MCKENZIE & CO.

MEMO

Response to Council Ecology Comment – Culverts and Hydrological Suitability

Project : Delmore

To: Madeleine Wright

Cc: Mark Delaney

From: Mckenzie & CO.

Date: 01/07/25

Subject: Update on Culvert Design

Dear Madeleine,

This memo provides a focused assessment of the changes proposed to Culverts 9, 10 and 11, with reference to their design details and potential compliance with NES-F permitted activity thresholds.

The remaining culverts retain their original structural design. This decision is based either on riverbed width constraints at their respective locations, or, in the case of Culvert 7, ecological considerations.

1. Culvert Approach

The updated designs for Culverts 9, 10, and 11 are compared with the original designs as follows. The decision to redesign these culverts was made following consultation with the project ecologist, Mark Delaney, the culvert manufacturer, and the early works contractor to determine the most suitable construction approach. Key factors in the use of circular culverts are reduced construction timeframes due to simplified install and lifting requirements which will lower the risk of any culvert being exposed to a large storm event during construction. This will also reduce the time that stream diversions are in place a positive ecological outcome.

Culvert No.	Existing Design	Proposed Design
9	4000 (W) * 3000 (H)	3000 (W) * 3000 (H)
10	6000 (W) * 2000 (H)	2100 Circular
11	4000 (W) * 4000 (H)	4000 (W) * 3000 (H)

2. Design Criteria

The key ecological aspects of the culvert design remain unchanged.

- An embedment depth of minimum 35% of culvert diameter for circular culvert,
- An embedment depth of minimum 350mm for box culvert,
- Width at embedment depth of 1.3 times the stream bed width unless located in wide flat area,
- Replicate the existing stream grades and substrate continuity.

In addition to the above ecological parameters the following hydraulic parameters have been maintained as well.

- Pass the 10% AEP event without heading up above the soffit level of the pipe
- Pass the 1% AEP event without heading up within 0.5m of road CL level.
- Velocities for the 1% AEP are less than 6.0 m/s
- Velocities for the 50% event exceed 0.6m/s
- Culverts do not increase the water level for upstream and downstream under 1% AEP event with 50% blockage of the culvert.

3. Conclusion

In conclusion, the redesign and downsizing of the culverts are justified by the improved accuracy of our final hydrological and hydraulic analyses. The initial larger sizes were a product of conservative but high-level assumptions. With detailed ground truth data and advanced modelling now in hand, we have right sized the culverts to match the true site conditions and flows. The revised culvert sizes provide the required capacity for storm events (including the critical 1% AEP flood) in full compliance with Auckland Council's Stormwater Code of Practice guidelines for design flow, headwater control, and velocity limits.

The three culverts under this memo do not comply with NES-F clause 70(2)(d) because their internal widths are less than 1.3 times the width of the stream bed, as required by the standard. This non-compliance is due to the local topography—these sites are in areas with gently sloping streambeds, where installing wider culverts is not practically feasible without causing adverse hydraulic impacts, such as altering upstream or downstream water levels and flow conditions.

