NORSKE SKOG ALBURY MILL

Revised Treated Process Water Management Strategies

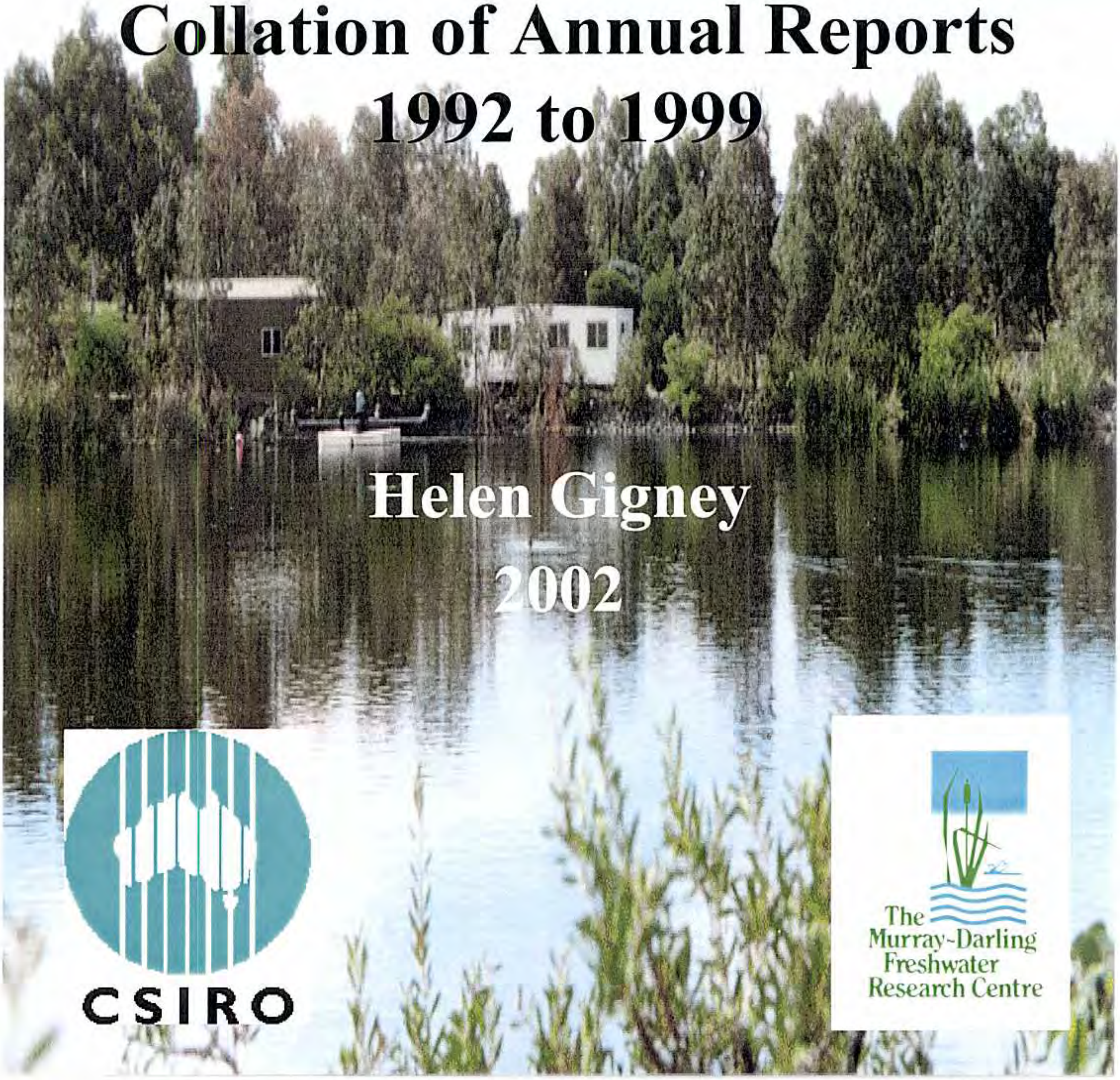
STATEMENT OF ENVIRONMENTAL EFFECTS

APPENDIX 7

Biomonitoring of Newsprint Mill Wastewater for Norske Skog

Part 1

Collation of Annual Reports 1992 to 1999



Helen Gigney

2002

CSIRO

The Murray-Darling Freshwater Research Centre

The Murray-Darling Freshwater Research Centre

30 July February 2002

Stephen Dahl
Norske Skog
Private Bag
Lavington NSW 2641

Dear Steve,

Re: Collation of Wastewater Monitoring Completed for Norske Skog
Norske Skog Purchase Order No. 22191

The collation documents titled "Biomonitoring of Newsprint Mill Wastewater for Norske Skog" were presented in two folders:
"Part 1: Collation of Annual Reports 1992 to 1999" and
"Part 2: Collation of Presentations and Scientific Publications 1992 to 2000 including Lake Ettamogah and Eight Mile Creek Studies"

This work completed on 15 March 2002 satisfies Part A of the work outlined in the proposal dated 15 February 2002. A copy of the proposal and an invoice for $3711 are attached.

As discussed, we will hold off on Part 2 of the proposal in favour of a new study. We trust this meets with your approval and look forward to working with you in the future.

Cheers,

Helen Gigney
Scientific Officer
MDFRC CSIRO Land and Water, Albury
PO Box 921, Albury, NSW, 2640
Ph: 02 6058 2300
Fax: 02 6043 1626
Email: Helen.Gigney@csiro.au

PROPOSAL FOR COLLATION OF WASTEWATER MONITORING COMPLETED FOR NORSKE SKOG[1] ALBURY 1991 - 2000

Component	Type of work completed or new work	Work involved
1. Complete compendium of Annual Reports	Existing reports	Copy only
2. "Sublethal Biomonitoring of paper mill effluent using fish ventilatory signals"	Conference Poster Presentation - Australasian Society for Ecotoxicology 1994 Sydney	9 page doc Compilation required
3. "Biomonitoring of paper mill effluent using fish ventilatory signals." Nielsen and King	Published Paper – Australasian Journal of Ecotoxicology Vol 2, 1995	Copy only
4. "Biological Monitoring of Paper Mill Wastewater."	Conference Poster Presentation – Australasian Society for Ecotoxicology 1995 Sydney	9 page doc Compilation required
5. "Seasonality of Benthic Macro-invertebrates in the River Murray at Albury and Impact of Newsprint mill wastewater."	Conference Poster Presentation - Australian Society for Limnology 1997 Albury	16 page doc Compilation required
6. "Bioaccumulation of Mn by the freshwater crayfish *Cherax destructor* – the role of Mn oxidising bacteria."	Conference Oral Presentation - Australian Society for Limnology 1998 Brisbane	9 page doc Compilation required
7. "Apparent bioaccumulation of Mn derived from paper-mill effluent by the freshwater crayfish *Cherax destructor* – the role of Mn oxidising bacteria." King and Baldwin	Published paper – the Science of the Total Environment Vol 226, 1999	Copy only
8. " The Fauna of ANM's Lake Ettamogah Forest Wastewater Re-use Scheme and Environs."	Report as Handout for school groups	Copy only (9 pages)
9. Eight Mile Creek Study	Annual Report	Copy only

[1] Formerly, Fletcher Challenge Paper; formerly, Australian Newsprint Mills Ltd

10. Comprehensive executive summary of Annual Reports	New work	Composition
11. Developmental work	New work	Composition
12. Brochure on Key aspects of Biological and chemical monitoring work completed including John Hawking's Eight Mile Creek Study (including images)	New work	Composition, design and publishing (copies 10)
13. Images for CD file	New work	Scanning photographs etc
14. CD copy of all work	New work	CD burn

COST FOR THE WORK OUTLINED IN THE PROPOSAL

The costing of this proposal has been divided into two parts (A & B).

Part A includes hard copies of all previously published documents arising from the consultancy (1991 to 2000) plus an executive summary, as well as a CD copy of these and scanned photographs of the monitoring operation. Part A could be completed by 31 March 2002.

Components 1 to 10, 13 & 14	5 days @ $624	$3120
Overheads	8.15%	$254
GST	10%	$337
Sub total		$3711

Part B is new work requiring significant composition and could be completed by September 2002

Components 11 & 12	6 days @ $624	$3744
Overheads	8.15%	$305
GST	10%	$404
Sub total		$4453
Parts A & B		
Total		**$8164**

This proposal was prepared by Helen Gigney for Stephen Dahl and is costed using CSIRO consultancy rates.

P

The Murray-Darling Freshwater Research Centre

Biomonitoring of Newsprint Mill Wastewater for Norske Skog Part 1

Collation Annual Reports 1992 to 1999

Preface

The Murray Darling Freshwater Research Centre was contracted by Norske Skog (formerly, Fletcher Challenge Paper, and previous to that, Australian Newsprint Mills Ltd) to provide this collation of work completed by the Centre under contact to the Mill commencing in 1991.

This collation includes a two page executive summary, and copies of the Annual Reports as submitted (without alteration) to Norske Skog for inclusions as appendices to their Annual Reports of Compliance with EPA License Requirements and Development Consent Conditions.

Helen Gigney (King)
Scientific Officer
MDFRC CSIRO Land and Water
PO Box 921
Albury, NSW, 2640
Ph: 02 6058 2300

ES

Executive Summary to Annual Reports of Biological and Chemical Monitoring for Norske Skog 1992 to 1999

A comprehensive wastewater monitoring program was conducted by the Murray-Darling Freshwater Research Centre for Norske Skog (formerly Fletcher Challenge Paper, and previous to that, Australian Newsprint Mills Ltd) over a period of seven years from 1992 to 1999.

The program was designed to comply with the Mill's wastewater discharge license conditions issued by EPA NSW and was reviewed annually by EPA NSW, DLWC and NSW Fisheries.

From 1992 to 1996 the program was largely unchanged and the overall wastewater quality was consistent. In 1997, following significant improvements to the discharged wastewater quality the program was reduced and some more specific studies into manganese bioaccumulation commenced. The focus of monitoring shifted to the Mill's irrigation storage facility, Lake Ettamogah in 1998 and continued to address bioaccumulation issues.

River Environment Monitoring Surveys

Macroinvertebrate Communities

Benthic macroinvertebrate communities were sampled monthly from 1992 to 1997 using artificial substrates in the Murray River at Albury. Good numbers of animals from a variety of taxonomic groups reflected seasonality and the influence of unregulated tributaries on this reach of the River. Multivariate techniques used to compare the samples showed no difference between sites in relation to the wastewater discharge, but some differences over time with respect to season.

Fish

Small fish species were targeted by the sampling program as these were considered more likely to reflect local conditions than larger fish. Monthly sampling failed to yield any significant catch data. This lack of data was of concern but thought to be typical of the paucity of these fish in a regulated river of this size. Following extensive consultation with NSW Fisheries, fish surveys were no longer required as part of the program from 1996.

Water Quality
Physical water quality parameters as well as nutrients and metals were measured from samples collected monthly at three locations in the Murray River from 1992 to 1997. The data show little if any variation between the sites despite their proximity to the discharged wastewater, but some seasonal variation.

Sediment Quality
Annual sediment samples collected from three deposition zones consistently showed that the sediment downstream of the wastewater outfall was within the normal range for sediment along this stretch of the river. Variations in concentrations of analytes correlated well with variation in the organic content of the sediment independent of the sites location.

Ecotoxicological and Bioaccumulation Monitoring

Toxicity Tests
Microcrustacea
Acute and chronic toxicity tests using *Daphnia carinata* were conducted monthly & 2 monthly from 1992 to 1997. Wastewater concentrations of 100% often resulted in significant adverse effects. Lower concentrations (10% or less) more often resulted in enhanced growth and reproduction. Microalgae and bacteria present in the wastewater were likely to be supplementing the artificial diets of the test animals.

Macroinvertebrates (Diptera larvae)
Acute toxicity tests using Chironomus tepperi larvae were conducted monthly from 1992 to 1997. These tests rarely produced any significant mortality.

Fish
Toxicity tests on fish eggs / larvae were only conducted in first couple of years due to the difficulty of obtaining reliable data and limitations imposed by increasingly stringent animal ethics requirements.

Bioaccumulation studies
Crustaceans
Bioaccumulation studies using the freshwater crayfish, *Cherax destructor* were run annually for around 6 to 9 months from 1992 to 1998. Good growth rates were observed in both the control and in the wastewater

treatments, but the animals from the latter did have slightly elevated concentration of some metals. Manganese was consistently higher in animals living in wastewater and further investigations showed that the metal was not accumulating with in the animal's tissues but on the shell as a result of surficial deposits laid down by the action of Mn oxidizing bacteria (1996 – 1998). Arsenic levels in animals from both the control and wastewater treatments reported in the 1995 Annual Report were found to be the result of contaminated pellet feed.

Fish
Bioaccumulation studies were conducted on small fish (silver perch fingerlings (1994 to 1996) and western carp gudgeon adults (1997)). Exposure to the wastewater resulted in either no difference compared with the controls, or an improvement with respect to growth rate and condition. Apart from some slightly higher values for aluminium and manganese in perch (1996), fish exposed to wastewater had consistently lower concentrations of all metals compared with those in the control water. This was attributed directly to greater proportional consumption of artificial food in the form of pellets by the fish in control water containing no naturally occurring food. (Wastewater from the holding pond was used unfiltered and contained significant number of microcrustaceans and macroinvertebrates.)

In 1999, adult golden and silver perch from Lake Ettamogah (stocked as fingerlings) were compared with wild fish caught locally in the Murray River and hatchery fish. The three year old stocked fish were healthy and demonstrated good growth, not surprising given the abundance of natural food and, although observed to be in spawning condition, there was some doubt that breeding would be viable in the Lake due to its elevated salinity. No fish larvae were caught in light traps only large numbers of macroinvertebrates (bugs and dragonfly larvae) and zooplankton.

