

IN THE MATTER of the Resource
Management Act 1991

AND

IN THE MATTER of an application by
TRUSTPOWER LTD
to the **BAY OF**
PLENTY REGIONAL
COUNCIL for water
permits associated
with the operation of
the Matahina
Hydroelectric Power
Scheme

STATEMENT OF SUPPLEMENTARY EVIDENCE OF BRUCE KELVIN CRABBE

1. INTRODUCTION

Qualifications and experience

- 1.1 My name is Bruce Kelvin Crabbe. I am the Rivers and Drainage Operations Manager for the Environmental Hazards Group ("EHG") of the Bay of Plenty Regional Council ("BOPRC") and my qualifications and experience are as set out in my principal brief of evidence.
- 1.2 At the hearing on 6 July 2011, the Hearing Committee requested that I provide details of costs associated with river edge protection works which are carried out by the Environmental Hazards Group ("EHG") on the Rangitaiki-Tarawera River Scheme ("River Scheme") downstream of Matahina Dam. The purpose of that request was to ascertain whether river edge protection work costs since 2004 demonstrated an upward "trend" which could be used to determine an appropriate contribution by TrustPower toward the River Scheme in order to mitigate the effects of the Matahina hydroelectric power scheme on the River Scheme.
- 1.3 My evidence therefore sets out the costs of river edge protection works incurred by the EHG since 2004 and comments on conclusions which can be drawn from that data.

Scope of evidence

- 1.4 In addressing the question from the Committee, I will:
- (a) Outline the analysis I have undertaken to attempt to answer the Committee's question (Section 2);
 - (b) Comment on the costs of river edge protection works (Section 3);
 - (c) Comment on the difficulty of identifying trends, due to confounding factors in the manner in which river scheme works are undertaken (Section 4); and
 - (d) Comment on information that has recently come to light (Section 5).

2. ANALYSIS

- 2.1 In order to provide the cost details requested by the Committee, I researched the scheme operating costs for the three reaches downstream of the Matahina Dam for the financial years from 2004/2005 until 2010/2011.
- 2.2 This involved reviewing the costs of work undertaken in each of the three reaches for all types of river bank maintenance works and flood repair works, and geotechnical strengthening works involving rock protection works. I then compiled the costs for these works in each of the three reaches (addressed below).

3. RIVER EDGE PROTECTION COSTS

- 3.1 The actual expenditure on river edge protection works carried out on the three reaches downstream of the Matahina Dam since 2004-2005 are set out in **Appendix A**.
- 3.2 The river edge protection works which the EHG carries out comprise:
- (a) Tree and edge vegetation protection works and maintenance;
 - (b) Rock edge protection works and maintenance;
 - (c) Flood damage repair works involving rockworks and tree works; and

(d) Rockworks/river bank reinstatement works associated with the Geotechnical Strengthening Works Project.

3.3 The costs are also separated into the three reaches - Reach 1 – Edgecumbe to the mouth; Reach 2 – Te Teko to Edgecumbe; Reach 3 – Matahina Dam to Te Teko.

3.4 Only minimal expenditure has occurred on repairs resulting from the January 2011 flood event due to the persistent wet weather in the region has experienced since that time. Therefore, the 2010 / 2011 figure cannot reliably be used to indicate costs incurred for that year.

3.5 My evidence in chief noted that the costs of those floods was estimated at \$1.1M¹, however, due to the repeated rainfall events since January, the damaged sites have continued to be aggravated by fresh events in the river and ongoing hydro dam fluctuations² while remaining in an unrepaired state.

3.6 The EHG has commenced the process of re-inspecting the damaged sites and, based on the inspections undertaken to date, it is now expected that repairs downstream of the dam will be significantly greater than this earlier estimate. We have therefore recently re-estimated the costs of repairs at approximately \$8M. For that reason, I have included the projected costs for 2011/2012 and 2012/2013 in Appendix A. I also address further observations that we were able to make on our recent inspections below.

3.7 No costs relating to maintenance or rebuilding of the flood protection stopbanks have been included in the table.

4. ANALYSIS – INABILITY TO IDENTIFY TRENDS

4.1 Analysis of the costs of river edge protection works over the three reaches since 2004 does not show any particular trend in costs associated with river edge protection works either over the years or across the three reaches. Rather, the costs analysis tends to show that expenditure since 2004 has been dominated by flood event repairs.

