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Analysis of the relationship between river management and bed level change in the Motueka River

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Analysis of the relationship between river management and bed level change in the Motueka River

Motueka Integrated Catchment Management
(Motueka ICM) Programme Report Series

by

Linde Henker and Les Basher

Landcare Research,
Private Bag 6
Nelson
NEW ZEALAND
Phone: 03 545 7700
Fax: 03 545 7701
Email: basherl@landcareresearch.co.nz

Cover Photo: Rock groynes and willows planted for bank protection in the Motueka River.

PREFACE

An ongoing report series, covering components of the Motueka Integrated Catchment Management (ICM) Programme, has been initiated in order to present preliminary research findings directly to key stakeholders. The intention is that the data, with brief interpretation, can be used by managers, environmental groups and users of resources to address specific questions that may require urgent attentin or may fall outside the scope of ICM research objectives.

We anticipate that providing access to environmental data will foster a collaborative problem-solving approach through the sharing of both ICM and privately collected information. Where appropriate, the information will also be presented to stakeholders through follow-up meetings designed to encourage feedback, discussion and coordination of research objectives.

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1 Introduction

Cross section surveys show the bed of the Motueka River has been degrading since the 1960s. Sriboonlue and Basher (2003) estimated a net mean bed level (MBL) change of –0.20 m between 1960 and 2000 in the upper Motueka (between the Wangapeka confluence and Norths bridge), and –0.64 m between 1957 and 2001 in the lower Motueka (between the coast and Alexander Bluff bridge). Gravel extraction is a significant factor contributing to this degradation and has been controlled since the 1950s because of concerns that it might lead to bank instability and lower groundwater levels. However, there remains considerable debate about the magnitude and significance of bed level degradation and there has been no quantitative analysis of the consequences of bed level degradation to bed and bank stability, or trends in groundwater level.

The Motueka Integrated Catchment Management programme has completed a comprehensive re-analysis of all the available bed level data (Sriboonlue and Basher 2003; Ball 2004) and is now examining the consequences of bed level degradation for bed and bank stability and groundwater levels. Bed level degradation varies considerably at different locations within the river. In the upper Motueka the change in mean bed level at individual cross sections ranged from –2.0 m to +0.65 m (Fig. 1), and in the lower Motueka it ranged from–2.82 m to +0.47 m (Fig. 2). It might be expected that where bed level degradation was greater there would be increased problems with bank instability as the river undermined and de-stabilised its banks, and therefore a greater requirement for river management to control bank instability.

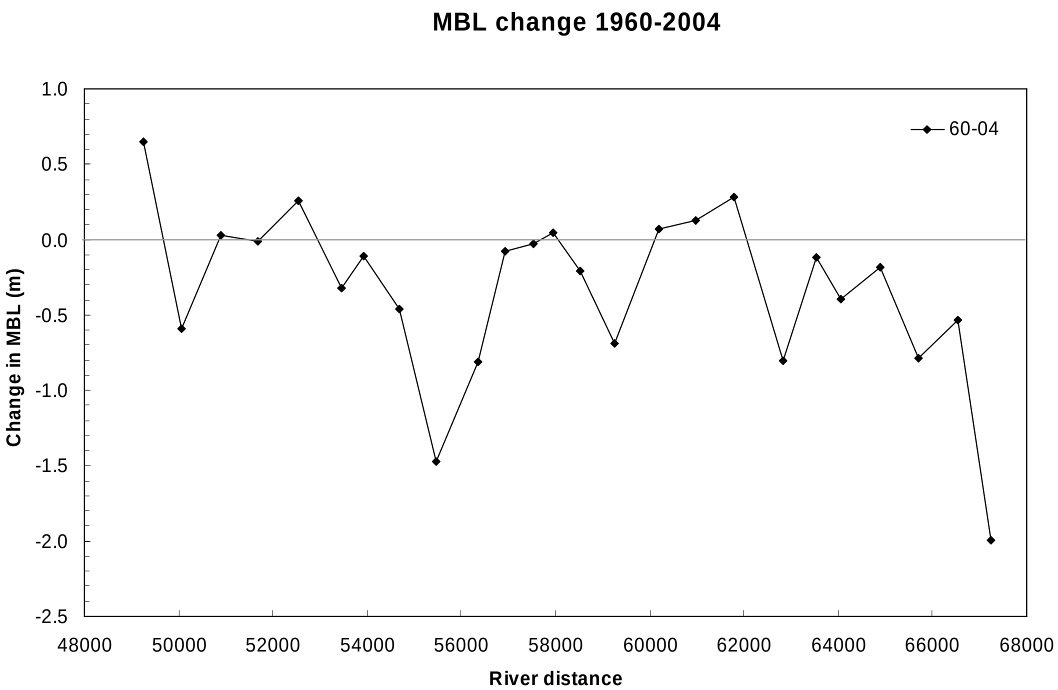


Fig. 1 Net change in mean bed level at upper Motueka cross sections 1960-2004

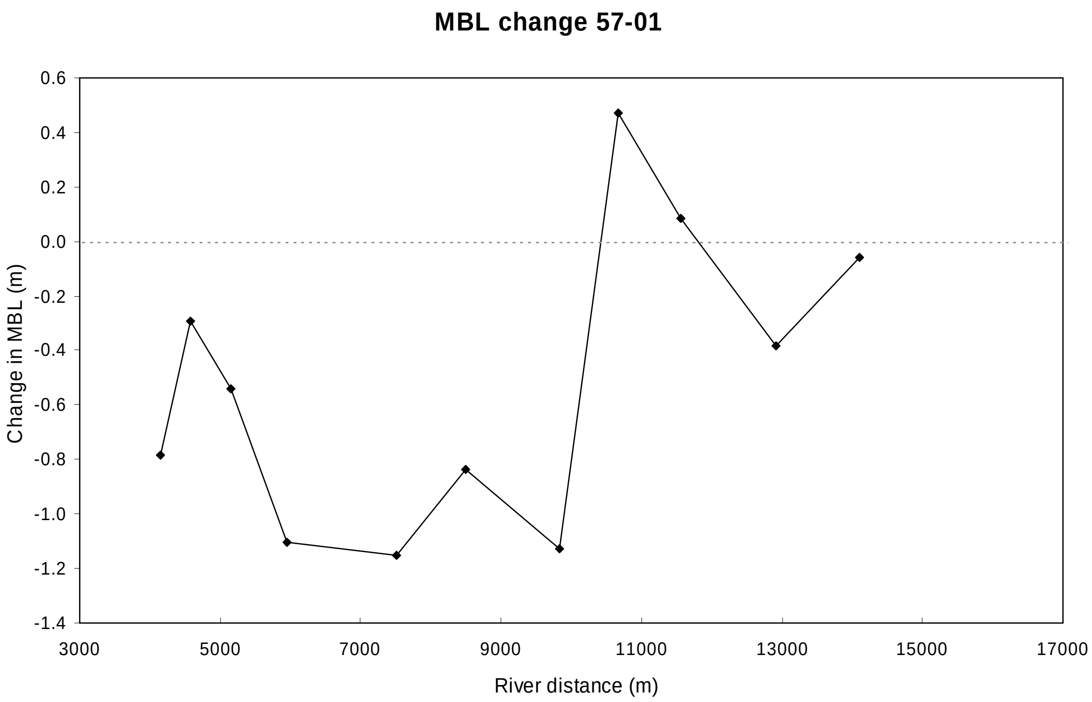


Fig. 2 Net change in mean bed level at lower Motueka cross sections 1957-2001

This report describes work aimed at assessing the relationship between bed level degradation and the amount of work undertaken for river control purposes, to test the proposition that bed level degradation increases bank instability and causes a greater requirement for river control works. The history of river management works undertaken in the Motueka River was compiled from Tasman District Council archives and is compared with the trends in bed level degradation. It was difficult to compile a reliable history of river management and the sources and limitations of the river management history data are also described.