Overall Conclusions
The wastewater generated by the newsprint mill was non toxic and capable of supporting significant biota. A species list for Lake Ettamogah compiled in 1998 (see Part 2) identified 5 species of fish, 16 species of aquatic insects and 7 species of crustaceans living in the wastewater, as well as amphibians, reptiles, birds and mammals associated with the environs of the Lake.

1999

The Murray-Darling Freshwater Research Centre

14 April, 2000

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Stephen Dahl
Fletcher Challenge Paper
Private Bag
LAVINGTON NSW 2641

Dear Steve,

Re: 1999 ANNUAL REPORTS OF BIOLOGICAL MONITORING

1. Bioaccumulation Monitoring

2. Murray River Environmental Monitoring

Two unbound copies of the 1999 Annual Reports are enclosed as requested.

Please do not hesitate to contact me on 6058 2355 for any additional information.

Yours sincerely

Helen King

Scientific Officer

Enc

Ellis Street, Thurgooona N.S.W. Telephone: (02) 6058 2300
P.O. Box 921, Albury, 2640 Facsimile: (02) 6043 1626

TABLE OF CONTENTS

1.0 INTRODUCTION

Fletcher Challenge Paper, Albury operates a 2100 ML irrigation storage dam (Lake Ettamogah) for tertiary treated wastewater. The Lake has been stocked with fish obtained from commercial hatcheries. The Murray-Darling Freshwater Research Centre was contracted to assess bioaccumulation of metals in these fish, as part of a long-term monitoring program.

2.0 AIMS

To undertake biological and chemical monitoring of FCP's wastewater discharged to the River Murray in accordance with proposals developed in consultation with EPA NSW and NSW Fisheries.

Environment Protection Authority New South Wales Licence No.001272; Section W11:
"A final summer survey of fish from the holding pond/winter storage dam shall be conducted to determine long term bioaccumulation of metals compared with fish of the same species from other local sources."

The null hypothesis tested "that fish living in wastewater are not different to those living in other local freshwater environments."

3.0 METHODS

Fish (golden perch (*Macquaria ambigua*) and silver perch (*Bidyanus bidyanus*)) from three different sources were used to assess bioaccumulation of metals in muscle tissue.

Ten three year old Silver Perch were purchased from Murray Cod Hatchery at Wagga Wagga in December 1998. Nine Golden Perch of mixed age were collected by anglers from the Murray River near Albury, downstream of Lake Hume between December 1998 and February 1999. Three Silver Perch and one Golden Perch were netted from FCP's Lake Ettamogah near Albury in December 1998.

The fish were anaesthetised and killed using benzocaine™. Total length, total weight and gonad weights were measured. The length and weight data were used to calculate two condition factors for each fish:

Index of Condition = Weight (g) x 10^5/Length^3 (mm)

Gonadosomal Coefficient = Gonad weight/(Total weight/gonad weight)

Ref: Clesceri *et al.* 1989

Pivot tables were used to then compare condition factors between source, species and sex.

Data from Lake Ettamogah fish collected in February 1998 (documented in the previous Annual Report) were also compared. These data are referred to as Ettamogah 1997 (summer of 1997) to differentiate them from the December 1998 samples.

Approximately 20g of muscle tissue (with skin and scales attached) were removed from behind the head of each fish. The sample was then frozen, freeze-dried, homogenised and then acid digested in preparation for assay of metals (Al, As, Cd, Cu, Fe, Mn, Pb, and Zn) by ICP at Australian Government Analytical Laboratories (AGAL). The resulting data, (expressed as mg/kg of muscle tissue), were then compared by source using scatter plots (mean ± standard deviation).

Otoliths were removed and sent to the Victorian Department of Natural Resources' Central Ageing Facility at the Marine and Freshwater Research Institute, Queenscliff, where age estimates were made without any prior knowledge of the date of capture or fish sizes. The ages were then adjusted using as birthdate the 1st January and the respective date of capture to group the fish into their correct cohorts.

4.0 RESULTS

Fish from Lake Ettamogah were observed to be robust and healthy at the time of capture (no skin lesions parasites or fin damage).

There was little difference overall in the mean (± standard deviation) physiological condition factors (Index of condition (IOC) and Gonadosomal Coefficient (GC)) between fish from each of the sources (Table 1). The mean IOC of the Hatchery fish was slightly lower than that of the fish from the other three sources, possibly due to their containment. Female fish from all sources demonstrated greater IOC than males, a reflection of sampling during the spawning season when the ovaries of females are ripe with eggs and may comprise up to one quarter of their body weight. The mean GC for female fish were greater than that of male fish except for the single Hatchery female, which although the same age and size as the males was sexually immature.

The mean concentrations of Al, As, Cd, Cu, Fe, Pb, Mn and Zn in muscle tissue are depicted in Figure 1. Iron, zinc and aluminium were the most abundant. Arsenic, cadmium and lead the least abundant. Overall, the metal concentrations were no different between the four sources, generally falling within similar ranges, except Manganese, Copper and Iron which were slightly elevated in the 1998 Lake Ettamogah fish compared with the controls. However, these were still lower than those recorded in the previous year (King 1998).

Metals in the fish from the hatchery were the least variable and those from Lake Ettamogah in the summer of 1997 were the most variable. Between the two Lake Ettamogah sampling periods (summer 97 and summer 98) the concentrations of As, Cu and Zn were significantly different ($t = 2.18$, $t = 2.35$, $t = 2.9$ respectively where $t_{crit} = 2.17$). Although the older fish contained more As and Zn, but less Cu compared with the younger fish, the concentrations of the former were still similar or less than the concentrations from the hatchery and river fish,. Overall, the concentrations of metals in the older fish tended to approach those of the " control" fish from the River and Hatchery.

Ageing data including images of the sectioned otoliths are included in Appendix 1. Silver Perch from Lake Ettamogah were three y/o old females. Golden Perch from the River were between three and fifteen years old (males 3 - 4 y/o and females 3 - 15 y/o). The one male Golden Perch from Lake Ettamogah was one year old. In Table 2, the physical measures are compared for three y/o old fish from each source. The mean index of condition was greatest for the Lake Ettamogah Silver Perch (females) and least for the Wagga Hatchery Silver Perch (primarily males), whilst their liver body mass ratio's were the same. A comparison of the gonadosomal coefficient is of little value due to the disparity of sex and species for the different sources. Of the ten Hatchery Silver Perch only one was female, whereas all three of the Lake Ettamogah Silver Perch were female. Three out of nine fish from the River were females but they were all Golden Perch.

5.0 DISCUSSION

The Lake Ettamogah and River fish were healthy and in spawning condition. The Hatchery fish were much smaller than Lake Ettamogah fish at the same age and the sole female was sexually immature. Fishing in Lake Ettamogah was abandoned after only a small number of fish were captured due to concern over capture of non target species.

Metals in the Stocked Fish (Lake Ettamogah) fell within an acceptable range compared with the two " controls" (Hatchery and River). Of the metals assayed the National Health and Medical Research Council specifies maximum residue limits in edible fish tissue for the heavy metals cadmium (0.2 mg/kg) and lead (1.50 mg/kg) (NHMRC 1988). The Lake Ettamogah fish assayed lower than the controls for both cadmium and lead, and all were below the NHMRC limits.

The greater index of condition for the Lake Ettamogah fish may be realistic and it would have been useful to compare the Lake Ettamogah data with the Murray River data in further detail. However, the comparison of small differences in physiological measures for the three y/o fish may be confounded by differences attributable to species and sex. Only Golden Perch were captured from the River. Despite an almost even proportion of males to females, the females tended to be older than the males and only one female could be included in the three y/o comparison. Further more, all of the three y/o fish caught in Lake Ettamogah were female Silver Perch and only one of the Hatchery Silver Perch was female.

Sexual maturity for both species is size (length) related (Golden Perch - 325 mm and 397 mm, and Silver Perch - 215 mm and 312 mm for males and females respectively) (Mallen – Cooper *et al.* 1995). These differences are also reflected in the approximate minimum age for mature fish reported by the same authors: Silver Perch - males 3 years and females 5 years; Golden Perch- males - 2 years and females - 4 years.). The immaturity of the female Silver Perch from the hatchery can be attributed to her small size. Gonads of mature females comprise a greater proportion of their body mass compared with males during spawning season and contribute significantly to their greater overall size. Although meaningful comparisons may be limited by differences of species and sex for the three sources, sexual maturity and size of the Silver Perch living in FCP's Lake Ettamogah compares favourably with similar data from the literature for wild stock.

There was no evidence of harm or significant bioaccumulation of the metals assayed in fish growing in FCP's wastewater at Lake Ettamogah.

6.0 COMMUNICATION

A research paper on the role of bacteria in manganese bioaccumulation was published in an international journal (King *et al.* 1999).

7.0 REFERENCES

Clesceri, L.S., Greenberg, A.E. and Trussell, R.R. (Eds) (1989), Fish (10600)/ Analysis of Collections. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Washington DC

King, H. (1998), Biological Monitoring - 1998 Annual Report for Fletcher Challenge Paper Albury. The Murray-Darling Freshwater Research Centre.

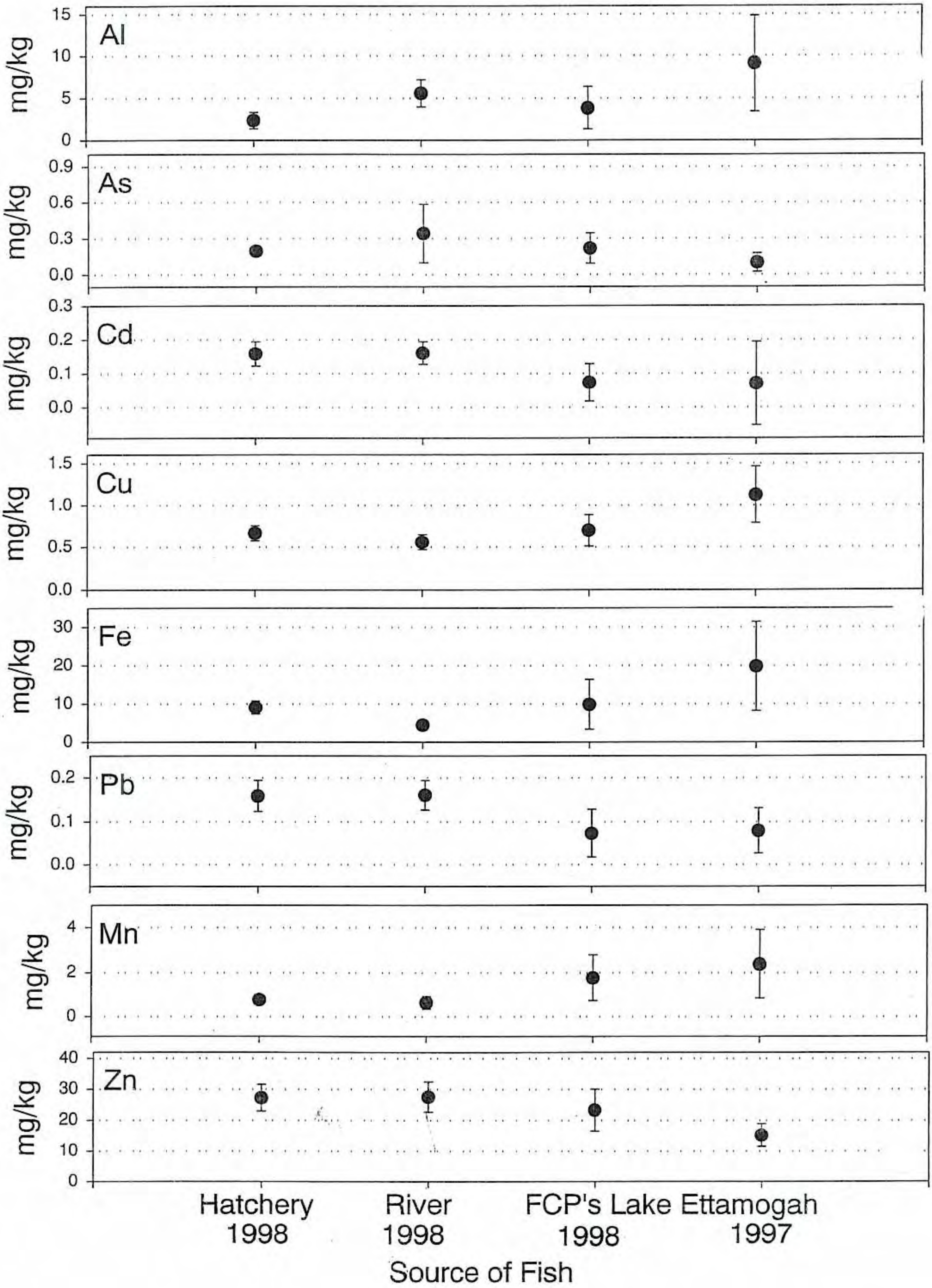
King, H.M., Baldwin, D.S., Rees, G.N. and McDonald, S. (1999), Apparent bioaccumulation of Mn by the freshwater crayfish *Cherax destructor* - the role of Mn-oxidising bacteria. Journal of the Science of the Total Environment.

Mallen-Cooper, M., Stuart, I.G., Hides-Pearson, F. and Harris, J.H. (1995), Fish Migration in the Murray River and Assessment of the Torrumbarry Fishway. NSW Fisheries Research Institute, and The Cooperative Research Centre for Freshwater Ecology.

