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Investigating the regional variation in rules and best management practices for forestry in New Zealand

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Under the Resource Management Act 1991 (NZ), the interpretation and implementation of environmental policy is primarily the responsibility of local government. The management of forestry operations may be influenced by statutory rules published in regional and district plans, and recommended best management practices (BMPs) published in guidelines. There are concerns that inconsistency between jurisdictions' rules have a negative impact on the forestry industry's financial and environmental outcomes. This research investigated and quantified the variation in Permitted Activity rules and BMPs, for culvert installation and earthworks, between New Zealand's 16 Regional Councils. Significant variation in these regional rules and BMPs existed in both the level of control (i.e., the number of rules and BMPs per council), and the nature of control (i.e., the proportion of rules or BMPs utilised). Further, the rules and BMPs of one council are seldom the same as another. This variation is apparent on both a national scale and when considering only neighbouring pairs of councils.

Keywords: Resource Management Act; environmental standards; earthworks; culverts

Introduction

Resource management activities in New Zealand, including forestry, are governed by the Resource Management Act 1991 (NZ). Under the Act, the making and implementation of policy is primarily the responsibility of local, rather than central, government (Furuseth 1995). The purpose of the Act, detailed in s.5, is to 'promote the sustainable management of natural and physical resources', which includes 'avoiding, remedying or mitigating any adverse environmental effects of activities on the environment'.

There are two levels of local government in New Zealand: Regional Councils and territorial authorities. Under the Act, Regional Councils serve a number of functions that territorial authorities do not, including: soil conservation; maintenance and enhancement of water quality, quantity and ecosystems; setting minimum or maximum water body flow levels; and controlling discharges of contaminants to water, land and air. Some territorial authorities also have the responsibilities of a Regional Council; these are known as unitary authorities. This research focuses only on the 16 councils with Regional Council responsibilities (Chatham Islands Council was excluded), as their functions are more closely linked to the environmental effects of forestry earthworks operations.

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Local governments publish resource management plans: statutory documents that underpin their implementation of the Act. These plans contain rules, often specified as conditions under which activities in the environment may take place. Some local authorities publish additional documents that detail practices determined by a council to be the most practicable means of avoiding, remedying or mitigating an activity's adverse environmental effects. These documents have a variety of titles, including 'guidelines', 'codes of practice' and 'technical publications'. These will be referred to hereafter as 'best management practices' (BMPs), where 'best' is determined by each Regional Council for the regulated activities.

There are concerns within the forestry industry that variation in environmental rules and BMPs between the 16 regional/unitary councils and 61 territorial authorities of New Zealand makes it difficult to plan operations or assess compliance. To investigate this variation, the Regional Councils' rules and BMPs were examined, with a focus on forestry earthworks operations.

Regulatory variation and effects

Under the Resource Management Act 1991 (NZ), local government is expected to set environmental rules and guidance based on locally specific values and environmental conditions. There are many core, nationally applicable values, such as water quality and soil protection, which should have led to the development of nationally consistent rules. Most local authorities displayed a reluctance to collaborate during the development of their rules following the introduction of the Act (Dixon et al. 1997), resulting in variation in rules across districts and regions.

Inter-regional inconsistency of regulation is not necessarily a flaw of the Act, but rather a reflection of its purpose. According to Furuseth (1995), the underlying belief of this resource management approach is that decisions should be made by those communities most affected. In fact, regional variability is considered the 'correct result' of the reform process (Furuseth 1995, 188). Nevertheless, some forestry companies have raised concerns that variation negatively impacts the industry. Companies have suggested that the resource management framework's complexity has led to increased administrative and operational expenses, greater focus on paperwork than field outcomes, confusion over rules in different jurisdictions and a reduction in the industry's ability to attract investors (Johnston 2010; Maunder 2010; PF Olsen Ltd 2010; Strang 2010).

Some companies' estates consist of several forests spread across New Zealand, while other estates or parts of estates can consist of one contiguous forest spread over several regions and districts (e.g., Kaingaroa Forest). In response to this situation, this research investigated variation on both a national scale and between neighbouring councils.

Under the Act, there is provision for National Environmental Standards (NESs): regulations promulgated by central government to ensure a nationally consistent decision-making process for a particular resource. Put simply, 'they create a level playing field' (MfE 2013a). In 2010, the central government took action to address the forestry industry's concerns by introducing the Proposed NES for Plantation Forestry (PNESPF). The intention was to 'improve national consistency in local authority plan rules relating to plantation forestry and provide certainty for those involved in managing plantation forests' (MfE 2013b). The PNESPF is yet to be issued, because it is currently subject to a Ministry for Primary Industries (MPI) review with multiple stakeholders (MPI 2014).