1 Evidence in chief, paragraph 5.7.

2 Evidence in chief, paragraph 6.11(b).

- 4.2 While there is no discernable trend, as set out in my primary evidence and the evidence of Mr Williams, damage during floods is exacerbated by weakened preconditions caused by the hydro fluctuations, hence the need for costly river bank rock protection works.³ In other words, the dominance of flood event repairs does not demonstrate that the effects of hydro fluctuations are eclipsed by the effects of the flood itself, but they contribute significantly to increased damage during a flood event and therefore increased flood event repair costs.
- 4.3 Any trend which might be discernable is also obscured by the nature of rivers and floods and the nature of river management. For example, the EHG is not able to undertake all works that need to be done at the same time and we have to prioritise those works. We tend to fix damage to stopbanked reaches first, which largely means prioritising work in Reaches 1 and 2. That means that damaged sites which are left unattended elsewhere can get worse and therefore increase the cost of repair. Another example is that when we need to undertake flood damage repair works, normal routine maintenance works can be delayed or are tied up with the flood repair works, thus the cost of routine maintenance may be less while the overall costs of river edge protection works increase.
- 4.4 The analysis does show that the costs being incurred each year are well in excess of the routine maintenance budget of \$201,674 per annum⁴ for those three reaches. TrustPower's current contribution is based on this annual budget estimate (excluding Reach 1 costs), rather than the actual costs incurred by the River Scheme each year.

5. FURTHER RELEVANT INFORMATION

- 5.1 I noted above that the EHG has recently re-inspected the damage caused by the January 2011 flood events and, on that basis, has re-estimated the cost of repair works that need to be undertaken.
- 5.2 During one of those inspections (on 10 August 2011 from 9:40am to 13:10pm), the river flow was approximately 47m³/s (river level of 550mm), as shown in the hydrographs attached at **Appendix B1 and B2**. This is

³ Evidence in chief, paragraph 4.21.

⁴ Evidence in chief, paragraph 4.12 and Appendix F.

slightly higher than the minimum flow⁵ provided for in TrustPower's expired resource consent and more than twice the minimum flow now sought.

5.3 As noted in my primary evidence, by contrast, the river flow during:

- (a) The Committee's site visit on 1 July 2011 was approximately 130 – 140 m³/s (river level of 2.1m);⁶ and
- (b) The EHG site visit on 3 July 2011 (at 13:30 to 16:00) was approximately 67 to 75 m³/sec⁷ (corresponding river level of 0.9 – 1.0m)⁸.

5.4 Our observations of the type and level of damage to the river banks as a result of that inspection are:

- (a) Extensive damage to the river bank works at and below the normal dam fluctuation range. The majority of this damage was out of sight below the river water level during the previous EHG inspections and the Commissioners' inspection.
- (b) Damage to the 2004 flood repair works is significantly worse than previously observed.
- (c) Damage and deterioration to the filter layers of weathered rock material which supports the rock protection works and protects underlying vulnerable insitu soil layers. This damage/deterioration occurs due to the regular routine fluctuations while repair works are in progress.
- (d) Slumping of the river bank, due to erosion undercutting, where existing vegetation has been well established.
- (e) Death of willow tree material that has been layered⁹ on the river bank as vegetative protection works. The purpose of layering is to force the layered limbs to establish root systems into the lower river bank. This reinforces the soil on the bank and also helps reduce water velocities at the river bank via the vegetative willow

5 Except when inflows are less than 40m³/s.

6 Crabbe primary evidence, paragraph 6.5 and Appendices J1 and J2.

7 Crabbe primary evidence, Appendix J2.

8 Crabbe primary evidence, paragraph 6.6 and Appendices J1.

9 Crabbe primary evidence, paragraph 4.8(a).

cover. The regular fluctuations adversely impact the vegetative material and prohibit this process occurring.

- 5.5 In order to assist the Committee further, I have included some photos of the river banks which demonstrate the damage described above. Refer **Appendix C**.
- 5.6 The extent of the erosion damages and large number sites where the damage has occurred has forced EHG to review its method of carrying out the repair works.
- 5.7 As noted above, many of the damaged sites include areas where the 2004 flood repairs had been carried out. These sites, which had been repaired generally between 2004 and 2007, should have life expectancy of approximately 15 years¹⁰ before rock replenishment is required. Many of these sites show rapid deterioration at the fluctuation zone and below, but their condition is generally stable above the regular fluctuation zone, subsequent significant flood events. This indicates that the regular river level fluctuations that have a significant adverse impact on the stability and life expectancy of these bank protection works.
- 5.8 The damage that has occurred has demonstrated that the frequency of replenishment needs to be is much sooner than currently programmed for and that the works have to be built to a more robust and therefore expensive standard.
- 5.9 Based on this information which has recently come to light, the EHG has now estimated its costs for these flood repairs for the 2011/2012 and 2012/2013 years at \$8M (approximately \$4M per year). This estimate includes rectifying the significant damage to the riverbanks and increased costs of future repair works due to amendments required to their design. These projected costs are included in **Appendix A**.