2 Methodology:

2.1 Raw data sources

Appendix 1 shows the information sources used to compile a list of all the river management works carried out in the Motueka River between 1957 and 2004. There were three types of sources provided by the Tasman District Council:

- works programmes (annual or monthly budgeted work),
- work's reports (annual reporting of works undertaken during the year) and
- computer files (provided by Philip Drummond and Colin Moffatt).

These data sources contained information on the type of work carried out (often as a coded abbreviation), its location (start and end distances, and/or information about the owner of the property on which the work was done), and the cost.

The most comprehensive information came from annual or monthly Works programmes, either drafts or final versions. But the information was sometimes inaccurate and incomplete, especially for the older documents where only the owners name was recorded and not the river distances. Thus, it was sometimes hard to determine an exact location, since some owner's properties extend a considerable distance along the river and can overlap many cross-sections. For some works, neither the distances nor the owner's name were specified. The works description included the type, quantity and the unit of the work. Some files also contained the cost, the job number and comments. But the description, when provided, was not always clear as it contained only a few letter codes (e.g. RRR, RS, SB...) or a word, and some explanation from TDC staff was required to translate these codes. Secondly, cost rates (calculated by dividing the cost by the quantity), were rarely equal, even for a similar type of work from the same document source.

While works programmes were very useful in providing the works planned for the coming year, the information had to be used carefully. First, some of the programmes were in draft form with manuscript annotations, suggesting later versions might exist. Thus, changes such as cancellation or additions of works, or modification to the quantities or location of the works may have occurred between the programme preparation and the implementation of works. Second, works such as flood damage repairs would not appear in the programme and the amount of such work could be major for years during which big floods occured. Comparison of the Work's programme and the Works report for 1990-1991 showed little difference. By contrast, the operation committee report suggested that many works planned for the period 1982-1989 were not done. Where possible, information such as report observations (“work done"...), invoices for works, or a fax containing monthly programmes allowed us to select the works that we think were carried out.

The annual Works Reports were the most accurate data sources as they effectively list the works done each year (Appendix 1). Unfortunately these documents were only available for a few years (1990, 1991, 1992), and also had incomplete or inaccurate information, similar to the limitations previously cited for the Works programmes.

TDC (Colin Moffatt and Philip Drummond) also provided four computer files. Document 35 provided information about work carried under subcontract by Montgomery Watson Harza between 2000 and 2005, for which there were no paper records. The other files (documents 33, 34, 36) contained data for the period 1957-1999, and especially 1957-1980, for which there weren’t good paper records of all the works carried out. However, the latter computer files also have some limitations:

- uncertainty about their accuracy and origin as it is not known who compiled them and what data sources were used in the compilation;
- the computer records contain works that don’t appear in the paper copy Work’s Reports, even though the Work’s reports should be the most accurate documents and include all works implemented. In addition, there is some data on river works that obviously overlap (same type of work, same location) but differ in the quantity, cost or date.

It is likely that documents 33, 34, 36 were compiled by TDC using the same document sourcesn as we used. However, by comparing them with our data compilation it appears that the TDC documents sources differ from the Works programmes and Works Reports we used. Indeed, there are only a few obvious overlaps between the data in the TDC computer files and the data we have compiled from paper records. The TDC computer files contain more data than we compiled, and had data for the years where paper documents were missing (60-70, 95-96 and around 1980).

The combination of the various forms of document sources gave us a broad picture of the works carried out in the Motueka Rivers for the period 1957-2005. Nevertheless, we retain some doubts about how complete the information is, and whether there are some unresolved overlaps between the various data sources.

The data was compiled into a spreadsheet that included the following field headings:

- work location (owner, start distance, end distance, left or right river bank);
- work description (code, type of work, description of work, length, quantity, cost);

- date (year of work, survey period work fits in to);
- other information (job number, month, comments, sources of information, reliability and accuracy of information, overlaps with other data).

The data was then sorted, by time period and location, and classified, by the type of work and its relevance to river instability, in order to provide an overview of Motueka River management and to analyse the relationship of river works with bed level trends.

2.2 Data transformation

2.2.1 Ordering and Classification

2.2.1.1 Types of work

When the information was compiled, the "description of work" contained almost 300 individual terms. Therefore, we reduced the number of terms by grouping them and separating relevant terms from irrelevant ones. Works that didn't directly relate to river control were grouped in two categories: "Irrelevant" was used for terms such as "drain, fencing, berm planting…" and "Maintenance" for terms such as "cutting, layering,….". Then we separated the terms relating to vegetative bank protection, such as "planting, weighted willow, tying…", from terms relating to structural control such as "rock works, groynes, riprap, railway iron, stop bank".

After this ordering relevant works were still described by many different terms. After discussion with Philip Drummond and Eric Verstappen, we chose, in order to make this study also valuable for TDC, to use the asset management system classification used by TDC. This classification contains the categories rock protection, railway iron, weighted felled trees, willow planting, stop bank and these are the terms used for grouping the type of work in this study.

2.2.1.2 River distances

Most of the works had a start distance and/or a finish distance listed. However, for locations only described by the owner's name an approximate distance was used based on the location of other works done on the same property. If it was not possible to find an accurate location "?" was recorded for location.

The convention for recording river distance changed in 2001, assigning a river distance of 0 m at the coast, which had previously had a river distance of c.3000 m (determined from inspection of TDC plan 4214/1 – lower Motueka bench mark locations). In order to standardise river distances for the data before and after 2001, we assumed that the new "0" river distance value corresponds to 3000m for the pre-2001 distances (this was only applied to data taken from Document 35).

2.2.1.3 Timing of work

For some works, the date of the work was unclear, particularly in the Register.xls file (Document 33; e.g., the date could be described as "63-64-72, 1991"). It is not clear whether this means that this work had been carried out during the period 1963-72 and during the year 1991, or had been carried out four times in 1963, 1964, 1972 and 1991. We decided to use the first interpretation where dates were closely spaced , and the latter when the years were spread in time.

2.2.1.4 Choice of the relevant information

Because most of our information sources were Work programmes, we needed to differentiate between the works that had been programmed and the ones that were implemented. We used the following code in the spreadsheet column "Accuracy":

R: Works listed in the TDC computer files, which we considered as works that had been done.
1: Works that we knew have been done, because the information came from a report or because of proof such as manuscript notes and invoices.
2: Works that had been programmed and which appear in the monthly programme or fax correspondence but which we are uncertain whether they had been done. Thus, it is possible that these works had been done.
3: Works that were programmed, but nothing demonstrated they had been done. Therefore we assumed they have not been carried out.

For this study, we decided to analyse only the works from categories R and 1. Therefore, in the spreadsheet column "state": "D" (for done) was recorded for the works we used for this study, and "?" for the others where their status was unclear. This would allow adding, in the future, categories 2 and 3, if it was decided they had been completed.

2.2.1.5 Overlaps and contradictory information

There were several different kinds of overlaps of information:

1. Overlaps between our data compilation and the TDC compilation. In some case, the overlaps were not always obvious at first, as the date, the cost or the quantity could differ, such as indicated below:

From	To	True	Work	Quantity	Unity	Cost	date	Sources
68250		L	Rock	50	m^3	2040	2000	Doc 36
68250		L	Add Rock	50	m^3		1999	Doc 15
56250	56310	R	Rock	170	m^3	6936	1999	Doc 36
56250	56310	R	Add work	170	m^3	5610	1998	Doc 27

2. Overlaps within the TDC files. These were also difficult to find: Indeed, the following table suggests three different works. But, in fact, date of work 3 (and generally, the date contained in Doc 36), is only the average of the two dates of Doc 34, thus work 3 is only an overlap. In addition, the quantity, unity and price, are not similar even if it's an overlap, which could also hide some overlaps.

