HORIZONS REGIONAL COUNCIL

POHANGINA-OROUA SCHEME AUDIT

JULY 2013

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Cover Photo
Plantings establishing well on right bank of Pohangina River at 5 km

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CONTENTS

1. Introduction

1.1 Scheme Description

The original scheme was established by the Manawatu Catchment Board in February 1966 to carry out river control and soil conservation works in the catchments of the Pohangina River (536 km^2) and Oroua River upstream of Kiwitea Stream (320 km^2).

The Pohangina-Oroua Scheme activities are now mainly confined to river control and maintenance works over 34 km of the lower Pohangina and 42 km of the Oroua River above Reid Line East, together with maintenance of 5.6 km of drains and 1.1 km of two small tributaries, the Tokeawa and Te Awaoteatua Streams.

The scheme also manages 38 hectares of exotic forestry and associated grade controls that protect the unstable sand deposits in the Goulter's Gully area located south east of Kimbolton at Oroua River distance 32 km.

There is some 56,000 hectares of rateable property in the scheme area, of which 62% is in the Pohangina catchment and 38% in the Oroua.

A Scheme Review was adopted by Council in September 2001 to implement a programme of works to achieve the most stable river alignments. In June 2006 this review was updated in light of changes to the scheme that occurred as a result of the very large February 2004 flood event and further damage from a significant flood at the end of April 2006. Other flood events in July 2006 and July 2007 caused considerable erosion damage and required reactive erosion protection works that severely depleted the emergency reserve fund.

Landowners subsequently agreed to contribute towards bank erosion protection works on their property, starting in 2008-09. Major flood damage again occurred in September and October 2010 but the emphasis is now finally on the intended proactive channel maintenance and buffer zone establishment.

1.2 Need for a Scheme Audit

A programme of scheme audits has been introduced to examine the degree to which the recommendations of Scheme Review have been carried out and how well the actual scheme costs align with the assumptions made in the Scheme Rating System.

It is accepted that some deviation from the recommendations will inevitably occur and that management must be flexible enough to accommodate changed circumstances and experience gained over the years since the review.

The purpose of the audits is therefore not to ensure that management blindly follows the review recommendations, but rather to ensure that where significant deviations have occurred there has been a well-informed, considered and documented process leading to that change.

The audits would report on changes that occurred since the review and identify any further changes required to performance and management strategies, as well as any changes to the rating system.

In summary the audit process will report on the following.

- Implementation of the 2006 Scheme Review Recommendations
- Scheme Changes since the Review
- Recommended Design Standards and Relevance to Present Conditions
- Actual and Estimated Expenditure for the Rating System Differentials
- Rating System Changes and Impacts
- Recommended Changes to Performance Standards and Rating System

The recommendations will ensure that the scheme continues to meet ratepayer expectations and the rating system continues to provide equitable funding.

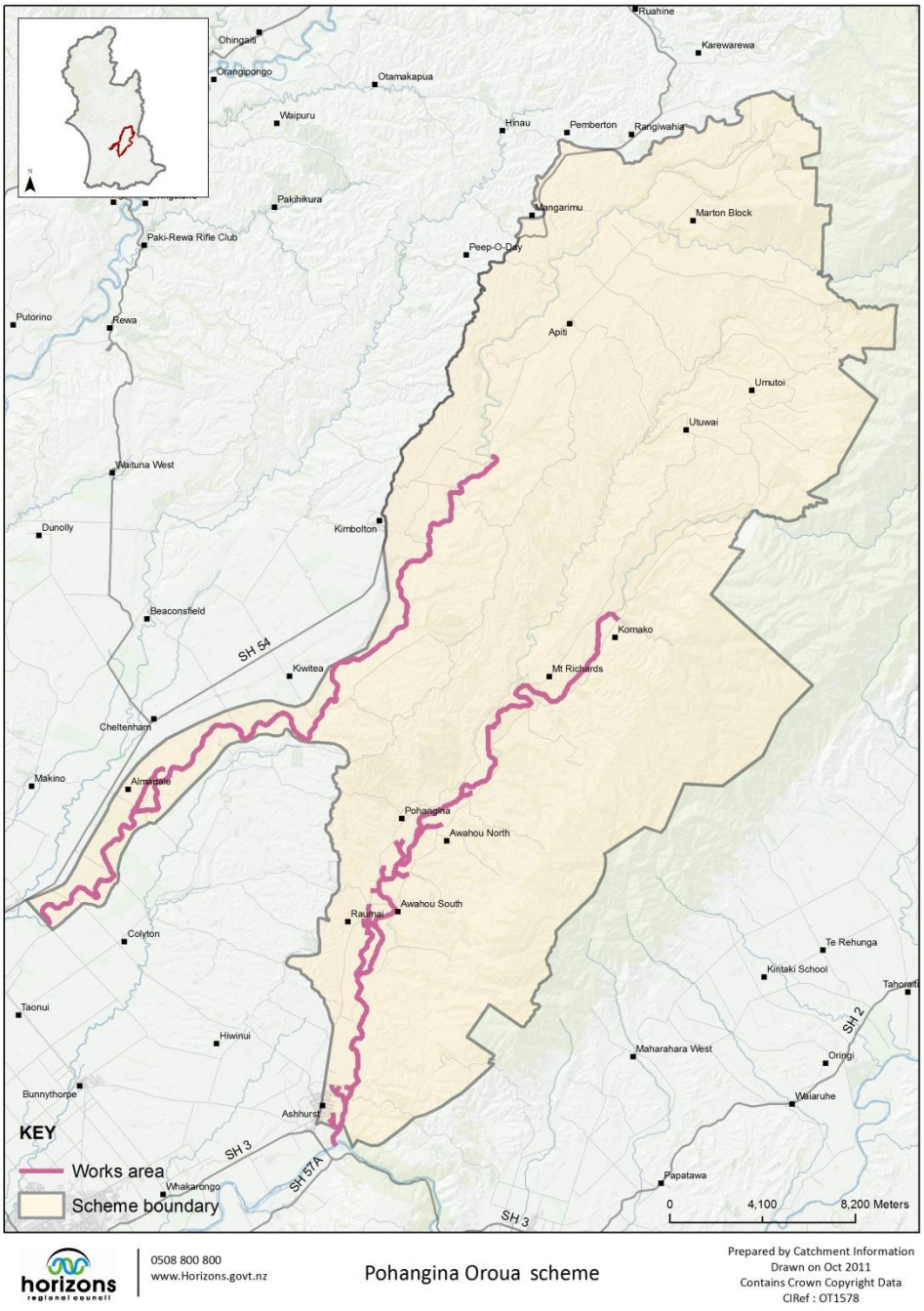


Figure 1: Scheme Map

2. Overview

2.1 Overview of the Scheme Works

The scheme maintains a range of assets to achieve its objectives. Erosion protection assets mainly involve tied tree works, training groynes and erosion protection plantings.

Permeable mesh units (PMU) were used extensively to repair 2004 flood damage but these are now being progressively phased out.

A relatively small amount of heavy bank protection is provided by rock and concrete riprap.

Goulter's Gully forestry is managed as Protection Production Forest primarily for soil conservation benefits in the Oroua catchment, but is also an important source of revenue for the scheme. Some 33 hectares of exotic forest were harvested and replanted again in 2002 and 2003. The forestry includes a number of grade controls and other soil conservation works to control erosion in the gully system.

All infrastructural assets managed by Horizons Regional Council (HRC), were revalued in July 2011 and quantities updated in 2012.

The total value of scheme assets is approximately $7.7 million, of which $6.8 million is river works, as set out in Table 1.

Note that the asset values are indicative and based on average costs for the various works. Quantities are subject to revision as asset data is updated following site inspections and GIS mapping. In addition, the drain quantities are incorrect as they have inadvertently not been adjusted to remove some 10 km of private drains that were deleted from the scheme during the development of the 2002 rating system.

Table 1: Asset quantities and replacement value 1 July 2012

Asset Type	Quantity		Replacement Value
Forestry	38.4	ha	$760,483
Drain Reach	17.08	km	$130,777
Permeable Groynes	4130	m	$1,177,050
Tied Tree Work	20,048	m	$3,327,496
Rock Lining	1280	t	$185,761
Protection Planting	97.68	ha	$1,554,407
PMU	1,163	m	$371,300
Concrete Riprap	1,120	t	$162,540
		Total	**$7,669,813**

Note that the forestry value is indicative only, as it is the inflation adjusted net value when the forest was harvested in 2001-02. Log prices at that time were close to historic highs and other factors such as wind damage mean that the net value at harvest in 2030 could vary significantly from the value shown.

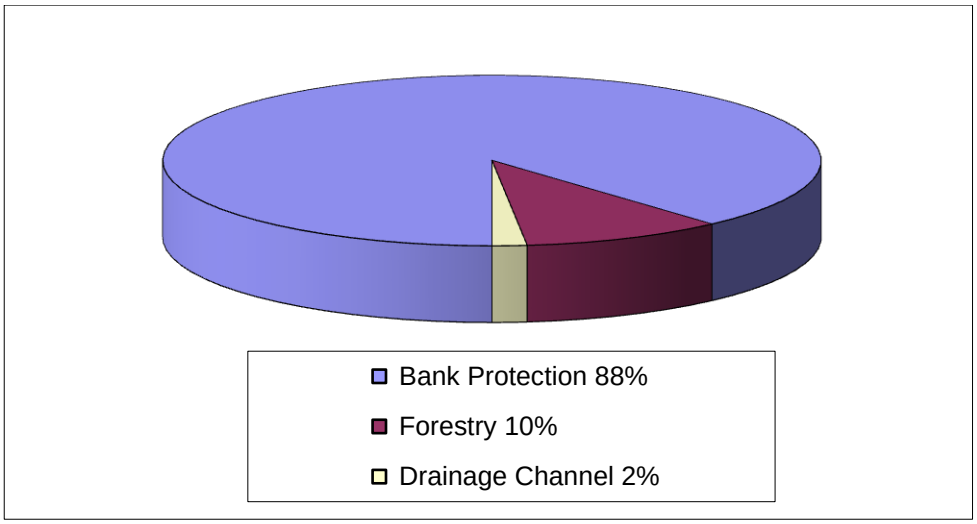


Figure 2: Pie chart showing % asset value

Figure 3 shows the distribution of assets on each river. In particular, there is significantly more tied tree work on the Pohangina and more protection planting on the Oroua.

Overall, the river assets are split 45% Pohangina and 55% Oroua. These proportions are likely to change as programmed works are progressively carried out on each river.

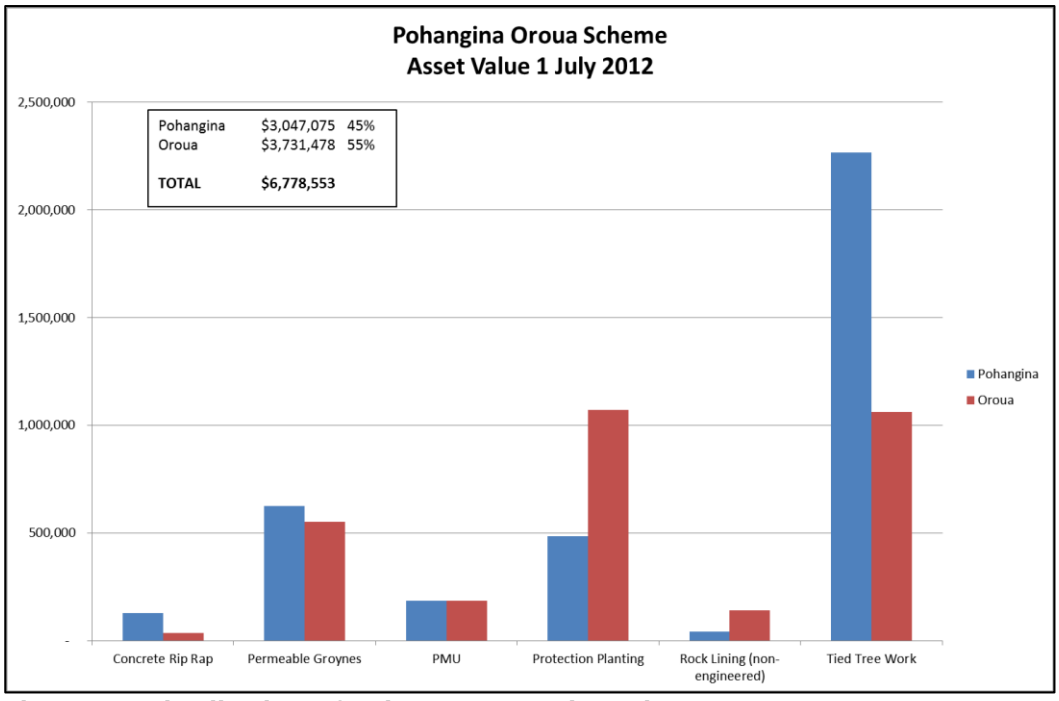


Figure 3: Distribution of scheme assets by value

2.2 The Differential Rating System

A differential rating system divides the scheme area into relative benefit categories that provide an equitable basis for the setting of rates to distribute the costs of carrying out erosion protection (both channel management and Goulter's Gully forestry) and drain maintenance works within the scheme.

The development of the rating system was carried out by John Philpott, Consulting Engineer, following the adoption of the Pohangina-Oroua Scheme Review by Council on 23 August 2001.

The Council adopted the new differential rating system on 24 June 2002 in time for striking the new rates on 1 July 2002.

Table 2 sets out the rates collected in each area category for the 2012-13 financial year.

Table 2: Scheme rating differentials and scheme rates for 2012-13

Description	Category	Relativity %	Area ha	Rates $/ha	Rates collected	% Share
POHANGINA - Below Totara Reserve						
Erosion Control – High benefit	P1	100	301	170.22	51,305	37.340
Erosion Control – Moderate benefit	P2	60	633	102.13	64,660	
Accretion Erosion Control – High benefit	P4	80	185	136.18	25,198	
Accretion Erosion Control – Moderate benefit	P5	48	35	81.70	2,901	
POHANGINA - Above Totara Reserve						
Erosion Control	P3	100	129	19.16	2,469	0.770
Accretion Erosion Control	P6	80	33	15.32	502	
OROUA - Below 13km						
Erosion Control	O1	100	398	125.10	49,820	13.160
Accretion Erosion Control	O3	80	9.5	100.08	953	
OROUA - Above 13km						
Erosion Control	O2	100	674	65.52	44,139	13.720
Accretion Erosion Control	O4	80	168	52.42	8,796	
EROSION ZONE	EZ	100	369	0.11	39	0.010
INDIRECT (excluding Ashhurst)	IN	92.79	55,404	2.26	125,323	35.000
INDIRECT ASHHURST URBAN	IA	7.21	57	170.26	9,736	
					$385,841	
GRAVITY DRAINAGE	DR	27.67				As required
			19.85	289.62	5,750	
					$391,591	

Rates for indirect benefit and contribution to the need for works make up 35% of the total rates and the remaining 65% for direct benefit is split approximately 60:40 between the Pohangina and Oroua. This split was derived from the estimated cost of scheme works over the long-term.

In addition, each river is split into two reaches to reflect the variation in works along their lengths. 98% of riparian rates on the Pohangina are below Totara Reserve and for the Oroua there is almost a 50:50 split for works above, and below, river distance 13 km, approximately 1 km above Almadale.

3. Audit Issues

3.1 Purpose of Audit

The key audit issues to be addressed are:

- Whether sound management practices are being followed? Is the operation and maintenance of the scheme following good practices that meet industry standards?
- Whether the scheme management is commensurate with the new scheme management regime, implemented from 1 July 2008?
- Whether sound gravel management policies are being followed or adjusted, to ensure erosion potential is minimized?
- Whether scheme finances are being accurately recorded and expended in accordance with the budgets?
- Whether the scheme rating is accurate and equitable? Whether the expenditure split between the two rivers broadly matches the rating income?

In order to conduct the audit, the scheme management was evaluated against several key documents:

- "Pohangina-Oroua Catchment Control Scheme: Scheme Review", Amended Report June 2006, John Philpott, Philpott Associates Ltd.
- "Pohangina-Oroua Catchment Control Scheme: Classification Report (Special Order Adopted 25 June 2002)", July 2002, John Philpott.
- "Pohangina-Oroua River Scheme Rating Map: Plan 4620/2", March 2009.
- "Pohangina-Oroua Scheme Newsletter", October 2007, Horizons Regional Council.
- "Pohangina River Totara Reserve: Assessment of Erosion Risk and Possible Mitigation Measures", 2007, Amended 2009, G & E Williams Consultants.
- "Part B Infrastructural Asset Management Plan: Pohangina Oroua Scheme", 1 July 2011, Paul Joseph and Lew Marsh, Horizons Regional Council.
- "Oroua River Gravel Resource Study", September 2012, Jon Bell, Horizons Regional Council.
- "Pohangina River Gravel Resource Study", January 2013, Jon Bell, Horizons Regional Council.

3.2 Scheme Management

Discussions with the Scheme Manager and detailed inspections of the scheme have revealed that the scheme is being managed very effectively. The findings of the detailed inspection are presented in Appendix A. River distances are shown on the photo plans (2005 imagery) in Appendix H. The summarised findings for each river are set out below.

3.2.1 Pohangina

1. Overall the channel maintenance and erosion protection scheme is in good condition.

2. In some places it is impractical and unnecessary to keep the channel within the Gary Williams design channel lines.

3. It will be important to aim for at least a 30 m buffer zone.

4. The scheme relies heavily on good channel maintenance and vegetative protection works. There are only a few groynes and permeable mesh units (PMUs).

5. In major floods substantial damage is expected, as the vegetative works cannot provide a robust defence. However, the channel maintenance and vegetative protection works, (especially those with large buffers) are markedly reducing the vulnerability to flood damage.

6. It is important for landowners on opposite banks to work together in achieving the river scheme goals.

7. There are significant areas of accretion land that have been developed as pastoral land alongside the Pohangina River and inevitably these are areas where risks of the river reclaiming the old course cannot be discounted. However, the scheme is designed to manage the river within design channels, so that risks to this land are minimised.

8. There are some beaches upstream of Raumai (13 km) where gravel extraction is recommended – as per the recommendations in the Jon Bell report.

9. There are also some beaches along the entire scheme where gravel redistribution is a very good option.

10. Gravel extraction downstream of Raumai must be retarded or embargoed as per the Jon Bell report.

3.2.2 Oroua

1. Overall the channel maintenance and erosion protection scheme is in good condition. The reach from Ridds Road to Almadale Road (7-12 km) is in particularly good condition.

2. Unlike the Pohangina River there are no design channel lines. However, generally the channel alignment and location is good.

3. It will be important to aim for at least a 20 m buffer zone.

4. The scheme relies heavily on good channel maintenance and vegetative protection works.

5. In major floods substantial damage is expected, as the vegetative works cannot provide a robust defence. However, the channel maintenance and vegetative protection works, (especially those with large buffers) are markedly reducing the vulnerability to flood damage.

6. It is important for landowners on opposite banks to work together in achieving the river scheme goals.

7. Again, there are some significant areas of accretion land that have been developed as pastoral land alongside the Oroua River and inevitably these are areas where risks of the river reclaiming the old course cannot be discounted. However, the scheme is designed to manage the river within accepted design channels, so that risks to this land are minimized.

8. There is a significant river misalignment at river distance 31.5 - 32 km and options for this reach require discussion with landowners.

9. It is important that the current planting at the base of the slip at river distance 20 km is continued to provide the best possible defence against undermining of the toe of the slip.

10. There are some beaches in the upstream reaches, particularly around the London Ford - Bartletts Ford areas where gravel extraction is recommended.

11. There are also some beaches along the entire scheme where gravel redistribution is a very good option.

12. Gravel extraction from a point at least 2 km downstream of Aorangi Railway Bridge to just downstream of Colyton Road must be suspended until riverbed levels recover.

13. Some of the permeable rail iron groynes need maintenance to ensure they provide continued riverbank protection.

3.3 New Scheme Management Plan

The need for a changed approach to the erosion protection activity arose from continued flood damage of erosion protection assets during even moderate flood events, the high cost of ongoing repairs, a history of redirection of budgets for reactive channel management activities, and the rapid depletion of scheme reserve funds.

The new Scheme Management Plan introduced 1 July 2008 was based on:

- 2007 flood damage repairs ($590,000) to be completed and funded by 50% drawdown on remaining reserves ($290,000) and loan drawdown of $400,000.

- The “current” year’s budget (2007-08) to be substantially spent on channel improvement work and edge vegetation management, in conjunction with flood damage repairs.

- Works budget in future years to be reduced from "current" levels of $243,000 to $200,000 and apportioned to channel management ($150,000), vegetation buffer establishment ($20,000), erosion protection maintenance ($25,000) and drain maintenance ($5,000).

- Only 25% of erosion protection, including flood damage reinstatement to be funded by the scheme. Riparian landowners requesting that work be done would be responsible for 75% of the costs (subsequently modified to 60% in 2009).

- Flood damage reinstatement projected to be necessary every four years, with repair cost of $400,000, and a scheme funding requirement of $100,000 (25%). Riparian landowners requesting that work be done would be responsible for 75% of the costs (subsequently modified to 60% in 2009).

3.4 Funding of Erosion Control Works

3.4.1 New Landowner Contributions

The new scheme management regime, implemented from 1 July 2008, focuses scheme activity on channel management works, with the objective of developing and maintaining a sustainable channel alignment. To facilitate this, and to ensure that allocated budgets are not redirected following flood events, alternative funding arrangements have been applied to repair river bank erosion protection works.

Key features of the new regime were:

- The costs of all erosion protection works to be funded 25% by the scheme and 75% by the landowner requesting the works.

- Landowners able to either undertake their own repair works or arrange their own contractors, and subject to compliance with a number of terms and conditions, would qualify for the 25% funding assistance.

- The Scheme Manager to supervise the works and assist with the provision of materials.

- All completed works to become scheme assets.

Subsequently, in May 2009 the Liaison Committee advocated, through a submission to the 2009-19 Long-term Plan (LTP), for general rates to be applied to the landowner share of works costs. The submission was successful, and from 1 July 2009 the cost of erosion protection works has been met by property owners (60%), scheme rates (20%) and general rate (20%).

3.4.2 Issues with New Funding Process

There is a well documented process for the pre-approval and management of the landowner funded erosion protection works, as set out in Appendix B.

This process has generally worked well, with $367,568 of contributions from 36 different landowners (15 Pohangina, 21 Oroua) in the four year period 2008-12.

Improvements have been made to improve consistency and reduce the amount of paperwork involved with landowner invoices and claims. All works are now carried out by the scheme, with landowners invoiced directly for their 60% share.

Other issues regarding the new funding regime are set out in section 3.7, “Audit of Rating System”.

3.5 Implementation of New Scheme Management Plan

The findings of this audit are that the scheme is indeed being managed in accordance with the new scheme management regime. The distribution of works has shifted to mainly focussing on channel management and indeed the channel is generally in good condition.

In reaching these findings the following points are noted:

1. There are a few locations on both rivers where the rivers are very narrow and this may cause gravel to settle upstream of the constriction to levels above optimum. This is likely to result in erosion to adjacent riverbanks. These locations should be identified and programmed in for further channel clearance works.

2. Gravel extraction on the lower reaches of both rivers should be suspended until riverbed levels improve.

3. The Pohangina-Oroua scheme relies heavily on tied tree works and buffer planting for protection. Repairs to 2004 flood damage severely depleted stands of willow trees adjacent to the river as well as planted buffer zones, to the point that willows had to be carted in by road from surrounding farms to complete flood damage works. Since that time over 100,000 willow poles have been planted (of which 70,000 within the last 5 years) to great success, giving a good standard of protection and providing materials for any future damage that may be incurred.

4. There are areas that do require more planting and some of these are identified in Section 4 “The Management of Difficult Areas” and the appended river inspection notes. There are also several areas mainly on the Oroua River, where landowners have fenced too close to the edge of the river. These landowners are being constantly encouraged to move fences back and allow more room for planting.

5. Expenditure on vegetation buffer establishment was increased from $20,000 to an average of some $40,000 for the last three years and should be increased further to $50,000 per annum, as requested by the Scheme Liaison Committee, and consistent with the average for the last four years. A good buffer zone goes hand-in-hand with the focus on channel management.

6. Expenditure on required channel maintenance was an average of $30,000 less than the $150,000 planned. This allowed the greater expenditure on vegetation buffer establishment.

7. Inevitably, there will be occasions where a misalignment may develop and riverbank armouring, groynes and/or channel realignments may be required, such is the aggressive nature of both rivers. However, expenditure on erosion protection works has been keeping well to budget if a long-term view is taken (i.e. $400k over four years). The average of $130,000 over the last five years is weighted by significant flood repair works in 2010-12.

8. Since changing to the new management regime, the scheme has responded well to floods with generally little damage. This being despite prolonged flooding in September-October 2010. The peak flows experienced in these floods were a 6 year return period flood (233 cumecs) for the Oroua at the Almadale site, increasing to around 10 years (341+ cumecs) at the Kopane Bridge location. The Pohangina experienced a 1.5 year flood (351 cumecs) at Mais Reach. However, the key feature was the multiple flood events experienced during this period, representing a 10 year or greater "combined event". The ratepayers' had to contribute an additional amount for flood damage, but it was not large.

3.6 Goulter's Gully Forestry

Options for managing the forest were considered in 2009 and it was agreed that the best return would be from a pruned log regime. This would yield an estimated net return of some $630,000 when harvested in 2029 or 2030.

One final thin is left to be carried out to complete the silvicultural programme. This second thinning has a budget of $19,800 and will be completed in the 2013-14 financial year.

Some contingency should be made for gully protection work in the future as the older gully plantings of poplar and willow might need replacing, and heavy rain events could still impact on the main gully system.

3.7 Audit of Rating System

By analysing the rates collected from riparian ratepayers, it can be determined that the ratio of rates collected from the Pohangina ratepayers to the rates from the Oroua ratepayers is approximately 60 to 40.

These proportions were derived from the proposed 10 year expenditure programme when the rating system was developed in 2002.

Actual long-term expenditure should ideally align with these proportions.

The audit has been hampered by a lack of an appropriate system to monitor and report on scheme expenditure in relation to the expenditure in each river, and on the implementation of the Scheme Review recommendations. Considerable time and effort has been required to collate the relevant data,

and while the results are believed to be sufficiently accurate for these audit purposes, they are not necessarily definitive due to the difficulties involved.

The improved recording of works completed, and associated cost information, would better facilitate future audit processes.

3.7.1 Rating Levels

Flood damage in 2004, 2006 and 2010 severely impacted on the scheme, depleting reserves, requiring scheme loans, and individual landowner contributions for erosion control works on their property.

A review in 2006 set out a revised programme of works that were in line with the 60 to 40 split, but subsequent floods have required greater expenditure on the Oroua and the average split over the last five years since the review has been 50:50.

This short-term variability is not unexpected given past experience. Historically there has been greater flood damage in the Oroua and this was recognised during development of the rating system by allocating 60% of the flood reserve contributions (a proxy for long-term flood costs) to the Oroua (compared with some 40% for normal maintenance).

