

Before a Board of Inquiry  
Transmission Gully  
Notices of Requirement and Consents

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*under:* the Resource Management Act 1991

*in the matter of:* Notices of requirement for designations and resource consent applications by the NZ Transport Agency, Porirua City Council and Transpower New Zealand Limited for the Transmission Gully Proposal

*between:* **NZ Transport Agency**  
*Requiring Authority and Applicant*

*and:* **Porirua City Council**  
*Local Authority and Applicant*

*and:* **Transpower New Zealand Limited**  
*Applicant*

Statement of rebuttal evidence of Dr Vaughan Francis Keesing (Freshwater ecology) for the NZ Transport Agency and Porirua City Council

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Dated: 20 January 2012

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**STATEMENT OF REBUTTAL EVIDENCE OF DR VAUGHAN FRANCIS KEESING FOR THE NZ TRANSPORT AGENCY AND PORIRUA CITY COUNCIL**

**INTRODUCTION**

- 1 My full name is Vaughan Francis Keesing.
- 2 I have the qualifications and experience set out at paragraphs 2-8 of my statement of evidence in chief, dated 17<sup>th</sup> November 2011 (*EIC*).
- 3 I repeat the confirmation given in my EIC that I have read, and agree to comply with, the Code of Conduct for Expert Witnesses (Consolidated Practice Note 2011).
- 4 In this statement of rebuttal evidence, I:
  - 4.1 Respond to the evidence of:
    - (a) Dr Mike Joy, on behalf of the Kapiti District Council;
    - (b) Dr Brett Ogilvie on behalf of the Department of Conservation.
- 5 The fact that this rebuttal statement does not respond to every matter raised in the evidence of submitter witnesses within my area of expertise should not be taken as acceptance of the matters raised. Rather, I rely on my EIC and this rebuttal statement to set out my opinion on what I consider to be the key freshwater matters for this hearing.
- 6 For the purposes of this evidence, I will refer to the NZ Transport Agency (*the NZTA*) Project<sup>1</sup> and the Porirua City Council (*PCC*) Project<sup>2</sup> collectively as the "Transmission Gully Project" (and hereafter, *the TGP* or *the Project*).

**SUMMARY OF EVIDENCE**

- 7 The evidence prepared by Dr's Joy and Ogilvie has not caused me to depart from the opinions and conclusions expressed in my evidence in chief. I re-confirm the conclusions reached in my evidence in chief.

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<sup>1</sup> The 'NZTA Project' refers to the construction, operation and maintenance of the Main Alignment and the Kenepuru Link Road by the NZTA.

<sup>2</sup> The 'PCC Project' refers to the construction, operation and maintenance of the Porirua Link Roads (being the Whitby Link Road and the Waitangirua Link Road) by PCC.

- 8 The freshwater adverse effects are on regionally significant aquatic systems as well as systems that are of lower value. All of the systems, regardless of their value are already somewhat modified and somewhat tolerant to perturbations.
- 9 In my opinion none of the water bodies affected by the Project are of sufficient quality, composition or sensitivity to require "total" avoidance in order to maintain their current values.

### **EVIDENCE OF DR MIKE JOY**

#### **Te Puka Diversion**

- 10 Dr Joy's primary concern is that he considers the Te Puka diversion (the upper 1.4 km) is unlikely to produce an aquatic habitat that will sustain a valuable aquatic community. He considers that the diversion will be unable to create a system that has a hyporheic zone<sup>3</sup> with lateral and vertical ground water connections, and that the array of artificial surfaces and drop structures that will be required may make it more challenging for fish passage.
- 11 Dr Joy has characterised the diversion as an artificial aqueduct perched above the valley floor and has suggested that water on the eastern side of the valley will end up in the lowest point of the valley creating a separate stream (with resulting reduced flows in the diversion). In fact, the diversion is a constructed channel, which will sit in what will be the lowest point of the valley to the east of the road batter. The former Te Puka channel will be buried beneath the road batter. All water in the valley will flow into the diversion, with all flows to the east of the valley running into it, and the true left road batter and culverts delivering all flows and water from the west of the valley to the proposed waterway and not (as understood by Dr Joy in his paragraphs 3.10 and 5.10) to a lower drainage system.
- 12 I agree that the formation of the diversion system (the main 1.4km) for the main stem of the Te Puka will be a significant challenge. I do not share Dr Joy's doubt that it will fail such that a reasonable level of mitigation will not be achieved. There are streams in the Wellington region (lower Duck Creek and Kenepuru for example) that have constructed channels or are so sediment filled that aquatic life is separated from the ground waters and the hyporheic zone is minimal or non-existent; those streams still maintain a range of aquatic communities and values and support continual fish passage to better quality up stream habitat.

