DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Tasmania

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Water Quality of Rivers in the Duck River Catchment

A Report Forming Part of the Requirements for 'State of Rivers' Reporting

PART 3iii

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The Department of Primary Industries, Water and Environment

The Department of Primary Industries, Water and Environment provides leadership in the sustainable management and development of Tasmania's resources. The Mission of the Department is to advance Tasmania's prosperity through the sustainable development of our natural resources and the conservation of our natural and cultural heritage for the future.

The Water Resources Division provides a focus for water management and water development in Tasmania through a diverse range of functions including the design of policy and regulatory frameworks to ensure sustainable use of the surface water and groundwater resources; monitoring, assessment and reporting on the condition of the State's freshwater resources; facilitation of infrastructure development projects to ensure the efficient and sustainable supply of water; and implementation of the *Water Management Act 1999*, related legislation and the State Water Development Plan.

2.4.3 Catchment Surveys - Metals

Samples taken during snapshot surveys were analysed for some of the main metals commonly found in environmental waters that may pose some risk to aquatic organisms or to human health. Due to budget limitation, only total metal concentrations were determined, although it is often the dissolved form that poses most threat to the environment. The detection limits for those metals that were analysed are listed below.

Metal	*Limit of Detection*
Aluminium	5µg/L
Arsenic	1µg/L
Cadmium	1µg/L
Copper	1µg/L
Lead	1µg/L
Zinc	1µg/L

Similar to many other parameters commonly tested for in surface waters, metals can be present in various forms. Trace amounts of some metals are naturally present in surface waters as a consequence of the weathering of rocks and soil. Metals can be present attached to suspended matter, colloids, or complex organic compounds. The relative toxicity of metals is dependant upon the degree of oxidation of the metal ion together with the form at which it is associated (UNESCO, 1992). The toxicity of metals will also vary depending on the environmental conditions in which they are found. Acidic conditions tend to increase the toxicity of most metals, whilst for others high concentrations of hardness can reduce their toxicity (ANZECC, 1992).

The new National trigger values for toxicants (ANZECC, 2000) were derived using a statistical distribution method calculated at 4 different protection levels. In the majority of cases the 95% protection level should be used for most ecosystems which can be classified as slightly to moderately disturbed and is suggested here as the default value (Table 2.2).

Table 2.2: Trigger values for observed metals at alternate levels of protection. Values in the grey shaded areas are the trigger values applying to typical slightly to moderately disturbed ecosystems (ANZECC, 2000).

Metals	**Trigger Values for freshwater (µg/L^{-1})**			
	Level of Protection (% species)			
	99%	95%	90%	80%
Aluminium pH > 6.5	27	55	80	150
Aluminium pH < 6.5	ID	ID	ID	ID
Arsenic (As III)	1	24	94	360
Arsenic (As V)	0.8	13	42	140
Cadmium (H)	0.06	0.2	0.4	0.8
Copper (H)	1.0	1.4	1.8	2.5
Lead (H)	1.0	3.4	5.6	9.4
Zinc (H)	2.4	8.0	15	31

In Table 2.2, ‘H’ represents those metals for which values have been calculated using a hardness of 30mg/L $CaCO_3$. These should be adjusted based on site hardness. For the Duck catchment, the following trigger values for these metals should be adopted based on the hardness of waters in the catchment:

Metal	Trigger Level for Duck catchment (Level of protection - 95%)
Copper	3.5
Zinc	25.0
Lead	13.6

No significant concentrations of cadmium or lead were recorded during either the summer or the winter survey. Arsenic was only recorded above the detection limit at DR17 (Allens Creek). Copper concentrations at most sites were only marginally above the detection limit (1 – 3 μg/L) and are below the catchment trigger level proposed above. Copper concentrations of this order are unlikely to represent any environmental threat. The only significant record is for DR1 (Duck River at Bass Highway), where a concentration of 12 μg/L was recorded during the winter survey. The copper concentration at all other sites was generally lower during the higher flows of winter.