While the catastrophic 2004 flood damage was fully funded externally, which shielded the scheme from the devastating impact of this event, the destabilised channels and the time required for tied tree works and protection planting repairs to become fully established, meant further damage, that had to be addressed by the scheme, was inevitable in the following years.

Annual rates increased 10% after the 2004 floods and 30% over the three years from 2007 to 2010, with a further 18% increase in 2011-12.

In the absence of large floods in the last few years, the scheme is now returning to more normal maintenance conditions and costs are tending to the expected long-term 60% to 40% split. A preliminary estimate for river works in 2012-13 is 69% and 31% (64% to 36% excluding the landowner share).

The net effect of the increases is that, after adjusting for inflation, the rates are now 40% higher than in 2002. In actual dollar terms, the current 2012-13 rates of $340,514 are 92% higher than the $177,473 in 2002-03, excluding GST. Note that GST changed from 12.5% to 15% in 2011-12, so the increase is actually 96% including GST.

It is noted that the changed scheme management philosophy, adopted in July 2008 following wide consultation with ratepayers, required a rate increase of 45% over three years in order to achieve a funding level that would sustain the envisaged level of service on an ongoing basis. In fact the increase was spread over a slightly longer period with rates increasing by 50% over the four year period 2008-12.

To be fair, and equitable, this increase needs to be consistent with the expenditure on each river reach, to match the proportions set in the rating system.

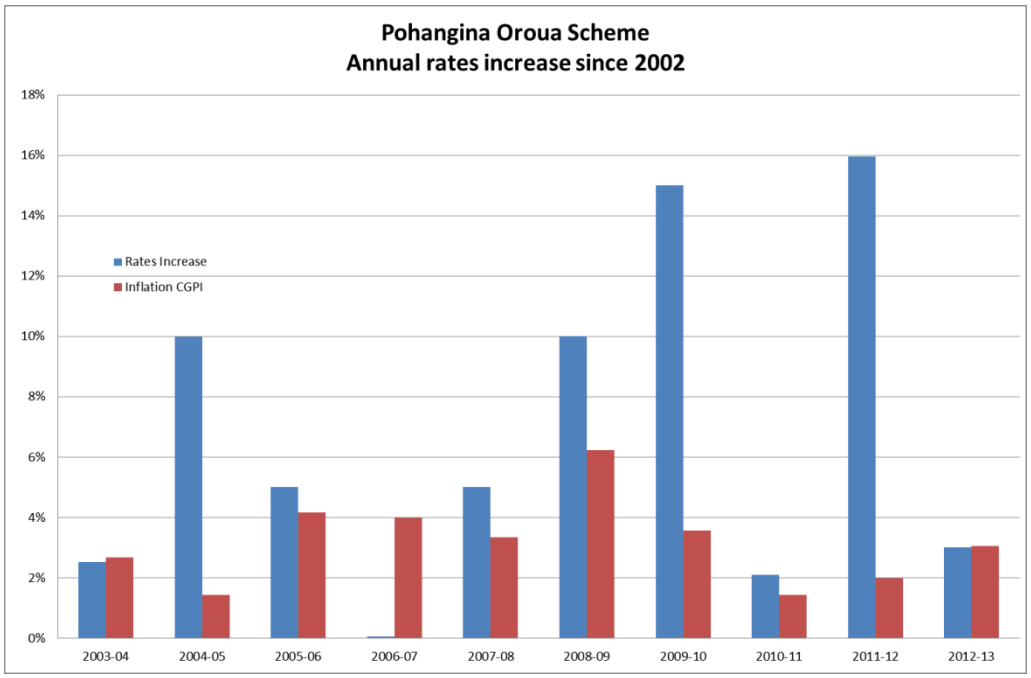


Figure 4: % Increase in annual rates since 2002

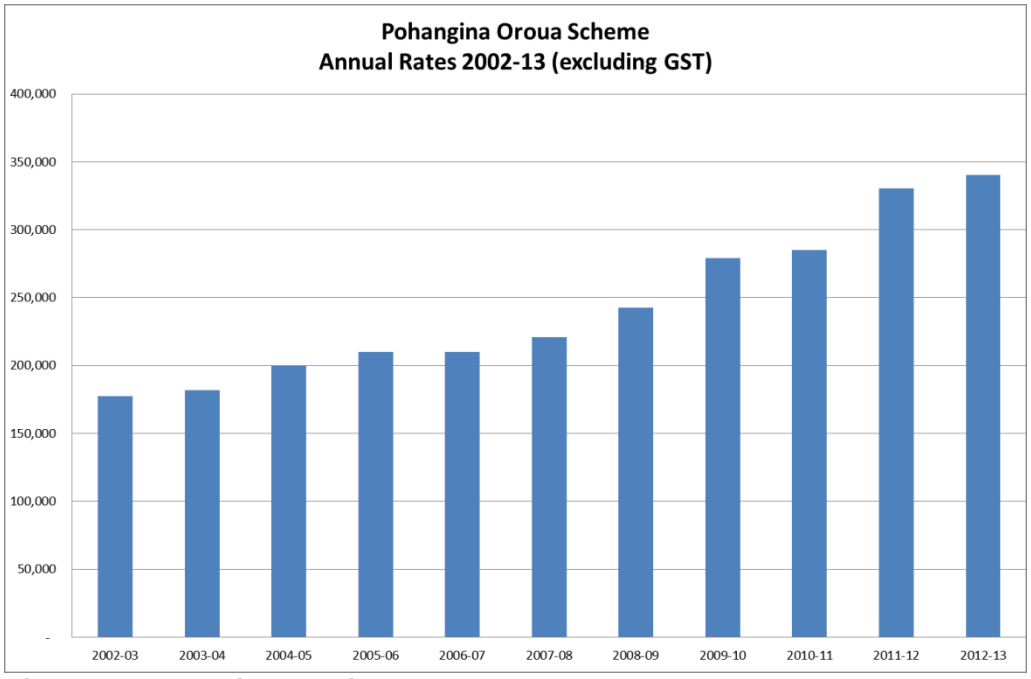


Figure 5: Annual rates since 2002

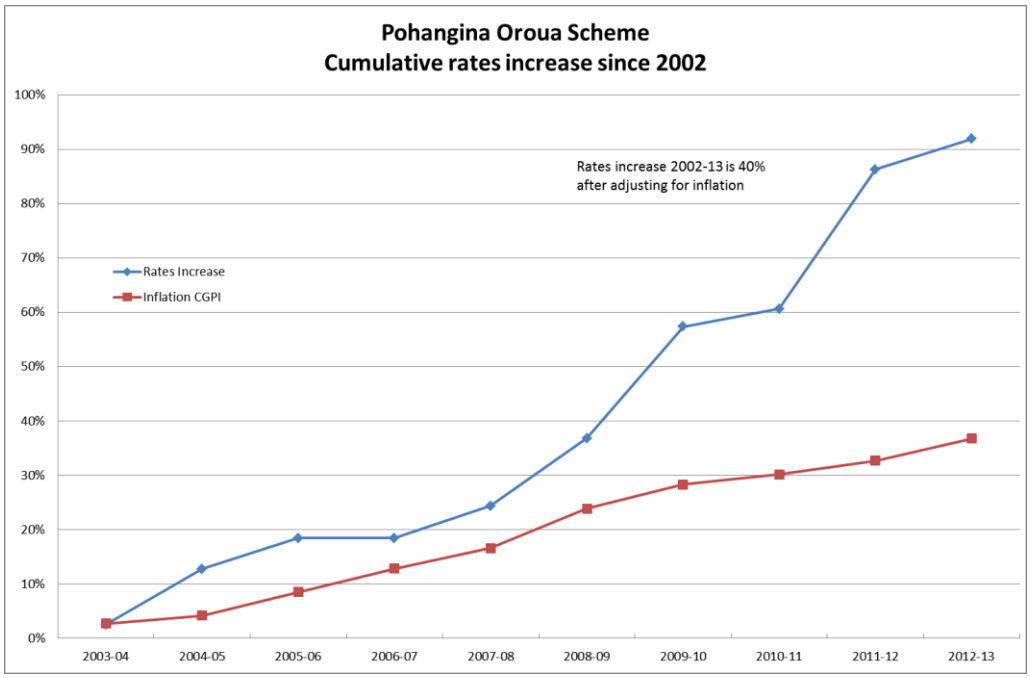


Figure 6: Cumulative rates increase since 2002

An analysis of the expenditure on river works since 2002 has been carried out, including landowner contributions, to compare with the proportions in the rating system. Charts showing the expenditure on each river are set out below.

As mentioned above, the overall trend in recent years is now in line with the 60 to 40 rating proportions.

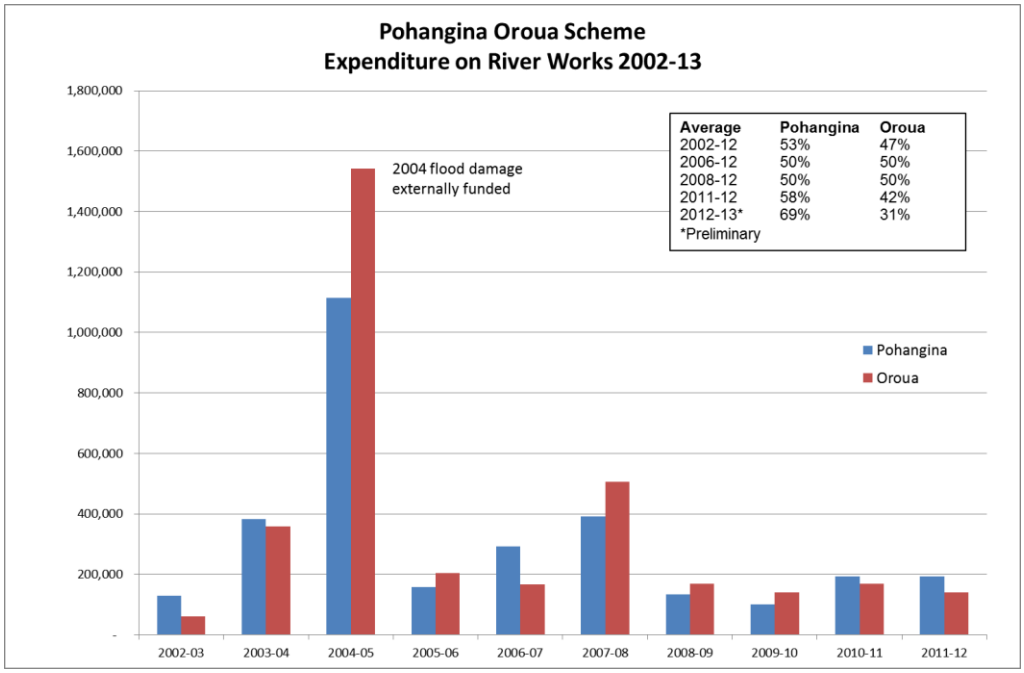


Figure 7: Expenditure on river works since 2002

Note that the river works expenditure includes landowner contributions for erosion control works for 2008-12.

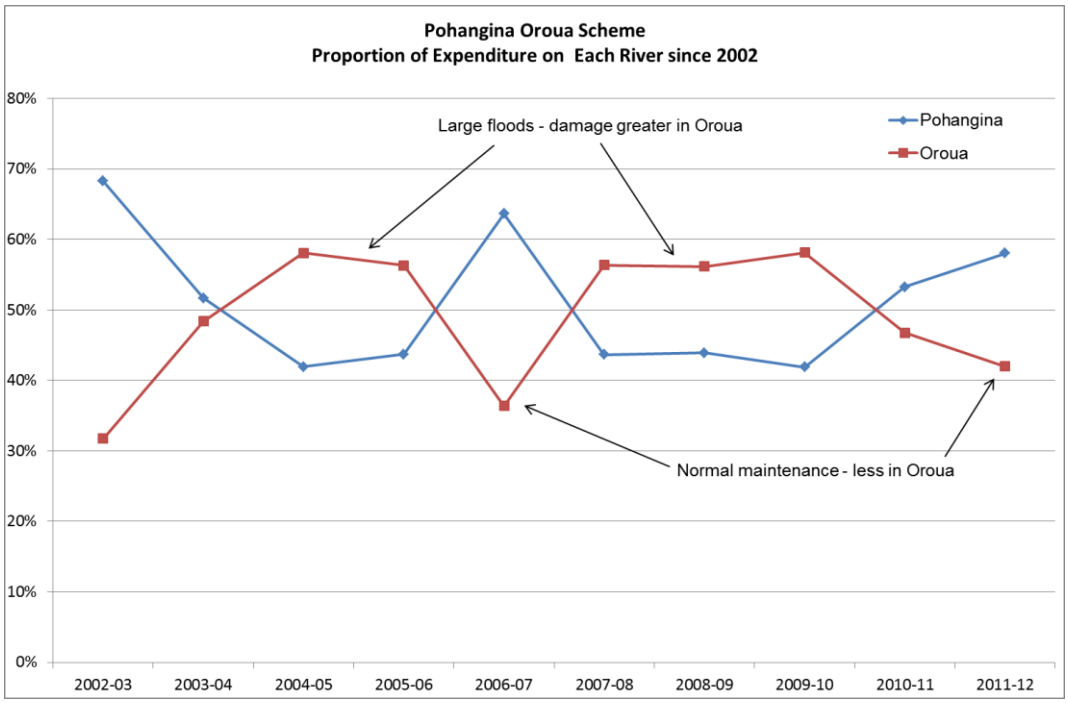


Figure 8: Proportion of expenditure on each river since 2002

Coincidentally, the trend to 60:40 is virtually identical if the landowner contributions are deducted. This is because the proportion of erosion control work on each river since 2008 has been similar to the total work, although slightly more on the Oroua.

Table 3: Proportion of works costs (excluding landowner contributions)

	2008-09	2009-10	2010-11	2011-12	Average
Pohangina	42%	45%	58%	61%	**52%**
Oroua	58%	55%	42%	39%	**48%**

In the last four years (2008-12), these landowner contributions have amounted to some $367,000 or 32% of the total river work costs (34% of the Oroua costs, 29% of the Pohangina). Average expenditure on erosion control works has been about $146,000, although this has varied widely and, as the table below shows, was substantially more than the $100,000 annual budget in 2010-11 and 2011-12.

However, the expenditure is quite consistent with the longer view budget of $400,000 over four years, if allowance is made for the significant flood damage repairs in 2010-12. Indeed, given the limited experience on what landowner demands might be, this budget provision has been remarkably accurate.

Nevertheless, there would need to be much less flood damage over the next four years to keep within this budget, but already preliminary figures for 2012-13 indicate expenditure of less than $90,000 and this downwards trend is expected to continue as the channel stabilises, so long as there are no major floods.

Table 4: Erosion control works (including landowner contributions)

River Works	2008-09	2009-10	2010-11	2011-12	Total 2008-12	% Total
Pohangina	**48,882**	**25,549**	**102,144**	**92,876**	**269,451**	**46%**
Above Totara		-	3,211		3,211	1%
Below Totara	48,882	25,549	98,933	92,876	266,239	99%
Oroua	**54,741**	**56,096**	**122,492**	**83,928**	**317,257**	**54%**
Above 13 km	54,741	56,096	69,048	79,636	259,521	82%
Below 13 km			53,443	4,293	57,736	18%
TOTAL	**103,622**	**81,645**	**224,636**	**176,804**	**586,707**	

Ideally, any under expenditure in future years would result in surplus funds being added to the scheme reserves and used for future erosion control works as required.

However, if past expenditure of $586,000 in the last four years is quite realistic, then experience suggests that the budget should be increased to $150,000 per annum ($600,000 in four years).

A summary and full schedule of landowner contributions to erosion control works since the implementation of the new funding arrangement in July 2008 is presented in Appendix C.

The following graphs show the irregular distribution of these works along each river, which supports the targeting of landowner contributions for the direct benefit to their properties.

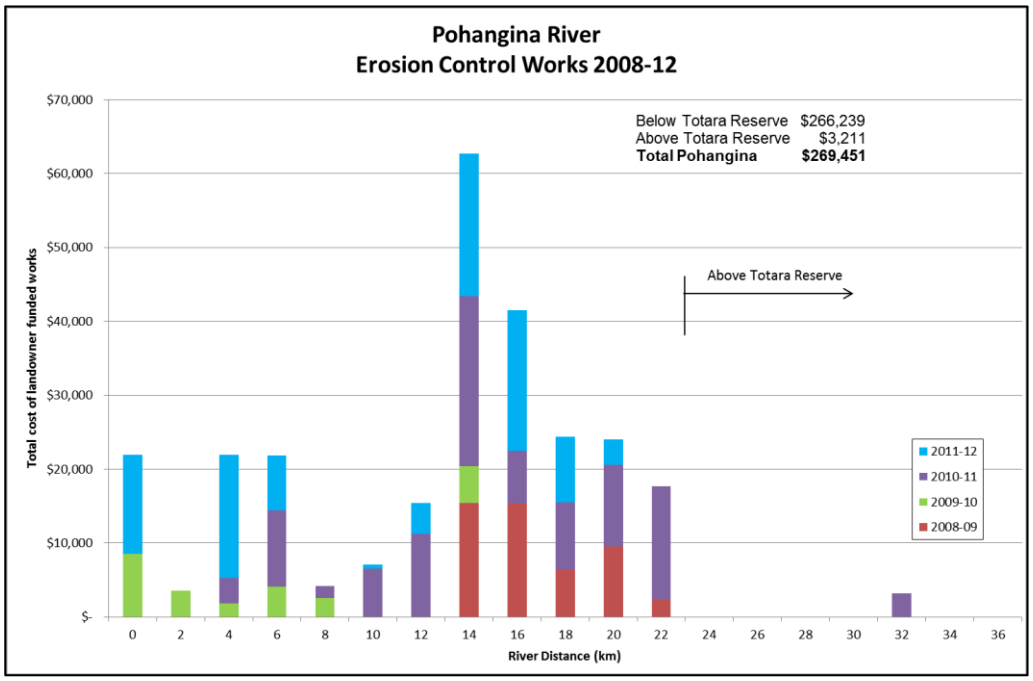


Figure 9: Pohangina River erosion control works 2008-12

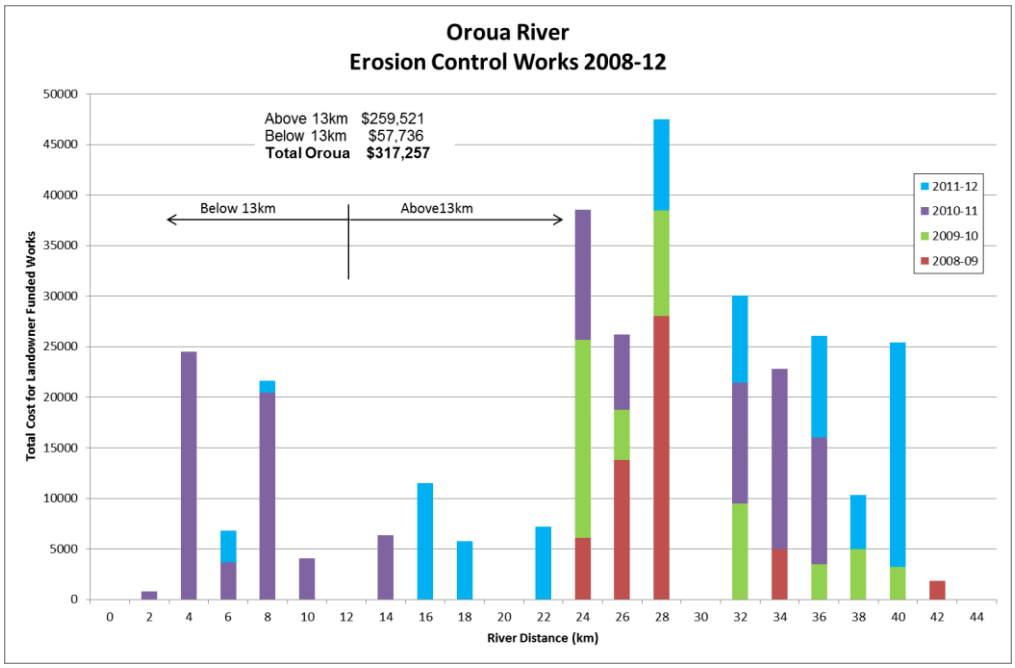


Figure 10: Oroua River erosion control works 2008-12

If the current budget of $100k for erosion control works was not covered by $60k landowner contributions, then scheme rates would have been 18-31% higher over the last few years, as set out in the table below.

Table 5: Rates required if erosion control work fully scheme funded

	2008-09	2009-10	2010-11	2011-12	2012-13
Scheme Rates	242,794	279,220	285,093	330,578	340,514
Add ECW	75,000	60,000	60,000	60,000	60,000
New rates	317,794	339,220	345,093	390,578	400,514
Increase	**31%**	**21%**	**21%**	**18%**	**18%**

1. Rates exclude GST.

Ratepayers have understandably sought measures to mitigate excessive increases, particularly as the erosion control works largely benefit the individual landowners contributing.

While this is a pragmatic approach in the short term to overcome the current financial pressure arising from high flood damage repairs, it does have some inherent risks and detracts from the general scheme concept.

For that reason, scheme members may wish to review the landowner contributions facility at some time in the future.

In particular, the following difficulties are noted:

- Lack of affordability – landowner reluctance can result in more damage to properties downstream, undermining a scheme approach to river management.

- Lack of risk spread – if new works are damaged before fully established then costs for reconstruction fall on the landowner rather than spread over the scheme.

- Loss of long-term equity – those who benefited from scheme funding of extensive works post-2004 flood should, ideally, be contributing to others in need now.

- Loss of rating equity – 35% of the landowner contributions would otherwise be funded by the indirect benefit rate.

- Management issues – reluctant landowners, pressure for cost-savings, more time consuming, administration more complex, overlap of "erosion control" with "channel maintenance" (e.g. layering and local erosion repairs) causing inconsistency, minor works done without landowner contributions.

Meanwhile, it should be noted that the development of the 2002 rating system included light erosion control works (live tree protection and layering) as an integral part of the scheme, to be funded by the ratepayers who would mutually benefit from the works.

However, the substantially greater costs facing the scheme in recent years certainly justified a review of that approach and the current 60% contributions from landowners is fair under the circumstances, especially given both the local and wider benefits of such works.

Despite some initial reluctance, which was largely addressed by reducing the landowner contributions from 75% to 60% in 2009, there are currently only two sites where landowners are reluctant to fund the works recommended by staff.

So although there are difficulties with the new management regime, it appears to be working effectively - only time will tell if it is a sustainable approach in the long-term.

3.7.2 Oroua Rating Reaches

While the overall proportions for works expenditure are coming in line with the 60:40 rating levels, there is wide divergence in the two Oroua rating reaches above and below 13 km.

The rating system recognises that the river changes character above 13 km (approximately 1 km above Armadale) and less work would be required there on a per kilometer basis.

Coincidentally, the estimated long-term expenditure for the 30 km up to Apiti Bridge was about the same as that for the 11.5 km below 13 km, so the two reaches effectively split the Oroua works in half for rating purposes.

Actual expenditure should ideally match the rating level, but in the last four years the proportion above 13 km has averaged 86%, significantly more than the 51% rating level.

Analysis shows that the proportion is virtually the same for total river costs (i.e. including works covered by landowner contributions for erosion control) and also for channel maintenance work only. The trend is not mitigated by works in the current year or planned for next year.

Table 6: Oroua River work costs (excluding landowner contributions)

Oroua	2008-09	2009-10	2010-11	2011-12	Average 2008-12	Target Rating
Above 13 km	91%	91%	71%	92%	**86%**	51%
Below 13 km	9%	9%	29%	8%	**14%**	49%

Even in the longer term, since 2002, the average has been 68% instead of the target 51%. If the 2004 flood is removed and only the last six year period since the 2006 review are considered then the average is 80%.

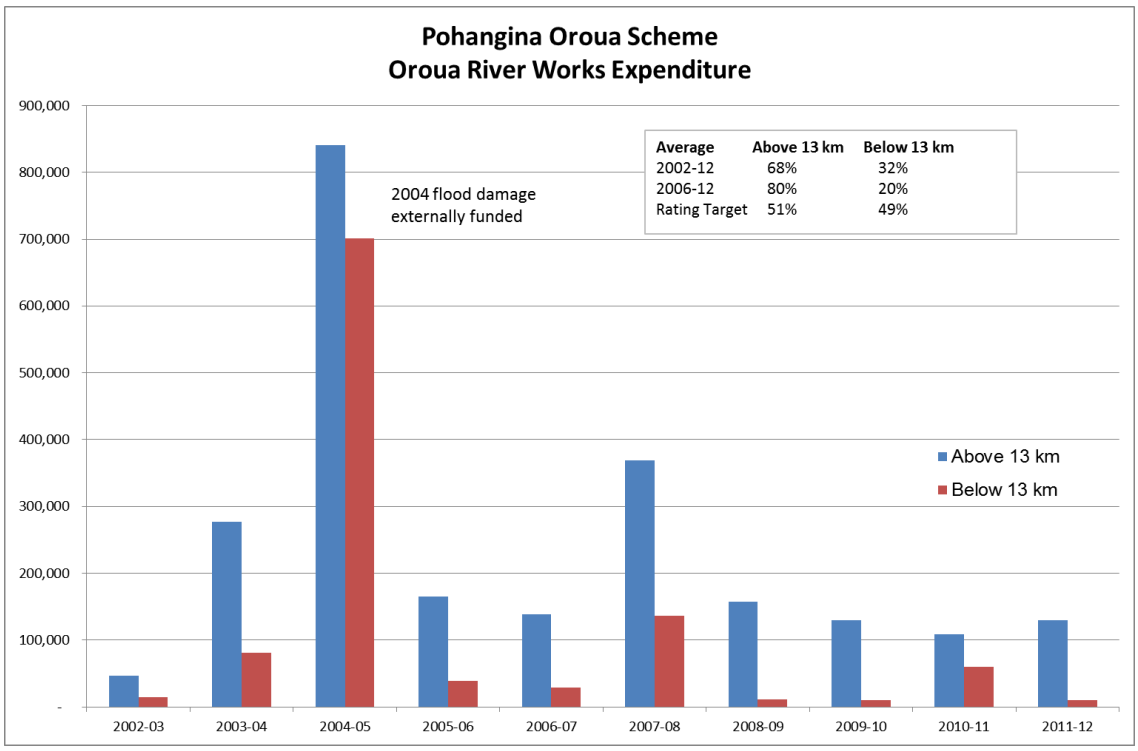


Figure 11: Oroua River works expenditure 2002-12

This analysis suggests that the Oroua rating levels are significantly out of line with expenditure and the rates calculation should be amended, for example by using the last six years proportion of 80% above 13 km.

An alternative would be to combine the rating areas as a single reach, which would be the same as having 67% above 13 km. This is similar to the long-term average of 68% since 2002.

Another alternative would be based on length – 11.5 km below 13 km, 30 km above 13 km – which would have 72% above 13 km. This would be similar to the long-term average and has a simple pragmatic basis. It is not as high as the 80%, but recognises the benefit of works above 13 km on the channel downstream. Less bank erosion means less gravel transport, reduced build up on beaches and a more stable alignment; also less debris blocking the channel.

