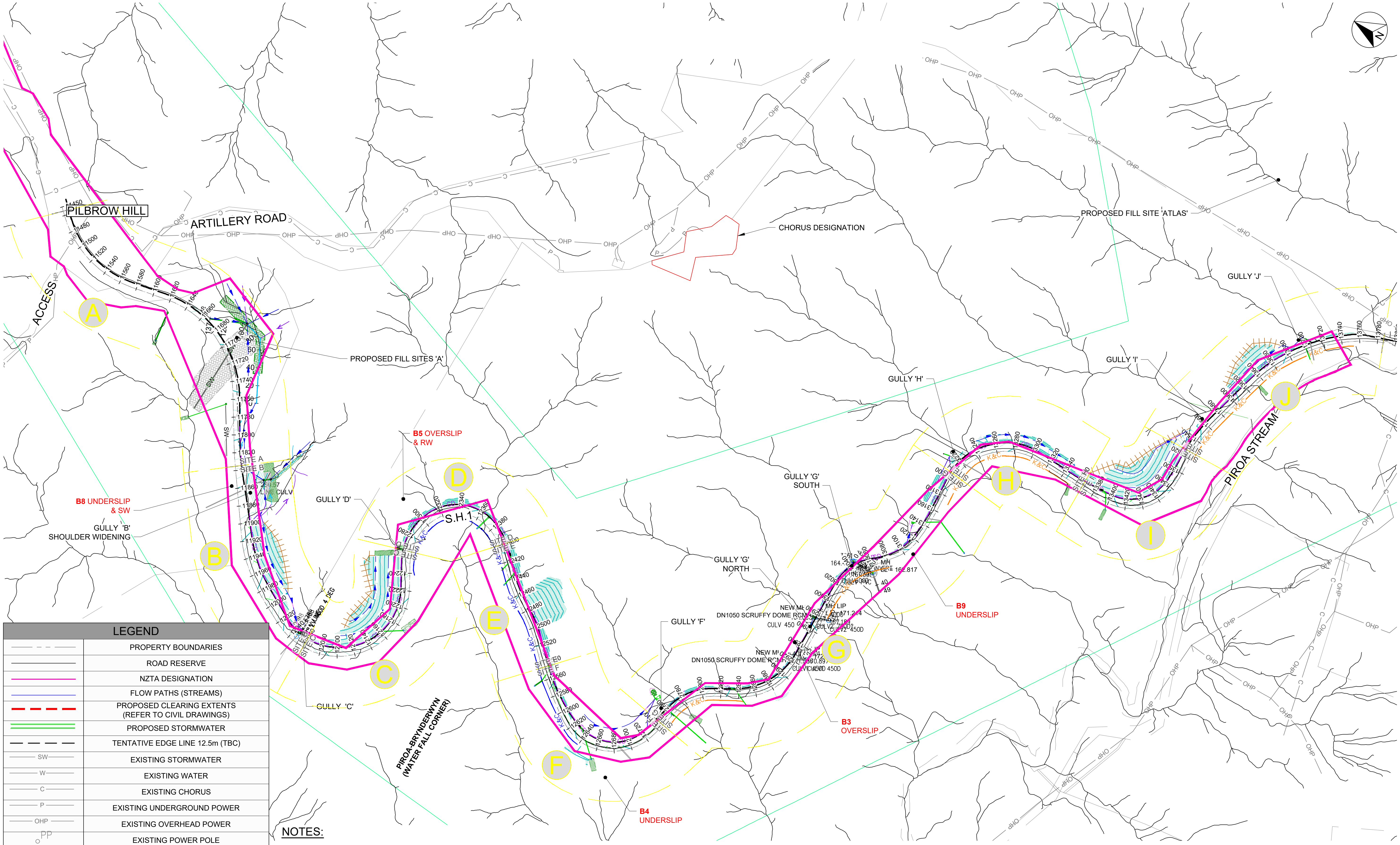




Reach 6R: Parabolic channel 600 wide, 100 deep



APPENDIX D – CONSTRUCTION DRAWINGS



LEGEND

	PROPERTY BOUNDARIES
	ROAD RESERVE
	NZTA DESIGNATION
	FLOW PATHS (STREAMS)
	PROPOSED CLEARING EXTENTS (REFER TO CIVIL DRAWINGS)
	PROPOSED STORMWATER
	TENTATIVE EDGE LINE 12.5m (TBC)
SW	EXISTING STORMWATER
W	EXISTING WATER
C	EXISTING CHORUS
P	EXISTING UNDERGROUND POWER
OHP	EXISTING OVERHEAD POWER
PP	EXISTING POWER POLE

1:2000 @ A1
1:4000 @ A3 0 20 40 60 80 100 120 140 160 180 200 m

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES
2. REFER TO WATER DISCIPLINE DRAWINGS FOR ADDITIONAL INFORMATION.

WORK IN PROGRESS
PRINTED 24/02/2024 10:32:46 am

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES 1:XXX AT A1 — ORIGINAL SIZE A1

DRAWN	DESIGNED	APPROVED
-	-	F. ROEST
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
K. MEIN	C. BROWN	-

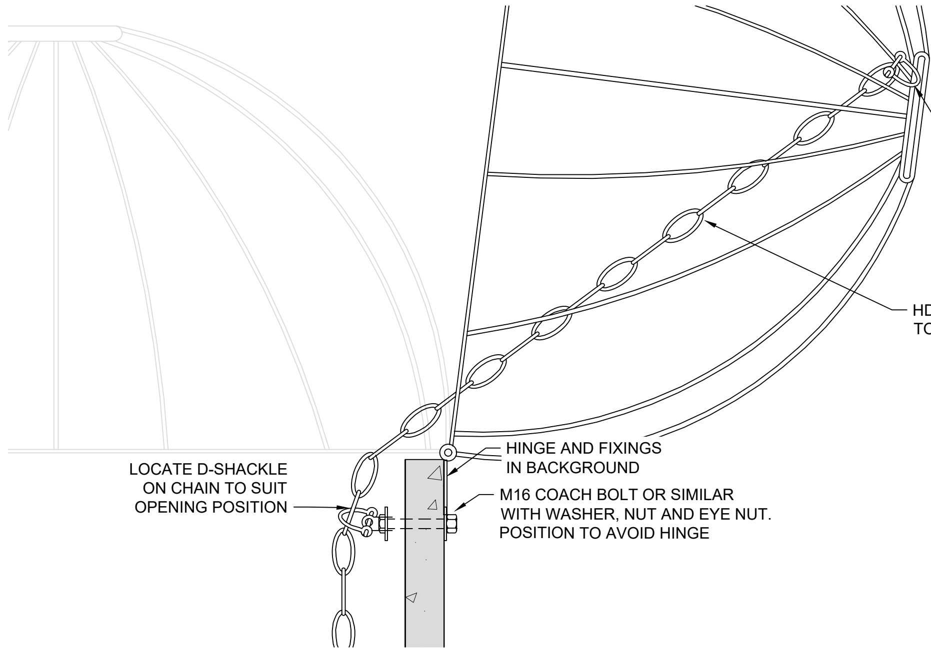
ISSUED FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

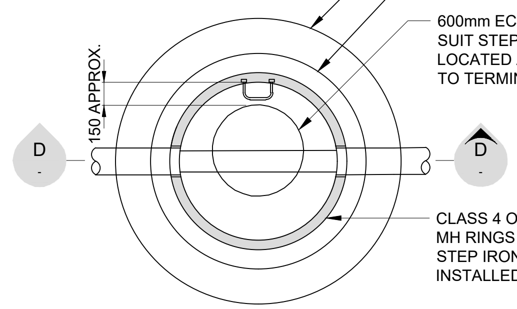
TITLE
OVERALL SITE
DRAINAGE PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-OA-DR
SHEET NO.: WA4200
REVISION: A

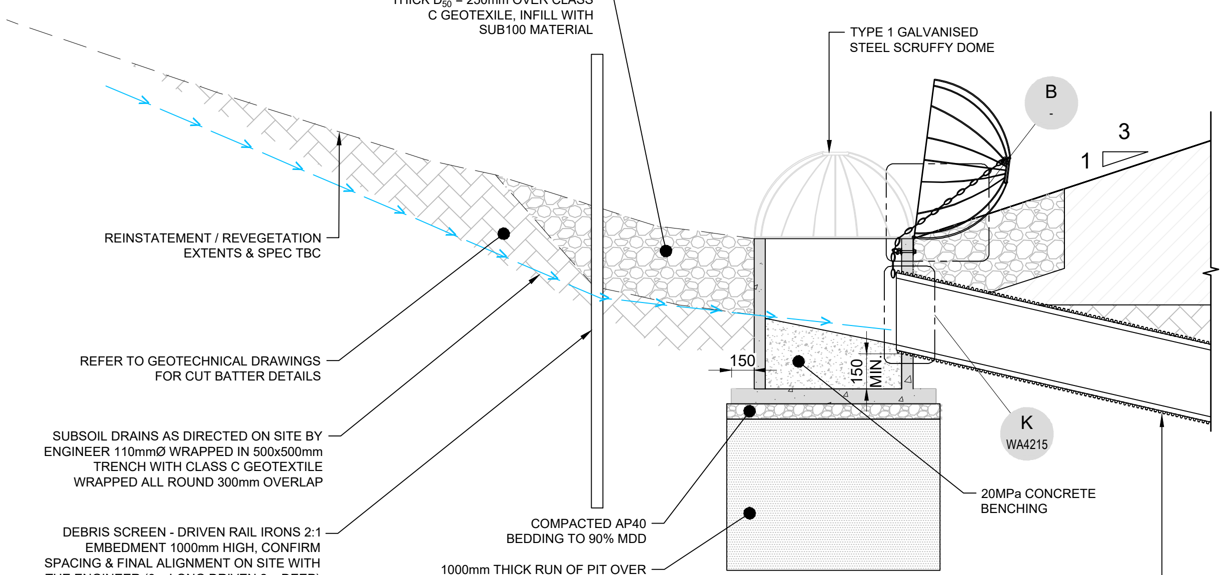
Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:32:46 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-EWGL-OA-DR-WA-4200.dwg WA-4200



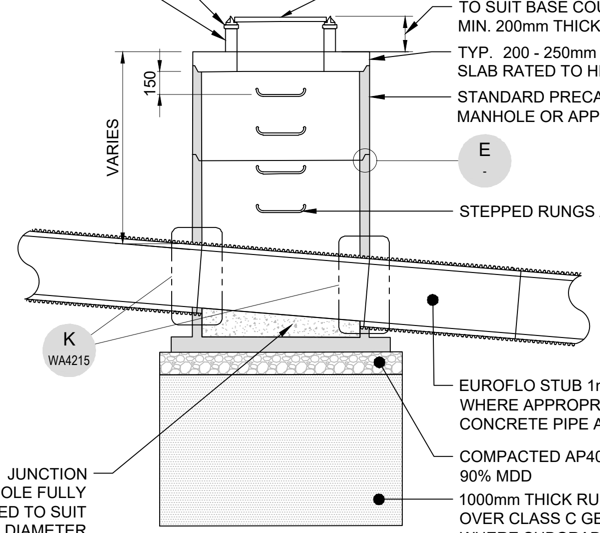
B - TYPICAL DETAIL - CHAIN ATTACHMENT
SCALE: 1:5



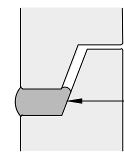
C - TYPICAL PLAN - GULLY JUNCTION MANHOLE
SCALE: 1:25



A - TYPICAL DETAIL - GULLY INLET SCRUFFY DOME MANHOLE
SCALE: 1:25



D - TYPICAL DETAIL - GULLY JUNCTION MANHOLE
SCALE: 1:25



E - DETAIL - JOINT
NTS

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.
2. REFER TO STORMWATER PLAN AND LONGSECTIONS FOR SCRUFFY DOME, OUTFALL AND PIPE INVERT INFORMATION.

1:25@ A1 / 1:50@ A3: 0 400 800 1200 1600 2000 2400 mm

1:5@ A1 / 1:10@ A3: 0 50 100 150 200 250 300 350 400 450 500 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	2023-12-14
2	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES		ORIGINAL SIZE
1:5, 1:25 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

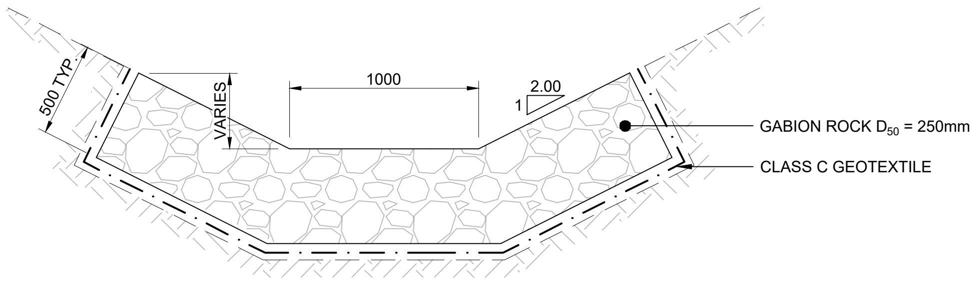
FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
OVERALL SITE
TYPICAL DETAILS - SHEET 1

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA4214	2

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:32:53 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-EWGL-OA-DR-WA-4214.dwg WA4214

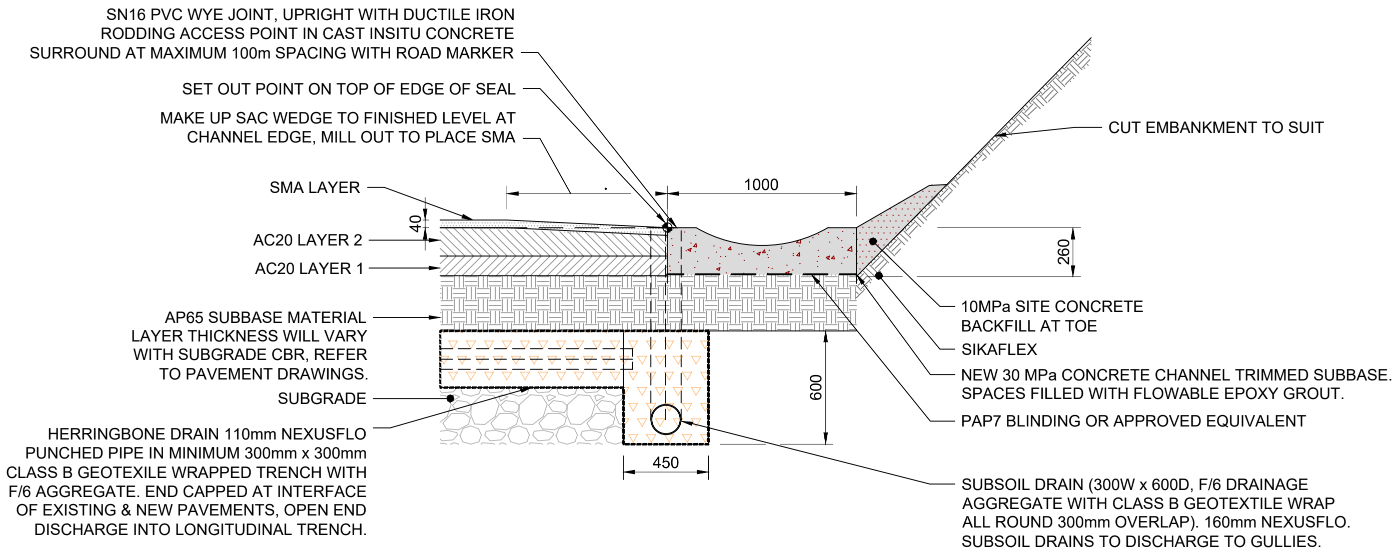


F - DETAIL - ROCK LINED DRAIN
SCALE: 1:20

SYMBOL	DEFINITION	UNIT
B	WIDTH OF TRENCH OR EMBEDMENT ZONE MEASURED AT THE SPRINGLINE OF THE PIPE	mm
De	DIAMETER OF THE MOST EXTREME EXTERNAL SURFACE ALONG THE PIPE BARREL, AVERAGED IN TWO DIRECTIONS	mm
Di	(MINIMUM) MEAN INTERNAL DIAMETER, WHICH IS THE AVERAGE OF THE MAXIMUM AND MINIMUM INTERNAL DIAMETERS	mm
H	COVER, VERTICAL DISTANCE BETWEEN THE TOP OF THE PIPE AND THE FINISHED SURFACE	mm
Id	DENSITY INDEX (SEE AS 1289.5.6.1)	mm
Ib	DEPTH OF BEDDING BELOW THE BOTTOM OF THE PIPE	mm
Ic	HORIZONTAL DISTANCE BETWEEN THE SPRING LINE AND THE TRENCH WALL OR PERMANENT TRENCH SUPPORT (NOT DISTANCE TO TEMPORARY TRENCH SUPPORTS)	mm
Io	DEPTH OF OVERLAY	mm

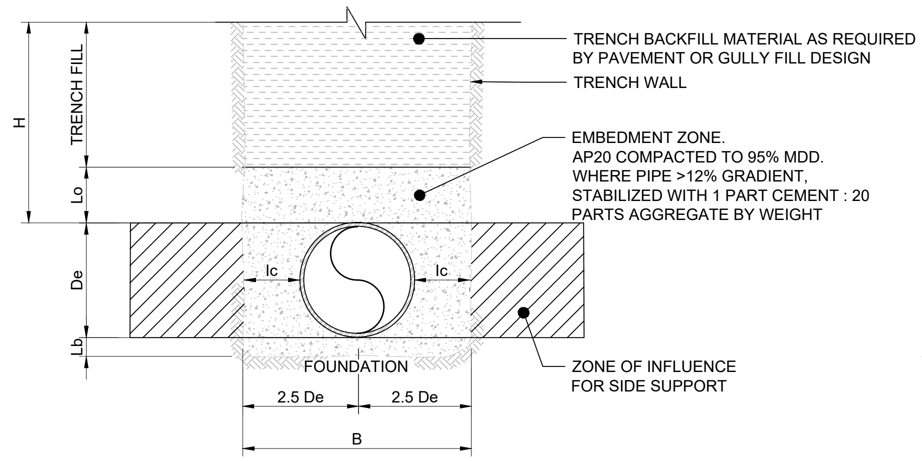
De		MINIMUM VALUES		
		Ib	Ic†	Io†
≥75	≤150	75	100	100
>150	≤300	100	150	150
>300	≤450	100	200	150
>450	≤900	150	300	150
>900	≤1500	150	350	200
>1500	≤4000	150	0.25 De	300

*THE OBJECTIVE IS TO ACHIEVE THE SAME CONDITIONS AND DEGREE OF COMPACTION ALL AROUND THE PIPE. VALUES MAY BE VARIED, AT THE DISCRETION OF THE DESIGNER, IN CIRCUMSTANCES WHERE SPECIAL CONSTRUCTION TECHNIQUES ARE USED OR WHERE NATIVE SOILS ARE SUITABLE FOR DIRECT EMBEDMENT, OR WHERE ONLY NOMINAL DESIGN LOADS ARE APPLIED

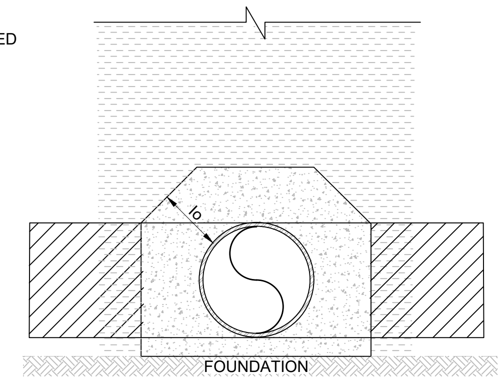


G - DETAIL - ROAD RUN OFF
SCALE: 1:20

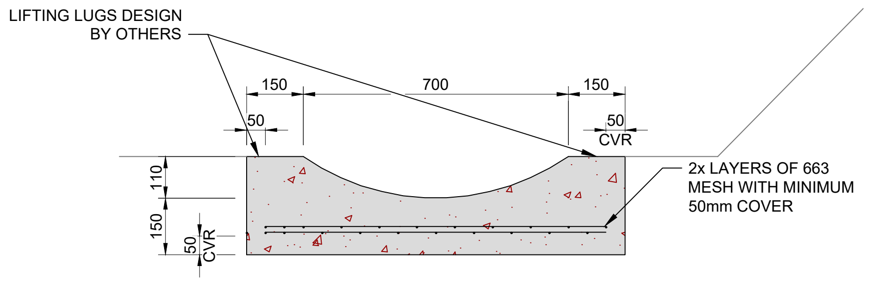
NOTE: REFER TO OA-DR-WA-4217 FOR SUPERELEVATION CHANNEL DETAILS



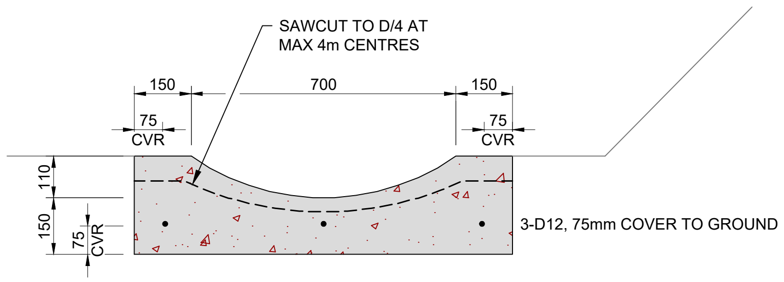
H - DETAIL - TRENCH INSTALLATION
SCALE: 1:20



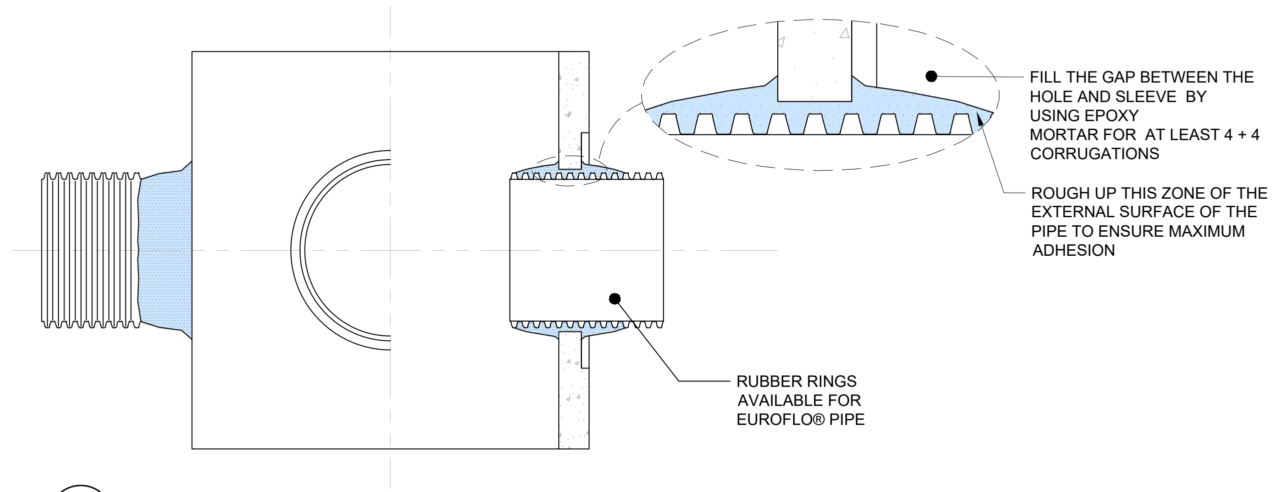
I - DETAIL - EMBANKMENT INSTALLATION
SCALE: 1:20



K - DETAIL - PRECAST CONCRETE CHANNEL
SCALE: 1:10



L - DETAIL - SLIPFORM CONCRETE CHANNEL
SCALE: 1:10



J - EUROFLO TO MANHOLE CONNECTION ELEVATION
SCALE: NTS

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES

1:10@ A1 / 1:20@ A3 — 0 100 200 300 400 500 600 700 800 900 1000 mm

1:20@ A1 / 1:40@ A3 — 0 200 400 600 800 1000 1200 1400 1600 1800 2000 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	2023-12-14
2	ISSUED FOR CONSTRUCTION - 80% DRAFT	C.B	2024-02-14

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

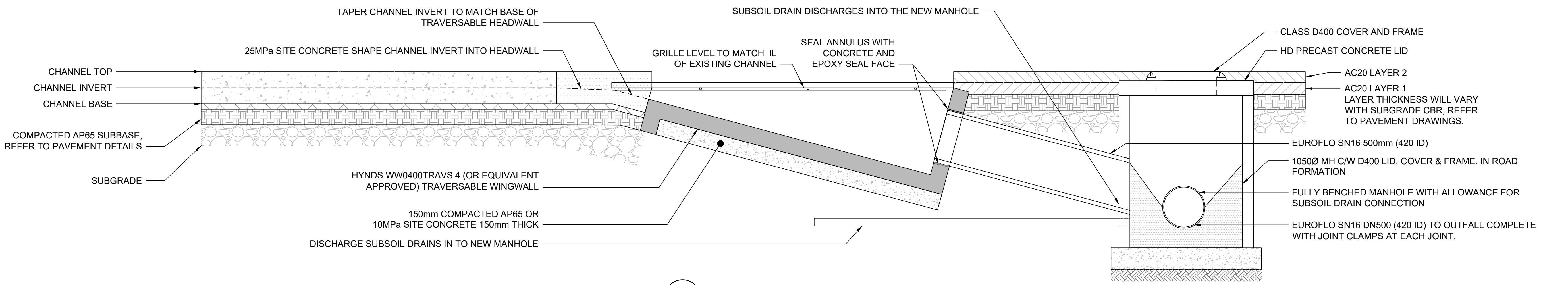
SCALES		ORIGINAL SIZE
1:10, 1:20 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	F. ROEST
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	C. BROWN	2024-02-14