Regional differences in forestry rules have already been analysed as part of the development of the PNESPF. A review commissioned by the New Zealand Ministry for the Environment (MfE; Devlin 2009) indicated that there is variation in regional forestry rules. Another MfE survey of plantation forestry rules across local governments resulted in the Review of Authority Rules, which compares rules' stringency across different authorities (MfE 2013a). However, these reviews neither outlined nor quantified all the variations between councils.

Research objectives

The objective of this research is to investigate regional variation in rules and BMPs affecting forestry. Rules and BMPs cover many different forestry activities; this research focuses on culverts and earthworks operations. Every region has rules or guidelines for these operations, and they are a common activity, which can have significant adverse environmental effects if poorly conducted, in forestry operations across the country. This research addresses how much variation exists in the rules and BMPs for forestry earthworks across, and between neighbouring, regional and unitary councils.

Methods

Quantifying variation between rules and BMPs requires that textual information be compared. This is different to comparing quantitative data and necessitated development of a system to facilitate comparison. As regional plans and BMP documents do not necessarily follow standard formats or use particular keywords, one could not simply compare two sections of text and deem them 'inconsistent' if the words were not exactly the same. A methodology was developed that required the texts to be read and interpreted before being sorted into a database for comparison. Due to the number of exclusions that had to be considered, no automated or software options were deemed suitable, this process was performed manually with a protocol developed to ensure the comparison remained objective.

Sources of evidence

The rules and BMPs examined were obtained from the regional plans and BMP documents published by the Regional Councils which applied during mid-2013 (Table 1). These documents were sourced from the websites of each council.

Exclusions

Based on the experiences of a short pilot study, it was decided that some rules would be excluded from this research.

(1) Rules regarding waahi tapu (sites sacred to Maori) and archaeological sites were excluded because these sites are regulated by the Heritage New Zealand Pouhere Taonga Act 2014 (NZ).
(2) Special rules for specific zones or areas were not included, because many of these rules reflect values of areas of importance, and are specific to each region. This study focussed only on the 'general' rules for each region.
(3) The rules examined from regional plans were sourced from the lowest level of control under the Resource Management Act 1991 (NZ). Under the Act, there is a hierarchy of stringency of control, from Permitted (least controlled) through

Table 1. Regional plans used as sources of rules for this research.

Region	Regional plan	Notification date	Operative date
Auckland	Auckland Council Regional Plan: Air, Land and Water	2010	2012
	Auckland Regional Plan: Sediment Control	1993	2001
Bay of Plenty	Bay of Plenty Regional Water and Land Plan	2002	2008
	Bay of Plenty Regional Air Plan	1997	2003
Canterbury	Canterbury Natural Resources Regional Plan	2009	2011
Hawke's Bay	Hawke's Bay Regional Resource Management Plan	2000	2006
Gisborne	Proposed Gisborne District Combined Regional Land and District Plan	2006	N/A[a]
	Regional Air Quality Management Plan	1996	2008
Manawatu-Wanganui	The Proposed One Plan – the Consolidated Resource Policy Statement, Regional Plan and Regional Coastal Plan for the Manawatu-Wanganui Region	2007	N/A[a]
	Land and Water Regional Plan	1999	2003
	Regional Air Plan for Manawatu-Wanganui	1996	1999
Marlborough	Wairau/Awatere Resource Management Plan	1997	2011
Nelson	Nelson Resource Management Plan	1996	2004
Northland	Regional Water and Soil Plan for Northland	1995	2004
	Regional Air Quality Plan for Northland	1995	2005
Otago	Regional Plan: Water for Otago	1998	2004
	Proposed Plan Change 6A (Water Quality) to the Regional Plan: Water for Otago	2012	2014[a]
	Regional Plan: Air for Otago	1998	2003
Southland	Regional Water Plan for Southland	2000	2010
Taranaki	Regional Fresh Water Plan for Taranaki	1998	2001
Tasman	Tasman Resource Management Plan	1996	2014[a]
Waikato	Waikato Regional Plan	1998	2007
Wellington	Regional Air Quality Management Plan for the Wellington Region	1995	2000
	Regional Soil Plan for the Wellington Region	1997	2000
	Regional Freshwater Plan for the Wellington Region	1997	2012
West Coast	Regional Air Quality Plan	1998	2002
	Proposed Regional Land and Water Plan	2013	2014[a]

[a]Regional plan was not yet operative (or newly-operative parts were not operative) at the time this research was conducted.