This latter option is therefore recommended and is set out in the table below as Option C.

The impact on rates would be to increase rates for properties above 13 km by 41% and decrease the rates for properties below 13 km by 43%.

Table 7: Oroua rating options

Oroua Rating Options - 2012-13 rates inc GST			Below 13 km	Above 13 km
Description	% Below 13 km	% Above 13 km	O1	O2
			$ / ha	$ / ha
Current	49	51	125.10	65.52
Option A	Combine		85.44	85.44
Option B	20	80	51.11	102.69
Option C	28	72	71.55	92.42
Option D	33	67	85.18	85.58
Option B % increase			-59%	57%
Option C % increase			-43%	41%
Option A/D % increase			-32%	30%

Option A Combines benefit categories, single reach approach.

Option B Proportions to suit expenditure, 20% below 13 km, 80% above.

Option C Proportions to suit length, 28% below 13 km, 72% above.

Option D Proportions required to match single reach approach (Option A), 33% below, 67% above.

It is therefore recommended that the 26.88% allocation to the Oroua rating categories in the rating calculation be changed as set out below.

Table 8: Proposed change to rating calculation – Oroua %

Description	Length	Current % Total rates	Current % Oroua Rates	Proposed % Total Rates	Proposed % Oroua Rates
Above 13 km	30 km	13.72%	51%	19.35%	72%
Below 13 km	11.5 km	13.16%	49%	7.53%	28%
Total	**41.5 km**	**26.88%**		**26.88%**	

3.7.3 Pohangina Rating Reaches

Contrary to the Oroua situation, the proportion of total works expenditure on the two Pohangina reaches above and below Totara Reserve closely align with the rating proportions of 2% and 98% respectively.

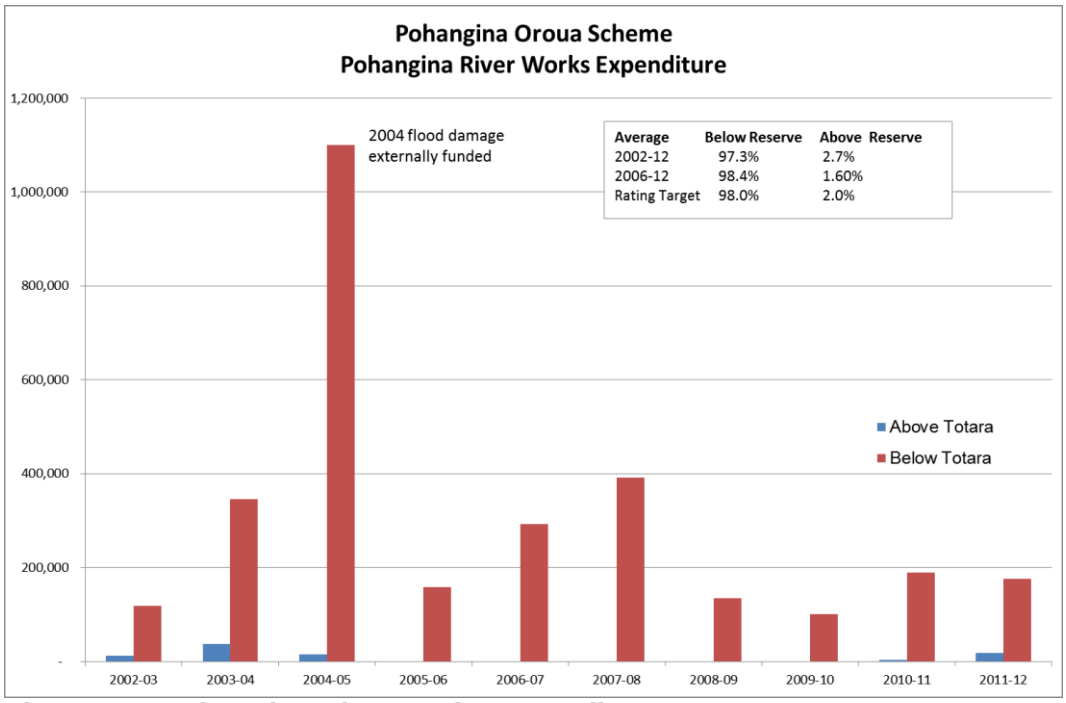


Figure 12: Pohangina River works expenditure 2002-12

Since 2002, the proportion below Totara Reserve has been 97.3%, which is also consistent with the average since 2008.

Table 9: Pohangina River works 2008-12

River Works	2008-09	2009-10	2010-11	2011-12	Average 2008-12	Target Rating
Above Totara	0%	0%	2%	9%	3%	**2%**
Below Totara	100%	100%	98%	91%	97%	**98%**

When the landowner contributions are deducted, or only channel maintenance is considered, then the proportion above Totara Reserve increases to 4-5%, but as no works were carried out above Totara Reserve in the preceding two years, then the long-term proportion will be closer to the target 2%.

No change is therefore required to the proportions of rates on the Pohangina.

3.7.4 Drainage Rates

The scheme currently maintains six drains with a total length of 5,670 m. This is 1400 m less than in 2002 due to the removal of Drain K from the scheme after a request from ratepayers in 2009. It is now a private drain, along with the six others removed from the scheme in 2002 on the request of landowners. The DR areas for Drain K properties were deleted from the rating database to suit.

DR rates are calculated directly from the annual scheme budget for drain maintenance, which was $4,000 for many years but is now $5,000.

Current drainage rates (DR) vary between $66 and $860 for the 14 individual ratepayers, with an average of about $400.

DR rates are calculated separate from the river rates, with the intention of recovering the full cost of maintaining the scheme drains from the landowners who receive direct benefit. The rates have been simply apportioned based on historic costs per unit length, which varied for each drain when the rating system was developed in 2002.

For future works a preliminary long-term maintenance plan based on two sprays per year and a machine clean every four years has now been prepared by scheme staff for consultation with landowners (see Appendix D). The average annual works cost is $4250, instead of the current $5,000. This reduction is more in line with the costs associated with the removal of Drain K and the drain rates should be amended to suit.

If this uniform maintenance regime is adopted then the costs per metre would be the same for each drain. This would allow simple rating plans to be drawn up based on a nominal 25 m strip of land along each drain, with say a 25% reduction in width for Drain B and Drain C where they receive water from the Ashhurst stormwater system. This would help future administration of the rating system when sub-divisions or other property boundary changes occur.

In the meantime, the rating administrator has been advised of the current area-based methodology to properly make any future changes and a number of errors identified in the current DR rated areas have now been corrected.

Tributary Streams

Minor works have been carried out by the scheme on the Tokeawa Stream and Te Awaoteatua Stream north of Raumai on the Pohangina River. Less than $2,000 has been spent on channel clearing since 2006.

No specific provision was made in the rating system for these streams.

The amounts involved for periodic channel maintenance are small and it would be reasonable to include them as integral to the local flood plain management. For example, removing blockages would help prevent overflows onto adjacent riparian rating areas.

For consistency any erosion control works should also be funded with landowner contributions.

Minor stopbanking has been built up along the streams and also serves to protect against overflows. These informal banks are not included as scheme assets and are probably constructed of gravel that would be prone to washouts.

3.7.5 Changes in Rating Levels

Over the years, the proportion of rates from each category has been calculated according to the rating system adopted in 2002 but the proportion of rates between categories has changed due to corrections to the rateable areas involved (see next section).

If the original areas were still being applied then all the rates, (except DR, which is rated as required) would have increased 92% in accordance with the

total rates increase. Instead the riparian rates have increased 110-131% on the Pohangina and 100-127% on the Oroua.

When related to the total rates the increases are 119-142% for the Pohangina and 108-137% for the Oroua, as shown in the following table.

By way of comparison, when related to the Pohangina P1 rates, the increase above Totara Reserve is 119% and 90-115% for the Oroua.

Most of the increase on the O1 and O3 categories is due to the removal in 2003 of the areas inadvertently included in the 1.5 km downstream of Reid Line to the Kiwitea confluence (see next section). This reach is included in the Lower Manawatu Scheme (LMS).

Table 10: Increase in scheme rates since 2002

Description	Code	Rates 2012-13 $/ha	% of Total increase	% of P1 increase
Pohangina Erosion Control				
Bridge-Reserve High	P1	170.219	119%	100%
Bridge-Reserve Moderate	P2	102.132	119%	100%
Pohangina Accretion Erosion Control				
Bridge-Reserve High	P4	136.175	119%	100%
Bridge-Reserve Moderate	P5	81.705	119%	100%
Reserve - Upstream				
Erosion Control	P3	19.157	142%	119%
Accretion Erosion Control	P6	15.325	142%	119%
Oroua Erosion Control				
Confluence – 13 km				
Erosion Control	O1	125.102	137%	115%
Accretion Erosion Control	O3	100.082	137%	115%
13 km - Bridge				
Erosion Control	O2	65.52	108%	90%
Accretion Erosion Control	O4	52.416	108%	90%
INDIRECT				
INDIRECT NON ASHHURST	IN	2.262	104%	87%
INDIRECT ASHHURST URBAN	IA	9736.08	100%	84%
GRAVITY DRAINAGE	DR	289.618	170%	143%
	TOTAL	**$391,591**	100%	84%

3.7.6 Rating Areas

The original rating areas as measured in 2002, were used for setting the rates from 1 July 2002 until 1 July 2008 when a project was undertaken to improve the quality of rating areas across the Region.

As a separate issue, in November 2003 it was discovered that the rating areas covering the 1.5 km downstream of Reids Line to the Kiwitea Stream confluence were included in error and needed to be deleted to remove overlap

with the LMS. Only four landowners were affected and they were refunded their rates and taken out of the Pohangina Oroua Scheme.

No change was deemed necessary to the proportion of rates above and below 13 km because the costings used for developing the rating system did not include this length below Reid Line; these had always been LMS costs.

In addition, although the change reduced the areas of O1 and O3 below 13 km by about 15%, there was no immediate change to the areas included in the rating calculations pending a regional update of property data that eventually occurred in 2008. Ratepayers in the O1 and O3 categories therefore benefited somewhat from rates that were 15% less (about $10 per hectare) than they should have been for a few years until the revised O1 and O3 areas were duly incorporated in the calculations with updated data for 2008-09.

Other amendments were required to correct a number of other relatively minor data errors in 2009-10 and 2010-11. Since then the areas have been properly maintained in accordance with the robust administrative processes developed as part of the Rating Project.

The corrections and adjustments made to the rating areas over the years have resulted in significant changes to the rates in each category – the proportions in the rating calculations have not changed, only the areas.

If the areas change, then the rates per hectare will necessarily change to retain the overall proportions between each river and within each reach.

The net result is that virtually all categories have reduced in area and most ratepayers are paying proportionally higher rates than they were originally in the period 2002-08 (see Table 10 in the previous section).

Only P1 and P6 areas have increased (by 7% and 14% respectively), all the rest have decreased up to 35% as set out in Table 11 below.

Those increases are likely to be due to the addition of surveyed accretion land or minor revision of the accretion areas above Totara Reserve.

The decreases are typically associated with changed land use and revision to the rateability of all or part of a property, for example where it has been set aside as QEII Trust conservation land.

Ongoing changes can be expected in future as property data is updated, but based on past experience they would generally be minor and unlikely to have a material impact on the level of rating.

Table 11: Change in rating areas since 2002

Description	Category	ORIGINAL	CURRENT	% Increase
		Area	Area	
		2002-03	2012-13	
POHANGINA - Below Totara Reserve				
Erosion Control – High benefit	P1	282.6	301.4	7%
Erosion Control – Moderate benefit	P2	656.3	633.1	-4%
Accretion Erosion Control – High benefit	P4	277.8	185.0	-33%
Accretion Erosion Control – Moderate benefit	P5	55.0	35.5	-35%
POHANGINA - Above Totara Reserve				
Erosion Control	P3	161.6	128.9	-20%
Accretion Erosion Control	P6	29.3	32.8	12%
OROUA - Below 13km				
Erosion Control	O1	469.3	398.2	-15%
Accretion Erosion Control	O3	11.0	9.5	-14%
OROUA - Above 13km				
Erosion Control	O2	686.0	673.7	-2%
Accretion Erosion Control	O4	191.2	167.8	-12%
EROSION ZONE	EZ	439.0	369.4	-16%
INDIRECT (excluding Ashhurst)	IN	56529.6	55403.7	-2%
INDIRECT ASHHURST URBAN	IA	60.3	57.2	-5%
GRAVITY DRAINAGE	DR	27.7	19.9	-5%

In addition, minor changes were anticipated in 2002 to allow for new riparian planted areas to be shifted into the EZ (non-rated erosion zone) category. However, the recommendation to put a plan in place to ensure periodic adjustments has not been implemented. To date, there has been no request for any adjustment as there has not been any significant encroachment by plantings. The plan in future should simply be to act on ratepayer or staff requests when significant plantings occur.

During this audit, a number of errors and anomalies have been identified. Some of these are due to difficulty in allocating the drainage benefit areas when sub-division has occurred. A small number of Crown properties excluded from the accretion categories should be reinstated as they are actually rateable. These have been passed on to the rating administrator for action.

3.7.7 Indirect Benefit Areas

The rural areas and Ashhurst urban area are rated for indirect benefit which incorporates a contribution to the need for works. The rural rate (IN) and indirect benefit (IA) categories together account for 35% of the total rates required, 30% for indirect benefit and 5% for contribution to the need for works arising from change in land use from the original forest.

All rateable land in each river catchment is included in the IN rural category.

Coincidentally, the relative IN area in the Pohangina and Oroua catchments is virtually the same as the overall 60 to 40 split of scheme works and direct benefit rates. Effectively each river is independent in terms of its rating.

The approximate areas in each catchment (including roads and rivers) are:

Pohangina	35,070 ha	62%
Oroua	21,140 ha	38%
Total	**56,210 ha**	

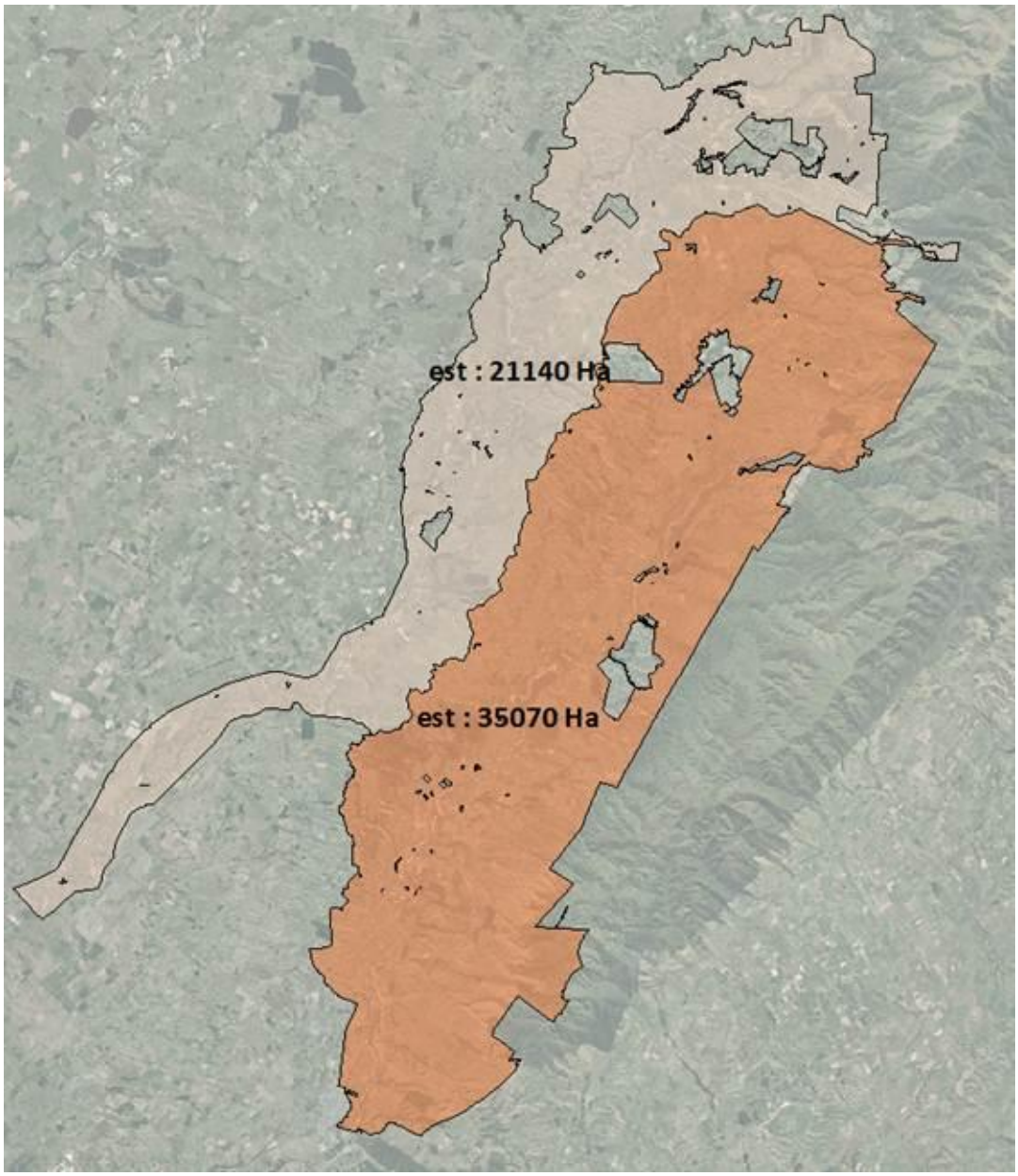


Figure 13: Indirect benefit areas in Pohangina and Oroua catchments

3.7.8 Ashhurst Rating

The Ashhurst IA currently amounts to $9,736 (including GST). This area-based urban rate is calculated as 7.21% of the total indirect benefit/contributor rates, with the remaining 92.79% covered by the rural IN rate ($125,323). Together they make up 35% of the total scheme rates.

Before the new rating system was introduced in 2002 the Ashhurst rates (IA) were set at approximately 4% of the scheme rates and invoiced to the local authority for payment each year. The amount involved was relatively small and it is likely that it was simply included in the overall district rates rather than targeted to residents in Ashhurst Township.

With the introduction of the new rating system in 2002, the proportion of rates dropped to 2.5% and this was invoiced directly to Palmerston North City Council (PNCC). In 2006-07 this practice was replaced by individual properties being rated directly by the Regional Council.

Only those properties east of the main street were rated because they were in the Ashhurst area shown in the rating plans, the area of catchment contributing stormwater to the Pohangina.

However, this area was simply used to determine the appropriate rating level for Ashhurst, not the distribution over the township. It was clearly intended that the Ashhurst rate would be applied over the whole township, as indicated by the bulk rates invoice to PNCC each year.

Indirect benefit is obviously not limited to half the township and any catchment based contribution to the need for drainage works due to urban stormwater runoff is relatively small.

In any case there have been major stormwater upgrades in recent years to divert runoff away from the Ashhurst Stream and into the Pohangina River, so the scheme area should be extended to cover most of the urban area, as indicated in red in the image below (the current IA rated area is blue).

Some rationalisation is clearly necessary and it is recommended that the whole township be rated IA based on capital value with the urban area defined the same as that for the Ashhurst Stream Scheme (see plan in Appendix G).

This would re-establish the original scope and intent of the rating and would have the effect of reducing existing individual IA rates to about 50-70% of their current levels. For a typical urban property the current rates are about $20 given that IA rates are $170/ha, so over the whole township the rates would typically be about $10-15.

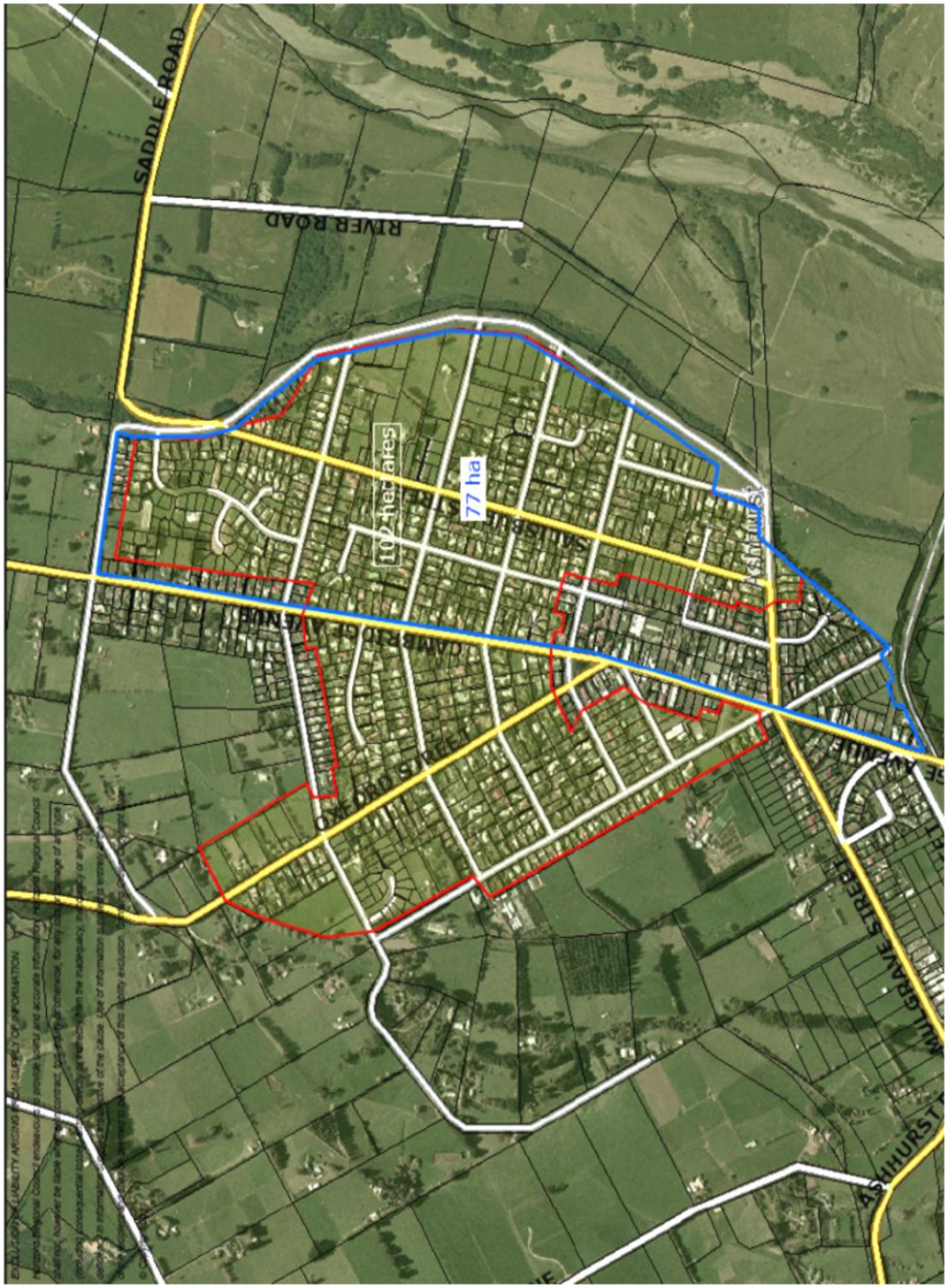


Figure 14: Ashhurst stormwater catchment (red) and rating area (blue)

4. The Management of Difficult Areas

There are several reaches of river within the scheme where the control of erosion and channel alignment are proving difficult to achieve within available budgets. These are not serious problems at this stage, but must be considered as part of the ongoing scheme management.

It is suggested that these priorities be re-assessed annually and that priorities be assigned for use of available funds.

Refer to the photo plans in Appendix H for the location of the reaches set out below.

4.1 Pohangina River

4.1.1 River Distance 5 km

This is a very difficult bend with flow directed against the right bank. The river is well outside the Gary Williams design channel. A permanent solution by realigning the river or armouring the riverbanks would likely be unaffordable.

Currently the riverbank is protected by plantings and a small buffer zone and these are establishing well with good growth. It will be most important to increase the width of this buffer zone, to ideally the design width of 30 m, and periodically layer the willows. This is the most practical and affordable option.

Photograph 1: **Plantings establishing well on right bank at Helen Johnson's 5 km Pohangina River**

4.1.2 River Distance 7.5-8.1 km – Left Bank

The river in recent years has been quite mobile by the left bank through this reach. The latest photo imagery shows the loss of a substantial buffer zone, but with the river now returned to the design channel. A stopbank has apparently been created to keep the river out of the left bank buffer zone.

It will be important to aim for the full 60 m buffer zone recommended by Williams for this reach.

4.1.3 River Distance 11.1-11.7 km – Right Bank

This is a difficult bend, where the river is always deep. Currently there is a narrow buffer zone and that is inadequate to provide security to adjacent land. Removal of the vegetation on the inside of the bend would ease pressures on the bend. However, for this to provide a sustainable solution widening of the buffer zone should proceed in tandem.

4.1.4 River Distance 14.2-14.8 km

There is significant erosion occurring on both banks here. It appears that initially erosion has occurred on the left bank and the erosion bay is now causing the river to turn towards the right bank causing erosion there. The river is now substantially beyond the design channel on the left bank.

It will take a concerted and cooperative effort between landowners on both banks here to attempt to mitigate this erosion. The erosion on the left bank is shown in Photographs 2 and 3.

Photograph 2: **Erosion on left bank at McDonald river distance 14.6 km**

Photograph 3: **Panorama of erosion on left bank at McDonald river distance 14.2-14.8 km**

4.1.5 River Distance 21.1-21.4 km

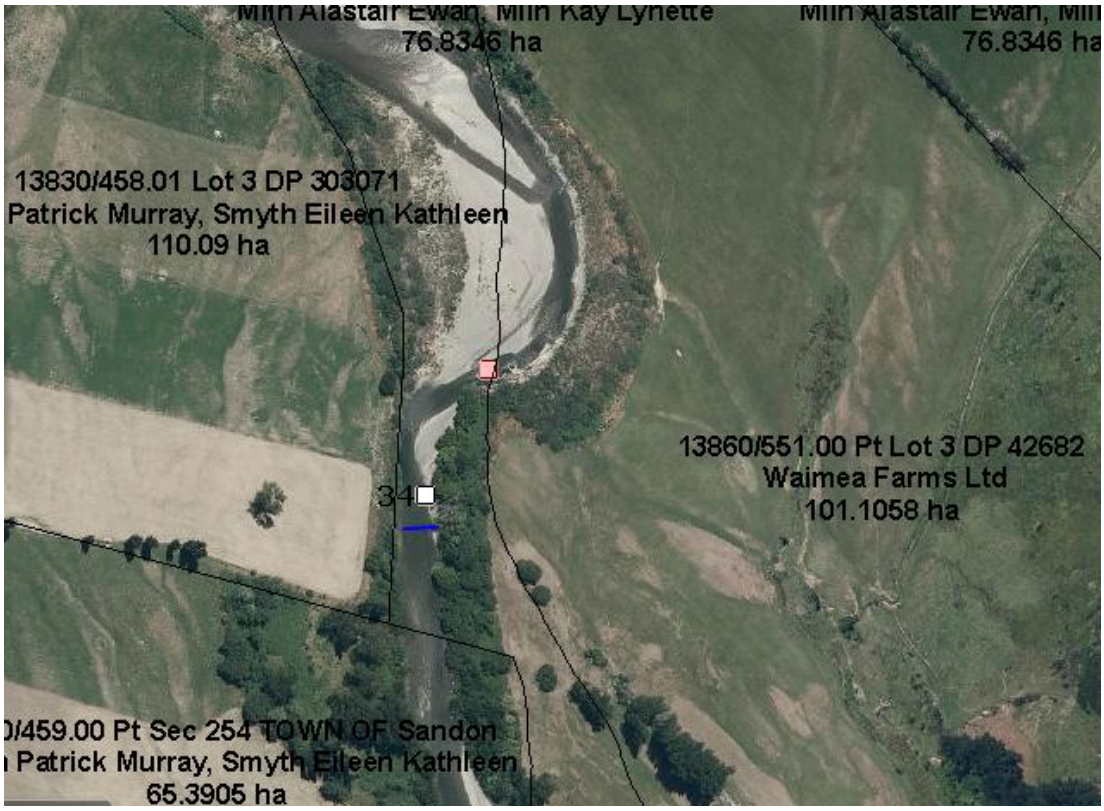
The river is outside the design channel through this short reach and it will need to be monitored to avoid further erosion. Several works could be contemplated including:

- A cut on the right bank.
- Lower and clear the high beach.
- Possibly some groyne work on the left bank, but this may be unaffordable.