	From	To	True	Work	Quantity	Unity	Price	Date	Sources
1	54400	54750	L	WP	1200	SQM	30000	1983	Doc 34
2	54400	54750	L	WP	1200	SQM	30000	1987	Doc 34
3	54400	54750	L	WP	12000	m	144000	1985	Doc 36

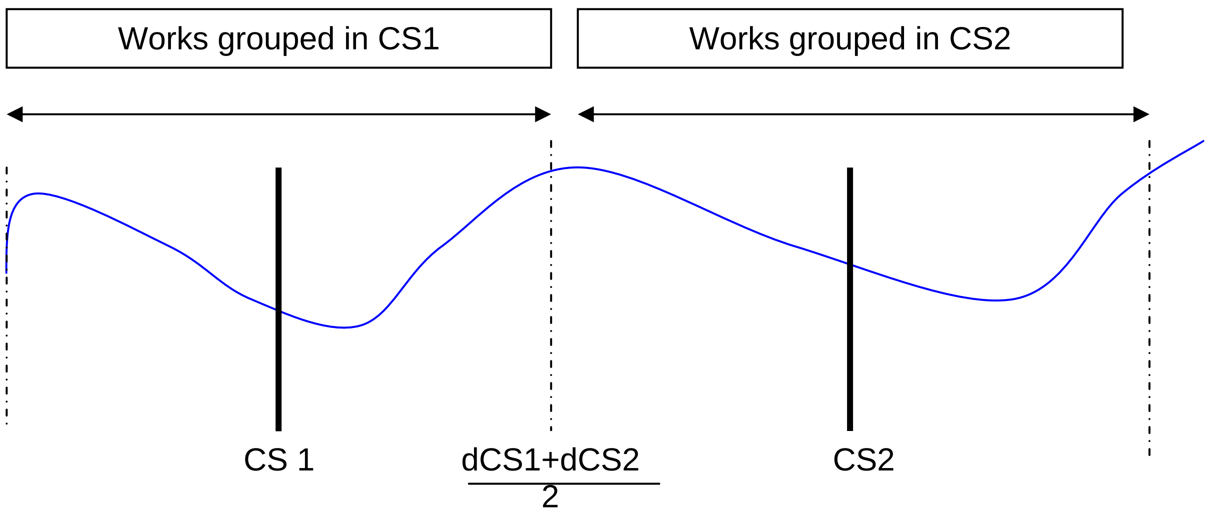
In this case, we decided to take the quantity of the file 34, since it is more coherent compared to the quantity from doc 36, which seems very high.

3. Overlaps between two successive years: We had to differentiate between works that occurred many times because they had been delayed to the following year (which is an overlap) from the works that were done over two or three years. When overlaps were located, to avoid counting the same work many times, we decided to record "1" in the column "Occurrence" for one of the works, and "O", as overlap, in the column "State" for the other repetitions.

2.2.2 Comparison with the MBL data

2.2.2.1 Cross-section groups

Because we wanted to analyse the relationship between the quantity of work carried out and changes in MBL, we had to group the works by cross-section. This was done by assigning the works to each cross-section by taking the midpoint of the distance between adjacent cross sections.



The cross-sections extend from RD48160 to 67243 m (upper Motueka) and 3500 to 16620 m (lower Motueka), so works listed between 48000 and 70000 m and between 3000 and 17000 m have been analysed. The works implemented outside these limits are indicated in the spreadsheet by:

- ">LM, <UM", for works located between the lower and the upper Motueka.
- ">UM", for the works located beyond 70000 m.

2.2.2.2 Time period groupings

In order to compare the MBL data with the river management works, we had to group the works by the time periods corresponding to cross section surveys:

- 1957-60, 1960-67, 1967-78, 1978-82, 1982-84, 1984-90, 1990-97, 1997-2001 for the lower Motueka.
- 1960-88, 1988-95, 1995-2001, 2001-04 for the upper Motueka.

2.2.3 Quantifying the amount of works

One of the main issues was quantifying the amount of work that had been done for each category of work. As the unit of work is different for rock work (volume) and tree work (meter, square meter, number of poles or wands), it was not possible to simply represent the works total as a quantity. Thus, we used both number of interventions and expenditure to represent the amount of river control work carried out in the Motueka River.

2.2.3.1 By cost

As the table below indicates, it was hard to find an average cost rate for each type of work, since the data was not very consistent concerning cost:

From	To	True	Work	Quantity	Cost	Date	Sources
52300	52300	L	Rock spurs	100	10000	1989	Doc 34
52300		L	Rock spurs	100	4080	1989	Doc 36

Therefore, we decided to use the TDC cost rate used by Collin Moffat. Using today's costs gives us an estimate of the net present cost of the work, and provides one means of representing the amount of each type of work carried out.

We used the cost rate in the following way: when the quantity of work was available, the cost was computed as the product quantity * cost rate, and inversely when the cost was available. However, the unit cost for older works could be much lower than the current costs and thus the quantity calculated from the cost (highlighted in yellow in the spreadsheet) might be underestimated. Nevertheless, even if it is a minimum estimate of the quantity, this calculation allow us to avoid some data loss, since many of the works don't have the quantity provided and could not be included in the study otherwise.

When neither the cost nor the quantity was available, the cell contains "no price". The change of the cost rate in the table on the Sheet "Cost" will automatically change the cost and quantity, thus the cost rate could be easily changed if a more relevant way of estimating works costs is found.

2.2.3.2 By the number of interventions

Analysing the number of interventions has the advantage that it represents the quantity of works without using the cost rate. This method also avoids data loss since the many of the works that were not taken into account in the expenditure analysis, because their prices couldn't be estimated, could be used. In addition, it limits the bias related to the differences of the cost of each works type (planting works have a low cost rate and are overwhelmed by rock works that have a higher cost, and perhaps do not appear as important as they should from the expenditure graph). Analysing the numbers of interventions reinstates this balance. By contrast, the analysis of numbers of interventions doesn't take into account the quantity of work done, therefore the analysis of expenditure is also useful since the quantity of work at any particular location may vary greatly.

3 Results

Results of the analysis are illustrated in Figs. 3 to 12 showing the works carried out in the Motueka River versus time and river distance. The legend used is: RP= rock protection, R= railway iron, WW= weighted felled trees, WP= willow planting and SB= stopbank.

3.1 Analysis of variation in expenditure and number of interventions with river distance

3.1.1 Lower Motueka

Figs. 3 to 6 show plots of the number of interventions and total expenditure versus river distance in the lower Motueka for the periods 1957-2001 and 1978-2001, and the net MBL changes for the same periods.

Fig. 3 shows concentrations of river control works interventions in three locations: from 12260m to13150m, from 9260m to 10900m and particularly from 5700 m to 7800m. These groupings also occur in Fig. 4, with a concentration of expenditure in the same areas, as well as at 4430m. The two graphs highlight that the main work implemented in the river is rock protection, followed by tree works (weighted felled trees and willow planting). Rock protections is well distributed along the river in significant quantity, whereas the other types of works appear in isolated spots and lower quantities. However, part of the domination of rock protection works could be explained by a more complete and accurate availability of information (compared to other types of work) rather than always a higher work implementation.