Bruce Crabbe
September 2011

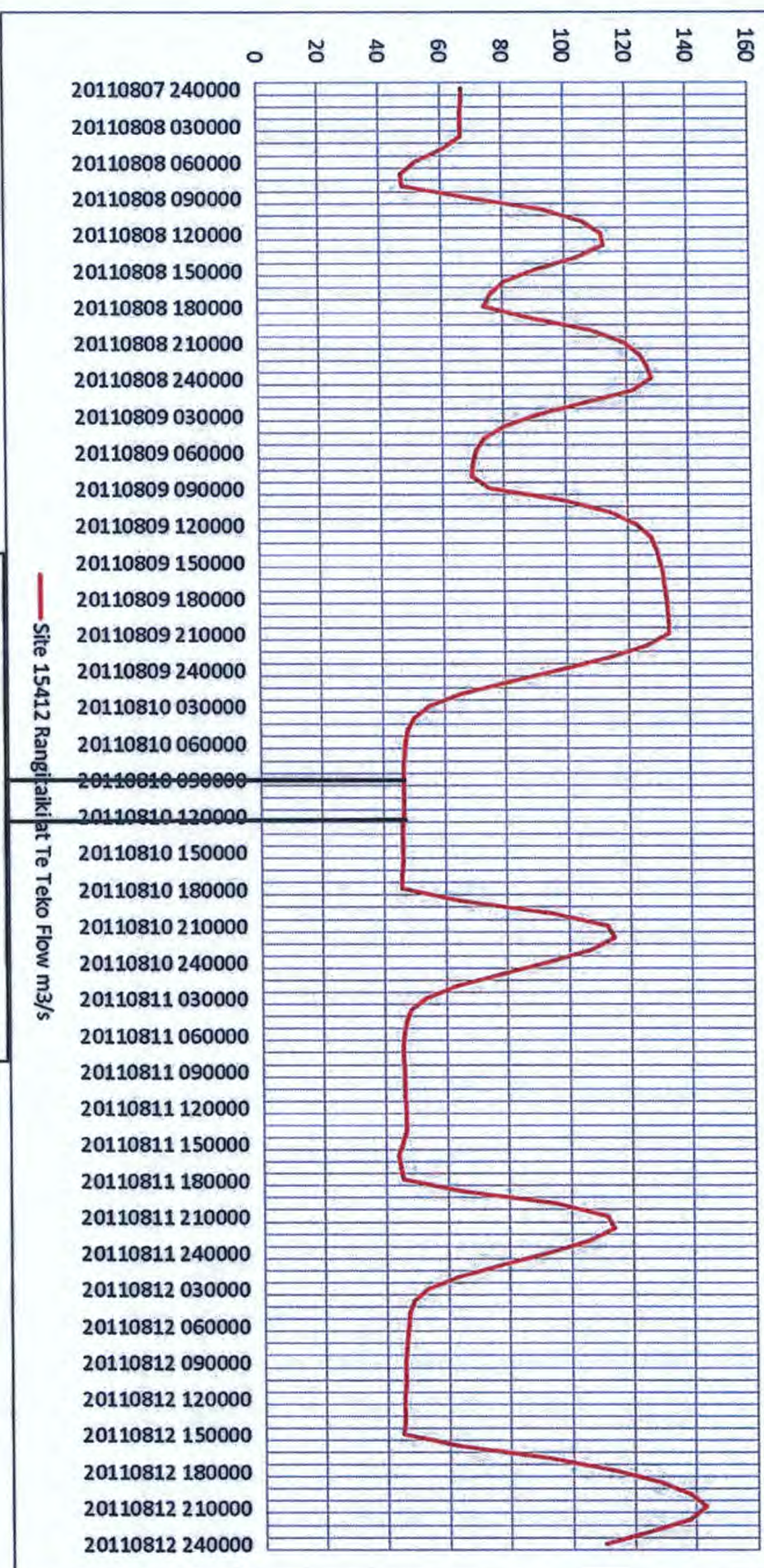
10 Crabbe primary evidence, paragraph 4.8(d).