4.2 OROUA

4.2.1 River Distance 34-34.4 km

There is a high beach on the right bank in this reach and this is putting pressure on the opposite riverbank. However, the root cause is the very narrow reach immediately downstream. This reach is as narrow as 20 m wide and is a major obstruction to flow. The consequence is that the throttled river slows down and deposits on the beach upstream, with consequent erosion on the opposite riverbank (refer photo imagery).



Photograph 4: **Aggrading beach upstream of 34 km and narrow reach throttling flow (blue line)**

4.2.2 River Distance 31.5-32 km

An accretion being recovered on the left bank has resulted in a sharp bend developing on the opposite riverbank – refer Photograph 6. The alignment into the right bank is sharp and protecting this will require some strong river edge protection works or an upstream realignment. Permeable groynes may not be adequate. It may be better to let the river return more to the 2005 position (Photograph 5), as this fits more harmoniously with the reach.

It is interesting to note that the original cadastral position of the Oroua River is shown on the left bank in these photographs. Conversely, the NZMS260 map shows the river located on the left bank – albeit without the sharp bend.

There will need to be discussion with the landowners on both sides of the river to determine where the river channel is best located.

Photographs 5 and 6: **Significant misalignment at 31.5-32 km. More favourable alignment in 2005 (top photograph), with ability to flow through left bank. Sharp bend 2011 (lower photograph)**

4.2.3 River Distance 26.4-27 km

A very difficult bend exists between 26.4 and 27 km. A significant amount of money has been expended on various solutions tried. A cut on the right bank proved effective for a while, but now has silted up. The best sustainable option appears to be reinforcing of the buffer zone on the left bank. The cadastral location of the river is beyond the right bank and is more favourable. However, it is not wise to try to return

the river to this as the works involved would be considerable, the land is developed now and the river is likely to always have a tendency to move towards the left bank.

4.2.4 River Distance 19.7-24.2 km

Through this reach several slips are evident on the true left bank. Some smaller slips are active through the reach from 23.5 to 24.2 km, but these appear to currently be stable. There is a very large slip from river distance 19.7 to 20.0 km below a forestry block. During a storm on 20 and 21 March 2012, this slip had a substantial collapse and completely blocked the river. The Oroua River was forced to travel across the adjoining pasture on the right bank, until a diversion channel was cut to return it to the old course. The flood event was 170 cumecs - almost exactly a mean annual flood.

Photograph 7: **Large slip off forestry block at river distance 20 km**

Upstream of this slip a layer of papa is visible, but it appears to dip underneath the river and provide no support at the slip. It is important that the current planting at the base of the slip is continued, to provide the best possible defence against undermining of the toe of the slip.

4.3 Totara Reserve

Investigations into the nature of the Pohangina River, including the development of design channels to guide river management, were undertaken in 2001 as part of a review of the Pohangina-Oroua Catchment Control Scheme. These investigations covered the river reach from its confluence with the Manawatu River up to the Totara Reserve, and a design channel was drawn for the river up to river distance 24 km in the lower part of the Totara Reserve. Following the large floods of 2004, a re-assessment was carried out, mainly focused on channel alignment, the works programme and scheme finances.

An assessment of the river reach through the Totara Reserve was conducted in March 2007 by Gary Williams of GF & E Williams Consultants. This was based on the earlier investigations of the (2001) Scheme Review. A design channel was then drawn up for the reserve reach, slightly modifying and extending the design channel of the Scheme Review, using the latest aerial photography. Based on the inspections and the management implications indicated by the design channel, practical erosion mitigation measures were considered. The character of the reserve and the river through the reserve, were taken into account when considering measures, and what would be appropriate within a nature reserve.

In 2008 a major river avulsion occurred, cutting off the long bend immediately downstream of the camping area. The breakthrough quickly developed into a channel of normal width, while re-vegetation rapidly took place over the abandoned channel reach. Refer photograph 8. The river bend lost almost 700 m in length. At the prevailing river grades this represents a mismatch in riverbed levels of around 3 m, so significant riverbed level adjustment would be expected to occur – maybe over a period of several years.

Photograph 8: Totara Reserve avulsion

Gary Williams revised his assessment in April 2009. The resulting report outlines the assessment and mitigation measures considered in 2007, and the effects of the river avulsion. It relies on the Scheme Review report, and should be seen as an addition to that report, covering the Totara Reserve reach of the river. His conclusions were:

"*There are a range of options for mitigating bank erosion and the loss of totara trees alongside the river channel. If nothing is done there would be significant erosion and loss of trees overtime, with ongoing loss of totara occurring at three locations in 2007. The avulsion has eliminated the risk at two of these locations — for some*

time. Severe attack is, though, still occurring at the end of the relatively straight reach, upstream of the high eroding cliff on the western side. Here a more pronounced bend has developed, with poorer entry conditions to the bend around the cliff. While the loss of land at this bend has mostly affected exotic species, totara trees are at risk.

The river will naturally migrate across its floodplain, and remove the trees as it does so. There would be, conversely, opportunities for re-colonisation. However, the overall area of large totara is quite small, as a forest remnant, and it takes a long time for totara to grow to large mature trees. At the same time, the introduced trees are better colonisers, with acacias establishing and spreading very rapidly. Over substantial parts of the reserve, the river side trees are exotics — willow, poplar, acacia etc — and they will be lost first.

Over time, break outs will occur from the river channel, with side channels being formed across the (forested) floodplain. There would, then, be a tendency for the river to break up into a number of channels, with more vegetation within the channels, if left alone.

Management could be undertaken to reduce the rate of loss of the remaining totara trees, and maintain a river channel essentially like the existing one, and within the constraints of natural channel migration and break outs. This could be done with relatively small scale works, utilising the natural responses of the river and its natural tendencies. The design channel provides a guide for these works, but should be seen as a pattern template and not as a fixed channel. In this case, the approach would be one of relatively frequent interventions, focused on tree alignment, channel obstructions and some channel shaping or re-forming.

Some minor land forming works could be carried out to provide a consistent level of flood protection along the camping area below the bridge. This would involve a topping up of the natural levee under the river side trees as required to be consistent with flood levels, and the forming of well defined outlets to ensure adequate flow capacity back to the river with minimal scouring, when overtopping does occur.

The short stopbank could be made more effective by extending it a short distance into the forest to a low terrace — which defines the landward side of the lower ground of the camping area. Any further protection (to the lower area) would require an embankment through the native forest area back to the high terrace face. This would have a major local effect on the forest, giving rise to a cleared strip."

The objectives of the audit of the management of Totara Reserve are:

1. Have the river management works been carried out in accordance with the Williams reports?

2. Were they successful?

3. Are there any recommended changes?

A detailed inspection of the Totara Reserve Reach has shown that in general, works have been carried out in accordance with the report and the reach is adjusting well to the avulsion. It is to be expected that it will take a few years for the reach to settle down, as the grade alters and alignments change. However, most of the works in the Williams report are well underway or completed.

In particular planting is progressing well at the entrance and exit of the channel lost by the avulsion. Both locations are vulnerable to erosion and the planting has been well backed up by installation of several tree groynes. More groyne works are still required at the downstream end to trap debris and build-up a robust bank edge protection system.

The wide meandering channel referenced around river distance 25 km has been well stabilised. This was achieved by machinery reshaping of the area outside the design alignment, groyne work and planting and is in a much improved condition.

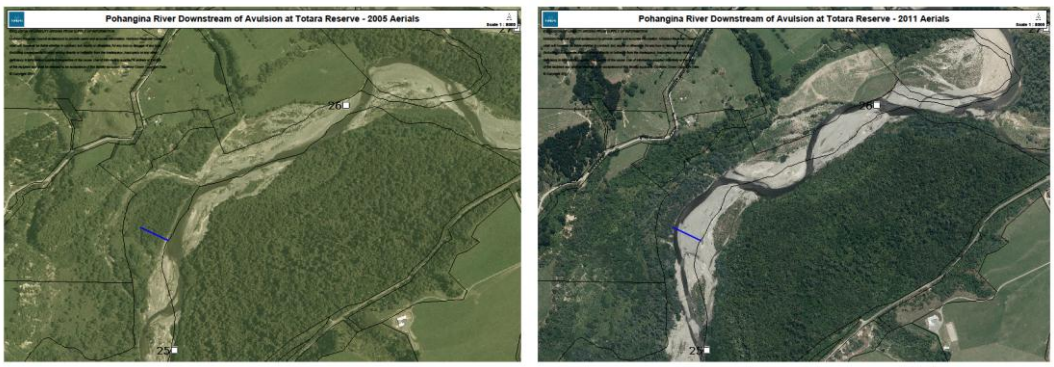
There has been a fair amount of planting straight into the gravel beaches and while strike rate has been good in some areas, others have had quite a pounding and are in need of follow up planting. Ongoing planting will continue to be needed to help strengthen buffers.

Yet to be achieved are:

a. The retreat of willow/poplar vegetation to re-establish in the back channel on the left bank at river distance 23.8 km. This is a lower priority job to be programmed in over the next two years.

b. Vegetation clearance, beach lowering and channel realignment on the right bank upstream of the Churchill Drive Bridge at river distance 28.5km. This would both improve the channel alignment to the cliff area on the right bank, and reduce the force on the tree groynes adjacent to the informal stopbank on the left bank. These groynes should be strengthened and the stopbank retreated.

However, it is very important to note that at river distance 25.4 km significant erosion of the right riverbank has occurred and the channel has moved around 100 m. Similarly the channel has developed a significant bend on the left bank at river distance 25.7 km. Refer photographs 9 and 10.



Photographs 9 and 10: **Downstream Totara Reserve avulsion showing channel migration from 2005 (left) to 2006 (right) including 100 m at river distance 25.5 km**

It is not unexpected that the Pohangina River is going through a very significant realignment process downstream of the avulsion. The design channels will need to be reviewed significantly (as recommended by Williams in his revised assessment of April 2009) and, as the river has lost 700 m in length, it may be difficult to constrain the river to a 60 m design channel through this reach.

However, as Williams notes: "*This (60 m) design channel fits the width and form of the actively worked channel. However, this channel is a migrating channel, within an alluvial floodplain, and should not be fixed in place. It is just one position for such a channel. Thus, channel management and bank protection can be guided by this design channel, which has a natural form appropriate to the river and reach, but it is not a fixed channel, with account being taken of migration trends and the general mobility of the channel. On the other hand, the natural cliff controls do impose a degree of fixity on the channel, while also giving rise to tight embayments into the alluvial floodplain*".

In view of the instability resulting from the avulsion, it is recommended that for the reach extending through Totara Reserve:

a. The design channel is reviewed. In particular alignments and river management require thorough review through the areas of significant erosion (at river distances 25.4 km and 25.7 km).

b. The "dominant flow" channel of 110 m is seen as a more important criterion. Constraining the channel to 60 m places significant stress on the edge protection work, beyond that normally possible with vegetative works.

c. Consideration is given to the "Fairway Channel" as adopted in parts of the Rangitikei River. This would essentially be 190 m and allow lateral migration of the channel and strong reliance on buffer zones. As this is a significantly different management stratagem than downstream it may not be possible to merge the stratagems.

A flooding vulnerability has been identified where water can outflow through the top camp site and flow across the road into the lower campsite (which has the new stopbank). One possibility is that water could be trapped behind the lower stopbank. This is a matter which must be addressed at some stage, but will be both costly and may impact on the forest itself, depending on the degree of flood protection required. The current informal stopbank (at river distance 28.5 km) should be retreated and could connect into high ground at the cliff, at the upstream end, and to high ground near the road bridge.

One major concern would be whether the loss of channel length is going to result in undermining of the riverbanks. This reach of the Pohangina River was resurveyed in November 2012 and the findings are:

1. At the bridge cross-section 16.5 miles at the upstream end of the reserve, the river thalweg level has dropped 0.5 m since August 2000. Mean bed levels have dropped only slightly (by around 0.1 m) but may continue to drop as the riverbed adjusts to the new regime. However, the mean bed level is the lowest of the six surveys since February 1970 – being some 0.35 m lower than 1970. This is likely a positive outcome, as the waterway at the bridge is choked, with low flood carrying capacity. It will also reduce the flows through the forest in large floods. There are no evident erosion problems yet.

2. At cross-section 16.0 miles there are several braids and the thalweg levels cannot be readily compared. However, the mean bed level has dropped 0.22 m since August 2012 – although it has increased slightly since 1970.

Thus the bed levels are dropping upstream of the avulsion and this response should be carefully monitored. However, on balance the avulsion is an act of nature that will have both benefits and disbenefits. Provided the design channels and channel edge protection works can be secured, then the drop in bed levels will to a degree reduce flooding risks.

Current expenditure and budgets appear appropriate to carry out the works necessary to mitigate the impacts of the channel avulsion. The actual expenditure in the 2012-13 financial year was:

Erosion Control	$	51,151.32
Channel Maintenance	$	8,778.75
Buffer Zone Planting	$	10,000.00 (2,500 poles)
Management	$	5,280.00
TOTAL 2012-13	**$**	**75,210.07**

A similar expenditure is programmed for the 2013-14 financial year, although there will be a greater emphasis on channel maintenance and buffer zone planting as follows:

Erosion Control	$	18,000
Channel Maintenance	$	30,000
Buffer Zone Planting	$	20,000 (5,000 poles)
Management	$	5,000
TOTAL 201-13	**$**	**73,000**

These budgets may require refinement once the design channel is reviewed.

5. Gravel Management

5.1 Pohangina River

Gravel management in the Pohangina River has recently been assessed and presented in the report entitled “Pohangina River Gravel Resource Study”, January 2013, Jon Bell, Design Engineer, Horizons Regional Council.

The main conclusions of this study are that the upstream part of the gravel reach of the Pohangina River, between the 12 and 21 mile marks (river distance 20.5 and 36 km), is aggrading and the lower part of the reach, below the 4 mile mark (6.3 km), is degrading. Both of these trends are noted both over the longer term between 1970 and 2012 as well as in the shorter term between 2000 and 2012.

The degradation that has been noted in the lower part of the reach is evidenced by the exposing of the piles beneath the abutments of the Rail Bridge (1.0 km), as shown in Figure 9.

The degradation at the bottom of the Pohangina is a worrying trend as it has the potential to undermine bridges as well as bank protection works. Furthermore, the degradation is starving the, already degraded, Lower Manawatu River of an important gravel source.

Figure 15: Rail Bridge abutments

The most significant recommendation of this study is that extraction of gravel from the Pohangina River should be stopped completely below the 4 mile mark. This recommendation is made because of the fact that significant degradation has occurred in this reach, and the halting of gravel extraction will allow the gravel resource to recover naturally.

In the reach between the 4 and 9 mile marks (6.3 and 15.2 km), approximately 12,000 cubic meters of gravel have been extracted annually since 2000. Whilst there has been an overall aggradation in this reach, it is proposed to limit the extraction to 10,000 cubic meters per annum. If this gravel is extracted from the more immobile, well armoured beaches, it will help with the overall river management whilst leaving the more mobile gravel to migrate downstream into the degrading reach.

In the upper reach, between the 9 and 21 mile marks (15.2 and 36 km), gravel has been extracted at a rate of approximately 3,500 cubic meters per annum over the last 12 years. Since there has been no cumulative change in the volume of gravel over this time it is proposed to continue the gravel extraction in this reach at the same rate.

Under these recommendations there are 13,500 cubic meters of gravel that can be extracted from the river per year.

The inspection of the gravel beaches that was undertaken as part of this investigation showed that above the 8.5 mile mark (14.2 km) at Raumai, there are a number of high beaches that are very well armoured. The gravel making up these beaches is unlikely to be mobilised by a flood event, and hence its extraction may be beneficial from a channel management perspective.

The existing global consent that allows gravel to be extracted from the Pohangina River allows for a total of 30,000 cubic meters of gravel to be extracted annually. This volume is sufficient to enable the recommended 13,500 cubic meters to be extracted along with any additional quantities that may be required for channel management purposes.

5.2 Oroua River

Gravel management in the lower Oroua River has also recently been assessed and presented in the report entitled “Oroua River Gravel Resource Study”, September 2012, Jon Bell, Design Engineer, Horizons Regional Council.

The main finding of this study is that there appears to be a general trend of degradation of the volume of gravel in the upper half of the reach (from Kaimatarau Road to a point just upstream of the confluence with the Kiwitea Stream, the upstream end of that report reach), and an aggradation trend in the lower half (down to the Manawatu confluence).

A careful inspection shows that the degradation at the upstream end continues for several kilometres upstream as evidenced at two current extraction sites:

- River distance 0.3 km (from the confluence with the Kiwitea Stream) at the site known as “Bismans”. The extraction through here has resulted in entrenchment of the Oroua River, with the riverbed some 3 m below the surrounding farmland; and

- River distance 2.7 km at the site known as “Hockens”. Extraction is causing riverbed degradation and bank erosion. At the end of the haul road it has recently been necessary to install demolition concrete to mitigate erosion.

On the right bank slightly downstream there is evidence of minor undermining. It is important the threat of undermining does not increase.

The degradation is also clearly visible at the Aorangi Railway Bridge. It is noticeable that the reach from Aorangi Road to almost Colyton Road is under much more erosion attack than for example the Ridds Road to Barrow Road reach, where extraction does occur, but at much lesser intensity. The riverbed has degraded and an array of protection works has been required.

Thus from a point at least 2 km downstream of Aorangi Railway Bridge through to just downstream of Colyton Road, it is recommended that extraction be currently suspended until bed levels recover (also refer below comments on Colyton Road). Whilst this reach straddles the LMS and Pohangina-Oroua Scheme areas, extraction management needs to be considered as a whole. Riverbed levels here need to recover 0.5 m to 1.0 m. In view of the degradation and extraction pressure on this reach, a set of cross-sections should be established linking through to the lower Oroua River cross-sections.

Detailed cross-section surveys are only available at a few selected sites upstream of the Kiwitea Confluence and these are described, along with the visual observations following.

- Colyton Road (river distance 4.0 km). A period of degradation occurred from 1999 to 2001, with aggradation roughly double the degradation from 2001 to 2012. Thus the reach has aggraded. However, visual inspection suggests that riverbed levels at Colyton Road are marginally low (by around 0.5 m) and in 1999 the bed levels may already have been below optimum.

- Riverbed levels from Colyton Road through to Barrow Road (river distance 19.1 km) are generally close to optimum. The small scale extraction that occurs in this reach should continue under careful control.

- Coulters Line (river distance 25.9 km). Significant fluctuations occur at this site, with a period of degradation from 1999 to 2000 and subsequent equivalent recovery through to 2012. The photograph of the bridge cross-section (contained in the inspection notes appended) nonetheless shows this site is significantly aggraded and requires extraction.

- Londons Ford (diver distance 40.7 km). The surveys show a major drop in riverbed levels from 1976 to 1980 followed by aggradation to 2012. The inspection notes record that for 4 km downstream of the Londons Ford Bridge the riverbed is aggraded and extraction warranted.

- Apiti Road (diver distance 44 km). The surveys show an almost continuous drop in bed levels from 1976 to 2012, with a drop in mean bed level of around 0.5 m and drop in thalweg of just over 1 m. Extraction in this location should be avoided.

6. Works Programme

If the recommendations of this audit are adopted, then the apportionment of works costs for 2013-15 across activities and river reaches would look like this. Engineering management and other on-costs are additional.

Table 12: Indicative Works Programme 2013-15

River Works	2013-14	2014-15	2015-16
Summary	**278,575**	**278,705**	**278,705**
Channel Maintenance	104,525	123,000	123,000
Buffer Planting	50,000	50,000	50,000
Erosion Protection	100,000	100,000	100,000
Drain maintenance	4,250	4,250	4,250
Forestry	19,800	1,455	1,455
Pohangina	**132,715**	**143,800**	**143,800**
Above Totara Reserve			
Channel Maintenance	1254	1476	1476
Buffer Planting	600	600	600
Erosion Protection	800	800	800
Below Totara Reserve			
Channel Maintenance	61,461	72,324	72,324
Buffer Planting	29,400	29,400	29,400
Erosion Protection	39,200	39,200	39,200
Oroua	**121,810**	**129,200**	**129,200**
Above 13 km			
Channel Maintenance	33,448	39,360	39,360
Buffer Planting	16,000	16,000	16,000
Erosion Protection	48,000	48,000	48,000
Below 13 km			
Channel Maintenance	8,362	9,840	9,840
Buffer Planting	4,000	4,000	4,000
Erosion Protection	12,000	12,000	12,000
TOTAL River works	**254,525**	**273,000**	**273,000**
Drain maintenance	4,250	4,250	4,250
Forestry	19,800	1,455	1,455
TOTAL Works	**278,575**	**278,705**	**278,705**

Note
Channel Maintenance and Buffer Planting: 60% Pohangina, 40% Oroua.
Erosion protection: 40% Pohangina, 60% Oroua.

All river works
Pohangina: 98% Below Reserve, 2% Above Reserve.
Oroua: 20% Below 13 km, 80% Above 13 km.
Forestry: Second thin 2013-14, preliminary costs 2014-16 indicative only.

7. Scheme Finances

7.1 Future Scheme Annual Reporting

The annual reports prepared for the scheme adequately report on scheme expenditure compared to budget over all work categories, but do not adequately break down that expenditure into river reaches that coincide with rating categories. This makes it much more difficult and time consuming to audit and adjust the rating system to ensure it is collecting rates in an equitable manner.

Two more columns could easily be added to the "Schedule of Completed Works" that would show in which rating area the works was undertaken and the cost of those works. The cost of each type of scheme works, are precisely detailed but these are not broken down into their respective rating areas.

7.2 Scheme Reserves

Historically, the scheme has relied on a combination of loans, reserves and insurance to fund damage from large floods.

Insurance has been provided under the LAPP scheme for high value scheme assets, specifically rock linings, concrete riprap and PMUs, but this only covered about 20% of the expected total losses in a 100 year event. The increasing cost of insurance after the 2010-11 Christchurch earthquakes and the limited cover provided, has led Council to withdraw insurance for the scheme and therefore to rely more heavily on reserves.

Disaster recovery assistance from central government was particularly helpful for the 2004 flood but should not be expected for floods less than 50 year events.

Therefore, a 50 year target level for scheme reserves was recently agreed by Council as an appropriate level for all schemes managed by HRC.

For the Pohangina Oroua Scheme, the target would be $1.3 million, as shown in the flood loss curve below. This is somewhat less than the $1.64 million presented earlier to Council due to update of the 2011 asset data and revised loss ratios, but is almost double the previous target of $750,000 (equivalent to the 22 year flood damage).

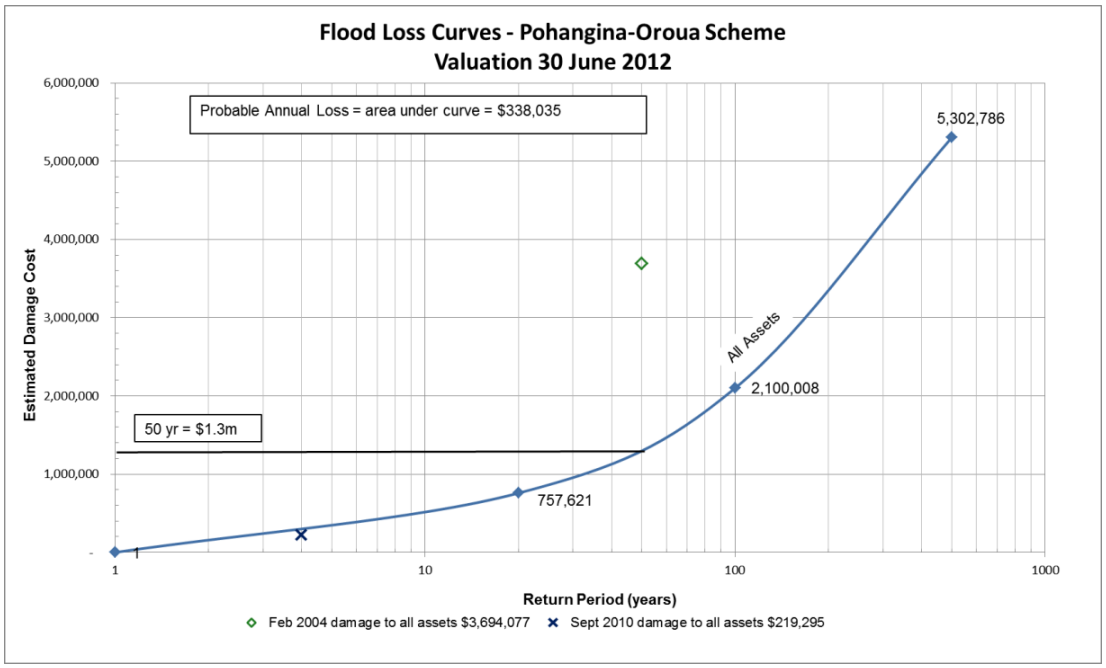


Figure 16: **Flood Loss Curve**

It is interesting to note, that as would be expected, the 50 year assessed flood damage on each river is more or less proportional to the value of the assets along each river (see separate flood loss curves in Appendix E):

Pohangina	$	600,000	46%
Oroua	$	710,000	54%
Total	**$**	**1,310,000**	

It could be argued that the current regime of landowner contributions would allow a lower level, however the $1.3 million target allows for possible future change in this scheme policy and leaves the scheme with more funding options for improvements and other works in future.

The flood loss curves are based on estimated replacement value (including management and supervision costs) and damage ratios for each asset type. Values of concrete riprap are based on replacement with rock to allow for a lack of sufficient demolition concrete to repair damage after a major flood.