Zinc concentrations throughout the catchment are shown in Table 2.3 below, as they could not be adequately represented in the map form used earlier in this section. Concentrations were generally quite low, with most readings within the range 1-10 μg/L. Concentrations of this order do not constitute any environmental threat, and given the turbidity levels in the catchment, are likely to be bound to clays and other suspended particulate material in the water column. No consistently elevated concentration was found between surveys at any site, although higher values were recorded at DR6, DR20 and DR25 on the Duck River and at DR17 on Allens Creek (where arsenic was also found in appreciable concentration). Further testing at DR17 may help to resolve questions as to why elevated concentrations of both zinc and arsenic occur at this site.

Table 2.3: Zinc concentrations (in µg/L) recorded at sites in the Duck catchment during 'snapshot' surveys conducted in March and August of 2000.

Site Name	Code	March 2000 [Zinc]	August 2000 [Zinc]
Duck at Bass Highway	DR1	< 1	6
Gaeles Creek at Bass Highway	DR2	2	6
Coventry Creek at Trowutta Road	DR3	< 1	9
Duck at SG station at Scotchtown	DR4	3	5
Gaeles Creek at Trowutta Road	DR5	< 1	6
Duck at Trowutta Road u/s Gaeles Creek	DR6	1	27
Duck at Lades Road	DR7	2	1
Copper Creek at Trowutta Road	DR8	9	5
Allen Creek at Allandale Farm	DR9	3	2
Edith Creek at Trowutta Road at Edith Creek	DR10	3	2
Edith Creek at Huetts Road (via Maxwells)	DR11	4	< 1
Duck at Huetts Road	DR12	2	< 1
Drive Creek at Trowutta Road at Edith Creek	DR13	4	< 1
Edith Creek at quarry 1 off South Road	DR14	3	4
Edith Creek at Moores Road	DR15	4	< 1
Edith Creek at quarry 2 off South Road	DR16	3	< 1
Allens Ck d/s confluence Allen &Blizzards Ck	DR17	15	< 1
White Water Creek at Poilinna Road	DR18	2	3
Duck at Poilinna Road	DR19	< 1	2
Duck at Trowutta Road at Roger River	DR20	5	19
Roger River at Roger River Road	DR21	11	3
Roger River at Buffs Road	DR22	8	4
Roger River at Croles Road	DR23	5	3
Faheys Creek at Maguires Road	DR24		4
Duck at Maguires Road	DR25	15	7
Lairds Creek at Maguires Road	DR26	11	8
Muckeye Creek at Faheys Road	DR27	5	5
Deep Creek u/s Lake Mikany	DR28	4	7
Deep Creek d/s Lake Mikany	DR29	1	6

The results for aluminium contrast greatly with those for the other metals that were tested. The results for the summer and winter snapshots are presented in Figure 2.34 and Figure 2.35 respectively, and show that concentrations throughout the catchment vary widely both spatially and between surveys. Comparison of concentrations against Nationally published trigger levels is unrealistic, given that these are measurements of 'total' aluminium as opposed to the more toxic 'dissolved' aluminium, and a large proportion of the aluminium measured is likely to have been adsorbed to clays and other suspended particles. This tendency for aluminium to adsorb to suspended particles is illustrated when samples collected during both surveys is plotted against turbidity (Figure 2.36). The graph clearly shows that aluminium concentration is broadly related to turbidity, though there is some variability around the relationship.