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<sup>3</sup> Hyporheic zone is the inter-substrate space under the surface of the stream bed (habitat within the gravels) where there is water. This zone can be several meters deep.

- 13 I have recommended that construction of the new waterway "dig" deeper than required and fill that depth with varied size cobble etc to form a limited hyporheic zone. While this will not equate to the existing zone in terms of expanse it should provide at least a metre (depending on the depth attained) of hyporheic zone habitat.

#### **Fish Passage**

- 14 The culverts in the Te Puka are associated with the side tributaries rather than the main stem in all cases except the upper intermittent headwater section. At that point the longest (265m) proposed culvert will be positioned. Otherwise the main stem is only affected by diversions (of 1.449 in the upper reach and three separate diversions in the lower reach of 224m, 30m and 80m. I note this is a total of 1.783km, not 2.3km (as suggested by Dr Joy at paragraph 5.1 of his evidence). The great majority of the tributary culverts service ephemeral systems. Of the 15 tributary culverts required on the western slopes of the Te Puka only one appears perennial and possibly 4 are considered intermittent. It is likely that only the perennial tributary potentially has fish in the upper reaches and so requires fish passage. The ephemeral habitat loss associated with these lateral culverts equates roughly to around 25% of the true left ephemeral aquatic habitat and none of the true right tributary habitat.

- 15 I agree that it is a challenge for fish passage to be achieved up the steep tributary culverts on the true left tributaries. For the main stem the necessity to have a stepped stream rather than a more consistent gradient will also present a challenge. However, it is possible to create cascades or drop structures that will allow passage to the native climbing fish that require passage. The use of mussel spat rope in the way proposed is experimental, however, I am confident that fish passage up those systems is generally infrequent or not actually required because of the limited water habitat in those tributaries. Therefore the placement of a possible passage mechanism is out of caution rather than necessity, and to potentially support a future potential for fish after catchment rehabilitation.

- 16 I consider there is a strong probability that a system can be constructed that allows climbing fish passage up the main stem and that produces a system with a limited hyporheic zone (in gravels) even if contained at times in an constructed channel.

#### **Te Puka mitigation**

- 17 I consider that the Te Puka can be mitigated to a reasonable and satisfactory degree on-site (especially given the terrestrial catchment mitigation in the same place). However, until success has been measured following construction (mitigation success monitoring as discussed in my evidence in chief) the sufficiency of the diversion as habitat cannot be known.

- 18 If, after attempting to construct a stream that approximates a natural system and monitoring its aquatic community recolonisation, its function and fish passage, it is found by empirical measure to have failed in the requirements of mitigation then there still remains the "off-site" mitigations Dr Joy has raised (Paragraph 6.1). The consent conditions need to reflect that alternative requirement.
- 19 However, I do not recommend that the NZTA or the Board of Inquiry move directly to that alternative mitigation option as the Te Puka system should not be abandoned without an attempt to maintain a waterway with habitat value and fish passage.
- 20 I note that part of the additional mitigation sought by Dr Joy was the removal of the perched culvert in the Wainui Stream. I can now advise that NZTA have decided to offer to correct the Wainui perched culvert as an additional mitigation action. This is somewhat similar to the Duck Creek situation as removal of a fish barrier will open up some 11,000 linear meters of Wainui upper system aquatic habitat to native fish. So even if the Te Puka diversion proves to be less than entirely successful, the perched culvert removal will already be providing some immediate offset mitigation.

#### **Consent Conditions**

- 21 From paragraph 6.2 of his evidence, Dr Joy discusses Consent conditions. I have no issues with his suggestions to strengthen consent conditions relating to sediment management by increasing the specificity of standards to be used and by including an expert to review the monitoring plans which are in any event prepared by an appropriate expert. However, I understood that the opportunity for an expert to review the monitoring plans is implicit in the GWRC certification process.
- 22 Nor do I have issue with his recommendations in 6.4 (although again this is implicit in the GWRC certification process), 6.5, 6.6 and 6.7.
- 23 In paragraph 6.8 of his evidence, Dr Joy suggests the approach of setting water quality triggers for monitoring effects is an inappropriate approach. I am at a loss to know why setting a trigger to identify raised water sediment is inappropriate. Trigger monitoring is a useful tool to detect change and to allow or require action to be taken above a certain level (which would not be set at a point where it is too late for mitigation as Dr Joy suggests).
- 24 Furthermore, Dr Joy states that plans should be designed to ensure even extreme events do not impact more than reference sites. I consider that that is the intended aim of the sediment management, however, in reality, no earthworks activity, and especially one on the scale proposed, can guarantee an impact as if the earthworks

were not present. However, the design and aim should be just that and triggers using the baseline reference can reflect that aim.

