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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STATEMENT OF EVIDENCE OF ALASTAIR STEWART MCEWAN (FRESHWATER STRUCTURES) ON BEHALF OF THE NZ TRANSPORT AGENCY

17 July 2018

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QUALIFICATIONS AND EXPERIENCE

1. My name is Alastair Stewart McEwan.

2. I am a Senior Environmental Engineer at WSP -Opus.

3. I have 25 years experience in civil and environmental engineering design with 11 years experience as a consulting engineer in environmental engineering investigation, assessment and design. I specialise in the design of stormwater, water and wastewater conveyance projects.

4. My project experience includes design of stormwater culverts, pipe networks and stream diversions for NZ Transport Agency state highway projects and local authority projects. Project experience relevant to this evidence includes design of stream diversions for fish passage and technical support of culvert design for the Waikato Expressway – Huntly Section project, fish passage design of an 1800 mm diameter culvert for Caseys Creek Upgrade project (Blenheim), design advice for fish passage through temporary culverts across the Ōpaoa River as part of the Opawa Bridge project (Blenheim) and review of fish passage design through culverts for other small scale projects.

5. I have the following qualifications and memberships relevant to the evidence I shall give:

   (a) Bachelor of Technology (Engineering and Management) at Deakin University, 2005;

   (b) New Zealand Certificate in Engineering (Civil) at The Open Polytechnic of New Zealand, 1993;

   (c) Chartered Member of Engineering New Zealand (CMEngNZ);

   (d) Registered Engineering Associate (REA); and

   (e) Member of Water New Zealand.

6. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

EXECUTIVE SUMMARY

7. Refinements to the design of a number of the Project's freshwater structures have been made since the Transport Agency's evidence in chief was filed on 25 May. These changes have been made primarily to seek to improve the provision of fish passage, taking into account the "*New Zealand Fish Passage Guidelines*

for Structures up to 4 Metres" ("**Fish Passage Guidelines**"), which were published in April 2018.

8. Potential design changes have been considered taking into account advice from Mr Keith Hamill, the Project freshwater ecologist. The revised design makes the following changes:

   (a) Culvert 12 has been replaced with a bridge.

   (b) Culverts 9 and 18 have been replaced with arch or box culverts sized for stream simulation.

   (c) Culverts 8, 14, and 16 have been made larger, grades flattened and embedment of culvert invert increased to achieve hydraulic design for fish passage.

   (d) Culvert 15 has had its embedment at the outlet increased from 20% to 25%. This culvert has been sized for hydraulic design of fish passage.

   (e) Culvert 17 has been made larger, to increase the culvert diameter to achieve 1.3 x the existing stream bankfull width.

9. It is my opinion that design of these culverts is appropriate for the provision of fish passage taking into account the site conditions, culvert lengths and ecological advice provided by Mr Hamill.

BACKGROUND AND SCOPE OF EVIDENCE

10. The New Zealand Transport Agency ("**Transport Agency**") has engaged me to advise it on its proposed Mt Messenger Bypass Project ("**Project**") to improve the section of State Highway 3 ("**SH3**") between Ahititi and Uruti, to the north of New Plymouth.

11. My role on the project is Drainage Design Team Leader. I have held this role since March 2018. My position comprises delivery of design for stream diversions, culverts under the proposed realignment of SH3, road drainage system and treatment of road rainfall runoff. Drainage design of the culverts and streams includes making appropriate provision of fish passage.

12. I note that I did not produce a statement of evidence as part of the Transport Agency's main set of evidence that was filed on 25 May 2018 – this is my first statement of evidence.

13. My evidence addresses the updated position in respect of structures associated with the Project that interact with the freshwater environment (including bridges and culverts), and in particular the refinements to the Project design in that respect since the Transport Agency's evidence was filed on 25 May.

DISCUSSIONS ABOUT FRESHWATER STRUCTURES SINCE 25 MAY

Fish Passage Guidelines

14. Since the Transport Agency's evidence was filed, I have held discussions with Keith Hamill, the Project Freshwater ecologist. We discussed the design of culverts with respect to the "*New Zealand Fish Passage Guidelines for Structures up to 4 Metres*" ("**Fish Passage Guidelines**"), which were published in April 2018.[1] The key potential design improvements we discussed were:

    (a) Increasing the size and/or improving the design for fish passage of the most important / largest culverts. Culvert 9 and culvert 15 were identified as the most important culverts as they drained significantly larger catchments (67 hectares and 50 hectares respectively) than the other culverts[2].