The graphs also show also the absence of railway irons and only one location with stopbanks. The rarity of stopbank works in the graphs might suggest that some data is missing, as the stopbank works should appear more often given the extensive stopbanking that has been implemented in the lower Motueka. It is possible that this has been recorded as rock protection, but it seems more likely from the numbers of interventions recorded (particularly when comparing the lower and upper Motueka) that there is missing data on stopbanks.

The comparison of the two graphs illustrate the loss of data with the expenditure chart: the stop bank present in Fig. 3 doesn't appear in the second graph, because the cost was not available. This occurs also for tree works, both weighted felled trees and willow planting.

At first inspection Figs. 3-6 don't appear to suggest a strong and consistent relationship between the amount of river protection works and net MBL change, although there aren't many cross sections that have data extending back to 1957. Figs. 5 and 6 suggest that net MBL change between 1978 and 2001 tends to increase downstream, and the amount and cost of river protection works shows the same general trend. However, the peaks in bed level dgradation are not matched by similar peaks in river cotrol expenditure or number of works interventions. For example, the high amount of degradation at cross section 6725 is not matched by a large number of river control interventions. Either the low values of MBL change (mostly <1 m) or the incompleteness of the river control data may make it difficult to demonstrate a relationship between the river works and MBL change.

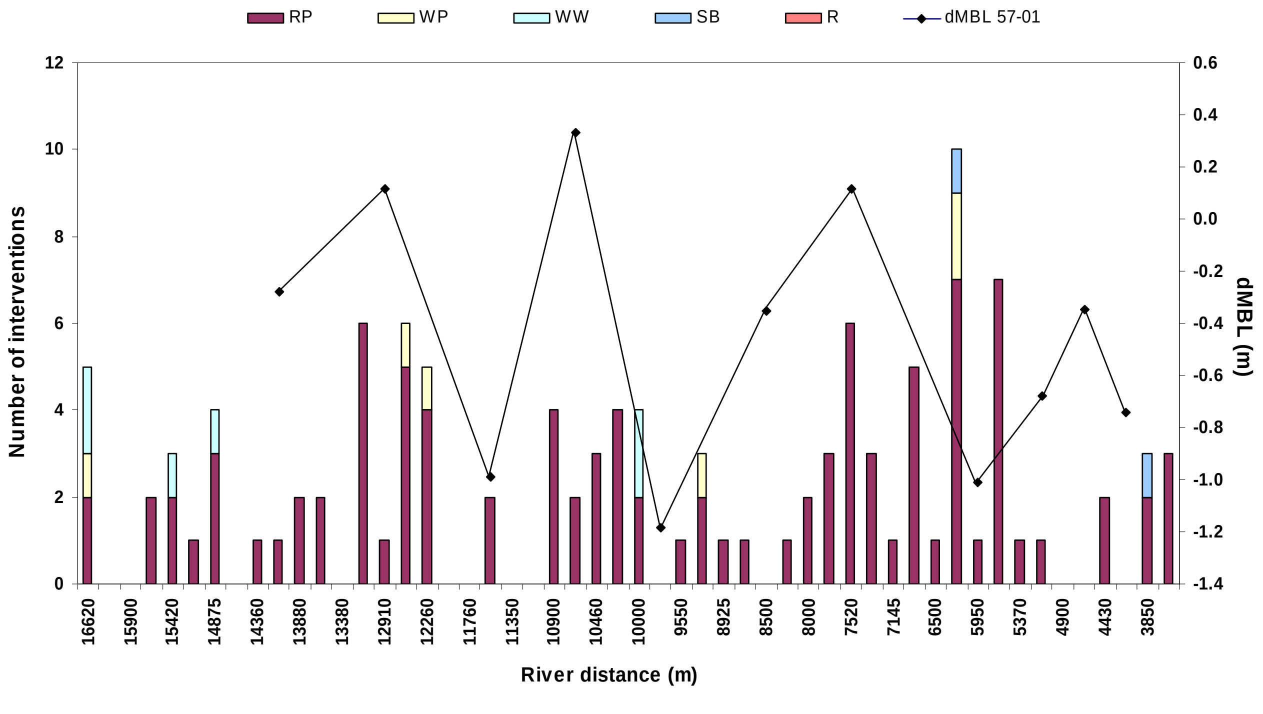


Fig. 3 Plot of number of interventions versus river distance in the lower Motueka for the period 1957-2001. Net changes in MBL over the same time period also shown.

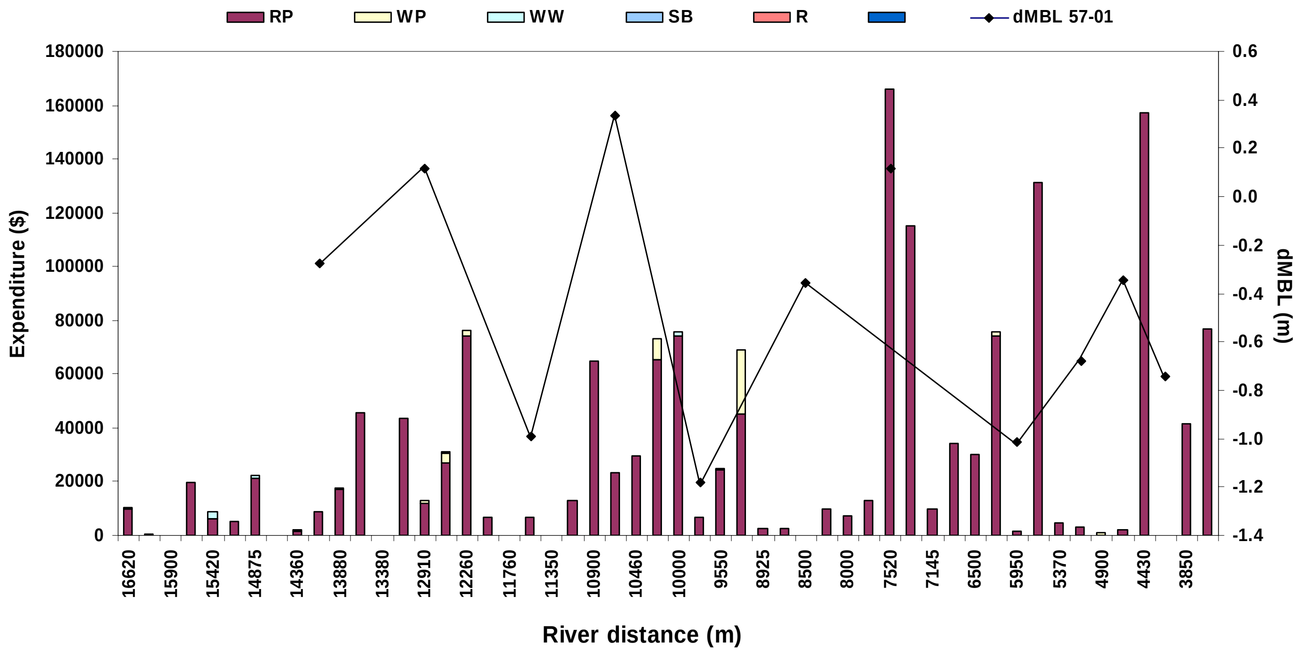


Fig. 4 Plot of total expenditure versus river distance in the lower-Motueka for the period 1957-2001. Net changes in MBL over the same time period also shown.