Table 13: Pohangina Oroua scheme assets - flood damage ratios

	20 yr	100 yr	500 yr
Asset Sub Type	**Damage**	**Damage**	**Damage**
Concrete Riprap	5%	25%	50%
Erosion Protection Reserve	10%	30%	85%
Forestry	0%		
Gabions	2%	10%	20%
PMU	5%	20%	40%
Protection Planting	10%	30%	85%
Rock Groynes	2.0%	10%	20%
Rock Lining (engineered)	0.5%	2.5%	5%
Rock Lining (non-engineered)	5%	25%	50%
Tied Tree Work	10%	30%	85%
Tree Groynes	20%	40%	70%

Importantly, the area under the curve (adjusted to an annual probability basis, i.e. 100 year return period is 0.01) can be used to determine the probable annual damage. This can be regarded as the annual premium in insurance terms and provides a sound basis for the long-term funding of flood damage by the scheme.

A 50 year probable annual damage model has been prepared to illustrate the funding required, assuming all floods larger than a 50 year event are funded externally from central government (see Appendix F). The diminishing annual loss for large floods means that the 50 year level covers 87% of the total probable annual damage (up to the 500 year level shown in the curve).

As indicated in the model, the scheme currently budgets $100,000 every year for erosion protection works, which is largely for flood damage. In addition, there is a $54,000 reserve contribution ($67,000 including 20% for future general rate contributions when expenditure occurs) and loan repayments for previous damage of some $63,000.

As the probable annual damage below the 50 year level is $294,430, this leaves a potential funding requirement of some $64,000 per year to be met by a combination of landowner contributions, loans and reserve contributions.

The three options presented in the model show that scheme exposure would be limited to additional funding of $13,000 to $32,000 per year, assuming at least 50% of the damage was erosion control works funded by landowners. This would require a fairly modest 4% to 9% increase in scheme rates to fund additional reserve contributions or repayment of future loans for flood damage.

However, the need for such an increase is mitigated by the extra funding from interest earned on the reserves fund as contributions accumulate.
Current long-term funding budgets aim to reach the $1.3 million target in about 10 years, with reserve contributions steadily increasing by some $16,000 over the next few years (largely from interest earned on the reserves fund) until the loan is paid off in 2016-17. At this level the need for a rates increase would largely be eliminated if most flood damage was landowner funded, although it would be prudent to allow an additional 5% increase ($16,000), or say 1% over five years.

From 2017-18 some of the surplus loan funds are budgeted to be diverted to increase reserve contributions to $110-120,000 per year so that the $1.3 million target is met on time. When the 20% future general rate contribution is added, then the total annual flood damage funding would amount to $238,000-$244,000 (including the $100,000 for erosion control works), which still leaves a potential funding requirement of some $50,000 per year. On the basis above, this would still require an additional $10-20,000 of rates (3-7% increase).

This small amount shows that the current funding provisions are quite reasonable, especially when income from the Goulter's Gully forestry is taken into account.

However, if there were no landowner contributions, then Option 3 in the model shows that the total rates increase would need to be 33% (including the $60,000 share of the erosion control works - see also Table 5). This again highlights the importance of the current funding regime.

The reserves balance at 30 June 2013 was $281,725.

This is only sufficient for about a 5 year event and a further loan is likely to be required before the $1.3m target is achieved. To repair damage, then ideally, the reserves contributions would be reduced to keep rates at the same level and consistent with the probable annual damage model.

The scheme therefore remains exposed to large flood events, especially if government policy changes for funding disaster recovery.

In any case, income from Goulter's Gully Forest provides an important supplement to the scheme reserves but it can not be relied upon due to the risks involved.

The current forestry value of $760,483 is based on the inflation adjusted net return from the harvest in 2001-02 (see Table 1). Actual returns when the forest is next harvested in 15-20 years time will depend on log prices and other risk factors such as wind damage.

While the forestry provides a windfall every 27 years or so, it is important that the scheme utilises it with due regard for the funding demands at the time and the need for intergenerational equity – it would not be fair that the current ratepayers benefit unduly at the expense of future generations.

8. Conclusion

The key finding of this audit is that the scheme is being well managed in accordance with the new scheme management regime**.** The distribution of works has shifted to mainly focussing on channel management and indeed the channel is generally in good condition.

In reaching these findings the following points should be noted:

1. There are a few locations on both rivers where the rivers are very narrow and this may cause gravel to settle upstream of the constriction to levels above optimum. This is likely to result in erosion to adjacent riverbanks. These locations should be confirmed and programmed in for further channel clearance works.

2. Gravel extraction on the lower reaches of both rivers should be suspended until river bed levels improve.

3. The vegetation buffer zone establishment has well exceeded the planned $20,000 per annum with an average expenditure of $40,000 from 2009 to 2012. This increase has been offset by a reduction in planned channel maintenance from $150,000 to $120,000.

4. There are locations where there are good opportunities to reinforce the buffer zone planting, by increasing expenditure from $40,000 to $50,000 per annum as requested by the Scheme Liaison Committee. A good buffer zone goes hand-in-hand with the focus on channel management.

5. Inevitably, there will be occasions where a misalignment may develop and riverbank armouring, groynes and/or channel realignments may be required – such is the aggressive nature of both rivers. However, on a long-term basis the erosion protection works is keeping well to budget.

6. Since changing to the new management regime, the scheme has responded well to floods with generally little damage. This being despite prolonged flooding in September-October 2010. The peak flows experienced in these floods were a 6 year return period flood (233 cumecs) for the Oroua at Almadale site, increasing to around 10 years (341+ cumecs) at the Kopane Bridge location. The Pohangina experienced a 1.5 year flood (351 cumecs) at Mais Reach. However, the key feature was the multiple flood events experienced during this period, representing a 10 year or greater “combined event”. The ratepayers did have to contribute an additional amount for flood damage, but it was not large.

7. A detailed inspection of the reach extending through Totara Reserve has shown that, in general, works have been carried out in accordance with the Williams Report (April 2009) and the reach is adjusting well to the avulsion. It is to be expected that it will take a few years for the reach to settle down, as the grade alters and alignments change. However, most of the works in the Williams report are well underway or completed.

8. In view of the instability resulting from the avulsion it is recommended that for the reach extending through Totara Reserve the design channel

is reviewed. In particular alignments and river management require thorough review through the areas of significant erosion (at river distances 25.4 km and 25.7 km). Constraining the channel to 60 m places significant stress on the edge protection work, beyond what is normally possible with vegetative works. Therefore, the "dominant flow" channel of 110 m is seen as a more important criterion. Consideration should also be given to the "Fairway Channel" as adopted in parts of the Rangitikei River. This would essentially be 190 m and allow lateral migration of the channel and strong reliance on buffer zones.

9. An annual expenditure of around $73,000 for the reach through Totara Reserve is appropriate to carry out the works necessary to mitigate the impacts of the channel avulsion. However, budgets may require refinement once the design channel review has been completed.

10. Overall expenditure for the Pohangina and Oroua Rivers is trending to the proportions 60 to 40, set by the rating levels.

11. Expenditure on the two reaches of the Oroua River is well out of line with the rating levels and the rates should be amended to come in line with the length in each reach – 72% above 13 km and 28% below 13 km, instead of 51% and 49%.

12. Expenditure on the Pohangina River is in line with the rating levels set above and below Totara Reserve.

13. The introduction in 2008 of a direct landowner contribution for funding erosion control works has largely been successful but does have some inherent risks and detracts from the general scheme concept– only time will tell if it is a sustainable approach in the long-term.

14. A proposed programme of drain maintenance needs to be agreed with landowners and the rating system amended to suit.

15. Ashhurst rates (IA) are incorrectly being collected from only those properties east of the main street. The whole township should be rated, which would effectively halve the current rates for individual urban properties.

16. Goulter's Gully Forest is an important asset for future reserves funding and is managed as a pruned log forest to maximise returns. A second thinning is now due and needs to be included in the 2013-14 works programme. Other maintenance work required on grade controls and other gully works needs to be assessed regularly.

17. The 50 year target level for scheme reserves is $1.3 million. Proposed annual reserve contributions to reach this aspirational target are consistent with the total funding required to cover the probable annual damage of $294,430, (assuming central government assistance for floods larger than 50 year events). Other funding includes the annual budget allowance of $100,000 for 60% landowner funded erosion control works, annual loan repayments and periodic "windfall" income from Goulter's Gully Forest.

9. Recommendations

It is recommended:

1. That it be noted that overall the Pohangina-Oroua River scheme is in good physical condition.

2. That the good work achieved by the Scheme Liaison Committee in supporting the scheme objectives be recognised as pivotal to the success of the scheme.

3. That the annual budgets for riparian vegetation development be increased to $50,000 per annum, with this increase to be offset in other budget components.

4. That in preparing the budget for 2014-15, consideration be given to increasing the provision for scheme contribution to landowner funded works from $20,000 to $30,000, to allow for such works to a total cost of $150,000 per year.

5. That it is clearly recognised that budgets simply are not large enough for hard protection works generally and thus vegetative works and channel maintenance are the key components to mitigating erosion.

6. That landowners consequently be strongly encouraged to extend their buffer zones where they do not yet reach those set in the 2006 Scheme Review.

7. That it be noted there are some reaches of river within the scheme where the control of erosion and channel alignment are proving difficult to achieve within available budgets. These are not serious problems at this stage but must be considered as part of the on-going scheme management.

8. That the gravel management for both rivers be conducted in accordance with the recommendations in the 2012 Oroua and 2013 Pohangina studies (as included in this report) and the findings in this report for the Kiwitea to Apiti Bridge reach of the Oroua River.

9. In view of the instability resulting from the avulsion, that for the reach extending through Totara Reserve:

    i. The design channel is reviewed. In particular alignments and river management require thorough review through the areas off significant erosion (at river distances 25.4 km and 25.7 km).

    ii. The “dominant flow” channel of 110 m is seen as a more important criterion. Constraining the channel to 60 m places significant stress on the edge protection work, beyond that normally possible with vegetative works.

    iii. Consideration is given to adopting the “Fairway Channel”. This would essentially be 190 m and allow lateral migration of the

channel and strong reliance on buffer zones. As this is a significantly different management stratagem than downstream it may not be possible to merge the stratagems.

10. That, to mitigate flooding at Totara Reserve, the current informal stopbank at the upstream end of Totara Reserve is retreated and connected into high ground.

11. That adequate provision be made for funding Goulter's Gully Forest as a pruned log regime and for maintenance of the erosion control structures in the gully system.

12. That the cost split of scheme expenditure be carefully monitored year by year to ensure the works expenditure is, within reasonable bounds, spent according to the following proportions:

Pohangina	60%
Oroua	40%

13. Should the cost split of expenditure vary by more than 10% from this over a three year average, then serious consideration should be given to amendments to the rating system.

14. That the rating calculator for the scheme be altered such that the proportions for the Oroua categories are changed from 13.16% and 13.72% to 7.53% and 19.35% respectively (this is the proportion of river lengths managed by the scheme above and below 13 km).

15. That the Ashhurst rates determined by the rates calculator be collected over the whole township on a capital value basis.

16. That a programme of drain maintenance is agreed with landowners and, if necessary, the rating system is amended to suit.

17. That the Scheme Annual reports be amended to include details of the expenditure on works within each rating reach i.e. above and below 13 km on the Oroua River, and above and below Totara Reserve on the Pohangina River.

APPENDICES

APPENDIX A

Pohangina River - Notes from Inspection 11 April 2013 by Robert Smith and Peter Blackwood

Summary Comments

1. Overall the channel maintenance and erosion protection scheme is in good condition.

2. In some places it is impractical and unnecessary to keep the channel within the Gary Williams design channel lines.

3. It will be important to aim for at least a 30 m buffer zone.

4. The scheme relies heavily on good channel maintenance and vegetative protection works. There are only a few groynes and PMUs.

5. In major floods substantial damage is expected, as the vegetative works cannot provide a robust defence. However, the channel maintenance and vegetative protection works (especially those with large buffers) are markedly reducing the vulnerability to flood damage.

6. It is important for landowners on opposite banks to work together in achieving the river scheme aims.

7. There are significant areas of accretion land that have been developed as pastoral land alongside the Pohangina River and inevitably these are areas where risks of the river reclaiming the old course cannot be discounted. However, the scheme is designed to manage the river within design channels, so that risks to this land are minimised.

8. There are some beaches upstream of Raumai where gravel extraction is recommended – as per the recommendations in the Jon Bell report.

9. There are also some beaches along the entire scheme where gravel redistribution is a very good option.

10. Gravel extraction downstream of Raumai must be retarded or embargoed as per the Jon Bell report.

River Distance 3-4 km Downstream Saddle Road Bridge

Pohangina River is close to desired alignment on both banks. River is minorly outside the alignment in places, but there are no real problems through this reach.

River Distance 4-4.8 km

The Pohangina River is right on the desired alignment on the outside of bend left bank. Hugh Akers has installed several competent groynes, predominantly Macrocarpa (Photograph 1).

Photograph 1: Stable left bank opposite with Akers groynes from pylon 4 to 4.8 km

River Distance 5 km

This is a very difficult bend with flow directed against the right bank. The river is well outside the Gary Williams design channel. A permanent solution by realigning the river or armouring the riverbanks would be likely unaffordable.

Currently, the riverbank is protected by plantings and a small buffer zone and these are establishing well with good growth. It will be most important to increase the width of this buffer zone, to ideally the design width of 30 m, and periodically layer the willows. This is the best practical option affordable.

Photograph 2: Plantings establishing well on right bank at Helen Johnson's 5 km

River Distance 5.5–7 km

Through this reach there are few river management problems. The 60 m Threshold of Motion meander form fits the channel reasonably well and there is little point at this stage to clear to the 110 m flow dominant meander form. There currently doesn't seem to be a need to widen to the Threshold of Motion form on the left bank reach upstream of the 6 km mark.

River Distance 6.2-7.4 km – Right Bank Accretion and Transition to Fairway Channel

The right bank accretion is now fully established as pastoral farmland. This area of land was created in the 1960s when the Pohangina River changed course (maybe around the time of the 1965-67 period of increased storminess referenced in the 2006 Philpott Scheme Review). As with most accretions there is a risk that the river will want to return to its previous course. Thus development of accretion land can put some strain on resources to prevent the channel re-entering the land. However, currently tree groynes (Photograph 3) are holding the riverbank at the upstream end of the accretion reasonably well – albeit the right bank is outside the design channel. This does not mean that avulsion of the river through the accretion land is likely and the scheme aim is to prevent that.

Interestingly the design channel form recommended by Williams widens to the 180 m Fairway Channel for around 1 km upstream of this point; thence returning to the flow dominant channel. The exact positioning and type of channel through this reach is a bit arbitrary and where the channel is outside the design channel is not a threat to the accretion land. The important point will be to monitor this reach closely.

Photograph 3: Established tree groyne on right bank at 7.2 km.

River Distance 7.5-8.1 km – Left Bank

The river in recent years has been quite mobile by the left bank through this reach. The latest photo imagery shows the loss of a substantial buffer zone, but with the river now returned to the design channel. A stopbank has apparently been created to keep the river out of the left bank buffer zone.

It will be important to aim for the full 60 m buffer zone recommended by Williams for this reach.

River Distance 8.1-11.1 km

The river is relatively stable through this reach and generally within the design channel.

River Distance 11.1-11.7 km – Right Bank

This is a difficult bend, where the river is always deep. Currently there is a narrow buffer zone and that is inadequate to provide security to adjacent land. Removal of the vegetation on the inside of the bend would ease pressures on the bend. However, for this to provide a sustainable solution widening of the buffer zone should proceed in tandem.

River Distance 11.7-12.7 km – Downstream of Raumai Bridge

The river is relatively stable through this reach and generally within the design channel.

River Distance 12.7-14.2 km

The river is relatively stable through this reach and close to the design channel. Around river distance 13.3 km erosion is occurring on the left bank in part because of a higher gravel beach on the opposite bank. This beach requires lowering plus an extensive clearance of the vegetation within the design channel is required.

River Distance 14.2-14.8km

There is significant erosion occurring on both banks here. It appears that initially erosion has occurred on the left bank and this erosion bay is now causing the river to turn towards the right bank causing erosion there. The river is now substantially beyond the design channel on the left bank.

It will take a concerted and cooperative effort between landowners on both banks here to attempt to mitigate this erosion. The erosion on the left bank is shown in Photographs 4 and 5.

Photograph 4: Erosion on left bank at McDonald river distance 14.6 km

Photograph 5: Panorama of erosion on left bank at McDonald river distance 14.2-14.8 km

River Distance 15.0 km – Tokeawa Stream Left Bank Tributary

This tributary is confined by stopbanks downstream of Pohangina Valley East Road. The tributary is aggrading to the point that the stream bed is now around 0.5 m higher than the adjacent farmland. Thus there is a high likelihood that flooding will periodically occur

particularly on the left bank of the stream. Remedying this is not within the ambit of the Pohangina River Scheme.

River Distance 15.2-15.6 km

Significant erosion has occurred on the right bank in the past and has been mitigated by installation of PMU units installed after the 2004 floods (refer Photograph 6). Some of these units have now settled, but in any case a very good vegetative swathe has been established and some, or all, of these units could now be removed and the willows layered.

A high beach opposite the PMUs should be lowered.

Photograph 6: PMU units and the very good vegetative swathe established behind at river distance 15.2-15.6 km

River Distance 16.0 km – Te Awaoteatua Stream Left Bank Tributary

There is very little work required on this tributary.

River Distance 15.6-17.3 km

Although there are several issues in this long reach, the river generally is reasonably close to the design channel – though not everywhere. However there is likely no need to shift the current river alignment. Generally, there is a very good buffer zone established both sides of the river throughout the reach. The buffer zone is narrower at 15.9 km on the right bank and should be widened.

A high beach on the right bank at 16.3 km should be lowered and cleared before the aggradation increases further (Photograph 7). Some poplar tree groynes on the opposite bank are not well anchored and tending to float – thus are vulnerable to failure.

Immediately upstream of the high beach, there is an area of erosion on the right bank at 16.7 km, which requires tree groynes. Erosion at this riverbank is accentuated by another high beach opposite and slightly upstream. Again this beach should be lowered and cleared.

At 17.1 km there is some erosion on the left bank adjacent to poplars. Through this area and downstream some wattles are becoming increasingly established. The wattles are to a degree killing off willows and poplar protection trees.

Photograph 7: Higher beach that requires clearing and lowering at river distance 16.3 km

River Distance 17.2-17.3 km

The river alignment is outside the design channel by the big slip on the left bank. The slip appears stable at present and is unlikely to adversely affect the Pohangina River in the foreseeable future.

Photograph 8: Currently stable slip on left bank at river distance 17.2-17.3 km

River Distance 17.5-18.2 km

The river channel is reasonably close to the design channel. At 17.7 km a previous erosion bay has been recovered by vegetative works. This area now needs some maintenance to avoid the bay redeveloping.

At 18 km it would be wise to redistribute some gravel from the left bank to the right bank and immediately upstream from the right to left bank.

River Distance 18.2-21.1 km

Over this long reach the river closely follows the design channel. Only minor layering and channel maintenance works are required.

River Distance 21.1-21.4 km

The river is outside the design channel through this short reach and it will need to be monitored to avoid further erosion. Several works could be contemplated including:

- A cut on the right bank.
- Lower and clear the high beach.
- Possibly some groyne work on the left bank, but this may be unaffordable.

River Distance 22.5 km

The Manawatu District Council (MDC) rock riprap lining is looking robust.

Oroua River - Notes from Inspection 18 April 2013 by Robert Smith & Peter Blackwood

Summary Comments

1. Overall the channel maintenance and erosion protection scheme is in good condition.

2. Unlike the Pohangina River there are no design channel lines. However, generally the channel alignment and location is good.

3. It will be important to aim for at least a 20 m buffer zone.

4. The scheme relies heavily on good channel maintenance and vegetative protection works.

5. In major floods substantial damage is expected, as the vegetative works cannot provide a robust defence. However, the channel maintenance and vegetative protection works (especially those with large buffers) are markedly reducing the vulnerability to flood damage.

6. It is important for landowners on opposite banks to work together in achieving the river scheme aims.

7. Again there are some significant areas of accretion land that have been developed as pastoral land alongside the Oroua River and inevitably these are areas where risks of the river reclaiming the old course cannot be discounted. However, the scheme is designed to manage the river within accepted design channels, so that risks to this land are minimised.

8. There is a significant river misalignment at 31.5-32 km and options for this reach require discussion with landowners.

9. There are some beaches in the upstream reaches, particularly around the London Ford-Bartletts Ford areas where gravel extraction is recommended.

10. There are also some beaches along the entire scheme where gravel redistribution is a very good option.

11. Some of the permeable rail iron groynes need maintenance to ensure they provide continued riverbank protection.

River Distance 40.7 km Londons Ford Bridge

The Oroua River bed levels are minorly high in this vicinity and periodically the intake to the MDC water supply has to be cleared. Refer Photograph 1.

River Distance 37-40 km Downstream Londons Ford

The Oroua River bed levels are frequently high in this vicinity and flooding of the right bank is accentuated in places. It will be important to keep the beaches clear and where possible, extract some gravel to lower the beaches. Refer Photograph 2.

Photograph 1: Looking downstream from Londons Ford Bridge. MDC water intake on left bank in channel that is periodically cleared and gravel redistributed.
River distance 40.7 km.

Photograph 2: Aggraded beaches 39-40 km reach. Need to be kept clear of vegetation and lowered.

River Distance 36-37.1 km Bartletts Reserve

Again, there are some high beaches in this reach and they should be either extracted or gravel redistributed to the outside of the bend (for example at river distance 36.2-36.3 km).

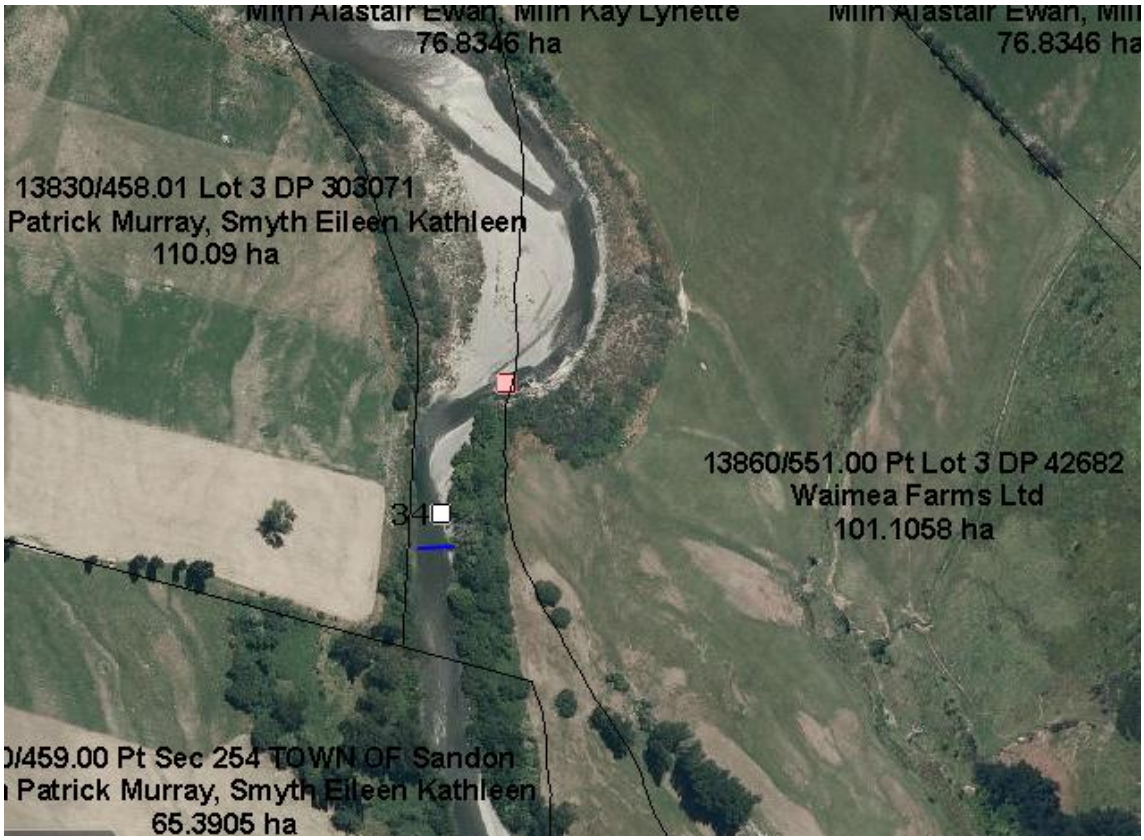
Around seven permeable rail iron groynes are located on the left bank opposite Bartletts Reserve at river distance 36.8 km. These now need some maintenance if they are to continued to armour the riverbank (refer Photographs 3 and 4). The groynes main function is to protect the riverbank beside the MDC road.

Permeable rail iron groynes are also located on the right bank at distance 36.4 km and appear to be in reasonably good condition.

Photographs 3 and 4: Permeable rail iron groynes opposite Bartletts Reserve protecting road.

River Distance 34-34.4 km

There is a high beach on the right bank in this reach and this is putting pressure on the opposite riverbank. However, the root cause is the very narrow reach immediately downstream. This reach is as narrow as 20 m wide and is a major obstruction to flow. The consequence is that the throttled river slows down and deposits on the beach upstream, with consequent erosion on the opposite riverbank (refer photo imagery).