Controlled, Restricted Discretionary, Discretionary, Non-complying and Prohibited Activities (most controlled). Where possible, rules for Permitted Activities were examined. If the activity was not Permitted, then Controlled Activity rules were examined, and so on. Restricted Discretionary, Discretionary and Non-complying Activity rules are more difficult to compare, as councils use their discretion in granting these resource consents, so there are few written rules to compare.

BMPs that directed a particular practice be adopted, or which detailed outcomes that should be achieved or avoided, were included. BMPs that encouraged one to 'consider' options but did not provide guidance on selection of options, discussed the merits of several options, or provided background information on adverse environmental effects, were excluded.

Categorisation

It was not possible to fit rules and BMPs into predetermined categories due to their number and variety. Instead, one council's documents were examined first, and a category was created for each rule and BMP encountered. The rules/BMPs of each council examined thereafter were either placed into these existing categories, or a new category was created. Examples of categories include 'Minimum Culvert Diameter', 'Maximum Fill Height', 'Water Quality – Visual Clarity' and 'Contaminants – Refuelling'. The order in which councils were examined was maintained to avoid sorting bias.

A rule or BMP may fit into more than one category if it has multiple foci. For example, a rule which states 'The activity shall not cause or induce erosion to land or to the bed or banks of any surface water body, where the erosion is persistent or requires active erosion control measures to bring it under control' (Bay of Plenty Regional Council 2008, 170) was included in three different categories: 'Erosion – Land', 'Erosion – Surface Water Body Bed' and 'Erosion – Surface Water Body Banks'.

Classification

The classification of each rule or BMP is made up of two elements. The first element indicates whether a rule/BMP is prescriptive or outcome-based, whilst the second element indicates whether a rule/BMP is the same as that of another council.

Prescriptive or outcome-based

The first element in the classification is the letter 'O' or 'P' (Table 2), which indicates whether the rule or BMP is outcome-based or prescriptive. This classification is based on the principle outlined by Williams et al. (1999), who stated that prescriptive codes of practice are audited by checking whether prescriptions have been complied with, while outcome-based codes are audited by checking if the desired outcome has been achieved (or the undesired outcome has been avoided).

In some cases, rules or BMPs may be prescriptive but also outline an (un)desired outcome. In these instances, they were classified as prescriptive if the prescription included sufficient detail to assess compliance without waiting for an outcome. If a rule or BMP prohibited a particular activity or practice, that rule was classified as a prescription.

Numbering

The second element of the classification is a number, which indicates whether a rule or BMP is the same as another in the category. If two rules or BMPs were classified as the same, they were assigned the same number. Likewise, different rules were assigned different numbers. For example, two rules denoted as O1 and O1 are the same – if they were denoted as O1 and O2, they would be different, even though both are outcome-based. Some key elements that determine if rules are the same, or different, are: the

Table 2. Examples of classification of rules and BMPs as prescriptive or outcome-based, note that outcomes are italicised.

Classification	Rule/BMP
P	'Watercourses should be crossed at right angles to the stream'.
P	'Avoid construction during fish spawning and migration periods'
O	'… is of sufficient size to contain the bankfull flow *without causing flooding onto neighbouring properties*'.
O	'… the culvert *shall not cause or induce erosion of the bed or banks of any surface water body*'.

method by which outcomes are measured (such as parameters for measuring the visual clarity of water); the wording/phrasing used; and similarity in quantitative specifications.

Collation of data set

The documents were systematically examined to ensure each rule and BMP was categorised and classified. The resultant data sets consist of the classified rules and BMPs, by council and category (Table 3 shows an example). If a council did not a have a rule or BMP for a particular category, that cell was left blank.

Table 3 shows an example of eight categories for culvert rules or BMPs. The first row in Table 3 shows that only two of the four councils (Bay of Plenty and Waikato) had a rule for 'Construction – Disturbance'. The classifications P1 and P2 for these councils show that both used a prescriptive rule rather than an outcome-based (O) rule, and also that the rules adopted by these councils were substantively different. If they had been the same, both council's rules would have been classified P1.

Analysis

Nationwide variation

The following analytical methods were used to answer the first research question: How much variation exists in the rules and BMPs for forestry earthworks across the regional and unitary councils of New Zealand?

Table 3. Sample of rows from a data set.