National Health and Medical Research Council (1988), Standard for Maximum Residue Limits of Pesticides, Agricultural Chemicals, Feed Additives, Veterinary Medicines and Noxious Substances in Food. Australian Government Publishing Services, Canberra

8.0 FIGURES

Figure 1: Mean (+/- Std deviation) Concentrations of Eight Metals in Muscle Tissue of Fish from Different Sources



9.0 TABLES

Table1: Pivot Table Comparing the Physiological Condition Factors of Fish of different Sex and Species from Different Freshwater Sources

Index of Condition

	Female						**Male**						**Overall**	
	Golden Perch		*Silver Perch*		**Female Overall**		*Golden Perch*		*Silver Perch*		**Male Overall**		**for each Source**	
Source	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
Ettamogah 97	1.71	-	2.43	0.36	2.31	0.43	1.69	-	1.81	0.09	1.78	0.09	2.1	0.43
Ettamogah 98	-	-	2.17	0.22	2.17	0.22	1.64	-	-	-	1.64	-	2.04	0.32
Hatchery	-	-	1.4	-	1.4	-	-	-	1.32	0.21	1.32	0.21	1.33	0.2
River	2.12	0.33	-	-	2.12	0.33	1.76	0.13	-	-	1.76	0.13	1.92	0.29
Overall for each sex & species	2.04	0.34	2.23	0.43	2.16	0.4	1.73	0.12	1.44	0.29	1.55	0.28	1.81	0.45

Gonodosomal Coefficient

	Female						**Male**						**Overall**	
	Golden Perch		*Silver Perch*		**Female Overall**		*Golden Perch*		*Silver Perch*		**Male Overall**		**for each Source**	
Source	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
Ettamogah 97	0.010	-	0.058	0.028	0.050	0.032	0.010	-	0.020	0.000	0.018	0.005	0.037	0.029
Ettamogah 98	-	-	0.086	0.044	0.086	0.044	0.002	-	-	-	0.002	-	0.065	0.055
Hatchery	-	-	0.007	-	0.007	-	-	-	0.053	0.029	0.053	0.029	0.048	0.031
River	0.103	0.085	-	-	0.103	0.085	0.007	0.005	-	-	0.007	0.005	0.05	0.072
Overall for each sex & species	0.084	0.084	0.062	0.038	0.070	0.057	0.007	0.005	0.045	0.029	0.031	0.030	0.047	0.047

Table 2: Physiological Measures for Three Year Old Fish from Wagga Hatchery (WH), Murray River (MR) and Lake Ettamogah (LE)

Sample Id	Perch Species	Sex	Age (years)	Total Length (mm)	Total Weight (g)	Gonad Weight (g)	Liver Weight (g)	IOC *	GS **	Liver:Body Mass Ratio
WH98-1	Silver	M	3	270	300.0	11.42	1.91	1.524	0.040	0.006
WH98-2	Silver	M	3	271	300.0	13.69	2.23	1.507	0.048	0.007
WH98-3	Silver	M	3	292	300.0	29.04	2.58	1.205	0.107	0.009
WH98-4	Silver	M	3	278	200.0	10.05	3.14	0.931	0.053	0.016
WH98-5	Silver	M	3	300	400.0	4.22	5.83	1.481	0.011	0.015
WH98-6	Silver	M	3	272	300.0	8.85	3.34	1.491	0.030	0.011
WH98-7	Silver	F	3	278	300.0	1.99	3.99	1.396	0.007	0.013
WH98-8	Silver	M	3	295	350.0	12.74	2.64	1.363	0.038	0.008
WH98-9	Silver	M	3	310	350.0	21.18	4.08	1.175	0.064	0.012
WH98-10	Silver	M	3	294	300.0	23.51	3.22	1.181	0.085	0.011
	mean			**286.00**	**310.00**	**13.67**	**3.30**	**1.325**	**0.048**	**0.011**
	std dev			**13.98**	**51.64**	**8.55**	**1.13**	**0.196**	**0.031**	**0.003**
MR98-1	Golden	M	3	385	900.0	11.54	15.07	1.577	0.013	0.017
MR98-2	Golden	M	3	380	1000.0	12.05	15.52	1.822	0.012	0.016
MR98-4	Golden	M	3	350	800.0	3.00	16.07	1.866	0.004	0.020
MR98-6	Golden	F	3	450	1700.0	4.46	31.96	1.866	0.003	0.019
	mean			**391.25**	**1100.00**	**7.76**	**19.66**	**1.783**	**0.008**	**0.018**
	std dev			**42.11**	**408.25**	**4.70**	**8.21**	**0.139**	**0.005**	**0.002**
LE98-1	Silver	F	3	370	1000.0	106.90	12.16	1.974	0.120	0.012
LE98-2	Silver	F	3	470	2500.0	233.83	30.60	2.408	0.103	0.012
LE98-4	Silver	F	3	470	2200.0	79.03	15.16	2.119	0.037	0.007
	mean			**436.67**	**1900.00**	**139.92**	**19.31**	**2.167**	**0.087**	**0.010**
	std dev			**57.74**	**793.73**	**82.51**	**9.89**	**0.221**	**0.044**	**0.003**

***Index of Condition: K = W*10^5/L^3**

****Gonadosomal Coefficient = Gwt/(Twt-Gwt)**

10.0 APPENDIX 1:

Ageing Data for Golden and Silver Perch

from

Fletcher Challenge Paper's Lake Ettamogah (Ref. prefix: LE)

Murray River Albury (Ref. prefix : MR)

Conducted by the Central Ageing Facility

Marine and Freshwater Research Institute

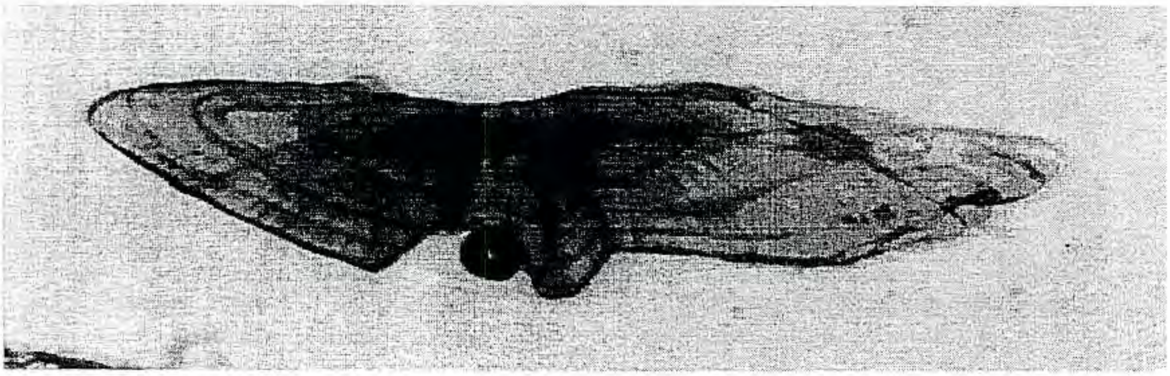
Queenscliff

Victoria

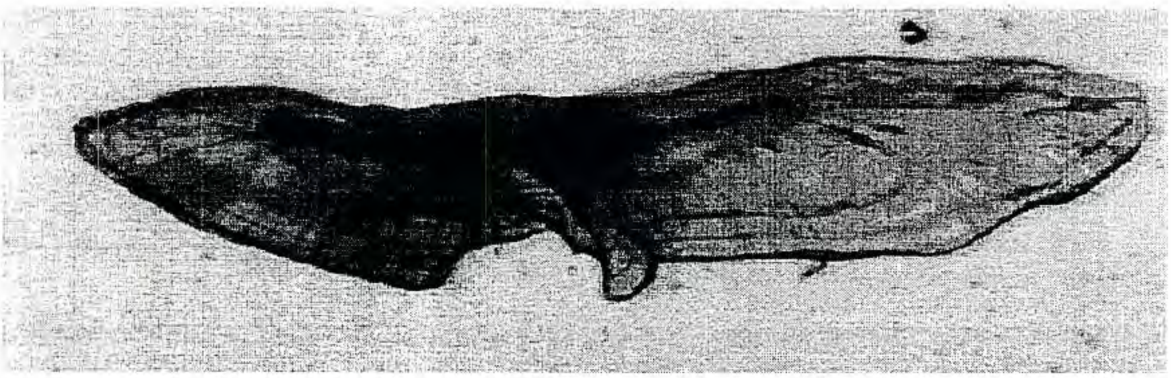
For

The Murray Darling Freshwater Research Centre

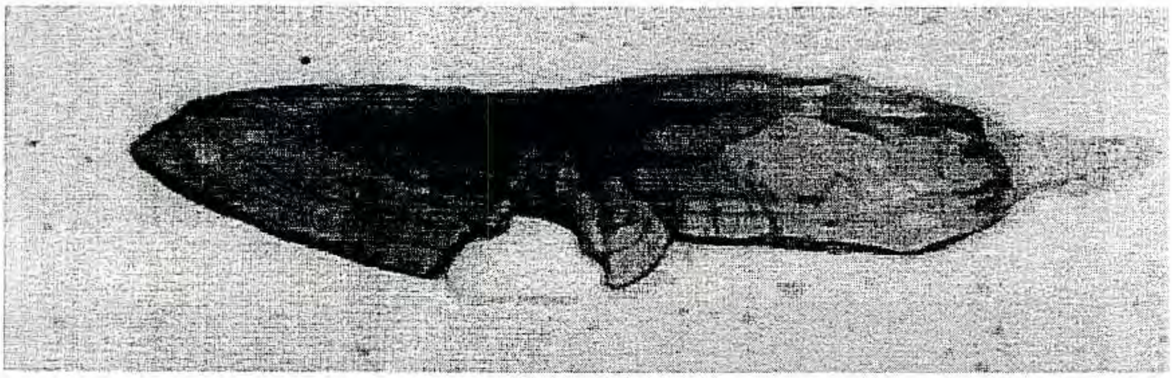
Silver Perch (*B.bidyanus*) Sectioned Otoliths



Silver Perch sectioned otolith, aged 3 years. Otolith RefLE98-1   Mag 16X

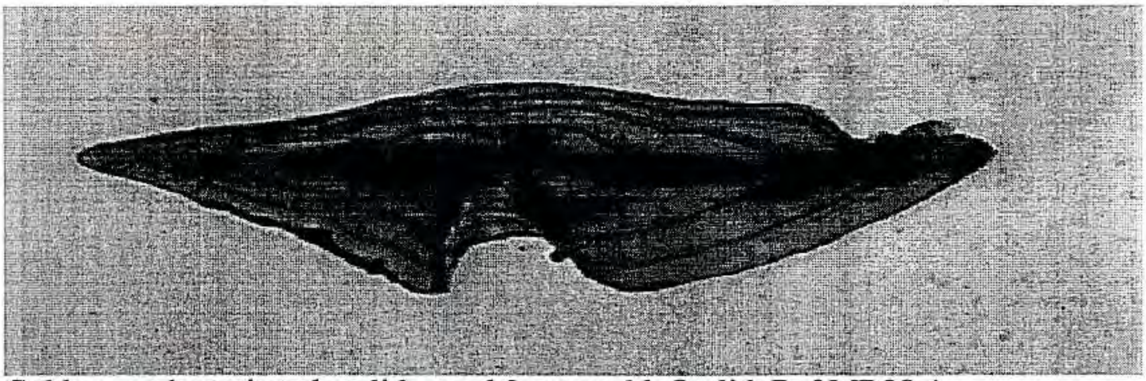


Silver Perch sectioned otolith, aged 3 years. Otolith Ref LE98-2

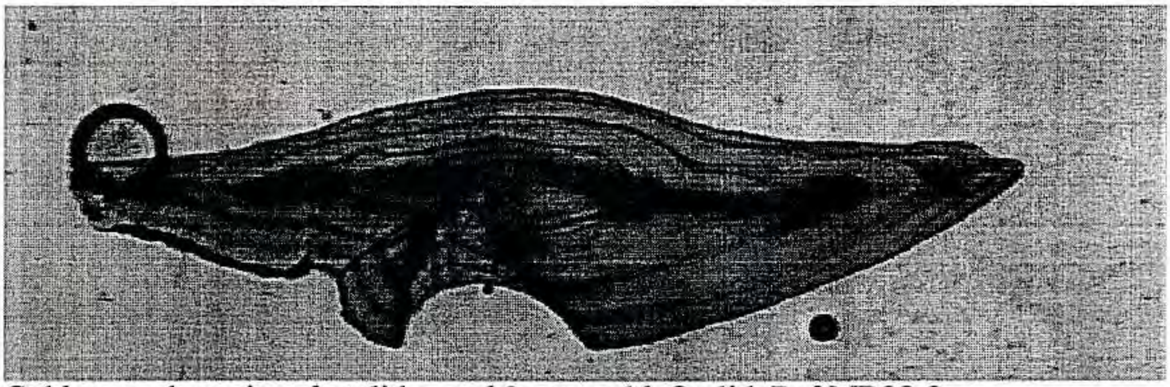


Silver Perch sectioned otolith, aged 3 years. Otolith RefLE98-4

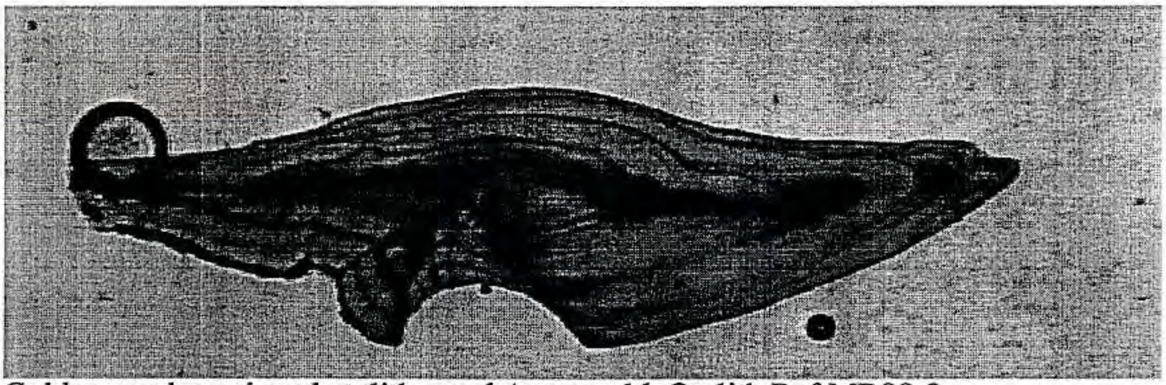
Golden Perch (*M.ambigua*) Sectioned Otoliths



