BEFORE THE TARANAKI REGIONAL COUNCIL AND NEW PLYMOUTH DISTRICT COUNCIL

MT MESSENGER BYPASS PROJECT

In the matter	of the Resource Management Act 1991
and	
In the matter	of applications for resource consents, and a notice of requirement by the NZ Transport Agency for an alteration to the State Highway 3 designation in the New Plymouth District Plan, to carry out the Mt Messenger Bypass Project

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SUPPLEMENTARY STATEMENT OF EVIDENCE OF KEITH DAVID HAMILL (FRESHWATER ECOLOGY) ON BEHALF OF THE NZ TRANSPORT AGENCY

17 July 2018

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INTRODUCTION

1. My full name is Keith David Hamill.

2. My supplementary evidence is given in relation to applications for resource consents, and a notice of requirement by the NZ Transport Agency ("the **Transport Agency**") for an alteration to the State Highway 3 designation in the New Plymouth District Plan, to carry out the Mt Messenger Bypass Project ("the **Project**").

3. I have the qualifications and experience set out in my statement of evidence in chief ("**EIC**") dated 25 May 2018.

4. I repeat the confirmation given in my EIC that I have read the 'Code of Conduct' for expert witnesses and that my evidence has been prepared in compliance with that Code.

5. In this evidence I use the same defined terms as in my EIC.

SCOPE OF EVIDENCE

6. My supplementary evidence updates my EIC to reflect refinements in the Project design, refinement of the Restoration Package and an update of the ELMP and adjustments to works. The key issues covered in this supplementary evidence are:

   (a) An update of stream off-set calculations using the SEV to reflect confirmed design changes and a small modification to the calculation approach.

   (b) The effects of the Project on fish passage based on refinements to the design for culverts and bridge crossings.

   (c) Ecological monitoring of fish and aquatic macroinvertebrates proposed in the revised ELMP.

REFINEMENTS TO THE PROJECT DESIGN

7. The Project design has been refined since the AEE was submitted. Key changes that affect freshwater ecology are:

   (a) The area of fill above Culvert 18/19 is no longer required. This reduces the length of stream diversion required by about 180m (see evidence by Mr Peter Roan). Changes to the SEV calculations have been made to reflect this change (see below).

   (b) Design changes have been made to eight of the culverts as described in the evidence of Mr McEwan.

8. In general, the design changes involve making the culvert diameters wider and the gradients less steep. This provides higher certainty of ensuring appropriate fish passage for a wider range of flows. Key changes are:

   (a) Culvert 8 widened to 1500mm, the grade reduced to 3% and embedded by 30%.

   (b) Culvert 9 (site Ea10a) and Culvert 18 (site Ea23) are now proposed to be either an arch or large box culvert, set well below bed level to allow a stream simulation design.

   (c) Culvert 12 (Site Ea13) is replaced by a bridge.

   (d) Culvert 14 (Site Ea15) has been widened to 1500mm, the grade reduced from 16% to <1% and more embedded. It is now longer (140m compared to 117m) and the offset calculations have been adjusted accordingly.

   (e) Culvert 15 (site Ea16) is more deeply embedded (25%) and the same grade (1%) but is longer (250m-280m compared to 210m). The offset calculations have been adjusted accordingly.

   (f) Culvert 16 (site E6) is wider, more deeply embedded and the grade reduced to <1% but is now also longer (147m instead of 115m) and the offset calculations have been adjusted accordingly.

   (g) Culvert 17 is wider and more deeply embedded but remains at a relatively steep grade of 14%.

   (h) Culvert 19 (Site Ea23a) is no longer required because the fill site is no longer occurring.

FISH PASSAGE AND EFFECTS OF CULVETS

9. The refinements to the design of culverts described above result in less effects on the stream and higher certainty of achieving appropriate fish passage at a wider range of flows. In my EIC (at paragraph 109) I assessed the effects of the Project on fish passage, following mitigation, as low. With the design refinements, the effects of the Project on fish passage remain low but:

   (a) there is higher certainty of long term successful ecological outcomes; and

   (b) some of the design changes will ensure more fish and macroinvertebrate habitat is retained within the stream (e.g. more crossings with bridges and more with a stream simulation design approach).