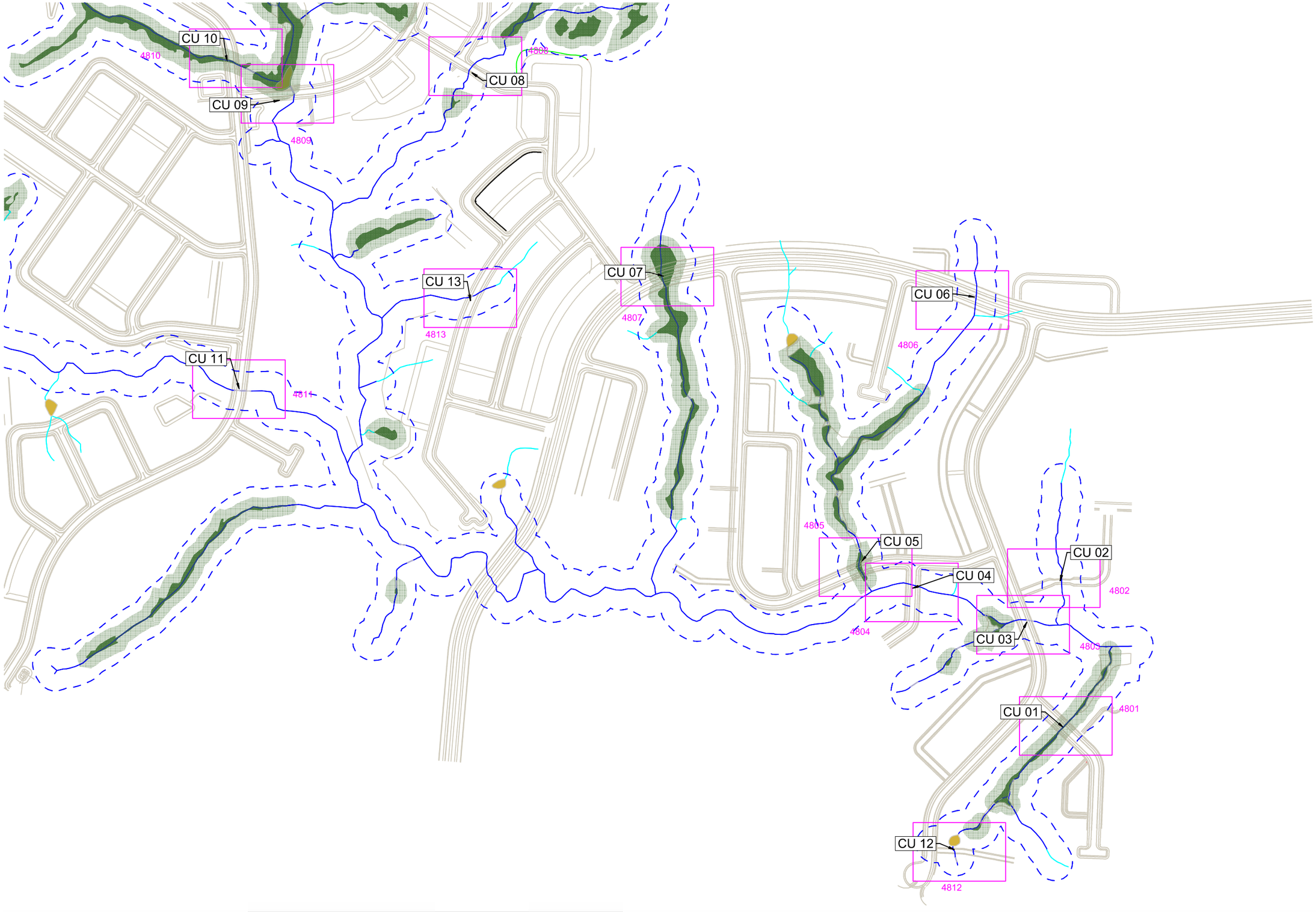
Despite this, the designs incorporate key ecological considerations, including embedded inverts and natural stream simulation, to support fish passage and maintain stream health as much as possible. Furthermore, hydraulic modelling has confirmed that the culvert designs effectively preserve upstream and downstream hydraulic conditions while minimising flood risk.

Please refer to the attached updated drawings, along with the latest detailed hydraulic analysis data and the culvert compliance assessment table, which provide supporting information for the revised culvert designs.

Zhongxin Wang

Civil Engineer

Mckenzie & Co



REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
E	S92	ZW	JK		19/06/2025
D	FOR TENDER	MO	PO		15/05/2025
C	Updated contours	SH	JK	JK	11/02/2025
B	Updated wetlands	SH	JK	JK	21/01/2025
A	FIRST ISSUE	SH	JK	JK	16/01/2025

MCKENZIE & CO.