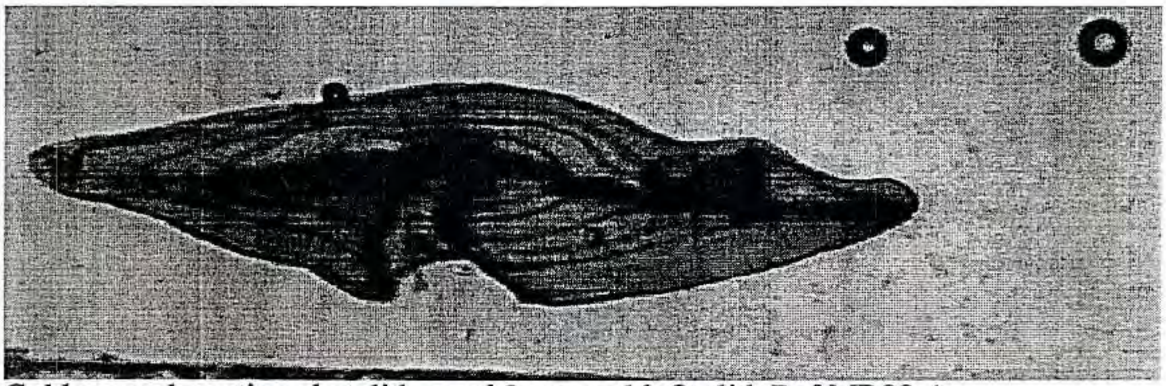
Golden perch sectioned otolith, aged 3 years old. Otolith Ref MR98-1



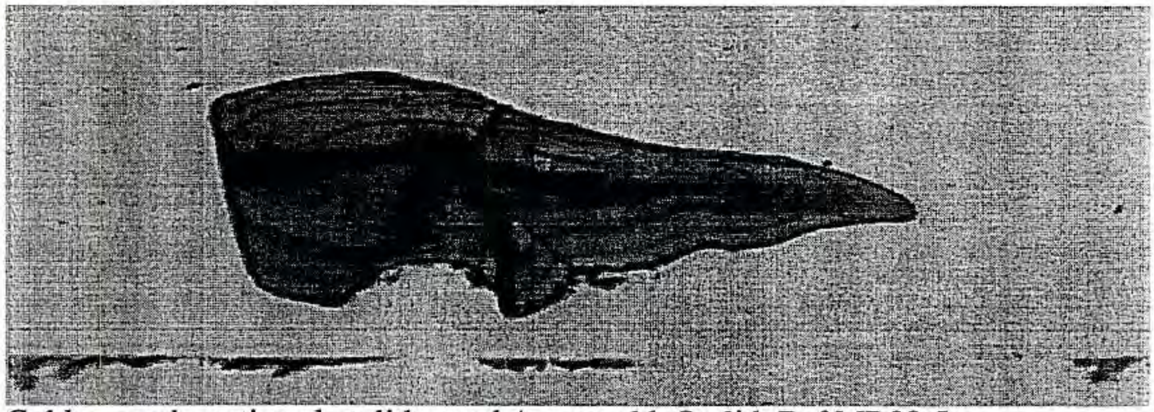
Golden perch sectioned otolith, aged 3 years old. Otolith Ref MR98-2

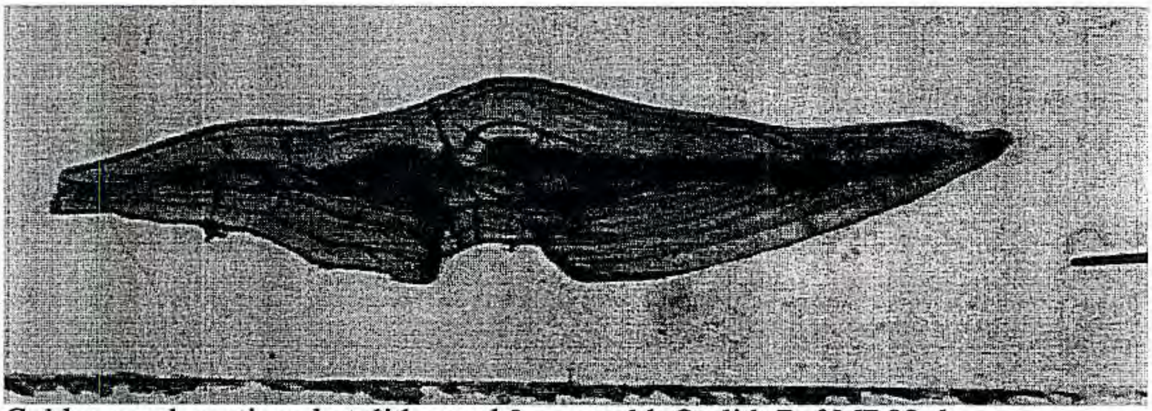


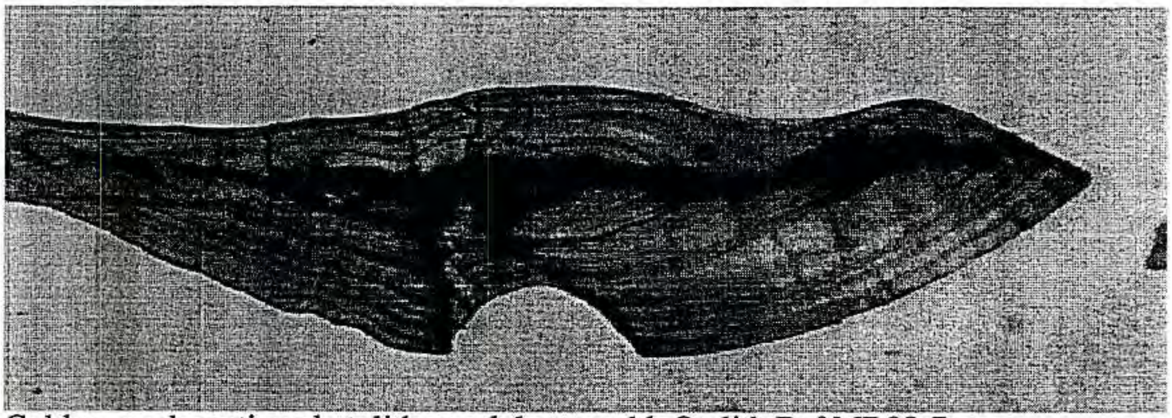
Golden perch sectioned otolith, aged 4 years old. Otolith Ref MR98-3

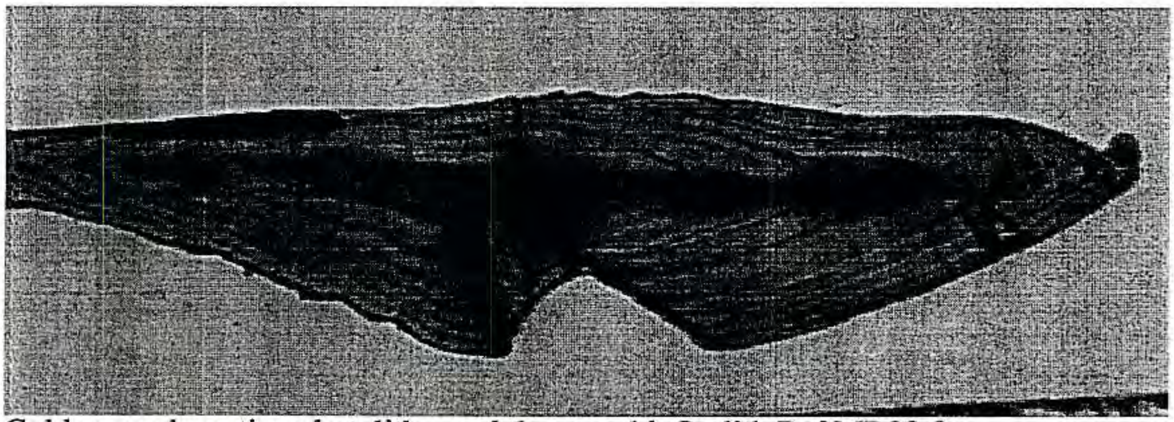


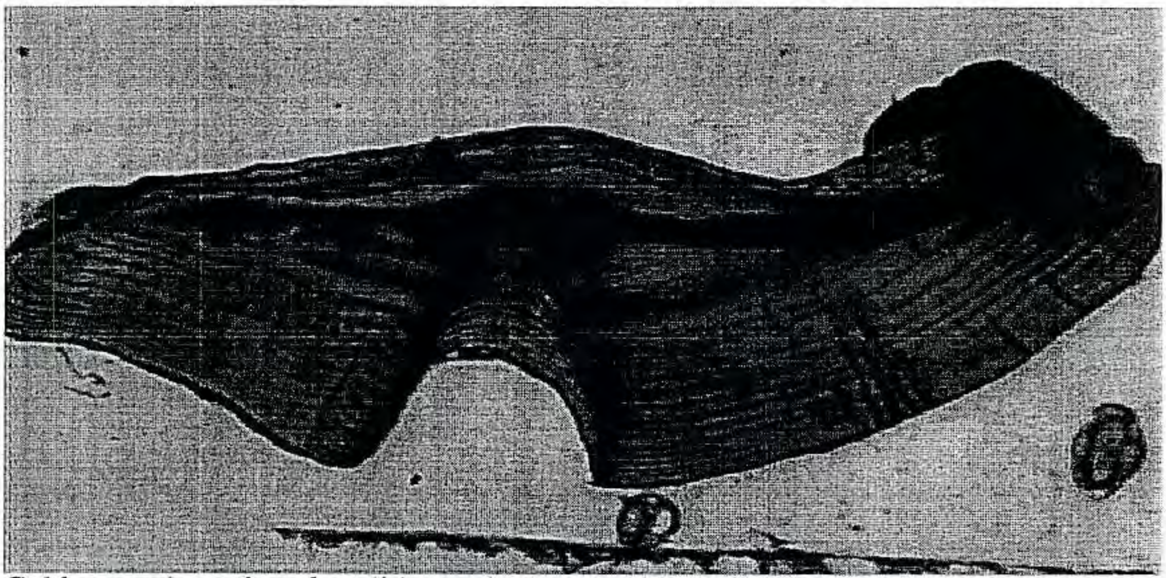
Golden perch sectioned otolith, aged 3 years old. Otolith Ref MR98-4


Golden perch sectioned otolith, aged 4 years old. Otolith Ref MR98-5

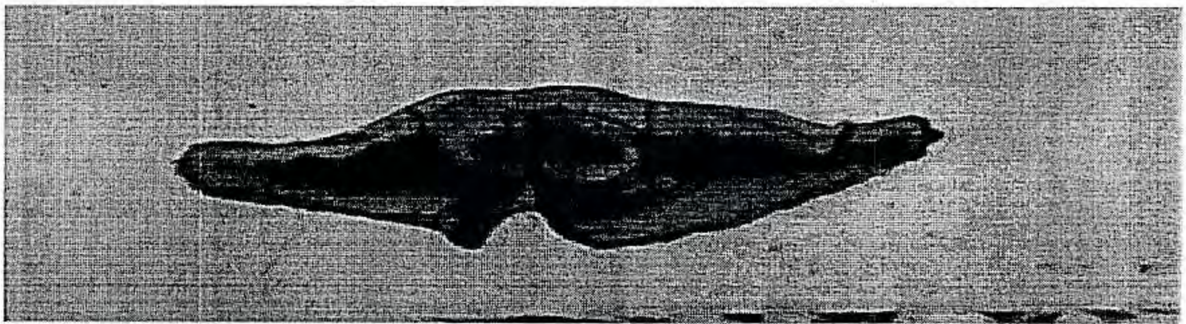

Golden perch sectioned otolith, aged 3 years old. Otolith Ref MR98-6


Golden perch sectioned otolith, aged 6 years old. Otolith Ref MR98-7


Golden perch sectioned otolith, aged 6 years old. Otolith Ref MR98-8



Golden perch sectioned otolith, aged 15 years old. Otolith Ref MR98-9



Golden perch sectioned otolith, aged 1 year old. Otolith Ref LE98-3

MURRAY RIVER
ENVIRONMENT MONITORING
1999 ANNUAL REPORT
FOR
FLETCHER CHALLENGE PAPER
ALBURY

H King
The Murray-Darling Freshwater
Research Centre

April 6, 2000

TABLE OF CONTENTS

1.0 INTRODUCTION

Fletcher Challenge Paper, Albury is licensed to discharge treated wastewater to the Murray River under their "Winter Release Program." The Murray Darling Freshwater Research Centre was contracted to conduct river water quality monitoring as a part of this program.

2.0 AIMS

To undertake biological and chemical monitoring of FCP's wastewater discharged to the River Murray in accordance with proposals developed in consultation with EPA NSW and NSW Fisheries.

Environment Protection Authority New South Wales Licence No.004889;
Section "W21 Annual Management Report...The report shall include...(f) Murray River Environmental Monitoring and bioassay testing programs".

The null hypothesis tested "that wastewater discharges have no effect on the quality of the receiving water."

3.0 METHODS

Three Murray River monitoring sites upstream of Albury were selected with reference to FCP's wastewater discharge:

- Mungabareena Reserve (4 km upstream)
- Railway Bridge (immediately downstream)
- Union Bridge (2 km downstream)

All three sites were used for a long-term water quality monitoring program conducted by the MDFRC for FCP (formerly, Australian Newsprint Mills Ltd) between 1991 and 1997.

Weekly monitoring of the sites was initiated on 19 April 1999, three days prior to the commencement of the discharge. The monitoring continued during the discharge period (21 April 1999 to 11 May 1999) and for four weeks following cessation of the discharge.

Grab samples of water were collected for chlorophyll, manganese, colour, total nitrogen, total phosphorus, zinc, mercury and DTPA.