Category	Northland	Waikato	Bay of Plenty	Gisborne
Construction – Disturbance		P2	P1	
Construction – End Haul	P1			
Construction – Fill		O1		P1
Construction – Maximum exposed area		P2	P1	
Construction – Maximum height/depth				
Construction – Maximum slope		P2	P1	
Construction – Maximum volume	P2	P3	P1	
Construction – Sidecast – Stabilisation	P2		P1	P2

(1) Count the number of categories for which each individual council has rules/BMPs.
(2) Count the number of categories which each individual council regulates using rules, and the number of categories regulated using BMPs.
(3) Count the total number of rules/BMPs which regulate each category across the country, and count how many unique rules/BMPs are in force (i.e. number of different classifications in category).
(4) Count the number of categories which are regulated by only prescriptive rules or BMPs, only outcome-based rules or BMPs, or a mixture of both, across the country.

The number of categories (measured by the analytical method (1) above) is a measure of the different criteria applied by councils to culvert and earthwork activities. A large number of categories indicates that councils consider there are many different criteria that need to be applied.

In contrast, the number of categories that each individual council regulates using rules/BMPs (measured by the analytical method (2) above) is a measure of variation between councils. If councils were consistent across New Zealand, all councils would have rules or BMPs in all categories. If individual councils do not have rules in all categories, then they are diverging from what other councils use as criteria in their rules and BMPs.

Likewise, the analytical method (3) above is a measure of divergence between councils, in that a large number of different classifications in each category shows that councils are choosing to specify a rule or BMP for a specific category in different ways. If all councils used a consistent approach to regulating a particular criteria, then there would be a small number of rules, with identical wording and method (prescriptive or outcome-based) used by all councils.

Variation between neighbouring councils

The following methods were used to answer the second research question: How much variation exists in the rules and BMPs for forestry earthworks between neighbouring regional and unitary councils? There are 23 pairs of neighbouring councils that share a border; these pairs were the focus of analyses.

(1) Count how many categories one or both of the neighbouring councils have rules or BMPs for (=n).
(2) Count how many categories for which:
    (a) both councils have the same rule/BMP (i.e. have the same classification),
    (b) both councils have different rules/BMPs (i.e. have different classifications),
    (c) Council A has a rule/BMP but Council B does not, and,
    (d) Council B has a rule/BMP but Council A does not.

Counts 2(a–d) above were expressed as percentages of n. This indicates how much similarity (2a) and difference (2b) there is in the rules and BMPs between councils, and also to what extent each council regulates in categories that its neighbour does not (2c–d.).

Subjectivity of results

Although every effort was made to conduct this study in an objective manner, categorising the rules and BMPs was conducted by only one person, the lead author.

To gauge possible subjective bias, a peer review exercise was conducted to test both the methods and results of this study. Five experts from Regional Councils and the forestry industry volunteered to take part in an exercise categorising and classifying rules for general earthworks from a subset of councils.

The experts' results were compared with the author's and with each other. Total agreement was not achieved by any pair of study personnel, so it is not possible to rule out all subjectivity. For the majority of categories (71 per cent) at least one expert was in agreement with the author's classifications. Likewise, for 58 per cent of categories the most common expert result concurred with the author's results. It was established that the author's interpretation of rules was not vastly different to that of the expert panel.

Results

Nationwide variation

By categorising and classifying the rules and BMPs for culverts, 549 classifications (different rules or BMPs) were made across 125 categories. In the case of earthworks, 318 classifications were made across 79 categories.

Number of categories addressed per Regional Council

The variation in the level and nature of regulation of each category was striking. Figures 1a (culverts) and 1b (earthworks) show the number of categories for which each Regional Council has a rule or BMP (or both, which is shown as a rule). The histograms would be uniform if there was no variation between regions; this is evidently not the case. The variation in proportions of rule and BMP use across the different councils is also apparent.

Number of Regional Councils per category

Some councils exercise more control than others, as is evident by the different numbers of rules/BMPs implemented. Individual councils addressed between 13.6 per cent and 46.4 per cent of the 125 culverts categories, and between 5.1 per cent and 49.4 per cent of the 79 earthworks categories. In both cases, the average category was addressed by only one quarter of councils. None of the councils are addressing the full scope of potential categories, and some are addressing significantly fewer than their counterparts.

Only 7.2 per cent of culverts categories and 3.8 per cent of earthworks categories were addressed by more than ten councils. The majority of categories were addressed by three or fewer councils (culverts: 53 per cent, earthworks: 59 per cent). There were no categories addressed by all of the Regional Councils (Figure 2).