CLIENT:
VINEWAY LIMITED

PROJECT:
DELMORE
STAGE 1 & 2
53A, 53B & 55 RUSSELL ROAD
OREWA

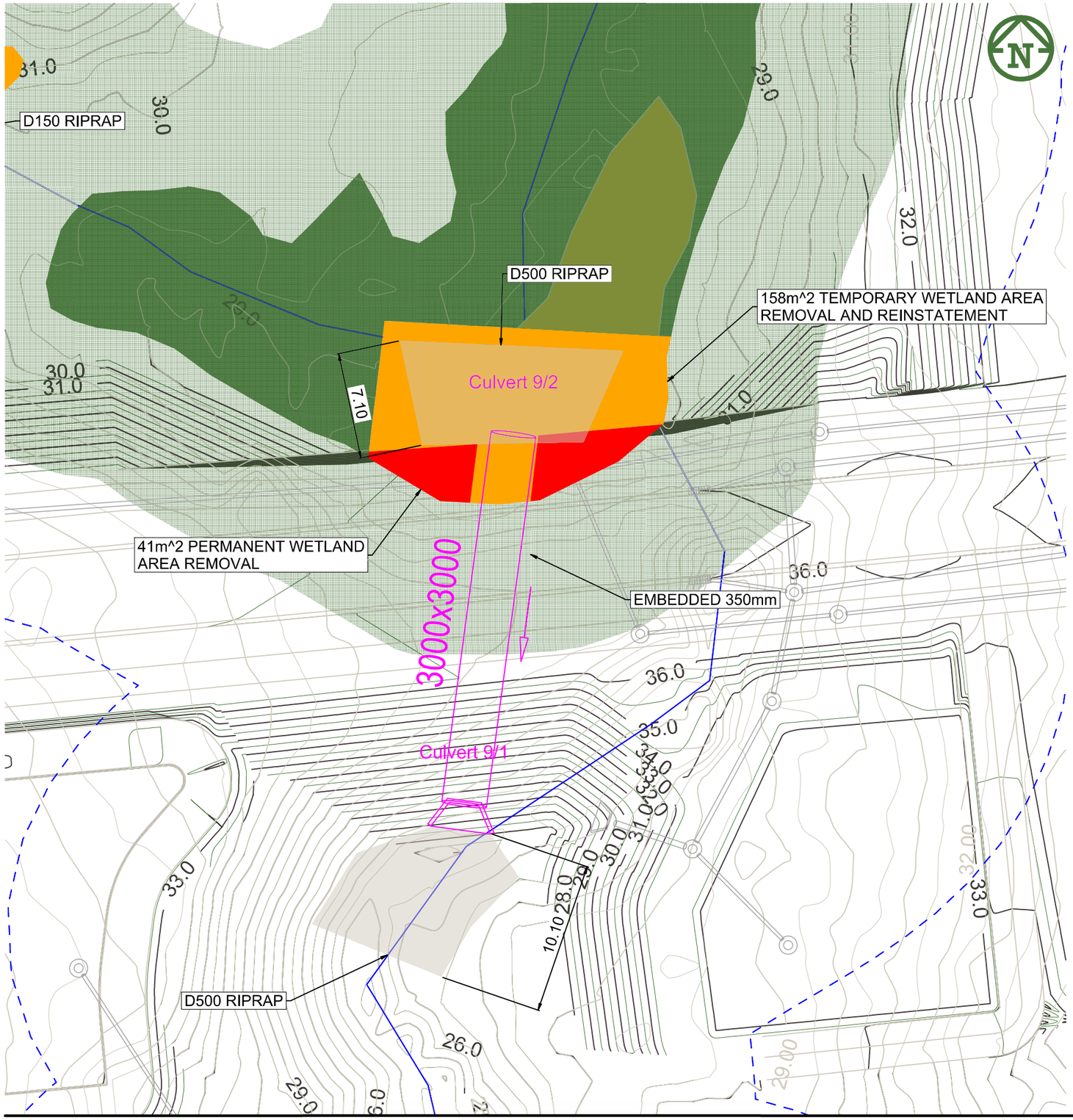
TITLE:
STORMWATER
CULVERT PLAN
OVERALL

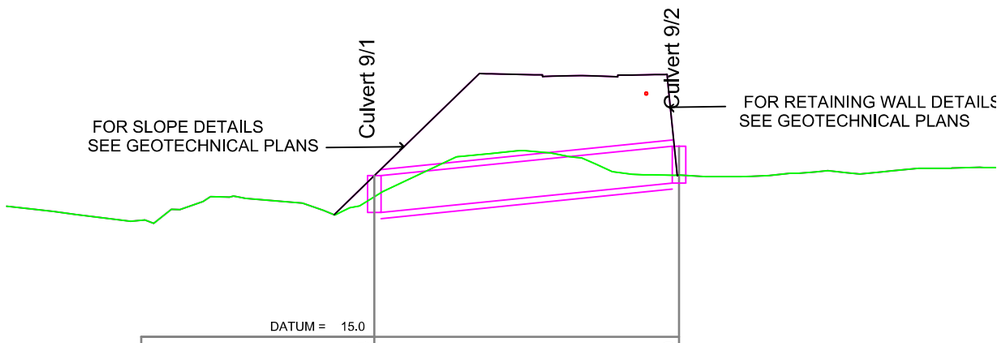
PURPOSE OF ISSUE:
FOR TENDER

SCALE:
1:4000 @A3
DO NOT SCALE

DRAWING NO: 3725-0-4800

REV: E





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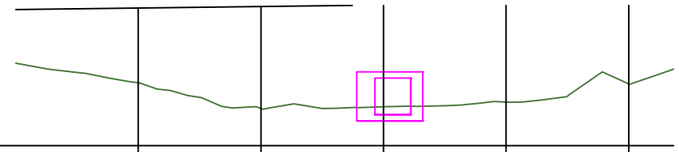
DESIGN SURFACE	28.14			28.20
DEPTH TO INVERT	2.99	2.99		0.65
INVERT LEVEL	25.15	25.15		27.55
EXISTING SURFACE	26.42			28.20
PIPE DETAILS		9.65% 3000x3000mmø BOX		
LENGTH		24.86m		

