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IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of application for Resource Consent 65750 by Trust Power Limited for Activities associated with the operation of the Matahina Dam.

FINAL REPORT OF
WILLIAM JOHN LANGDON PHILPOTT, CONSULTING ENGINEER

A. INTRODUCTION

1. This evidence is supplementary to my pre-circulated Section 42A report.

2. This report considers all of the evidence presented during the hearing and offers my final opinion on appropriate measures to avoid, remedy or mitigate the effects of the proposed operating regime of the Matahina Hydro-Electric Power Scheme on the Rangitaiki River Scheme. I offer my opinion as to an appropriate, current level of financial contribution to allow for the event that TrustPower offer this before the close of the hearing. However, in my conclusion I also offer an opinion on the appropriate operational measure to avoid, remedy or mitigate effects on the Rangitaiki River Scheme in the event that a financial contribution is not offered by TrustPower (TPL).

3. In my Section 42 Report, I refer to my experience in the field of river engineering but I consider some further expansion on this would be useful.

4. In my 15 years with Horizons Regional Council and the 11 years as Director of John Philpott & Associates, I have managed the operations of and undertaken reviews, prepared management plans and new funding systems for ten large river and flood control Schemes and five smaller schemes with a total combined maintenance budget for 2010/11 of over $8 million. In my current contract roll with Taranaki Regional Council, I am responsible for the management and upgrading of three medium to large river control Schemes with a combined budget of $3 million and have been involved in a major review of the Waipaoa River and on works in the Waiapu River in the Gisborne District.

B. GENERAL COMMENT

5. As noted in my original evidence, in my opinion the Matahina Scheme adversely affects the stability of the Rangitaiki River and significantly increases the cost of managing the River Scheme. Whilst the evidence presented by the applicant

reluctantly acknowledges that the Matahina Scheme will have some adverse on the River Scheme, it largely dismisses these effects as minor.

6. The adverse effects are to a large degree caused by riverbank erosion that is caused by the fluctuations in river level that occur as a result of the operation of the Matahina Scheme. It is my opinion that these adverse effects will be further exacerbated by the proposed changes to the operation regime of the Matahina Scheme.

7. River levels fluctuate naturally in rivers in response to rainfall events in their catchments and I have observed through many years of managing both large and small river control schemes that when floods occur in close succession, even relatively small floods, river banks become less stable and require remedial works to repair and prevent further erosion damage. When flood flows are well spaced, erosion damage is generally less severe.

8. Very frequent and on-going fluctuations in river level will result in a number of adverse effects on the Rangitaiki River.

9. These include the inability of the River Scheme to establish and maintain effective vegetative riverbank protection works on the lower riverbanks leaving them vulnerable to erosion during both small and large flood events and requiring them to be protected with very expensive (compared to vegetation protection) rock riprap protection. Whilst such rock protection sounds straight forward and will generally prevent a problem at the site from reoccurring, the delay involved in being able to design, fund and construct suitable rock riprap protection works can leave the riverbank and potentially the stopbank vulnerable to the next flood event or the next series of peaking events.

C. DISCUSSION ON MATTERS RAISED IN THE APPLICANTS EVIDENCE

10. I would like now to refer to the evidence of Graham Levy and Dr Toan. I note in this evidence that there are five common themes. These are:

Theme 1

11. **That because erosion occurs in flood events, it cannot be caused by the operation of the Matahina Scheme because the flow discharging from the Scheme during normal operation is much smaller than that of a flood event.**

12. This in my opinion is incorrect. Erosion damage occurs during flood events both large and small but the extent and the nature of the damage is very dependent on the condition of the river bank protection measures that existed prior to the flood event.

13. Because the operation of the Matahina Scheme significantly affects the ability of the river scheme to establish effective vegetative protection measures and has a significant impact on the stability of the river banks within, and for that matter above, the area affected by the water level fluctuations (peaking), and because river bank erosion normally starts from the toe of a river bank and not from the top of the bank, the Matahina Scheme is clearly impacting on the erosion that occurs to the river banks during flood events.

14. There are also a number of places in the applicant's evidence that dismiss the erosion issue now that long lengths of the riverbank are rock protected. It is true that there are extensive lengths of river bank that are protected which were funded with loans following the 2004 and 2010/11 flood events and will be paid for over an extended period. As the operation of the Matahina Scheme has contributed to the need for the erosion protection works, in my opinion TPL has a responsibility to assist with their funding.