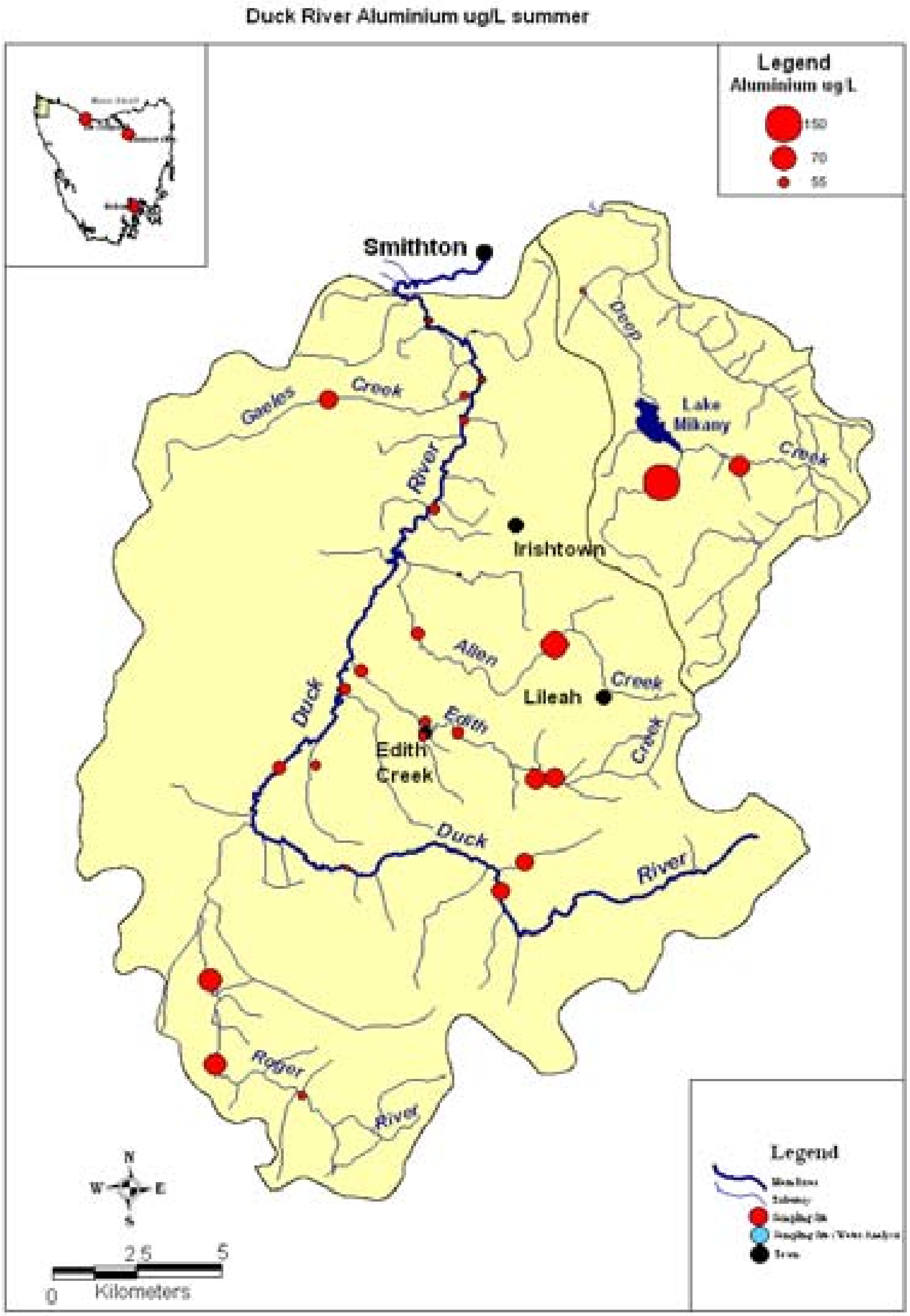

Figure 2.34: Snapshot of Total Aluminium concentrations recorded in the Duck catchment on 21 March 2000.