Culvert 09 - LONGSECTION



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DESIGN SURFACE	36.23	36.35	36.48	36.60	36.72
CUT/FILL DEPTHS	6.10	8.31	8.29	8.04	6.70
EXISTING SURFACE	30.13	28.05	28.18	28.56	30.02
CHAINAGES	10.0	20.0	30.0	40.0	50.0

Culvert 09 - ELEVATION VIEW

SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
E	S92	MO	PO		19/06/2025
D	FOR TENDER	MO	PO		15/05/2025
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A	FIRST ISSUE	SH	JK	JK	16/01/2025

MCKENZIE & CO.

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE
STAGE 2
88, 138 & 132 UPPER OREWA ROAD
OREWA

TITLE: STORMWATER
CULVERT PLAN
CULVERT 9

PURPOSE OF ISSUE: FOR TENDER

SCALE: 1:300 @ A3
DO NOT SCALE

DRAWING NO: 3725-0-4809

REV: E

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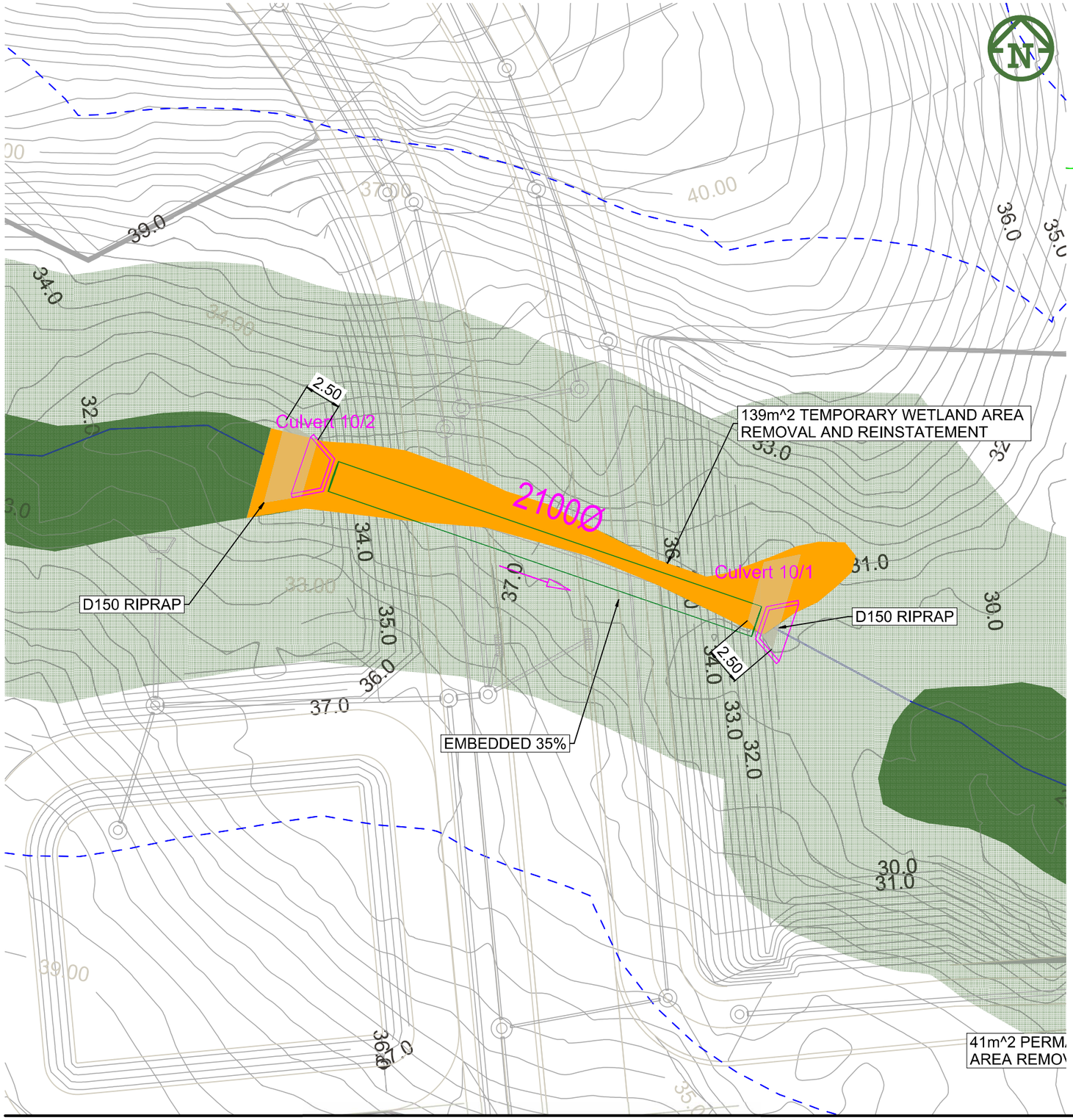