    (b) Increasing the size of other culverts (Mr Hamill identified six specific culverts for consideration) in light of the Fish Passage Guidelines criteria for minimum culvert width of 1.3 x the bankfull width.

    (c) Confirming previous discussions that all culvert gradients should be reduced or kept to less than 2% where this is achievable, with a preference of 0.5% or less.

    (d) Spoiler baffles are often preferred to iris type baffles. However, spoiler baffles have limited success for culverts with gradients of greater than 3%. Therefore, if culverts from this Project require gradients steeper than 3%, iris baffles would be preferred.

Foundations for culverts 9 and 18

15. I also discussed the foundation design of culverts 9 and 18 with the Project geotechnical design team. In these locations the existing soil bearing strength for culvert foundations is poor.

16. Stream simulation design is now proposed for fish passage design of these culverts, constructing a stream inside an open bottom arch or an arch/ box culvert with a base. Investigations and design calculations of proposed ground improvement works are required to determine design solutions to achieve adequate bearing strength for foundations, and to assess the risk of erosion of the stream banks.[3]

[1] Mr Hamill discusses the Fish Passage Guidelines in his supplementary evidence.
[2] Refer to drawings MMA-DES-DNG-C0-DRG-1000 to MMA-DES-DNG-C0-DRG-1010 in Volume 2 of the AEE report for culvert numbering system to identify culverts.
[3] This task will be carried out during the post-consenting detailed design phase.

Construction methodology for culvert 15

17. I spoke with Hugh Milliken, Alliance Manager, and Andy Serancke, Construction Superintendent, regarding the construction methodology of culvert 15. Construction of an arch cut into the steep rock sides of the existing stream was discussed as a possible alternative design approach. This alternative design was raised as the existing stream bed would be retained, with no change to the existing stream gradient and geomorphology. This design concept was discredited (and has not been progressed) due to:

    (a) The narrow work area for large sections of the stream and very limited access to the site to get construction plant to the site;

    (b) Variability of the stream widths and vertical drops requiring complex design and construction techniques to be able to construct an arch. In particular there are three significant waterfalls (3 to 5 m in height) that would increase the cost and difficultly in construction;

    (c) The very long construction time frame and potential safety issues during construction that would flow from the complex construction; and

    (d) Extreme difficulty in the design and construction of the arch foundations.

CHANGES MADE IN RESPECT OF FRESHWATER STRUCTURES

18. Following the discussions I have held and attended, changes have been made to the design of eight of the culvert structures. These changes were made to improve the design for provision of fish passage through these structures. I have taken the Fish Passage Guidelines into account in developing the design changes. The Fish Passage Guidelines provide a five-tier hierarchy of design solutions listed below in order of preference (from most to least preferred);

    (a) Bridge;

    (b) Culvert: Stream Simulation (stream within a culvert);

    (c) Culvert: Single barrel circular or box culvert, hydraulic design;

    (d) Culvert: Multi-barrel culvert; and

    (e) Ford over a multi cell culvert.

Fish Passage Culvert Design Solution Process

19. At each site I have considered the relative priority level for fish passage as assessed by Mr Hamill, existing site characteristics and constructability. In selecting the design solution, costs were also taken into account (I took advice on costs from the Project team).

20. As set out in the original application documents and the EIC, the most preferred design solution, a bridge, has been adopted at chainage 4200

(Bridge 1). This is due to the high ecological and environmental value of the Mimi River and in particular the Kahikatea swamp forest wetland the bridge crosses.

21. For culvert 12, a bridge solution has now been adopted in order to minimise loss of vegetation and better provide for fish passage in this relatively high ecological value location.[4] The bridge solution is of a comparable cost to alternative design solutions at this location.