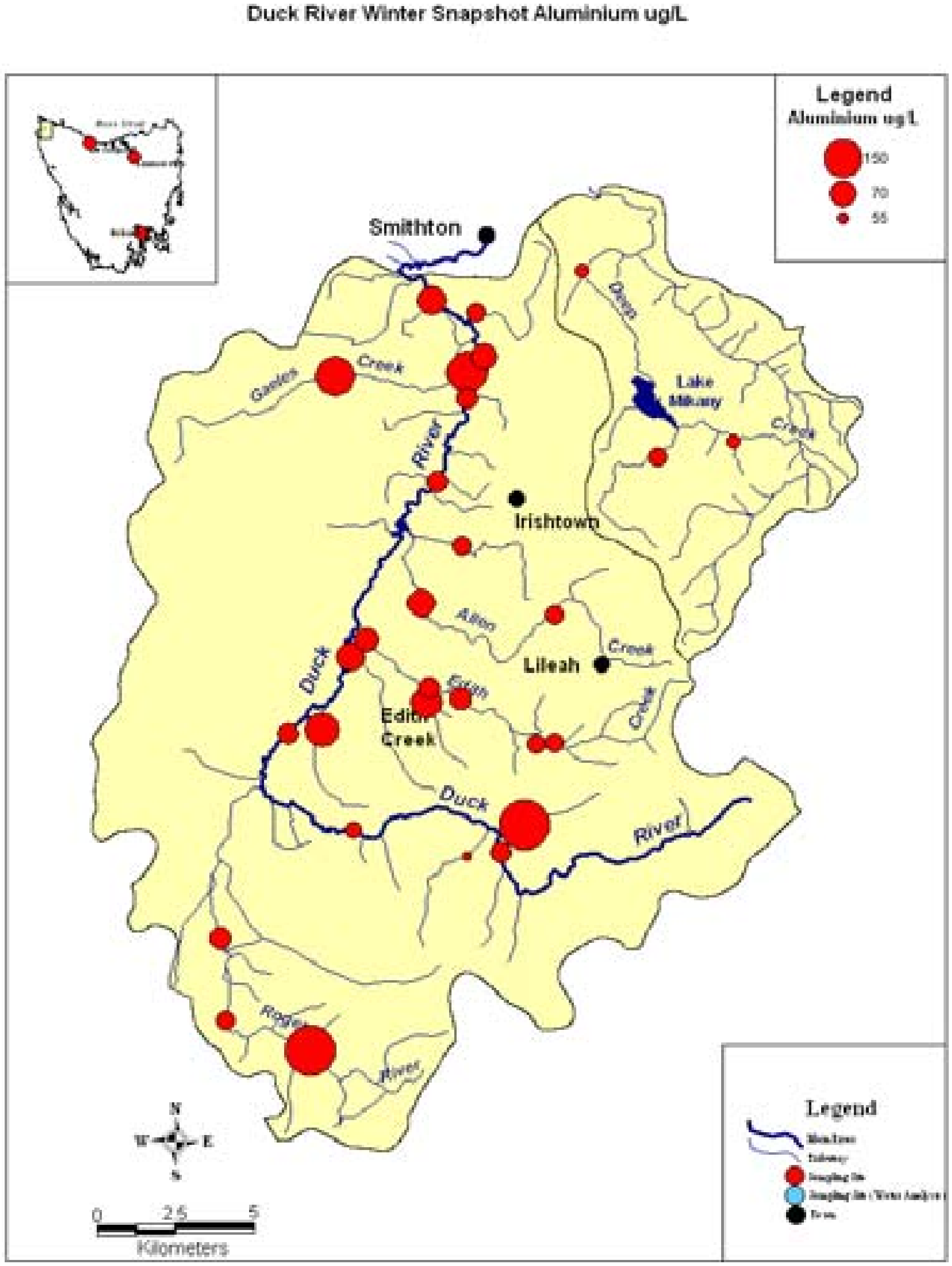

Figure 2.35: Snapshot of Total Aluminium concentrations recorded in the Duck catchment on 31 August 2000.