10. I note that adjustments in SEV calculations discussed below have been made on a conservative basis. They do not directly account for the improved habitat within the culvert itself that the stream simulation design refinements provide.

11. The *New Zealand Fish Passage Guidelines for Structures up to 4 Metres* (2018) ("**Fish Passage Guidelines**") provide guidance on designing stream crossings. The Fish Passage Guidelines describe a hierarchy of design preferences in terms of effects on fish passage (see Figure 1). Bridges are the most preferred solution as they avoid fish passage effects, followed by stream simulation culvert designs. These crossing types best maintain the stream conditions to which local fish species are adapted. Traditional single barrel culverts can be designed and installed in a way that ensures passage of migrating fish, however traditional culverts can have greater uncertainty of ensuring suitable fish passage and are therefore less preferred by the Fish Passage Guidelines than using a stream simulation approach. Both the stream simulation and the hydraulic design approach are consistent with providing passage for fish and other organisms as described in the Fish Passage Guidelines[1].

12. Stream simulation culvert design is a wholistic approach that creates a natural and dynamic channel through the structure similar to the characteristics of the channel. A key feature of this approach is to create a structure that that encompasses at least the natural bankfull width of the channel. The hydraulic design approach applied for some culverts in this Project involves replicating stream hydraulic characteristics within and around the culverts, similar to that of the existing stream.

13. In order to inform the culvert design team, I ranked the Project culverts according to their relative importance in ensuring fish passage. I ranked the stream crossings simply on catchment size (see Table 2 of my EIC). Catchment size was chosen as a proxy as larger streams within the Project footprint typically have more fish habitat and higher abundance of native fish.

14. Higher ranking streams were prioritised for developing fish passage designs higher on the hierarchy of preferences in order to maximise confidence in ensuring good fish passage outcomes. In practice, not all streams with a relatively high ranking could be crossed with a bridge or culvert using the stream simulation approach (e.g. culvert 15).

[1] See page 38 of the Fish Passage Guidelines.

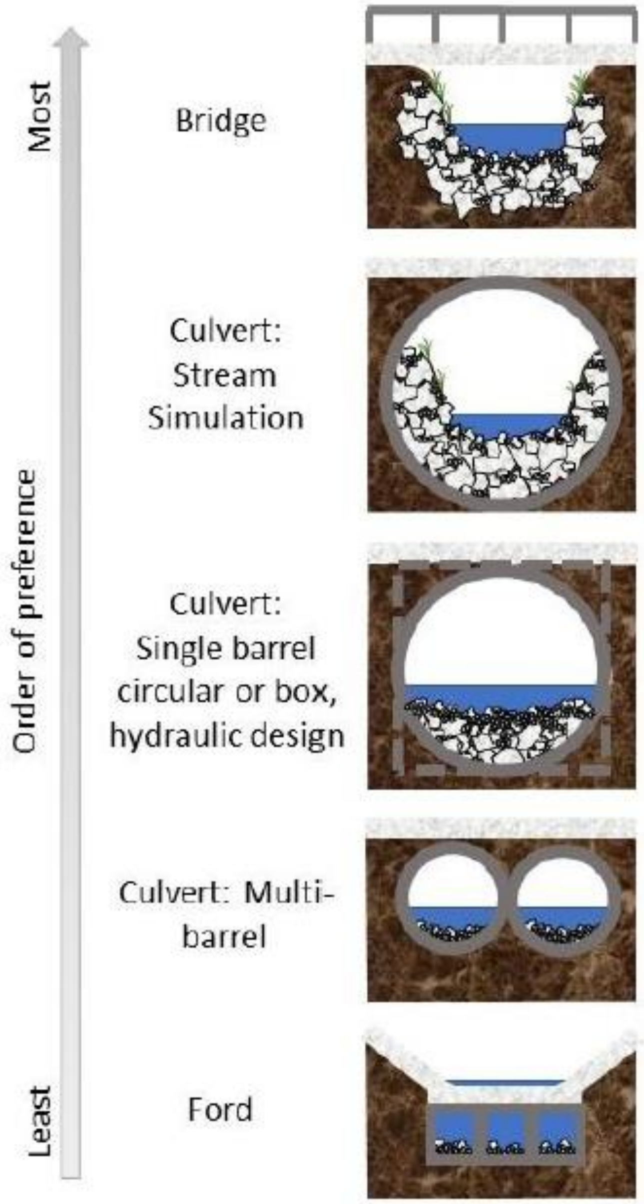

Figure 1: Order of preference for road crossing design (NZ Fish Passage Guidelines 2018).