Appendix A

Summary of Rangitāiki-Tarawera River Scheme River Edge Protection Costs					
Year	Reach 1	Reach 2	Reach 3	Totals	Comments
Estimated costs:					
2012/13	\$880,000	\$1,920,000	\$1,200,000	\$4M	Re-estimated flood repair works of approximately \$8M to be spread over these two financial years. Excludes routine maintenance works.
2011/12	\$880,000	\$1,920,000	\$1,200,000	\$4M	As above
Actual costs:					
2010/11	\$135,971	\$111,381	\$71,221	\$318,573	Excludes most of the originally estimated \$1.1M of 2011 flood repair works.
2009/10	\$51,358	\$605,769	\$212	\$657,339	Costs dominated by Geotech rockworks
2008/09	\$3,735	\$222,096	\$94,377	\$320,208	
2007/08	\$317,104	\$258,661	\$86,836	\$662,601	Final 2004 flood repairs and new flood repairs
2006/07	\$549,248	\$351,112	\$169,368	\$1,069,728	Costs dominated by 2004 flood repair works
2005/06	\$651,588	\$611,650	\$856,328	\$2,119,566	Costs dominated by 2004 flood repair works
2004/05	\$403,110	\$1,004,010	\$0	\$1,407,120	Costs dominated by 2004 flood repair works
2003/04	?	?	?	?	Cost details were not separated into reaches at this time and it is not possible to derive information for the lower reaches prior to 2004/05.
Totals	\$2,112,113	\$3,164,678	\$1,278,343		
Notes:					
<ol style="list-style-type: none"> Costs include routine river edge protection works maintenance, flood damage repairs to river banks and rock edge protection works that have been carried out under the Geotechnical Strengthening Works project. Only minimal expenditure on the estimated 2011 flood repair works has occurred to date. 					

Appendix B1: River flow at Te Teko (cumecs)

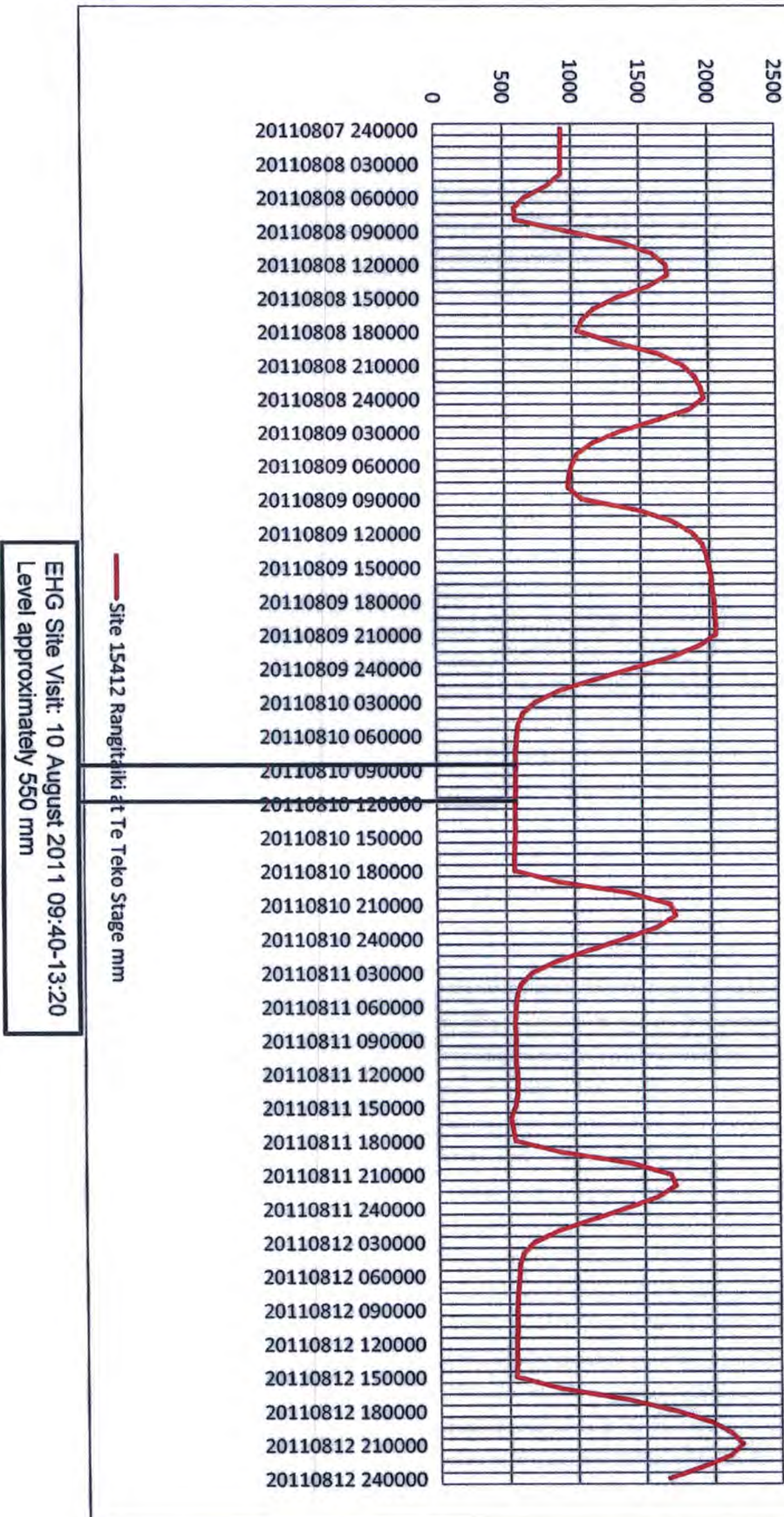
Site 15412 Rangitaiki at Te Teko Flow m³/s