Theme 2

15. **That any work involving the construction, reconstruction or repair of stopbanks is not required as a result of the Matahina Scheme.**

16. Stopbanks are reconstructed for a number of reasons. Firstly they may be reconstructed because there is a desire to improve their shape or compaction standard and thus their ability to resist erosion, wear and tear or seepage. Secondly they may be constructed to raise the standard of protection provided, and thirdly they may need to be shifted away from the river bank where riverbank erosion has placed them at risk. The effect on the stability of the riverbank arising from the operation of the Matahina Scheme that increases the likelihood of riverbank erosion increases the risk of stopbank damage and thus the need for stopbank repair or their reconstruction further away from the riverbank.

Theme 3

17. **That because sediment deposits on the riverbank would be washed away in a subsequent flood event, there is little if any benefits derived from the deposition of sediment on the river banks.**

18. Sediment deposition on riverbanks can provide both positive and negative effects. In a river where sediment loads are large, the build up of sediment can cause slumping problems. However because sediment transport in the Rangitaiki River is already restricted by the upstream dams, this is unlikely to be a problem. However, sediment deposition on the Rangitaiki River banks, albeit small, will aid vegetation growth and

can assist with the sealing of the riverbanks that may reduce the risk of piping and heave failures during a flood event.

19. If the Matahina Scheme was operated as a run of the river scheme or with minimal peaking, vegetation would establish on the riverbanks, sediment would be trapped in that vegetation or would remain in place because the vegetation would reduce river edge velocities. The vegetation would then flourish, further improving the protection provided by the vegetation. The sediment would not be washed away as purported by the applicant and would provide the positive benefits noted above.

Theme 4

20. **That the operation of the Matahina Scheme does not make the riverbank more susceptible to failure arising from drawdown of river levels after peaking.**

21. This issue is mentioned by Graham Levy and discussed in more detail by Dr Toan. River bank slumping is a natural process that commonly occurs following flood events when the soil in the bank becomes saturated when the river level is high and then causes the bank to slump when the support provided by the river water is removed. The slower the flood recession, the less likely it is that slumping will occur. Whilst the rising stage of a flood can be relatively fast, the falling stage especially once the river has dropped down to the riverbank level is generally quite slow. Whilst I have no data for the Rangitaiki River, I have examined the falling stages of a number of flood events in rivers in the Manawatu Wanganui Region and this shows that the existing downward ramping rate proposed by TPL is about twice a steep as the falling stage of floods in these rivers and the proposed downward ramping rate is twice as steep again. The nature of the soils in Rangitaiki River Catchment result in long flood recessions making the difference between the natural and the proposed rate even more significant. The steep ramping rates will ensure that the water that seeps into the Rangitaiki riverbanks when the water level is high will drain out to the river with a very steep gradient and will cause bank slumping.

22. To understand the magnitude of this problem, it is worth noting the size of change in water level that can occur when the downward ramping occurs. In reaches 2 & 3 of the river, the river level will drop 1.8 to 2.4 m in the more usual operating range and even by more when the full operating range is utilised.

23. Dr Toan dismisses the likelihood of slumping. In my experience, drawdown of water level of this magnitude will almost certainly cause bank slumping in the Rangitaiki River. This slumping will increase the steepness of the riverbanks and will increase the likelihood of erosion during a future flood event.

Theme 5

24. **That the operation of the Matahina Scheme has only a minor effect on river bank erosion.**

25. Graham Levy's evidence has no details that support his assertion that the operation of the Matahina Scheme has only a minor effect on river bank erosion and largely attributes the bank erosion to natural processes. Whilst I would agree that erosion is a natural process that largely occurs in large and small flood events, precondition is a very critical factor and cannot be ignored. The existing operating regime of the Matahina Scheme clearly affects the ability of vegetation to establish on the riverbanks within the zone of water level fluctuation, and increases the lengths of bank exposed to the erosive river flows. This effect will be greater in the proposed operating regime.

26. In regard to Dr Toan's evidence on this matter. His calculations of factors of safety are theoretical and not related to the reality of the river itself. An eroding riverbank will be very different to that of the banks analysed in his report and as erosion will be exacerbated by the operation of the Matahina Scheme, slumping induced by rapid drawdown of water level by as much as 2.4 metres in a relatively short period is almost certain to further aggravate this erosion.

27. Levy, paragraph 175, sets out three measures by which TPL propose to address the effects of the Matahina Scheme on river bank erosion. One of these is to set limits on the maximum up and down ramping rates and on the magnitude of the operating range.

28. In my opinion this measure ensures that there will be an adverse effect. As discussed above the downward ramping rate is very steep, is twice as steep as the existing and as the existing is already causing adverse effects on the river, the steeper rate cannot possibly address these effects.

29. Levy, paragraph 232, questions my suggestion that sediment deposition would help seal the banks, avoiding the risk of piping failures. I agree that whilst the stopbank failure that occurred in 2004 may have occurred as a result of underlying geotechnical issues, riverbank siltation can only reduce the risk of failure. I made no suggestion that the design of the flood protection measures relied on the sediment deposition, but the stopbanks are there and any deposition can only assist.