15. The stream crossings with the highest ranking (largest catchment area) were: culvert 9 (site Ea10a, 67ha), culvert 15 (site Ea 16, 51 ha), culverts 18 and 19 (site Ea23, 26ha), and bridge 1 (site Ea20, 15ha). The design refinements:

    (a) Allow the stream simulation approach to be applied to culvert 9. The effectiveness of the fish passage in culvert 9 will be monitored post-construction as set out in the ELMP.

    (b) Allow a solution for culvert 15 that provides high confidence of ensuing unimpeded fish passage for naturally occurring climbing species. A strict stream simulation design may not be possible because of the culvert's length. However, the culvert is sufficiently wide (2.5m) and has sufficiently flat gradient (1%) to apply hydraulic design approach with a high level of certainty. This will include the use of baffles and rest areas along its length. It's width is similar to the bankfull width at the inlet and its gradient is considerably flatter than the natural stream bed. The effectiveness of the fish passage in culvert 15 will be monitored post-construction as set out in the ELMP.

(c) Allow the stream simulation approach to be applied to culvert 18. The effectiveness of the fish passage in culvert 18 will be monitored post-construction as set out in the ELMP.

(d) Remove culvert 19;

(e) Retain Bridge 1, which ensures ongoing avoidance of fish passage effects at site Ea20.

16. Stream crossings with catchment area between 5 ha to 15 ha were ranked as moderate. These are all small streams, but they do have habitat for fish upstream of the crossing. Crossings in this category are culverts 3, 6, 7, 8, 12, 16, 20 and 21.

17. Culvert 12 (site Ea13, 10ha) is now being replaced with a bridge. This was previously a steep culvert with high quality habitat so there are considerable benefits in bridging this site even though it was ranked as moderate based on catchment size. All other culverts in this ranking are sufficiently wide and flat (<1% to 3% grade) to successfully use baffles and the hydraulic design approach. Culverts 7 (site Ea8) and culvert 8 (site Ea9) have a 3% grade – this is consistent with the natural grade of the stream which has small cascades which naturally restrict fish species that are weak at climbing such as inanga.

Intermittent waterways

18. Nine stream crossings have very small catchments (<5ha) with intermittent or ephemeral waterways (Culverts 1, 2, 4, 5, 10, 11, 13, 14, and 17). In these locations, there is little or no permanent fish habitat available upstream of the Project alignment due to the shallow water and intermittent flows. However, koura were found in one of the steams (Site Ea21, culvert 17).

19. Baffles will be used to provide fish passage in most of these culverts. As discussed in my EIC (paragraph 107), some of these culverts are very steep (culvert 11 (Ea12), culvert 13 (Ea14), culvert 17 (Ea21)) and the fish passage may be partial, even with baffles. However, the effect on aquatic ecology will be limited due to the intermittent flow and limited upstream habitat suitable for fish.

20. There are three culverts where fish passage is not being provided - culvert 2 (site Ea2, 1.8ha), culvert 10 (site Ea11, 2ha) and culvert 13 (site Ea14, 1.7ha). These culverts have scruffy domes as the primary/only inlet and are located

within road cuts with vertical cut slopes to the upstream sub-catchment. As discussed in my EIC, these streams are all ephemeral and do not provide fish habitat except, perhaps for temporary foraging during rain events. My view remains that the effect of not providing fish passage to these ephemeral streams will be small.

UPDATED OVERALL RESTORATION PACKAGE

21. The overall restoration package has been modified to increase the area of pest management. As discussed in paragraph 112 of my EIC, pest management may provide additional benefits to streams. For example:

    (a) removing undulates may reduce stream bank erosion; and

    (b) reducing rat numbers may reduce predation on kākahi, which are known to occur in the upper Mimi River near the area of additional pest management.

22. I have not quantified the magnitude of these particular benefits, but they are additional to the no-net-loss approach taken in stream offset calculations.