Number of rules and BMPs per category

Any one category could include up to 16 rules/BMPs, assuming every council had a different rule/BMP. If there was no variation between regions, Figure 3 would show a frequency of 125 (culverts) and 79 (earthworks) categories with only one rule/BMP. Instead, the number of different rules/BMPs per category ranged from 1 to 11 (Figure 3). The most varied category for culverts was 'Flood Flow', and for earthworks was 'Water Quality – Visual Clarity'.

Few categories had no variation in rules/BMPs between multiple councils. In all, 37 per cent of earthworks categories and 34 per cent of culverts categories featured only one

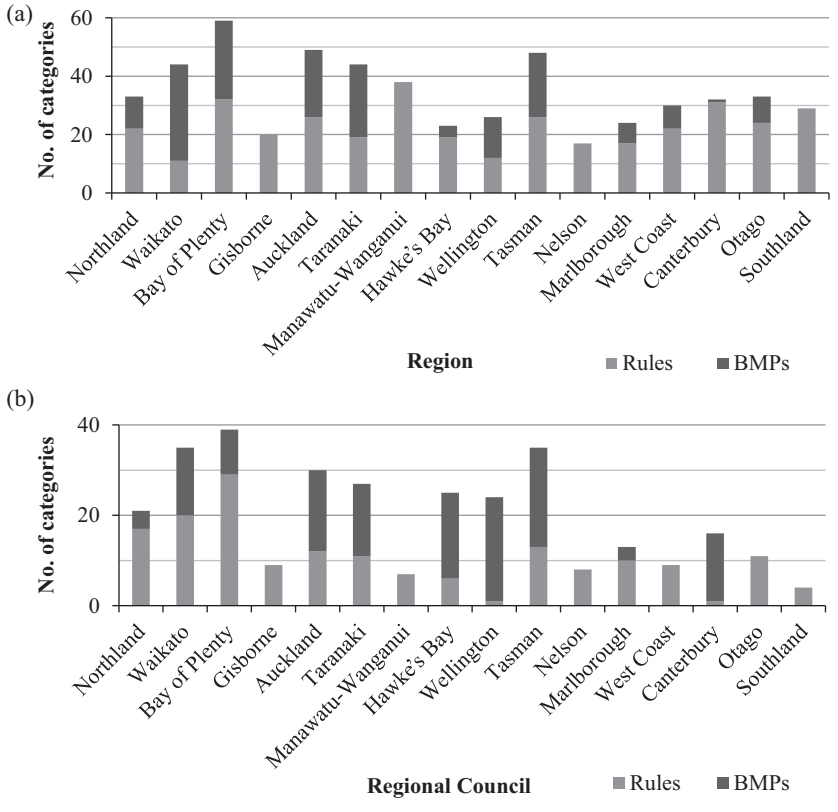

Figure 1. (a) Number of categories for rules or BMPs for culverts, by Regional Council. (b) Number of categories for rules or BMPs for earthworks, by Regional Council.

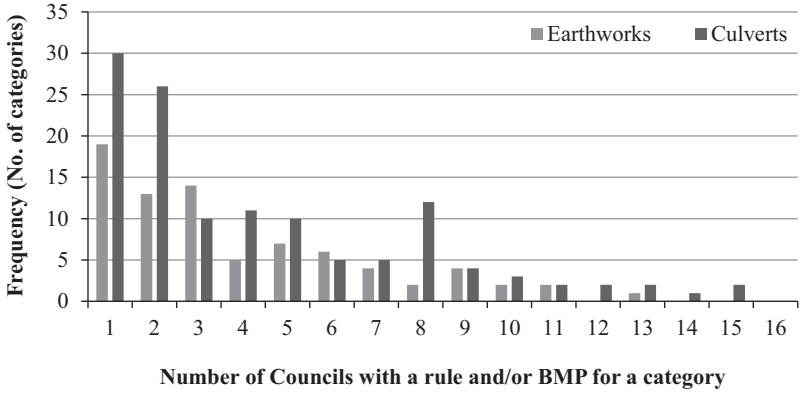

Figure 2. Frequency of number of councils to have a rule/BMP for any one category.

