



Stock Exclusion Survey

MAF Technical Paper No: 2011/102

Prepared for Ministry of Agriculture and Forestry
by Robert Sanson and Wayne Baxter, AsureQuality Limited

ISBN 978-0-478-38761-2 (online)
ISSN 2230-2794 (online)

December 2011



Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere



Disclaimer

While every effort has been made to ensure the information in this publication is accurate, the Ministry of Agriculture and Forestry does not accept any responsibility or liability for error or fact omission, interpretation or opinion which may be present, nor for the consequences of any decisions based on this information.

Any view or opinions expressed do not necessarily represent the official view of the Ministry of Agriculture and Forestry.

Requests for further copies should be directed to:

Publication Adviser
MAF Information Bureau
P O Box 2526
WELLINGTON

Telephone: 0800 00 83 33
Facsimile: 04-894 0300

This publication is also available on the MAF website at
<http://www.maf.govt.nz/news-resources/publications>

© Crown Copyright, December 2011 - Ministry of Agriculture and Forestry

Contents	Page
Executive summary	1
Objective	3
Methodology	3
Sample Frame	3
Sample size determinations	3
Field observation and data recording	4
Data analysis	4
Results	5
Conclusion	11
Glossary	12
References	13
Appendix 1 – Field data collection form	14

Executive summary

This Stock Exclusion Survey was commissioned by the Ministry of Agriculture and Forestry (MAF). It is an independent survey to assess progress by dairy farmers towards achieving the Dairying and Clean Streams Accord (the Accord) target of dairy cattle to be excluded from 50 percent of streams, rivers, and lakes by 2007, rising to 90 percent by 2012.

The Accord was agreed between Fonterra, the Minister for the Environment, the Minister of Agriculture and regional councils in May 2003. The parties agreed to work together to achieve clean healthy waterways (streams, rivers, lakes, groundwater, and wetlands) in areas where Fonterra has dairy supplier farms. The Accord does not apply to the West Coast region or the Gisborne District as Fonterra has no or very few dairy supplier farms in these areas.

The Accord sets out five targets for dairy farmers:

1. Dairy cattle to be excluded from 50 percent of streams, rivers, and lakes by 2007, rising to 90 percent by 2012.
2. Fifty percent of regular crossing points to have bridges or culverts by 2007, and 90 percent by 2012.
3. All dairy farm effluent discharge to comply with resource consents and regional plans immediately.
4. All dairy farms to have in place systems to manage nutrient inputs and outputs by 2007.
5. Fifty percent of regionally significant wetlands to be fenced by 2005, rising to 90 percent by 2007.

The Ministry of Agriculture and Forestry administers the Accord. Progress against the five Accord targets is measured annually by independent assessors contracted to Fonterra and regional councils, and is reported in an annual Snapshot of Progress report (the Snapshot).

This independent survey focused on assessing progress by dairy farmers towards achieving the Accord target of dairy cattle to be excluded from 50 percent of streams, rivers, and lakes by 2007, rising to 90 percent by 2012.

The results are not directly comparable to other assessments conducted by Fonterra and regional councils. For example, the annual Dairying and Clean Streams Accord Snapshot of Progress relies on self-reporting by farmers, and is generally conducted between October and April (winter milkers between June and July), whereas this survey was conducted by technicians in the drier months of March to May. Seasonal and annual variations in rainfall will affect on-ground interpretations on whether a waterway is “deeper than a red-band gumboot (ankle deep), wider than a stride (one metre) and permanently flowing” and therefore defined as an Accord Waterway.

Five hundred and eighty-seven farms owned or utilised by Fonterra dairy suppliers were surveyed between March – May 2011. These properties were randomly selected from a complete list of Fonterra suppliers provided by Fonterra, using a multi-stage sampling plan. Thirteen regions throughout the country were surveyed. Farms stratified by size (number of dairy cows being milked) within each region to ensure that the samples were representative of the region. Regional sample sizes were calculated to give a 90 percent confidence of measuring the percentage of properties that had achieved complete stock exclusion to a precision of plus or minus 10 percent, with an assumed a priority stock exclusion rate of 70 percent.