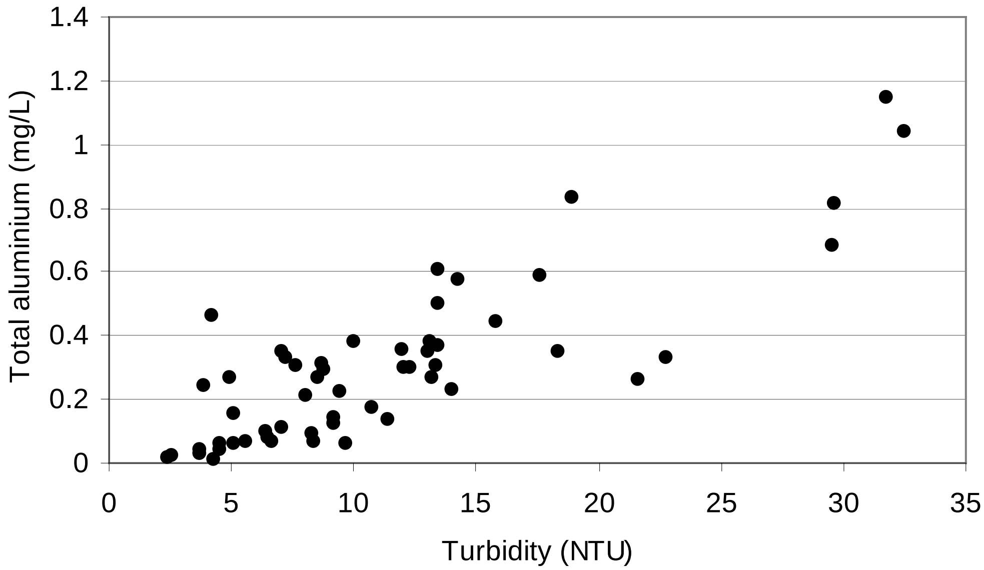

Figure 2.36: Relationship between total aluminium concentrations and turbidity in the Duck catchment using data collected during 'snapshot' surveys of the catchment conducted in March and August 2000.

However, although there is a high likelihood that most of the aluminium measured presents no risk to aquatic biota, some sites can be highlighted as having quite elevated aluminium concentrations relative to the rest of the catchment.

During the summer survey the majority of sites (18) were less than about 150 μg/L. Turbidity throughout the catchment at the time of the survey was quite low (median of 6NTU). Sites that were noticeably above this 'background' were DR2 (upper Gaeles Creek), DR15 and DR16 on Edith Creek, DR17 on Allens Creek, both sites on Roger River and sites located on the tributaries draining into Lake Mikany. A concentration of 835 μg/L was recorded during the summer survey at Muckeye Creek, where turbidity at the time was also much higher than elsewhere in the catchment (turbidity of 18NTU).

Two extremely high aluminium concentrations were recorded during the winter survey (Figure 2.35). A concentration of 10,000 μg/L was recorded at DR23 (Roger River at Croles Rd) and 3,670 μg/L was recorded at DR26 (Lairds Creek). Both of these readings are suspect as turbidity at both sites was not excessively high at the time. No clear explanation can be provided for these results.

2.4.4 Catchment Surveys – Bacteria

Due to local interest in the bacterial condition of waterways in the catchment, some monitoring of bacteria was undertaken during the course of the project. Unfortunately, the nearest registered laboratory for analysing samples was too remote from the catchment to make rigorous and accurate testing feasible. It was therefore decided to undertake testing using new technology (NALGENE® 'Micro Monitors') that allowed meaningful results to be gained locally at relatively low expense. While this testing was not able to be quality assured in the way that registered laboratories might choose, some comparative tests were carried out against a registered laboratory in Launceston to determine whether results from this procedure were likely to reflect 'true' environmental conditions. These preliminary tests showed that results gained from this newer, technically simpler methodology are capable of yielding data that are within acceptable limits for accuracy and could be used to show 'relative bacterial condition' with some degree of confidence.

To facilitate the production of reliable results for the Duck catchment, a small laboratory was set up in Smithton, and contained sterilisation equipment, an incubation oven and a clean environment in which to operate. This setup was used to prepare and incubate samples collected in the field. Duplicates were frequently taken as an internal quality assurance measure. The limitations of this technique meant that there was an upper maximum for readings of 12,000 cfu/100ml.

This technique was used during the summer and winter surveys in the Duck catchment. The results are plotted in Figures 2.37 & 2.38, with sites low in the catchment on the left-hand side and those in the headwaters on the right. As expected, the summer pattern is for generally higher faecal coliforms at sites in the lower parts of the catchment, where agricultural activities are most intense. Locations in the lower catchment where faecal pollution is most apparent are DR4 (Duck River at Scotchtown Rd), DR9 (Allen Creek) and DR10 (Edith Creek). All three of these areas are areas where there is heavy dairy use, and Edith Creek was an area targeted during previous stream sampling in the Duck catchment by DPIF to examine pollution from dairy shed effluent.