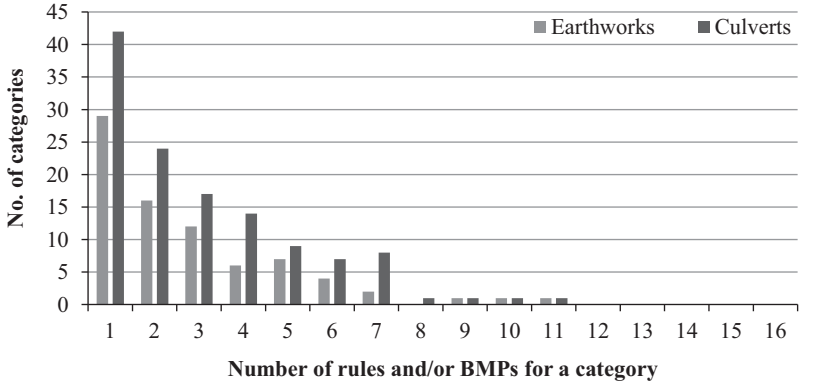

Figure 3. Number of categories for culverts and earthworks, versus number of rules and/or BMPs in any one category.

rule/BMP utilised by only one council. The exclusion of those categories addressed by only one council revealed that 13 per cent (earthworks) and 10 per cent (culverts) of categories featured total agreement, where a sole rule/BMP was applied by multiple councils. A further 42 per cent (earthworks) and 30 per cent (culverts) of categories featured partial agreement, where several councils applied the same classification, and other councils applied a different one. Total disagreement featured in 33 per cent (earthworks) and 24 per cent (culverts) of categories, with no common rules/BMPs between councils.

Variation between neighbouring councils

There was considerable variation in the number of categories addressed by the 23 pairs of neighbouring councils. If there was no variation, the same categories would be addressed by every pair of councils. None of the pairs addressed all of the same categories. For culverts, the proportion of categories addressed by both neighbouring councils ranged from 28 per cent to 66 per cent, with an average of 45 per cent. For earthworks, the range was 15–72 per cent, with an average of 42 per cent.

The proportion of categories addressed by only one of the paired councils ranged from 57 per cent to 96 per cent for earthworks and 43 per cent to 89 per cent for culverts (67 per cent to 89 per cent, excluding the West Coast – Otago pair). Thus, for all bar one of the pairs, the majority of categories were addressed by only one of the two. In the majority of cases, councils disagreed on those occasions when both councils addressed a category. Across all neighbouring councils, the number of categories over which neighbours agreed ranged from 0 to 14 (culverts) and 0 to 11 (earthworks). Zero agreement featured for 3 (culverts) and 15 (earthworks) pairs. The average number of matching categories between two neighbouring councils was 3.2 (culverts) and 1.5 (earthworks). The highest degree of agreement between a pair of neighbouring councils was 25 per cent (earthworks) and 35 per cent (culverts), with the remainder all less than 17 per cent (earthworks) and 11 per cent (culverts). If there was no variation, the agreement between all pairs would be 100 per cent, so it is evident that there is marked variation between neighbouring councils.

Examples of variation

The following are examples of the variation between Regional Councils' rules/BMPs. In some of the examples, councils are neighbours (indicated by a superscript to the council name).

Maximum area of soil exposure

The maximum permitted area of soil exposed by earthworks operations was specified by five councils, each with a unique rule. Areas ranged from 500 m^2 to 10,000 m^2 (Table 4).

Fill height over culverts

There were two categories for fill height over culverts; one for maximum and another for minimum. Nine councils addressed the maximum and six addressed the minimum. Whilst some councils set limits and conditions, others simply recommended complying with manufacturer recommendations (Table 5).

Some councils included details on fill height measurement: Bay of Plenty measured from the culvert crest, whereas Taranaki and Otago measured from bed level. This rule has some interesting consequences in the latter two regions. Taranaki and Otago Regional Councils specified maximum fill depths of 1 and 1.5 metres above the bed level, respectively (Table 5). Assuming a culvert diameter of 1 metre (the maximum permitted diameter in Taranaki (Taranaki Regional Council 2001, 137; Otago does not specify a maximum diameter), a culvert in Taranaki would have no fill over it, whilst one in Otago would have 500 millimetres over it. The New Zealand Forest Road Engineering Manual recommends that the depth of fill over a culvert should be equal to the culvert pipe diameter (Gilmore et al. 2011, 115). Under those guidelines, culverts in Taranaki and Otago would be lacking 1 metre and 0.5 metres of fill, respectively.

Discussion

Differentiation of rules and BMPs

In analysing the results of this study, rules and BMPs were not considered separately. If rules and BMPs had been considered 'different' it would have inflated disagreement

Table 4. Rules for the 'Maximum Exposed Area of Soil' category.