All Accord waterways on each property were walked or driven along and visualised byASUREQuality field technicians. Handheld global positioning systems (GPS) units and paper maps of each property were used by technicians, to assess whether or not dairy stock were excluded from the waterways. Stock exclusion was defined as including fencing, natural barriers such as a cliff face, as well as dense riparian strips. Where stock exclusion was not complete on any given waterway, the length of bank with stock exclusion was approximated by a visual assessment.

Outcomes assessed for each region were:

- the mean percentage of waterway banks (by length) that were protected from stock access;
- the percentage of farms that had achieved complete stock exclusion; and
- the percentage of distinct Accord waterways on surveyed properties that were fully protected from stock access.

Results were then combined nationally. Nationally:

- a mean of 78.4 percent of the surveyed bank lengths on each farm were assessed as being protected from stock access (margin of error ± 2.3 percent);
- 42.1 percent of farms had achieved complete stock exclusion on all Accord waterways (margin of error ± 4 percent); and
- 57 percent of distinct Accord waterways traversing or bordering surveyed farms were completely protected from stock (margin of error ± 2.7 percent).

The survey has revealed that a number of pieces of information can contribute to understanding the complete picture of stock exclusion from Accord waterways. Each indicator provides different information on the extent of stock exclusion in New Zealand. For example, the mean percentage of waterway banks (by length) that were protected from stock access provides information on the remaining length of waterways that require fencing. The percentage of farms that have achieved complete stock exclusion provides information on the number of farms that have and have not achieved stock exclusion.

Objective

To conduct a nation-wide field-based survey to observe and assess stock exclusion from Dairying and Clean Streams Accord type waterways on a representative sample of Fonterra dairy supplier farms.

Methodology

SAMPLE FRAME

A list of all Fonterra suppliers, including their location and the number of cows milked was provided to AsureQuality by Fonterra.’

These suppliers were matched to farms in AgriBase¹ (Sanson and Pearson, 1997). Once this process was completed, the farm boundaries of all matched farms were extracted from AgriBase and intersected with a topographical dataset of all streams, rivers and lakes in New Zealand. Fonterra suppliers with ≥ 50 milking cows and likely to have Accord type waterways traversing or bordering their properties were then selected.

SAMPLE SIZE DETERMINATIONS

The sampling unit was a farm, within which all Accord type waterways were viewed to establish the degree of stock exclusion over their length.

The three pieces of information collected for the survey were:

- the mean percentage of waterway banks (by length) that were protected from stock access;
- the percentage of farms that had achieved complete stock exclusion; and
- the percentage of distinct Accord waterways on surveyed properties that were fully protected from stock access.

A sample size was determined for each region, to provide a 90 percent confidence of measuring the true percentage of complete farm-level stock exclusion with a precision of plus or minus 10 percent (margin of error), based on a presumed *a priori* stock exclusion rate of 70 percent.

To ensure representative coverage of larger and smaller farms within each region, the distribution of herd sizes in each region was analysed and quartiles determined. Twenty-five percent of the required sample for each region was drawn randomly from the lower quartile herds, and 25 percent were drawn randomly from the upper quartile herds, with the remainder (50 percent) drawn randomly from the middle two quartiles.

AsureQuality field technicians contacted the selected farmers in each region to arrange a time for the field visit. If farmers chose not to participate, or there were no Accord type waterways present on the farm, then a random replacement from the same region and quartile was selected. Thirty nine farmers out of 626 (6 percent) approached chose not to participate.

¹ The AgriBase database holds information on different types of rural properties. Geospatial technology allows a user to render information from AgriBase into virtual features for display and geospatial analysis.

FIELD OBSERVATION AND DATA RECORDING

Field technicians were each equipped with a handheld Garmin GPS device, with maps of each of the selected farms in their regions loaded into the unit. Each of the technicians had one day of training on a selection of farms with differing features. The training focus was on survey requirements, observation and recording of data and the use of the GPS device. An A3-sized map of each property was also printed from the AgriBase database. A data-collection form was designed to capture the relevant data on each property (see Appendix 1).

Field technicians walked or drove along the length of each Accord type waterway on each farm, such that the level of stock exclusion could be visually assessed. Accord streams are defined as deeper than a red-band gumboot (ankle deep), wider than a stride (1 metre) and permanently flowing and, for the purposes of this report, natural lakes. Whilst the size of a stream could be determined at the time of visit, its permanence required input based on the farmer's observations at the time of visit.