Sites above DR11 have a noticeably lower level of faecal pollution, with average counts across upper catchment sites of about 150 cfu/100ml. A clear outlier in this area is the Duck River at Maguires Rd, where the river emerges from relatively undisturbed forest. This highlights the fact that faecal coliforms can often be found in rivers and streams within relatively 'unimpacted' areas, where native animals are the only contributors to faecal pollution.

The situation encountered during the winter survey (Figure 2.38) forms much less of a clear spatial trend than was found during the summer. Average coliform concentrations across the catchment were much higher during the winter survey, with 8 sites having maximum counts (>6000 cfu/100ml). Three of these were within the Edith Creek drainage system, and highlight Edith Creek as a significant source of faecal pollution during the higher flows of winter. Once again a significant outlier in the upper catchment was Roger River at Croles Rd (DR23) where unexpectedly high coliform counts were recorded.

Approximately monthly monitoring for faecal coliforms was also conducted during 2000-2001, with 18 samples collected at four sites. The data from this monitoring is summarised in the boxplot of Figure 2.39, and provides further confirmation that there is substantial faecal pollution to sites DR4 (Duck River at Scotchtown Rd) and DR10 (Edith Creek) compared to upper catchment sites (DR20 and DR22).

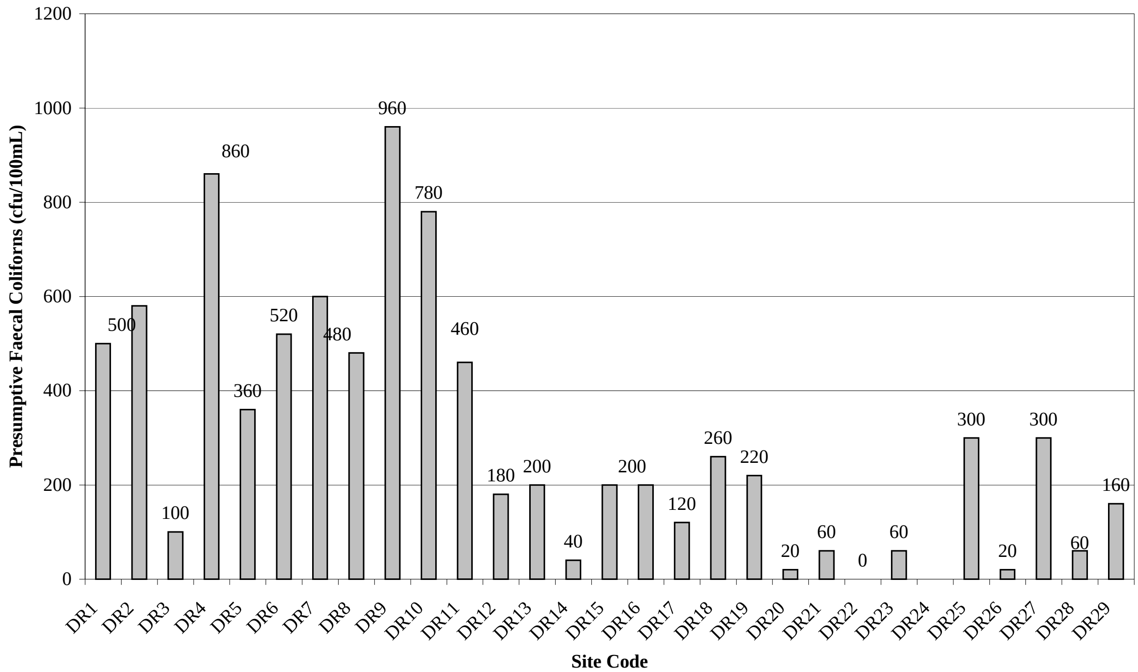

Figure 2.37: Snapshot survey for thermotolerant (faecal) coliforms in ambient waters of the Duck catchment in March 2000.