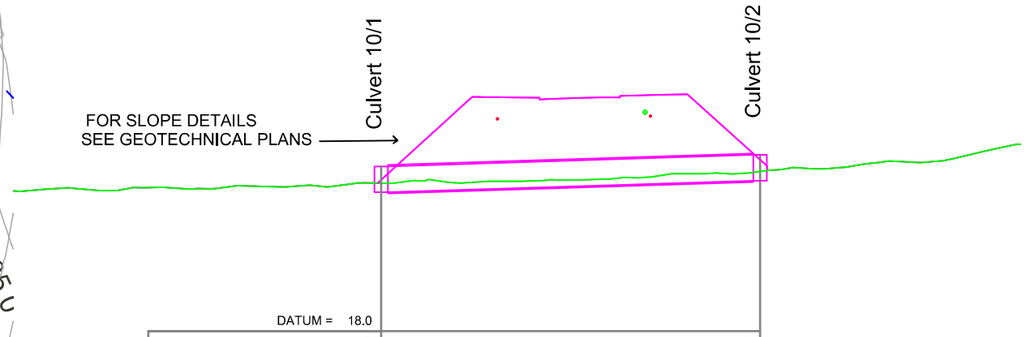

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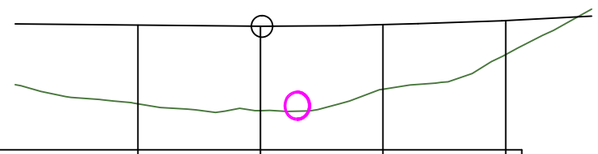
DESIGN SURFACE	30.33			31.96
DEPTH TO INVERT	1.00	1.00		1.70
INVERT LEVEL	29.33	29.33		30.27
EXISTING SURFACE	30.05			31.01
PIPE DETAILS	3.02% 2100mmø RCRRJ Class 4			
LENGTH	30.91m			

Culvert 10 - LONGSECTION



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DESIGN SURFACE	37.17	37.08	37.22	37.55
CUT/FILL DEPTHS	6.42	6.88	5.27	2.79
EXISTING SURFACE	30.75	30.20	31.95	34.76
CHAINAGES	10.0	20.0	30.0	40.0

Culvert 10 - ELEVATION VIEW

SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
E	S92	MO	PO		19/06/2025
D	FOR TENDER	MO	PO		15/05/2025
C	Updated contours	SH	JK	JK	11/02/2025
B	Updated wetlands	SH	JK	JK	21/01/2025
A	FIRST ISSUE	SH	JK	JK	16/01/2025

MCKENZIE & CO.

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE
STAGE 2
88, 138 & 132 UPPER OREWA ROAD
OREWA