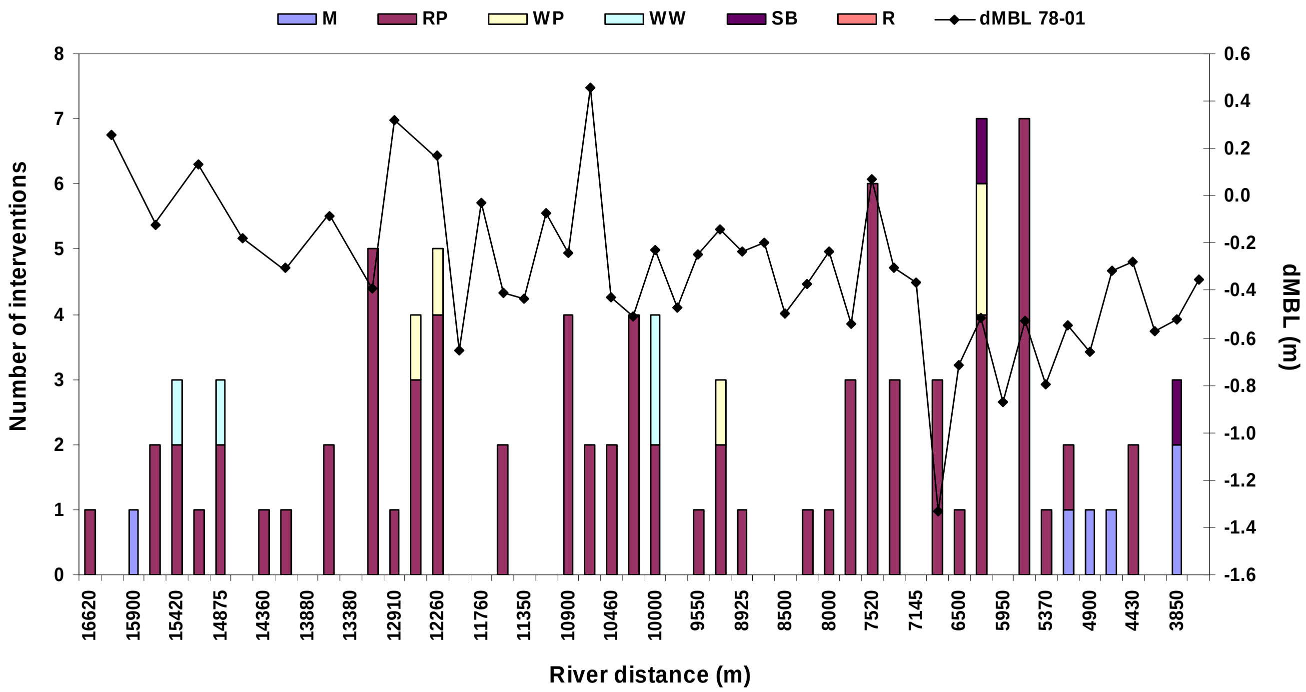


Fig. 5 Plot of number of interventions versus river distance in the lower Motueka for the period 1978-2001. Net changes in MBL over the same time period also shown.

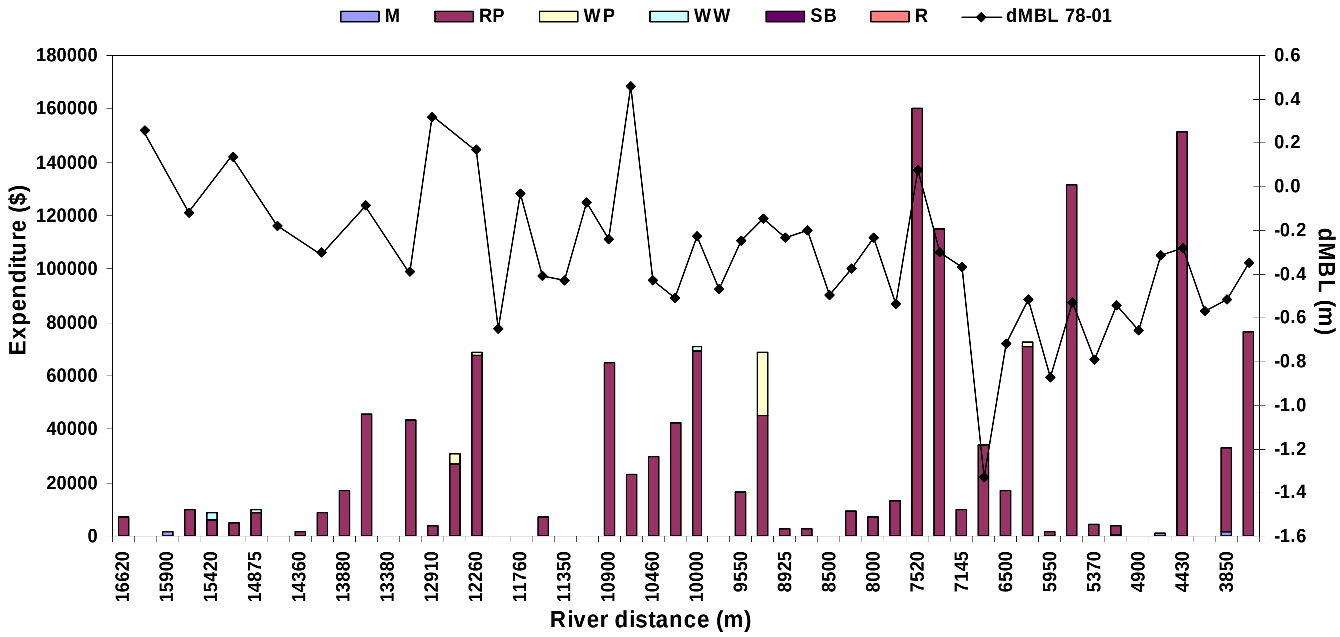


Fig. 6 Plot of total expenditure versus river distance in the lower-Motueka for the period 1978-2001. Net changes in MBL over the same time period also shown.

3.1.2 Upper Motueka

In the upper Motueka, Figs. 7 and 8 indicate a concentration of works from 53445 to 56355 m, from 58512 to 60205m, and from 61780 to 66547m. These trends are more obvious when expressed as the number of interventions rather than in terms of cost. For example, the weighted willow works are hardly apparent because of their low price, whereas they are well represented by the numbers of interventions.

Compared to the lower Motueka, the works are more diverse. Rock protection still dominates (but to a lesser extent), followed by willow planting works, weighted felled trees, railway iron and stopbanks. The last two types of works are much more common than in the lower Motueka (despite the fact that stopbanks are much more extensive in the lower Motueka). And the amount of expenditure, as well as the number of interventions is higher for the upper Motueka than for the lower Motueka – again this is surprising since most of the river control works carried out as part of the Motueka River control scheme are concentrated in the lower Motueka.

There appears to be a stronger relationship in the upper Motueka between the amount or cost of river protection works and net MBL change, with peaks in bed level degradation coniciding with peaks in the number of river control interventions. For example the high amount of bed level degradation at cross sections 55740 and 66547 is matched by concentrations of river works. However, there are other areas where river works are concentrated where bed level degradation is relatively low (e.g., from cross sections 51677 to 54690, and 62840 to 64050).