FOR CONSTRUCTION - 80% DRAFT

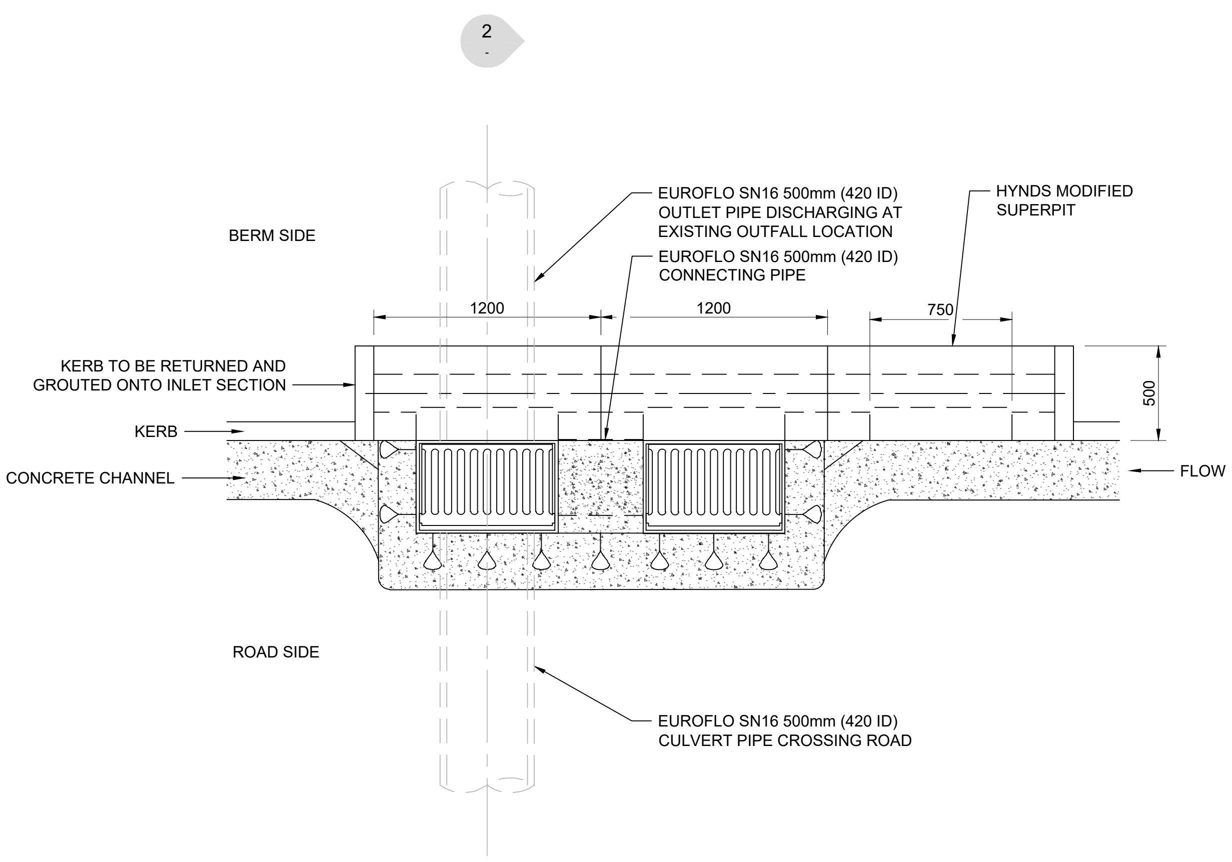
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
GULLY SITE C
TYPICAL DETAILS - SHEET 2

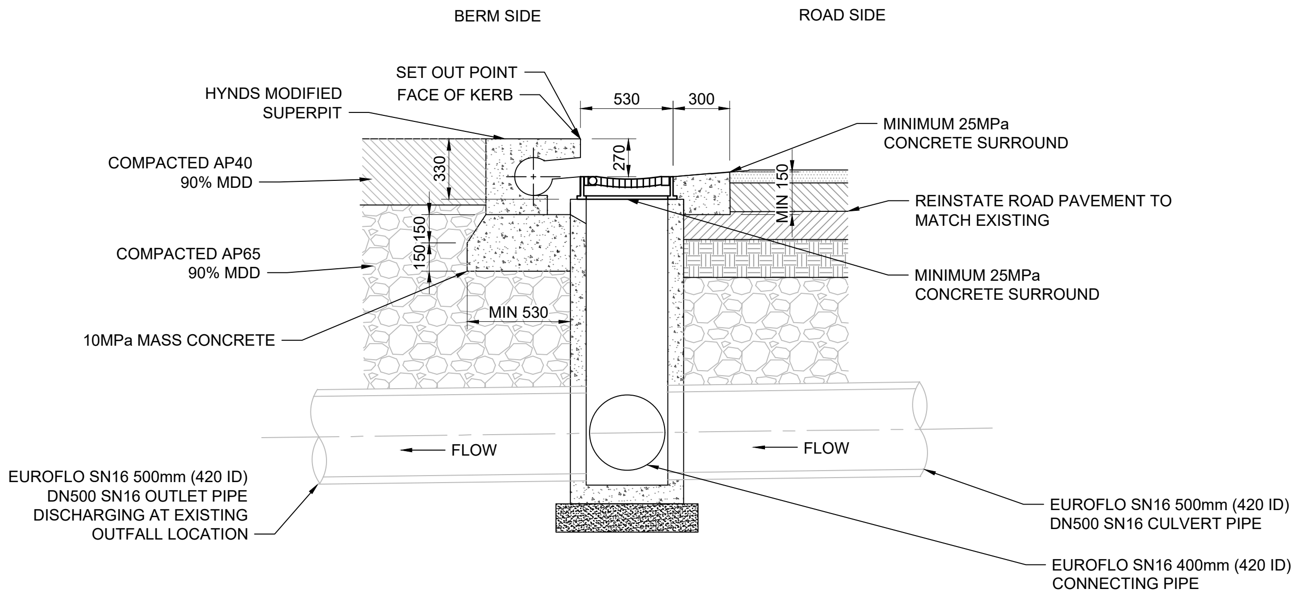
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA4215	2



1 - SECTION - TRAVERSABLE INLET
SCALE: 1:20



DETAIL - DOUBLE SUPERPIT
SCALE: 1:20



2 - SECTION 2 - DOUBLE SUPERPIT
SCALE: 1:20

1:20@ A1 / 1:40@ A3 — 0 200 400 600 800 1000 1200 1400 1600 1800 2000 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:10, 1:20 AT A1 — ORIGINAL SIZE: A1

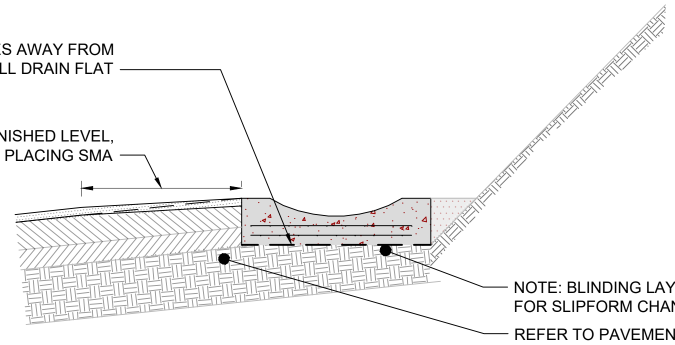
DRAWN	DESIGNED	APPROVED
J. BALDECANAS	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

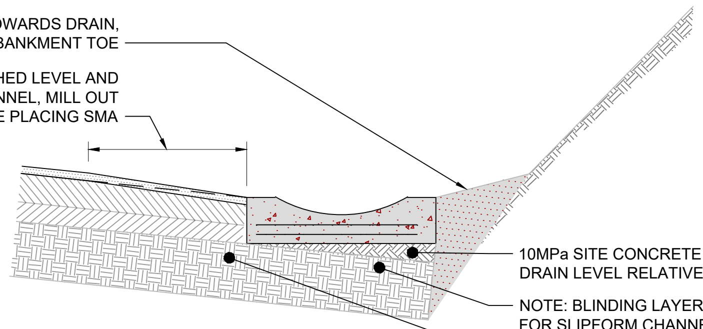
TITLE
OVERALL SITE
TYPICAL DETAILS - SHEET 3

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA4216	1



M - DETAIL - SUPER ELEVATION - AWAY FROM CHANNEL

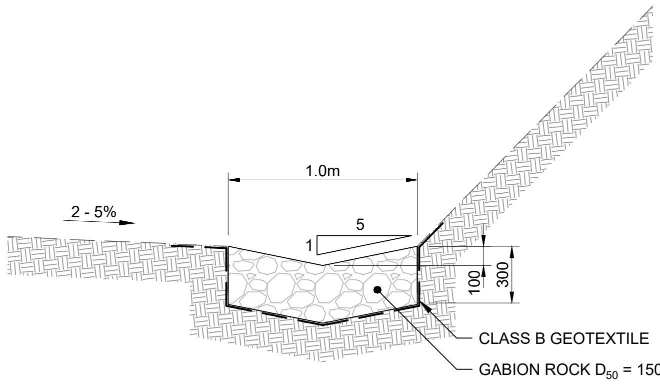
SCALE: 1:20



N - DETAIL - SUPER ELEVATION - TOWARDS CHANNEL

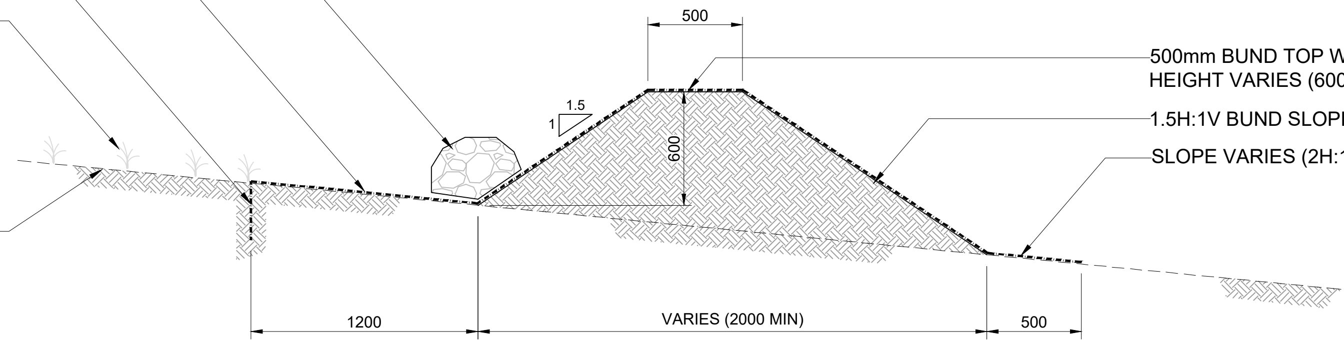
SCALE: 1:20

NOTE: PACK SUB BASE TO INSTALL DRAIN FLAT WHERE SUPERELEVATION EXCEEDS 8%. CONFIRM ON SITE WITH THE ENGINEER



P - DETAIL - ROCK LINED DRAIN

SCALE: 1:20



O - DETAIL - CLEAN WATER DIVERSION BUND

SCALE: 1:20

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES

1:20@ A1 / 1:40@ A3 — 0 200 400 600 800 1000 1200 1400 1600 1800 2000 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	C.B	2024-02-14

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp — Whangarei Office +64 9 430 1700 — Private Bag 9017, Whangarei 0148, New Zealand

WATER

SCALES: 1:20 AT A1 — ORIGINAL SIZE: A1

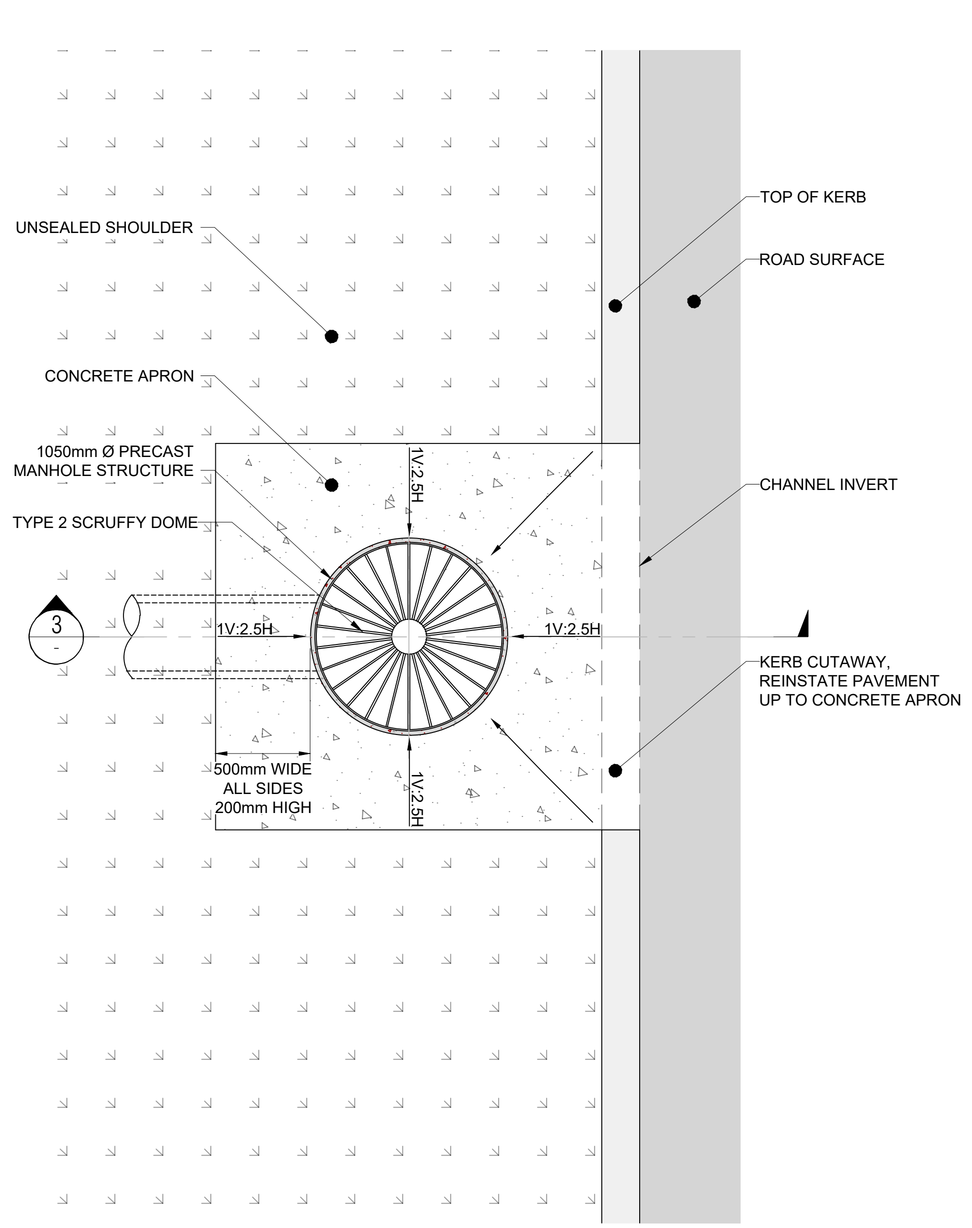
DRAWN	DESIGNED	APPROVED
J. BALDECANAS	M. CHIARONI	F. ROEST
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
-	C. BROWN	2024-02-14

FOR CONSTRUCTION - 80% DRAFT

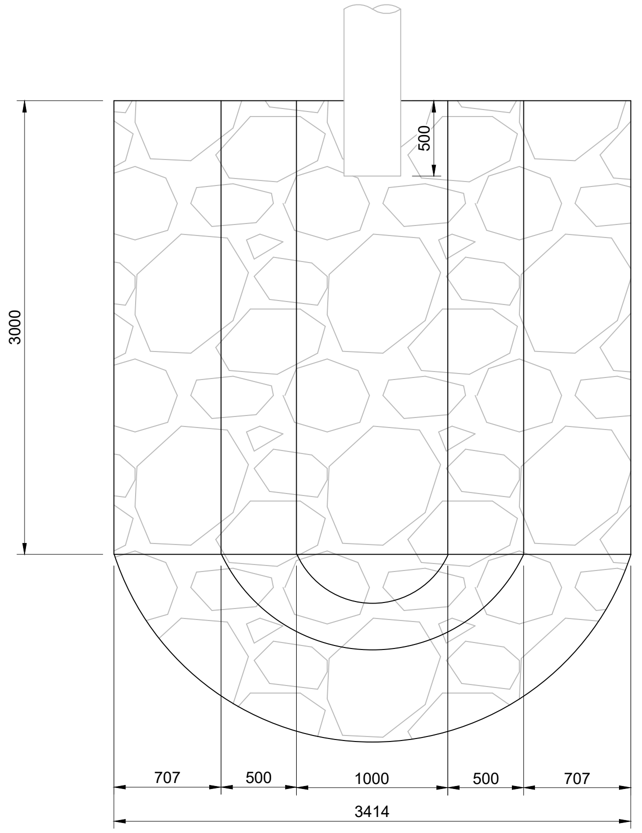
PROJECT: WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE: GULLY SITE C
TYPICAL DETAILS - SHEET 4

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-EWGL-OA-DR	WA4217	1

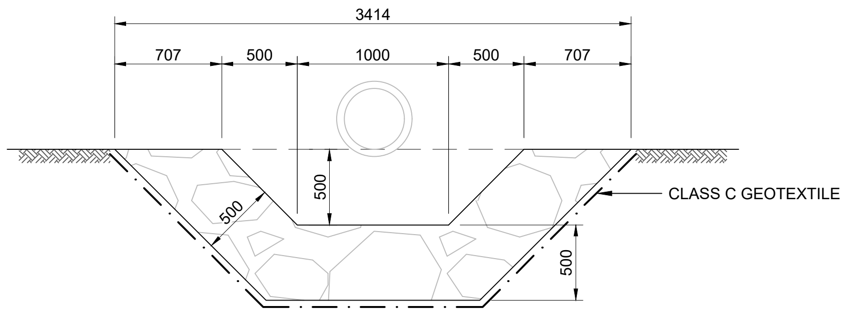


P DETAIL - CONCRETE APRON
SCALE: 1:20



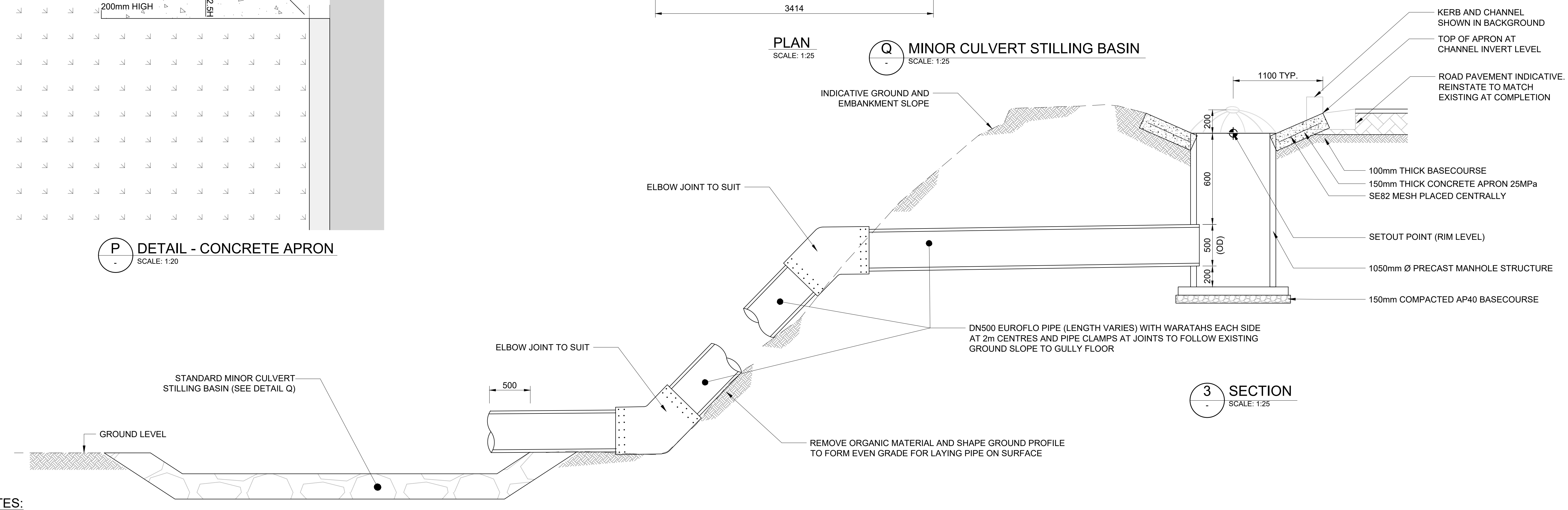
PLAN
SCALE: 1:25

ROCK CLASS	SIZE (m)	LAYER THICKNESS	% OF ROCK LARGER THAN
LIGHT	0.30 0.25 0.13	0.50m	0% 50% 90%



ELEVATION
SCALE: 1:25

Q MINOR CULVERT STILLING BASIN
SCALE: 1:25



3 SECTION
SCALE: 1:25

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES

1:20@ A1 / 1:40@ A3 — 0 200 400 600 800 1000 1200 1400 1600 1800 2000 mm
1:25@ A1 / 1:50@ A3 — 0 400 800 1200 1600 2000 2400 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: AS SHOWN
ORIGINAL SIZE: A1
DRAWN: J. BALDECANAS
DESIGNED: M. CHIARONI
APPROVED: -
DRAWING VERIFIED: -
DESIGN VERIFIED: -
APPROVED DATE: -

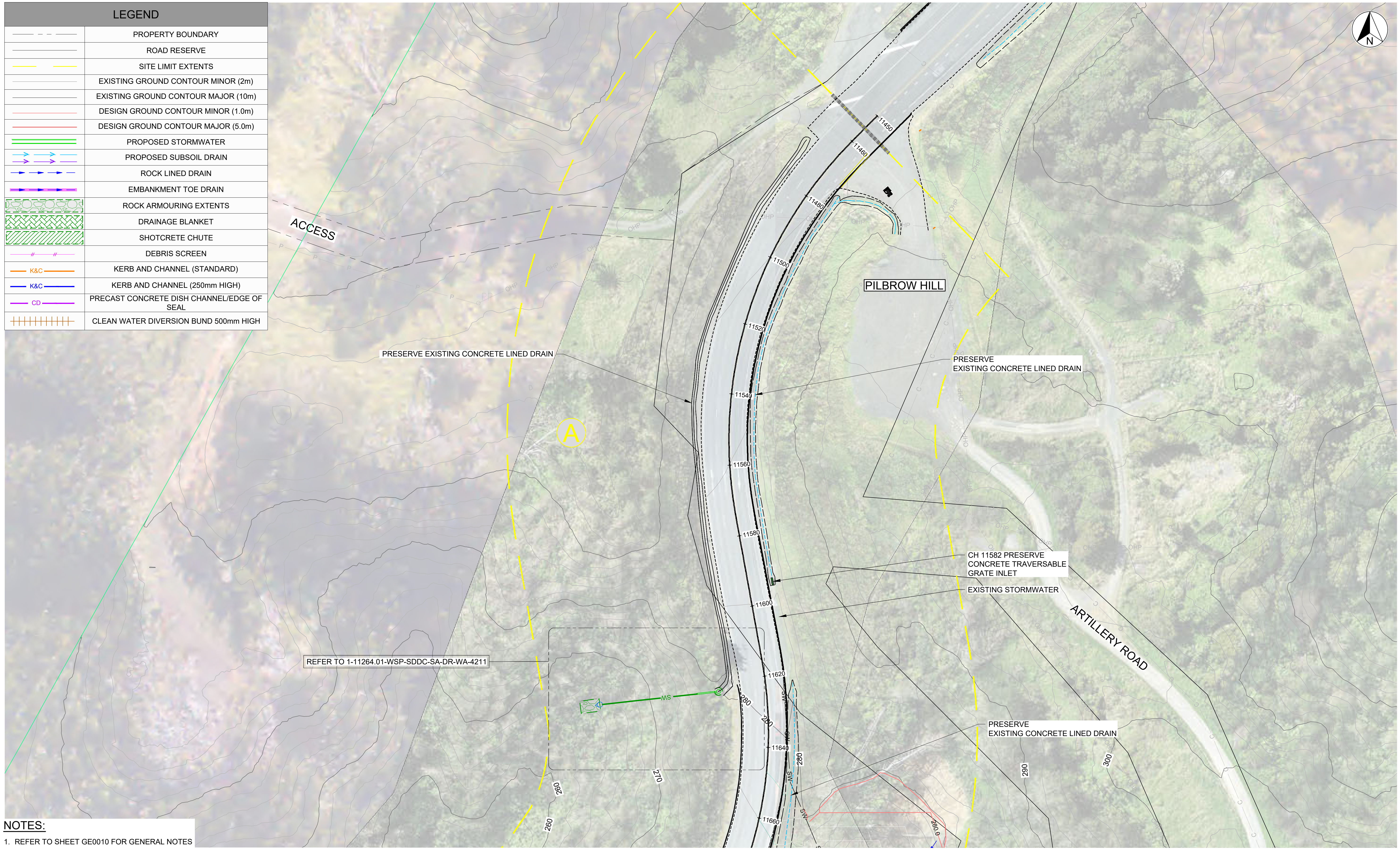
FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS - ENABLING WORKS

TITLE
OVERALL SITE
TYPICAL DETAILS - SHEET 5

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-EWGL-OA-DR-WA
SHEET NO.: WA4218
REVISION: 1

LEGEND	
	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH



NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

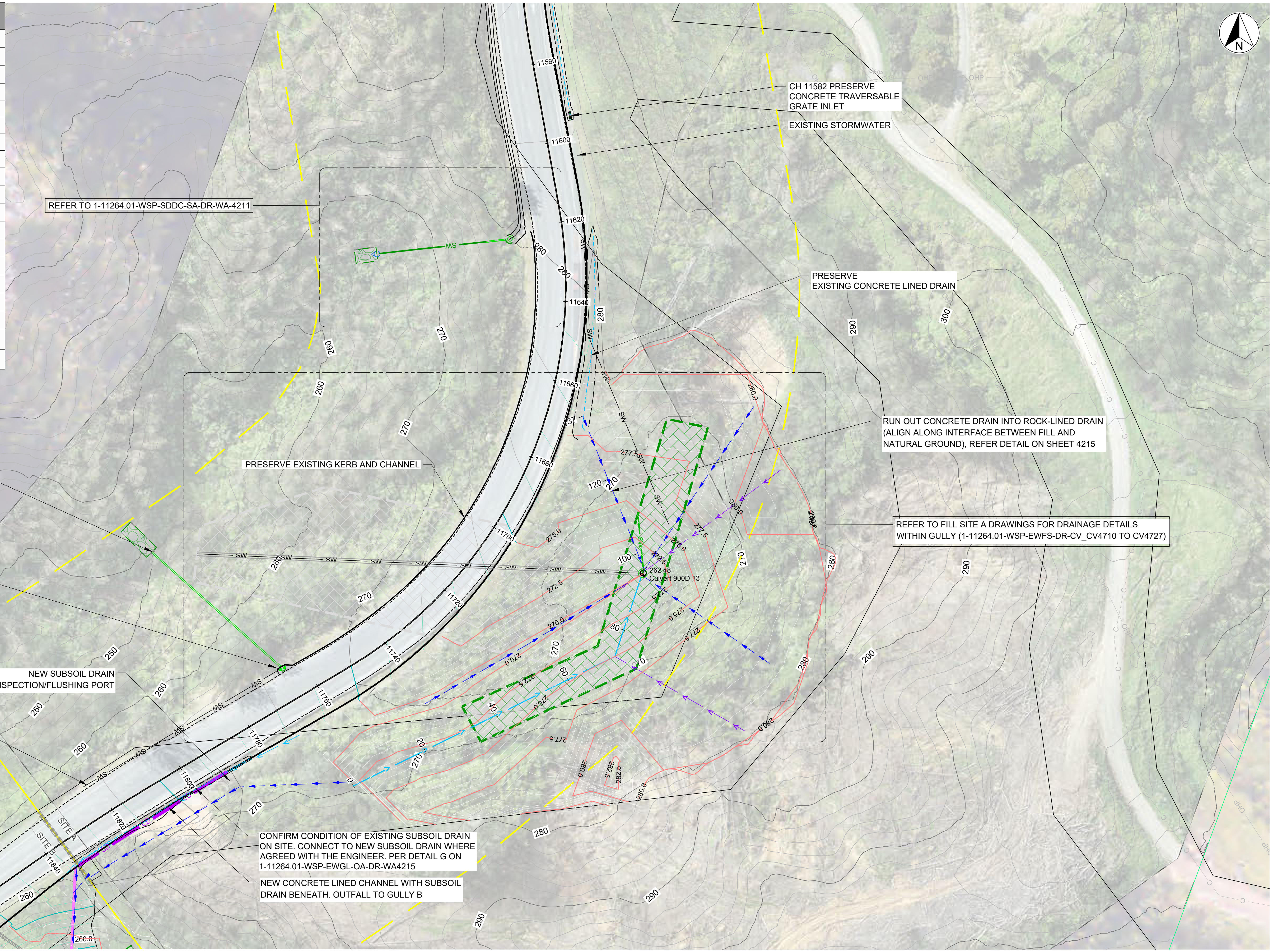
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
WATER - DRAINAGE PLANS
SITE A - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SA-DR-WA4000
SHEET NO.: SHEET 01A
REVISION: 1