Chlorophyll-*a* was determined at the MDFRC Algal Laboratory using the standard Boiling Ethanol Method. Manganese, total phosphorus, total nitrogen and true colour were determined at the MDFRC Chemistry Laboratory using standard methods (AS2769 – 1985, MDFRC 6, MDFRC 7, and APHA 2120B respectively). Total zinc and total mercury were analysed by EML (CHEM) Pty Ltd. DTPA was determined at Fletcher Challenge Paper, Process and Product Support Group, Boyer, Tasmania.

Physical parameters were measured *in situ* using a Horiba U10 water quality checker at the time of collection.

4.0 RESULTS

Weekly physical parameters were measured once before the discharge commenced, twice during the discharge period and three times following cessation of the discharge (Figure 1). Dissolved oxygen, turbidity (NTU), temperature, conductivity (mS) and pH tracked consistently for the three sites on each sampling day except the last, where conductivity and turbidity readings from the upstream control were slightly elevated. Water temperatures at all sites demonstrated a downward trend (from 18 to 12 °C) consistent with the onset of winter conditions.

Weekly nutrient (total nitrogen and total phosphorus), and colour measurements were similar though out the sampling period for all sites (Figure 2). Manganese was slightly elevated downstream immediately following cessation of the discharge but had returned to background levels by the following week. Chlorophyll-*a* was not measured during the discharge, but was similar at all three sites before the discharge, and immediately following cessation of the discharge, and fell for the downstream sites in the last two samples.

Zinc, Mercury and DTPA were measured at the three sites on day 14 of the discharge. All were below detection limits (<0.02 mg Zn/L, <0.0001 mg Hg/L and 0.1 mg DTPA/L).

River flow (Figure 3) over the discharge period fell from 13460 to 8000 ML/day resulting in concentrations (Figure 4) of between ~ 0.04 % on the first day of the discharge to ~0.14% on the last day of the discharge.

Figure 1: Fletcher Challenge Paper River Monitoring
Weekly Physical Parameters for 3 Sites

—o— Upstream - Mungabareena
—□— Mixing Zone - Railway Bridge
—◇— Downstream - Union Bridge

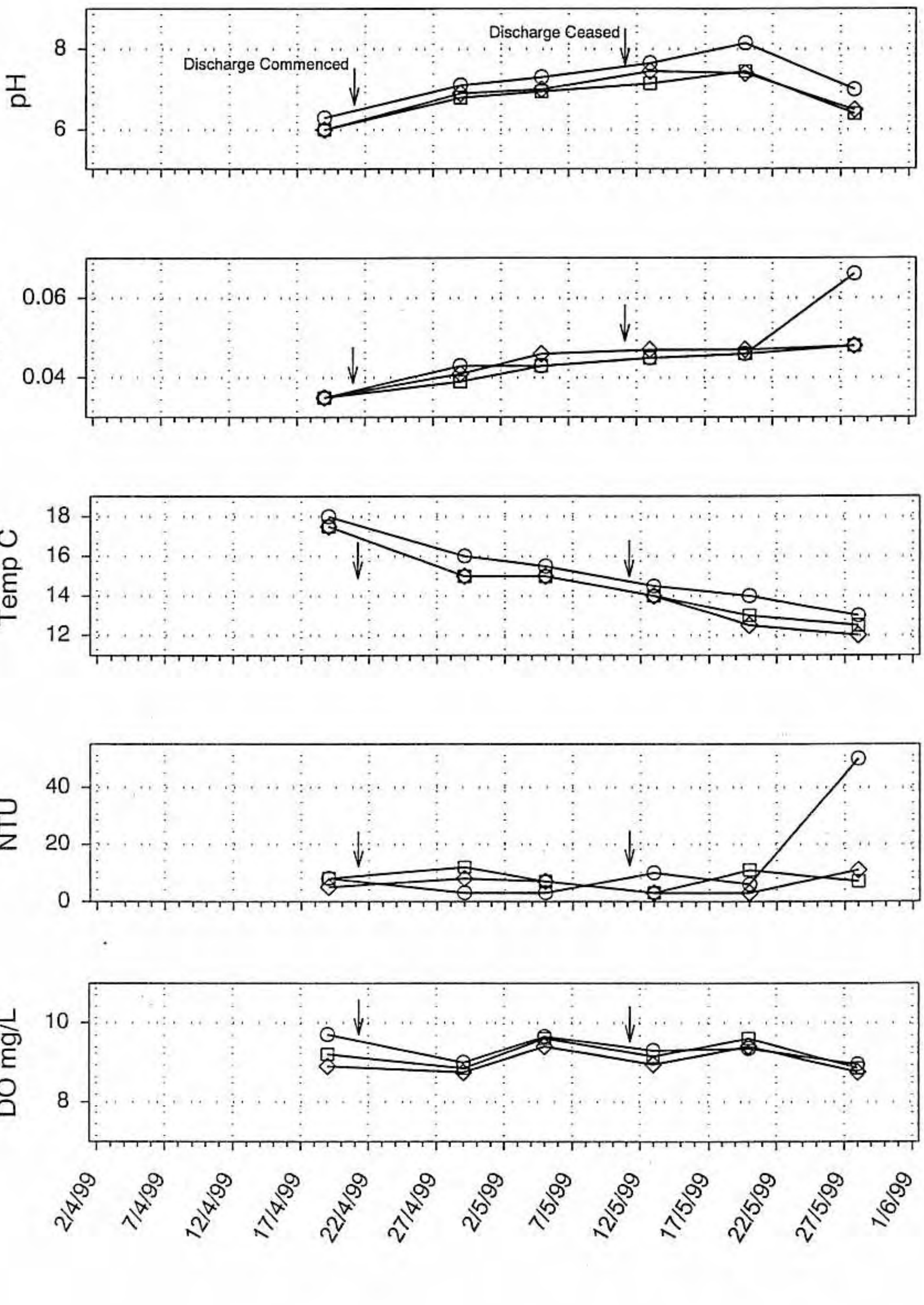


Figure 2: Fletcher Challenge Paper River Monitoring
Weekly Chemical Parameters for 3 Sites

Upstream - Mungabareena
Mixing Zone - Railway Bridge
Downstream - Union Bridge

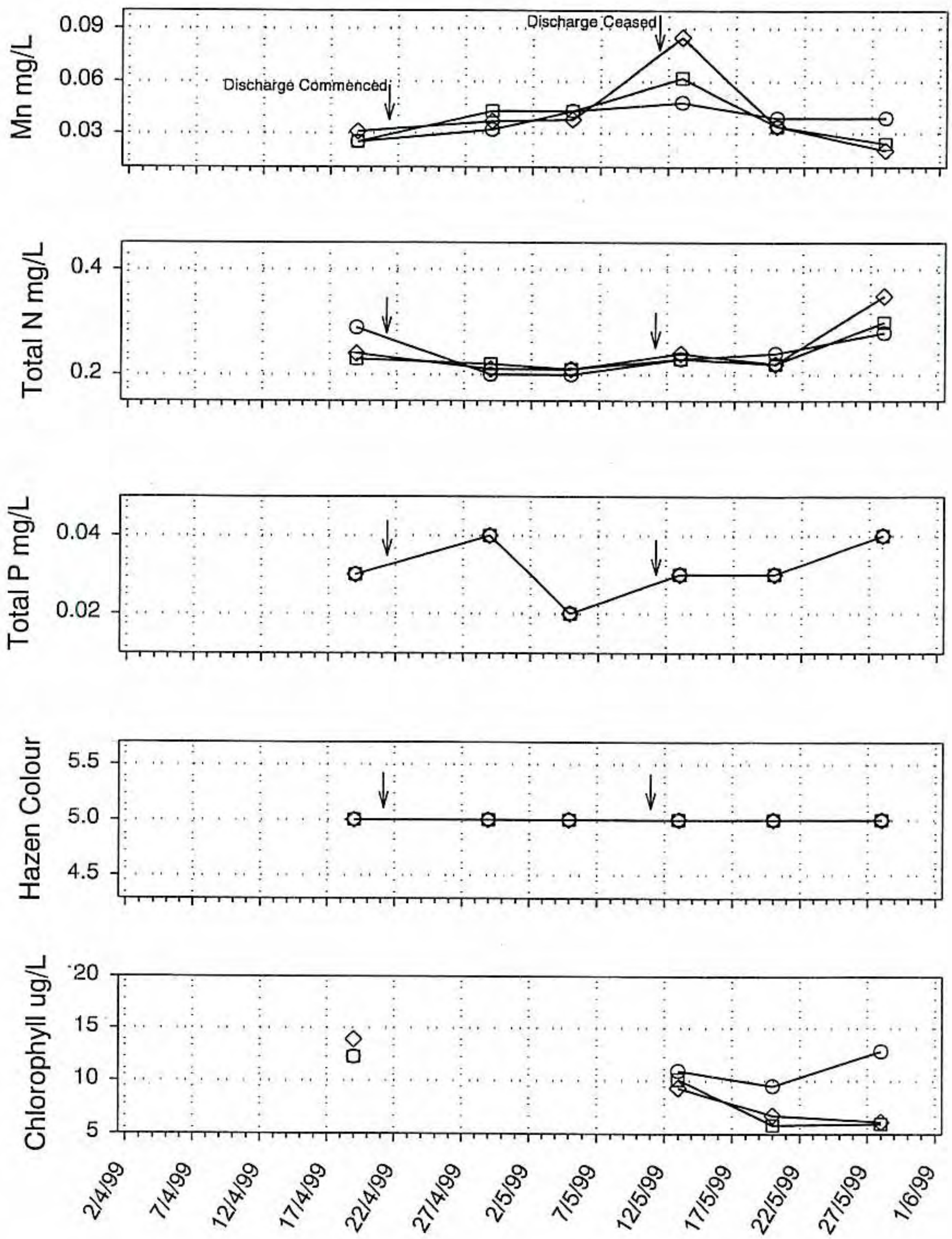


Figure 3: Fletcher Challenge Paper River Monitoring
River Flow @ Doctors Point
[Source: MDBC River Murray Water - Weekly Reports]

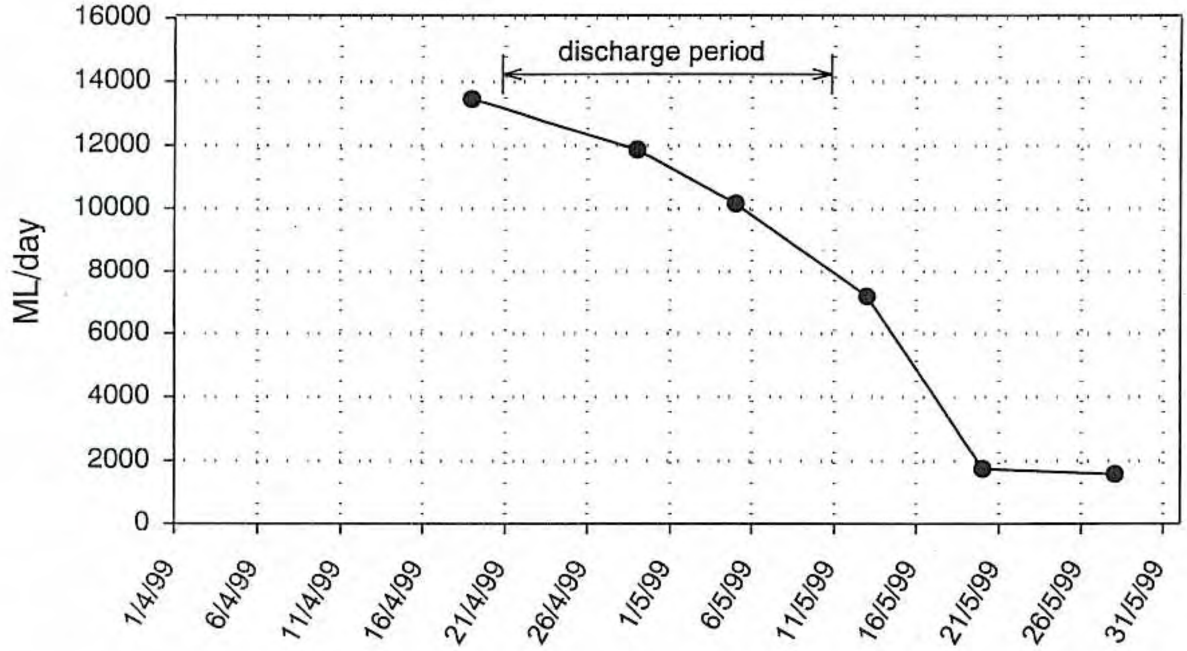
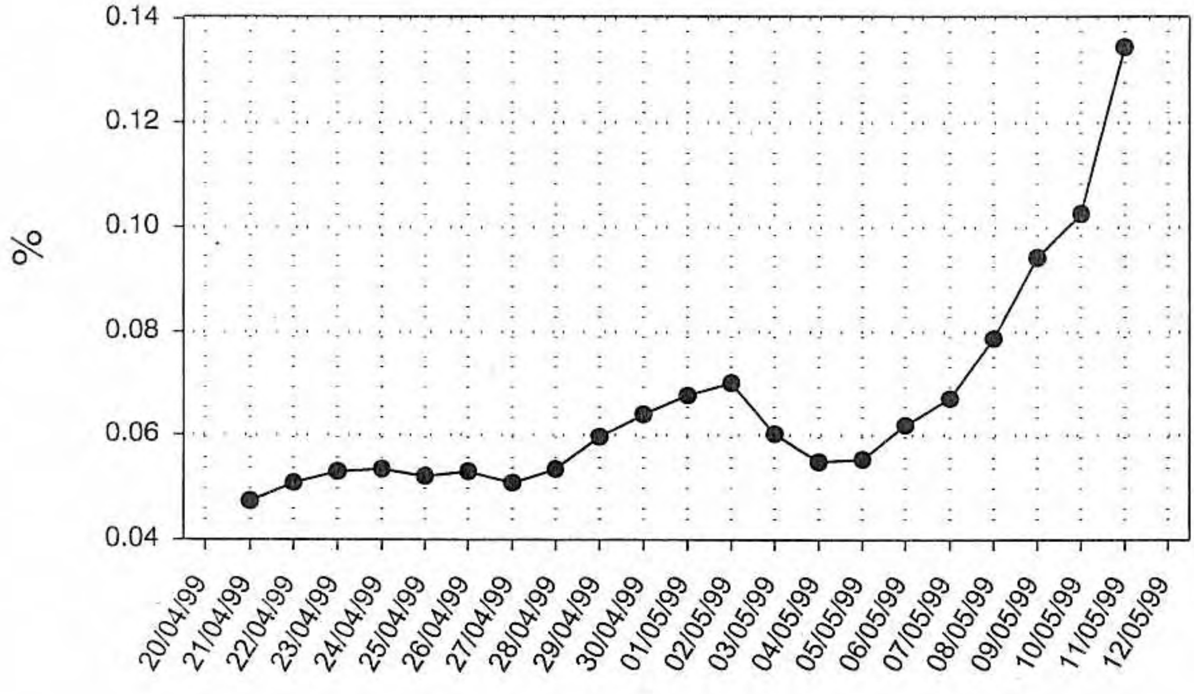


Figure 4: Fletcher Challenge Paper River Monitoring
Concentration of Effluent Flow in River Flow
(Source: Fletcher Challenge Paper Albury)



5.0 DISCUSSION

The suite of physical parameters, metals and nutrients was selected to best indicate any potential impact of Fletcher Challenge Paper's wastewater discharge on the water quality of the Murray River based on previous long term monitoring. All measurements were within the ranges measured for those sites during the monitoring program conducted by MDFRC from 1992 to 1997 (King and Baldwin 1997).