FRESHWATER ECOLOGY OFFSETTING – UPDATE TO SEV CALCULATIONS

23. Since submitting my EIC, my approach to calculating offsets for freshwater ecology effects using the Stream Ecological Valuation (SEV) method has been reviewed by Dr Martin Neale. As set out in his evidence[2], Dr Neale has confirmed his view that my approach to calculating offset was comprehensive and appropriate. Dr Neale made several observations and suggestion relating to the SEV calculations. I have summarised the key points below and described my response:

    (a) Dr Neale suggested applying a lower impact SEV score for steep culverts where fish passage might be restricted. I have adopted this suggestion, and following discussions with Dr Neale applied a lower SEV impact score of 0.15 to culverts over 6% grade or with scruffy dome inlets. This is lower (more conservative) than the theoretical SEV score for culverts with no fish passage invertebrate habitat. The streams affected by these culverts are very small (intermittent) and have very limited upstream fish habitat, so the actual effect on fish passage is small. I discuss this further below.

    (b) Dr Neale suggested expressing the typical ECR used for stream diversions in a different way. I have excluded remediation of stream diversions in my offset calculations and have generally applied an ECR of 0.5, i.e. remediation of the stream diversion plus another 50%. Offset lengths have been calculated on this basis. An alternative approach which Dr Neale prefers, is to use a ECR of 1.5 but include remediation of

[2] Being filed with the Transport Agency's supplementary evidence.

diversion lengths as part of the offset. This gives the appearance of a higher ECR but, as Dr Neale notes, makes no meaningful difference. With this in mind, I have retained my original approach (excluding remediated stream diversions) to this to avoid any confusion with the methods described in the AEE[3].

(c) Dr Neale noted some inconsistency in lengths of culverts in Table 2.1 and lengths of streams reported in Table 2.12 of my Freshwater Ecology Supplementary Report. The length of culverts and stream diversions do not always match my estimate of the length of stream affected by the Project. This is mainly because I have applied a buffer, and the route taken by stream diversions and culverts is often different from the original stream resulting in different lengths. It is important to note that in most reaches, the stream lengths affected by works either match or are less than the combined culvert and diversion length. Where a diversion results in a shorter overall stream length, this absolute loss is included in offset calculations as a separate item assuming an SEV impact score of 0. This only occurs at stormwater wetland W2 (near site E3) where the proposed stream diversion will cut off a bend in the Mangapepeke River.

24. I have updated the SEV calculation of offset required for freshwater to reflect:

(a) recent changes in the Project design and

(b) the small modifications to calculating the SEV as described above.

25. My updated estimate for the amount of stream affected by the Project is 3705m / 3376m^2 (as opposed to 3,822m and 3,361m^2 in my EIC), and the amount of stream required to be restored to offset this effect is 8455m / 8153m^2 (as opposed to 8,627m and 8,157m^2 in my EIC) - see Table 1 and the detailed working in Appendix 1. These figures supersede and update those contained in the equivalent tables provided in the Freshwater Ecology Supplementary Report.

26. Overall the updated SEV offset calculation is very similar to that provided in the Freshwater Ecology Supplementary Report. Some changes resulted in less offset and some changes resulted in more offset. The differences are mostly due to:

(a) Less effect on the stream at Ea23 due to the fill no longer being required and consequent removal of culvert 19 and most of the stream diversion.

(b) Replacement of Culvert 12 with a bridge, resulting in effects on this reach of stream being minimised.

[3] Note that a classic SEV approach is used for stream diversions where the current SEV score is high and unlikely to be attained by the diversion (see method in Freshwater AEE).

(c) Additional length was accounted for as potentially affected by the access track at E4 downstream of fill 12. In practice this short-term effect on the stream may not occur but it has been allowed for in the SEV calculations.

(d) In some cases, additional stream length was affected by modifying the design to make culvert gradients flatter (see above).

Table 1: Extent of stream affected by the Project and the area of offset required to achieve 'no net loss'. (This table replaces Table 4 in my EIC).