LEGEND

— · —	PROPERTY BOUNDARY
——	ROAD RESERVE
— — (yellow)	SITE LIMIT EXTENTS
——	EXISTING GROUND CONTOUR MINOR (2m)
——	EXISTING GROUND CONTOUR MAJOR (10m)
—— (red)	DESIGN GROUND CONTOUR MINOR (1.0m)
—— (red)	DESIGN GROUND CONTOUR MAJOR (5.0m)
══ (green)	PROPOSED STORMWATER
→ →	PROPOSED SUBSOIL DRAIN
→ → (blue)	ROCK LINED DRAIN
→ → (magenta)	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
—//—	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
++++	CLEAN WATER DIVERSION BUND 500mm HIGH



NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

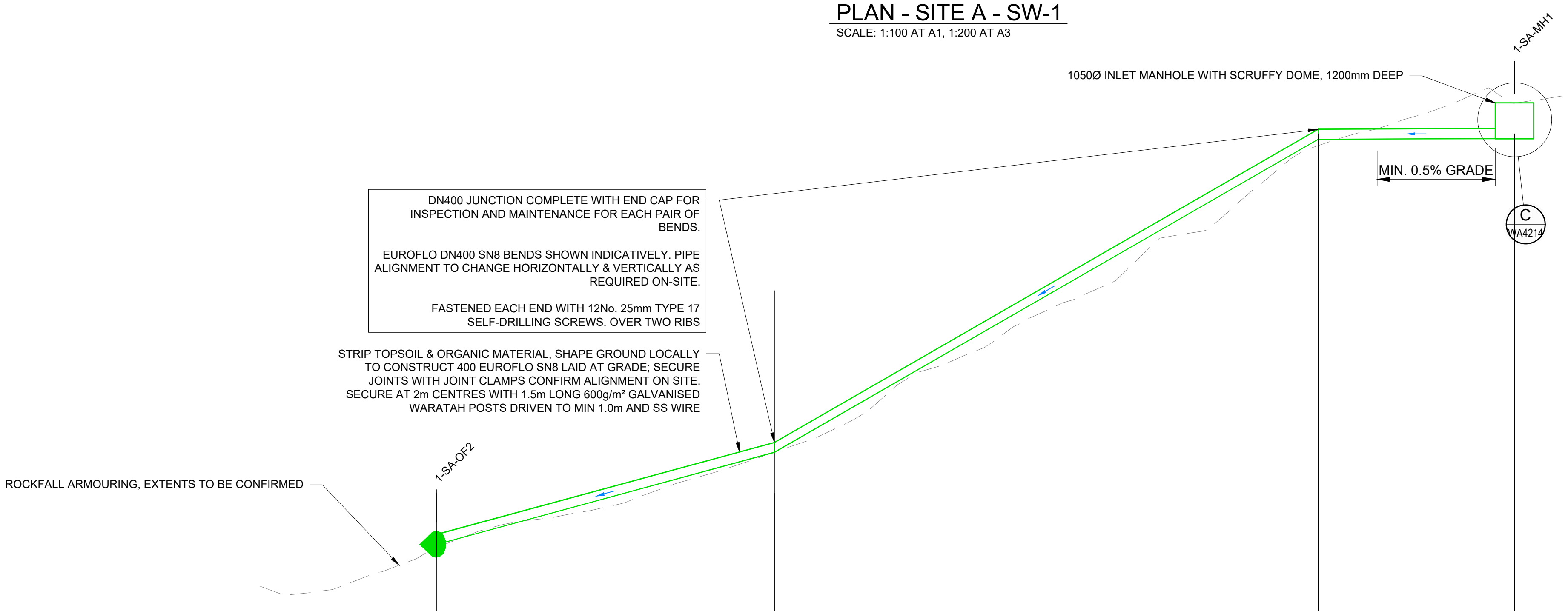
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
WATER - DRAINAGE PLANS
SITE A - PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SA-DR-WA4000	SHEET 01B	1

PLAN - SITE A - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 262.00

GROUND LEVEL (m)	264.82	267.80 267.80		277.33 277.33	278.64
DEPTH TO INVERT (m)	-0.11	0.01 0.01		-0.20 -0.20	1.09
PIPE INVERT LEVEL (m)	265.23	268.10 268.10		277.83 277.83	277.85
DISTANCE (m)	5.5	16.0 16.0		32.9 32.9	39.0
GRADIENT	27.24% (1:4)		57.63% (1:2)		0.35% (1:286)
PIPE SIZE AND MATERIAL	EUROFLO DN400 SN8		EUROFLO DN400 SN8		EUROFLO DN400 SN8

LONGSECTION - SITE A - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE A - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SA-MH1	DN1050 RCMH	CL = 278.955 1-SA-P1 INV OUT = 277.855	E: 369109.48 N: 889864.29
1-SA-OF2	OUTFALL	CL = 267.682 1-SA-P3 INV IN = 265.234	E: 369076.20 N: 889860.57

PIPE DATA - SITE A - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SA-P1	EUROFLO DN400 SN8	6.1	6.1	0.35%	277.85	277.83
1-SA-P2	EUROFLO DN400 SN8	16.9	19.5	57.63%	277.83	268.10
1-SA-P3	EUROFLO DN400 SN8	10.5	10.9	27.24%	268.10	265.23

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1
1:200 @ A3 0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3 | ORIGINAL SIZE: A1

DRAWN: V. GILES | DESIGNED: M. CHIARONI | APPROVED: -

DRAWING VERIFIED: - | DESIGN VERIFIED: - | APPROVED DATE: -

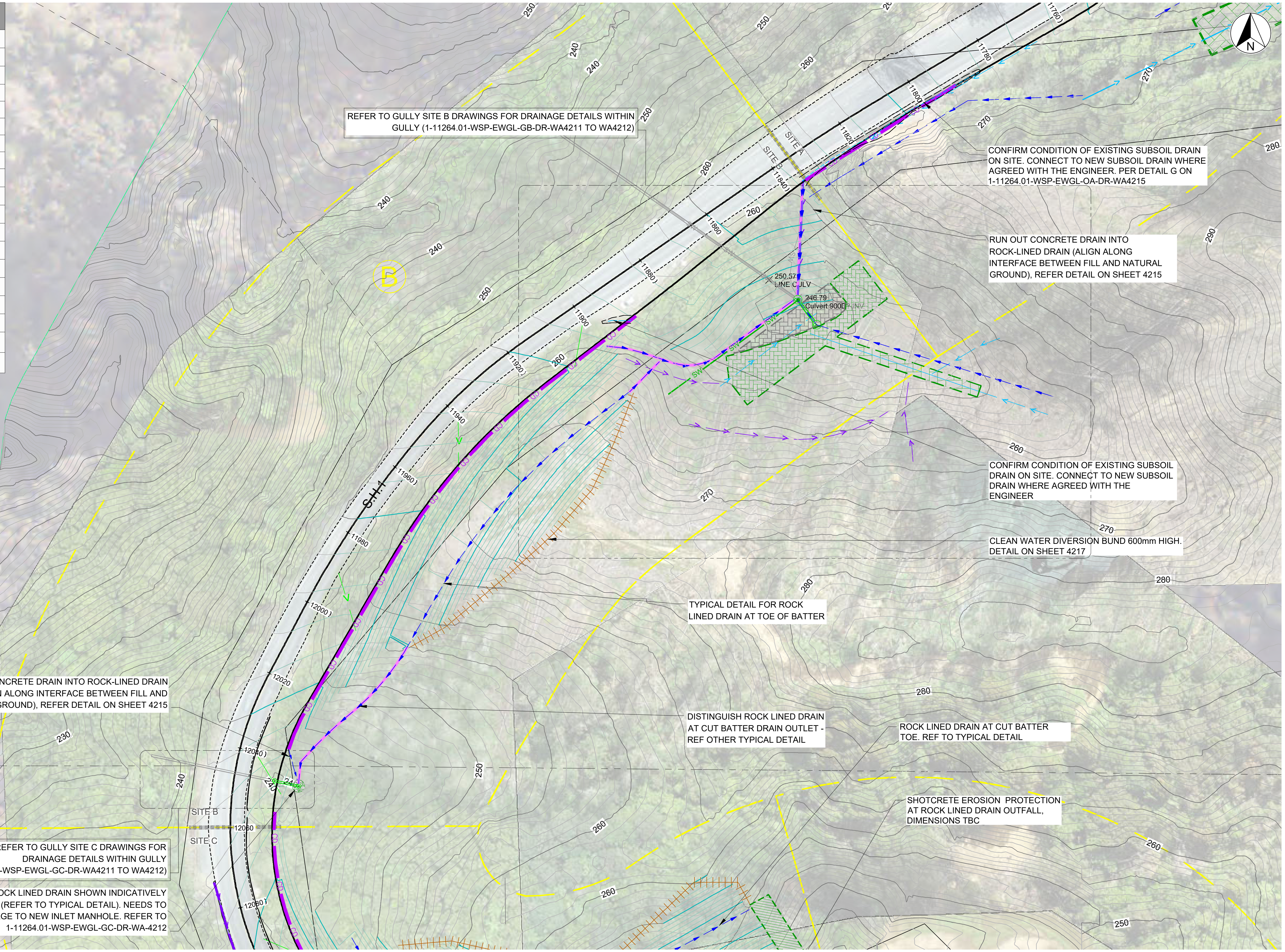
FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE A
DRAINAGE PLAN AND LONGSECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SA-DR | SHEET NO.: WA4211 | REVISION: 1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:36:08 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SA-DR-WA-4211.dwg WA4211



LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3 0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
8	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

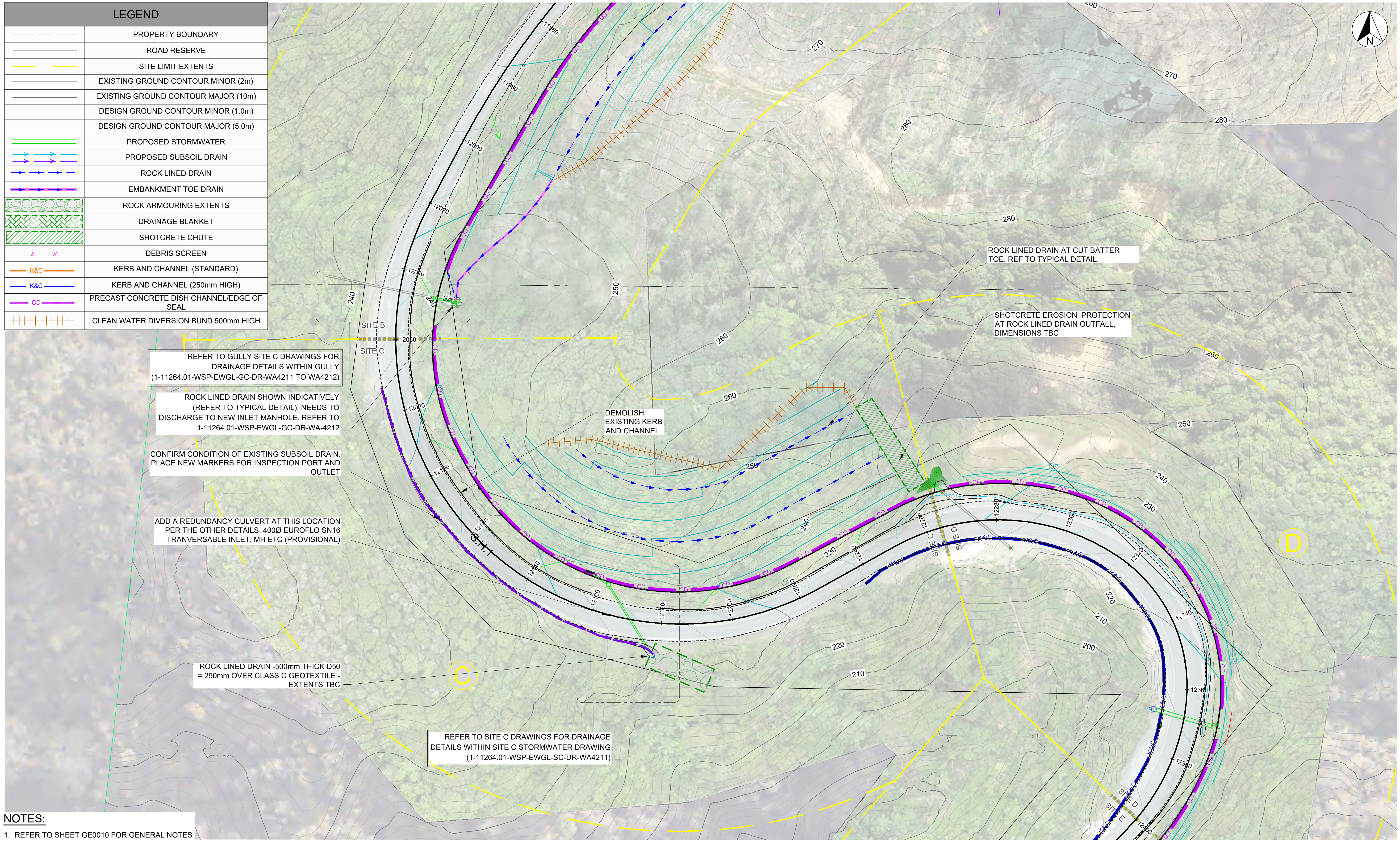
TITLE
WATER - DRAINAGE PLANS
SITE B - PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SB-DR-WA4000	SHEET 02	1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:37:11 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SB-DR-WA-4000.dwg WA4000

LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH



NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
7	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

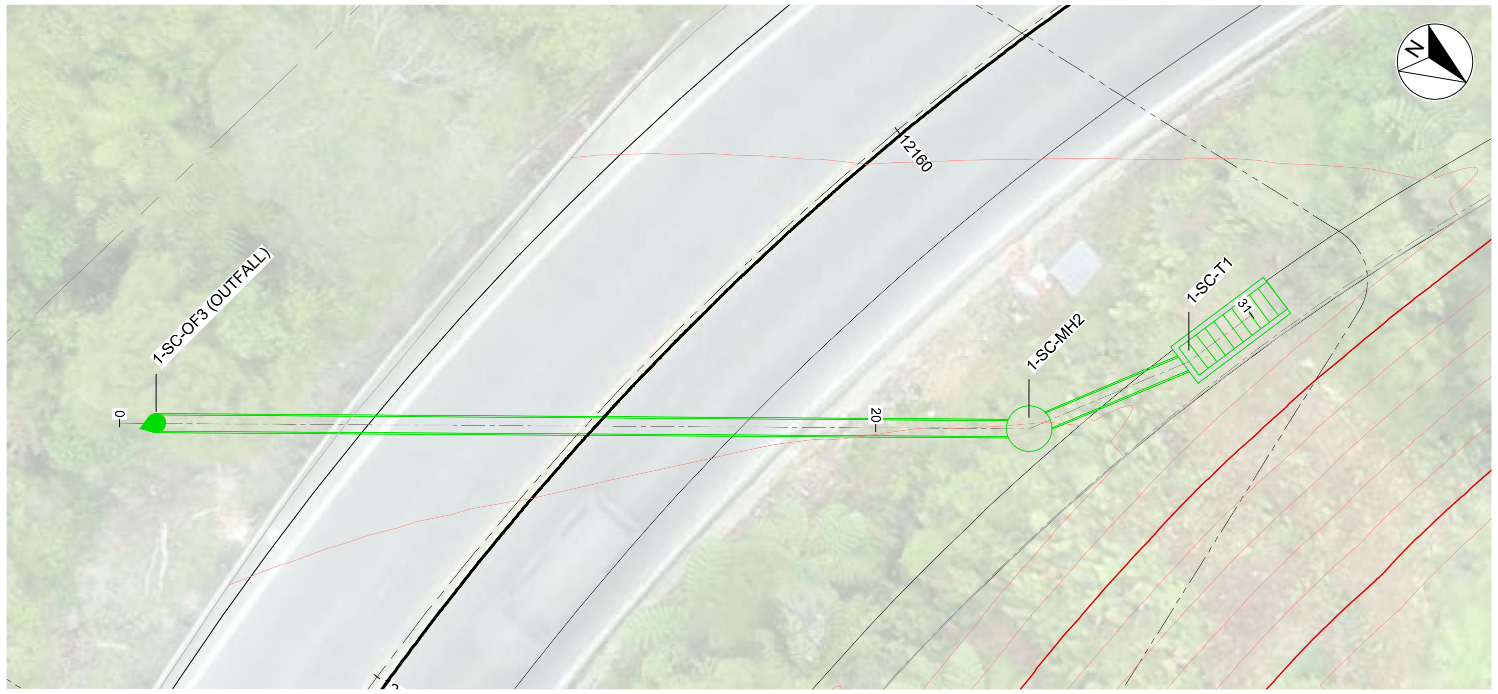
FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
WATER - DRAINAGE PLANS
SITE C - PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SC-DR-WA4000	SHEET 03	1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:38:21 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SC-DR-WA-4000.dwg WA4000



PLAN - SITE C - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

DATUM R.L. 230.00

		1-SC-OF3 (OUTFALL)	1-SC-MH2	1-SC-T1
GROUND LEVEL (m)		232.83	232.98 232.98	233.16
DEPTH TO INVERT (m)		1.66	1.65 1.57	0.61
PIPE INVERT LEVEL (m)		231.17	231.33 231.41	232.55
DISTANCE (m)		1.0	24.0 24.0	28.6
GRADIENT		0.70% (1:144)	25.00% (1:4)	
PIPE SIZE AND MATERIAL		EUROFLO DN500 (ID420) SN16	EUROFLO DN500 (ID420) SN16	

LONGSECTION - SITE C - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE C - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID
1-SC-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 233.257 1-SC-P1 INV OUT = 232.553	E: 368914.67 N: 889480.63
1-SC-MH2	DN1050 INLET MH WITH GRATE	CL = 232.982 1-SC-P1 INV IN = 231.407 1-SC-P2 INV OUT = 231.333	E: 368918.42 N: 889477.99
1-SC-OF3 (OUTFALL)	OUTFALL	CL = 231.854 1-SC-P2 INV IN = 231.172	E: 368930.51 N: 889458.32

PIPE DATA - SITE C - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SC-P1	EUROFLO DN500 (ID420) SN16	4.6	4.7	25.00%	232.55	231.41
1-SC-P2	EUROFLO DN500 (ID420) SN16	23.1	23.1	0.70%	231.33	231.17

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1 0 1 2 3 4 5 6 7 8 9 10 m
1:200 @ A3

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

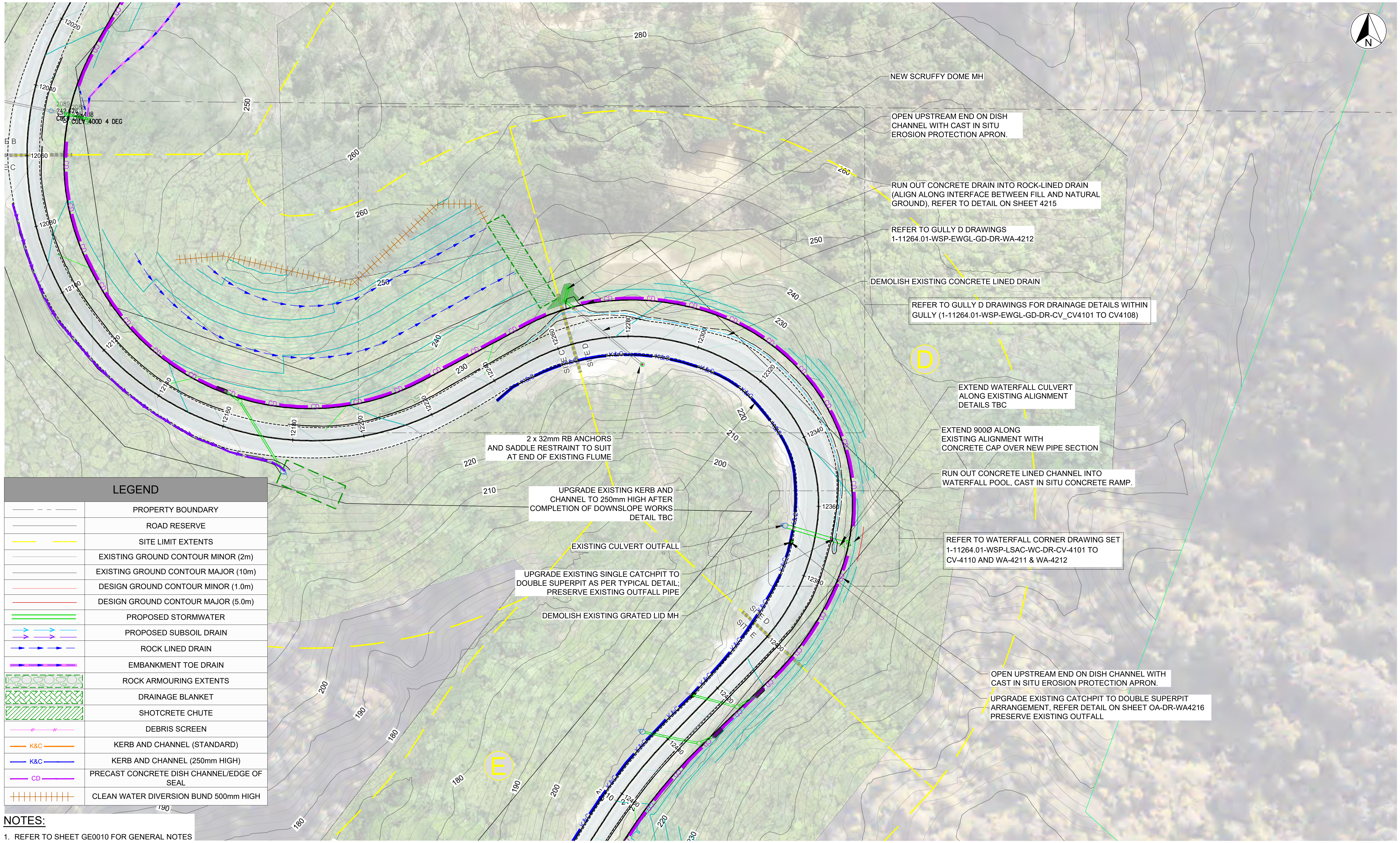
FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE C
DRAINAGE PLAN AND LONGSECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SC-DR
SHEET NO.: WA4211
REVISION: 1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:38:50 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SC-DR-WA-4211.dwg WA4211



LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1 / 1:1000 @ A3 — 0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
6	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp Whangarei Office +64 9 430 1700 — Private Bag 9017 Whangarei 0148 New Zealand

CIVIL

SCALES: 1:500 AT A1 — ORIGINAL SIZE: A1

DRAWN: V. GILES — DESIGNED: M. CHIARONI — APPROVED: -

DRAWING VERIFIED: - — DESIGN VERIFIED: - — APPROVED DATE: -

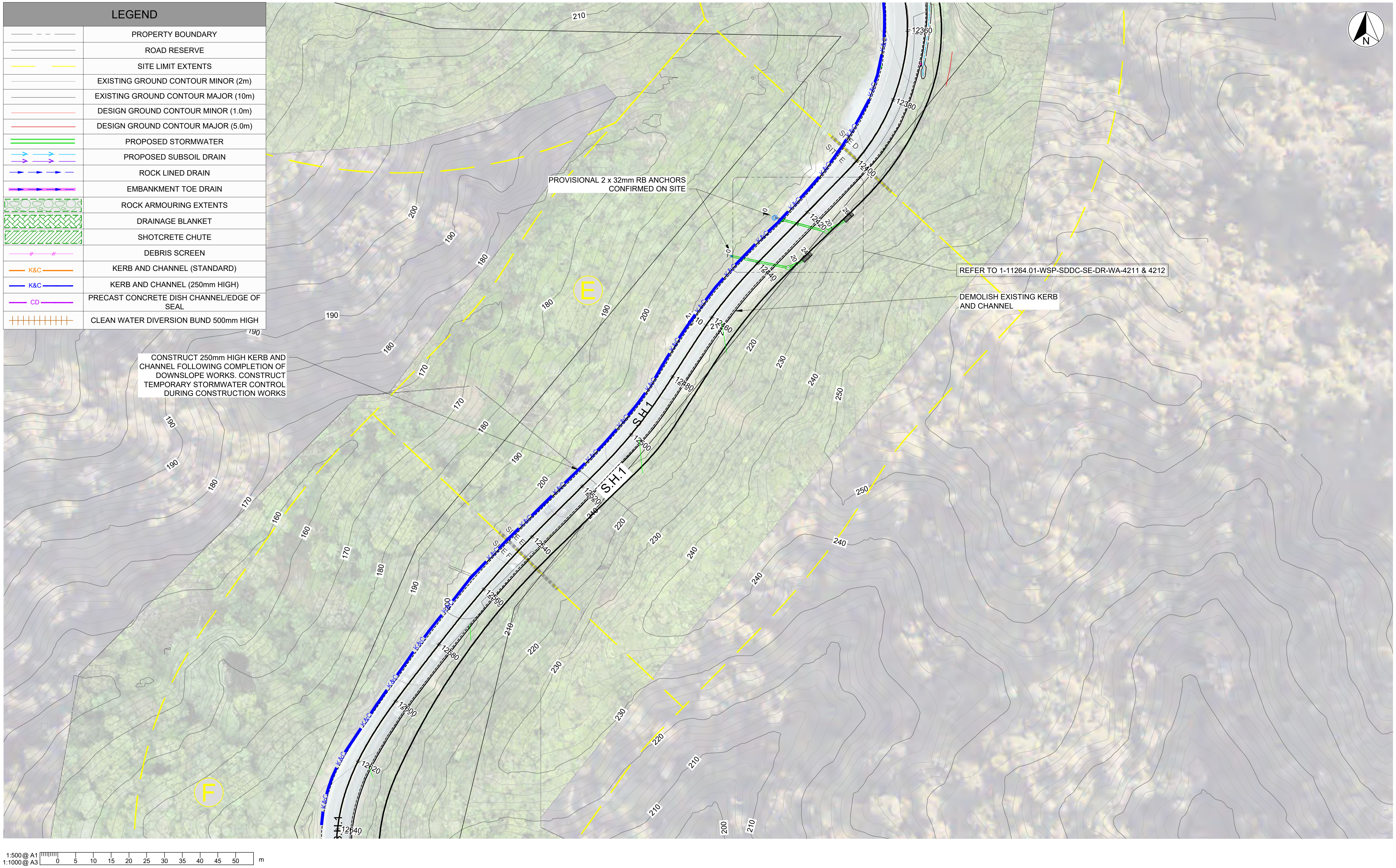
FOR CONSTRUCTION - 80% DRAFT

PROJECT: WAKA KOTAHI NZ TRANSPORT AGENCY BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0 BRYNDERWYN HILL REPAIRS

TITLE: WATER - DRAINAGE PLANS SITE D - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SD-DR-WA4000 — SHEET NO.: SHEET 04 — REVISION: 1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:39:53 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SD-DR-WA-4000.dwg WA4000