There was no measurable difference between the sites before, during or after the discharge. The impact of Fletcher Challenge Paper's temporary wastewater discharge was not detectable by water quality measurements in the Murray River. This is probably due in part to the level of dilution of the wastewater with cooling water and River water.

6.0 REFERENCE

King, H. and Baldwin, D. 1997. Chemical and Biological Monitoring - 1997 Annual Report for Australian Newsprint Mills Ltd, Albury. The Murray-Darling Freshwater Research Centre.

1998

The Murray-Darling Freshwater Research Centre

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14 January, 1999

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Jeff Lassman
Fletcher Challenge Paper
Private Bag
LAVINGTON NSW 2641

Dear Jeff,

1998 ANNUAL REPORT OF BIOLOGICAL MONITORING

Please find enclosed an unbound copy of the 1998 Annual Report of Biological Monitoring for Fletcher Challenge Paper, undertaken by The Murray-Darling Freshwater Research Centre. This Annual Report complies with the Licence Condition of bioaccumulation monitoring.

Please do not hesitate to contact me on 60582355 for any additional information.

Yours sincerely

Helen King

Scientific Officer

Enc. 1998 Annual Report.

BIOLOGICAL MONITORING 1998 ANNUAL REPORT

FOR

FLETCHER CHALLENGE PAPER ALBURY

(FORMERLY - AUSTRALIAN NEWSPRINT MILLS Ltd)

H King

The Murray-Darling Freshwater Research Centre

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION:

The 1998 biological monitoring program focuses on Fletcher Challenge Paper's 2100ML Lake Ettamogah used as an irrigation storage dam for tertiary treated wastewater. Lake Ettamogah provides habitat for water fowl including the protected musk duck (*Biziura lobata*) and blue-billed duck (*Oxyura australis*), is rich in microcrustaceans (copepods, daphnids and shrimp) and has been stocked with silver and golden perch. The assessment of long-term bioaccumulation is essential to address questions with respect to the potential impact on local wildlife.

2.0 AIMS

To undertake biological and chemical monitoring of FCP's wastewater discharged to the River Murray in accordance with New South Wales Environment Protection Agency Licence No.01272; Sections W9 (Long term bioaccumulation monitoring using fish) and W10 (Microbial oxidation of manganese on artificial substrates) for May 1997 to April 1998. The null hypothesis tested in all cases "that there is no difference between control water and wastewater treatments."

3.0 METHODS

3.1 Bioaccumulation Monitoring

Trials were conducted to determine the levels of bioaccumulation of metals from FCP's final outfall wastewater using a crustacean (yabby, *Cherax destructor*) and stocked fish species (golden perch (*Macquaria ambigua*) and silver perch (*Bidyanus bidyanus*)).

3.1.1 Yabby *(Cherax destructor)*

Bioaccumulation trials were undertaken using FCP's stored wastewater from the irrigation storage dam Lake Ettamogah.

Yabby trials were conducted in six preconditioned 1000L flow through plastic tanks fed with stored water pumped from Lake Ettamogah, or Murray River water. Three tanks were randomly assigned to each treatment, the control tanks fed with river water and the test tanks fed with FCP stored wastewater. All tanks contained short sections of PVC water pipe as habitat.

125 Male yabbies were purchased from a local commercial yabby farm - 20 animals were randomly allocated to each tank and 5 retained as an initial (pre-trial) sample for chemical analysis. Each tank contained a minimum/maximum thermometer. Physicochemical water quality (temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity) was assessed in each tank fortnightly. 10 animals were measured (weight and carapace length) each month and 4-7 animals removed at the termination of the trial for chemical analysis. The animals retained for chemical analysis were frozen, freezedried and divided in half dorsoventrally. One half of each was then homogenised and acid digested in preparation for assay of metals (Al, As, Cd, Cu, Fe, Mn, Pb and Zn) by ICP at Australian Government analytical Laboratories (AGAL). The other half of each was separated into three major body parts; tail/claw (muscle), exoskeleton (shell), and other organs gills/gastrolith/hepatopancreas/gut (viscera), homogenised, acid digested, and assayed for manganese by AAS at MDFRC's chemistry Laboratory.

Growth and general metals data were analysed and reported in quarterly progress reports to FCP. A synopsis of these and the Mn assays to determine the site of Mn deposition in the animals are included in this annual report.

3.1.2 Stocked Fish from FCP Wastewater Holding Ponds

Growth, sexual maturity and tissue metals concentrations were assessed for 3 year old silver and golden perch population released into Lake Ettamogah as fingerlings. The surveys were conducted in summer using nets. The fish were anaesthetised and killed using benzocaine™ and assessed for size, age (using otoliths), and gonad development. 20g muscle/skin samples were removed from behind the head, frozen, freezedried and homogenised then acid digested in preparation for assay of metals (Al, As, Cd, Cu, Fe, Mn, Pb, and Zn) by ICP at Australian Government Analytical Laboratories (AGAL).

3.1.3 Stocked Fish v Hatchery and Wild Fish

It is intended that bioaccumulation of metals in 4 year old fish living in wastewater will be compared with similar fish from two other sources;

(1) grown in a commercial hatchery/farm (control)

(2) from the Murray/Murrumbidgee Rivers (control)

The surveys will be conducted in summer during the breeding season. Fish in Lake Ettamogah will be captured using nets or electrofishing. Angling Clubs and NSW Fisheries will be consulted for their cooperation in supplying data and flesh samples from fish caught in the rivers. Ten fish from each source will be anaesthetised and killed using benzocaine™ and assessed for size, age and sex. Flesh samples will be assayed as above. A report will be submitted to FCP by June 1999 for incorporation as an appendix to their annual report of compliance with EPA licence requirements and development consent conditions.

3.2 <u>Manganese-oxidising Bacteria</u>

3.2.1 Isolation and characterisation of Mn-oxidising bacteria

Mn oxidising bacteria were obtained from wastewater by serial dilution and inoculation onto WW media, as well as from surficial biofilms by scraping artificial substrates and yabbies and inoculating Pedomicrobium (PC) agar (Tyler and Marshall 1967c). Wastewater (WW) medium was prepared by supplementing (1L) wastewater with NH_4Cl (0.1g), KH_2PO_4 (0.2g), $MnSO_4$ $4H_2O$ (0.02g) and agar (15g). All plates were incubated at 27°C and kept under observation for the presence of colonies which turned brownish/black as Mn oxide formed. Colonies testing positive for manganese oxide with Leucocrystal Violet (LV) indicator (Spratt *et al.* 1994, ASTM 1990) were subcultured onto fresh media until a pure culture was obtained. Subsequent liquid culture was carried out as described by Green and Madgwick (1988). Fresh colonies were tested for catalase and oxidase activity with 3% pharmaceutical H_2O_2 and Pyo-test™ strips (for detection of cytochrome oxidase) respectively. Standard Plate Count agar (BBL, Cockeysville, USA) was used to test growth in the absence of manganese.

3.2.2 Mn^{2+} oxidation studies on wastewater

Mn-oxidation in the wastewater was determined by measuring the rate of loss of added Mn^{2+} from both unfiltered wastewater and wastewater which had passed through a "Spin-Klin™" filtration plant (nominal cut-off 115 μm). 40 mL of filtered wastewater, unfiltered wastewater or Milli-Q water were placed into two series of 50 mL screw-cap polyethylene centrifuge tubes. 1000 μg Mn^{2+} L^{-1} (as Mn_2SO_4) was added to one series and none to the other. Microbial activity in half of the samples was inhibited by the addition of 0.25 mL of 1.75 M NaN_3. The tubes were placed on an orbital shaking table and maintained at 20 ± 1 °C. Aliquots were periodically removed from the tubes and the concentration of Mn^{2+} was determined by the tetra(*p*-carboxyphenyl) porphyrin method of Ishii *et al.* (1982) as modified by Johnson *et al.* (1995).

3.3 Lake Ettamogah Biological Survey

A survey of the biota of Lake Ettamogah was conducted using light traps, sweep nets, and artificial substrates to supplement existing survey data (Klomp and Costello 1997, Merritt unpublished). An inventory of micro-invertebrates, macro-invertebrates, amphibians, fish and birds, along with habitat notes was compiled. This inventory was submitted to FCP in a form appropriate for an educational resource for visiting students.

3.4 Reporting

Quarterly reports containing all test results and observations including physico-chemical data were submitted to FCP. This Annual Report containing a summary of results from the monitoring program was submitted to FCP for incorporation as an appendix to their annual report to fulfil their requirements for Condition W16 of Licence No.01272 issued by the NSW Environment Protection Authority.

4.0 RESULTS AND DISCUSSION

4.1 Bioaccumulation Monitoring

4.1.1 Yabby *(C. destructor)*

A two month *C. destructor* trial commenced in November 1997. Those grown in wastewater were significantly (P = 0) smaller than the controls. Metals assayed (aluminium, arsenic, cadmium, copper, iron, lead, manganese and zinc) are presented in Figure 1. The mean and standard deviation (n = 4 to 7) for each are plotted against treatment (initial control, river water control and wastewater treatment). Animals exposed to wastewater accumulated aluminium, iron and manganese. Those in river water accumulated cadmium, copper, lead and zinc; and lost aluminium, iron and manganese.

Manganese concentration in major body parts of *C. destructor* (Figure 2) identifies the shell as the primary location of Mn accumulation and to a lesser extent the viscera in animals exposed to wastewater. This confirms the preliminary investigation documented in our 1997 annual report and supports the theory of Mn being associated with biofilms adhering to the surface of the carapace or being ingested by benthic grazing.

4.1.2 Stocked Fish from FCP's Lake Ettamogah Wastewater Storage Dam

17 silver perch and 4 golden perch were netted from Lake Ettamogah in February. All of which were estimated to be three years old. Growth rates and condition factors were

greater than those obtained by NSW Fisheries in surveys of silver perch from impoundments and rivers (Mallen-Cooper *et al.* 1995, Paul Brown pers. comm.). The elevated year round water temperatures and abundance of invertebrates and lack of competition are all contributing factors.

Most of the captured fish were sexually mature and ripe to spawn, but no fish larvae or fry were found with trawls or trapping at night, so it likely that either the cues to spawn are not present in the Lake, or fertilisation / larvae survival is unsuccessful due to the salinity of the water (Brett Ingram pers. comm.).

Muscle metals concentrations were low (<4mg/kg), with iron, zinc and aluminium the most abundant (9-20mg/kg). These results are documented in the second quarter progress report to FCP.

4.1.3 Stocked Fish v Hatchery and Wild Fish

Fishing is scheduled for December 1998 or January 1999. The comparison of metals in muscle of fish from the three sources will then be undertaken and included in a report to FCP by 30 June 1999.

4.2 Manganese-oxidising Bacteria

4.2.1 Isolation and Characterisation of Mn-oxidising Bacteria

Isolation on agar in the laboratory of two manganese-oxidising bacteria from an artificial substrate and a yabby carapace was successful. Pure cultures were obtained with one isolate each from the artificial and yabby surfaces selected for further study. Strain ANM1 (*Sphingomonas* sp. B. Patel pers. comm.) obtained from an artificial substrate was a budding gram negative curved rod. After 2 weeks incubation colonies on PC medium were less than 1 mm, black and irregular, whereas the colonies on medium without manganese were 0.5-2.0 mm, yellow and circular with an entire margin. Strain ANM2 (*Leptothrix*-like bacterium G. Rees pers. comm.) isolated from the carapace of the yabby was filamentous and slow growing. The colonies took upwards of 3-4 weeks before they were clearly visible on PC agar.

4.2.2 Mn^{2+} Oxidation studies on Wastewater

Both native and added Mn^{2+} was oxidised in wastewater (Figs. 3 & 4). The shape of the oxidation curve is consistent with a biotically mediated process rather than an abiotic process. A lag phase can be observed where little oxidation occurs in about the first 4 days of incubation. However, much of the Mn is oxidised in the next 4 days of incubation. The rate of oxidation was significantly reduced when microbial activity was inhibited by the addition of NaN_3 (Fig 3). The rate of Mn^{2+} oxidation was also severely reduced in wastewater filtered to a nominal 115μm (to remove particulates) by the filtration plant (Fig. 4) (King *et al.* in press).