30. Levy, paragraph 228 (b), has misinterpret my Section 42 evidence. In my opinion, whilst TPL should not be required to contribute to the cost of construction and the general maintenance of stopbanks required to achieve and maintain the design

standard of flood protection, they should be required to contribute to the cost of any work associated with their relocation or reconstruction that arises from river bank erosion or piping failures attributable to the operation of the Matahina Scheme.

31. Levy, paragraph 228 (d), considers that recognising the impact of additional peaking by increasing the first year's contribution would be speculative. After further consideration of this matter, I believe that if additional peaking is to be permitted then it will cause additional flood damage that should then be funded in part by TPL. Increasing the TPL share based on expected increases in damage and then increasing their share based on actual damage could result in double counting.

32. Levy, paragraph 229 (b), misconstrues my comment regarding the percentage of vegetated banks. The real issue is the percentage of bank lacking vegetative protection. If the 3700 metres of un-vegetated banks were rock protected, the cost of this work would be in the range of 1.8 to 5.5 million dollars.

33. Levy, Paragraph 229 (d), suggests that I favour EHG model of calculating existing and postulated future series of maintenance and capital costs, whereas TPL's position is that the contribution should be based on actual cost. This comment is somewhat confusing as in Graham Levy's evidence, attachment 13, page 7, the costs for (forecasted) routine maintenance are for all intent and purpose the same as those used in the EHG model. With respect to the EHG model, I would agree that at first glance, it does appear confusing and whilst it does include some projections for future costs, it fully allows for actual costs to be input as they occur, to ensure any apportionment of the cost is fair and equitable. To aid understanding however I have adopted the more simple model in the format used by TPL. This model only sets out the proposed TPL share for year 1 of a long term contributing agreement and a more complex model will be required to ensure fair and equitable contributions are provided in the future.

D. DISCUSSION ON MATTERS RAISED IN THE EHG EVIDENCE

Bruce Crabbe

34. I will make a few comments regarding matters addressed by Bruce Crabbe.

35. [3.7] He notes that historically the Rangitaiki River was managed by means of rockworks (used at high energy sites) and a variety of willow based soft engineering works. The River below the Matahina Dam is now protected with rock riprap at many locations that are not high energy sites. Most rivers that I am familiar with, such sites would be either protected with willow or even battered back and grassed.

36. [3.8] notes that the hard engineering is very expensive both in terms of capital expenditure and maintenance. Generally well-constructed rock riprap will have relatively minor maintenance requirements. The fact that the maintenance requirements are high for riprap could in part result from the river itself and the difficulties involved with its construction but also it is clear the destabilising nature of the very frequent river level fluctuations increases the need for this maintenance.

37. [4.14 – 4.15] I fully support the comments in these paragraphs regarding the repair of erosion damage being just another maintenance activity.

38. [4.25] I fully support the matters raised in this paragraph regarding the components of capital works that should be funded in part by TPL.

39. [6.11 a - e] I unreservedly support the matters addressed in this paragraph regarding the impacts of water level fluctuations.

Gary Williams

40. I am in general agreement with Gary Williams' discussion on the effects on the river arising from the operation of the Matahina Scheme.

41. I refer to attachment D in his report that sets out estimates of TPL's contribution to the Rangitaiki River Scheme. Whilst I note these various percentages of costs that should be funded by TPL, I believe that managing this process will be difficult and that a more suitable allocation system would be to combine all annual maintenance costs, all flood repair costs (including large floods), and scheme management and apply the percentage figures to these totals on a reach by reach basis. Scheme management associated with all capital upgrade works must be separately accounted for and excluded from this allocation.

42. The allocation of Geotechnical works and Capital improvements I believe will need additional consideration and I do not believe that the allocation of a fixed percentage is practicable. An independent assessment based on a set of agreed criteria would be the best option for these items of work.

43. The photographs of the river banks clearly shows that a significant erosion problem exists and I agree with Gary Williams that this problem is significantly aggravated by the operation of the Scheme.

D. RAMPING, PEAKING AND LOW FLOWS

Ramping

44. The applicant proposes to slightly increase the upward and double the downward ramping rates. Whilst a steep upward ramping rate will have less adverse effect than the downward rate, the effect cannot be ignored.

45. The impacts of downward ramping are: rapid drawdown that increases the amount of riverbank slumping, and the erosion of material from the river bank that arises from acceleration and deceleration of the river flow.