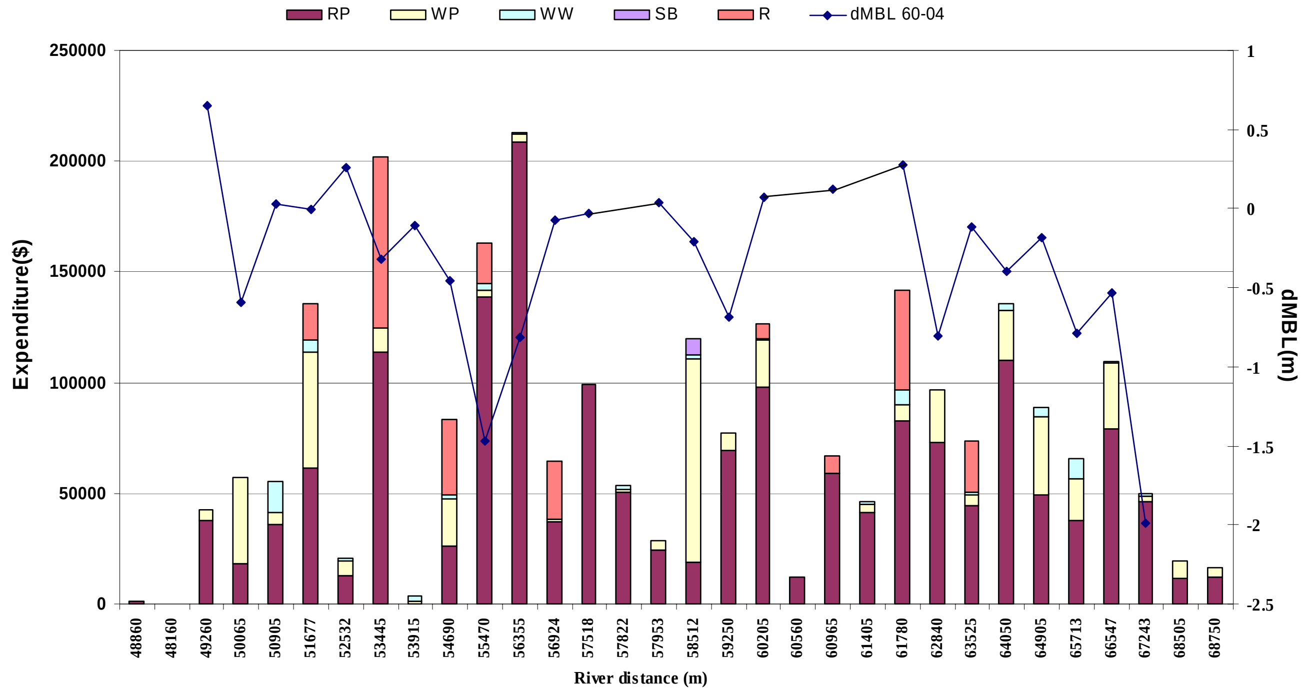


Fig. 7 Plot of total expenditure versus river distance in the upper-Motueka for the period 1960-2004. Net changes in MBL over the same time period also shown.

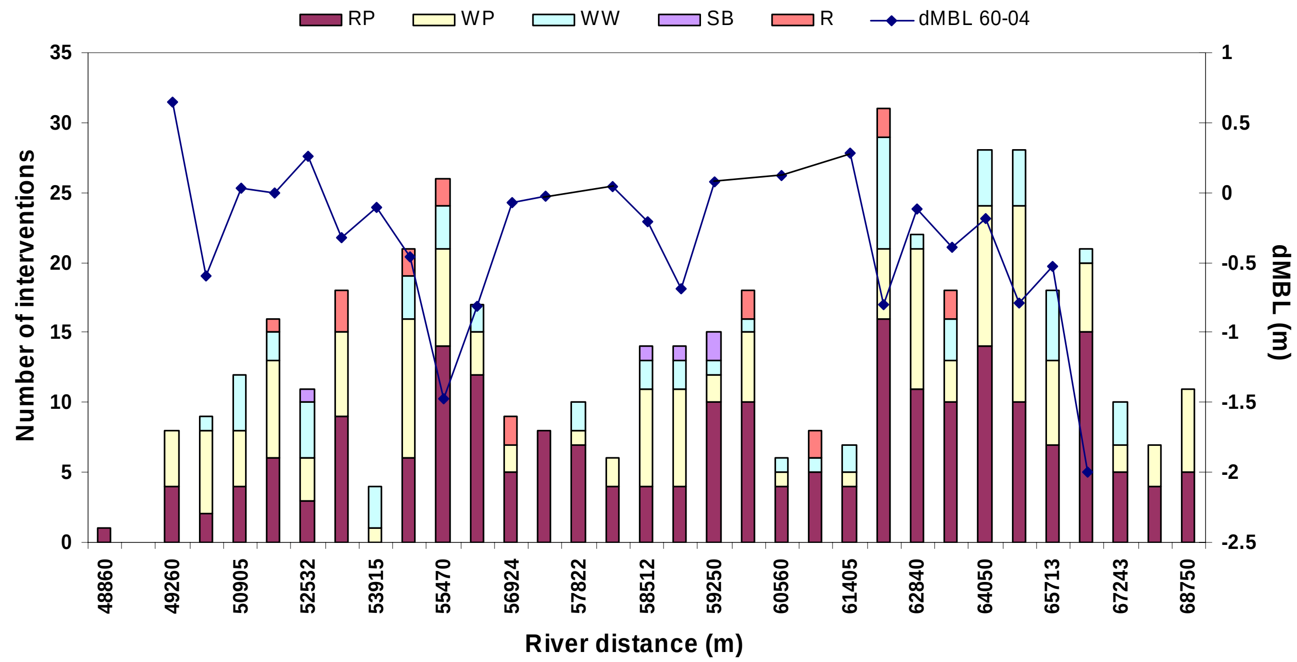


Fig. 8 Plot of number of interventions versus river distance in the upper-Motueka for the period 1960-2004. Net changes in MBL over the same time period also shown.

3.2 Analysis of temporal variation in the rate of expenditure and number of interventions

Figs. 9 to 12 show plots of the number of interventions per year, and total expenditure per year, versus river distance in the lower and upper Motueka for each of the cross section survey periods, and the net MBL changes for the same periods.

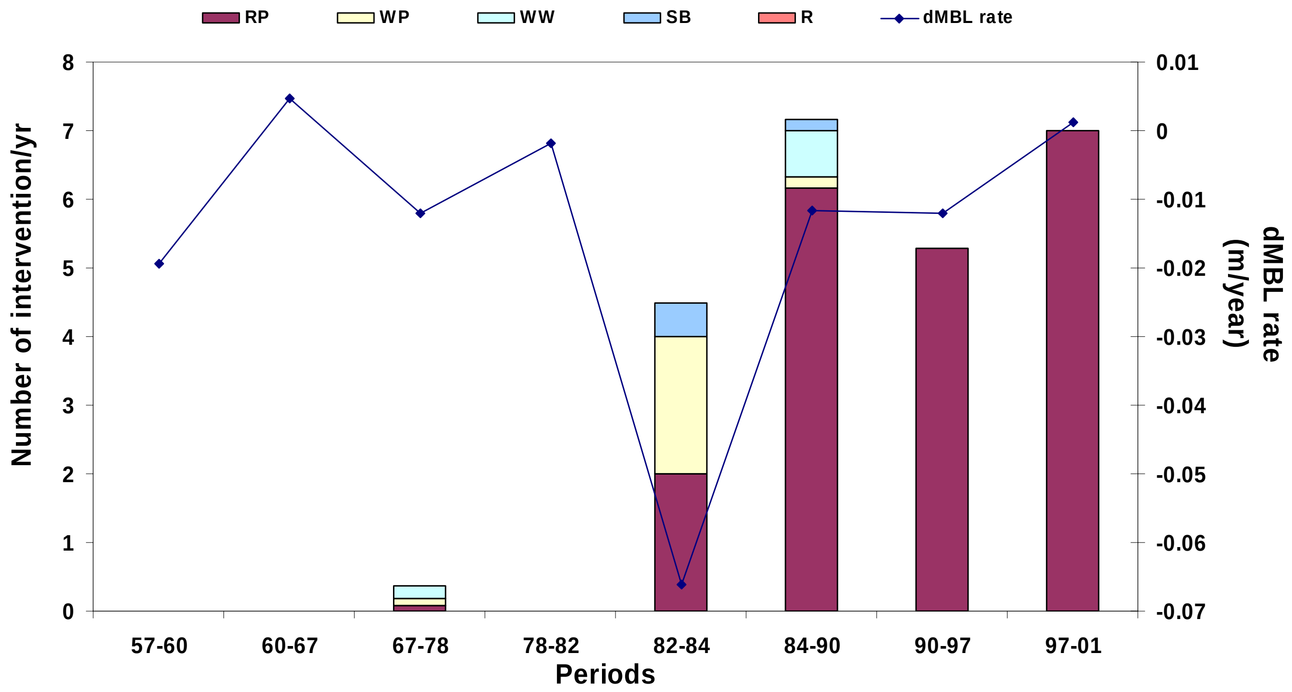


Fig. 9 Plot of number of interventions per year and the rate of change of MBL in the lower Motueka for each of the survey periods.