REVISION	AMENDMENT	APPROVED	DATE
5	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1

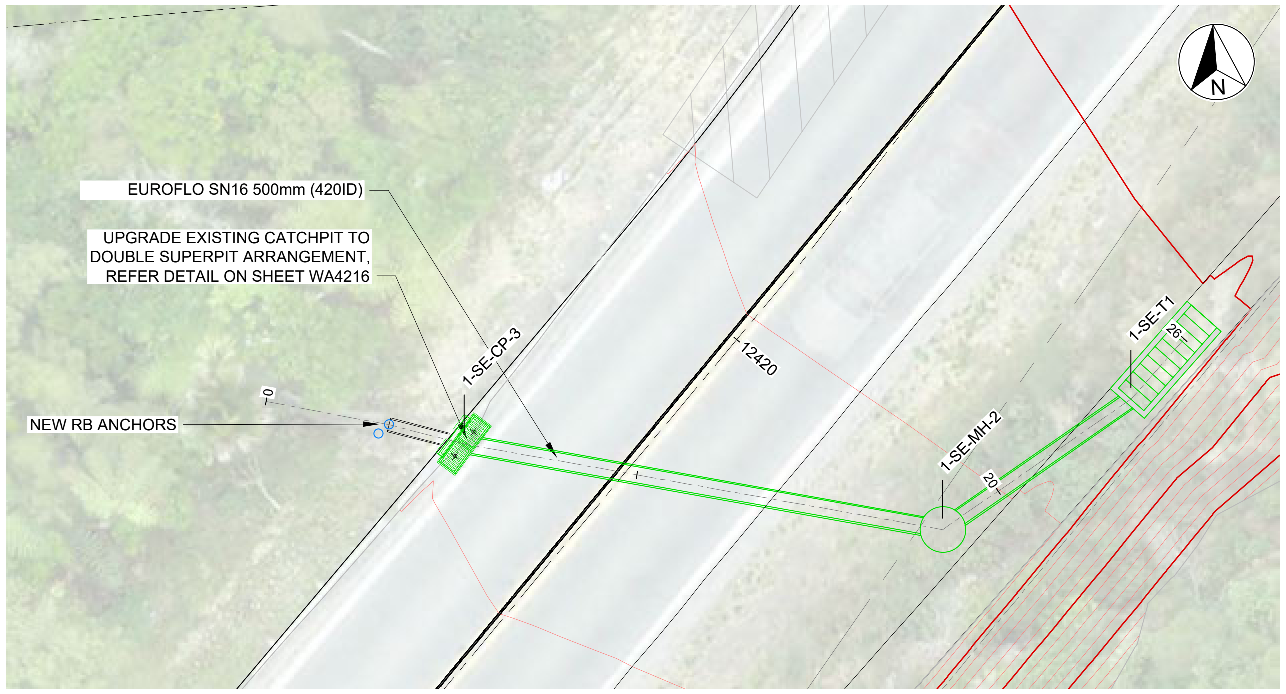
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

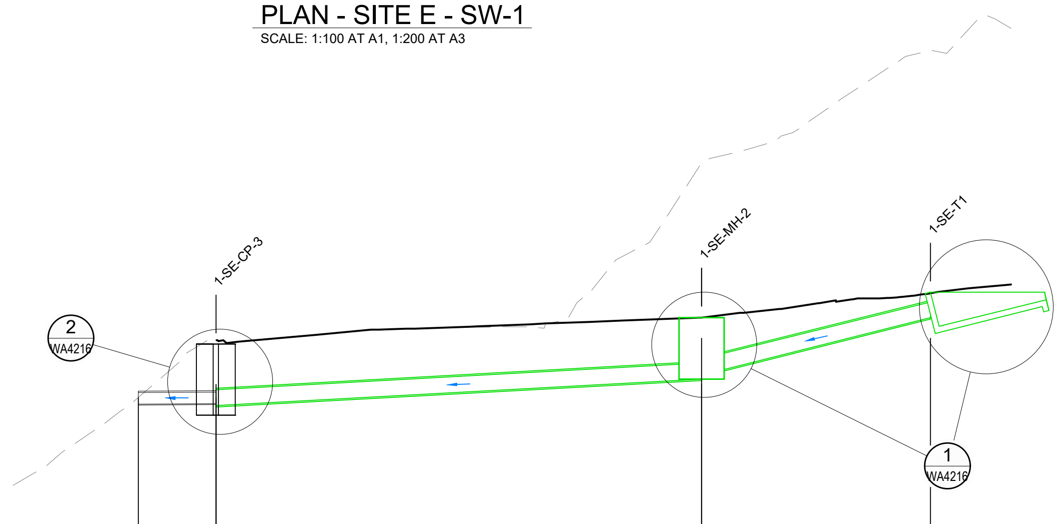
TITLE
WATER - DRAINAGE PLANS
SITE E - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SE-DR-WA4000
SHEET NO.: SHEET 05
REVISION: 1



PLAN - SITE E - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 208.00

GROUND LEVEL (m)	211.35	212.76	212.63	213.33	213.33	213.94
DEPTH TO INVERT (m)	0.17	1.57	1.62	1.62	1.52	0.61
PIPE INVERT LEVEL (m)	211.51	211.52	211.47	212.17	212.27	213.79
DISTANCE (m)	3.3	5.4	5.4	18.2	18.2	24.3
GRADIENT	0.54% (1:185)		5.47% (1:18)		25.00% (1:4)	
PIPE SIZE AND MATERIAL	EX DN300		EUROFLO DN500 (ID420) SN16		EUROFLO DN500 (ID420) SN16	

LONGSECTION - SITE E - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE E - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SE-CP-3	DOUBLE SUPERPIT	CL = 213.093 1-SE-P-2 INV IN = 211.468 1-SE-P-3 INV OUT = 211.522	E: 369045.42 N: 889395.62
1-SE-MH-2	DN1050 INLET MH WITH GRATE	CL = 213.796 1-SE-P-1 INV IN = 212.275 1-SE-P-2 INV OUT = 212.171	E: 369057.84 N: 889392.34
1-SE-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 214.465 1-SE-P-1 INV OUT = 213.789	E: 369063.09 N: 889395.37

PIPE DATA - SITE E - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SE-P-1	EUROFLO DN500 (ID420) SN16	6.1	6.2	25.00%	213.79	212.27
1-SE-P-2	EUROFLO DN500 (ID420) SN16	12.9	12.9	5.47%	212.17	211.47
1-SE-P-3	EX DN300	2.1	2.1	0.54%	211.52	211.51

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1 1:200 @ A3 0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

WSP
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3
ORIGINAL SIZE: A1

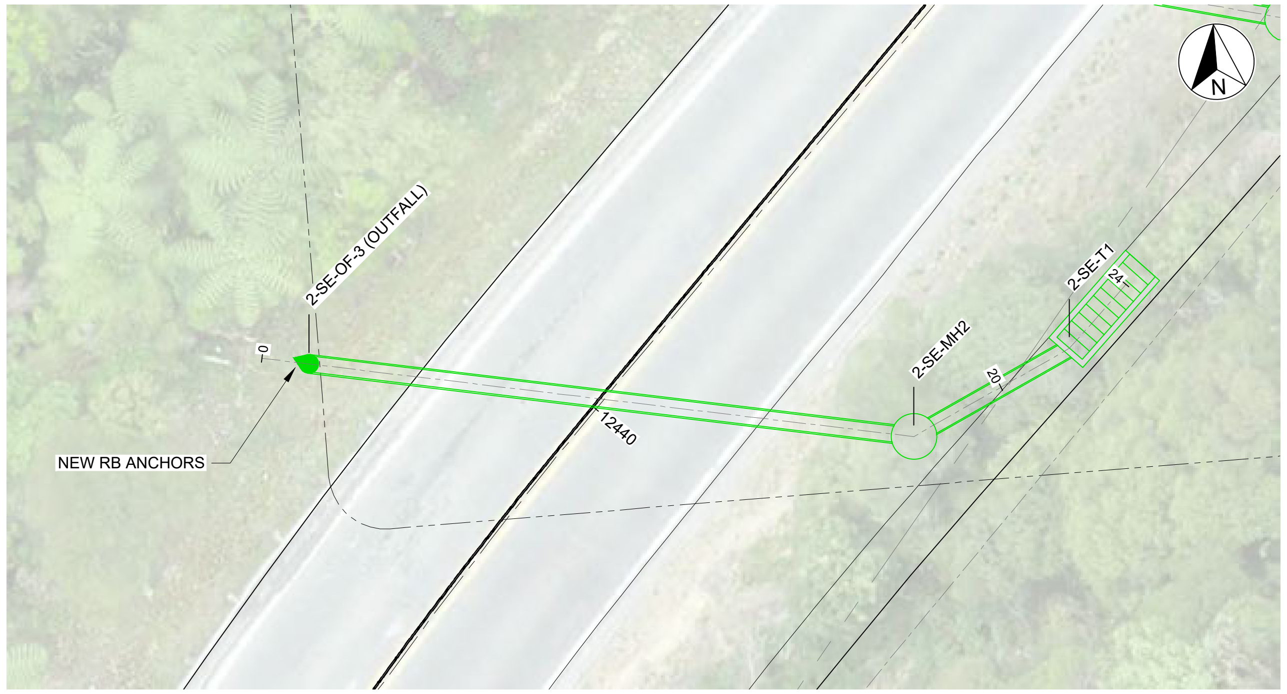
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

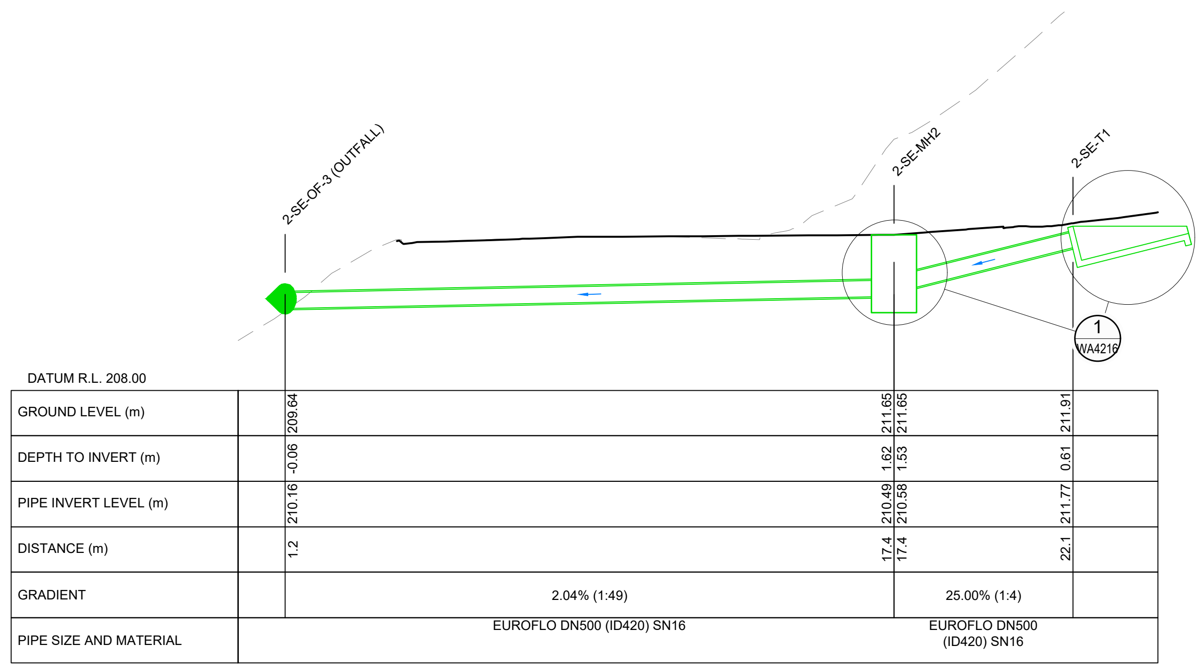
TITLE
SITE E
DRAINAGE PLAN AND LONGSECTION - SHEET 1

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SE-DR	WA4211	1



PLAN - SITE E - SW-2

SCALE: 1:100 AT A1, 1:200 AT A3



LONGSECTION - SITE E - SW-2

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE E - SW-2

ID	TYPE	DETAILS	CO-ORD (CENTROID)
2-SE-MH2	DN1050 INLET MH WITH GRATE	CL = 212.116 2-SE-P-1 INV IN = 210.584 2-SE-P-2 INV OUT = 210.491	E: 369047.10 N: 889382.14
2-SE-OF-3 (OUTFALL)	OUTFALL	CL = 212.373 2-SE-P-2 INV IN = 210.162	E: 369031.31 N: 889385.36
2-SE-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 212.340 2-SE-P-1 INV OUT = 211.766	E: 369051.39 N: 889384.13

PIPE DATA - SITE E - SW-2

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
2-SE-P-1	EUROFLO DN500 (ID420) SN16	4.7	4.9	25.00%	211.77	210.58
2-SE-P-2	EUROFLO DN500 (ID420) SN16	16.1	16.1	2.04%	210.49	210.16

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1 1:200 @ A3 0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp

Whangarei Office
+64 9 430 1700

Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3

ORIGINAL SIZE: A1

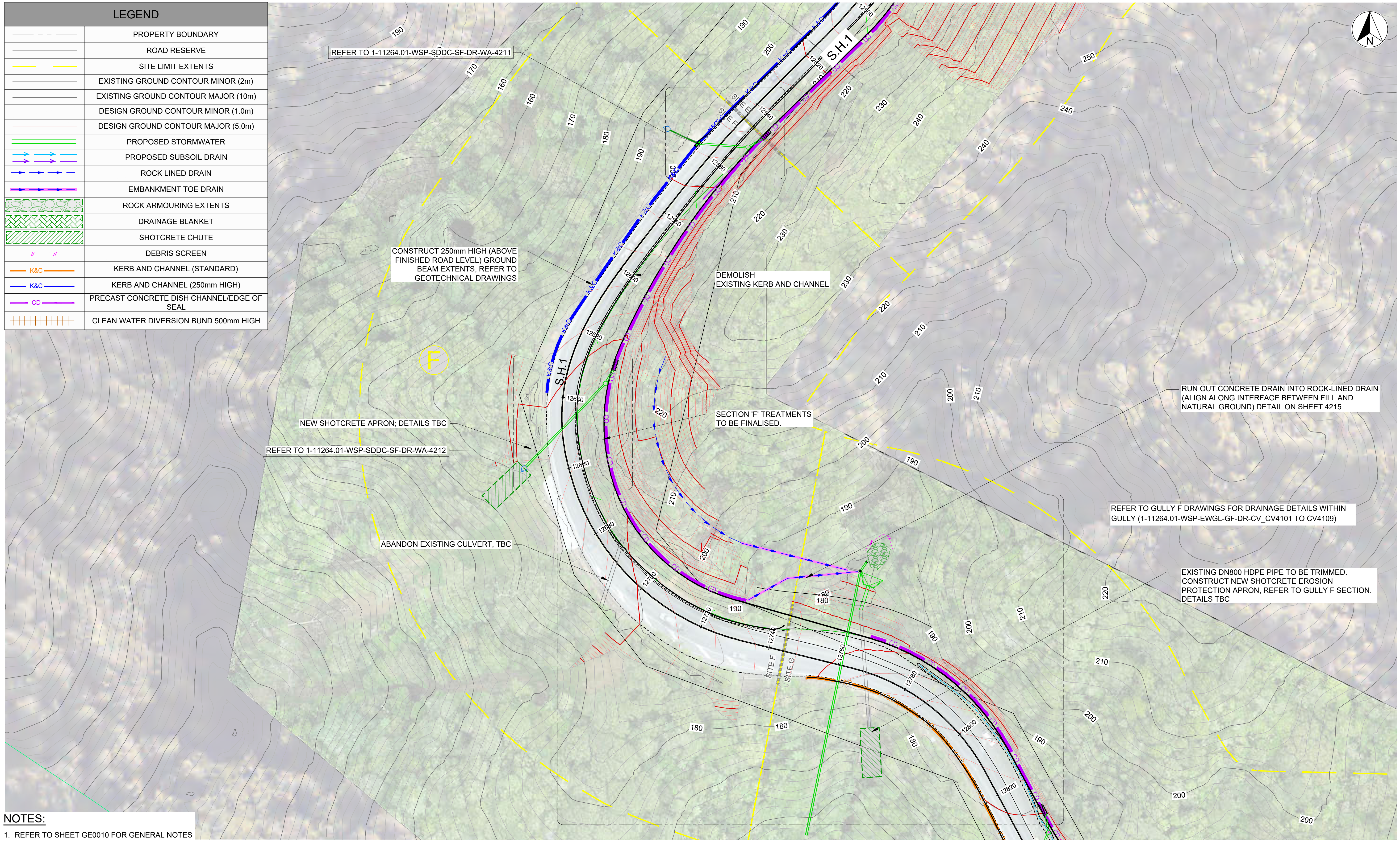
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE E
DRAINAGE PLAN AND LONGSECTION - SHEET 2

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SE-DR	WA4212	1



LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
4	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:500 AT A1 — ORIGINAL SIZE: A1

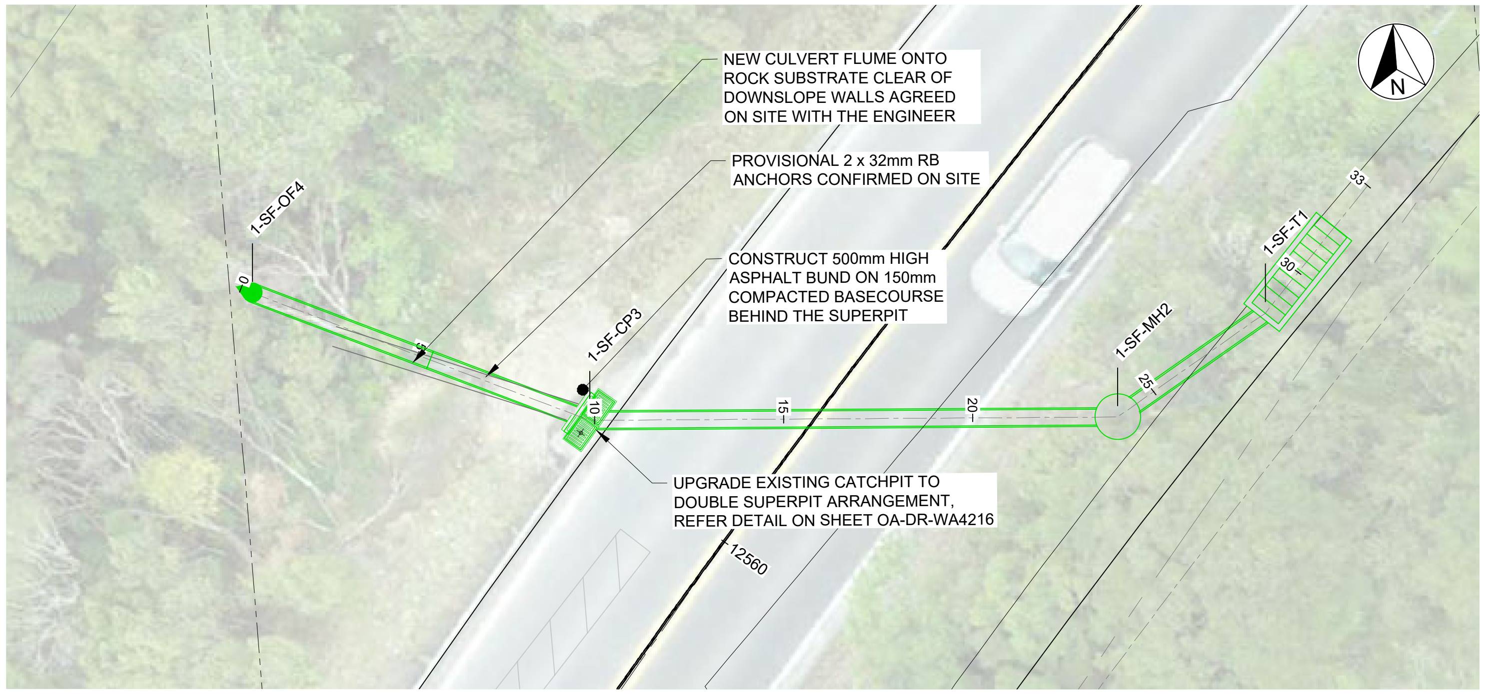
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

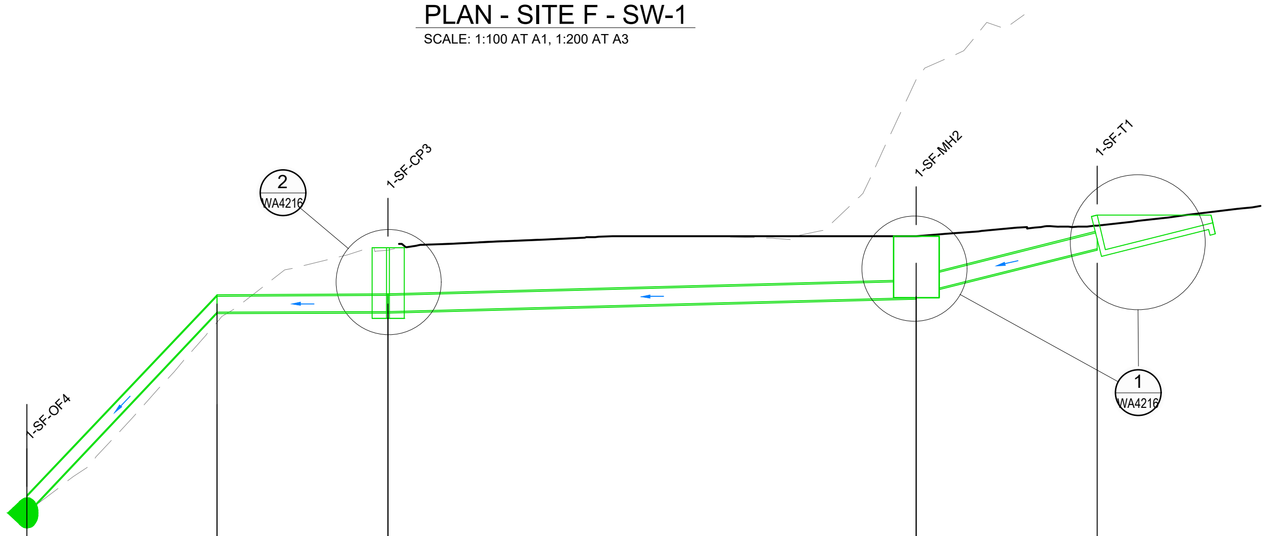
TITLE
WATER - DRAINAGE PLANS
SITE F - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SF-DR-WA4000
SHEET NO.: SHEET 06
REVISION: 1



PLAN - SITE F - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 193.00

GROUND LEVEL (m)	194.18		199.18 / 199.18		201.15 / 201.15		201.45 / 201.45		201.73
DEPTH TO INVERT (m)	0.04		-0.26 / -0.26		1.69 / 1.69		1.62 / 1.53		0.61
PIPE INVERT LEVEL (m)	194.14		199.44 / 199.44		199.46 / 199.46		199.83 / 199.92		201.12
DISTANCE (m)	0.3		5.3 / 5.3		9.9 / 9.9		23.8 / 23.8		28.6
GRADIENT		105.54% (1:1)		0.50% (1:200)		2.62% (1:38)		25.00% (1:4)	
PIPE SIZE AND MATERIAL		EUROFLO DN500 (ID420) SN16		EUROFLO DN500 (ID420) SN16		EUROFLO DN500 (ID420) SN16		EUROFLO DN500 (ID420) SN16	

LONGSECTION - SITE F - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE F - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SF-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 202.002 1-SF-P-1 INV OUT = 201.117	E: 368976.54 N: 889296.86
1-SF-MH2	DN1050 INLET MH WITH GRATE	CL = 201.451 1-SF-P-1 INV IN = 199.923 1-SF-P-2 INV OUT = 199.826	E: 368972.42 N: 889294.44
1-SF-CP3	DOUBLE SUPERPIT	CL = 201.150 1-SF-P-2 INV IN = 199.461 1-SF-P-3 INV OUT = 199.461	E: 368958.49 N: 889295.48
1-SF-OF4	OUTFALL	CL = 194.601 1-SF-P-4 INV IN = 194.136	E: 368949.87 N: 889299.58