DATA ANALYSIS

Of those farms sampled, farm-level data was aggregated regionally and nationally to show:

- number and percentage of farms that had achieved complete stock exclusion;
- number and percentage of Accord waterways that were fully protected from stock;
- percentage of bank lengths for which stock exclusion had been achieved;
- number of farms sampled;
- number of Accord waterways surveyed;
- average number of Accord waterways per farm;
- length of banks crossing or bordering farms;
- average length of banks per farm; and
- length of banks along which stock exclusion had been achieved.

Confidence intervals around the regional and national percentages were calculated using R v2.13.1 (R Development Core Team, 2007). Ninety-five percent confidence intervals for each proportion (percentage) were calculated using the Agresti-Coull method (Agresti and Coull, 1998). Where the lower bound for the calculated confidence interval was negative, the exact method was used. A bootstrap² technique was used to estimate confidence interval around the mean percentage of bank lengths that were protected. The margin of error reported is half the width of the confidence interval.

The results are not directly comparable to other assessments conducted by Fonterra or regional councils. Seasonal and annual variations in rainfall will affect on-ground interpretations on whether a waterway is “deeper than a red-band gumboot, wider than a stride and permanently flowing” and therefore an Accord Waterway. Amongst other differences, the annual Dairying and Clean Streams Accord snapshot relies on self-reporting by farmers, and is generally conducted between October and April (winter milkers between June and July), whereas this Stock Exclusion Survey was conducted by technicians in 2011 in the drier months of March to May.

A survey of the riparian characteristics of the Auckland Region occurred during September and December 2007 and measured fencing rather than stock exclusion which includes natural barriers. The report of the riparian characteristics of pastoral streams in the Waikato region took place between November 2007 and December 2008 and stream lengths were actually measured rather than by a visual assessment.

² A statistical technique whereby many sub-samples are created by randomly dropping out one member.

Results

Five hundred and eighty-seven farms were surveyed between March – May 2011. The number of farms surveyed in each region is shown in Table 1. The locations of these properties are shown in Figure 1. Additional region-specific comments reported back by the field technicians who conducted the survey are made in Table 2.

Table 1. Farms Surveyed by Region

Region	Number of farms surveyed
Auckland	45
Bay of Plenty	50
Canterbury	52
Hawke's Bay	28
Manawatu-Wanganui	52
Marlborough	24
Northland	52
Otago	46
Southland	51
Taranaki	55
Tasman	35
Waikato	58
Wellington	39
National	587

Table 2. Region-specific notes on topography and fencing challenges.

Region	General Observations
Auckland	Cyclone Wilma passed through Northern Auckland Regional Council area.
Bay of Plenty	In Eastern Bay of Plenty there are significant drainage canals that meet the criteria.
Hawke's Bay	Geography ranged from northern hill country dairy farms with rivers and deep gorges that provided fencing challenges, to flat easier fencing options around Takapau.
Manawatu-Wanganui	Many properties with straightened rivers/streams to meandering streams and therefore difficult fencing on farms on the North eastern foothills of the Tararua Range.
Marlborough	Three farms reported losing fencing in recent floods. These were assessed as stock-proof where they were flood-damaged within the last six months and there was an intention to repair. Terrain and multiple valleys can make fencing difficult on many properties.
Northland	Typically this region's topography (i.e. farms with a lot of broken country such as valleys, bluffs, stoney ground etc) provides fencing challenges for the owners. Cyclone Wilma also passed through this area.
Southland	A growth dairy area. Southland Regional Council requires waterway fencing as part of the Resource Consent for dairy conversions.
Tasman	One farm reported losing fencing in recent floods. This was assessed as stock-proof where fences were flood damaged within the last six months and there was intention to repair. Terrain and multiple valleys can make fencing difficult on many properties.
Wellington	Wairarapa - many farms with irrigation canals (good fencing conditions) and backing onto Lake Wairarapa. Horowhenua - a lot of lakes within the coastal land.