46. River bank slumping is a natural process that commonly occurs on the falling stage (the downward ramping stage) of a flood event when the soil in the bank becomes saturated when the river level is high and then slumps from the riverbank when the support provided by the river water is removed. The slower the flood recession, the less likely it is that slumping will occur. Whilst the rising stage of a flood can be relatively fast, the falling stage especially once the river has dropped down to the riverbank level is generally quite slow. Whilst I have no data for the Rangitaiki River, I have examined the falling stages of a number of flood events in rivers in the Manawatu Wanganui Region and this shows that the existing downward ramping rate proposed by TPL is about twice a steep as the falling stage of floods in those rivers and the proposed downward ramping rate is twice as steep again. The nature of the soils in Rangitaiki River Catchment result in very long flood recessions making the difference between the natural and the proposed rate even more significant. The steep ramping rates will ensure that the water that seeps into the Rangitaiki riverbanks when the water level is high will drain out to the river with a very steep gradient and will cause bank slumping.

47. In order that the ramping rates associated with the operation of the Matahina Scheme do not cause significant adverse effects to the river scheme, they should be as flat as possible. The existing ramping rates are already causing erosion problems and steepening them will only aggravate these problems.

48. As a minimum, the existing ramping rates should be retained but ideally to minimise adverse effects on the river, the rates should be flattened. The questions must be by how far and this is a difficult one. The best rate would be a run of the river rate but I understand the practicalities of operating a hydro scheme with this as a control.

Peaking

49. The applicant proposes to increase the number of peaks from two per day up to an unlimited number within limits set by a constraints envelope.

50. Very frequent fluctuations in river level will result in a number of adverse effects on the Rangitaiki River.

51. The first is linked to the adverse effects arising from steep ramping rates and this has been addressed above.

52. The second includes the inability of the River Scheme to establish and maintain effective vegetative riverbank protection works on the lower riverbanks leaving them vulnerable to erosion during both small and large flood events and requiring them to be protected with very expensive (compared to vegetation protection) rock riprap protection.

53. If the Matahina Scheme was operated as a run of the river scheme or with minimal peaking, vegetation would establish on the riverbanks, sediment would be trapped in that vegetation or would remain in place because the vegetation would reduce river edge velocities. The vegetation would then flourish, further improving the protection provided by the vegetation. The sediment would not be washed away as purported by the applicant and would provide the positive benefits noted above.

54. The river has and still is suffering as a result of the existing peaking regime. In my opinion the existing level of contribution from TPL is completely inadequate and does not offset the adverse effects of the operation and the proposed contribution is little better. As the effects of increasing the peaking is unknown, it is not possible to determine a suitable contribution level that would offset an increased peaking regime and I would have to recommend that the peaking regime should be as limited as practicable and I suggest that this is one or possibly two but no more.

Minimum flow reduction

55. A reduction in the minimum operating flow would increase the fluctuation range and whilst this will not have a further impact on riverbank vegetation it will increase the extent of drawdown and the amount of riverbank slumping which will in turn increase the amount of erosion. For this reason I believe that reducing the minimum flow would adversely affect the river scheme and increase scheme maintenance costs.

E. COSTS SHARE

56. Whilst I am well aware of the limitation on the ability of the hearing panel to impose a financial contribution, I offer this following comment.

57. In my experience, determining appropriate shares of river control schemes to be funded by scheme beneficiaries and by those who contribute to the need for the scheme, can result in a complicated funding system that is hard to manage in the long term.

58. The challenge for this scheme is to determine a mechanism that is fair and equitable to all parties and is dynamic enough to be able to cater for what is known and what is unknown, what the future adverse effects may be, and what the future costs of mitigating those will be, and is simple to use.

59. With respect to the cost share for scheme maintenance, there are components of scheme works that are affected by the Matahina Scheme and others that may not be. However they are all required to be undertaken to manage the scheme. Precisely separating out these components over an extended period can be difficult and problematic and in my opinion unnecessary. Components like fencing repairs and stopbank repairs (not upgrades) are generally small costs. Maintenance must include the repair of all flood damage for both small and large floods.

60. What I am suggesting here is that an agreement should be reached to fund a set proportion of all scheme maintenance for each of the three river reaches below the dam. Maintenance also includes all management costs as nothing organises itself and as it is probably more difficult to separate management costs into river reaches, I would recommend that these cost are apportioned based on the relative maintenance costs.

61. For future capital works that involve scheme upgrading, TPL should not be required to contribute.

62. For Capital works where there is a component that relates to the effects of the Matahina Scheme, if the proportion to be funded by TPL cannot be simply agreed, I recommend that a suitably qualified independent engineer be engaged to make a final determination.

E. CONCLUSION

63. In my opinion the existing and proposed operating regime for the Matahina Scheme has a significant adverse effect on the management of the Rangitaiki River Scheme and unless TrustPower Ltd agree to contribute to the ongoing cost on managing the Scheme consent should only be granted to operate the Matahina Scheme as a run of the river Scheme.