PIPE DATA - SITE F - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SF-P-1	EUROFLO DN500 (ID420) SN16	4.8	4.9	25.00%	201.12	199.92
1-SF-P-2	EUROFLO DN500 (ID420) SN16	14.0	14.0	2.62%	199.83	199.46
1-SF-P-3	EUROFLO DN500 (ID420) SN16	4.5	4.5	0.50%	199.46	199.44
1-SF-P-4	EUROFLO DN500 (ID420) SN16	5.0	7.3	105.54%	199.44	194.14

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1
1:200 @ A3
0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

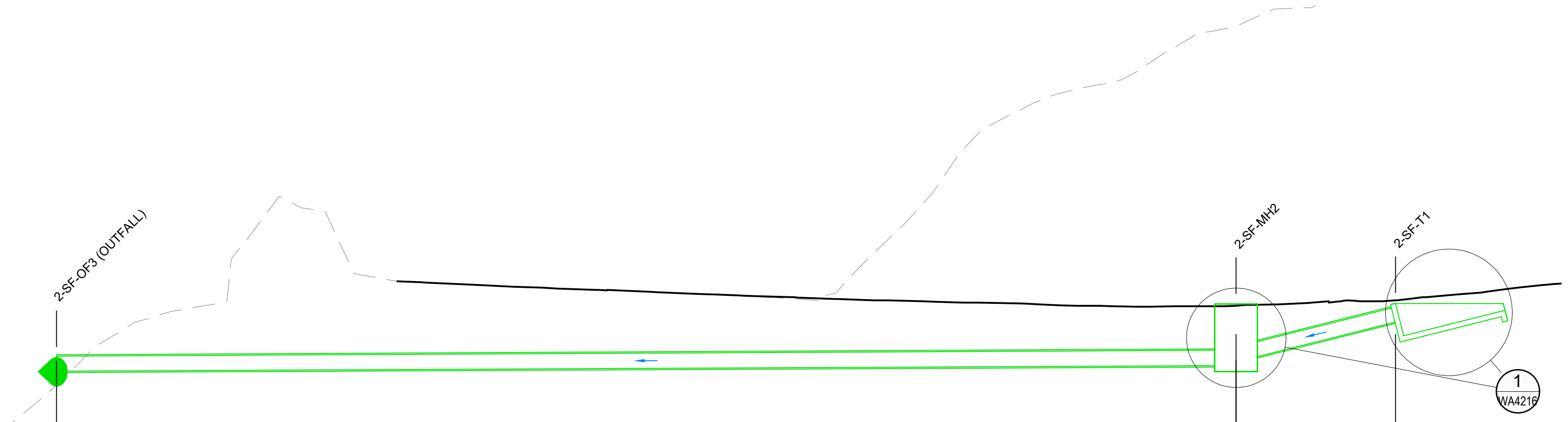
TITLE
SITE F
DRAINAGE PLAN AND LONGSECTION - SHEET 1

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SF-DR	WA4211	1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:43:14 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SF-DR-WA-4211.dwg WA4211

PLAN - SITE F - SW-2

SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 190.00

	2-SF-OF3 (OUTFALL)	2-SF-MH2	2-SF-T1
GROUND LEVEL (m)	191.41	193.61 193.61	193.76
DEPTH TO INVERT (m)	-0.36	1.67 1.58	0.61
PIPE INVERT LEVEL (m)	191.78	191.94 192.03	193.15
DISTANCE (m)	1.4	34.4 34.4	38.8
GRADIENT	0.50% (1:200)	25.00% (1:4)	
PIPE SIZE AND MATERIAL	EUROFLO DN500 (ID420) SN16	EUROFLO DN500 (ID420) SN16	

LONGSECTION - SITE F - SW-2

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE F - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SF-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 202.002 1-SF-P-1 INV OUT = 201.117	E: 368976.54 N: 889296.86
1-SF-MH2	DN1050 INLET MH WITH GRATE	CL = 201.451 1-SF-P-1 INV IN = 199.923 1-SF-P-2 INV OUT = 199.826	E: 368972.42 N: 889294.44
1-SF-CP3	DOUBLE SUPERPIT	CL = 201.150 1-SF-P-2 INV IN = 199.461 1-SF-P-3 INV OUT = 199.461	E: 368958.49 N: 889295.48
1-SF-OF4	OUTFALL	CL = 194.601 1-SF-P-4 INV IN = 194.136	E: 368949.87 N: 889299.58

PIPE DATA - SITE F - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SF-P-1	EUROFLO DN500 (ID420) SN16	4.8	4.9	25.00%	201.12	199.92
1-SF-P-2	EUROFLO DN500 (ID420) SN16	14.0	14.0	2.62%	199.83	199.46
1-SF-P-3	EUROFLO DN500 (ID420) SN16	4.5	4.5	0.50%	199.46	199.44
1-SF-P-4	EUROFLO DN500 (ID420) SN16	5.0	7.3	105.54%	199.44	194.14

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1
1:200 @ A3
0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3
ORIGINAL SIZE: A1

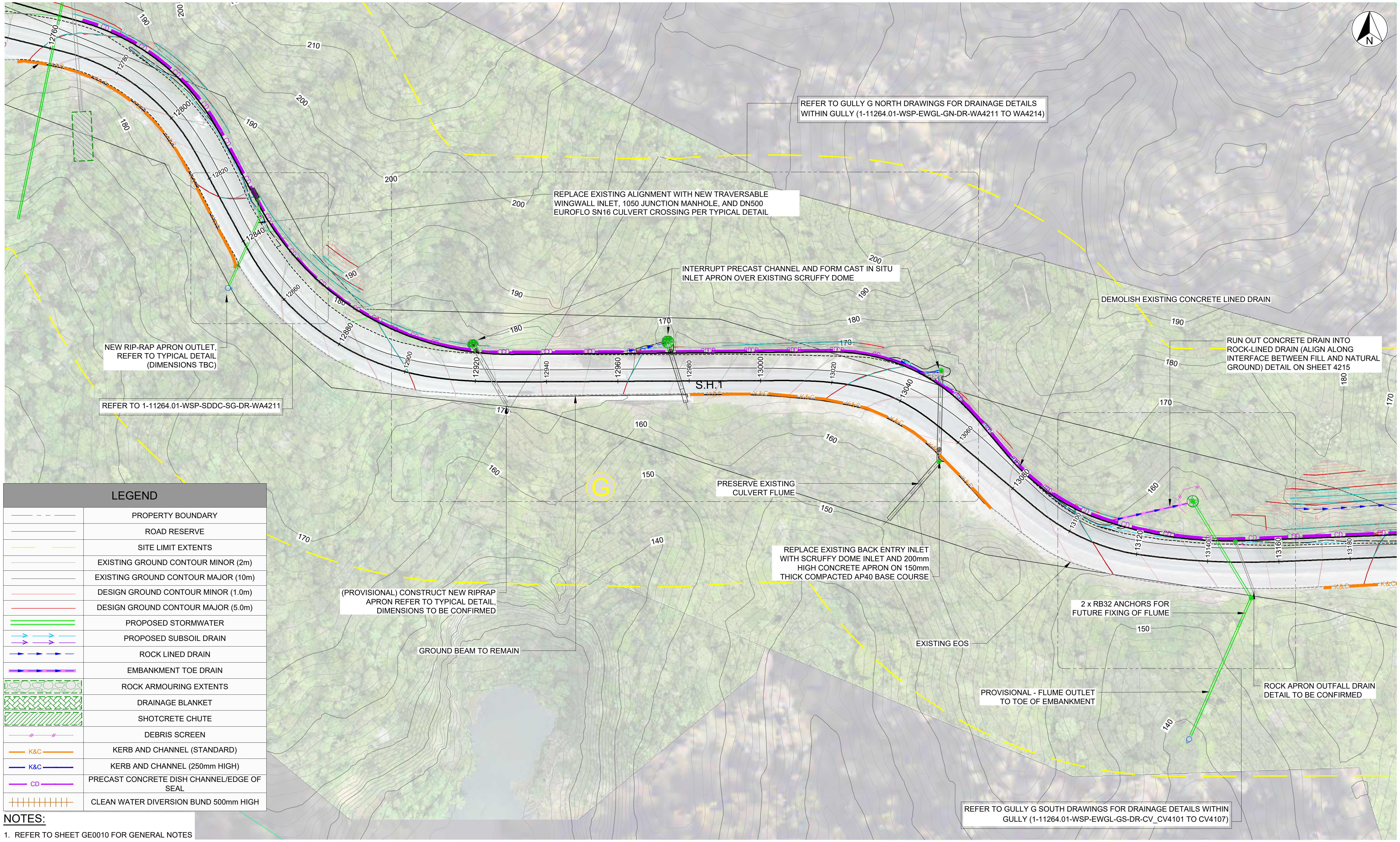
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE F
DRAINAGE PLAN AND LONGSECTION - SHEET 2

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SF-DR
SHEET NO.: WA4212
REVISION: 1



LEGEND

— — —	PROPERTY BOUNDARY
———	ROAD RESERVE
— —	SITE LIMIT EXTENTS
———	EXISTING GROUND CONTOUR MINOR (2m)
———	EXISTING GROUND CONTOUR MAJOR (10m)
———	DESIGN GROUND CONTOUR MINOR (1.0m)
———	DESIGN GROUND CONTOUR MAJOR (5.0m)
———	PROPOSED STORMWATER
→ →	PROPOSED SUBSOIL DRAIN
→ →	ROCK LINED DRAIN
→ →	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
—#—#—	DEBRIS SCREEN
—K&C—	KERB AND CHANNEL (STANDARD)
—K&C—	KERB AND CHANNEL (250mm HIGH)
—CD—	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
3	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

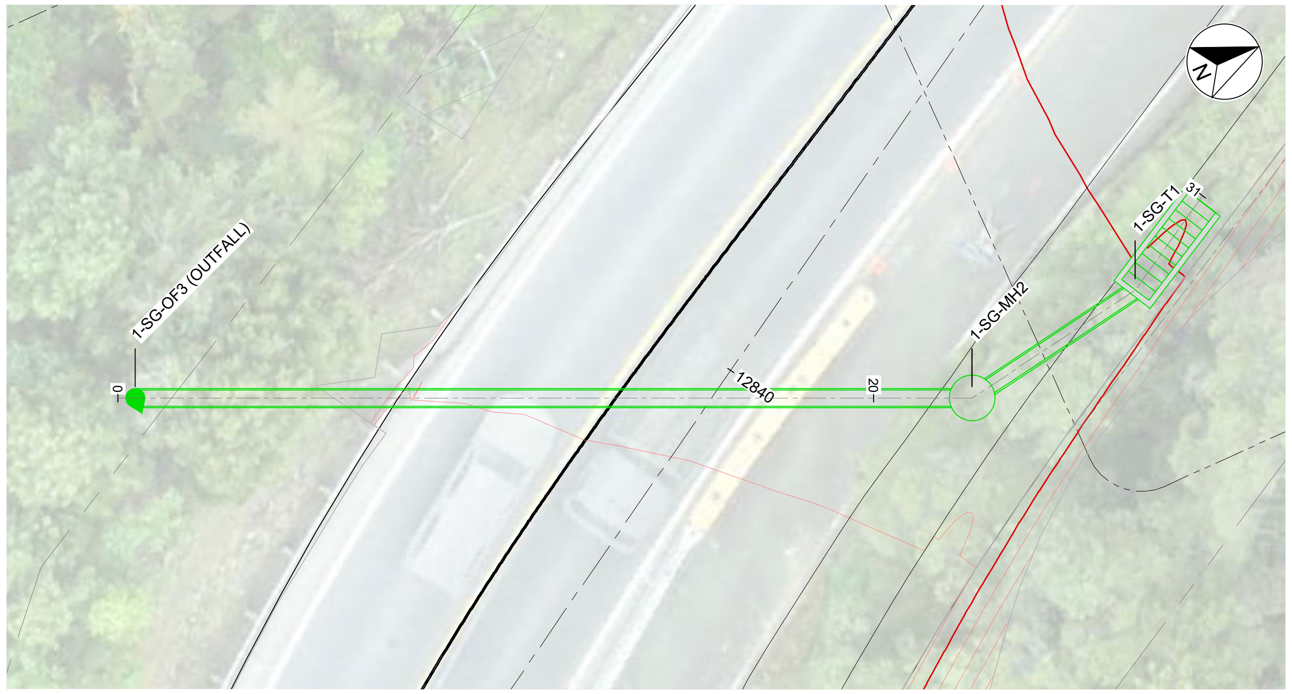
SCALES: 1:500 AT A1		ORIGINAL SIZE: A1
DRAWN: V. GILES	DESIGNED: M. CHIARONI	APPROVED: -
DRAWING VERIFIED: -	DESIGN VERIFIED: -	APPROVED DATE: -

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

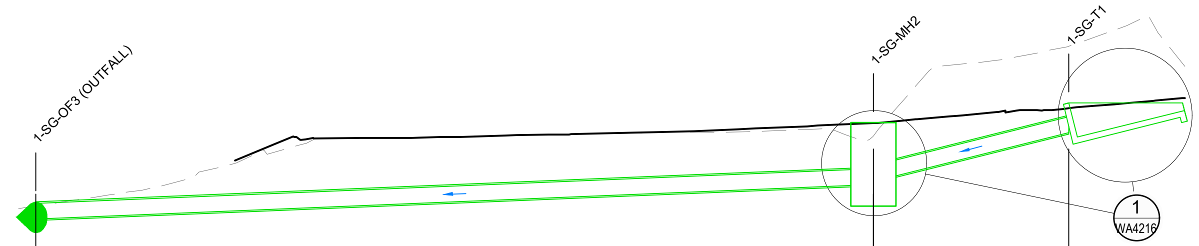
TITLE
WATER - DRAINAGE PLANS
SITE G - PLAN

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SG-DR-WA4000	SHEET 07	1



PLAN - SITE G - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 176.00

	1-SG-OF3 (OUTFALL)	1-SG-MH2	1-SG-T1
GROUND LEVEL (m)	177.22	179.40 / 179.40	179.76
DEPTH TO INVERT (m)	0.35	1.62 / 1.54	0.61
PIPE INVERT LEVEL (m)	176.86	177.78 / 177.86	179.15
DISTANCE (m)	0.5	22.6 / 22.6	27.8
GRADIENT	4.12% (1:24)	25.00% (1:4)	
PIPE SIZE AND MATERIAL	EUROFLO DN500 (ID420) SN16	EUROFLO DN500 (ID420) SN16	

LONGSECTION - SITE G - SW-1

SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE G - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SG-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 179.937 1-SG-P1 INV OUT = 179.152	E: 369055.85 N: 889107.30
1-SG-MH2	DN1050 INLET MH WITH GRATE	CL = 179.413 1-SG-P1 INV IN = 177.858 1-SG-P2 INV OUT = 177.775	E: 369056.67 N: 889102.19
1-SG-OF3 (OUTFALL)	OUTFALL	CL = 179.144 1-SG-P2 INV IN = 176.863	E: 369047.55 N: 889082.00

PIPE DATA - SITE G - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SG-P1	EUROFLO DN500 (ID420) SN16	5.2	5.3	25.00%	179.15	177.86
1-SG-P2	EUROFLO DN500 (ID420) SN16	22.2	22.2	4.12%	177.78	176.86

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1
1:200 @ A3 0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES: 1:100 AT A1, 1:200 AT A3
ORIGINAL SIZE: A1

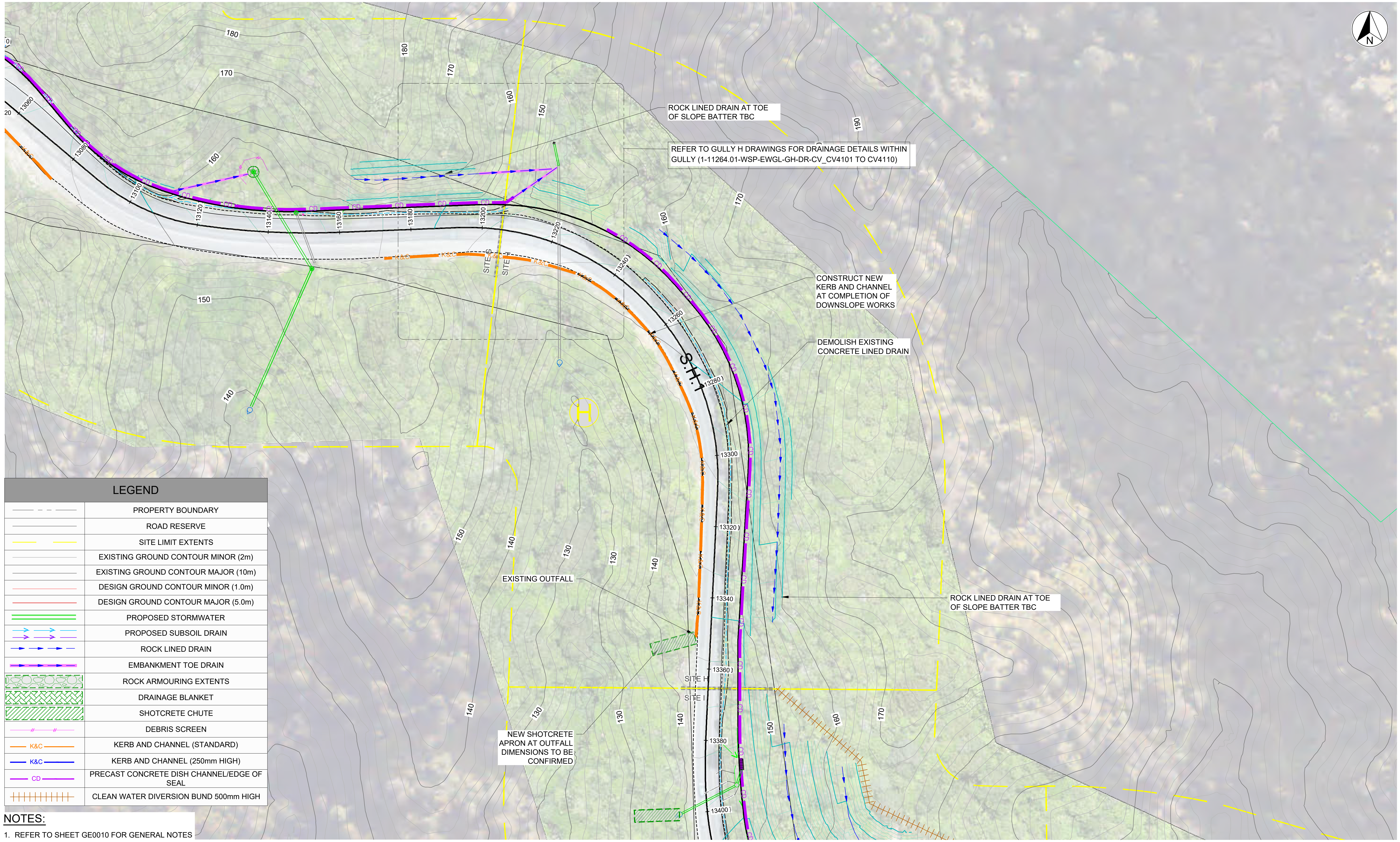
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE G
DRAINAGE PLAN AND LONGSECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SG-DR
SHEET NO.: WA4211
REVISION: 1



LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
2	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

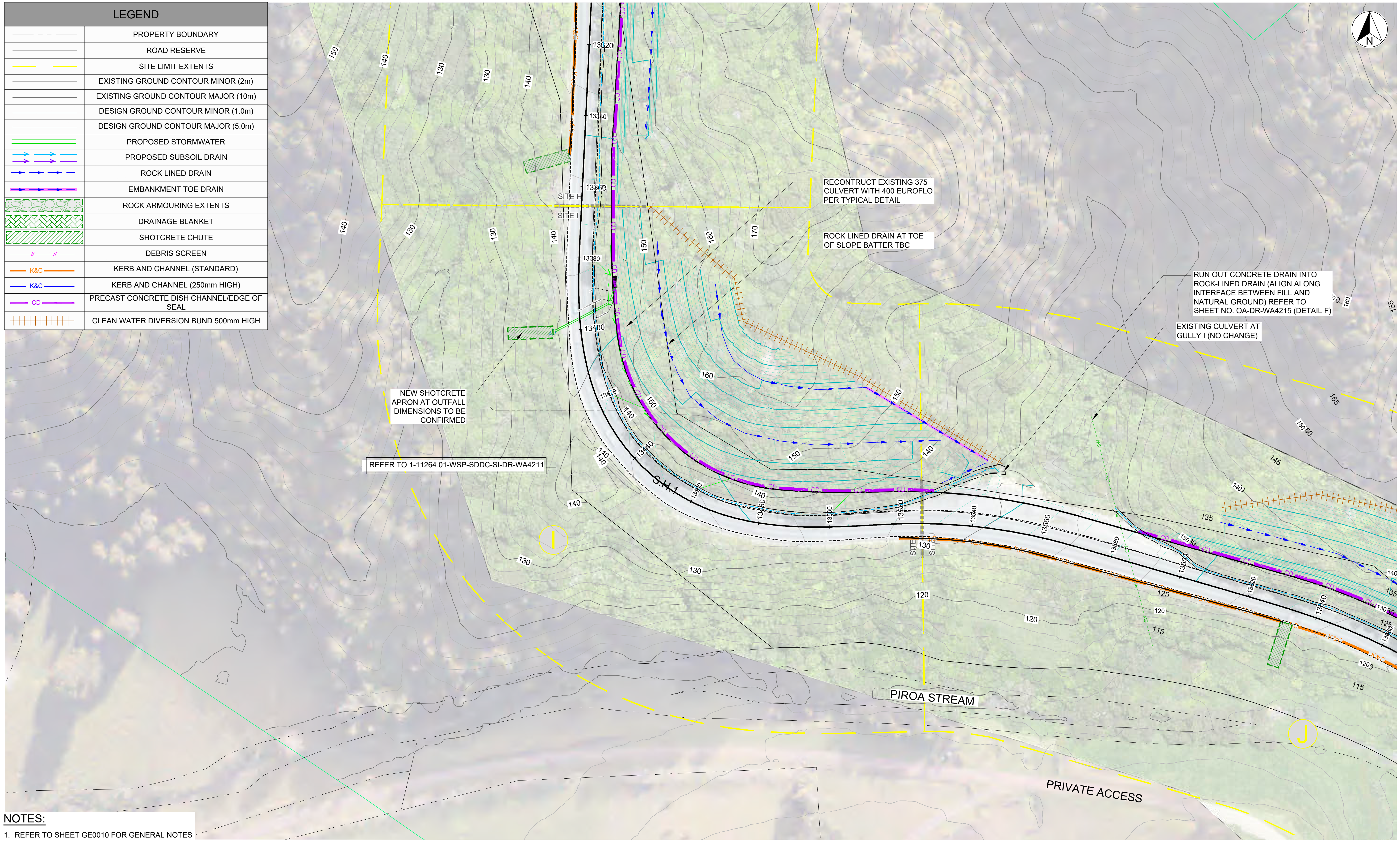
SCALES: 1:500 AT A1
ORIGINAL SIZE: A1
DRAWN: V. GILES
DESIGNED: M. CHIARONI
APPROVED: -
DRAWING VERIFIED: -
DESIGN VERIFIED: -
APPROVED DATE: -

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
WATER - DRAINAGE PLANS
SITE H - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SH-DR-WA4000
SHEET NO.: SHEET 08
REVISION: 1



LEGEND

	PROPERTY BOUNDARY
	ROAD RESERVE
	SITE LIMIT EXTENTS
	EXISTING GROUND CONTOUR MINOR (2m)
	EXISTING GROUND CONTOUR MAJOR (10m)
	DESIGN GROUND CONTOUR MINOR (1.0m)
	DESIGN GROUND CONTOUR MAJOR (5.0m)
	PROPOSED STORMWATER
	PROPOSED SUBSOIL DRAIN
	ROCK LINED DRAIN
	EMBANKMENT TOE DRAIN
	ROCK ARMOURING EXTENTS
	DRAINAGE BLANKET
	SHOTCRETE CHUTE
	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1
DRAWN: V. GILES
DESIGNED: M. CHIARONI
APPROVED: -
DRAWING VERIFIED: -
DESIGN VERIFIED: -
APPROVED DATE: -

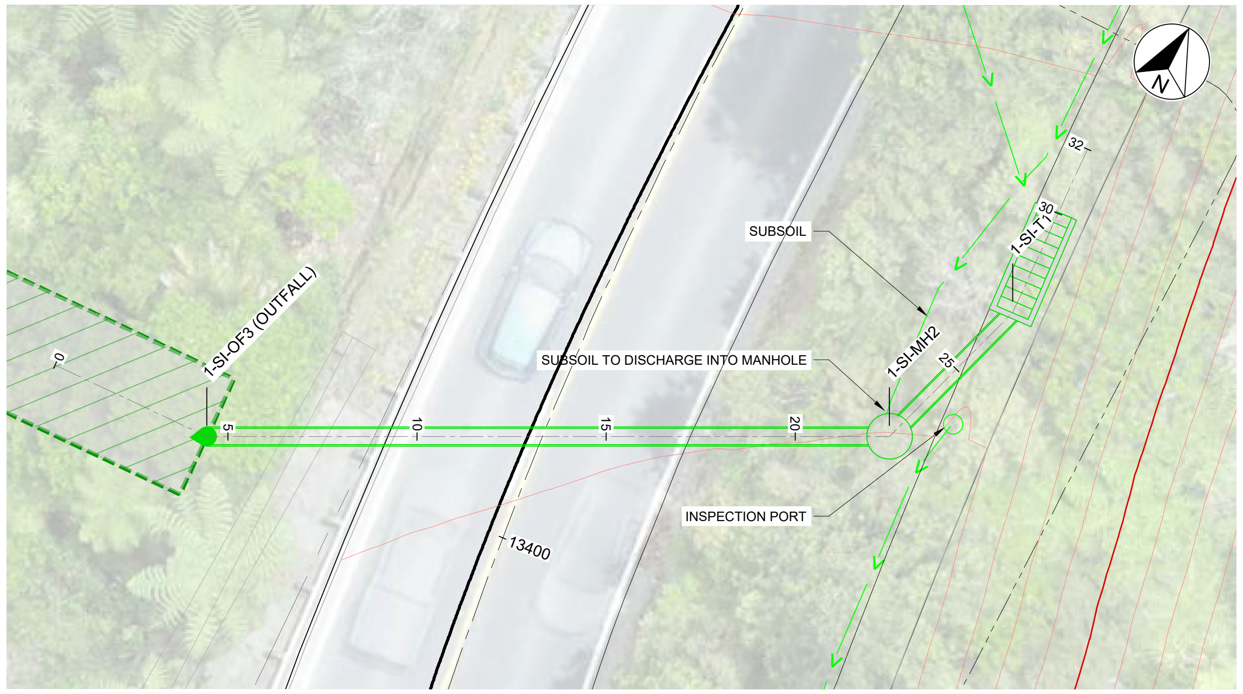
FOR CONSTRUCTION - 80% DRAFT

PROJECT: WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

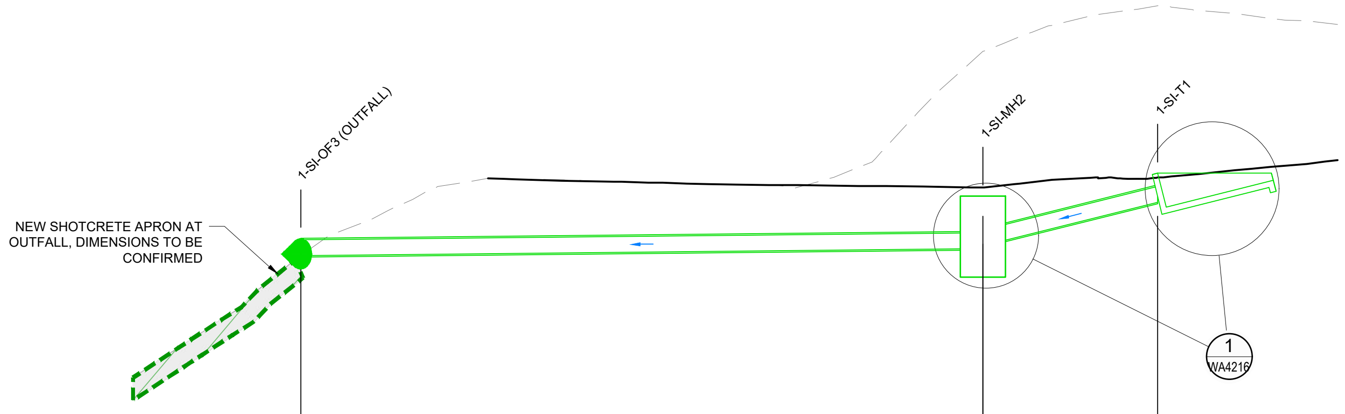
TITLE: WATER - DRAINAGE PLANS
SITE I - PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SI-DR-WA4000
SHEET NO.: SHEET 09
REVISION: 1