	Impact		Offset	
Catchment	**Length (m)**	**area (m^2)**	**Length (m)**	**area (m^2)**
Mangapepeke	2882	2810	6383	6565
Mimi	823	567	2071	1588
Total	3705	3376	8455	8153

27. While the updated SEV figures are very similar to those set out in the EIC, I would emphasise that the changes made since my EIC was filed will reduce the level of effects the Project will have on freshwater ecology values.

ECOLOGICAL MONITORING IN THE REVISED ELMP

28. The revised ELMP (Chapter 8) attached to Mr Roan's supplementary evidence, includes additional ecological monitoring for streams to assess the effects of the Project on stream habitat and biota. The proposed stream ecological monitoring now includes additional monitoring of fish, aquatic macroinvertebrates, macrophytes and stream habitat at control sites and impact sites.

29. Additional ecological monitoring sites have been added downstream of Fill 12 (Managpepeke Stream) and downstream of Fill 13 (Mimi River Tributary) to better assess the effects of the large earthworks in these areas and to address concerns raised by DoC relating to these earthworks (see supplementary evidence by Mr Ridley). Immediately downstream of these two Fill sites (u/s E4 and d/s E6) the streams are still hard-bottom and dominated by gravel substrate. This makes the aquatic macroinvertebrate community more sensitive to sedimentation compared to further downstream where the streams become soft-bottom with fine sediment naturally dominating the substrate. The hard-bottom streams at these sites also mean that most of the methods described in the NZ Sediment Assessment Protocols (Clapcott et al. 2012) will be more effective at detecting any additional sedimentation within the stream.

30. The ecological monitoring described in the revised ELMP takes a risk-based approach. Additional monitoring sites close to fills 12 and 13 will occur for the duration of earthworks in this area. Monitoring at all sites will initially occur twice a year (spring and summer) but after the first year of earthworks it will

reduce to once a year unless more than minor effects on aquatic life are found to be occurring, e.g. a change in the Quantitative Macroinvertebrate Index (QMCI) of >20%.

31. The stream ecological monitoring in the ELMP will be used alongside the water quality monitoring described in the CWDMP to assess and manage any effects of the construction on streams. In my view, the approach taken in the ELMP is reasonable for detecting effects given the nature of the streams.

32. Mr Ridley describes in his supplementary evidence that the approach to water quality monitoring in the CWDMP has been updated and now includes a requirement for continuous turbidity sampling at downstream locations from the Project earthworks. This allows a pre-construction baseline to be determined and will also allow turbidity levels to be continuously recorded during construction activities. I support this updated approach that incorporates turbidity monitoring. In my view the water quality monitoring and the ecological monitoring in the ELMP together provide an appropriate way of detecting and managing effects of the Project on streams.

Keith Hamill

17 July 2018

APPENDIX 1: SITE-BY-SITE CALCULATION OF OFFSET USING THE SEV APPROACH TO ADDRESS EFFECTS OF THE PROJECT ON STREAMS

This Table supersedes Table 2.4 in the freshwater ecology supplementary report. The shaded cells indicate the key changes in the table.