Figure 1. Map of Fonterra suppliers surveyed

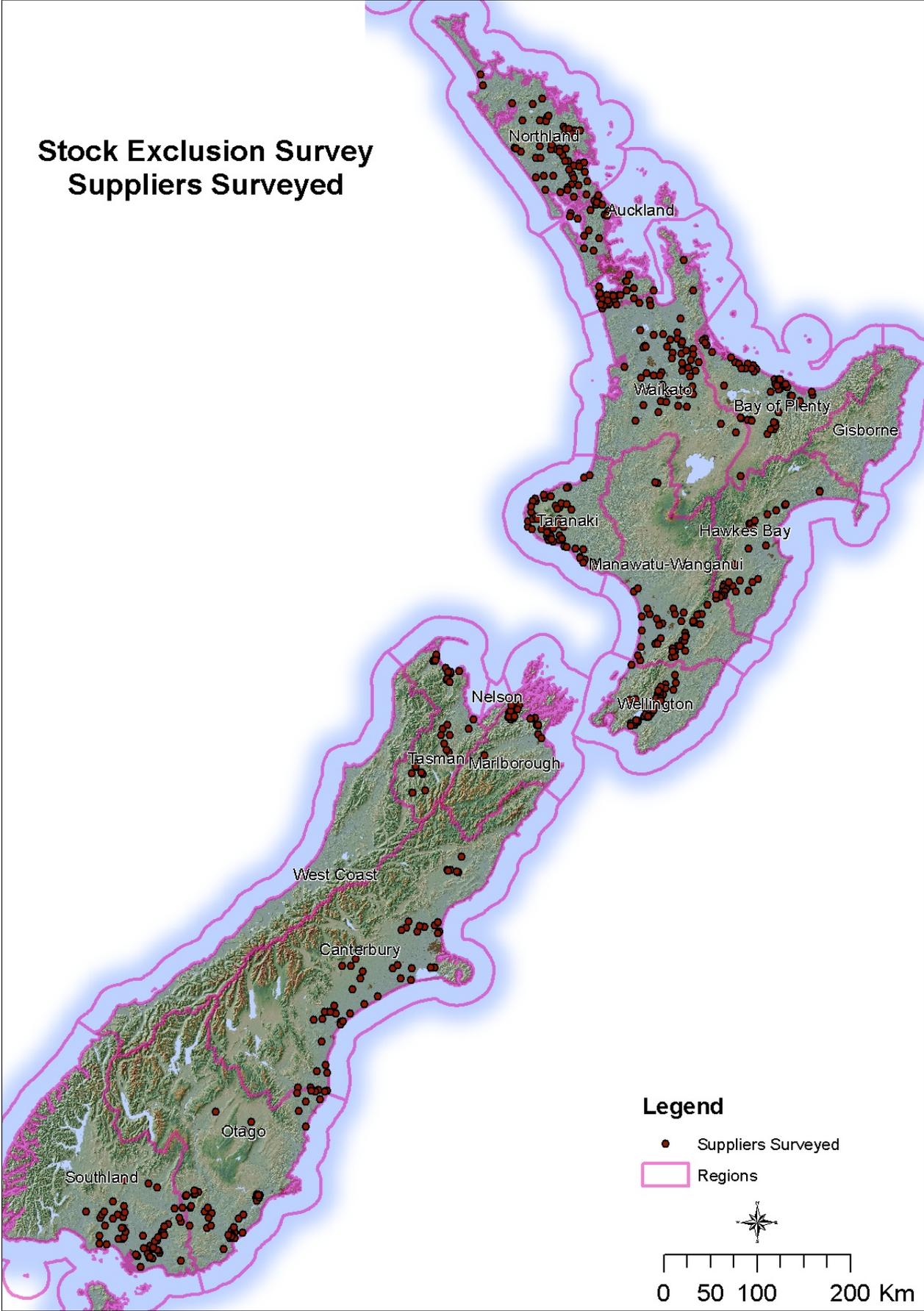


Table 3 shows the percentage of farms that have achieved complete stock exclusion within each region, the percentage of Accord streams that have complete stock exclusion within each region and the mean percentage of Accord stream bank length that have stock exclusion within each region.