EHG Site Visit: 10 August 2011 09:40-13:20
Flow approximately 47 m³/s

Appendix B2: River level at Te Teko (mm)

Site 15412 Rangitaiki at Te Teko Stage mm



Appendix C

Note: All location measurements are from the mouth of the Rangitāiki River. Refer to river centreline distances on aerial photo-map “Rangitaiki River, Site Visits” filed on 8 July 2011.

IMG488 (10 August 2011), 28.7km, Reach 3, Right bank: Rock protection works bare of vegetation and eroding through hydro dam fluctuation

zone.



Appendix C (continued)

IMG 489 (10 August 2011), 28.68km, Reach 3, Right bank: Rock protection works bare of vegetaion and eroding through hydro dam fluctuation zone.



Appendix C (continued)

IMG511(10 August 2011), 26.9km, Reach 3, Right bank: Erosion of rock works at fluctuation zone. Rock works in good condition and reinforced with vegetation above the fluctuation zone despite being subjected to several large flood events. This site (Carter/McCauley) is a 2004 Flood Repair work completed in 2006.



Appendix C (continued)

IMG522 (10 August 2011), 26.2km, Reach 3, Right bank: Erosion of rock works at fluctuation zone. Rock works in good condition above the fluctuation zone despite being subjected to several large flood events. This site (Demetroff) is a 2004 Flood Repair work completed in 2006.



Appendix C (continued)

IMG524 (10 August 2011), 26.14km, Reach 3, Right bank:Raw river bank continuously eroding at the fluctuation zone. Note rate of erosion by collapsed length of fenceline.



Appendix C (continued)

IMG538 (10 August 2011), 24.9km, Reach 3, Left bank:Section of eroded river bank with protection works in progress. First stage to place a filter layer of weathered rock for foundation of the larger rock material is being eroded by the regular fluctuations before the covering layer of rock can be placed. Note height of regular



fluctuations.

Appendix C (continued)

IMG540 (10 August 2011), 24.85, Reach 3, Left bank: Close to previous photograph. Rock protection works being placed over the foundation layer of weathered rock material.



Appendix C (continued)

IMG553(10 August 2011), 24.5km, Reach 3, Left bank:Section of eroded river bank with protection works in progress. First stage to place a filter layer of weathered rock for foundation of the larger rock material (see rock stockpiles in background). Note height of regular fluctuations.



Appendix C (continued)

IMG555 (10 August 2011), 24.45km, Reach 2, Left bank: Layered willow edge protection works. Tree material in fluctuation zone dying off and bare eroding river bank behind.



Appendix C (continued)

IMG569 (10 August 2011), 22.9km, Reach 2, Right bank: Bare river bank at fluctuation zone and slumping rock works at left.



Appendix C (continued)

IMG573 (10 August 2011), 22.2km, Reach 2, Right bank:Raw river bank continuouslyeroding at the fluctuation zone. Note height of regular fluctuations on bank in centre of photo that is undercutting the vulnerable soils.



Appendix C (continued)

IMG577 (10 August 2011), 21.6km, Reach 2, Right bank: Bare river bank through the regular fluctuation zone. Erosion and undermining of trees occurring.



Appendix C (continued)

IMG614 (10 August 2011), 15.45km, Reach 2, Left bank: Erosion of rock works at fluctuation zone. Rock works in good condition above the fluctuation zone despite being subjected to several large flood events. This site (Eruera) is a 2004 Flood Repair work completed in 2005.



Appendix C (continued)

IMG617 (10 August 2011), 15.3km, Reach 2, Left bank: Erosion of rock works at fluctuation zone. Rock works in good condition above the fluctuation zone despite being subjected to several large flood events. This site (Eruera) is a 2004 Flood Repair work completed in 2005.