22. All other high and moderate priority streams were considered for stream simulation (level two of the fish passage design hierarchy). Low priority streams were considered for upgrading to hydraulic design, which is level three on the fish passage design hierarchy. These low priority streams were not considered for stream simulation design based on their small catchment size, and therefore lower ecological value and smaller culverts required.

Fish Passage Culvert Design Change Details

23. Changes in design approach have been made to eight culverts following the process described above. The details of these changes are presented in Table 1 to the Appendix of this evidence. Culvert 19 has been removed.

24. Table 1 references the relevant culvert by the numbering system and the chainage (distance) used in the Drawings in Volume 2 of the AEE[5]. For each culvert, the table specifies:

    (a) the relative fish priority;

    (b) the catchment size;

    (c) the culvert design as presented in the AEE report; and

    (d) the design solution now adopted, noting what level in the Fish Passage Guidelines hierarchy that solution represents.

25. By way of summary, the culverts that have been subject to design changes, with a brief description of the change made:

    (a) Culvert 8 Culvert size increased to 1500 mm and embedment of culvert invert

    (b) Culvert 9 Culvert replaced with Arch/Box culvert achieving stream simulation

    (c) Culvert 12 Culvert replaced with a Bridge

[4] The location of the bridge is at chainage 2400 of the proposed SH3 alignment.
[5] Refer to drawings MMA-DES-DNG-C0-DRG-1000 to MMA-DES-DNG-C0-DRG-1010 in Volume 2 of the AEE report for culvert numbering system to identify culverts.

(d) Culvert 14 Culvert size increased to 1500 mm and embedment of culvert invert

(e) Culvert 15 Increase embedment to 25%

(f) Culvert 16 Culvert size increased to 2100 mm and embedment of culvert invert

(g) Culvert 17 Culvert size increased to 900 mm and embedment of culvert invert

(h) Culvert 18 Culvert replaced with Arch/Box culvert achieving stream simulation

(i) Culvert 19 Culvert not required. Refer to Mr Roan's evidence.

26. A summary list of all Project culverts is provided in Table 2 of the Appendix for ease of reference.

My comments on the Design Changes

27. Replacing culvert 12 with a bridge achieves the most preferred design for fish passage under the Fish Passage Guidelines. At this location there are additional benefits (assessed by specialists in their appropriate field) of minimising loss of vegetation and ecological habitat. This is an appropriate design solution for this location.

28. Culverts 9 and 18 serve large catchments and have been assessed as high priority culverts for fish passage by Mr Hamill. These culverts are relatively short being less than 50 m in length and can be installed with gradients of 1.0% or less. This achieves the second most preferred fish passage design solution under the Fish Passage Guidelines. Due to the high priority and the culvert dimensions, it is my opinion that stream simulation is an appropriate solution for these two culverts.

29. Culvert 15 is a special case, being assessed as a high ranking culvert for fish passage, at least 250 m long and 2.5 m in diameter.[6] Constructing a stream simulation solution (including the arch solution referred to under paragraph 17), and ensuring stream simulation is maintained for the life of the Project would be very difficult. Culvert 15 has therefore been sized for hydraulic design of fish passage (the third most preferred option under the Fish Passage Guidelines). In the circumstances I consider this to be an appropriate design solution.[7]

30. The design solution adopted for culverts 8, 14 and 16 is hydraulic design for fish passage (the third most preferred option under the Fish Passage Guidelines). These culverts are moderate to low priority fish passage culverts.

[6] See Mr Hamill's supplementary evidence in terms of the ranking assigned to the various culverts.
[7] For completeness I note that constructing a bridge would be extremely expensive (in the order of $10 – 15 million) and therefore a bridge solution was not seriously considered.

All of these culverts have been made larger, and the embedment of culvert invert increased to achieve hydraulic design for fish passage. In addition, the grades have been flattened. This solution is the third most preferred solution under the Fish Passage Guidelines. It is my opinion that the design solution adopted is appropriate for the fish passage priority levels and culvert size.

31. Culvert 17 has been sized to achieve 1.3 x the existing stream bankfull width and 30% embedment at the culvert outlet. The proposed culvert gradient of 14% is based on the existing stream gradient.[8]

Alastair McEwan

17 July 2018

[8] I note that due to the steep grade, hydraulic design for fish passage cannot be guaranteed.