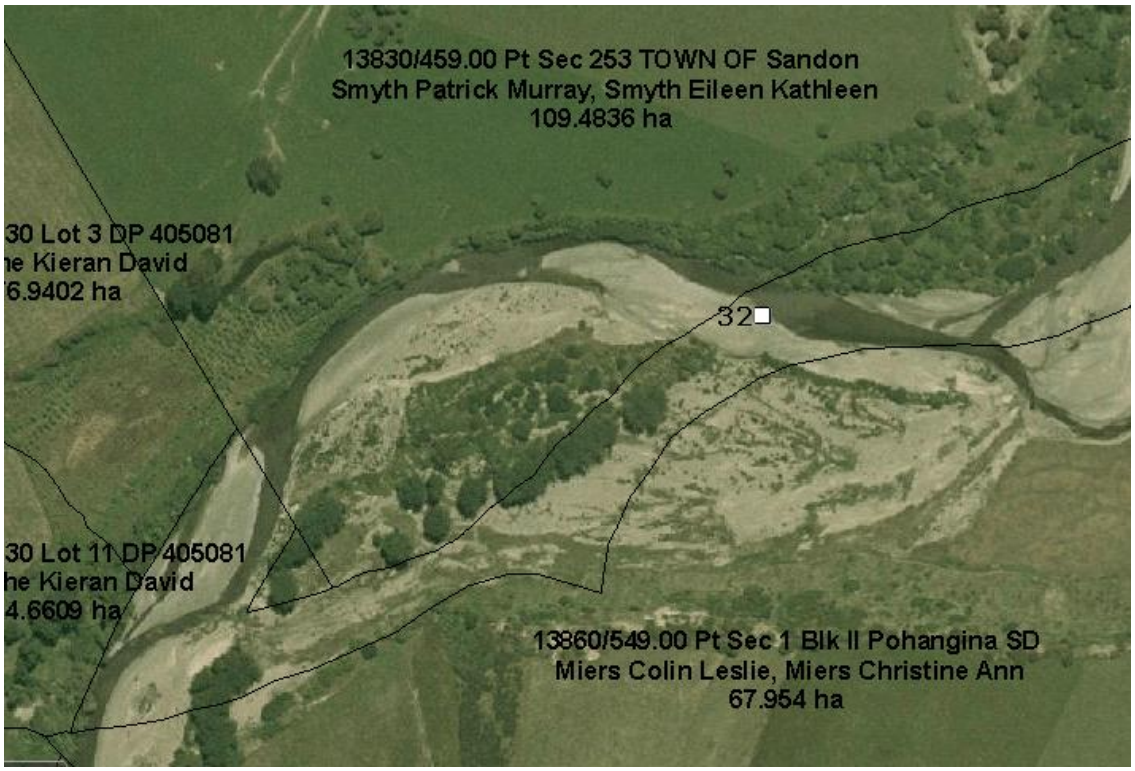
Photograph 5: Aggrading beach upstream of 34 km and narrow reach throttling flow (blue line)

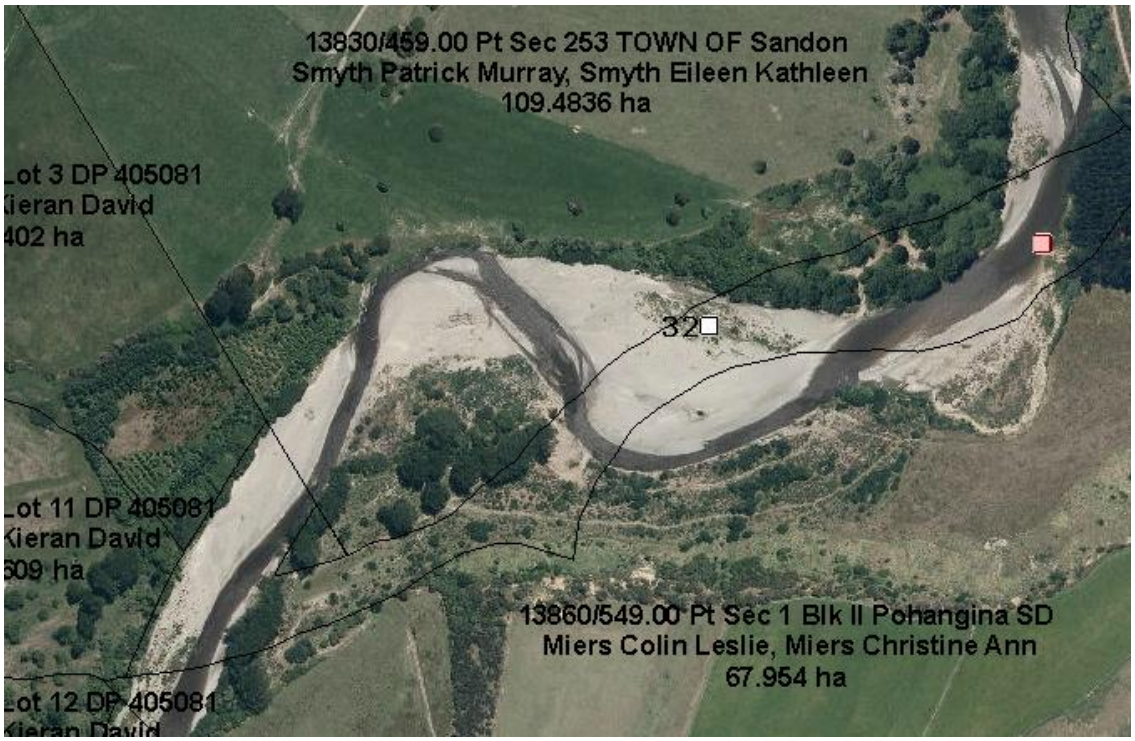
River Distance 31.5-32 km

An accretion being recovered on the left bank has resulted in a sharp bend developing on the opposite riverbank – refer Photograph 7. The alignment into the right bank is sharp and protecting this will require some strong river edge protection works or an upstream realignment. Permeable groynes may not be adequate. It may be better to let the river return more to the 2005 position (Photograph 6), as this fits more harmoniously with the reach.

It is interesting to note, that the original cadastral position of the Oroua River is shown on the left bank in these photographs. Conversely the NZMS260 map shows the river located on the right bank – albeit without the sharp bend.

There will need to be discussion with the landowners on both sides of the river to determine where the river channel is best located.





Photographs 6 and 7: Significant misalignment at 31.5-32 km. More favourable alignment in 2005 (top photograph), with ability to flow through left bank. Sharp bend 2011 (lower photograph)

Downstream from River Distance 31.6 km Right Bank Accretion

A significant accretion has been recovered on the right bank downstream of river distance 31.6 km. This has been developed as pastoral farmland, with farm buildings that service this

land located just out of the accretion land. Works are placed to keep the river from avulsing and returning to the accretion land. These works will need to be monitored and maintained.

River Distance 26.4-27 km

A very difficult bend exists between 26.4 and 27 km. A significant amount of money has been expended on various solutions tried. A cut on the right bank proved effective for a while, but now has silted up. The best sustainable option appears to be reinforcing of the buffer zone on the left bank. The cadastral location of the river is beyond the right bank and is more favourable. However, it is not wise to try to return the river to this as the works involved would be considerable, the land is developed now and the river is likely to always have a tendency to move towards the left bank.

River Distance 25.9 km Coulters Line Bridge

The river is significantly aggraded at Coulters Line Bridge. In years past there was plenty of clearance for passage of vehicles underneath, but that is impossible now – refer Photograph 8.

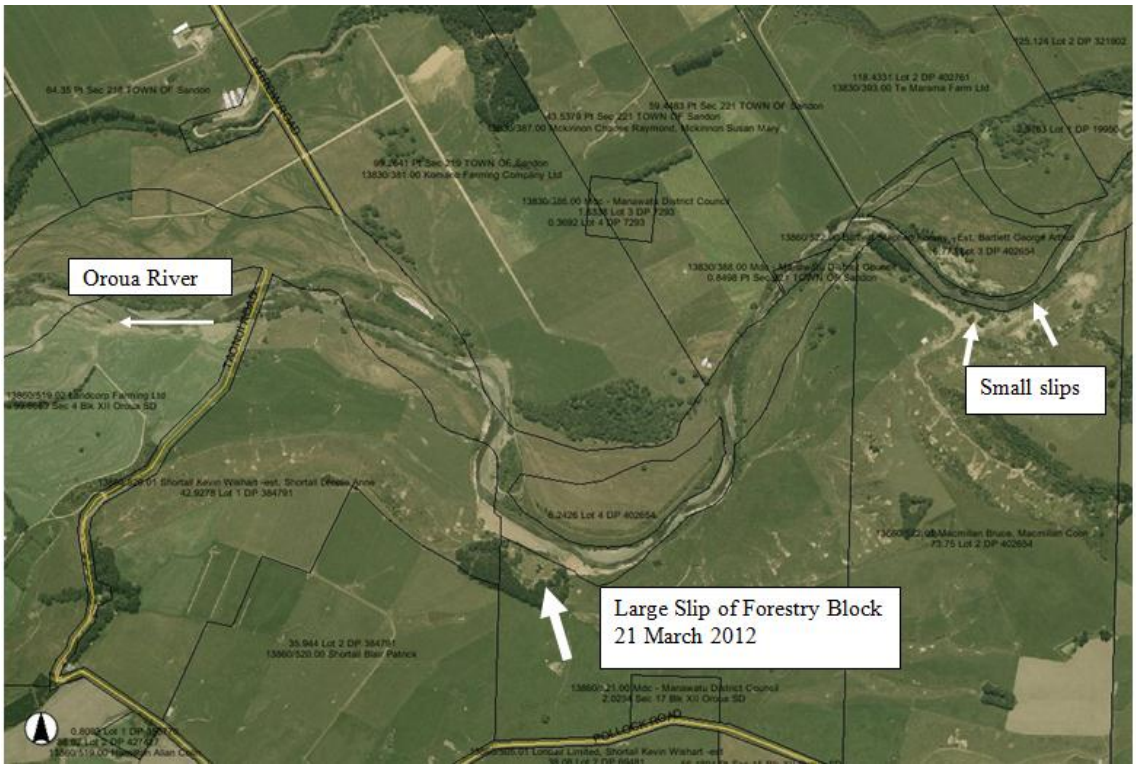
Photograph 8: Significant aggradation at Coulters Line Bridge 25.9 km

Further Inspection 22 May 2013

River Distance 19.7-24.2 km

Through this reach several slips are evident on the true left bank. Some smaller slips are active through the reach from 23.5 to 24.2 km, but these appear to currently be stable. There is a very large slip from river distance 19.7 to 20.0 km below a forestry block. During a

storm on 20 and 21 March 2012, this slip had a substantial collapse and completely blocked the river. The Oroua River was forced to travel across the adjoining pasture on the right bank, until a diversion channel was cut to return it to the old course. The flood event was 170 cumecs - almost exactly a mean annual flood.



Photographs 9 & 10: Large slip off forestry block at river distance 20 km

The face of the slip still appears most unstable, with tunnels evident also. There could be several modes of failure possible. Upstream of this slip a layer of papa is visible, but it appears to dip underneath the river and provide no support at the slip - refer Photograph 11. It is important that the current planting at the base of the slip is continued, to provide the best possible defence against undermining of the toe of the slip.

Photograph 11: Dipping papa layer upstream of large slip at river distance 20 km

The MDC water supply intake is located on the true right at river distance 22 km. Erosion risks at this site were mitigated by installation of a rock riprap lining in 2008. This was a complex design as the river is quite confined within this reach with high velocities. However, it is understood the works are functioning well – although not part of the Pohangina-Oroua Scheme.

River Distance 18.2-19 km

There is a small scale gravel extraction through this reach. Little is extracted and riverbed levels appear close to optimum. It is important that careful monitoring is applied so that this reach does not degrade, as it could adversely affect the stability of the slip upstream. However, it does not appear to be a factor in the 2012 collapse.

River Distance 12-19 km Barrow Road to Almadale Road

Through this reach the Scheme Manager reports that there are few areas of erosion and the reach appears to be in very good condition.

River Distance 7.5-12 km Almadale to Ridds Road (Spur Road LB)

Through this reach the Scheme Manager reports that there are few areas of erosion and again the reach appears to be in very good condition. The riverbanks very commonly grade easily down to the riverbed and erosion potential is low. Edge protection willows are well established throughout the reach. The below photograph shows the typical condition of this reach.

Photograph 12: Scheme in very good condition looking downstream from Almadale Road at river distance 12 km

There is a narrow reach just upstream of 11 km, but no evident associated problems in this case. The riverbed levels on the beach upstream appear close to optimum.

There are several PMUs in very good condition on the left bank at river distance 10.8 km. There is a further set of PMUs on the left bank also in very good condition extending for 300 m between 9.5 - 9.8 km. These PMUs are very well founded with the rail irons some 6 m long and that is critical to their success. The planting that follows their installation is also critical to a long-term erosion protection solution.

Refer to Photographs 13 and 14.

Gravel levels on the beach on the left bank at river distance 9.5 - 9.8 km are maybe slightly above optimum and the rear portions of this beach could be lowered – refer Photograph 13.

Photographs 13 & 14: PMUs providing good riverbank protection on left bank river distance 9.5 to 9.8 km

River Distance 4-7.5 km Ridds Road (Spur Road LB) to Colyton Road

Again, through this reach, the Scheme Manager reports that there are few areas of erosion. Again many places the riverbanks grade easily down to the river and erosion potential is low. Refer Photograph 15.

Photograph 15: Looking upstream at river distance 7 km - riverbanks grading easily down to the river with low erosion potential

The buffer zone should be strengthened on the left bank at river distance 6.4 km – slightly downstream of the gravel extraction site. The river is currently not attacking this site and it provides a good opportunity to strengthen the buffer zone. There is also some erosion on the opposite riverbank, but it appears to be not progressing at present. This should be monitored and if it continues then causes and remedial works identified.

The river travels round the very sharp 180 degree bend from 5.5 to 5.9 km with no apparent erosion. This may well be due to the PMU groynes established there.

At the gravel extraction reach around Colyton Road the riverbed levels appear to be around 0.5 m below optimum. Extraction should be carefully controlled to avoid developing erosion problems.

River Distance 1.5-4 km Colyton Road to Reids Line East

The main concern through this reach is the lowered bed levels and the consequent need to install several lengths of demolition concrete protection works – and their extension

downstream to the Kiwitea Stream (in the LMS Scheme). The nature of the riverbank stability noticeably changes from the upstream stable reaches.

Bed levels through this reach are noticeably lower than in the upstream reaches to Barrow Road. For example at the gravel extraction plant adjacent to the beach extending between 2.6 and 2.9 km the riverbed levels are at least 1 m below optimum, and maybe 1.5 m below. Extraction should be ceased at this site as soon as practicable.

Similarly, the beaches adjacent to the extraction plant at 0.3 km are degraded, with the bed levels around 3 m below the adjoining farmland – and at least 1 m below optimum. Whilst this is outside of the scheme area the extraction here should be ceased until riverbed levels reached.

APPENDIX B

Process for Management of Erosion Control Works

The process to be followed for pre-approval and management of erosion protection works subject to landowner contributions is currently:

1. The need for works is identified either by the Scheme Manager or by the landowner concerned.
2. A site meeting is arranged by Scheme Manager and held with landowner within one week of initial contact, other than in exceptional circumstances. Scope of works, estimated costs, material requirements/responsibilities and inspection programme agreed in principle.
3. Formal agreement prepared by Scheme Manager and forwarded to property owner for signing, within two days of site meeting. (Note. It should be possible to complete agreements for most works at the initial site meeting).
4. Scheme Manager engages contractor and notifies OSH of intention to undertake 'notifiable work'.
5. Work commences and proceeds with periodic inspections.
6. Scheme Manager supervises work and signs off when completed to his satisfaction. The cost of supervision is met by the scheme.
7. HRC settles contractor's account.
8. Landowner issued an invoice from HRC for 60% of the total cost of the works.
9. The completed works are entered in the Pohangina-Oroua Scheme asset register.

APPENDIX C

Landowner Contributions to Erosion Control Works 2008-12

Summary by landowner:

Landowner	2008-09	2009-10	2010-11	2011-12	Total
Oroua	**$41,055**	**$33,658**	**$73,495**	**$50,357**	**$198,565**
Christie				687	687
Collis	1,395	750			2,145
Genet			2,428		2,428
Hoggard	14,915	10,108	7,731	4,312	37,066
James			478		478
Landcorp				10,375	10,375
Malcolm			16,888		16,888
Manville	21,025	9,231	4,457	5,388	40,101
Martin				1,889	1,889
Mathews			3,817		3,817
Miln		2,074	10,114	6,019	18,207
Nesdale		1,941		1,349	3,290
Pettigrew		2,250		11,976	14,226
Roberts			12,271		12,271
Silk		3,704			3,704
Smyth	3,720		15,310	5,171	24,200
Smyth / Roache / Nesdale / Paki Iti		3,600			3,600
Thevenard				3,193	3,193
Pohangina	**$36,661**	**$15,329**	**$61,287**	**$55,726**	**$169,003**
Akers		5,675	6,200	4,472	16,347
Bolton		5,139		8,040	13,179
Carroll			2,045	752	2,797
Dutt	4,793				4,793
Edwards	11,475		3,750	443	15,668
Fairless				8,346	8,346
Galyer			5,453	5,346	10,799
Johnston				9,998	9,998
Jones		1,536	983		2,519
Leamy	2,937		8,550	8,604	20,092
MacDonald	8,637		11,411	2,496	22,544
Passey	8,819		15,929	1,281	26,029
Roberts			1,927		1,927
Spelman				368	368
Ward		2,979	5,039	5,580	13,598
Total	**$77,717**	**$48,987**	**$134,782**	**$106,083**	**$367,568**

Schedule of Erosion Control Works 2008-12

River	Distance	Bank	Landowner	Works	Qty	Total	Scheme	Local
2008-09						100%	25%	75%
Pohangina	15	RB	Leamy	LTBPW	60	3,916	979	2,937
Pohangina	15	LB	MacDonald	LTBPW	120	11,517	2,879	8,637
Pohangina	17	RB	Edwards	Tree Groynes	160	15,300	3,825	11,475
Pohangina	19	RB	Dutt	LTBPW	50	6,390	1,598	4,793
Pohangina	21	RB	Passey	LTBPW	20	1,390	348	1,043
Pohangina	21	RB	Passey	LTBPW	40	4,094	1,024	3,071
Pohangina	21.1	RB	Passey	LTBPW	45	4,041	1,010	3,031
Pohangina	23	RB	Passey	LTBPW	40	2,233	558	1,675
						$48,883	**$12,221**	**$36,662**
Oroua	24	RB	Hoggard	LTBPW	60	6,078	1,519	4,558
Oroua	27	RB	Hoggard	LTBPW	80	13,809	3,452	10,357
Oroua	28.5	LB	Manville	LTBPW	160	28,034	7,008	21,025
Oroua	35	RB	Smyth	Groynes	120	4,960	1,240	3,720
Oroua	43	LB	Collis	LTBPW	30	1,860	465	1,395
						$54,741	**$13,685**	**$41,055**
2009-10						100%	40%	60%
Pohangina	1.2	LB	Bolton	Tree Groynes	280	8,565	3,426	5,139
Pohangina	3.9	RB	Akers	LTBPW	70	3,534	1,414	2,120
Pohangina	5.6	LB	Akers	LTBPW	50	1,845	738	1,107
Pohangina	7	LB	Akers	LTBPW	120	4,080	1,632	2,448
Pohangina	8	RB	Jones	LTBPW	50	2,560	1,024	1,536
Pohangina	15	LB	Ward	LTBPW	40	4,965	1,986	2,979
						$25,550	**$10,220**	**$15,330**
Oroua	24	RB	Hoggard	LTBPW	50	4,330	1,732	2,598
Oroua	24.3	LB	Silk	LTBPW	40	2,723	1,089	1,634
Oroua	24.8	RB	Hoggard	LTBPW	100	12,518	5,007	7,511
Oroua	27.2	LB	Manville	LTBPW	30	4,948	1,979	2,969
Oroua	28.9	LB	Manville	LTBPW	50	9,163	3,665	5,498
Oroua	28.9	LB	Manville	Tree Groynes	40	1,275	510	765
Oroua	32	LB	Smyth / Roache / Nesdale / Paki Iti	Tree Groynes	140	6,000	2,400	3,600
Oroua	33.5	LB	Silk	LTBPW	40	3,451	1,380	2,070
Oroua	36.7	LB	Miln	Tree Groynes	60	3,456	1,382	2,074
Oroua	39.2	LB	Collis	LTBPW	30	1,250	500	750
Oroua	39.6	RB	Pettigrew	Tree Groynes	40	3,750	1,500	2,250
Oroua	41	RB	Nesdale	Tree Groynes	80	3,235	1,294	1,941

						$56,096	**$22,438**	**$33,658**
2010-11						100%	40%	60%
Pohangina	4.5	LB	Carroll	LTBPW	30	3,408	1,363	2,045
Pohangina	6.8	LB	Akers	LTBPW	60	10,334	4,134	6,200
Pohangina	8		Jones	LTBPW	20	1,638	655	983
Pohangina	11.6	RB	MacDonald	LTBPW	60	6,500	2,600	3,900
Pohangina	13.5	LB	MacDonald	LTBPW	60	5,619	2,248	3,371
Pohangina	13.6	LB	MacDonald	LTBPW	60	5,619	2,248	3,371
Pohangina	14.2	RB	Leamy	LTBPW	40	9,028	3,611	5,417
Pohangina	14.4	RB	Leamy	LTBPW	40	5,223	2,089	3,134
Pohangina	14.4	LB	MacDonald	RipRap	30	1,280	512	768
Pohangina	15	LB	Ward	LTBPW	40	7,476	2,990	4,486
Pohangina	16.4	LB	Ward	RipRap	30	922	369	553
Pohangina	16.8	RB	Edwards	Repair Groynes	80	6,250	2,500	3,750
Pohangina	19.5	RB	Galyer	LTBPW	60	9,088	3,635	5,453
Pohangina	21	RB	Passey	LTBPW	60	11,063	4,425	6,638
Pohangina	22	RB	Passey	LTBPW	40	4,556	1,823	2,734
Pohangina	22	RB	Passey	LTBPW	40	4,040	1,616	2,424
Pohangina	23	RB	Passey	LTBPW	60	6,890	2,756	4,134
Pohangina	33.2	RB	Roberts	LTBPW	100	3,211	1,285	1,927
						$102,144	**$40,858**	**$61,287**
Oroua	3.6	LB	James	LTBPW	15	797	319	478
Oroua	4.5	RB	Malcolm	LTBPW	120	15,806	6,322	9,484
Oroua	4.6	RB	Malcolm	LTBPW	80	8,666	3,467	5,200
Oroua	6.5	RB	Malcolm	LTBPW	40	3,675	1,470	2,205
Oroua	8.4	RB	Roberts	LTBPW	120	18,308	7,323	10,985
Oroua	8.8	RB	Roberts	LTBPW	20	2,144	858	1,286
Oroua	10.5	RB	Genet	LTBPW	40	4,046	1,619	2,428
Oroua	14.5	LB	Mathews	LTBPW	120	6,362	2,545	3,817
Oroua	24.3	RB	Hoggard	LTBPW	30	3,891	1,557	2,335
Oroua	24.5	RB	Hoggard	PMU Repair	80	8,993	3,597	5,396
Oroua	27.2	LB	Manville	LTBPW	20	7,428	2,971	4,457
Oroua	32	RB	Smyth	LTBPW	40	11,949	4,779	7,169
Oroua	35.4	LB	Miln	LTBPW	80	8,832	3,533	5,299
Oroua	35.5	RB	Smyth	LTBPW	60	9,013	3,605	5,408
Oroua	36	RB	Smyth	Tree Groynes	60	4,555	1,822	2,733
Oroua	36.4	RB	Miln	Tree Groynes	60	4,495	1,798	2,697
Oroua	36.5	LB	Miln	Tree Groynes	50	3,530	1,412	2,118
						$122,492	**$48,997**	**$73,495**

2011-12						100%	40%	60%
Pohangina	1.2	LB	Bolton	TBPW	200	13,400	5,360	8,040
Pohangina	4.8	RB	Johnston	TBPW	100	16,663	6,665	9,998
Pohangina	6.8	LB	Akers	TBPW	70	7,453	2,981	4,472
Pohangina	10.7	LB	Spelman	TBPW	30	614	246	368
Pohangina	13.8	RB	MacDonald	TBPW	60	4,160	1,664	2,496
Pohangina	14.4	RB	Leamy	TBPW	120	14,340	5,736	8,604
Pohangina	15.5	LB	Ward	TBPW	60	3,680	1,472	2,208
Pohangina	15.6	LB	Ward	Riprap	20	1,260	504	756
Pohangina	16.2	LB	Ward	TBPW	60	4,359	1,744	2,616
Pohangina	16.5	RB	Edwards	TBPW		738	295	443
Pohangina	16.7	RB	Fairless	TBPW	200	13,911	5,564	8,346
Pohangina	19.5	RB	Galyer	TBPW	80	8,911	3,564	5,346
Pohangina	21.1	LB	Carroll	TBPW	40	1,253	501	752
Pohangina	21.1	RB	Passey	TBPW	40	2,135	854	1,281
						$92,877	**$37,151**	**$55,726**

Oroua	7.6	RB	Martin	TBPW	30	3,148	1,259	1,889
Oroua	8.3	RB	Christie	TBPW	30	1,145	458	687
Oroua	17.9	LB	Landcorp	TBPW	120	11,528	4,611	6,917
Oroua	18.7	LB	Landcorp	TBPW	60	5,764	2,306	3,458
Oroua	23.5	RB	Hoggard	TBPW	180	7,186	2,875	4,312
Oroua	28	LB	Manville	TBPW	60	8,980	3,592	5,388
Oroua	32	RB	Smyth	TBPW	40	4,309	1,724	2,585
Oroua	33	RB	Smyth	TBPW	40	4,309	1,724	2,585
Oroua	36.4	LB	Miln	TBPW	60	10,032	4,013	6,019
Oroua	38.4	RB	Thevenard	TBPW	60	5,322	2,129	3,193
Oroua	40	RB	Pettigrew	TBPW	150	19,959	7,984	11,976
Oroua	40	LB	Nesdale	TBPW	40	2,248	899	1,349
						$83,928	**$33,571**	**$50,357**

APPENDIX D

Proposed Long-term Drain Maintenance Programme

	Length	Spray 0.35	Mech 0.9	Total 4 yrs	Avg per yr	Mgt 12hrs 100	Total per yr	2002 Classfn ha	Current Rates $	
Drain B	800	1680	720	2400	600	169	769	1.85	476	Low-subsidised by Ashhurst contrib
Drain C	1400	2940	1260	4200	1050	296	1346	4.85	1247	Ok with Ashhurst contrib
Dain H1	340	714	306	1020	255	72	327	1.96	504	>50% High
Drain H2	380	798	342	1140	285	80	365	2.20	566	>50% High
Drain H3	350	735	315	1050	262.5	74	337	2.02	520	>50% High
Drain N	2400	5040	2160	7200	1800	508	2308	8.32	2140	10% low
Total	5670	11907	5103	17010	4252.5	1200	5453	21.20	5453	

Management 12

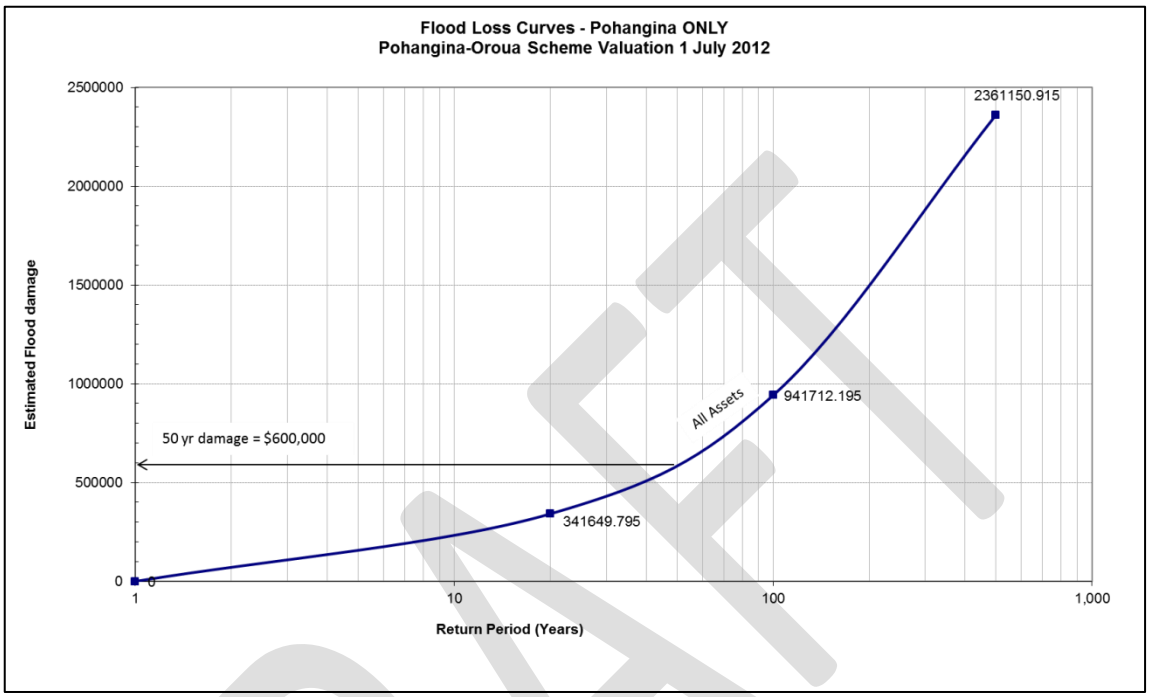
Management on Average I would Spend 12 hours a year in total on drains, that includes two lots of inspections then organising staff or contractor.