Original sheet size A1 (841x594) Plot Date 2024-02-24 at 10:47:35 am C:\DC\ACCDocs\WSP ANZ projects (AMER)\1-11264.01 Brynderwyn Hill Repairs\Project Files\01_WIP\WA\Sheets\1-11264.01-WSP-SDDC-SI-DR-WA-4000.dwg WA4000



PLAN - SITE I - SW-1
SCALE: 1:100 AT A1, 1:200 AT A3



DATUM R.L. 134.00

		1-SI-OF3 (OUTFALL)	1-SI-MH2	1-SI-T1	
GROUND LEVEL (m)		138.72	140.52 140.52	140.74	
DEPTH TO INVERT (m)		0.00	1.62 1.55	0.61	
PIPE INVERT LEVEL (m)		139.18	139.36 139.43	140.59	
DISTANCE (m)		4.4	22.5 22.5	27.1	
GRADIENT		1.03% (1:97)	25.00% (1:4)		
PIPE SIZE AND MATERIAL		EUROFLO DN500 (ID420) SN16	EUROFLO DN500 (ID420) SN16		

LONGSECTION - SITE I - SW-1
SCALE: 1:100 AT A1, 1:200 AT A3

PIPE STRUCTURES - SITE I - SW-1

ID	TYPE	DETAILS	CO-ORD (CENTROID)
1-SI-T1	HYNDS WW0450 TRAVS.4 HEADWALL	CL = 141.364 1-SI-P1 INV OUT = 140.590	E: 369455.02 N: 888854.68
1-SI-MH2	DN1050 INLET MH WITH GRATE	CL = 140.750 1-SI-P1 INV IN = 139.435 1-SI-P2 INV OUT = 139.362	E: 369453.62 N: 888850.28
1-SI-OF3 (OUTFALL)	OUTFALL	CL = 139.614 1-SI-P2 INV IN = 139.175	E: 369437.58 N: 888842.00

PIPE DATA - SITE I - SW-1

PIPE ID	TYPE	2D LENGTH	3D LENGTH	GRADE	US IL	DS IL
1-SI-P1	EUROFLO DN500 (ID420) SN16	4.6	4.8	25.00%	140.59	139.43
1-SI-P2	EUROFLO DN500 (ID420) SN16	18.1	18.1	1.03%	139.36	139.18

NOTES:

1. REFER TO SHEET CV4701 FOR GENERAL NOTES.

1:100 @ A1 / 1:200 @ A3 0 1 2 3 4 5 6 7 8 9 10 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

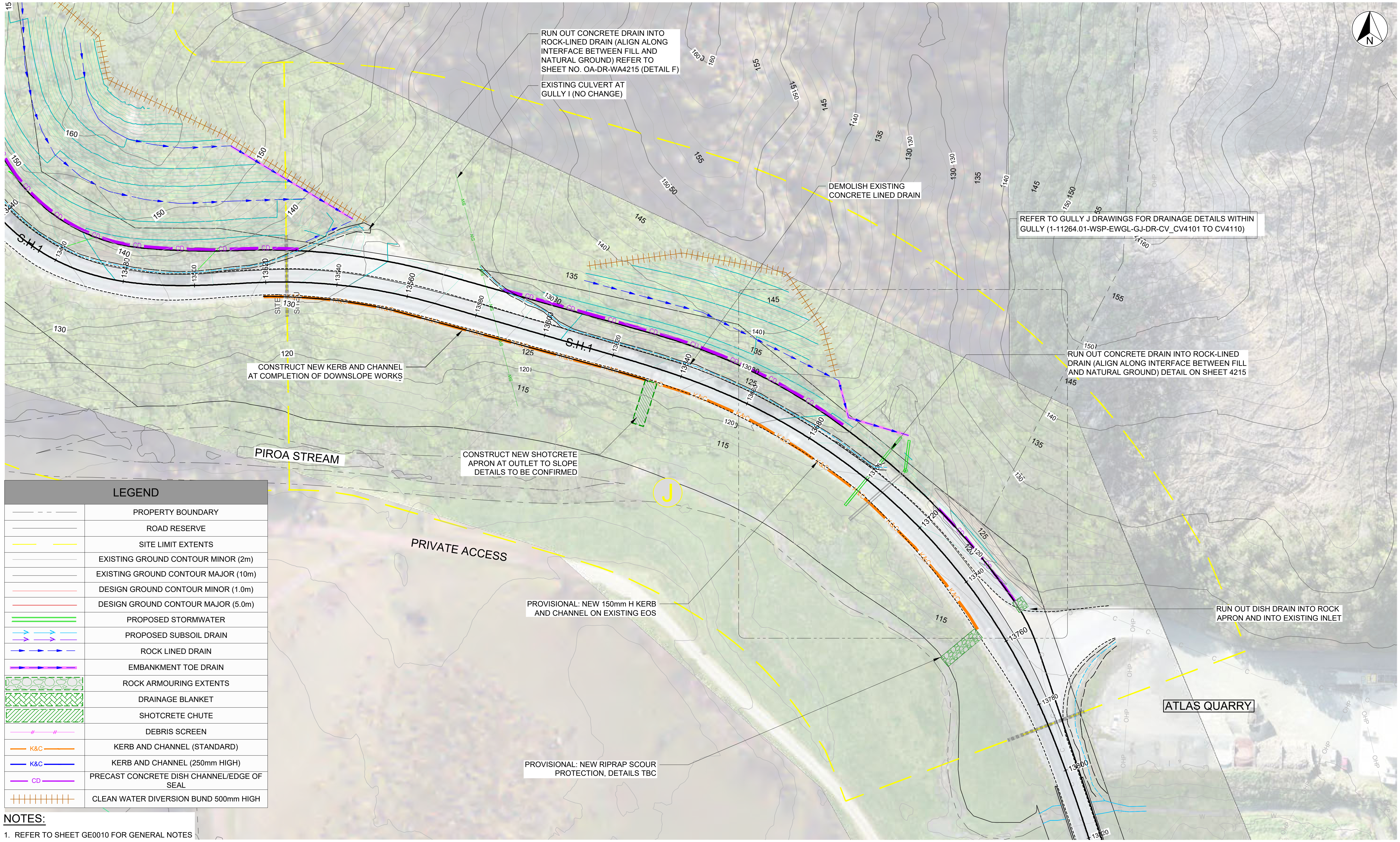
SCALES: 1:100 AT A1, 1:200 AT A3 — ORIGINAL SIZE: A1
DRAWN: V. GILES — DESIGNED: M. CHIARONI — APPROVED: -
DRAWING VERIFIED: - — DESIGN VERIFIED: - — APPROVED DATE: -

FOR CONSTRUCTION - 80% DRAFT

PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

TITLE
SITE I
DRAINAGE PLAN AND LONGSECTION

WSP PROJECT NO. (SUB-PROJECT): 1-11264.01-WSP-SDDC-SI-DR — SHEET NO.: WA4211 — REVISION: 1



LEGEND

(symbol)	PROPERTY BOUNDARY
(symbol)	ROAD RESERVE
(symbol)	SITE LIMIT EXTENTS
(symbol)	EXISTING GROUND CONTOUR MINOR (2m)
(symbol)	EXISTING GROUND CONTOUR MAJOR (10m)
(symbol)	DESIGN GROUND CONTOUR MINOR (1.0m)
(symbol)	DESIGN GROUND CONTOUR MAJOR (5.0m)
(symbol)	PROPOSED STORMWATER
(symbol)	PROPOSED SUBSOIL DRAIN
(symbol)	ROCK LINED DRAIN
(symbol)	EMBANKMENT TOE DRAIN
(symbol)	ROCK ARMOURING EXTENTS
(symbol)	DRAINAGE BLANKET
(symbol)	SHOTCRETE CHUTE
(symbol)	DEBRIS SCREEN
K&C	KERB AND CHANNEL (STANDARD)
K&C	KERB AND CHANNEL (250mm HIGH)
CD	PRECAST CONCRETE DISH CHANNEL/EDGE OF SEAL
(symbol)	CLEAN WATER DIVERSION BUND 500mm HIGH

NOTES:

1. REFER TO SHEET GE0010 FOR GENERAL NOTES

1:500 @ A1
1:1000 @ A3 0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
0	ISSUED FOR CONSTRUCTION - 80% DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
V. GILES	M. CHIARONI	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

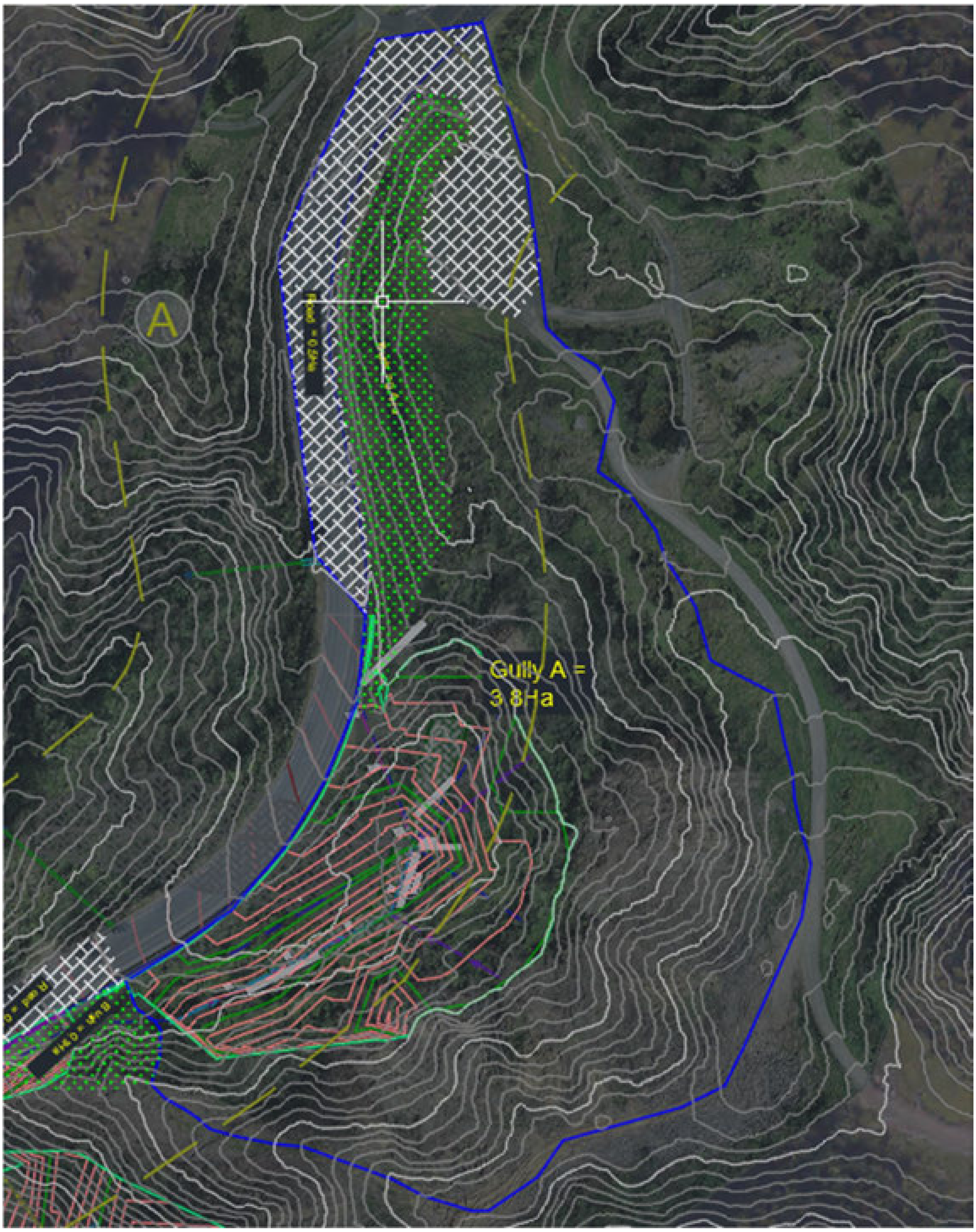
FOR CONSTRUCTION - 80% DRAFT

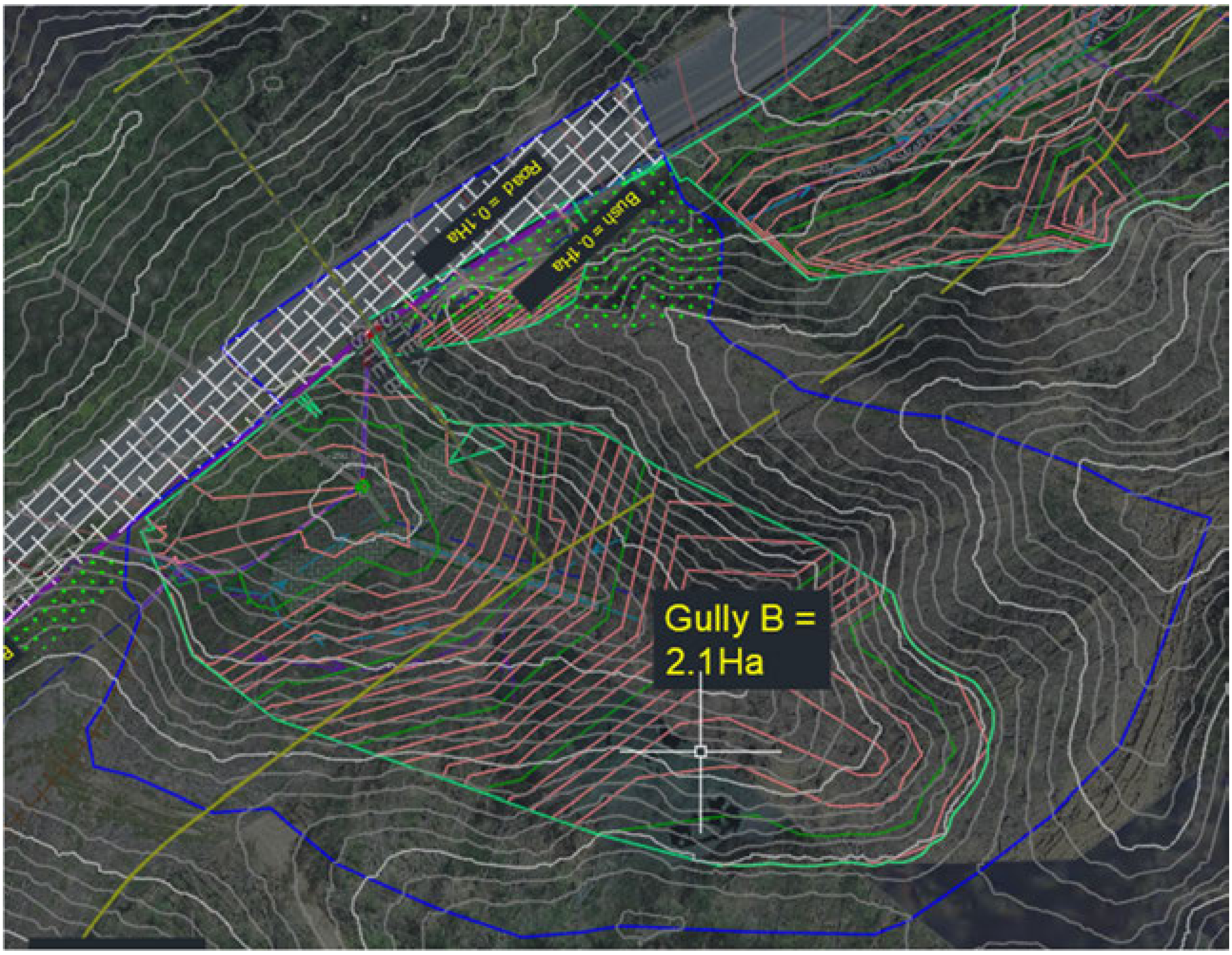
PROJECT
WAKA KOTAHI NZ TRANSPORT AGENCY
BRYNDERWYN HILLS - S.H.1 R.S 303 R.P 11450.0 - R.P 13902.0
BRYNDERWYN HILL REPAIRS

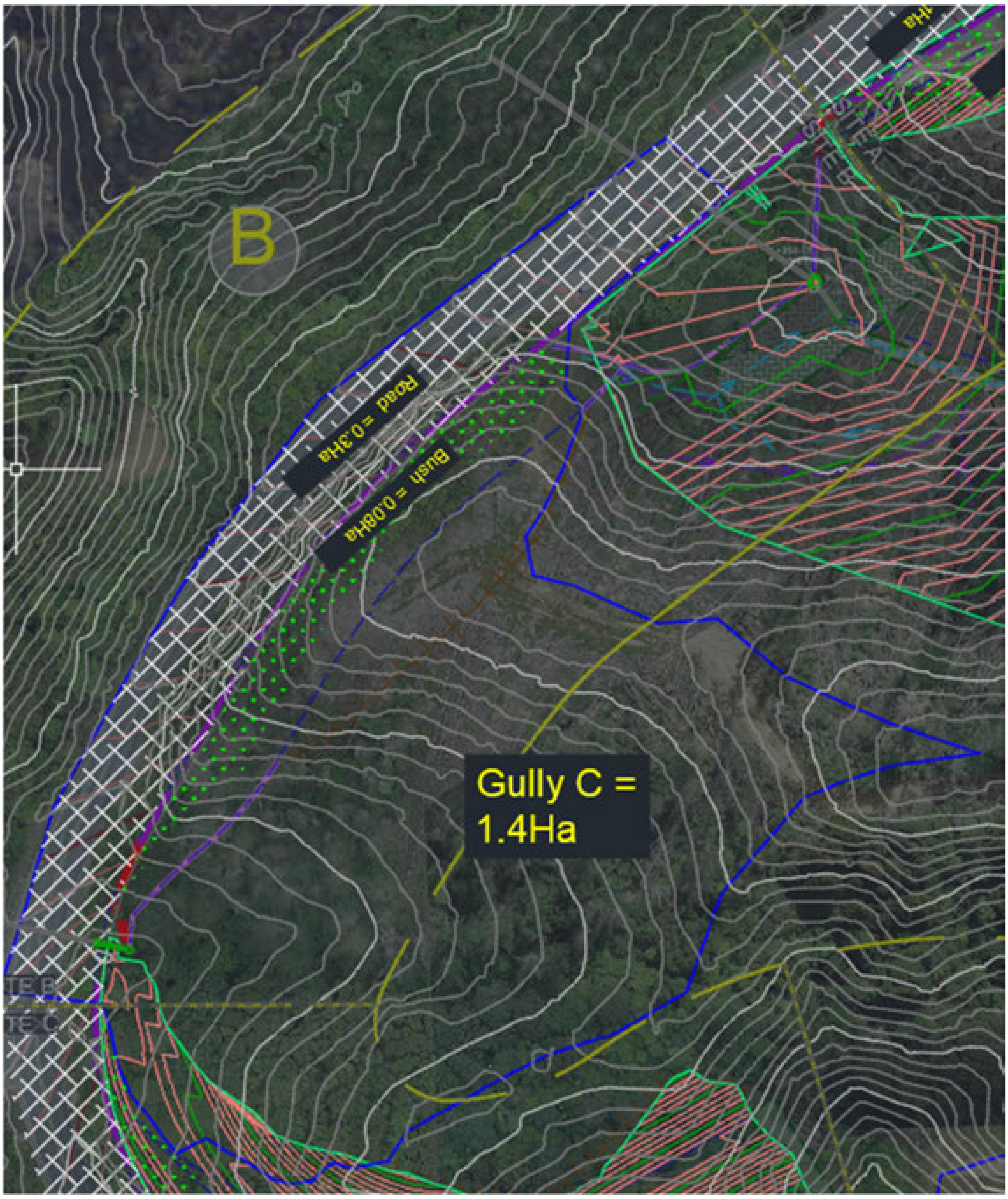
TITLE
WATER - DRAINAGE PLANS
SITE J - PLAN

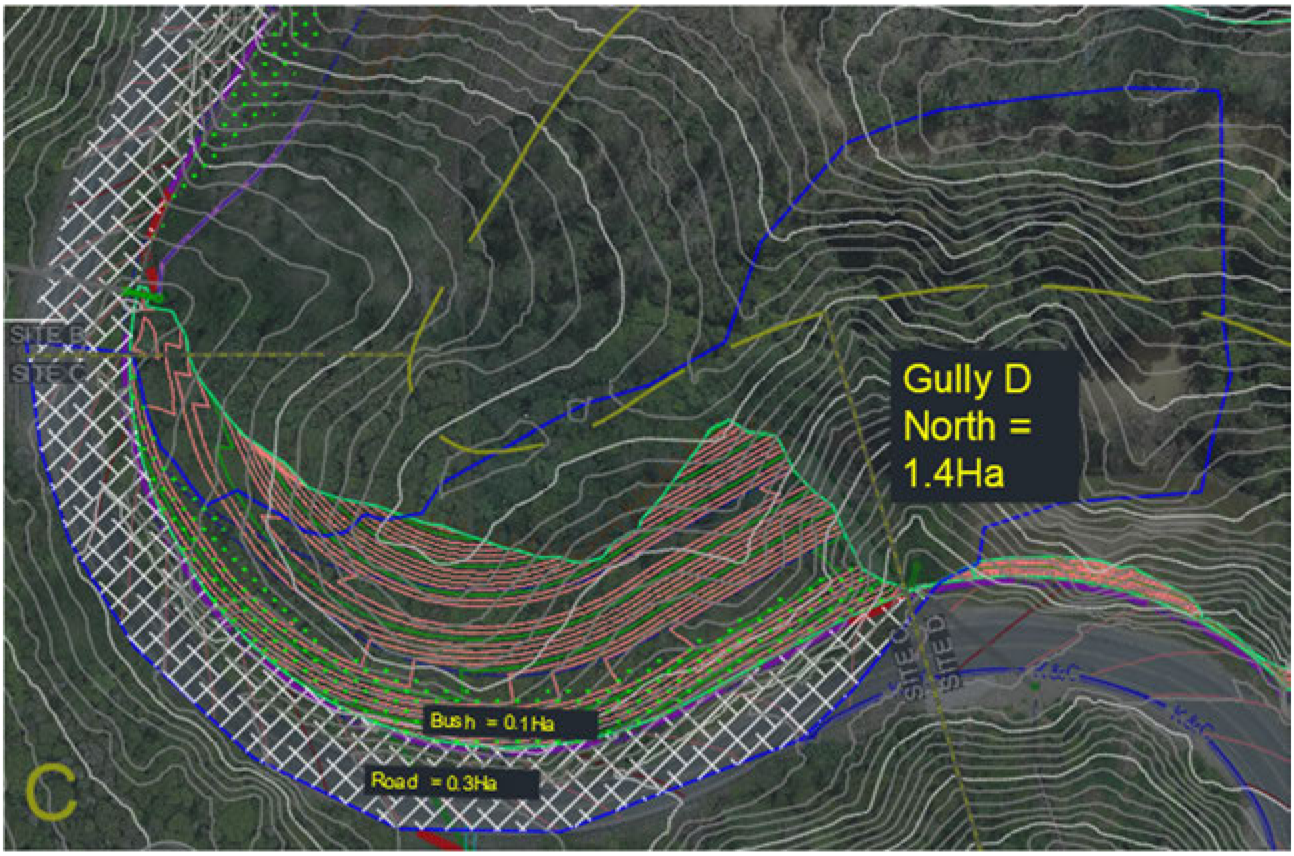
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11264.01-WSP-SDDC-SJ-DR-WA4000	SHEET 10	1