Table 3. Results of survey

Region	Percent of Farms with Complete Stock Exclusion	Percent of Streams with Complete Stock Exclusion	Mean Percent of Bank Length with Stock Exclusion	Mean Bank Length Still to Fence per farm (km)
Auckland	40 (± 13.8)	50 (± 10.8)	65.7 (± 10.8)	0.90
Bay of Plenty	52 (± 13.3)	65.7 (± 9.1)	72.5 (± 10.5)	0.60
Canterbury	65.4 (± 12.6)	78.2 (± 6.8)	93.8 (± 3.7)	0.33
Hawke's Bay	57.1 (± 17.2)	77.6 (± 9.9)	93.9 (± 4.3)	0.26
Manawatu-Wanganui	26.9 (± 11.8)	44.4 (± 9.2)	73.3 (± 8.3)	0.79
Marlborough	8.3 (± 12.9)	26.8 (± 10.2)	68.1 (± 8.9)	1.61
Northland	32.7 (± 12.4)	34.6 (± 10.2)	63.9 (± 8.9)	1.40
Otago	45.7 (± 13.8)	68.3 (± 8.2)	87.4 (± 6.2)	0.62
Southland	60.8 (± 13.0)	77.9 (± 6.7)	89.9 (± 5.5)	0.68
Taranaki	32.7 (± 12.1)	49.6 (± 8.6)	77.9 (± 7.3)	0.73
Tasman	17.1 (± 12.7)	33.7 (± 8.8)	77.7 (± 6.8)	1.3
Waikato	46.6 (± 12.4)	57 (± 9.5)	77.9 (± 7.8)	0.55
Wellington	43.6 (± 14.9)	50 (± 11.7)	76.8 (± 9.2)	0.79
National	42.1 (± 4)	57 (± 2.7)	78.4 (± 2.3)	0.78

Discussion

An Accord type waterway is defined in the Accord as “deeper than a Red Band (ankle depth) and wider than a stride, and permanently flowing”. For this survey the definition for “Accord Type Waterways” was given more clarity. Accord type waterways were defined as: “Streams that are deeper than a red-band gumboot (ankle deep), wider than a stride (1 metre) and permanently flowing and, for the purposes of this survey, natural lakes”.

The size of a stream was determined at the time of visit but its permanence was a matter of judgement, especially for smaller streams whose size varied depending on seasonal variations in rainfall. If the farmer was present at the visit, this point could be discussed, otherwise it was up to the field technician to assess whether the stream fitted the criteria of an Accord waterway (based on the training they were provided).

Sometimes Accord waterways did not meet the criteria throughout their entire length on a property. For example, a stream could run the entire length of a gully but it might only meet the Accord criteria for width at a mid point due to water feeding it from another spring or stream. These and similar examples were deemed Accord waterways only from the point where they met the criteria and downstream from there.

Whilst many properties with sea boundaries had their properties fenced for stock security, for the purposes of this survey, the sea was not regarded as an Accord waterway.

The mean percentage of bank lengths that had been protected was 78.4 percent while the percentage of farms that had achieved complete stock exclusion on all of their Accord waterways was 42.1 percent nationally. Fifty-seven per cent of all Accord waterways surveyed were completely protected.

Nationally 39 farmers out of 626 approached chose not to participate. If we assumed those farmers did not have their streams fully stock-proofed, then it would drop the overall protection rate from 42.1 to 39.46 for farms that were fully protected, which is still within the margin of error (+/- 4 percent).

Northland had the highest relative numbers of refusals to participate (18). If we assumed that all of the refusals had failed to protect their streams, then the farm protection rate would drop from 32.7 percent to 24.3 percent, still within the +/- 12.4 percent margin of error.

The average amount of fencing still to be completed by each farm in each region is shown in Table 3. The length of fencing required ranges from 0.26 km in Hawke’s Bay to 1.61 km in Marlborough. While this is an important indicator of remaining progress required, it also reflects some of the more challenging regions to fence. For example Marlborough farms have the third highest bank lengths to protect amongst the regions with an average of 5.23km per farm.

There was considerable variation in stock exclusion levels across the thirteen regions. There were varying fencing issues the landowners had to contend with, such as topography, multiple valleys, meandering streams, changed flow of watercourses, damaged fencing due to fallen trees and flooding in areas such as Auckland, Northland, Tasman and Marlborough. These all impact on the cost of and provision of stock exclusion to a greater or lesser extent.