Spray twice each year
Mech clean every 4 years (no spray that yr)
Mgt 12 hrs

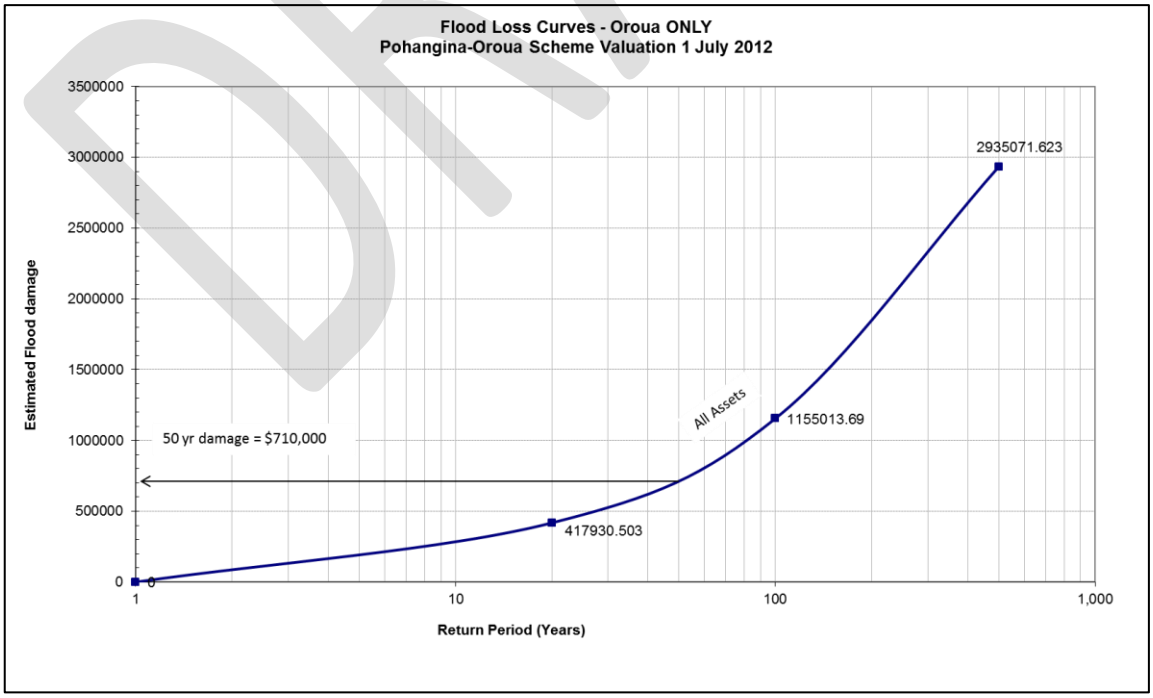
Each drain sprayed twice per year except every fourth year a mechanical clean.
Length based 25 m wide buffer area approach to rating is appropriate rather than current area allocation.

APPENDIX E

Flood Loss Curves for Each River



Flood Loss Curve - Pohangina River



Flood Loss Curve - Oroua River

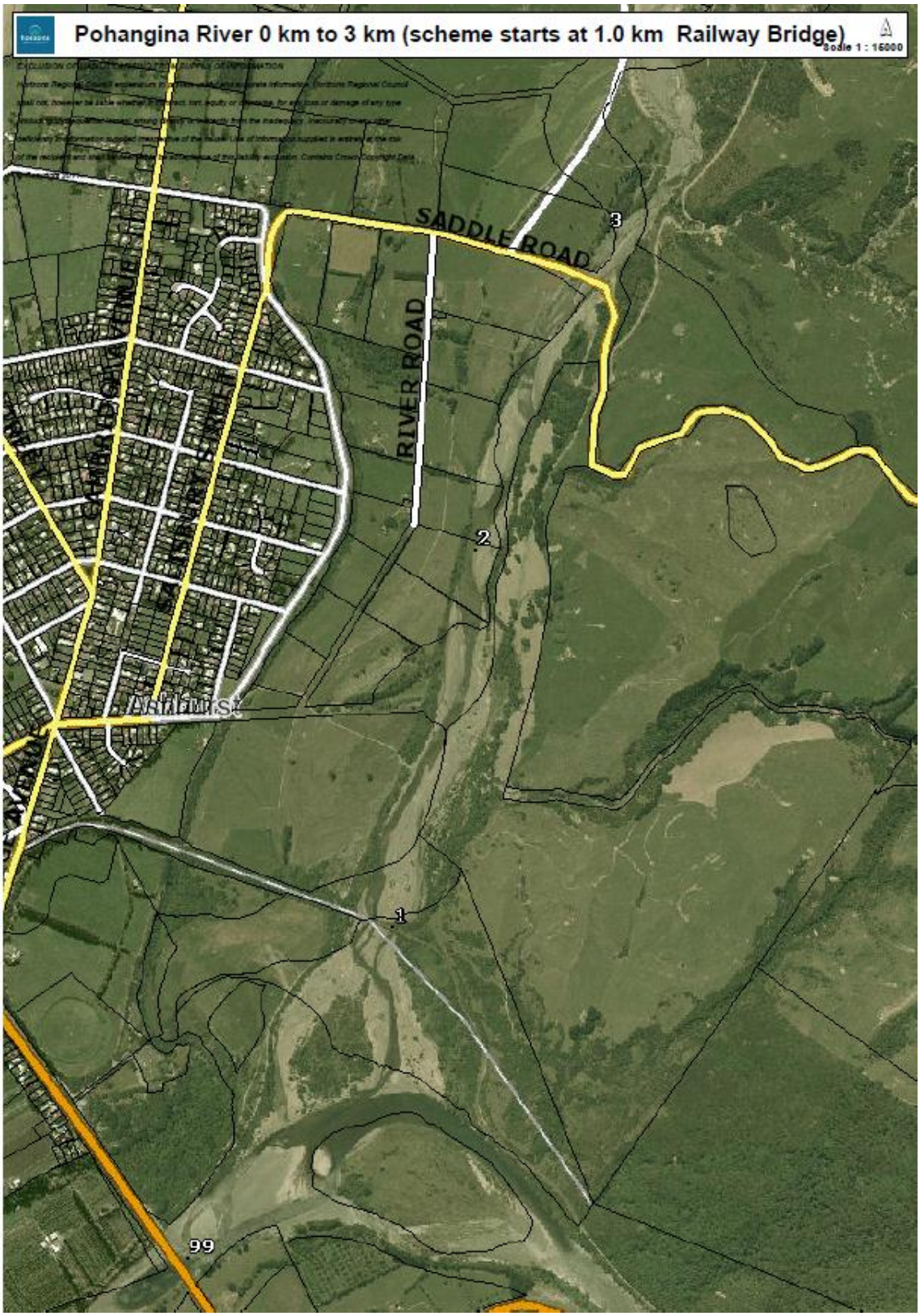
APPENDIX F

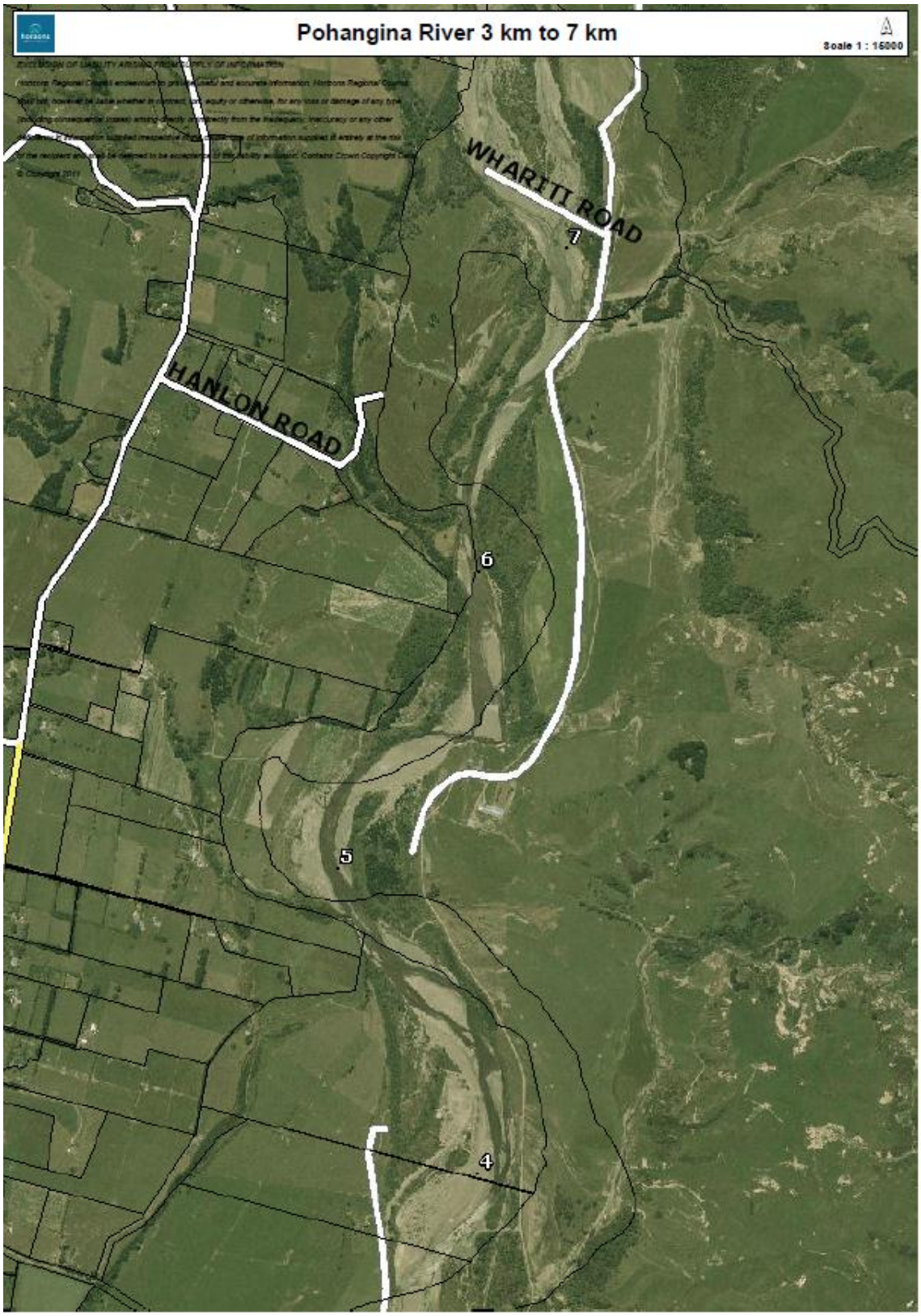
50 yr Probable Annual Damage Model									
4 yr PAD	105,000	area under curve to 4yr (0.25 probability)							
4-50yr PAD	189,430	area under curve 4yr to 50 yr (0.25 to 0.02 probability)							
Scheme PAD <50yr	294,430								
>50 yr PAD (Govt/other)	43,604	area under curve 50yr to 500 yr (0.02 to 0.002 probability)							
Total PAD (< 500yr)	338,035								
Scheme Funding for <50 yr	**2011-12**								
Annual ECW	100,000								
Reserves Contribution	67,334	53,867	before 20% future general rate contribution						
Loan repayments	62,868		Loan balance June 2012 = $263,890						
	230,202								
Scheme PAD <50 yr	294,430								
Extra funding req'd	64,229								
			Future loan	710,000	Period yrs	20			
Option 1 - Future Loan for Erosion Control Work			for Erosion Control Work		Interest	6.5%			
Scheme rates 2012-13	340,492	Excl GST			Payments	$64,437			
Loan $710k net (ECW only)	12,887				Less 20%	$12,887	general rate		
Increased rates req'd	4%				Less 60%	$38,662	Landowner contribution		
					Net Scheme	$12,887			
Option 2 - 50% Erosion Control Work 50% Channel Mtce									
Scheme rates 2012-13	340,492	Excl GST			Payments	$64,437			
Loan $710k net (50% ECW only	32,219				Less 20%	$12,887			
Increased rates req'd	9%				Less 60%/2	$19,331	Landowner share for 50% of total work		
					Net Scheme	$32,219			
Option 3 - no landowner contributions									
Scheme rates 2012-13	340,492				Payments	$64,437			
Loan $710k net	51,550				Less 20%	$12,887			
Increased rates req'd	15%				Net Scheme	$51,550			
Plus 60% of ECW	60,000								
	111,550								
	452,042	33%							

APPENDIX G
Ashhurst Stream Scheme - Urban Rating Area AC

APPENDIX H

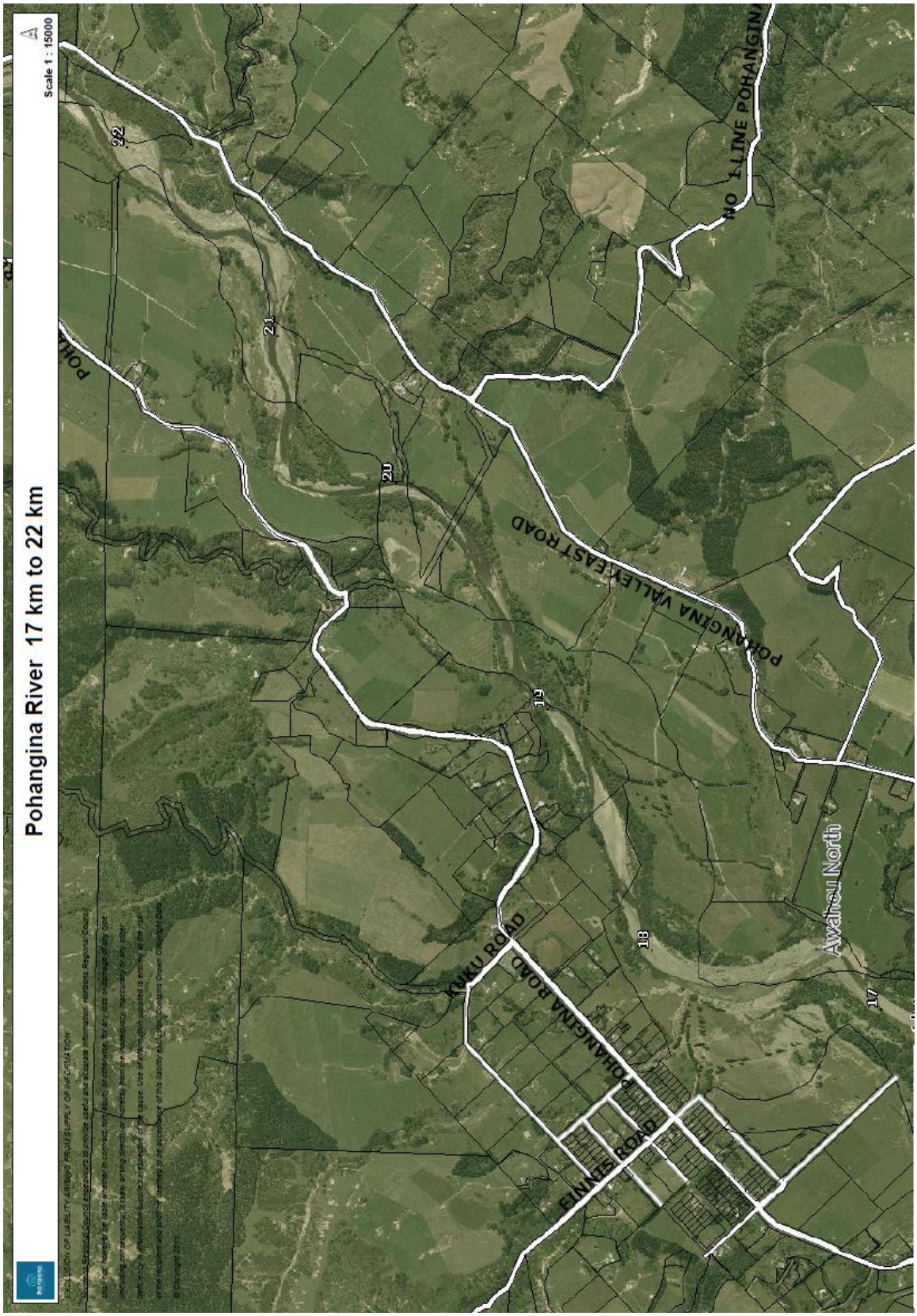
RIVER DISTANCES (2005 aerial photos)

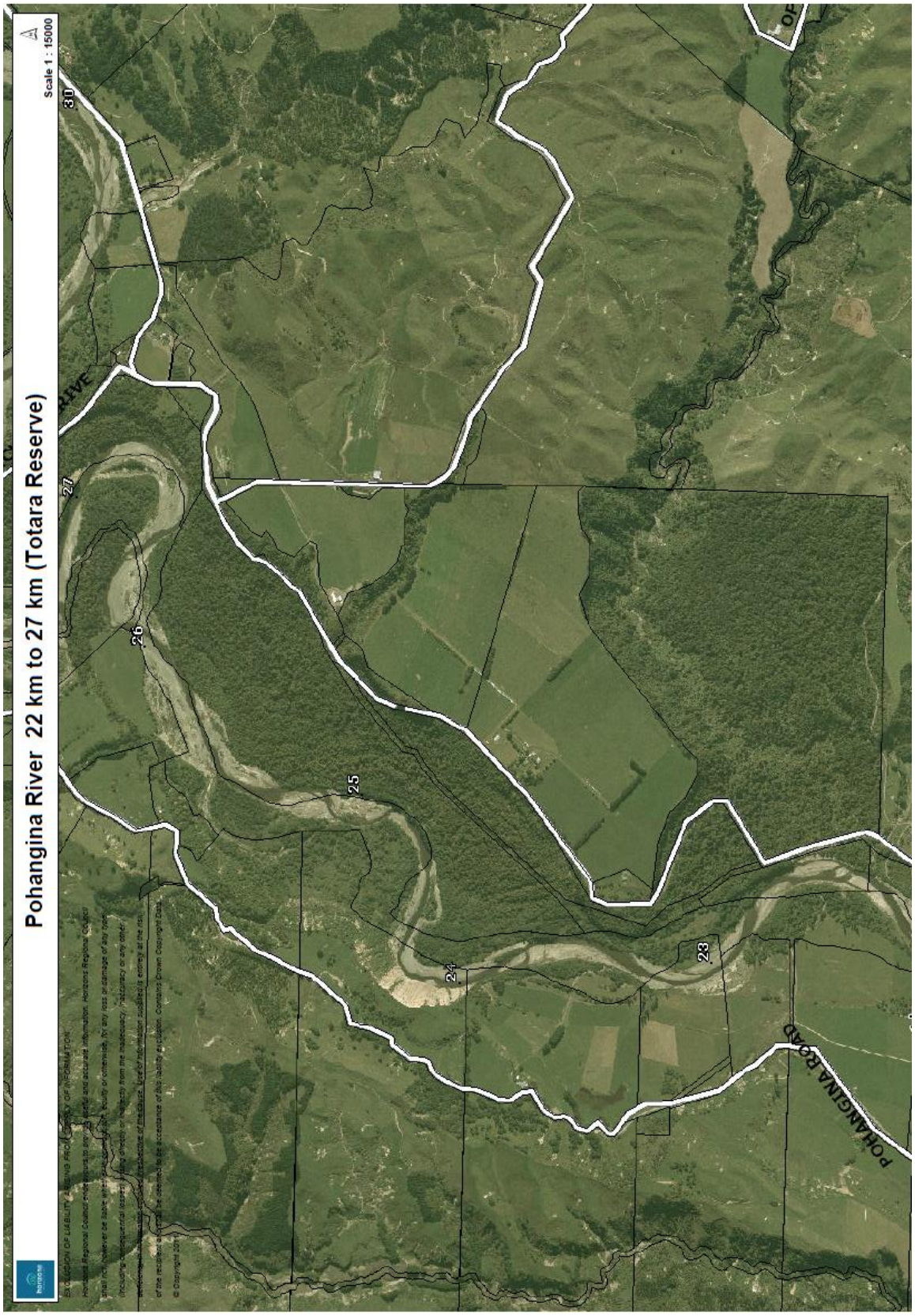

Pohangina River 0 km to 3 km (scheme starts at 1.0 km Railway Bridge)
Scale 1 : 16000
SADDLE ROAD
RIVER ROAD
3
2
1
99

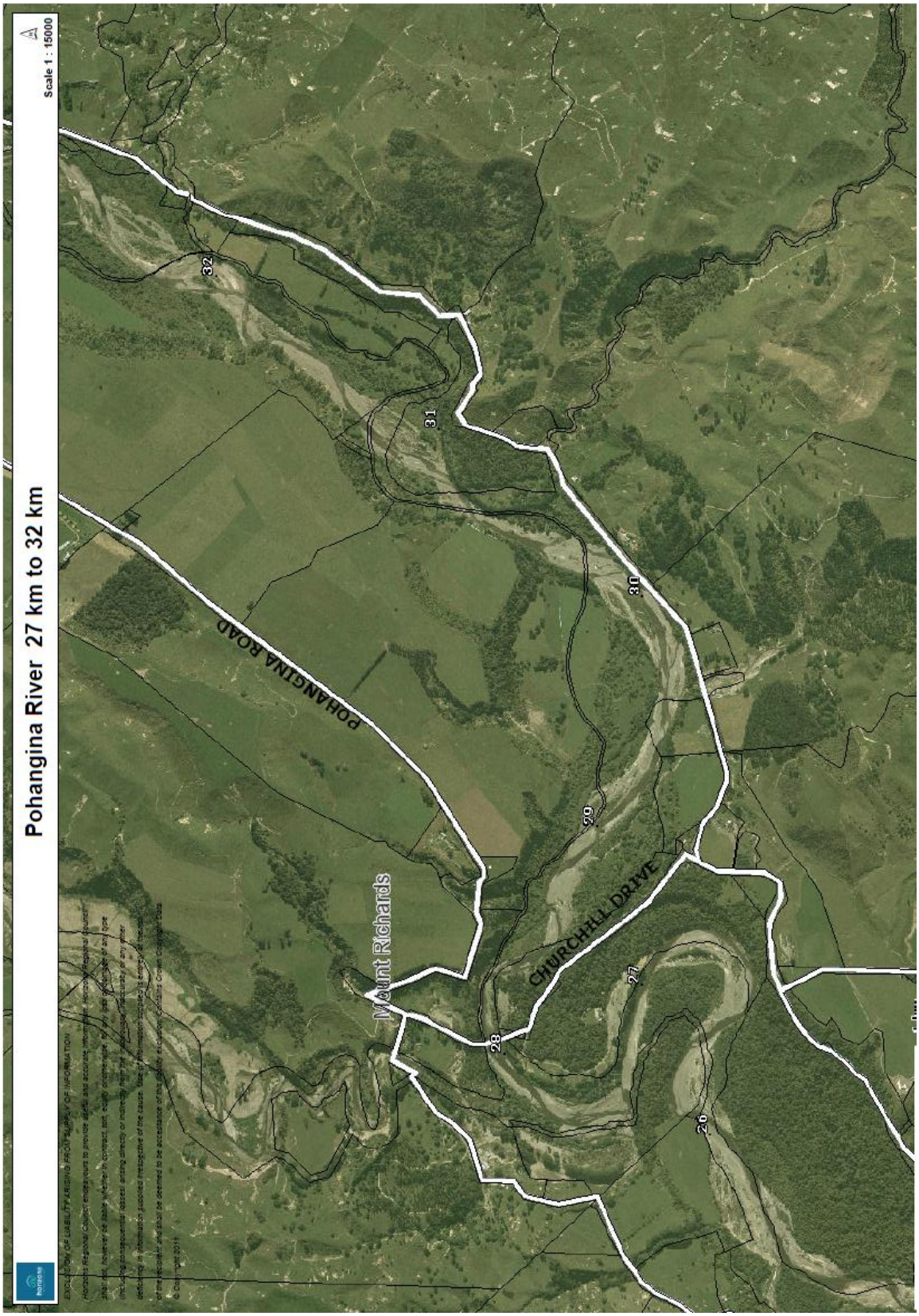

Pohangina River 3 km to 7 km
Scale 1 : 16000
WHARITI ROAD
HANLON ROAD
7
6
5
4

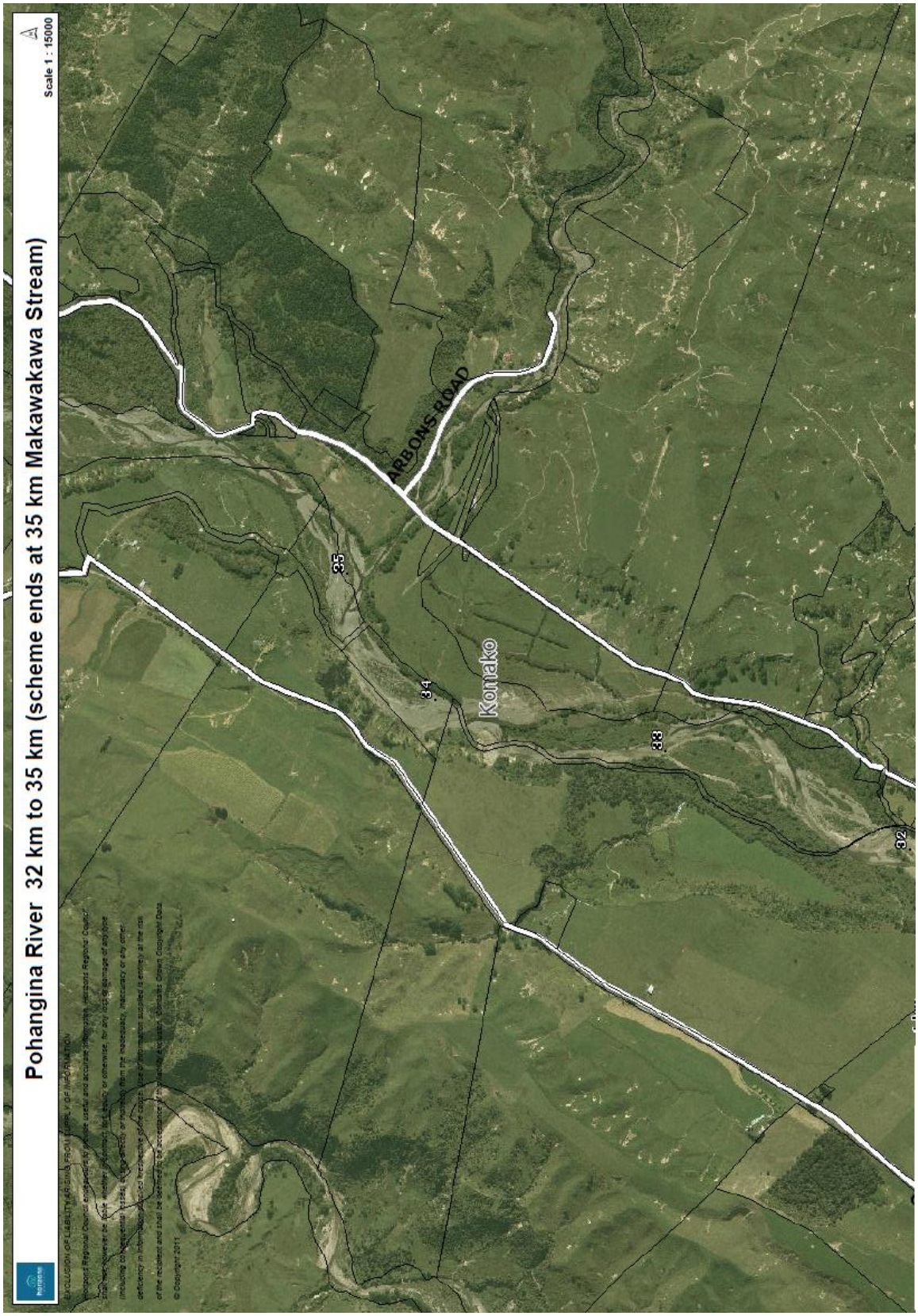

Pohangina River 8 km to 11 km
Scale 1 : 15000
POHANGINA ROAD
AWAHOU S
Awahou South
11
10
9
8