Council	Classification	Rule (R)/BMP (B)	Maximum area
Bay of Plenty[a]	P1	R	Within any 12-month period: Slope 0–15°: 10,000 m² Slope >15–25°: 5000 m² Slope >25–35°: 500 m²
Waikato[a,b,c]	P2	R	Within any 12-month period: Slope > 25°: 2000 m²
Auckland[b]	P3	R	Slope: <15°: 10,000 m^2 Slope: ≥15°: 2500 m^2
Taranaki[c]	P4	R	8000 m^2
Tasman	P5	R	Within any 12-month period: 10,000 m^2

Note: Superscripts to council names indicate neighbouring councils.

Table 5. Rules and BMPs for minimum and maximum fill height over culvert categories.

	Maximum height		Minimum height	
Council	Rule (R)/ BMP (B)	Details	Rule (R)/ BMP (B)	Details
	R	1.5 metres above lowest part of bed.		
Otago[g,h]	B		B	Check manufacturer's recommendations
Northland	B		B	
Waikato[a,d,i]	B		B	
West Coast[b,f,g]	B	Check manufacturer's recommendations	B	
Bay of Plenty[a,c]	R	1.5 metres above culvert crest.	B	Recommended minimum: 800 mm
Canterbury[b,h,j]		N/A	R	500 millimetres, or the diameter of the culvert, whichever is the greater
Gisborne[c]	R	2.5 metres		N/A
Taranaki[e,i]	R	1 metre above bed level		N/A
Manawatu-Wanganui[d,e]	R	2 metres, unless a spillway is constructed for passage of 200 year flood without fill being overtopped		N/A
Tasman[f,j]	R	2 metres, unless culvert is designed for 1 per cent Annual Exceedance Probability (AEP) flood flow and has secondary flow path		N/A

Note: Superscripts to council names indicate neighbouring councils.

between councils. BMPs were included in this study to acknowledge the use of non-statutory documents, so to automatically assign them different classifications would make little sense. However, the difference in legal status of rules and BMPs had to be recognised. If two councils had the same rule, but one had an additional BMP, which would change the classification, that BMP was disregarded. If one council had a rule and another council had a different rule and a BMP, which, in combination, made the classifications the same, that BMP would be included. This recognises that while a council may use fewer rules than another council and 'fill the gaps' with BMPs, they do not alter the legal requirements outlined in a regional plan.

Outdating of research

It should be noted that the results of this research were already outdated before publication. Regional plans are subject to change, with new plans being proposed and existing plans being modified. One such change was the notification of the draft Auckland Unitary Plan, becoming a proposed plan with legal effect on 30 September 2013

(Auckland Council 2013). Other plans and BMP documents may have since been changed or replaced, so this research is a snapshot of the regulatory environment during mid-2013.

Justification of variation

The results of this research have shown that there is variation in the rules and BMPs of Regional Councils, which leads to the question of whether the variation is justified. One would expect minimal variation between Regional Councils' Permitted Activity conditions for activities conducted in general areas. Although inconsistency of policy is not necessarily a flaw of the Resource Management Act 1991 (NZ), but rather a reflection of its purpose (Furuseth 1995), it is questionable whether the variation could be justified by this alone. For example, it seems unlikely that the communities of Taranaki, Bay of Plenty and Gisborne chose to disallow more than 1, 2 and 2.5 metres of fill over a culvert, respectively. It would be difficult to justify such trivial differences between rules, or argue against convergence, using this argument.

Geomorphological variation across New Zealand could also be presented as justification. However, given that the rules relating to areas of special geomorphology were excluded from the study, it seems an unlikely source of variation. Some variation could possibly be attributed to differences in the overall geomorphology of one region compared to another. However, that seems unlikely given the low levels of agreement between neighbouring councils.

This research cannot conclusively show whether the variation between the Regional Councils' rules and BMPs can be justified by differences in community and geomorphology. Nor can it identify the sources of that variation, or show whether the variation in rules and BMPs is simply arbitrary. However, it can be stated that the degree of variation found between Regional Councils is high.

A final question is, are there critical elements of the rules or BMPs that have a higher weighting in regards to consistency? It may be that inconsistency between different Regional Councils is mainly with respect to categories or issues that are less critical. This would need further research to determine. There appear to be differences between Regional Councils in which issues are considered important since, in many cases, some Regional Councils did not have rules or BMPs for categories that were regulated by other Councils.

Convergence and divergence

An international study of pulp and paper mill environmental compliance, which included New Zealand mills, found evidence of convergence. When one jurisdiction tightened its rules, others followed suit. It is not uncommon for one authority to model their policies on those of another, although there may be a time lag (Kagan et al. 2003).