filter sites	Site	ID culvert	width (m)	Project impact	Effect type	SEVi-C	SEVi-P	SEVi-I	SEVm-P - SEVm-C	ECR	Length of impact (m)	Length to restore (m)	Area to restore (m^2)
1	Ea1	1	0.2	Widen existing culvert	P	0.75	0.75	0.15	0.24	3.8	15	56	11
1	Ea2	2	0.2	Widen existing culvert	P	0.5	0.65	0.23	0.24	2.6	15	39	8
1	E1		1.4							n.a.	0		
1	Ea3	3	0.35	Culvert and d/s diversion. The consent shows this as a new stream diversion but it is the existing channel.	P	0.57	0.77	0.23	0.24	3.4	72	243	85
2	Ea3		0.35	Diversion section	D	0.57		0.57		0.5	45	23	8
1	Ea3a		0.3	Drain replaced with new swale	P	0.35	0.65	0.23	0.24	2.6	65	171	51
1	Ea4	4	0.2	Shift cut-off drain upslope. Existing drain replaced by similar length of grassed swales. No waterway exists where culvert is shown.	D	0.35	0.65	0.4		0.5	80	40	8
1	Ea5	5	0.35	Culvert 5	P	0.57	0.77	0.23	0.24	3.4	45	152	53
1	E2		1.4	Access track crossing main step about 3 times	S a	**0.57**	0.77	0.58		0.5	45	23	32
1	Ea6	SD2 swale	0.35	Stream cut-off at the top of the cut and directed to stormwater. No fish passage provided unless allowed via stormwater pond. No culvert at present.	P	0.73	0.77	0.35	0.24	2.6	70	184	64
1	Ea7	6	0.4	Culvert 6 + stream diversion. Road drainage runs to treatment pond.	P	**0.73**	0.77	0.23	0.24	3.4	40	135	54
2	Ea7		0.4	stream diversion section + access track.	D	**0.73**	0.77	0.73		0.5	60	30	12
1	E2a		1.3			0.58	0.77			n.a.	0		
1	Ea8	7	0.4	Culvert 7 + stream diversion.	P	0.57	0.77	0.23	0.24	3.4	40	135	54
2	Ea8		0.5	stream diversion section + access track.	D	0.57		0.57		0.5	40	20	10
1	Ea9	8	0.5	Culvert 8	P	0.57	0.77	0.23	0.24	3.4	50	169	84
2	Ea9		0.5	stream diversion section + access track.	D	0.57		0.57		0.5	15	8	4
1	Ea10a	9	1	tributary section	P	**0.73**	0.86	0.23	0.24	7.9	20	158	158
1	Ea10b	SD5	1.2	total of 190m of stream lost in this area. More stream lost than culvert length because diversion is shorter.	P	**0.73**	0.86	0.23	0.24	7.9	45	354	425
2	Ea10b	SD5	1.2	110m diversion section of the total of 190m of stream lost in this area.	D	**0.73**	0.86	0.75	0.24	2.0	110	220	264
2	Ea10b		1.2	works area, dirty water drain, access track crossing	S a	**0.73**	0.86	0.75	0.24	2.0	15	30	36
1	E3		1.25	Diversion for wetland W2 near culvert 8 (chainage 1650-1750). Design change could reduce impact length from 200m to 110m. Impact length of 200m.	D	**0.58**	0.77	0.58		0.5	200	100	125
1	E3		1.25	Diversion for wetland W2 near culvert 8. Allows for a loss of 80m of stream length from 120m diversion.	P	**0.58**	0.77	0	0.24	4.8	80	385	481
2	E3		1.25	Access track crossing + dirty water	S a	**0.58**	0.77	0.58		0.5	15	8	9
1	Ea11	10	0.2	Culvert 10. Stream to man hole, conveyed back to existing stream.	P	0.86	0.86	0.23	0.24	3.9	40	158	32
2	Ea11		0.2		S a	0.86	0.86	0.75	0.24	0.7	15	10	2
1	Ea12	11	0.2	Culvert 11	P	0.86	0.86	0.15	0.24	4.4	35	155	31
2	Ea12		0.2		S a	0.86	0.86	0.75	0.24	0.7	20	14	3
1	Ea13	bridge	0.6	Culvert 12 replaced with a bridge	D	**0.86**	0.86	0.75	0.24	0.7	70	48	29
2	Ea13		0.75	clean water diversion works	S a	**0.86**	0.86	0.75	0.24	0.7	20	14	10
1	E4		1.8	inside temporary footprint est. to be 150m, but may be 50m	S a	**0.72**	0.85	0.75	0.24	0.6	150	94	169
1	Ea14	13	0.2	Culvert 13	P	0.86	0.86	0.15	0.24	4.4	20	89	18
2	Ea14		0.3		S a	0.86	0.86	0.75	0.24	0.7	15	10	3
1	E5	SD6	2.5	250m of stream lost d/s Ea16. 90m to stream diversion.	D	**0.92**	0.92	0.55	0.24	2.3	90	208	520
2	E5b		2.5	250m of stream lost d/s Ea16. remainder	P	**0.92**	0.92	0.23	0.24	4.3	160	690	1725
2	E5		2.5	access track + dirty water drain	S a	**0.92**	0.92	0.75	0.24	1.1	100	106	266
1	Ea15	14	0.4	Ea15, 120m stream loss but Culvert 14 length = 140m. 20m assigned to E5b	P	0.86	0.86	0.23	0.24	3.9	125	492	197
2	Ea15		0.4	Access tracks expected	S a	0.86	0.86	0.75	0.24	0.7	40	28	11
1	Ea16	15	1.2	Ea16, 95m stream loss but CU15 = 280m. Relevant balance assigned to E5b	P	0.92	0.92	0.23	0.24	4.3	100	431	518
2	Ea16		1.2	Sediment ponds	S a	0.92	0.92	0.75	0.24	1.1	40	43	51
1	Ea17	SD7	1	Clean water diversion length (380m) = stream loss.	D	0.92	0.92	0.55	0.24	2.3	380	879	879