TITLE: STORMWATER
CULVERT PLAN
CULVERT 10

PURPOSE OF ISSUE: FOR TENDER

SCALE: 1:300 @ A3
DO NOT SCALE

DRAWING NO: 3725-0-4810

REV: E

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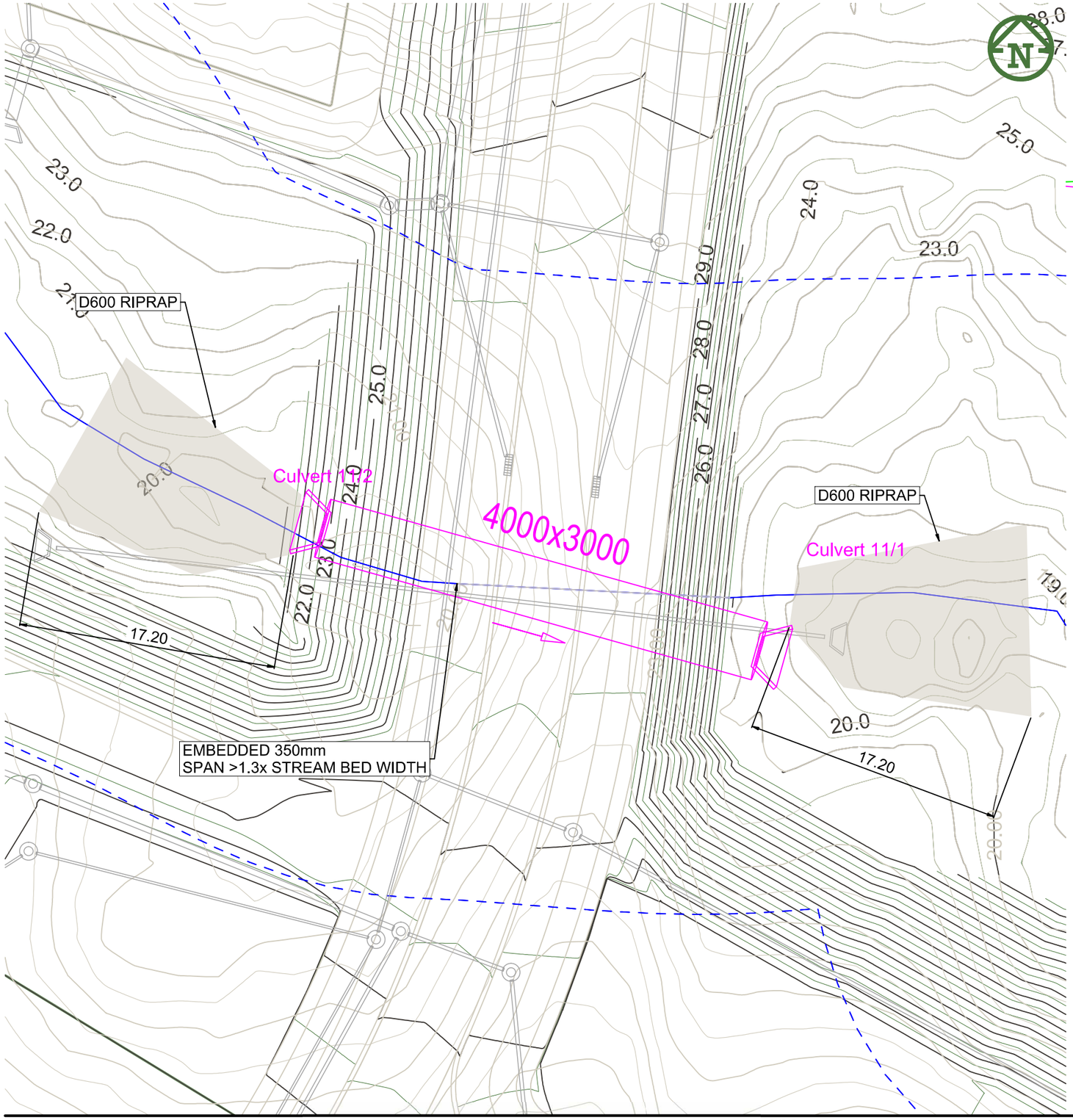
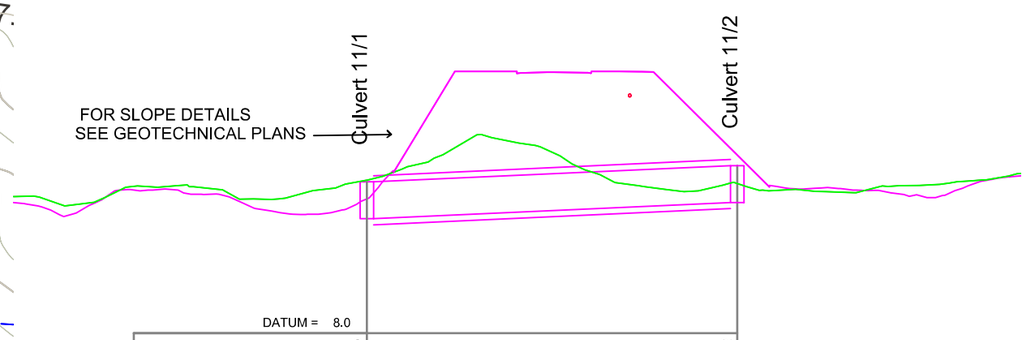
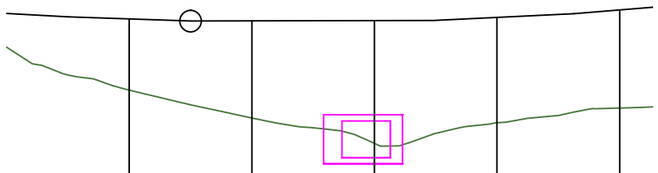