Field technicians observed that farms within a locality often demonstrated similar standards of fencing, possibly reflecting local conditions, regional council influence and peer pressure. Some regional councils, for example, are contributing to the fencing costs of streams that are unfenced.

Several farms in Northland and Auckland had suffered flooding with subsequent fencing damage from Cyclone Wilma at the end of January 2010. Where sections of Accord waterways on these properties had obviously been previously fenced, and the landowner showed every intention to replace the affected sections, they were accepted as being stock excluded. A similar situation existed in Tasman and Marlborough where four farms had lost fencing due to flooding in January 2011.

Conclusion

MAF undertook a nation-wide field based randomised statistical survey to assess Stock Exclusion from Dairying and Clean Streams Accord type waterways to determine the percentage of stock exclusion from streams and provide an independent look at progress towards the Accord targets. The survey will inform partners in the Dairying and Clean Streams Accord.

Learning all we can about the degree of stock exclusion from our waterways is important for enhancing the protection and sustainable management of our natural resources including those used in farming. This independent survey contributes to the growing evidence base available on stock exclusion.

The survey contributes a different and useful set of data to that already available. However, it is difficult to compare the Stock Exclusion Survey to other surveys which used different methodologies and were carried out at different times and seasons of different years. This latest survey provides data on three key pieces of information on stock exclusion. For example stream length demonstrates how many kilometres of stream length fencing need to be provided to achieve 90 percent stock exclusion and the percentage of waterways with 100 percent stock exclusion demonstrates the number of streams fully protected.

The survey highlights the extent of the challenges faced by dairy farmers when excluding stock from waterways on their farms, within regions and across the whole country. It emphasises the need to work in partnership with the dairying sector to address the challenges they face. The survey contributes to the growing information available to partners in the Dairying and Clean Streams Accord from which quality decisions can be made.

Glossary

Term	Definition
Full stock exclusion from farms	All Accord waterways present on a given farm are entirely protected from access by dairy cattle. In large multi-enterprise properties, only the dairy platform was assessed. Run-offs were not assessed.
Full stock exclusion from streams	On some farms there were more than one distinct Accord waterway. In this case each distinct Accord waterway was assessed as to whether or not dairy cattle were excluded. Where the stream crossed a farm, both banks were assessed separately. Where an Accord waterway formed the boundary of a property, only the nearside bank was assessed.
Stock exclusion	This means dairy cattle could not access the stream bed itself. Exclusion could be by fencing, dense riparian strips, or by natural barriers such as cliffs. Electric fencing was deemed as satisfactory for stock exclusion as long it was fit for the purpose of keeping dairy cattle out and permanent i.e. not on a reel.
Accord waterway	Defined in the Dairying and Clean Streams Accord as deeper than a "Red Band" (ankle depth) and "wider than a stride", and permanently flowing.
Confidence interval (CI)	A statistically computed interval within which the true parameter of interest is likely to fall a given percentage of times, should the survey be repeated many times. So, in the context of this survey, one of the outcomes is the percentage of Accord waterways protected within a given region. So, the 95 percent confidence interval was calculated such that if the survey was repeated many times, 95 percent of those times the true stream protection rate would fall within the upper and lower bounds. The formula takes into account the sample size and the point estimate of the outcome. The width of the interval is widest for small sample sizes and results close to 50 percent. Larger sample sizes and results closer to 0 or 100 percent lead to narrower confidence intervals. The margin of error is half the width of the confidence interval.
Accord regions	Thirteen regional council areas within which the majority of Fonterra suppliers are located. They exclude Gisborne, Nelson and the West Coast of the South Island.
Mean percent of bank length with stock exclusion	For each farm, we measured the total length of Accord waterway banks under the responsibility of the farm, and then calculated the percentage of the length that had stock exclusion. All of the farm percentages were then averaged by region.

References

Agresti, A; Coull, B A. (1998) Approximate is better than “exact” for interval estimation of binomial proportions. *American Statistician*, 52:119-126.

R DEVELOPMENT CORE TEAM (2007) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.

Sanson, R; Pearson, A (1997) AgriBase - a national spatial farm database. Proceedings of 8th International Symposium on Veterinary Epidemiology and Economics, Paris, 7-11 July 1997. *Epidémiologie et Santé Animale* 31-32: 12.16.1-12.16.3.