Table Continued

Site	ID culvert	width (m)	Project impact	Effect type	SEVi-C	SEVi-P	SEVi-I	SEVm-P - SEVm-C	ECR	Length of impact (m)	Length to restore (m)	Area to restore (m^2)
Ea18	SD8	0.5	200m stream loss (inc tribs), Diversion is longer.	D	0.94	0.94	0.55	0.24	2.4	200	488	244
Ea19	16	0.9	85m stream loss to CU 16	P	0.94	0.94	0.23	0.24	4.4	100	444	399
E6		1.2	155m stream loss, 60m assigned to Culvert 16	P	**0.94**	0.94	0.23	0.24	4.4	60	266	320
E6		1.2	155m stream loss, 100m assigned to diversion d/s CU16	D	**0.94**	0.94	0.55	0.24	2.4	100	244	293
E6		1.2	E&S ponds	S a	**0.94**	0.94	0.75	0.24	1.2	50	59	71
Ea20	Bridge	0.9	Bridge		0.86	0.86			n.a.	0		
Ea21	17	0.4	Culvert 17	P	0.86	0.86	0.15	0.24	4.4	33	146	59
Ea22	swale	0.35	Collected by grass swales to stormwater treatment pond.	P	0.35	0.77	0.4	0.24	2.3	50	116	40
Ea23	18	0.6	Culvert 18. Culvert 19 no longer needed.	P	**0.78**	0.78	0.23	0.24	3.4	40	138	83
Ea23a	18	0.7	No longer require the fill sites and resulting stream diversion u/s SH3	D	**0.78**	0.78	0.55	0.24	1.4	20	29	20
E7		2.1		D	**0.52**		0.52			na		
Ea24	20	0.6	Extend/replace existing culvert. Exit to farm drain.	P	0.35	0.77	0.23	0.24	3.4	10	34	20
Ea29	21	0.5	Replace existing culvert with Culvert 21. 340m grass swale at u/s end.	P	0.35	0.77	0.23	0.24	3.4	10	34	17
Ea30		0.3	Main stream avoided. Cut-off drain replaced.	D a	0.35		0.4		0.5	150	75	23
Ea31	SD	0.3	Cut-off drain shifted, main tributary avoided.	D	0.35		0.4			0		
Ea25		1	No direct disturbance but downstream of Project.	R					n.a.	0		
Ea26	R	1.1	Potential restoration site	R	**0.62**	0.86			n.a.	0		
Ea27	R	1.5	Potential restoration site	R	**0.54**	0.77			n.a.	0		
Ea28	R	0.9	Potential restoration site	R	**0.35**	0.77			n.a.	0		
E TL1		0.25	Access track culvert extension	P a	0.48	0.77	0.23	0.24	3.4	5	17	4
E TL2		0.2	Access track culvert extension	P a	0.48	0.86	0.23	0.24	3.9	5	20	4
E TL3	SD3	0.2	Fill - diversion section.	D a	0.48		0.55		0.5	75	38	8
E TL3		0.2	Access track culvert extension	P a	0.48	0.77	0.23	0.24	3.4	5	17	3
E TL4	SD4	0.3	Fill - diversion section.	D a	0.48		0.55		0.5	175	88	26
E TL4		0.3	Access track culvert extension	P a	0.48	0.77	0.23	0.24	3.4	5	17	5
E TL5		0.5	Access track. Potential restoration site	R, P a	**0.48**	0.86	0.23	0.24	3.9	5	20	10
E TL6		0.3	Access track culvert extension	P a	0.48	0.86	0.23	0.24	3.9	5	20	6

Effect type: P = permanent loss, D = stream diversion, S = short term, R = possible restoration site, a = access or fill site