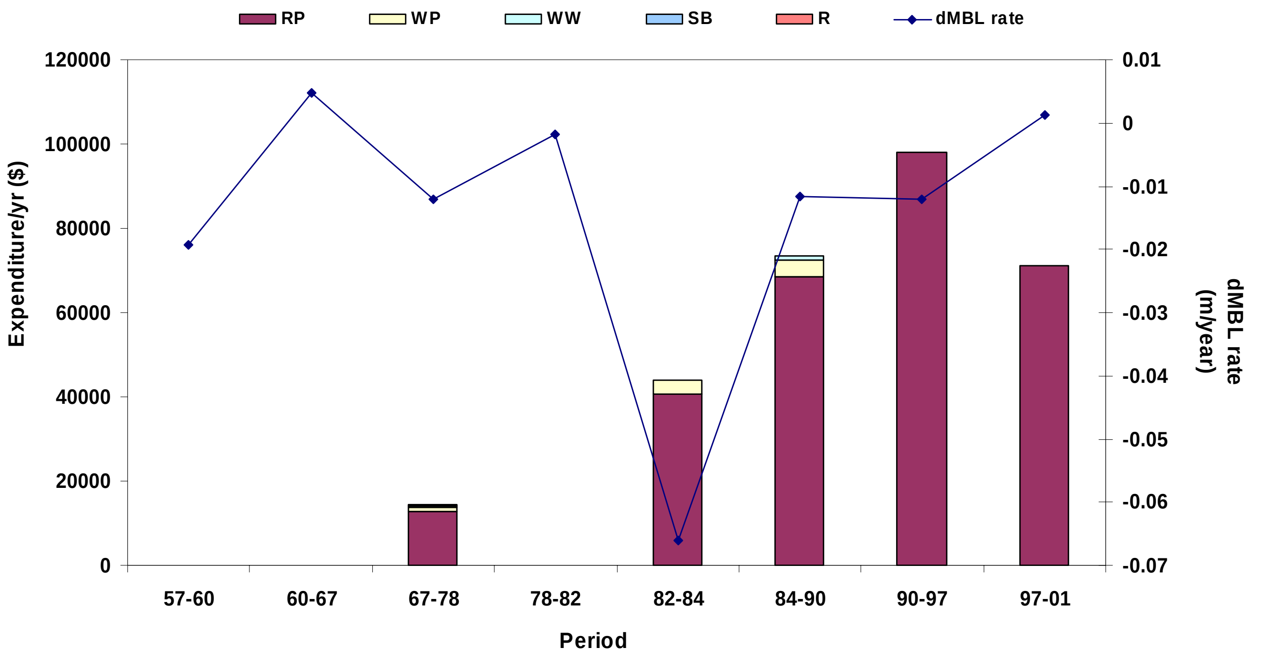


Fig. 10 Plot of expenditure per year and the rate of change of MBL in the lower Motueka for each of the survey periods.

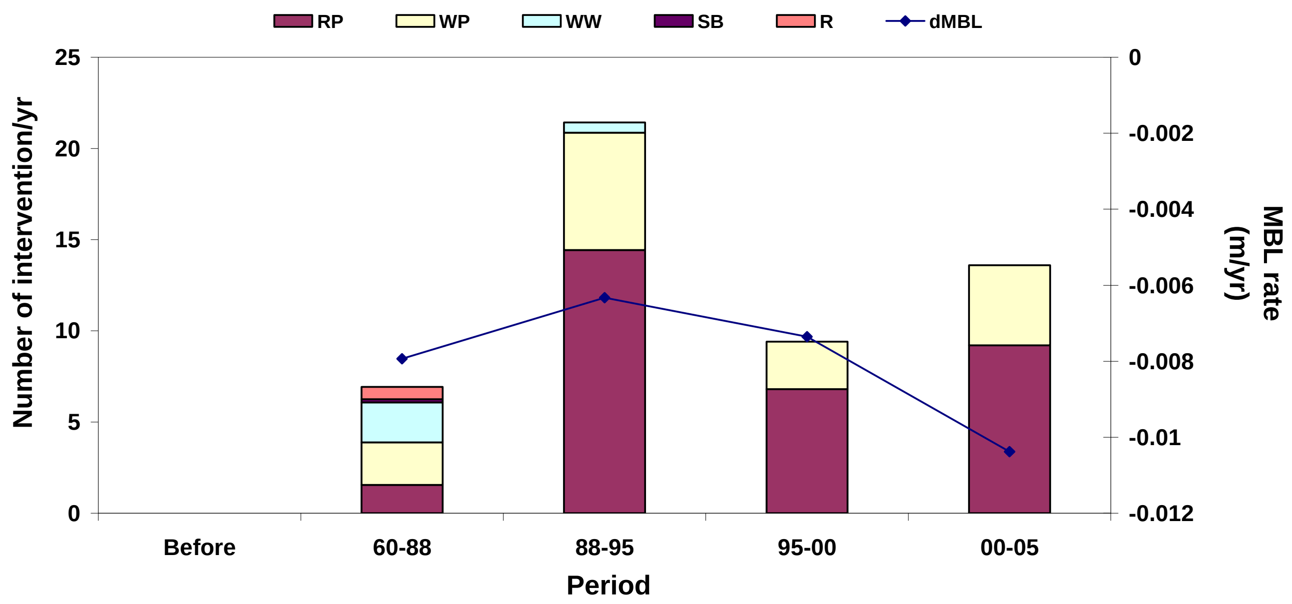


Fig. 11 Plot of number of interventions per year and the rate of change of MBL in the upper Motueka for each of the survey periods.

