4398	CULVERT CHECKLIST Auckland Council SW CoP	CHECK OK	Culvert 1 COMMENTS	CHECK OK	Culvert 2 COMMENTS	CHECK OK	Culvert 3 COMMENTS	CHECK OK	Culvert 4 COMMENTS	CHECK OK	Culvert 5	CHECK OK	Culvert 6 COMMENTS
V.J.J.J.		CILCROX	Bottom to top of embankment more than 4m,	JINGS OA	Bottom to top of embankment more than 4m,	LINCO OR	Bottom to top of embankment more than 4m,	and of	Bottom to top of embankment more than 4m,	JINCH OK	Bottom to top of embankment more than 4m,	- ILCA OK	Bottom to top of embankment more than 4m,
	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 to of the embankment to the top is more than 4 m and		storage less than 20,000m3.		storage less than 20,000m3.		storage > 20000m3.		storage > 20000m3.		storage less than 20,000m3.		storage > 20000m3.
a)	embankment to the top is more than 4 m and 2) The total stored volume of fluid is more than 20,000 m3	Y		Υ		N		N		Y		N	
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.	v	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	v	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	v	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	v	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model
1			Headwater < 3m above embedment invert.		Headwater < 3m above embedment invert.		Headwater < 3m above embedment invert.		Headwater <3m above embedment invert.		Headwater < 3m above embedment invert.		Headwater < 3m above embedment invert.
	The headwater point created by the culvert during the 15% AEP cent shall have a depth of exceeding 3.0 in above the insert of the pipe and shall provide 500 mm freeboard to the edge of the said of the road (or similar feature) at the top of the embalment. For case where the approach velocity is greater than 2 m/s, the freeboard shall be at least 1.5 times the velocity lead at the entrance. The headwater point created by the 10% AEP event shall not be higher than the soffict of the pipe.		Freeboard satisfied. 10% AEP headwater lower than soffit		Freeboard satisfied. 10% AEP headwater lower than soffit		Freeboard satisfied. 10% AEP headwater lower than soffit		Freeboard satisfied. 10% AEP headwater lower than soffit.		Freeboard satisfied. 10% AEP headwater lower than soffit		Freeboard satisfied. 10% AEP headwater lower than soffit
	users to use pupil. University shall be designed such that the maximum velocity within the culvert generated by the 1% AFP event does not exceed 6.0 m/s. Higher velocities in culverts require approval from Aucthand Countil. High collect velocities are likely to cause scour and erosion of natural channels and reference shall be made to Aucthand Countil technical report. TR.D.013/LIB. Note that energy discipation shall be required at far lower velocities than the maximum allowed within the		Velocity < 6m/s		Velocity < 6m/s	,	velocity < 6m/s	,	Velocity < 6m/s		Velocity < 6m/s	,	Velocity < 6m/s
d)	conduit stated above. Culverts shall be designed such that for the 50% AEP design	Y	Minimum > 0.6m/s	Υ	Minimum > 0.6m/s	Y	Minimum > 0.6m/s						
e)	storm, an absolute minimum velocity of 0.6 m/s and desired minimum of 1.0 m/s is achieved. 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	Y		Υ		Y		Y		у		Y	
f)	Design Manual). A suitable transition structure is required at both the Inlet and untilet 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	Y		Y		Y		Y		Υ		Y	
g)	Manual for special requirements adjacent to roads)	Y	Culvert has capacity if 50% blocked	Υ	Culvert has capacity if 50% blocked	Y	Culvert overtops if 50% blocked. Road to be	Y	Culvert overtops if 50% blocked. Road to be	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked
	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 2), unless demonstrated by specific design to Auckland Council's approval that a lower blockage factor can be applied.	Y		Y	,	Y	specially designed to allow overtopping	Υ	specially designed to allow overtopping	Ψ		Y	
	Allowance for 100% blockage of pipes greater than DN1,500 may be necessary in some circumstances. The risk of blockage creating from the contributing cathemat shall be assessed on a case-by-case basis (this includes situations where a safety grille or debtris screen is used) to determine if specific cubert design including consideration of a secondary intel is												
1)	required. No obtrusive brand names on proprietary devices and other visible components of the stormwater system shall be visible	N/A		N/A									
۵	once constructed. 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, markingshall be in accordance with Auctioan Transport Code for	N/A	Not required	N/A	Not required								
	Practice and Auckland Transport Technical Design Manual	21/2		21/2		21/2		21/2		**/*		M/A	
.,	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).	WA.	Details TBC	n/n	Details TBC	WA.	Details TBC	N/A	Details TBC	w/A	Details TBC	N/A	Details TBC
	Culverts under road fencing or barriers are to be designed to Auckland Transport requirements.		Details TBC	v	Details TBC		Details TBC	,	Details TBC	v	Details TBC	v	Details TBC
	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.		Details TBC		Details TBC								
	Fish passage shall be provided in accordance with Section		Details TBC		Details TBC								
0)	4.2.8. 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.	Y N/A	Not required	Y N/A	Not required	N/A	Not required	N/A	Not required	Y N/A	Not required	N/A	Not required
