Levels of *E. coli* in New Zealand rivers

NIWA Client Report: HAM2004-157
December 2004

NIWA Project: MFE05222

Levels of *E. coli* in New Zealand rivers

M. Scarsbrook
G. McBride

Prepared for

Ministry for the Environment

NIWA Client Report: HAM2004-157
December 2004
NIWA Project: MFE05222

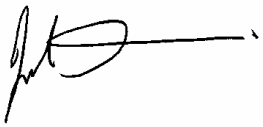
National Institute of Water & Atmospheric Research Ltd
Gate 10, Silverdale Road, Hamilton
P O Box 11115, Hamilton, New Zealand
Phone +64-7-856 7026, Fax +64-7-856 0151
www.niwa.co.nz

Contents

Reviewed by:

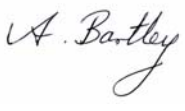
Dr Mark Meleason

Approved for release by:



Dr John Quinn

Formatting checked



1. Introduction

The purpose of this report is to summarise information on levels of the faecal indicator bacteria *Escherichia coli* in New Zealand rivers. We present a re-analysis of a national dataset (410 river sites) and relate observed levels to current microbiological guidelines for recreational uses of freshwater.

In a previous report to MfE, Larned et al. (2003) summarised water quality state and trends in rivers throughout New Zealand. Their analyses included a summary of levels of *E. coli* in rivers draining different land use classes, and they also presented information on *E. coli* in rivers of different climate and source of flow classes of the REC (Snelder & Biggs 2002). Levels of *E. coli* were compared against MfE (2002) recreation guideline values. Larned et al. (2003) found that 72% of sites had levels of *E. coli* that exceeded the 2002 recreational guideline value. However, Larned et al. (2003) compared site means against the 2002 guideline, whereas the guideline value relates to median values (i.e., median < 126 cfu/100 ml). As a result, Larned et al. (2003) may have over-estimated the proportion of sites failing to meet the 2002 guideline (cf. Table 10 in that report). We refer readers to Larned et al. (2003) for details about data collection, analyses and more detailed results and discussion.

MfE has requested that the *E. coli* dataset of Larned et al. (2003) be re-analysed and compared against the 2003 Microbiological Guidelines for Marine and Freshwater Recreation (MfE/MoH 2003). The guideline level at which bathing water is considered unsuitable for bathing is 550 *E. coli* /100 ml. This data is to be presented in an OECD report and will also contribute to MfE's work under the Government's Water Programme of Action.

The project brief involved addressing the following question: What percentage of monitoring sites fails the following criteria in the **recreational** guidelines?

a) MfE (2002) median value >126 *E. coli*/100 ml.

b) MfE/MoH (2003) 95th percentile >550 *E. coli*/100 ml.

c) MfE/MoH (2003) maximum >550 *E. coli*/100 ml.

Note that criterion b) refers to the D "Microbiological Assessment Category" for the "Suitability for Recreation Grade" in Tables E1 and E2 of the 2003 Guideline. criterion c) refers to the "Action/Red Mode" surveillance limit on page E9 of those Guidelines.

2. Methods

Larned et al. (2003) brought together *E. coli* data from 410 sites throughout New Zealand sampled between 1996 and 2002. The total number of sample records was 9552. The number of sample records per site varied from 1 to 114 (median = 19).

Note that these sites are principally water quality monitoring sites, and do not necessarily reflect sites used for recreation.

As requested, we provide a breakdown by land use categories (Note: Bush, Tussock, Scrub and Bare were collapsed into 'Natural'), and sites at the source of flow level of the REC (Snelder & Biggs 2002).

3. Results & discussion

Our re-analysis alters some of the results, but not the conclusions given by Larned et al. (2003). In particular, Table 10 of that report over-estimates the proportion of sites exceeding *E. coli* guidelines (i.e., MfE 2002). The only serious over estimation relates to sites in natural landcover types (Bush, Tussock, Scrub and Bare). We now show that 14% of sites have median levels of *E. coli* exceeding 126 /100 ml, whereas the previous reported proportion was 42%.

Note that sites in the D Microbiological Assessment Category in the MfE/MoH (2003) Guidelines can be described as "Poor" or "Very Poor". Therefore, an interpretation of values in the table below is that "Of the 410 sites in the dataset, 69% of streams surveyed are rated as "Poor" or "Very Poor" for recreational uses under the MfE/MoH (2003) guidelines". This is very similar to the finding of Larned et al. (2003) that 72% of sites failed the 2002 guidelines.

Assessments using 95%iles and maxima for all but the CX/Lk sites give very similar conclusions[1]. Also, we conclude that the 2002 Guidelines' median criterion is generally less stringent than the 2003 Guidelines.

[1] We used DataDesk software to calculate medians. It uses the Hazen estimator, as required by the 2003 Guidelines (Table E1). For sites with less than 11 samples the Hazen estimator sets the 95%ile equal to the maximum, so absolute agreement between the 95%ile and maximum can be expected in those 94 sites with less than 11 observations.

Table: Percentage of sites failing recreational guideline values for *E. coli* (number /100 ml). The first column refers to landuse and climate/source of flow classes of the REC.

	# sites	Median >126 MfE (2002)	Median >550	95th%ile >550 MfE/MoH (2003)	Max >550
All sites	410	55	12	69	73
EF	25	24	4	24	24
N	103	14	1	43	50
P	269	71	15	83	85
U	13	100	46	92	92
CD/H	32	41	0	66	69
CD/L	69	88	33	91	94
CW/H	81	31	1	41	43
CW/L	65	68	9	80	82
CW/Lk	18	17	6	33	33
CX/H	20	5	0	40	50
CX/L	15	47	13	80	87
CX/Lk	8	13	0	38	63
WD/L	12	92	50	92	92
WW/L	73	77	12	89	90
CW/M	5	*	*	*	*
WW/Lk	3	*	*	*	*
WW/H	2	*	*	*	*
WX/L	2	*	*	*	*
CX/G	2	*	*	*	*
CD/M	1	*	*	*	*
CX/M	1	*	*	*	*

'*' Too few sites for meaningful analysis

Please note that the 'Median >550' column does not relate to either the 2002 or 2003 Guideline, and is for interest only.

4. References

Larned, S.; Scarsbrook, M.; Snelder, T; Norton, N. (2003). Nationwide and regional state and trends in river water quality 1996-2002. NIWA Client Report CHC2003-051.

MfE (Ministry for the Environment). (2002). Microbiological water quality guidelines for marine and freshwater recreational areas. Ministry for the Environment, Wellington, New Zealand.

MfE/MoH (Ministry for the Environment/Ministry of Health). (2003). Microbiological water quality guidelines for marine and freshwaters 2003. Ministry for the Environment, Wellington, New Zealand.

Snelder, T.H.; Biggs, B.J.F. (2002). Multiscale river environment classification for water resources management. *Journal of the American Water Resources Association 38(5)*: 1225-1239.