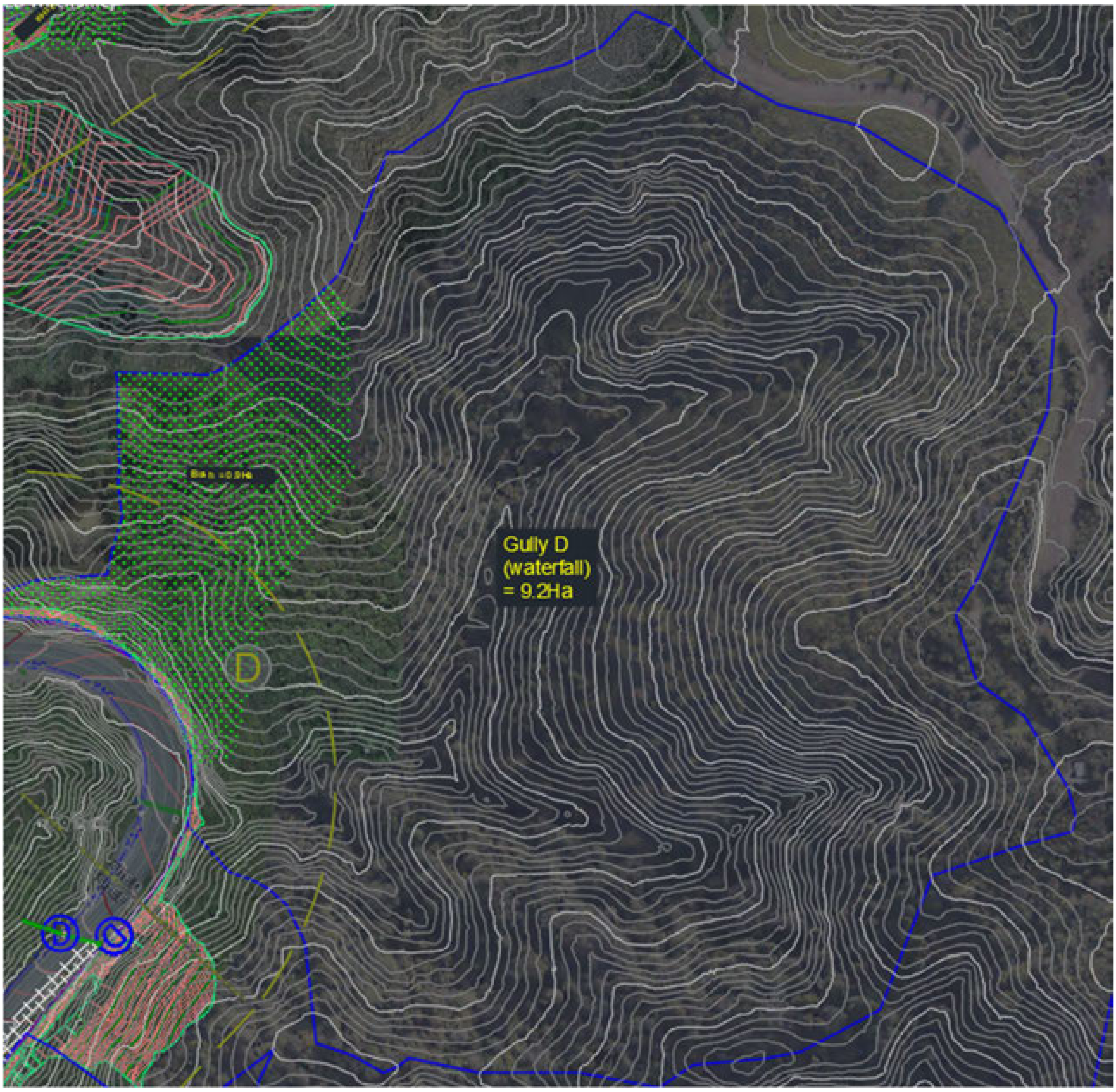
APPENDIX E – CHATCHMENT MEASUREMENT AREAS