-	Culverts shall be single-barrelled unless specific design is		Single box culvert		Single box culvert		Single bax culvert		Single box culvert		Single box culvert		Single box culvert
q)	approved by Auckland Council. NES Everburger Standards	Y		Υ		Y		Y		Y		Y	
	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,												
a)	extend, or reconstruct the culvert The culvert must be laid parallel to the slope of the bed of the	Y		Y		Y		Y		Y		Y	
c)	river or connected area The mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches	Y		Y		Y		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 $w \le 3$, $s \ge 1.3 \times w$: (ii) where $w > 3$, $s \ge (1.2 \times w) + 0.6$	Y		Y		Y		Y		Υ		Y	
	The culvert must be open-bottomed or its invert must be placed so that at least 25% of the culvert's diameter is below												
e) f)	the level of the bed 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 Y		Y		Y Y		Y Y		y y	
	The culvert provides for continuity of geomorphic processes												
g)	(such as the movement of sediment and debris)	Y		Υ		Y	<u> </u>	Υ	l	Υ		Υ	

	CULVERT CHECKLIST		Culvert 7	Culvert 8			Culvert 9		Culvert 10		Culvert 11		Culvert 12		Culvert 13
4.3.9.8	Auckland Council SW CoP	CHECK OK	COMMENTS Bottom to top of embankment more than 4m,	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS Bottom to top of embankment more than 4m,	CHECK OK	COMMENTS	CHECK OK	COMMENTS Bottom to top of embankment less than 4m,	CHECK OK	COMMENTS Bottom to top of embankment more than 4m,
af ti	f the culvert embankment can be considered a dam under the dam safety regulations, the requirements of those egulations shall take precedence over those stated here. The		Bottom to top of embankment more than 4m, storage less than 20,000m3.		Bottom to top of embankment more than 4m, storage less than 20,000m3.		Bottom to top of embankment more than 4m, storage less than 20,000m3.		Bottom to top of embankment more than 4m, storage less than 20,000m3.		Bottom to top of embankment more than 4m, storage less than 20,000m3.		Bottom to top of embankment less than 4m, storage less than 20,000m3		Bottom to top of embankment more than 4m, storage less than 20,000m3.
fc 1	following thresholds under the AUP apply: [)Vertical height from the downstream toe of the embankment to the top is more than 4 m and [) The total stored volume of fluid is more than 20,000 m3	,		Y		Y		Y		Y		Y		Y	
le	The culvert shall be designed to cater for the flows and water evels generated by the 1% AEP event without adversely affecting upstream or downstream property.	,	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 Headwater > 3m above embedment invert.	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	γ	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model Headwater > 3m above embedment invert.	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	γ	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model
e 0 0 0 0 0 0 0 0 0 0	The headwater pond created by the culvert during the 1% AEP venet 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 meaniment. For cases where the approach velocity is yeater than 2 m/s, the freeboard shall be at least 15.5 times he velocity head at the entrance. The headwater pond resided by the 10% AEP event shall not be higher than the offit of the pipe.	,	Headwater - 3m above embedment invert. Freebeard statified. 10% AEP headwater lower than sofflit	N	Headwater 3 and above emboarnest invert. Freeboard statified. 10% AEP headwater greater than soffit.	N	Neadwater > 3m above embedment invert. Freeboard satisfied 10% AEP headwater greater than soffit	N	Headwater - 3m above embodment invert. Freeboard sattlifed. 10% AEP headwater less than soffit	N	resolouster > sm above emboanment invert. Freeboard statified frees than soffit 100% AEP headwater less than soffit the deep water area is very limited, specific inlet design will be done later.	¥	Headwater 4 Im above embedment invert. Freeboard salfel. 10% AEP headwater lower than soffit	Y	Headwater 3 m above embedment invert. Freeboard satisfied 10% AEP headwater lower than soffit
si fi d)	Lulverts shall be designed such that the maximum velocity within the culvert generated by the 1% AFP event does not recorded 5.0 m/s. High velocities in culverts require approval from Auckland Council. High outlet velocities are likely to suuse scour and erotion of natural channels and reference shall be made to Auckland Council technical report TRZD31078. Note that energy dissipation shall be required at air lower velocities than the maximum allowed within the conduit stated above.	,	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Υ	Velocity < 6m/s	Υ	Velocity < 6m/s	Y	Velocity < 6m/s	Υ	Velocity < 6m/s
st C	Culverts shall be designed such that for the 50% AEP design storm, an absolute minimum velocity of 0.6 m/s and desired	,	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	N	Minimum < 0.6m/s	N	Minimum < 0.6m/s due to backwater effects	Y	Minimum > 0.6m/s	N	Minimum < 0.6m/s	Y	Minimum > 0.6m/s
Ti	Infilmum to 1.0 mys a sourcevou. Universt shall have a minimum internal diameter of 375 mm for whiche crossing standards refer to the Auckland Fransport Code of Practice and Auckland Transport Technical Design Manual).	,		Y		Y		Y		Y		Y		Υ	
n	A suitable transition structure is required at both the inlet and outlet to the proposed culvert which shall ensure that there is to scour or erosion in the watercourse, private property only for the road formation (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads)	r		Y		Y		Y		Y		Y		Y	