DATUM = 8.0			
DESIGN SURFACE	18.95		22.52
DEPTH TO INVERT	1.62	1.62	3.87
INVERT LEVEL	17.33	17.33	18.65
EXISTING SURFACE	20.48		20.20
PIPE DETAILS		4.37% 4000x3000mmø BOX	
LENGTH		30.22m	

Culvert 11 - LONGSECTION



DATUM = 16.00

DESIGN SURFACE	29.68	29.51	29.53	29.80	30.41
CUT/FILL DEPTHS	5.80	7.92	10.00	8.59	7.99
EXISTING SURFACE	23.88	21.60	19.54	21.21	22.42
CHAINAGES	10.0	20.0	30.0	40.0	50.0

Culvert 11 - ELEVATION VIEW

SCALE HORIZ=1:500 @ A3 VERT=1:500 @ A3

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
E	S92	MO	PO		19/06/2025
D	FOR TENDER	MO	PO		15/05/2025
C	Updated contours	SH	JK	JK	11/02/2025
B	Updated wetlands	SH	JK	JK	21/01/2025
A	FIRST ISSUE	SH	JK	JK	16/01/2025

MCKENZIE & CO.

CLIENT: VINEWAY LIMITED

PROJECT: DELMORE
STAGE 2
88, 138 & 132 UPPER OREWA ROAD
OREWA

TITLE: STORMWATER
CULVERT PLAN
CULVERT 11

PURPOSE OF ISSUE: FOR TENDER

SCALE: 1:300 @ A3
DO NOT SCALE

DRAWING NO: 3725-0-4811

REV: E

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CULVERT NAME	TYPE	Culvert Parameters			1% AEP				OUTLET - TR 2013-018 (Hydraulic Energy Management)				1% AEP, 50% blocked				10% AEP				50% AEP		
		Span (mm)	Rise (mm) (WITHOUT EMBEDMENT)	Embedment (mm)	1% AEP flow (m^3/s)	Headwater above embedment (m)	Outlet depth (m)	Outlet velocity (m/s)	Equation 20 Froude No	Equation 21 Riprap size D50	Riprap size (m)	Equation 23 Apron Length (m)	Embedment (mm)	Headwater above OG embedment (m)*	NOTES:	Outlet velocity (m/s)	10% AEP flow (m^3/s)	Headwater above embedment (m)	Water level below soffit?	Outlet velocity (m/s)	50% AEP flow (m^3/s)	Headwater above embedment (m)	Outlet velocity (m/s)
Culvert 9	BOX	3000	3000	350	17.912	2.254	0.438	3.828	1.85	0.20	0.80	5.5	350	2.63		3.248	10.752	1.639	Y	3.365	5.055	0.979	2.764
Culvert 10	CIRCULAR	2100	2100	735	3.113	0.954	0.298	2.4	1.40	0.10	0.30	3.2	735	1.116		2.129	1.981	0.677	Y	2.114	1.048	0.382	1.9
Culvert 11	BOX	4000	3000	350	38.301	3.456	0.812	5.28	1.87	0.38	0.80	10.3	350	4.874	PONDING IN IN-LET AREA (EXISTING STREAM BUND)	4.323	23.656	2.5	Y	3.86	11.749	1.55	3