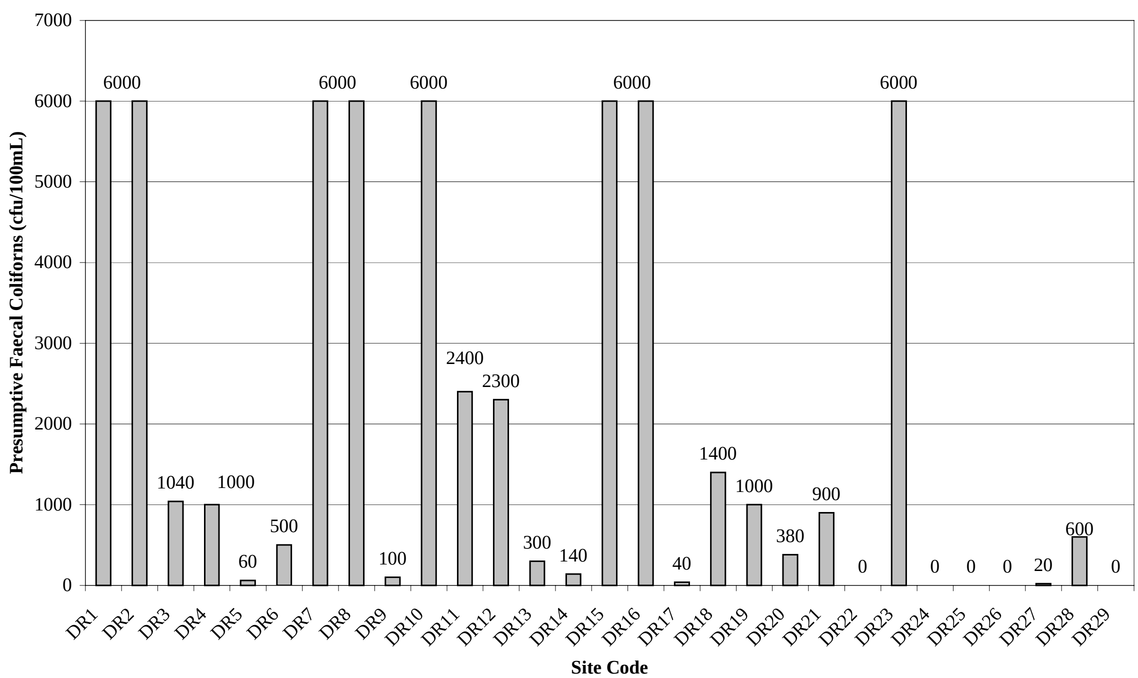

Figure 2.38: Snapshot survey for thermotolerant (faecal) coliforms in ambient waters of the Duck catchment in August 2000.

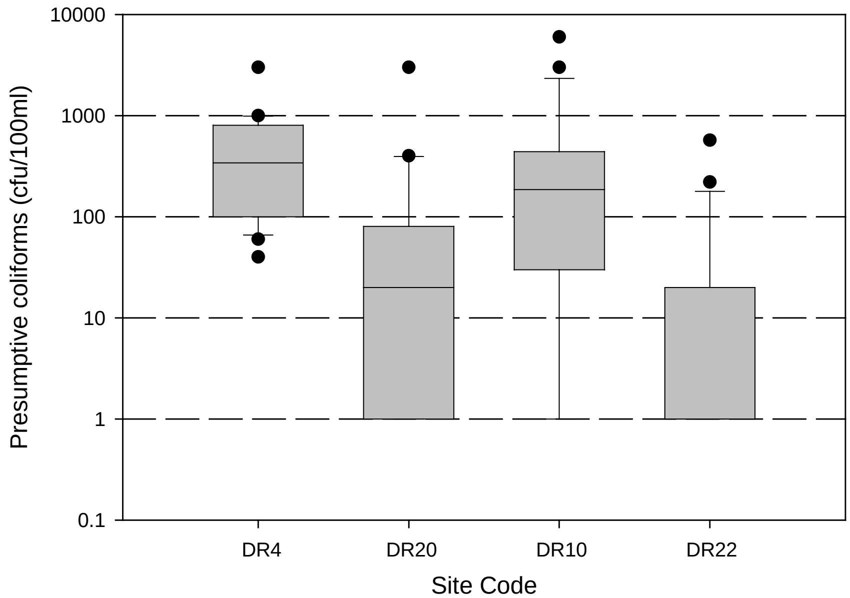

Figure 2.39: Thermotolerant (faecal) coliforms in ambient waters of the Duck catchment (n = 18).