Ti b ai	A secondary flow path shall be kept unobstructed at all times. The secondary flow path design shall assume the total slockage of the culver lin cases where it it less than DMI, 500, and 50% capacity reduction if the culvert is greater than or qual to DMI, 500 (177m²2), unless demonstrated by specific lesign to Audiand Council's approval that a lower blockage store can be applied.	r	Culvert has capacity if 50% blocked	Y	Culvert headwater will back up into existing wetland area if blocked. The spillway is the road which is lower than upstream lot levels. Existing stream area will provide basin function. The effect for up/down stream property is less than minor.	Y	Culvert headwater will back up into existing wetland area if blocked. The spillway is the road which is lower than upstream to levels. Existing stream area will provide basin function. The effect for up/down stream property is less than minor.	Y	Culvert headwater will back up into existing wetland area if blocked. The spillway is the road which is lower than upstream lot levels. Existing stream area will provide basin function. The effect for up/down stream property is less than minor.	Υ	Culvert overtops if 50% blocked. Existing stream area will provide basin function. The effect for up/down stream property is less than minor.	Y	Road to be specially designed to allow overtopping if completely blocked	Υ	Culvert has capacity if 50% blocked
o sa co	bllowance for 100% blockage of pipes greater than DN1,500 may be necessary in some circumstances. The risk of blockage setuling from the contributing catchment shall be assessed on a case-by-case basis (this includes situations where a affety grille or debriss zeren is usued) to determine if specific subsert design (including consideration of a secondary inlet) is required.	N/A		N/A		N/A		N/A		N/A		N/A		N/A	
)) o	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		N/A		N/A		N/A		N/A	
si tt si	For culverts whose inlets may be difficult to locate if ubmerged, 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 that be in accordance with Auckland Transport Code of Practice and Auckland Transport Technical Design Manual sequirements.	N/A	Not required	N/Δ	Not required	N/Δ	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required
P a c	Provision of safety measures may be required, e.g. a barrier solong the culvert headwall (refer to the Auckland Transport code of Practice and Auckland Transport Technical Design		Details TBC		Details TBC		Details TBC		Details TBC		Details TBC		Details TBC		Details TBC
, c	Manual for special requirements adjacent to roads). Culverts under road fencing or barriers are to be designed to Auckland Transport requirements.		Details TBC		Details TBC		Details TBC		Details TBC	v	Details TBC		Details TBC	,	Details TBC
A ir	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 may be appropriated to the contraction of the propriate and the provision of the provision of the provision of the provision of the provision of the provision of provision of provi	,	Details TBC	v	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
p)	Fish passage shall be provided in accordance with Section	,	Details TBC	Y	Details TBC	γ	Details TBC	v	Details TBC	v	Details TBC	Y	Details TBC	v	Details TBC
TI CI	The need for debris screens shall be subject to specific design, considering the likelihood of debris flowing from the	N/A	Not required	N/4	Not required	N/A	Not required	11/4	Not required	w/6	Not required	N/A	Not required	N/A	Not required
С	upstream catchment and potential impact on the culvert. Culverts shall be single-barrelled unless specific design is approved by Auckland Council.	N/A	Single box culvert	N/H	Single box culvert	v v	Single circular culvert	N/H	Single circular culvert	v.	Single box culvert	nyA v	Single circular culvert	v v	Single circular culvert
H) 3	pproved by Auckland Council. NES Freshwater Standards The culvert must provide for the same passage of fish														
a) e	Ine cuivert must provide for the same passage or rish paptream and downstream as would exist without the cuivert, except as required to carry out the works to place, alter, extend, or reconstruct the cuivert The cuivert must be laid parallel to the slope of the bed of the liver or connected area	<u>, </u>		Y		Y		y v		Y		Y		Y	
Ti b	inver or connected area The mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river eaches	,		Y		Υ		Y		Y		Y		Y	
ri lo fo d) ×	The culvert's width where it intersects with the bed of the iver or connected area (s) and the width of the bed at that ocation (w), both measured in metres, must compare as oillows: (i) where $w \le 3$, $s \ge 1.3 \times w$: (ii) where $w > 3$, $s \ge 1.2 \times w$: (ii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iii) where $w \ge 3$, $s \ge 1.3 \times w$: (iiii) where $w \ge 3$, $s \ge 1.3 \times w$: (iiii) where $w \ge 3$, $s \ge 1.3 \times w$: (iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	N	Located in wide flat area. Impractical to span the bed completely	Y		N	Located in wide flat area. Impractical to span the bed completely	N	Located in wide flat area. Impractical to span the bed completely	Υ		Y		Υ	
p)	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 bod	,		Y		Y		Y		Y		Y		Y	
f) ci	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		Y		Y		Y	
g) (:	The culvert provides for continuity of geomorphic processes such as the movement of sediment and debris)	,		Υ		Y		Y		Y		Y		Y	