Although convergence and divergence are analysed by comparing rule changes over time, which has not been done for this research, the (dis)similarities between Regional Councils can indicate whether convergence has occurred.

Rules

One may expect that regional plan convergence would have occurred in the last 22 years. However, this research found very few matching rules between neighbouring jurisdictions, which indicates limited convergence. Convergance would require a significant level of cooperation. The structure of regional plans varies, so any attempt to streamline the plans would likely require the adoption of a common structure along with a rewrite of rules.

BMPs

It appears that convergence has occurred between the BMPs of Regional Councils. The Auckland Regional Council's Technical Publication Number 90 (1999) has been adopted, in whole or in part, by a number of other councils. Likewise, both Waikato Regional Council's Clean Streams (Legg 2004) guideline and Wellington Regional Council's Fish-friendly culverts and rock ramps in small streams (2003) pamphlet have been adopted by others (Northland Regional Council 2013; Otago Regional Council 2005; West Coast Regional Council 2004).

Perhaps the prevalence of convergence in BMPs is due to their status. As BMPs are not necessarily statutory documents, it would be much easier for councils to converge their BMPs than their regional plans.

There is also some evidence of divergence. The Technical Publication Number 90 (Auckland Regional Council 1999) was not the source of the Auckland region's BMPs for this research. Rather, the forestry-specific Technical Publication 223 (Dunphy et al. 2007) was used. A number of Regional Councils have converged their BMPs based on the first document, whilst the publishing council has adopted a new document. There is already evidence of convergence towards the new, with Hawke's Bay Regional Council using it as the basis of its guideline (Shaver 2009).

Future convergence

The issue which spurred this research is the inconsistency of environmental regulation governing forestry in New Zealand. By pushing for consistency, the forestry industry is applying pressure for convergence to occur.

The adoption of a standardised set of BMPs would not completely address the issue of inconsistency. The limitations of this option have already been analysed as part of the development of the PNESPF. A key limitation identified by the MfE was that BMPs do not have legal status, and as such 'there is no guarantee that councils would implement it and therefore long-term national certainty cannot be assured' (MfE 2010, 116).

How, then, to achieve consistency? There are a number of different options, the merits of which have already been analysed by the MfE (2010, Appendix 4). The PNESPF outlines standardised sets of activity conditions for both 'earthworks' and 'river crossings', among other activities (MfE 2010). The results of this research have shown that the general Permitted Activity conditions for these operations are inconsistent; the PNESPF may be a viable option for setting a consistent basic standard for these operations.

Effect on industry

Variation in regulation can lead to increased administrative and operational expenses, and requirements for multiple resource consents make investment less attractive to share-holders (Johnston 2010; PF Olsen Ltd 2010; Strang 2010). The number of consents required would not be altered by a reduction in variation between Regional Councils, but it may make the consent application process easier. The results of this study found little common ground between neighbouring Regional Councils in terms of the categories addressed, and even fewer matching rules and BMPs. It is easy to see how operating under multiple Regional Councils may be confusing for operational personnel and contractors.

Conclusion

This study shows considerable variation in the level and nature of regulation of culverts and earthworks operations. On a national level, the minority of categories featured total agreement (i.e., a single rule or BMP being applied by multiple councils). It was most apparent in the analysis of neighbouring councils, with low proportions of matching rules/BMPs between neighbours, including several pairs featuring nil agreement. Given that only the 'general' rules and BMPs were examined, and that those rules that applied to areas of special importance or value were excluded, one would expect there to be little variation. The level of control varies between Regional Councils, with some councils addressing more categories than others; whilst the nature of regulation varied in the proportions of rules and BMPs utilised.

Only a small number of councils addressed most categories, whilst the majority of councils addressed few categories. As such, few operational aspects must be considered when working with multiple councils, whilst individual councils require that certain aspects are managed which others do not. Considering the results for neighbouring councils, it was apparent that the majority of categories were addressed by only one of each pair of councils, showing that subscription to individual categories varied across regional boundaries.

The variation between Regional Councils' rules and BMPs for earthworks and culverts is significant, and begs the question, is it justified in terms of efficient and sustainable management of natural resources? Converging rules and BMPs between regions to improve consistency may require significant cooperation between local and central governments, especially if the goal is to streamline 'best practice' to the extent that it is nationally consistent. At the very least, neighbouring councils should converge their rules and BMPs so that there is more consistency across neighbouring jurisdictions.

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