CULVERT CHECKLIST

4.3.9.8	Auckland Council SW CoP	Culvert 1 CHECK OK	Culvert 1 COMMENTS	Culvert 2 CHECK OK	Culvert 2 COMMENTS	Culvert 3 CHECK OK	Culvert 3 COMMENTS	Culvert 4 CHECK OK	Culvert 4 COMMENTS	Culvert 5 CHECK OK	Culvert 5 COMMENTS	Culvert 6 CHECK OK	Culvert 6 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.	N	Bottom to top of embankment more than 4m, storage > 20000m3.	N	Bottom to top of embankment more than 4m, storage > 20000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	N	Bottom to top of embankment more than 4m, storage > 20000m3.
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	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	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.	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
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	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	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		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		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. Road to be specially designed to allow overtopping	Y	Culvert overtops if 50% blocked. Road to be specially designed to allow overtopping	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked
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		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		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	N/A	Not required	N/A	Not required		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	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	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	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	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	N/A	Not required	N/A	Not required		Not required
q)	Culverts shall be single-barrelled unless specific design is approved by Auckland Council.	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single box 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		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		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		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 ≤ 3, s ≥ 1.3 × w: (ii) where w > 3, s ≥ (1.2 × w) + 0.6	Y		Y		Y		Y		Y		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		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		Y		Y		Y	
g)	The culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris)	Y		Y		Y		Y		Y		Y	

4.3.9.8	Auckland Council SW CoP	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	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.		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.
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.		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model		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.	N	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	N	Headwater > 3m above embedment invert. Freeboard satisfied. 10% AEP headwater greater than soffit	N	Headwater > 3m above embedment invert. Freeboard satisfied. 10% AEP headwater greater than soffit	N	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater less than soffit	N	Headwater > 3m above embedment invert. Freeboard satisfied. 10% AEP headwater less than soffit The deep water area is very limited, specific inlet design will be done later.	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
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	Y	Velocity < 6m/s	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	N	Minimum > 0.6m/s	N	Minimum < 0.6m/s	Y	Minimum < 0.6m/s due to backwater effects	N	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		Y		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		Y		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 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 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 lot levels. Existing stream area will provide basin function. The effect for up/down stream property is less than minor.	Y	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	Y	Culvert has capacity if 50% blocked
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		N/A		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		N/A		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	N/A	Not required	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	Y	Details TBC	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	Y	Details TBC	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	Y	Details TBC	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	Y	Details TBC	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	N/A	Not required	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 box culvert	Y	Single circular culvert	Y	Single box culvert	Y	Single box culvert	Y	Single circular culvert	Y	Single circular 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		Y		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		Y		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		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 ≤ 3, s ≥ 1.3 × w: (ii) where w > 3, s ≥ (1.2 × w) + 0.6	N	Located in wide flat area. Impractical to span the bed completely	N		N	Located in wide flat area. Impractical to span the bed completely	Y	Located in wide flat area. Impractical to span the bed completely	Y		Y		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		Y		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		Y		Y		Y		Y	
g)	The culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris)	Y		Y		Y		Y		Y		Y		Y	