- 25 In paragraph 7.9 (a discontinuation of paragraph number in Dr Joy's evidence), he notes that I state that "impacts would be fully mitigated". What I said was that the Te Puka effects would be accounted for fully within the Te Puka catchment –in reference to not using Horokiri mitigation actions to fulfil Te Puka requirements. I did not mean to infer that all adverse effects in the Te Puka would be completely mitigated by what is proposed. I clearly stated and acknowledge that the Te Puka design is experimental, albeit it is simply an extension of previous proven designs. I am confident that a good level of re-establishment of habitat can be achieved, and that there is a back-up plan of improvement to the adjoining Wainui Stream should measurement indicate a failure to achieve those habitat goals.

### **EVIDENCE OF DR BRETT OGILVIE**

- 26 Dr Ogilvie's concerns primarily relate to the calculation of the quantum of mitigation. Specifically, he does not consider the SEV tool appropriate to quantify compensation for lost biodiversity values (and so to set aquatic mitigation); and he does not consider that I have applied the tool appropriately. Furthermore, he is worried about the apparent omission of mitigation for ephemeral systems (around 6,000 linear m).

### **SEV Tool**

- 27 As an initial response to Dr Ogilvie's concerns with the SEV model, and what he perceives as its failure to directly consider biodiversity, I refer to the comments made by Mr Fuller in his rebuttal response to Dr Baber that:<sup>4</sup>

"Biodiversity, despite the recent increase in its focus, is a subset of ecology. Ecology looks beyond species and diversity to also consider physical habitat aspects of ecological process and functions."

- 28 I support this statement; ecology is about physical and biotic processes, patterns and interactions, the richness and abundance of species (diversity) is reliant on the physical environment, the habitat types and conditions. Biodiversity cannot be separated or considered in the absence of habitat function and condition and indeed those aspects in large part drive biological diversity potential.
- 29 SEV and Habitat-Hectare are both just models. Their use and outputs require substantial subjective judgements because of the need to guess at the outcomes of certain management actions. The future cannot accurately be predicted, only estimated.

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<sup>4</sup> Paragraph 103 of Mr Fuller's rebuttal

- 30 Both models have virtues, both have relevant uses and both can be argued as deficient in some ways. I have experience in the use of both (I was involved in the formulation of the Habitat-Hectare model that set the mitigation requirements in the HMR contact wind farm Board of Inquiry in 2010) and I am aware that that system has an array of multipliers for imagined scenarios (including defaulting, interest on "natural capital" etc) which require substantial estimation of parameters out to the future that affect the outcome. The SEV is no different in this respect but has the benefit of being somewhat simpler.
- 31 I refer also to the concerns noted by Mr Fuller about the Habitat-Hectare model in his rebuttal evidence. As Mr Fuller notes, the model is still in development and has not been accepted by ecological practitioners as an industry standard. As Mr Fuller also notes, the Habitat-Hectare model bases its results on a large number of highly subjective assumptions with various multipliers that can produce perverse and highly variable results.
- 32 While there are a number of smaller and minor criticisms in regard to the SEV as a tool and my use of it and the quantum of mitigation (26,000 linear metres) that that has resulted in, the reality is that some 10,000m of intermittent and perennial streams will be mitigated by stream remediation of nearly 3 times that length and inclusive of whole catchment headwater protection (Te Puka and Horokiri); while the loss of 6,000m of ephemeral system is mitigated by the protection of some 17,000 linear metres.
- 33 I note that there was an extensive review carried out by independent experts appointed through the RATAG process prior to lodgement of the applications. The Freshwater studies and reports, including the methods used (including in particular SEV), were checked as sufficient and appropriate by that review. DOC staff were involved in workshops for development of the SSEMPs and criticism of the use of the SEV process was not raised then either.
- 34 One of Dr Ogilvie's primary concerns with the SEV model is that it excludes biotic functions when scoring proposed compensation measures. However, he then also criticises my inclusion of these same biotic functions in my calculation of the Ecological Compensation Ratios (ECRs). While Rowe et al (2008) do not recommend including the biotic functions in the SEV scores for the ECR calculations (because they are hard to predict), I believe with care and reference sites they can be reliably predicted, Furthermore I consider that they are required because of the focus on biotic functions for calculating the effect of removing fish barriers and increasing riparian shade. In all respects they are no less unpredictable in the SEV model than they would be in the Habitat-Hectare model. I consider my inclusion of the biotic functions in

calculation of the ECRs addresses Dr Ogilvie's concerns about the failure of the SEV model to compensate for lost biotic values.