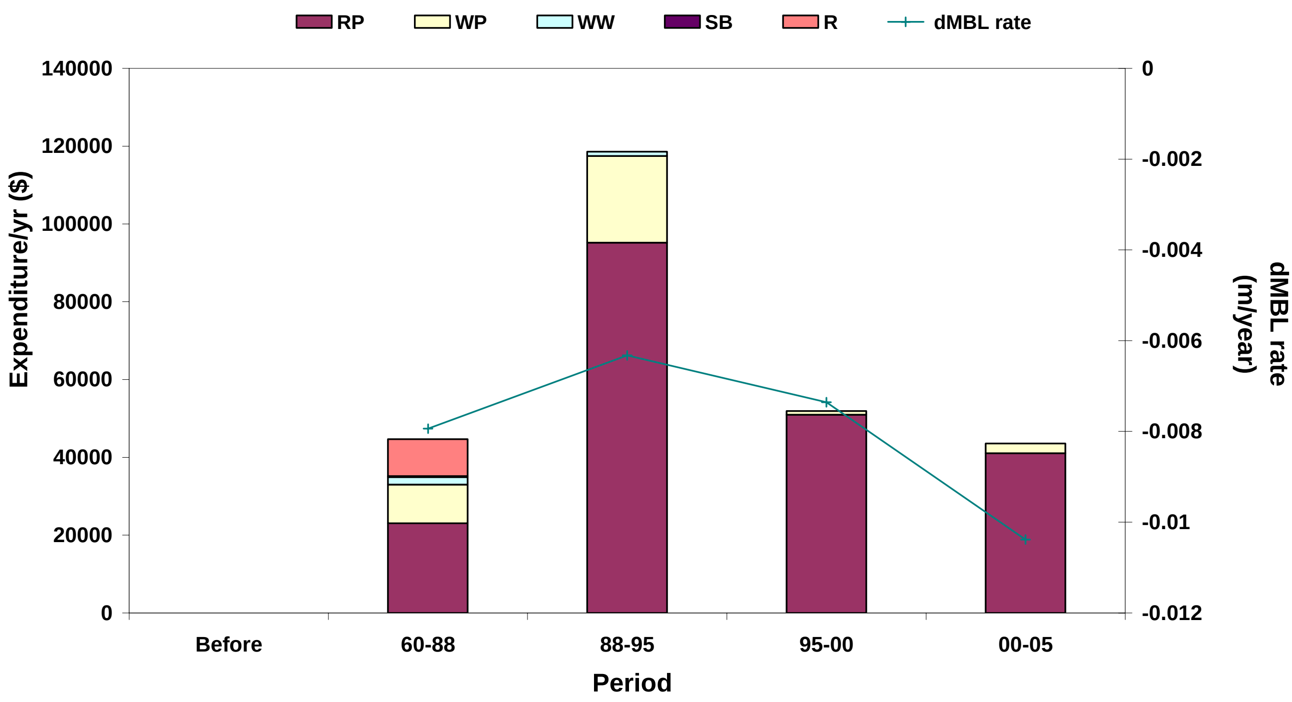


Fig. 12 Plot of expenditure per year and the rate of change of MBL in the upper Motueka for each of the survey periods.

These plots suggest there may be a better record of the more recent river control works than the older works. In the lower Motueka in particular there is very little data for the earlier periods (pre-1982) but a significant amount of river control works are likely to have been carried out prior to 1982. The graphs (Figs. 9 to 12) don't indicate a strong and consistent temporal relationship between bed level change and river control works for either the lower or upper Motueka. This applies whether river control works are expressed as expenditure (Figs. 10 and 12) or number of interventions (Figs. 9 and 11).

The two graphs also indicate a a reduction in the variety of types of works implemented for both reaches of the river, with less use of railway iron, weighted felled trees, and willow planting and an emphasis on rock protection. It is not clear if this is due to a change in the way data has been compiled, or due to a real lessening in the diversity of river control works.

4 Limitations of the work:

There are a two main limitations to this analysis. Firstly there is uncertainty about the completeness of the data. Besides the assumptions made to deal with inaccuracies in the data, the main limitation of the study is the potential for missing data. The magnitude of this is not known, but it could have a significant effect on the conclusion of the study. For instance there may be missing information about stop bank works. As these works may have a high impact on the amount and cost of river protection works, this missing information may be distorting the results of the study.

Secondly, ther is uncertainty about the accuracy of data. A large number of the river control works (almost 550 out of the total of 1590 items of work compiled) were not incorporated into the analysis, because of incomplete description of the type of work, uncertainty about the location or date of work, or about the cost or quantity of work. The following table represents the type of data not used. This shows that in the majority of cases the issue is inaccurate location or price/quantity. This loss of information may be important, as it concerns two major types of works that is rock protection and willow planting.

	Not taken into account in the study because:					
	Inaccurate location	**Inaccurate work description**	**Price or quantity missing**	**Overlap**	**Outside the RD limits**	**Category ”2”**
M	10			2	3	22
W P	20			55	27	17
WW	10			20		3
RP	8	27	70			52
R	1			1		0
SB	7	10	1	5	7	3

Table 1 Data not taken into account in the study

The other reason for data loss is that we included in the study only works from “1” and “R” categories (i.e. that we were reasonably certain had been undertaken), but it is probable that some works of the category “2” have also been completed and should be integrated into the study. In many cases it was difficult to be certain which ones should be included or discarded.

Conclusions

Although the data compilation and it’s analysis have some limitations, a few points can be highlighted. The river works expenditure and numbers of interventions show some areas where river works are concentrated in both the upper Motueka and the lower Motueka. As well, there appears to be a change in the type of works through time, with a homogenization of the works implemented (more rock protection and less emphasis of railway, weighted willows, etc). The estimation of the expenditure in the River and its association with the type of works, indicates a dominance of rock works, followed by willow planting and weighted felled trees.There doesn't appear to be a very strong link between the amount of bed level degradation and the amount of river control works, in either the lower and upper Motueka, neither on the cross-section scale, nor on the entire river level. However, the linkage is stronger in the upper Motueka than the lower Motueka.

Recommendations:

- The documents used for the compilation of the computer files provided by TDC could help to verify some of the timing and quantity data that are doubtful. It would be extremely useful to determine the source(s) of these files.
- The change of river distance measurement should be checked to ensure its accuracy.
- Information from people who used to work on the Motueka River management could be useful to deal with the some of the incomplete information, and to check our assessment of relevant expenditure. This may also help to understand the reason for works concentration in some areas and the evolution of the type of works through time.
- The limits of the present study suggest that a better way of compiling and archiving river control works is needed in order to make this kind of study easier and to facilitate an improved analysis of the comparison between the river control works and MBL change.

Acknowledgements

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References

Ball, L.G.A. 2004: Quantifying the morphological effects of gravel extraction on the Motueka River. M.Appl. Sci. thesis, Lincoln University.

Sriboonlue, S. Basher, L.R. 2003: Trends in bed level and gravel storage in the Motueka River 1957–2001: a progress report on results from analysis of river cross section data from the upper and lower Motueka River. ICM Report 2002-03/04, Landcare Research, Lincoln.

Appendix 1 Documents used to compile a history of river management in the Motueka River

		Date	ID	Source
Documents	Annual programme of Work from the Nelson catchment Board and regional water Board.	1983-84	Doc 1	Pauline Coy
		1984-85	Doc2	
		1985-86	Doc3	
		1986-87	Doc4	
		1987-88	Doc5	
		1988-89	Doc6	
		1989-90	Doc7	
		04-06 1990	Doc8	
	Nelson Operations Works programme from the Nelson- Marlborough Regional Council:	1991/1992	Doc9	
		1998/1999	Doc10	
		1992/1993	Doc11	
	Rivercare annual Programme	1997/1998	Doc12	
	River Annual Programme, with also Memorandum and correspondence of the year.	1997/1998	Doc26	
		1998/1999	Doc28	
		1999-2000	Doc31	
	Long term conceptual scheme.	1977	Doc19	
	Detail of work that have been done	1979	Doc20	
	River works Programme	1994/1995	Doc21	
		1985/1986	Doc22	
		1993/1994	Doc23	
		1995/1996	Doc24	
		1996/1997	Doc25	
Reports	Chairman operation committee, operations manager's report	From 82-89	Doc13	Pauline Coy
	Nelson- Marlborough Regional Council report	1991/1992	Doc14	
		1990/1991	Doc15	
	Details of claims that have been done by the engineering officer	1963-1966	Doc16	
		1966-1971	Doc17	
	Detailed reports of works carried out	1972-1974	Doc18	
		1998-1999	Doc29	

		Date	ID	Source
		1999-2000	Doc30	
Computer Files	Register.xls WORKS.xls Contract508BentireContract.xls Book1.xls		Doc33 Doc34 Doc35 Doc36	Philip Drummond Collin Moffat
Other	Rivers Account invoices	1998/1999 1999/2000	Doc27 Doc32	Philip Drummond