CULVERT CHECKLIST		Culvert 9		Culvert 10		Culvert 11	
4.3.9.8	**Auckland Council SW CoP**	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS
a)	If the culvert embankment can be considered a dam under the dam safety regulations, the requirements of those regulations shall take precedence over those stated here. The following thresholds under the AUP apply: 1)Vertical height from the downstream toe of the embankment to the top is more than 4 m and 2) The total stored volume of fluid is more than 20,000 m3	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.
b)	The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without adversely affecting upstream or downstream property.	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model
c)	The headwater pond created by the culvert during the 1% AEP event shall have a depth not exceeding 3.0 m above the invert of the pipe and shall provide 500 mm freeboard to the edge of the seal of the road (or similar feature) at the top of the embankment. For cases where the approach velocity is greater than 2 m/s, the freeboard shall be at least 1.5 times the velocity head at the entrance. The headwater pond created by the 10% AEP event shall not be higher than the soffit of the pipe.	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	N	Headwater > 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit The deep water area is very limit, specific inlet design will be done later.
d)	Culverts shall be designed such that the maximum velocity within the culvert generated by the 1% AEP event does not exceed 6.0 m/s. Higher velocities in culverts require approval from Auckland Council. High outlet velocities are likely to cause scour and erosion of natural channels and reference shall be made to Auckland Council technical report TR2013/018. Note that energy dissipation shall be required at far lower velocities than the maximum allowed within the conduit stated above.	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s
e)	Culverts shall be designed such that for the 50% AEP design storm, an absolute minimum velocity of 0.6 m/s and desired minimum of 1.0 m/s is achieved.	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s
f)	Culverts shall have a minimum internal diameter of 375 mm (for vehicle crossing standards refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual).	Y		Y		Y	
g)	A suitable transition structure is required at both the inlet and outlet to the proposed culvert which shall ensure that there is no scour or erosion in the watercourse, private property and/or the road formation (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads)	Y		Y		Y	
h)	A secondary flow path shall be kept unobstructed at all times. The secondary flow path design shall assume the total blockage of the culvert in cases where it is less than DN1,500, and 50% capacity reduction if the culvert is greater than or equal to DN1,500 (1.77m^2), unless demonstrated by specific design to Auckland Council's approval that a lower blockage factor can be applied.	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked	Y	Culvert overtops if 50% blocked. Existing stream area will provide basin function. The effect for up/down stream property is lees than minior.
i)	Allowance for 100% blockage of pipes greater than DN1,500 may be necessary in some circumstances. The risk of blockage resulting from the contributing catchment shall be assessed on a case-by-case basis (this includes situations where a safety grille or debris screen is used) to determine if specific culvert design (including consideration of a secondary inlet) is required.	N/A		N/A		N/A	
j)	No obtrusive brand names on proprietary devices and other visible components of the stormwater system shall be visible once constructed.	N/A		N/A		N/A	
k)	For culverts whose inlets may be difficult to locate if submerged, green retro-reflective raised pavement markers shall be required to mark the presence of the culvert under the roadway. For all culverts associated with roads, markings shall be in accordance with Auckland Transport Code of Practice and Auckland Transport Technical Design Manual requirements.	N/A	Not required	N/A	Not required	N/A	Not required
l)	Provision of safety measures may be required, e.g. a barrier along the culvert headwall (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads).	Y	Details TBC	Y	Details TBC	Y	Details TBC
m)	Culverts under road fencing or barriers are to be designed to Auckland Transport requirements.	Y	Details TBC	Y	Details TBC	Y	Details TBC
n)	Adequate provision shall be made for maintenance. This shall include, but not be limited to, access to inlet and outlet for inspection, debris removal and scour protection maintenance, and any other activities stated in the operation and maintenance manual.	Y	Details TBC	Y	Details TBC	Y	Details TBC
o)	Fish passage shall be provided in accordance with Section 4.2.8.	Y	Details TBC	Y	Details TBC	Y	Details TBC
p)	The need for debris screens shall be subject to specific design, considering the likelihood of debris flowing from the upstream catchment and potential impact on the culvert.	N/A	Not required	N/A	Not required	N/A	Not required
q)	Culverts shall be single-barrelled unless specific design is approved by Auckland Council.	Y	Single box culvert	Y	Single circular culvert	Y	Single box culvert
	NES Freshwater Standards						
a)	The culvert must provide for the same passage of fish upstream and downstream as would exist without the culvert, except as required to carry out the works to place, alter, extend, or reconstruct the culvert	Y		Y		Y	
b)	The culvert must be laid parallel to the slope of the bed of the river or connected area	Y		Y		Y	
c)	The mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches	Y		Y		Y	
d)	The culvert's width where it intersects with the bed of the river or connected area (s) and the width of the bed at that location (w), both measured in metres, must compare as follows: (i) where $w \leq 3$, $s \geq 1.3 \times w$: (ii) where $w > 3$, $s \geq (1.2 \times w) + 0.6$	N	Located in wide flat area. Impractical to span the bed completely	N	Located in wide flat area. Impractical to span the bed completely	Y	
e)	The culvert must be open-bottomed or its invert must be placed so that at least 25% of the culvert's diameter is below the level of the bed	Y		Y		Y	
f)	The bed substrate must be present over the full length of the culvert and stable at the flow rate at or below which the water flows for 80% of the time	Y		Y		Y	
g)	The culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris)	Y		Y		Y	