### **ECR Calculation**

- 35 Initially having undertaken a compensation analysis I calculated the need for 26,000 linear meters of stream to be enhanced as mitigation. This is an average 2.6:1 ratio of gain to loss for stream length (or a 2:1 ratio in terms of aquatic habitat surface area). Table 6 in my evidence in chief (page 39) shows that the ECR ratio varies from 1.7-6 with the average result a 2.6:1 ratio. While the calculation of the ECR was done using representative SEV scores for representative river sections there is no other viable way to undertake such an analysis. Representative sampling and scaling up is a typical scientific approach and I am confident in the result of my work.
- 36 Dr Ogilvie considers that I have made some errors in the use of the ECR. I acknowledge one of those errors in retaining the 1.5 multiplier when establishing the "benefit" of removal of the Duck Creek perched culverts.
- 37 Dr Ogilvie's suggested "errors" Paragraphs 74-78, lead him to suggest a 33% potential error in my calculation (a difference of 7,800m). I think this is overly exaggerated.
- 38 I have been through my ECR spread sheet again and altered it to reflect Dr Ogilvie's suggestions (removing the biotic function components, removing the multiplier from the Duck calculation). I found an average 1% difference in the ratio numbers I initially calculated, e.g. 4.06 instead of the 4.11 for steep culverts. I therefore stand by my calculations and note that given the levels of subjectivity no two researchers are likely to come up with exactly the same ECR's and resultant figures. Mr Fuller also makes this point in his rebuttal in regard to the potential Habitat-Hectare model use.
- 39 The mitigation proposed involves (for diversion, culverting and armouring losses) 27,000m of stream way<sup>5</sup>. The stream mitigation is predominantly in the Te Puka, Horokiri and Duck catchments (and includes 33.8 ha of riparian planting (13.1 ha of which have already been successfully established)). There is now an addition of around 11000m to be made available to native fish in the Wainui arm as a result of NZTA agreeing to remove and fix the existing perched culvert under the State highway (depicted below).

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<sup>5</sup> This is a change from the 30,000 noted in the reports and in my evidence in chief paragraph 140 due to a GIS calculation error I discovered in undertaking checks when writing this rebuttal evidence. Some REC classes linear lengths were counted in duplication to LINZ waterway linear lengths.





*Twin barrel perched culvert of the Wainui arm as it emerges from under State Highway 1.*

- 40 On top of this the Project provides for the wider protection, revegetation and enrichment plantings and removal of damaging land uses for the whole of the upper catchments of Te Puka and Horokiri as well as areas for terrestrial and landscape mitigation on the Ration, Pauatahanui and in the Duck, that collectively result in total of around 627 ha of land retirement and rehabilitation.
- 41 I think that this quantum of direct and supporting indirect mitigation is more than sufficient and allows for some flexibility in the possible ECR type calculation and in variances of the type suggested by Dr Ogilvie.

### **Ephemeral Streams**

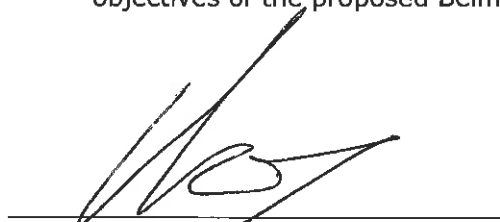
- 42 Ephemeral systems are included in the wider catchment mitigation and a large linear meterage of ephemeral (headwater) systems are captured by the mitigation in the Te Puka, Horokiri and Duck Creek systems. An estimate of the ephemeral habitat area in linear meters was made by using aerial photographs and identifying water channels up stream of the LINZ mapped waterways. That figure is 17,730m.<sup>6</sup> So while I appreciate Dr Ogilvie's concern in regard to the ephemeral systems, they are not forsaken and do form part of the wider mitigation proposed in the Te Puka, Horokiri and Duck catchments.

### **Baffles**

- 43 In regard to culverts requiring fish baffles as discussed by Dr Ogilvie, in culverts with more than minor gradients and which are long (say over 30m) they can assist passage and I have no reservations in agreeing with his suggestions that baffles be added to the longer, steeper main channel culverts.

### **Conclusion**

- 44 In the end as an experienced freshwater ecologist I am confident that both the array of mitigation actions proposed and the quantum of mitigation are cautious, responsive to the effects (both likely and of lesser possibility), produce an average 2.6:1 compensation ratio, will result in the protection of 2 of the best remaining upper catchments (that otherwise are likely to have continued to decline into the future under private land use), as well as providing initial retirement and revegetation of Duck Creek, which meets the objectives of the proposed Belmont Regional Park strategy.



**Vaughan Francis Keesing**

20 January 2012

<sup>6</sup> This figure was not calculated into the SEV ECR mitigation quantum calculated (being ephemeral), but is nevertheless part of the "aquatic" system.