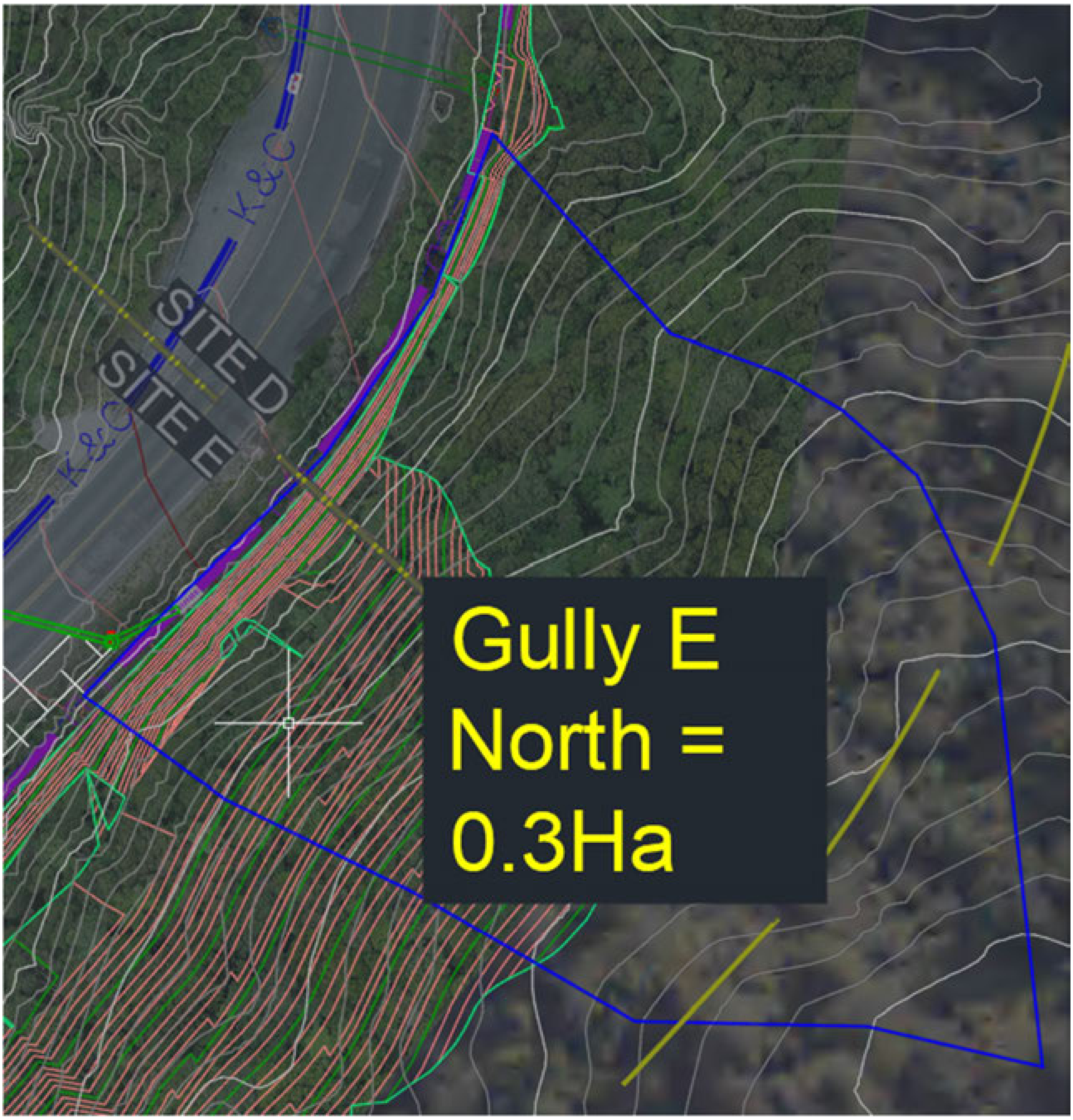

A
Gully A =
3.8Ha

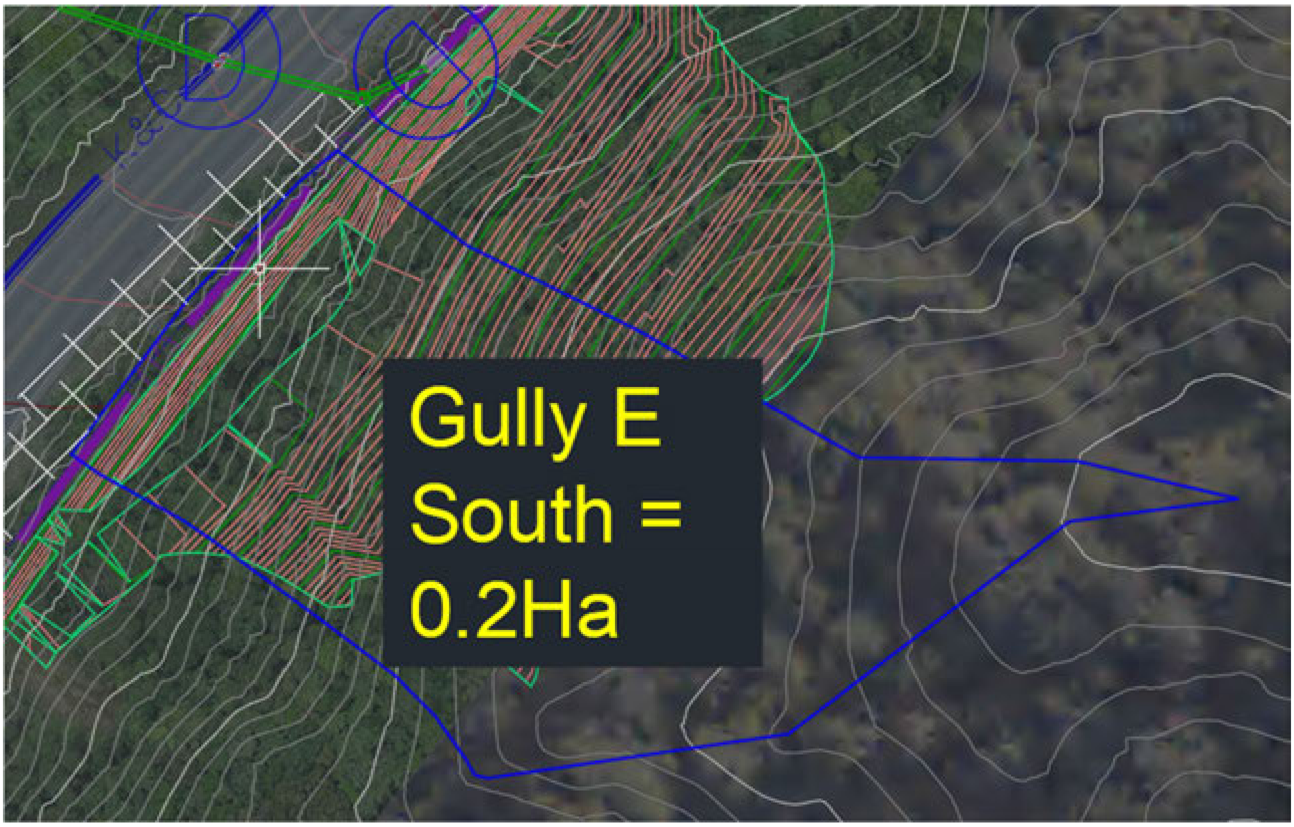

Road = 0.1Ha
Bush = 0.1Ha
Gully B =
2.1Ha

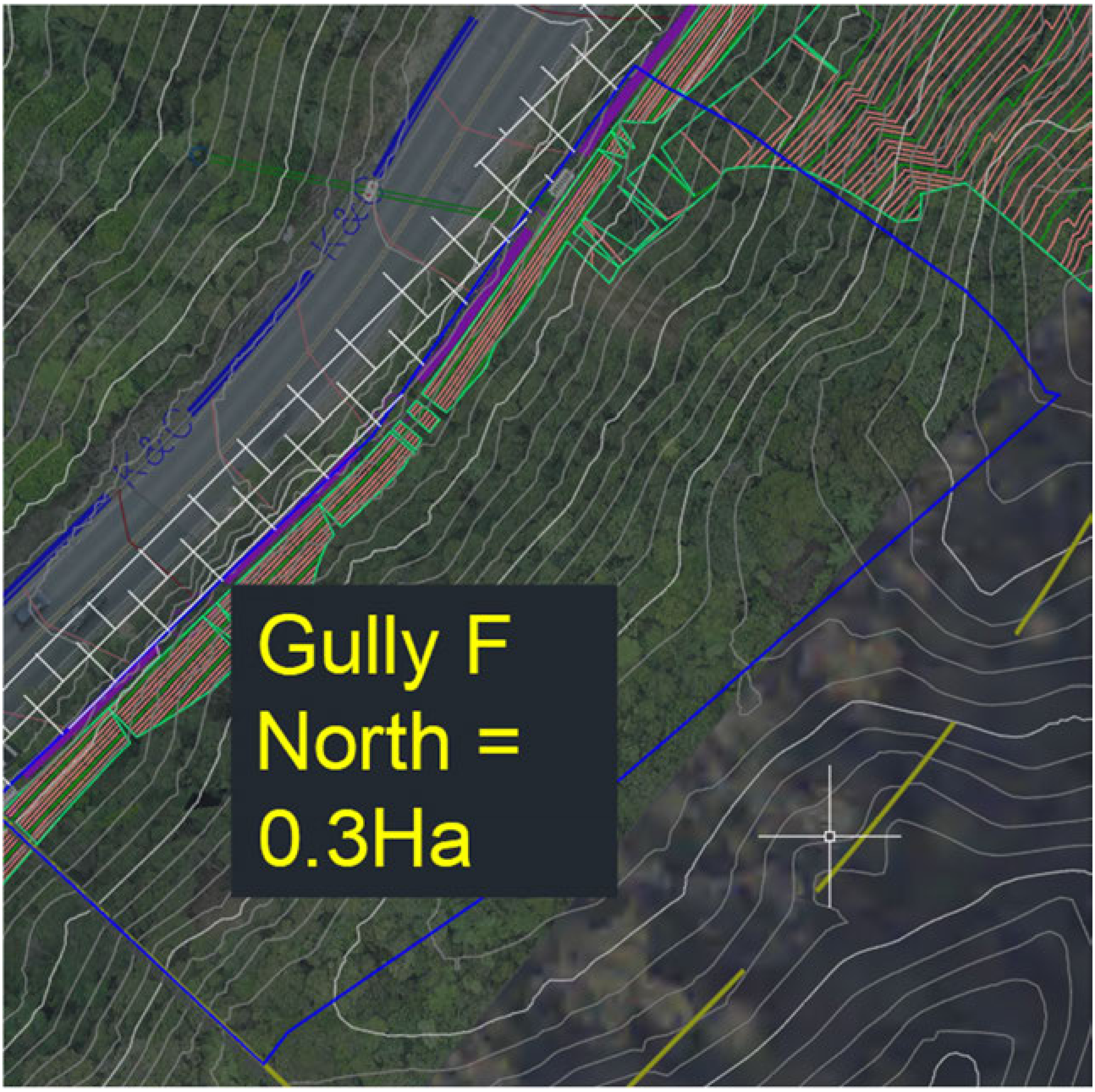

B
Road = 0.3Ha
Bush = 0.08Ha
Gully C =
1.4Ha

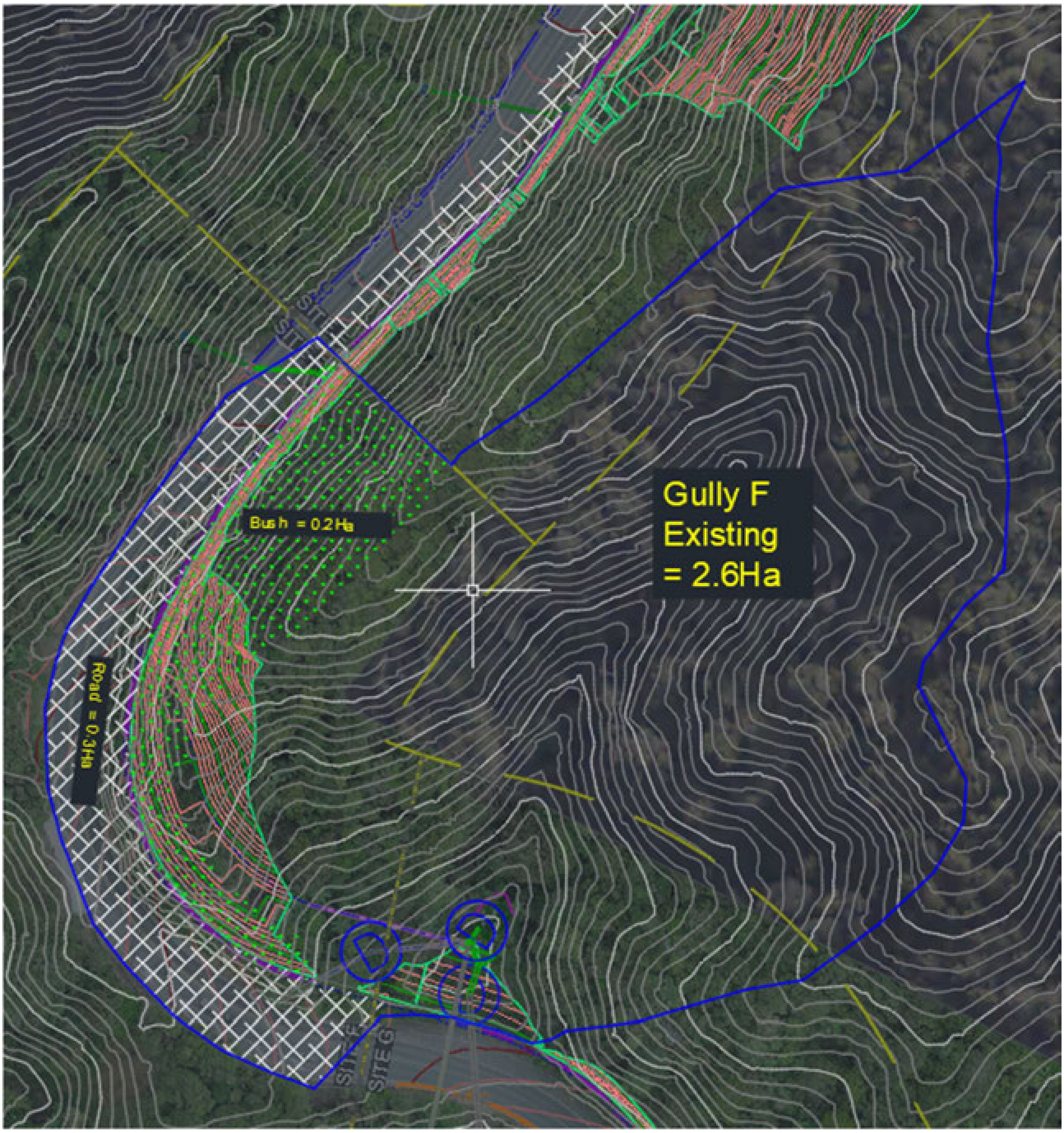

SITE B
SITE C
Gully D
North =
1.4Ha
Bush = 0.1Ha
Road = 0.3Ha
C
SITE C
SITE D


Gully D
(waterfall)
= 9.2Ha
D

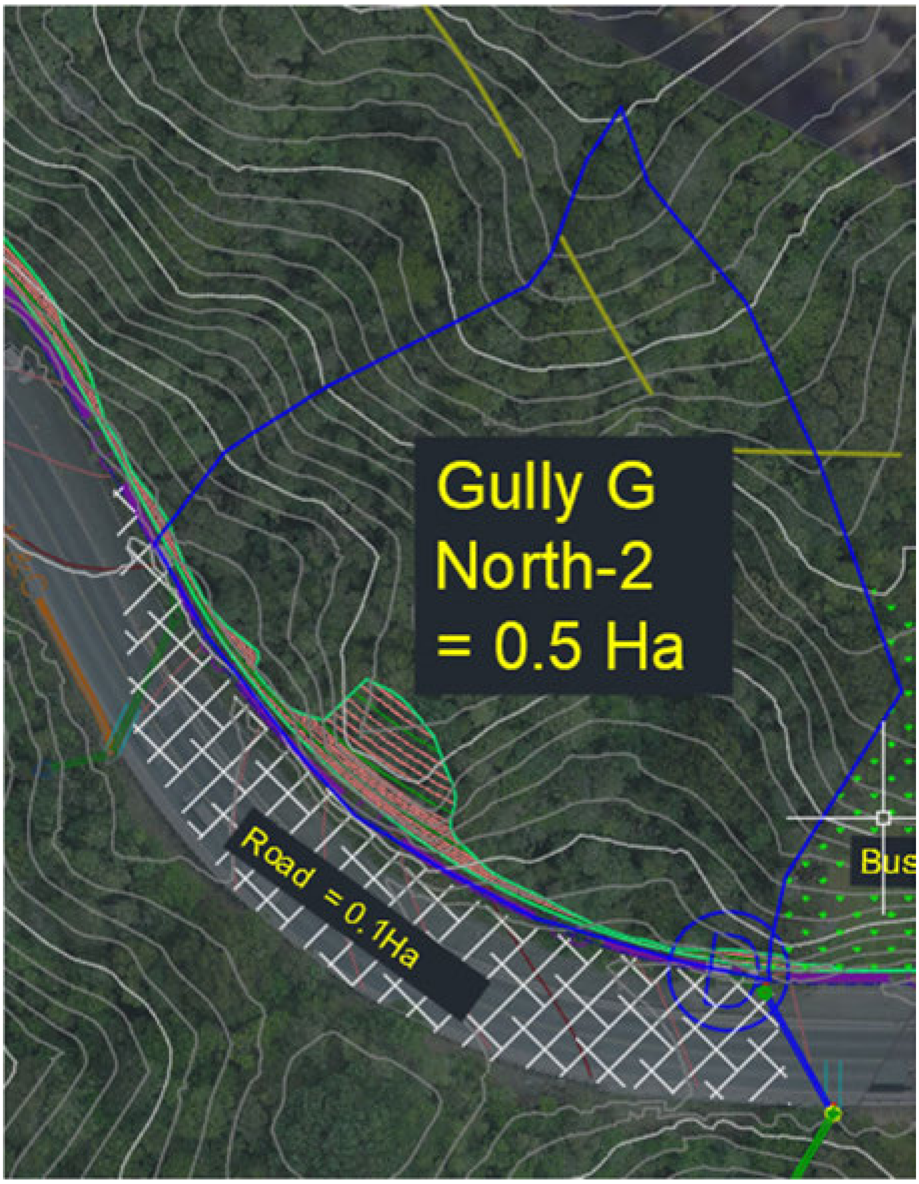

K&C
SITE D
SITE E
K&C
Gully E
North =
0.3Ha

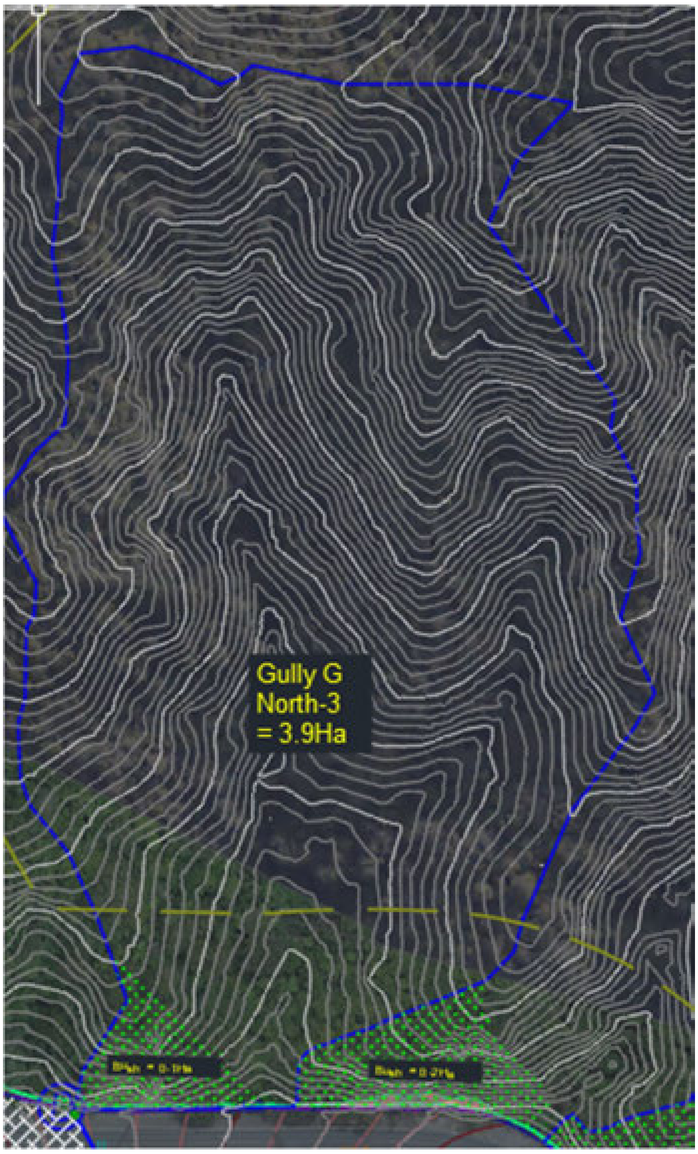

Gully E
South =
0.2Ha


Gully F
North =
0.3Ha

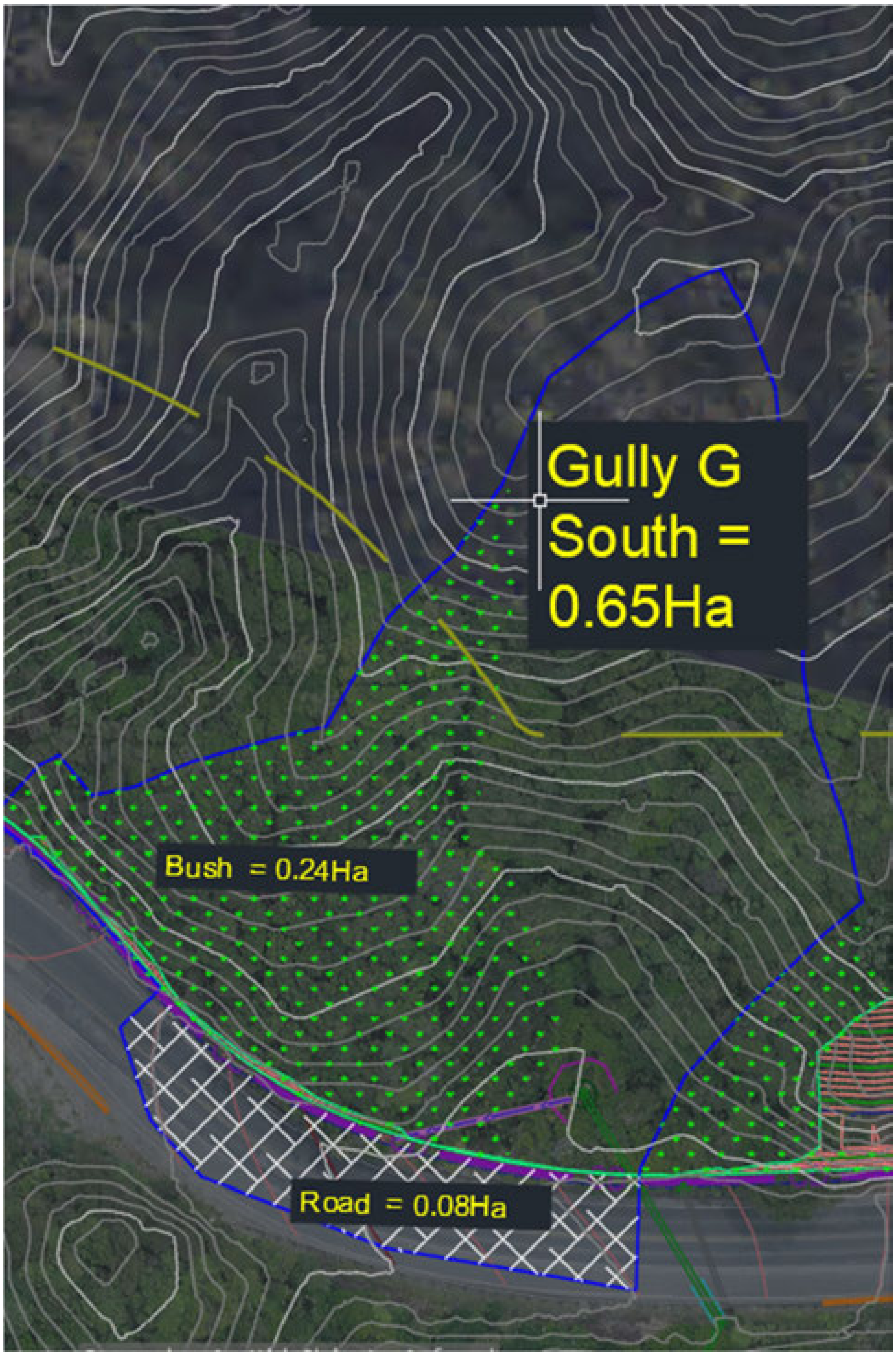

Gully F
Existing
= 2.6Ha
Bush = 0.2Ha
Road = 0.3Ha


Gully G
North-1
= 0.3Ha

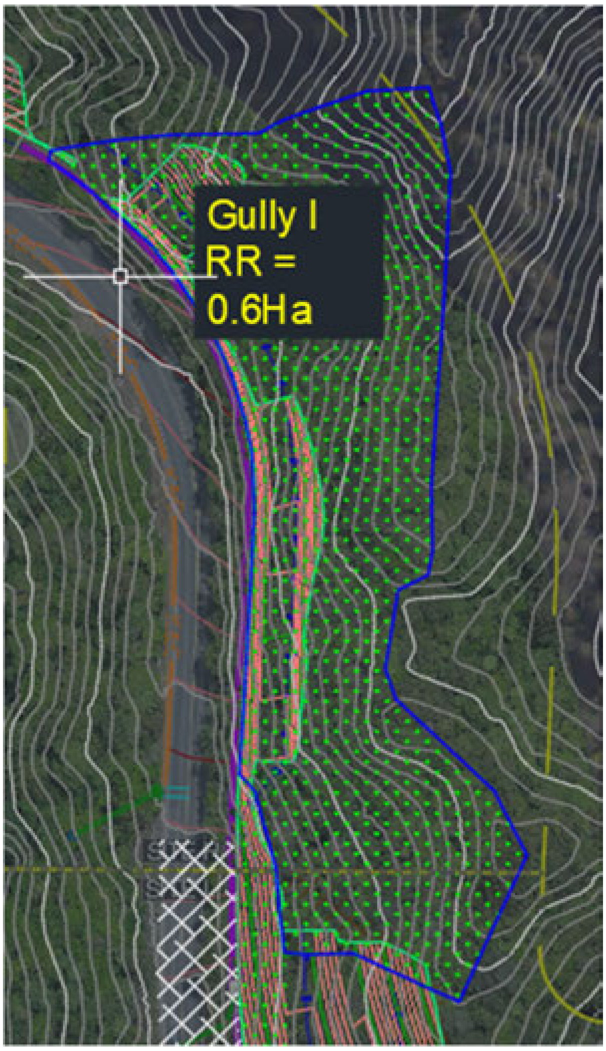

Gully G
North-2
= 0.5 Ha
Road =0.1Ha
Bus


Gully G
North-3
= 3.9Ha


Gully G
North-4
= 3.6Ha

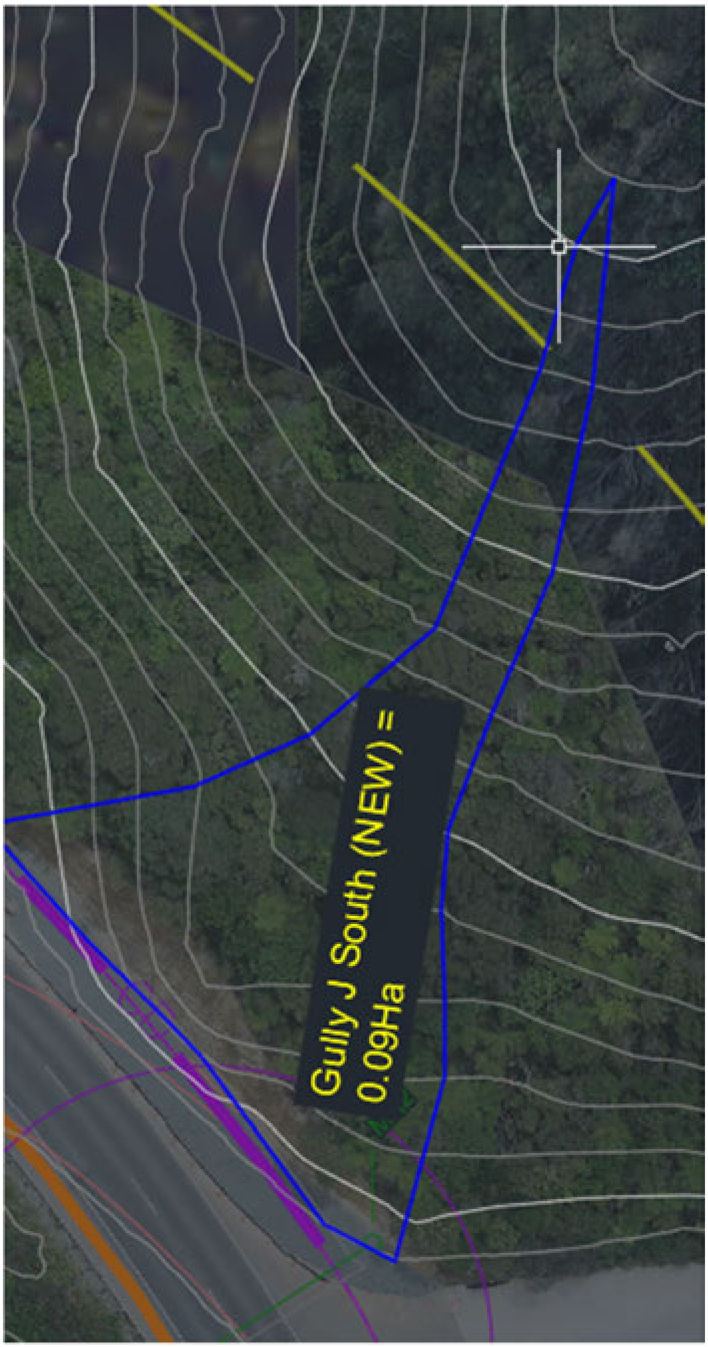

Gully G
South =
0.65Ha
Bush = 0.24Ha
Road = 0.08Ha


Gully H
= 6.0Ha
Command: _AecHideObjects 1 found
Command: _.HIDEOBJECTS


Gully I
RR =
0.6Ha


Gully J
North =
8.9Ha


Gully J
South =
Command: _AecHideObjects 1


Gully J South (NEW) =
0.09Ha

APPENDIX F – STRUCTURAL CALCS

DESIGN LIVE LOADS

Worksheet Description:

Item	Description	Symbol	Unit	Shallo Cover	Xtra shallow	Reference
SITE AND DESIGN CONDITIONS						
1	Cover	H	m	0.60	0.50	
2	Single or dual lane used for design			Single	Single	
APPROACH A - DESIGN LIVE LOAD USING NZTA BRIDGE MANUAL LOAD CLAUSE 4.10.3						
3	**Design live loads using NZTA BM clause 4.10.3**	w_q	kPa	**115.99**	**160.68**	NZBM 4.10.3
APPROACH B - DESIGN LIVE LOAD USING AS/NZS 2566.1 LOAD DISTRIBUTION AND IMPACT FACTOR						
	Single Lane					
4	Live load impact factor / dynamic load factor	α		1.31	1.33	(See below for references)
5	**Lane Load** (does not have load factor for HN or stress reduction factor for HO)					NZBM 4.10.2
	Lane load at top of pipe	$w_{q\ (lane)}$	kPa	4.59	4.64	
6	**HN Loading**					
	Load overlaps			-	-	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	1.37	1.23	
	Parallel	L_2	m	1.07	0.93	
	HN axle load at top of pipe	$w_{q(axle)}$	kPa	53.62	70.16	
	Load factor			1.35	1.35	
	HN design live load	w_q	kPa	78.58	100.98	
7	**HO Loading - Alternative a**					
	Load overlaps			wheel	wheel	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	3.87	3.73	
	Parallel	L_2	m	1.07	0.93	
	HO axle load at top of pipe - Alternative a	$w_{q(axle)}$	kPa	75.93	92.29	
	Stress reduction factor			1.00	1.00	
	HO design live load - Alternative a	w_q	kPa	80.51	96.93	
8	**HO Loading - Alternative b**					
	Load overlaps			-	-	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	1.77	1.63	
	Parallel	L_2	m	1.47	1.33	
	HO axle load at top of pipe - Alternative b	$w_{q(axle)}$	kPa	60.42	73.85	
	Stress reduction factor 1/1.33 - ref. 1994 TNZ BM			1.00	1.00	
	HO design live load - Alternative b	w_q	kPa	65.00	78.48	
9	**Maximum average intensity of design live loads (worse case)**	w_q	kPa	80.51	100.98	
	Dual Lane (two 3 m lanes with nominated lane gap)					
10	**Lane Load** (does not have load factor for HN or stress reduction factor for HO)					NZBM 4.10.2
	Lane load at top of pipe	$w_{q\ (lane)}$	kPa	4.59	4.64	
11	**Axle Loading - 2 x HN**					
	Load overlaps			Lane	Lane	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular - HN + HN	L_1	m	6.17	6.03	
	Parallel	L_2	m	1.07	0.93	
	Axle load at top of pipe	$w_{q(axle)}$	kPa	47.62	57.06	
	Load factor			1.35	1.35	
	Dual lane load reduction factor			0.90	0.90	
	Dual lane design live load - 2 x HN	w_q	kPa	63.43	74.96	
12	**Axle Loading - HO (HO Alt(b) + HN)**					
	Load overlaps			Lane	Lane	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular - HO + HN	L_1	m	6.52	6.38	
	Parallel	L_2	m	1.27	1.13	
	Unfactored axle load at top of pipe	$w_{q(axle)}$	kPa	56.95	66.51	
	Stress reduction factor			1.00	1.00	
	Dual land load reduction factor			0.90	0.90	
	Dual lane design live load - HO + HN	w_q	kPa	55.38	64.03	
13	**Maximum average intensity of design live loads (worse case)**	w_q	kPa	63.43	74.96	
	Design Live Load					
14	Worst case - single or dual lanes			Single	Single	
15	Single or dual lane used for design			Single	Single	
16	**Design live load**	w_q	kPa	**80.51**	**100.98**	
APPROACH C - DESIGN LIVE LOAD USING NZTA BRIDGE MANUAL LOAD DISTRIBUTION AND IMPACT FACTOR						
	Single Lane					
17	Live load impact factor	α		1.12	1.15	
18	**Lane Load** (does not have load factor for HN or stress reduction factor for HO)					NZBM 4.10.2
	Lane load at top of pipe	$w_{q\ (lane)}$	kPa	3.92	4.03	
19	**HN Loading**					
	Load overlaps			-	-	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	1.08	0.96	
	Parallel	L_2	m	0.78	0.66	
	HN axle load at top of pipe	$w_{q(axle)}$	kPa	79.77	108.90	
	Load factor			1.35	1.35	
	HN design live load	w_q	kPa	112.98	152.45	
20	**HO Loading - Alternative a**					
	Load overlaps			wheel	wheel	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	3.58	3.46	
	Parallel	L_2	m	0.78	0.66	
	HO axle load at top of pipe - Alternative a	$w_{q(axle)}$	kPa	96.26	120.86	
	Stress reduction factor			1.00	1.00	
	HO design live load - Alternative a	w_q	kPa	100.18	124.89	
21	**HO Loading - Alternative b**					
	Load overlaps			-	-	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular	L_1	m	1.48	1.36	
	Parallel	L_2	m	1.18	1.06	
	HO axle load at top of pipe - Alternative b	$w_{q(axle)}$	kPa	76.96	95.73	
	Stress reduction factor			1.00	1.00	
	HO design live load - Alternative b	w_q	kPa	80.88	99.75	
22	**Maximum average intensity of design live loads (worse case)**	w_q	kPa	112.98	152.45	
23	**Comparison of live loads - w_q NZTA over w_q AS/NZS**	w_q/w_q		1.40	1.51	
	Dual Lane (two 3 m lanes with nominated lane gap)					
24	**Lane Load** (does not have load factor for HN or stress reduction factor for HO)					NZBM 4.10.2
	Lane load at top of pipe	$w_{q\ (lane)}$	kPa	3.92	4.03	
25	**Axle Loading - 2 x HN**					

DESIGN LIVE LOADS

Worksheet Description:

Item	Description	Symbol	Unit	Shallo Cover	Xtra shallow	Reference
	Load overlaps			-	-	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular - HN + HN	L_1	m	NA	NA	
	Parallel	L_2	m	0.78	0.66	
	Axle load at top of pipe	$w_{q(axle)}$	kPa	NA	NA	
	Load factor			1.35	1.35	
	Dual lane load reduction factor			0.90	0.90	
	Dual lane design live load - 2 x HN	w_q	kPa	NA	NA	
26	**Axle Loading - HO (HO Alt(b) + HN)**					
	Load overlaps			Lane	Lane	
	Length of base of load prism measured in relation to the direction of travel of the vehicle					
	Perpendicular - HO + HN	L_1	m	6.23	6.11	
	Parallel	L_2	m	0.98	0.86	
	Unfactored axle load at top of pipe	$w_{q(axle)}$	kPa	66.04	78.79	
	Stress reduction factor			1.00	1.00	
	Dual lane load reduction factor			0.90	0.90	
	Dual lane design live load - HO + HN	w_q	kPa	62.96	74.53	
27	**Maximum average intensity of design live loads (worse case)**	w_q	kPa	62.96	74.53	
	Design Live Load					
28	Worst case - single or dual lanes			Single	Single	
29	Single or dual lane used for design			Single	Single	
30	**Design live load**	w_q	**kPa**	**112.98**	**152.45**	
RESULTS						
31	Load Case used			NZTA BRIDGE MANUAL LOAD DISTRIBUTION AND IMPACT FACTOR	NZTA BRIDGE MANUAL LOAD DISTRIBUTION AND IMPACT FACTOR	Typically use AS/NZS 2566.1 case unless pipe is in a State Highway
32	Design Live Load	w_q	**kPa**	**112.98**	**152.45**	

NZTA Vehicle Loads from the NZTA Bridge Manual

Description	Symbol	Unit	Reference
NZTA HN Loading			
Axle spacing	J	m	AS/NZS 3725; NZBM Figure 3.1
Axle load	ΣP	kN	AS/NZS 3725; BM Figure 3.1
Wheel load	P	kN	
Contact area parallel to direction of travel	a	m	AS/NZS 3725; BM Figure 3.1
Contact area perpendicular to direction of travel	b	m	AS/NZS 3725; BM Figure 3.1
Distance between centre-lines of wheel load	G_1	m	AS/NZS 3725 Suppl.; BM Figure 3.1
Spacing between 3 m lanes - Lane gap		m	
Distance between centre-lines of wheel load - dual lane	G_2	m	AS/NZS 3725 Suppl.; BM Figure 3.1
Load factor			BM 3.2.1
NZTA HO Loading			
Axle spacing	J	m	AS/NZS 3725; BM Figure 3.1
Axle load	ΣP	kN	AS/NZS 3725; BM Figure 3.1
Wheel load	P	kN	
Alternative a			
Contact area parallel to direction of travel	a	m	AS/NZS 3725; BM Figure 3.1
Contact area perpendicular to direction of travel	b	m	AS/NZS 3725; BM Figure 3.1
Alternative b			
Contact area parallel to direction of travel	a	m	AS/NZS 3725; BM Figure 3.1
Contact area perpendicular to direction of travel	b	m	AS/NZS 3725; BM Figure 3.1
Distance between centre-lines of wheel load	G	m	AS/NZS 3725; BM Figure 3.1
Stress reduction factor 0.75 (=1/1.33) or 1 (see Reference note)			BM Table 3.1: 1/1.33 in 1994 TNZ BM; 1.0 in NZTA BM
NZTA Lane Loading			
UDL lane load		kN/m^2	BM Figure 3.1
Lane width		m	BM Figure 3.1
NZTA Dual Lane Load Reduction Factor			
(Note: not to be applied to HO load element)			BM 3.2.4

Structural Design of Buried Flexible Pipelines, in accordance with AS/NZS 2566.1.

Based on AS/NZS 2566.1 Supplement examples.

Worksheet Description:

Item	Description	Symbol	Unit	Shallow cover	Shallow cover	Very shallow cover, moderate in situ strength	Reference to AS/NZS 2566.1	Notes
PIPE SPECIFICATION AND PROPERTIES OF PIPE WALL								
1	Pipe Material			PE100	PE100	PE100		
2	Pipe Wall Construction			Profiled Wall	Profiled Wall	Profiled Wall		
3	Nominal Diameter	DN	-	630	500	500	ased on what Euroflo pipe would fit onto existing pipe	
4	Pressure Rating/Stiffness Rating/Profile Number		-	SN8	SN8	SN8		
5	Internal diameter	D_i	m	0.533	0.427	0.427		
6	External diameter	D_e	m	0.626	0.497	0.497		
7	Wall Thickness (minimum)	t	m	NA	NA	NA		
8	Ductile iron or steel pipes - thickness of cement mortar lining	t_c	m				(Clause C2.2.1)	Leave blank if no cement mortar lining
9	Moment of inertia for ring bending	I	$10^{-6}m^4/m$	NA	NA	NA	Eq. 2.2.1.2 and Clause C2.2.1	Shows an error if no data in cell below
	Moment of inertia for ring bending (User Specified for profiled or composite materials)			4.034	2.007	2.007		Obtain relevant values from manufacturer
10	Distance from neutral axis to internal surface	c_2	m	0.016	0.012	0.012	Figure 1.2 (profile wall pipe)	Value not provided by manufacturer, 1/3 of profile height used
11	Initial (3-minute) ring-bending modulus of elasticity	E_b	MPa	950	950	950	Table 2.1	
12	Long-term ring bending modulus of elasticity (50-years)	E_{bL}	MPa	260	260	260	Table 2.1	
13	Diameter of neutral axis	D	m	0.565	0.451	0.451		
14	Initial (3-minutes) ring-bending stiffness	S_{DI}	N/m/m	21,248	20,785	20,785	Eq. 2.2.1.1(1)	
	Initial (3-minutes) ring-bending stiffness (User defined for GRP)							Supplier supplied or leave blank
15	Long term (50-year) ring-bending stiffness	S_{DL50}	N/m/m	5,815	5,688	5,688	Eq. 2.2.1.1(2)	
	Long term (50-year) ring-bending stiffness (User defined for GRP)							Supplier supplied or leave blank
16	Ratio of long term (2-year) to initial (3-minute) ring-bending stiffness	S_{DL2}/S_{DI}	-	0.3552	0.3552	0.3552	Eq. 2.2.3	
17	Long term (2-year) ring-bending stiffness	S_{DL2}	N/m/m	7,548	7,384	7,384		
18	Allowable long-term hoop stress	σ_{hall}	MPa	8.0	8.0	8.0	Table 2.1	
19	Allowable long-term internal pressure - calculated	P_{all}	MPa	NA	NA	NA	Cl. 1.5 (from manufacturer or calc for plain wall pipes)	
	Allowable long-term internal pressure - from manufacturer							Supplier supplied or leave blank
20	Poisson's ratio	v	-	0.45	0.45	0.45	Table 2.1	From manufacturer
LIMITING PARAMETERS FOR THE PIPE								
21	Allowable long-term vertical deflection	Δ_{yall}/D	-	7.5%	7.5%	7.5%	Table 2.1	
22	Allowable long-term ring bending strain	ε_{ball}	-	4.0%	4.0%	4.0%	Table 2.1	
23	Design factor for buckling	F_s	-	2.5	2.5	2.5	Clause 5.4	
24	Factor of safety for							
	- long-term internal pressure	η_p	-	1.25	1.25	1.25	Table 2.1	
	- long-term ring bending strain	η_b	-	2.00	2.00	2.00	Table 2.1	
	- long-term combined loading	η	-	1.25	1.25	1.25	Table 2.1	
SITE CONDITIONS								
25	Cover	H	m	0.6	0.6	0.5		From hydraulics spreadsheet (Height diff column + pipe diameter)
26	Native soil							
	- classification		-	CH-MH	CH-MH	CH-MH	Table 3.2	Text value not used in calculation
	- Standard penetration test		-	-	-	-	Table 3.2	Text value not used in calculation
	- soil modulus	E'_n	MPa	3.0	3.0	3.0	Table 3.2	No reliable modulus values for these materials (Table 3.2)
27	Embedment							
	- classification		-	SP	SP	SP	Table 3.2	Text value not used in calculation
	- density index (estimated field compaction)	I_D	%	95	95	95	Table 3.2	Text value not used in calculation
	- soil modulus	E'_e	MPa	10.0	10.0	10.0	Table 3.2	
28	Width of trench at the springline	B	m	1.20	1.10	1.10	Figure 3.1	
29	Height of water surface above top of pipe	H_w	m	0.0	0.0	0.0		Assuming no ground water
30	Internal working pressure	P_w	MPa	0.0	0.0	0.0		For drainage pipes P_w = 0
31	Internal vacuum	q_v	kPa	0	0	0		This should be zero for gravity pipes
32	Unit weight of trench fill	γ	kN/m^3	20	20	20	Clause 4.3, Paragraph C4.2.2	
33	Buoyant unit weight of trench fill	γ_{sub}	kN/m^3	12.46	12.46	12.46	Eq. 5.4(2)	
34	Specific gravity of soil particles (blank if unknown)	ρ_s	-					If unknown leave blank
DESIGN DEAD LOAD AND LIVE LOADS DETERMINATION								
35	Design load due to external dead loads	w_g	kPa	12.00	12.00	10.00	Eq. 4.3	
36	Design load due to superimposed dead loads	w_{gs}	kPa				Clause 4.6	
37	Live load / average intensity of design live loads	w_q	kPa	112.98	112.98	160.68	Equation 4.7.2(1) or Figure 4.1	Calculate with Live Load Calculation Sheet
DETERMINE EFFECTIVE SOIL MODULUS								
38	E'_e/E'_n		-	3.33	3.33	3.33		
39	B/D_e		-	1.92	2.21	2.21		
40	Design Factor	Δ_f	-	0.59	0.72	0.72	Equation 3.4.3(3)	
41	Leonhardt correction factor	ζ	-	0.42	0.46	0.46	Equation 3.4.3(2); Figure 3.2	
42	Effective soil modulus	E'	MPa	4.20	4.60	4.60	Equation 3.4.3(1)	
CHOOSE LONG TERM DESIGN BASIS								
43	Long-term design basis		years	50	50	50	Clause 5.1.2 and C2.2.2	Do not use 50 years by default
44	Long-term ring-bending stiffness (either S_{DL2} or S_{DL50})	S_{DL}	N/m/m	5,815	5,688	5,688	Equation 2.2.3	
DETERMINE DEFLECTION								
45	Predicted long-term vertical deflection	$\Delta y/D$	-	4.13%	3.83%	5.23%	Equation 5.2(2)	
46	**Therefore deflection is**			Ok	Ok	Ok		

Structural Design of Buried Flexible Pipelines, in accordance with AS/NZS 2566.1.

Based on AS/NZS 2566.1 Supplement examples.

Worksheet Description:

Item	Description	Symbol	Unit	Shallow cover	Shallow cover	Very shallow cover, moderate in situ strength	Reference to AS/NZS 2566.1	Notes
DETERMINE STRAIN								
47	Shape factor	D_f	-	3.54	3.60	3.60	Equation 5.3.1(3)	
48	Effective wall thickness of pipe	t_{es}	m	0.061	0.046	0.046	Clause 1.5	
49	Predicted long-term ring-bending strain	ε_b	-	1.58%	1.40%	1.92%	Equation 5.3.1(2)	
50	**Therefore strain is**			**Ok**	**Ok**	**Ok**		
DETERMINE EFFECTS OF EXTERNAL LOADING INCLUDING HYDROSTATIC PRESSURE AND INTERNAL VACUUM								
51	Buckling pressure on pipe for -							
	Unit weight of external liquid	γ_L	kN/m^3	10	10	10	Section 1.5	
	$H \geq H_w$		kPa	132.01	130.57	176.26	Equation 5.4(1) (see note below)	
	$H < H_w$		kPa	NA	NA	NA	Equation 5.4(1) (see note below)	
52	Allowable buckling pressure (see Item 23) -							
	H < 0.5 m	q_{all1}	kPa	NA	NA	NA	Equation 5.4(4)	
	H ≥ 0.5 m	q_{all1}	kPa	70.00	68.47	68.47	Equation 5.4(4)	
		q_{all2}	kPa	187.21	197.62	197.62	Equation 5.4(5)	Note:example in AS/NZS 2566.1 Supp uses S_{DL} rather than S_{DI} which is why this fi
		Max q_{all1} or q_{all2}	kPa	187.21	197.62	197.62	Equation 5.4(4) or 5.4(5)	

Structural Design of Buried Flexible Pipelines, in accordance with AS/NZS 2566.1.

Based on AS/NZS 2566.1 Supplement examples.

Worksheet Description:

Item	Description	Symbol	Unit	Shallow cover	Shallow cover	Very shallow cover, moderate in situ strength	Reference to AS/NZS 2566.1	Notes
53	**Therefore buckling is**			**Ok**	**Ok**	**Ok**		
	NOTE: Where the possibility of concurrent application of live load and vacuum is unlikely, the lesser of the terms w_q and q_v may be omitted from Equations 5.4(1) and 5.4(3). This has been done here. NOTE: q_v should be considered only when critical. Where q_v is included, S_{DL} in the Equation 5.4 should be replaced by short-term stiffness S_{DI}. This has been done here by use of an IF statement to determine if q_v critical.						Clause 5.4	
DETERMINE EFFECTS OF COMBINED LOADING								
54	Re-rounding coefficient (P_w < 3.0 MPa)	r_c	-	NA	NA	NA	Equation 5.3.3	
55	$P_w / \eta_p P_{all}$		m	NA	NA	NA	Equation 5.3.3	
56	$r_c \varepsilon_b / \eta_b \varepsilon_{ball}$		-	NA	NA	NA	Equation 5.3.3	
57	Addition of above two items		-	NA	NA	NA	Equation 5.3.3	
58	**Therefore combined loading is**			**NA**	**NA**	**NA**		