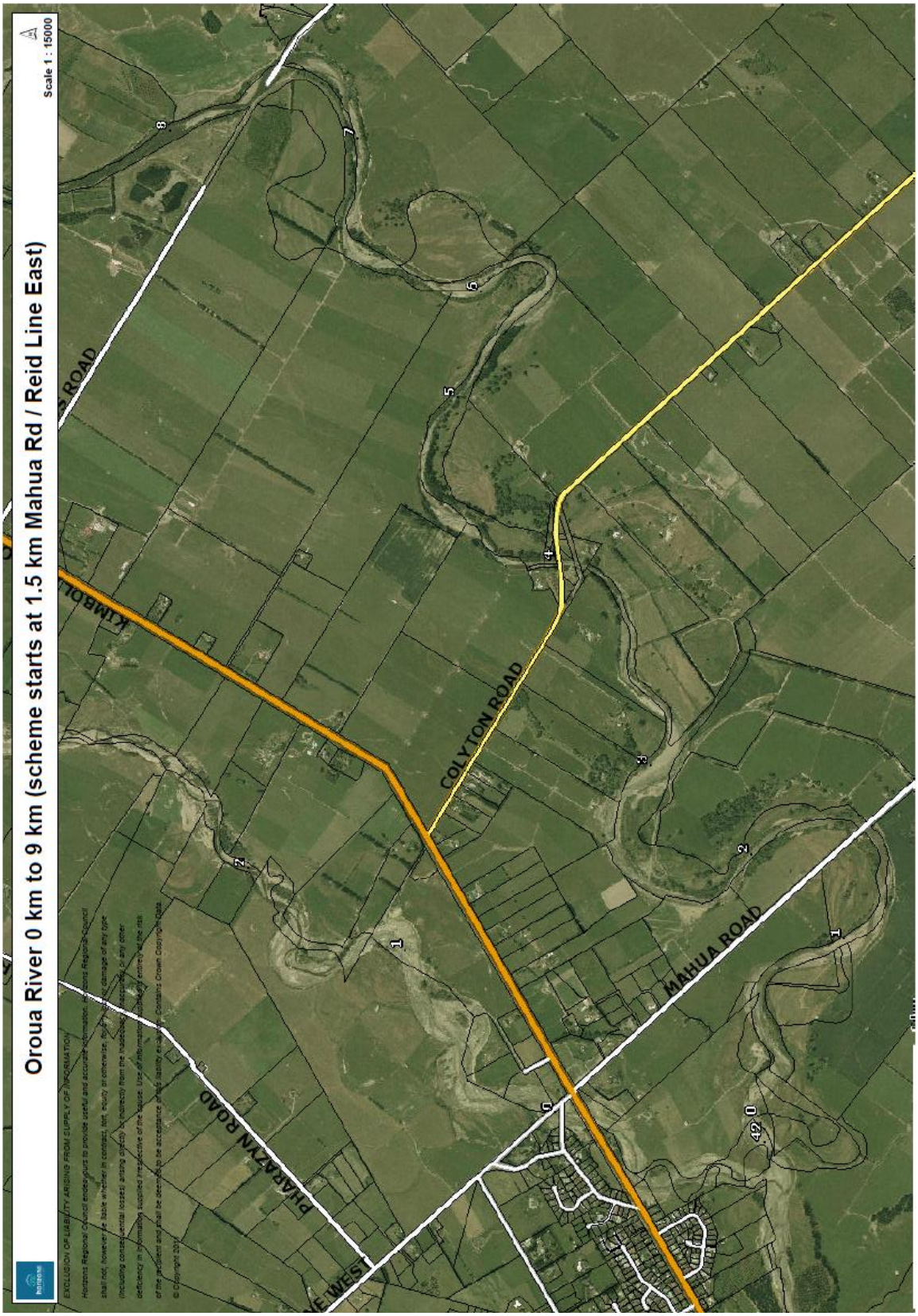

Pohangina River 12 km to 17 km
Scale 1 : 15000
16
15
14
13
12
POHANGINA VALLEY EAST ROAD
POHANGINA VALLEY EAST ROAD
Raumai

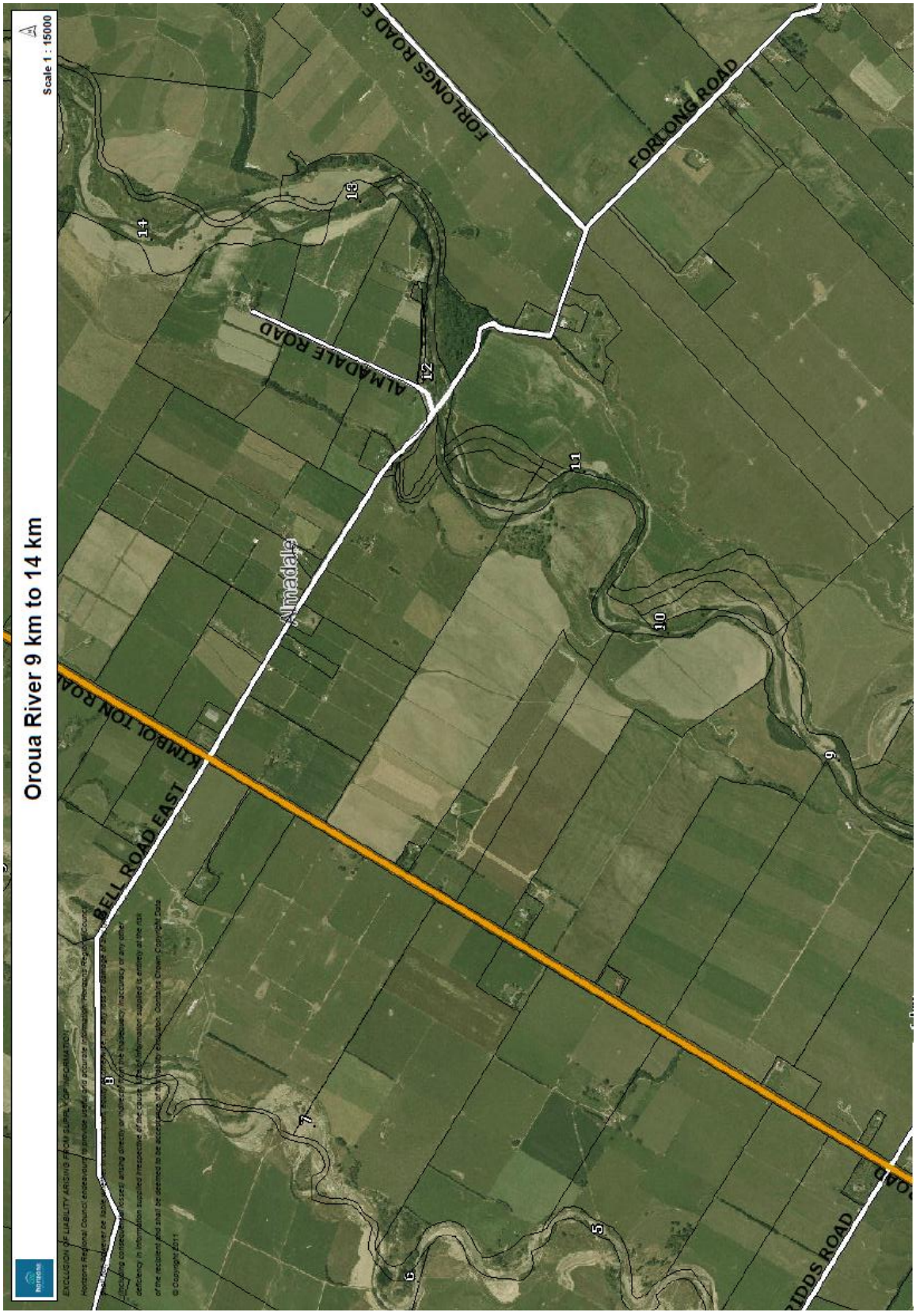

Pohangina River 17 km to 22 km
Scale 1 : 15000
22
21
20
19
18
17
POHANGINA VALLEY EAST ROAD
KUKU ROAD
POHANGINA ROAD
GINNS ROAD
Awahou North

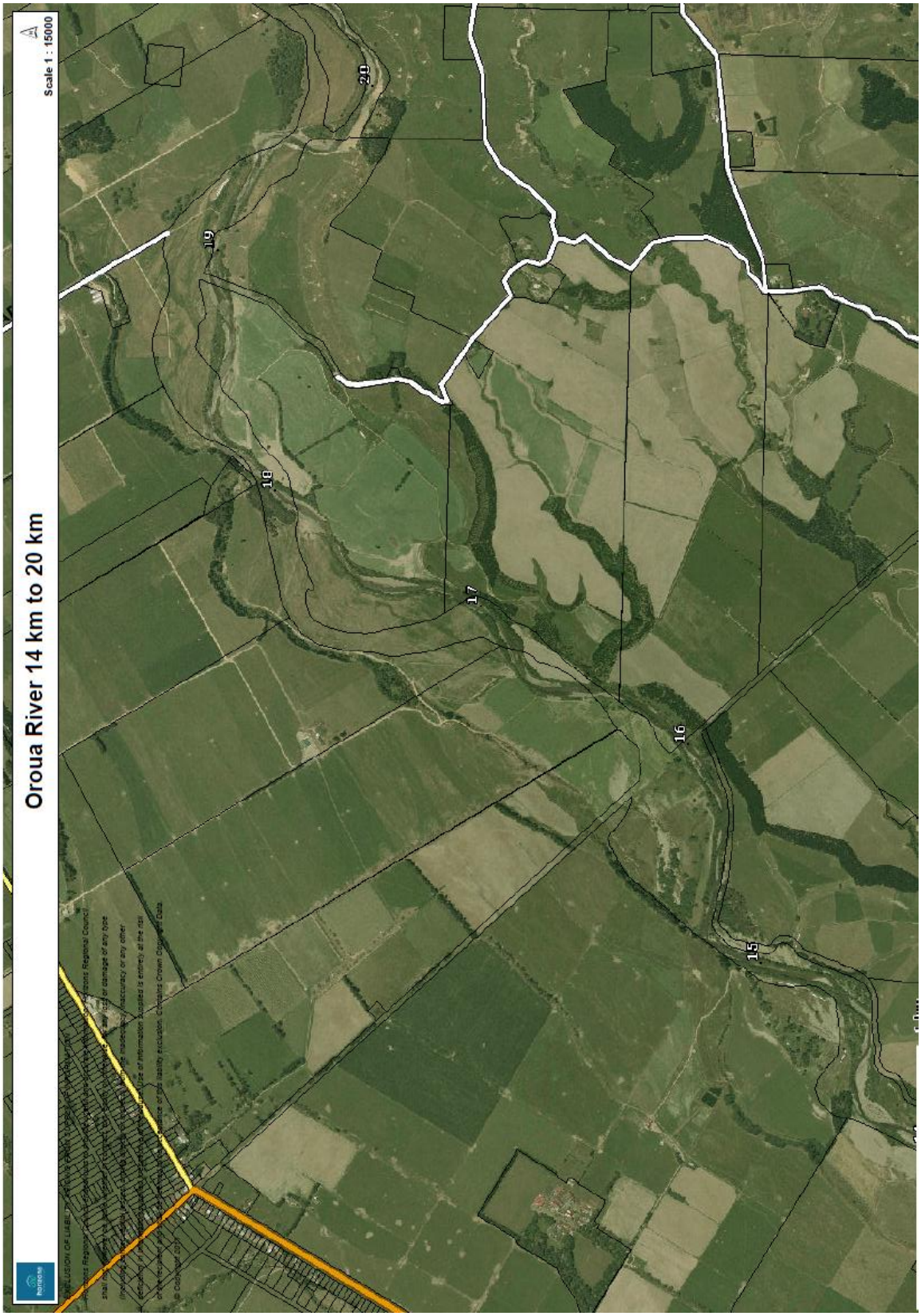

Pohangina River 22 km to 27 km (Totara Reserve)
Scale 1 : 15000
30
27
26
25
24
23
POHANGINA ROAD

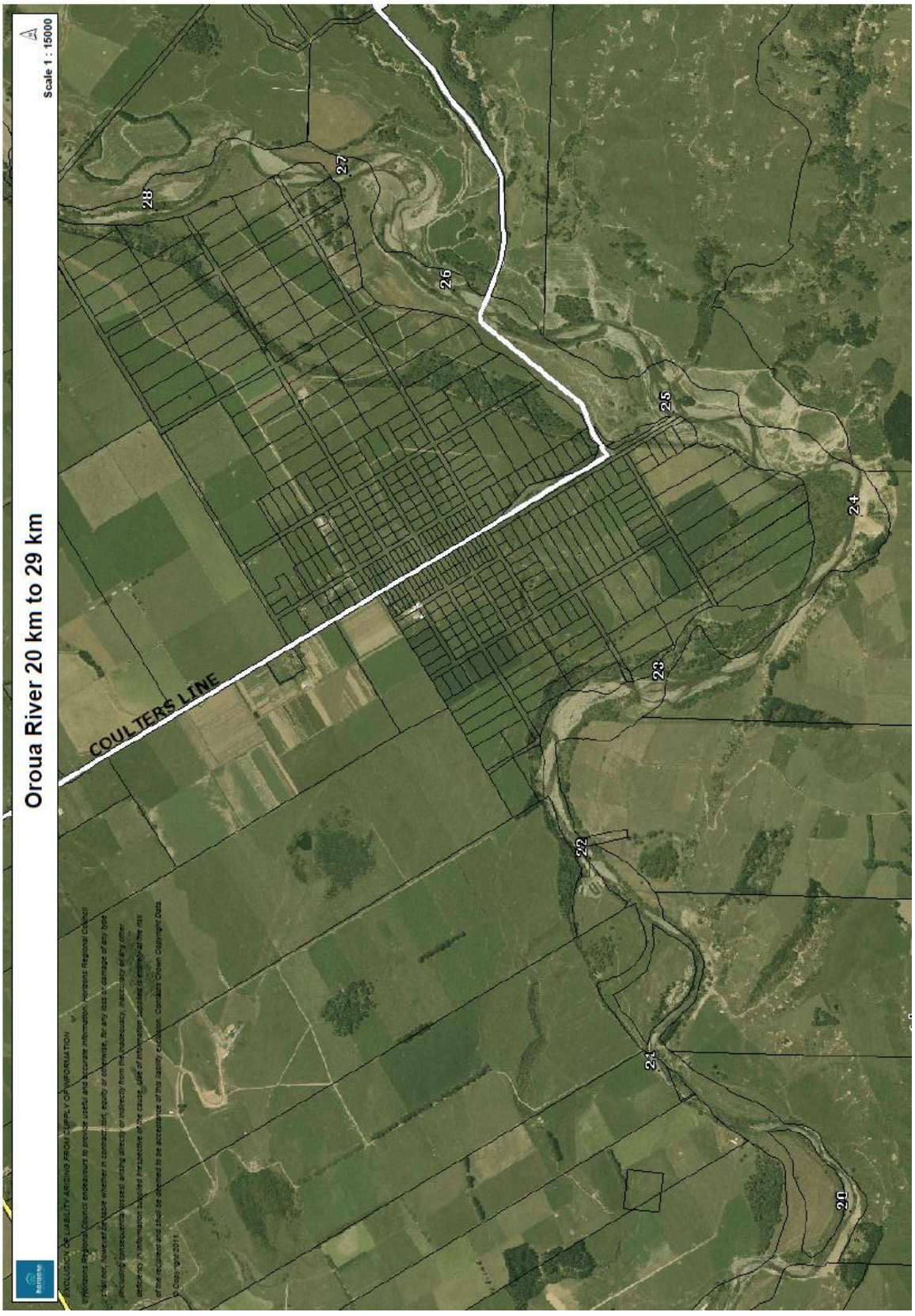

Pohangina River 27 km to 32 km
Scale 1 : 15000
POHANGINA ROAD
Mount Richards
CHURCHILL DRIVE
26
27
28
29
30
31
32


Pohangina River 32 km to 35 km (scheme ends at 35 km Makawakawa Stream)
Scale 1 : 15000
ARBONS ROAD
35
34
33
32
Komako

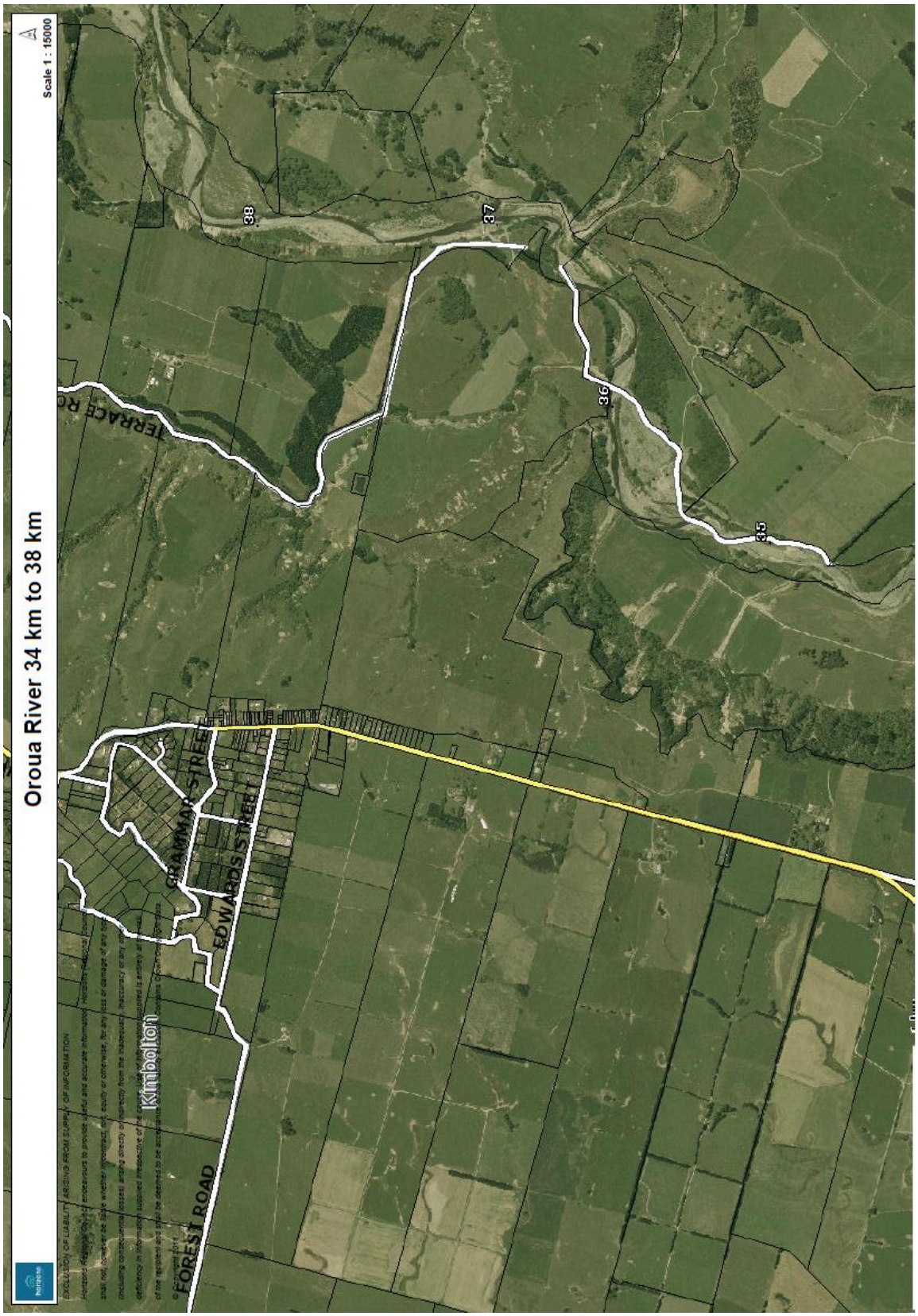

Oroua River 0 km to 9 km (scheme starts at 1.5 km Mahua Rd / Reid Line East)
Scale 1 : 15000
COLYTON ROAD
MAHUA ROAD
PHARAZYN ROAD
EXCLUSION OF LIABILITY ARISING FROM SUPPLY OF INFORMATION

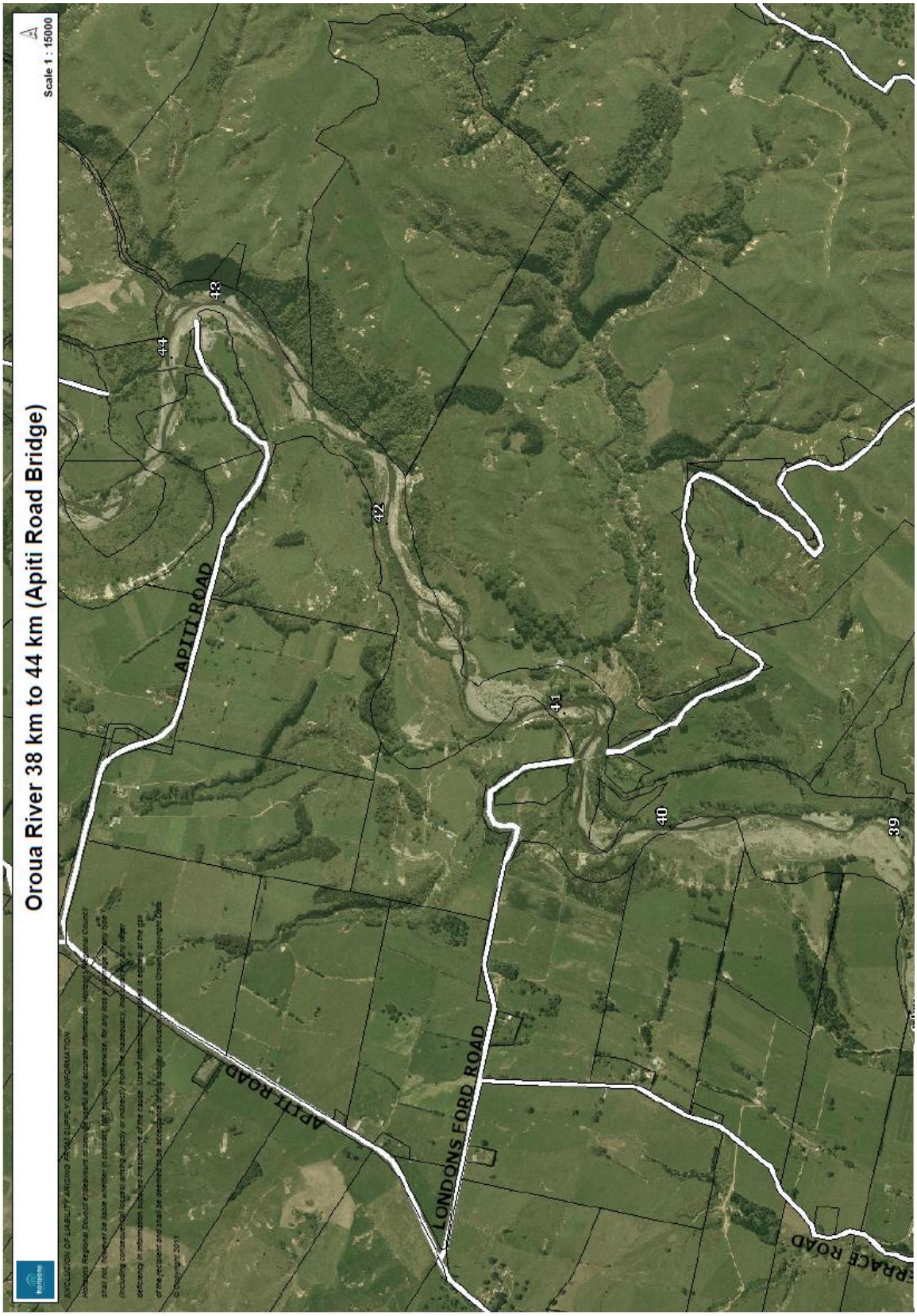

Oroua River 9 km to 14 km
Scale 1 : 15000
FORLONGS ROAD E
FORLONG ROAD
ALMADALE ROAD
Almadale
KIMBOLTON ROAD
BELL ROAD EAST
RIDDS ROAD
14
13
12
11
10
9
7
6
5


Oroua River 14 km to 20 km
Scale 1 : 15000
20
19
18
17
16
15


Oroua River 20 km to 29 km
Scale 1 : 15000
COULTERS LINE
20
21
22
23
24
25
26
27
28


Oroua River 29 km to 33 km (Goulters Gully)
Scale 1 : 15000
33
32
31
30
29
WA ROAD


Oroua River 34 km to 38 km
Scale 1 : 15000
38
37
36
35
TERRACE RO
GRAMMAR STREET
EDWARDS STREET
Kimbolton
FOREST ROAD


Oroua River 38 km to 44 km (Apiti Road Bridge)
Scale 1 : 15000
APITI ROAD
LONDONS FORD ROAD
APITT ROAD
43
44
42
41
40
39