Indications for FCP are that the holding ponds whilst aerobic are active in reducing the concentration of manganese in wastewater and further supports the theory that Mn accumulation in yabbies is microbially mediated. Also it appears that by removing suspended particles, the irrigation system's filtration plant, reduces the potential for fouling of the reticulation infrastructure.

4.3 <u>Lake Ettamogah Biological Survey</u>

The inventory ".....Fauna of FCP's Lake Ettamogah Forest Wastewater Re-Use Scheme and Environs" included: 163 species of vertebrates; 126 Birds, 11 Mammals (including 4 marsupials), 12 Reptiles, 10 Amphibians, 5 fish; and 24 species of Invertebrates

5.0 COMMUNICATION

The revised monitoring program entitled "Biological Monitoring Program Proposal for Australian Newsprint Mills Albury for the 1998/99 Financial Year" was submitted to NSW Fisheries and EPA NSW in April 1998 and approved. The program incorporated modifications to the program following the Annual Review on 25 November 1997.

The paper : King, H.M., Baldwin, D.S., Rees, G.N. and McDonald, S. (in press) Apparent bioaccumulation of Mn by the freshwater crayfish *Cherax destructor* - the role of Mn-oxidising bacteria; was presented at the Annual Congress of the Australian Sociey for Limnology in Brisbane, 3-6 July 1998.

Resource material for visiting school groups was prepared in consultation with FCP communication staff. The 9 page handout "The Fauna of FCP's Lake Ettamogah Forest Wastewater Re-Use Scheme and Environs" was submitted to FCP along with the second quarter progress report in September 1998.

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Tyler, P.A. and Marshall K.C. (1967b). Hyphomicrobia - A significant factor in manganese problems. *Journal of American Water Works Association*, 59, 1043-1048.

Tyler, P.A. and Marshall K.C. (1967c). Form and function of manganese oxidising bacteria. *Archiv fur mikrobiologie*, 56, 344-353.

7.0 FIGURES

Figure 1: Concentration of metals in whole yabbies prior to the commencement of the 1998 bioaccumulation trial (initial) and those exposed to river water (control) and FCP wastewater (mean & standard deviation).

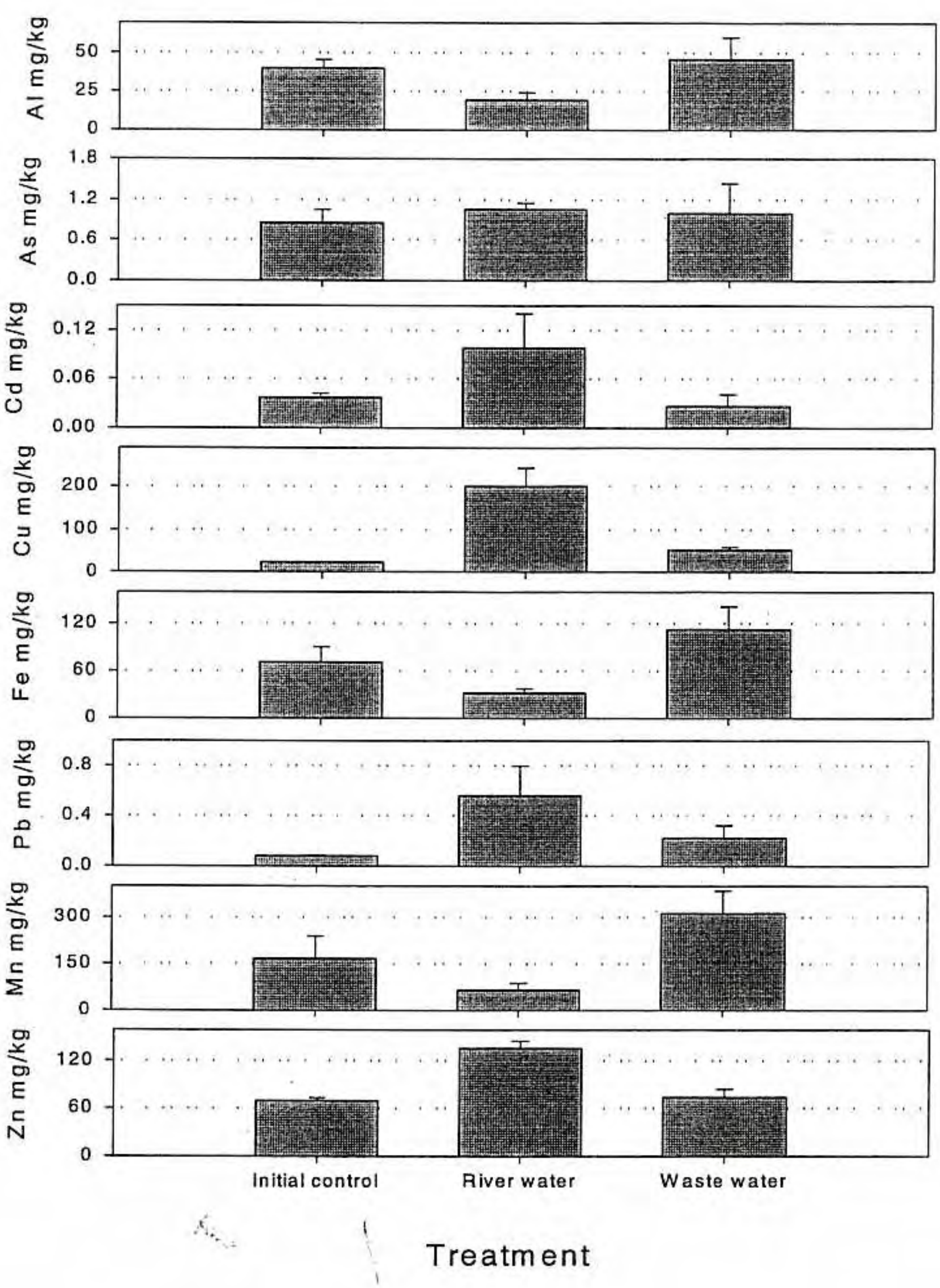


Figure 2: Concentration of Mn in major body parts of yabbies exposed to river water (control) and wastewater in the 1998 bioaccumulation trial.

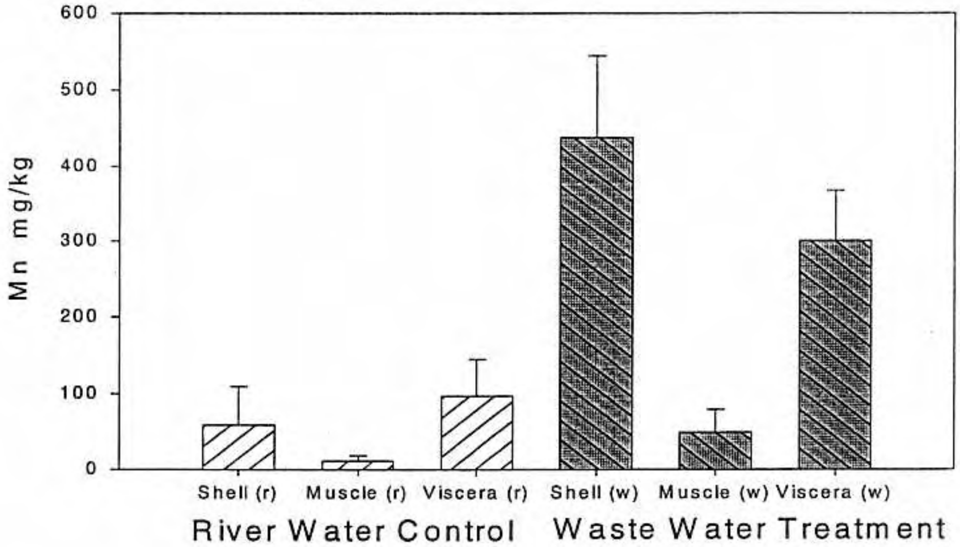


Figure 3: Oxidation of Mn^{2+} in unsterilised (closed circles) and sterilised (open circles) storage dam wastewater, to which; (A) no Mn^{2+} and (B) 1000 μg/L Mn^{2+} was added.

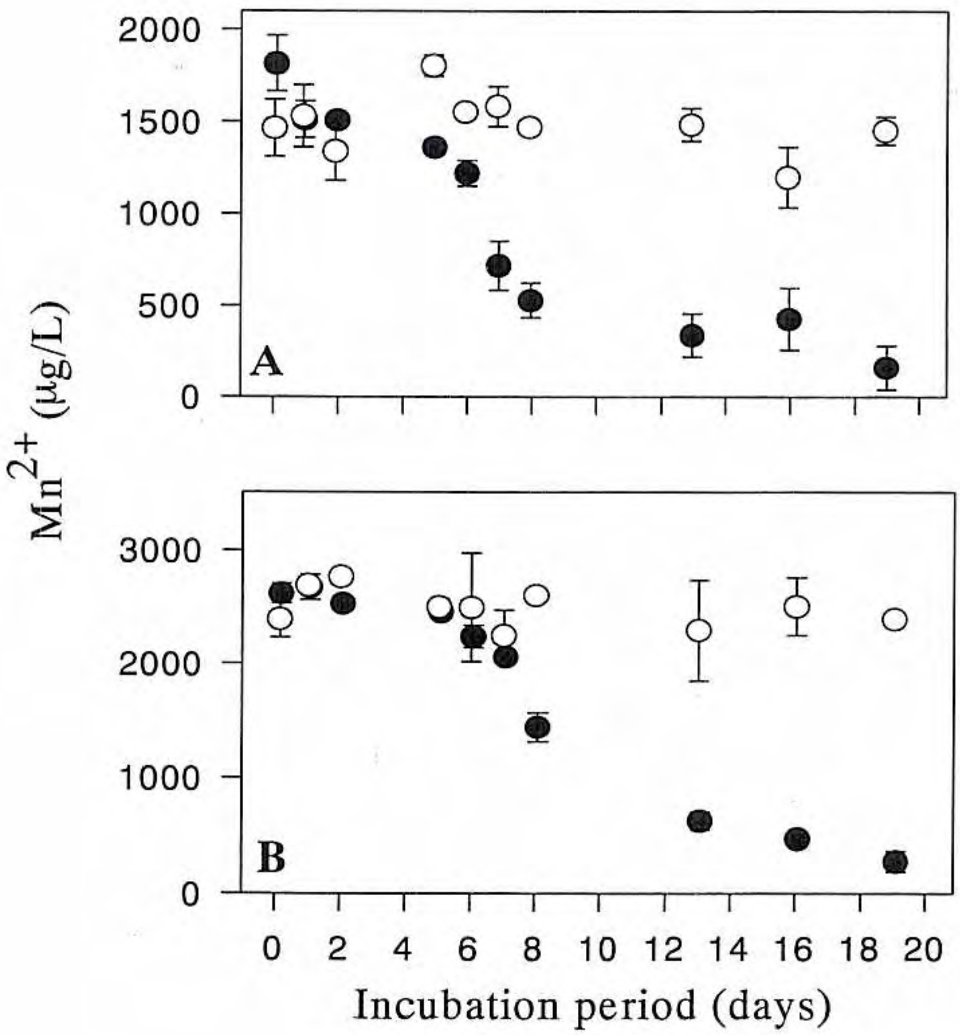
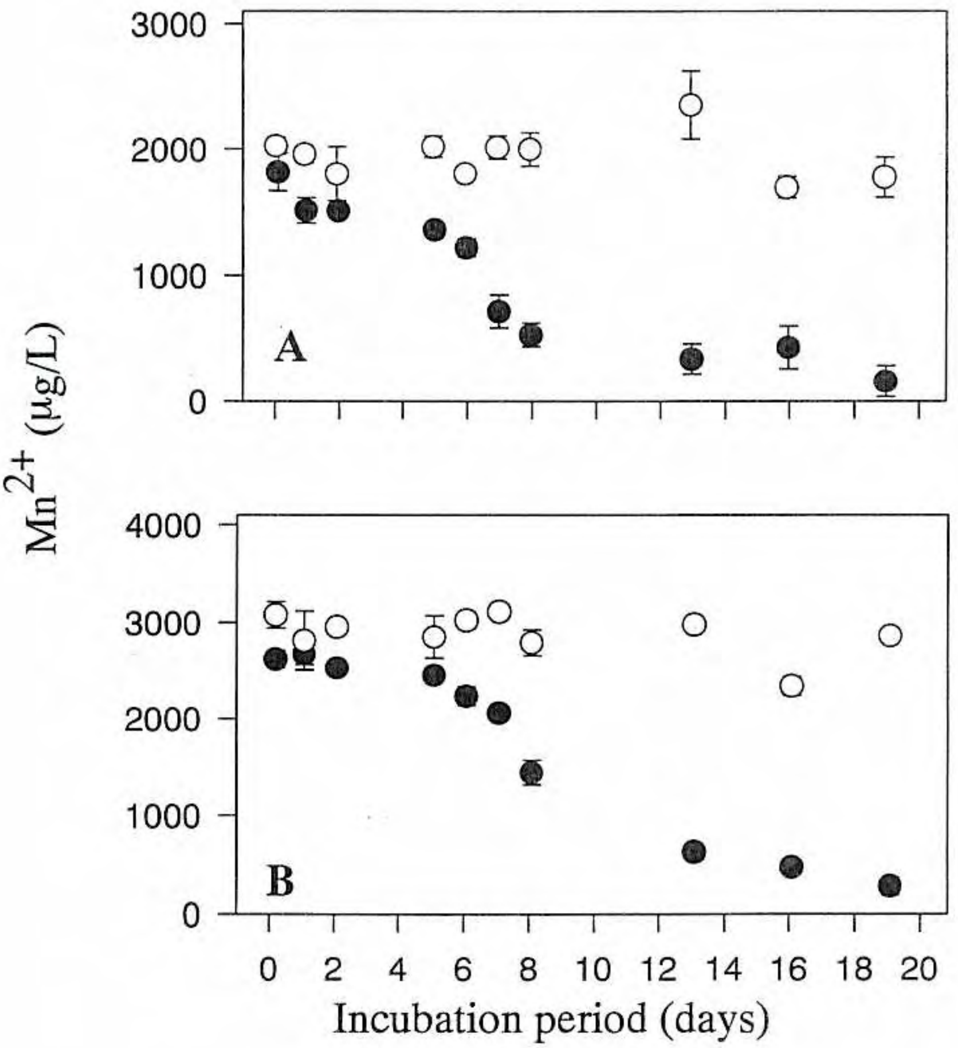


Figure 4: Oxidation of Mn^{2+} in unfiltered (closed circles) and filtered (open circles) storage dam wastewater, to which; (A) no Mn^{2+} and (B) 1000 µg/L Mn^{2+} was added.



THE FAUNA OF ANM'S LAKE ETTAMOGAH FOREST WASTEWATER RE-USE SCHEME AND ENVIRONS.

The wastewater re-use scheme operated by Australian Newsprint Mills Ltd at Ettamogah includes a large holding dam, grassland and a forest plantation containing both introduced and native tree species. The size of the operation and the inclusion of a variety of habitat types influences the diversity of fauna that use the area.

The fauna can be divided initially into two broad categories **vertebrates** (those with a spinal column) and **invertebrates** (those without a spinal column). These can be further divided into classes of animal. The number of species for each animal class (**Table 1 & 7**) indicates the diversity, eg. there are many more species of bird than mammal. Species lists for each of these classes (**Tables 2, 3, 4, 5, 6 & 8**) provide both scientific and common names where possible.

VERTEBRATES

TABLE 1: Vertebrate fauna recorded from ANM's Lake Ettamogah Forest Wastewater Re-use Scheme includes 163 species:

Number of species	Class of Animal
126	Birds
11	Mammals (including 4 Marsupials)
12	Reptiles
10	Amphibians
5	Fish

TABLE 2: BIRDS

The large number of **birds** can be grouped according to their dominant **habit** (way of life) which indicates which parts of the **habitat** (area they require to live, feed and breed) they use.

Habit	**Common Name**	***Species name***
Swimming Bird	Hoary-headed Grebe	*Poliocephalus poliocephalus*
Swimming Bird	Australasian Grebe	*Tachybabtus novaehollandiae*
Swimming Bird	Australian Pelican	*Pelecanus conspicillatus*
Swimming Bird	Darter	*Anhinga melanogaster*
Swimming Bird	Pied Cormorant	*Phalacrocorax varius*
Swimming Bird	Little Pied Cormorant	*Phalacrocorax melanoleucos*
Swimming Bird	Great (Black) Cormorant	*Phalacrocorax carbo*
Swimming Bird	Black Swan	*Cygnus atratus*
Swimming Bird	Australian Shelduck	*Tadorna tatorniodes*

Habit	**Common Name**	***Species name***
Swimming Bird	Pacific Black Duck	*Anas superciliosa*
Swimming Bird	Mallard	*Anas platyrhynchos*
Swimming Bird	Australian Grey Teal	*Anas gracilis*
Swimming Bird	Chestnut Teal	*Anas castanea*
Swimming Bird	Australasian Shoveller	*Anas rhynchotis*
Swimming Bird	Pink-eared Duck	*Malacorhynchus membranaceus*
Swimming Bird	Hardhead	*Aythya australis*
Swimming Bird	Maned Duck	*Chenonetta jubata*
Swimming Bird	Blue-billed Duck	*Oxyura australis*
Swimming Bird	Musk Duck	*Biziura lobata*
Wading Bird	Pacific Heron	*Ardea pacifica*
Wading Bird	White-faced Heron	*Ardea novaehollandiae*
Wading Bird	Great Heron	*Ardea alba*
Wading Bird	Intermediate Egret	*Ardea intermedia*
Wading Bird	Australian White Ibis	*Threskiornis aethiopica*
Wading Bird	Straw-necked Ibis	*Threskiornis spinicollis*
Wading Bird	Royal Spoonbill	*Platalea regia*
Wading Bird	Yellow-billed Spoonbill	*Platalea flavipes*
Wading Bird	Eurasian Coot	*Fulica atra*
Wading Bird	Dusky Moorhen	*Gallinula tenebrosa*
Wading Bird	Black-fronted Plover	*Elseyornis melanops*
Wading Bird	Black-winged Stilt	*Himantopus himantopus*
Wading Bird	Banded Stilt	*Cladorhynchus leucocephalus*
Wading Bird	Common Sandpiper	*Actitis hypoleucos*
Water Bird	Silver Gull	*Larus novaehollandiae*
Bird of Prey	Black-shouldered Kite	*Elanus notatus*
Bird of Prey	Brown Goshawk	*Accipiter fasciatus*
Bird of Prey	Whistling Kite	*Milvus spenurus*
Bird of Prey	Wedge-tailed Eagle	*Aquila audax*
Bird of Prey	Little Eagle	*Hieraaetus morphnoides*
Bird of Prey	Spotted Harrier	*Circus assimilis*
Bird of Prey	Peregrine Falcon	*Falco peregrinus*
Bird of Prey	Australian Hobby	*Falco longipennis*
Bird of Prey	Brown Falcon	*Falco berigora*
Bird of Prey	Australian Kestrel	*Falco cenchroides*
Night Bird	Barn Owl	*Tyto alba*
Night Bird	Southern-boobook Owl	*Ninox novaeseelandiae*
Night Bird	Tawny Frogmouth	*Podargus strigoides*
Aerial Bird	White-backed Swallow	*Cheramoeca leucosternum*
Aerial Bird	Welcome Swallow	*Hirundo neoxena*

Habit	Common Name	*Species name*
Aerial Bird	Fairy Martin	*Hirundo amel*
Aerial Bird	Rainbow Bee-eater	*Merops ornatus*
Tree Trunk Bird	White-throated Tree-creeper	*Cormobates leucophaea*
Tree Trunk Bird	Brown Tree-creeper	*Climacteris picumnus*
Bush Bird	Peaceful Dove	*Geopelia placida*
Bush Bird	Common Bronzewing	*Phaps chalcoptera*
Bush Bird	Crested Pigeon	*Geophaps lophotes*
Bush Bird	Galah	*Cacatua roseicapilla*
Bush Bird	Little Corella	*Cacatua pastinator*
Bush Bird	Sulphur-crested Cockatoo	*Cacatua galerita*
Bush Bird	Swift Parrot	*Lathamus discolor*
Bush Bird	Crimson Rosella	*Platycercus elegans*
Bush Bird	Eastern Rosella	*Platycercus eximus*
Bush Bird	Red-rumped Parrot	*Psephotus haematonotus*
Bush Bird	Pallid Cuckoo	*Cuculus pallidus*
Bush Bird	Fan-tailed Cuckoo	*Cuculus flabelliformis*
Bush Bird	Black-eared Cuckoo	*Chrysococcyx osculans*
Bush Bird	Horsefield's-bronze Cuckoo	*Chrysococcyx basalis*
Bush Bird	Laughing Kookaburra	*Dacelo novaguineae*
Bush Bird	Sacred Kingfisher	*Todirhampus sancta*
Bush Bird	Black-faced Cuckoo-shrike	*Corancina novaehollandiae*
Bush Bird	Jacky Winter	*Microeca leucophaea*
Bush Bird	Golden Whistler	*Pachycephala pectoralis*
Bush Bird	Rufus Whistler	*Pachycephala rufiventris*
Bush Bird	Crested Shrike-tit	*Falcunculus frontatus*
Bush Bird	Grey Shrike-thrush	*Collurincincla harmonica*
Bush Bird	Restless Flycatcher	*Myiagra inquieta*
Bush Bird	Grey Fantail	*Rhipidura fuliginosa*
Bush Bird	Willie Wagtail	*Rhipidura leucophrys*
Bush Bird	Superb Fairy-wren	*Malurus cyaneus*
Bush Bird	White-browed Scrub-wren	*Sericornis frontalis*
Bush Bird	White-throated Gerygone	*Gerygone olivcacea*
Bush Bird	Eastern Yellow Robin	*Eopsaltria australis*
Bush Bird	Brown Thornbill	*Acanthiza pusilla*
Bush Bird	Striated Thornbill	*Acanthiza lineata*
Bush Bird	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Bush Bird	Yellow Thornbill	*Acanthiza nana*
Bush Bird	Red Wattlebird	*Anthochaera carunculata*
Bush Bird	Noisy Friarbird	*Philemon corniculatus*
Bush Bird	Little Friarbird	*Philemon citreogularis*
Bush Bird	Noisy Miner	*Manorina melanocephala*
Bush Bird	White-plumed Honeyeater	*Lichenostomus pencillatus*
Bush Bird	Brown-headed Honeyeater	*Melithreptus brevirostris*

Habit	Common Name	*Species name*
Bush Bird	Black Honeyeater	*Certhionyx niger*
Bush Bird	Mistletoebird	*Dicaeum hirundinaceum*
Bush Bird	Spotted Pardalote	*Pardalotus punctatus*
Bush Bird	Striated Pardalote	*Pardalotus striatus*
Bush Bird	Silver-eye	*Zosterops lateralis*
Bush Bird	European Goldfinch	**Carduelis carduelis*
Bush Bird	Masked Woodswallow	*Artamus personatus*
Bush Bird	Dusky Woodswallow	*Artamus cuanopterus*
Bush Bird	Blackbird	**Turdus merula*
Bush Bird	Olive-backed Oriole	*Oriolus sagittatus*
Bush Bird	Pied Currawong	*Strepera graculina*
Bush Bird	Australian Raven	*Corvus coronoides*
Bush Bird	Little Raven	*Corvus mellori*
Grassland Bird	Masked Lapwing	*Vanellus miles*
Grassland Bird	Banded Lapwing	*Vanellus tricolour*
Grassland Bird	Golden-headed Cisticola	*Cisticola exilis*
Grassland Bird	Diamond Firetail	*Stagnopleura guttata*
Grassland Bird	Red-browed Firetail	*Neochemia temporalis*
Grassland Bird	Double-Barred Finch	*Taeniopygia bichenovii*
Grassland Bird	Flame Robin	*Petroica phoenica*
Grassland Bird	Red-capped Robin	*Petroica goodenovii*
Grassland Bird	Hooded Robin	*Melanodryas cucullata*
Grassland Bird	Brown Songlark	*Cincolorhamphus crucalis*
Grassland Bird	Rufous Songlark	*Cincolorhamphus mathewsi*
Grassland Bird	Singing Bushlark	*Mirafra javanica*
Grassland Bird	Stubble Quail	*Coturnix pectoralis*
Grassland Bird	Richards Pipit	*Anthus novaeseelandiae*
Grassland Bird	White-fronted Chat	*Ephthainura albifrons*
Grassland Bird	Chough, White-winged	*Corcorax melanorhamphos*
Grassland Bird	Australian Magpie-lark	*Grallina cyanoleuca*
Grassland Bird	Australian Magpie	*Gymnorhina tibicen*
Grassland Bird	Common Starling	**Sturnus vulgaris*
Grassland Bird	House Sparrow	**Passer domesticus*
Grassland Bird	Skylark	**Alauda arvenis*

**introduced species*

Habit classification adapted from Slater *et. al* 1989 with assistance from Judy Frankenberg (MDFRC).

Reference: Slater, P., Slater, P. and Slater, R. (1989) "The Slater Field Guide to Australian Birds", Weldon Publishing, Sydney

TABLE 3: MAMMALS (including Marsupials)

Marsupials are a subclass of Mammals. Both have hair to help them maintain body temperature and give birth to live young which they feed with milk from mammary glands. These animals are most likely to be observed at night while they are feeding.

Common Name	*Species name*
Mammals	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Chocolate Wattled Bat	*Chalinolobus morio*
Goulds Wattled Bat	*Chalinobus gouldii*
Large Forest Bat	*Vespardelus sagitula*
Southern Forest Bat	*Vespardelus regulus*
Small Forest Bat	*Vespardelus vulturus*
Southern Freetail Bat	*Mormopterus planiceps (lpf)*
Marsupials	
Short-beaked Echidna	*Tachyglossus aculeatus*
Common Ringtail Possum	*Pseudocheirus peregrinus*
Common Brushtail Possum	*Trichosurus vulpecula*
Eastern Grey Kangaroo	*Macropus giganteus*

TABLE 4: REPTILES

Reptiles cannot maintain their body temperature as well as mammals, but they can use some behaviours (eg. basking in the sun) to keep their temperature within an appropriate range. Their bodies are protected by tough skin or scales.

Common Name	*Species name*
Southern Rainbow Skink	*Carlia tetradactyla*
(no common name)	*Cryptoblepharus carnabyi*
Large Striped Skink	*Ctenotus robustus*
Tree Skink	*Egernia striolata*
Coventry's Skink	*Leiolopisma coventryi*
Grass Skink	*Leiolopisma delicata*
Bouganville's Skink	*Lerista bouganvillii*
(no common name)	*Morethia boulengeri*
Marbled Gecko	*Phyllodactylus mamoratus*
Lace Monitor	*Varinus varinus*
Brown Snake	*Pseudonaja texitilis*
Long-necked turtle	*Chelodina longicollis*

TABLE 5: AMPHIBIANS

Most amphibians require moist **habitats** so that they can regain the water they lose by evaporation through their moist skins during exercise.

Common Name	*Species name*
Banjo Frog (Eastern Pobblebonk)	*Limnodyastes dumerilli*
Giant Pobblebonk Frog	*imnodyastes interioris*
Spotted Marsh Frog	*Limnodyastes tasmaniensis*
Plains Brown Tree Frog	*Litoria parewingi*
Southern Brown Tree Frog	*Litoria ewingi*
Common Froglet	*Crinia signifera*
Plains Froglet	*Crinia parinsignifera*
(no common name)	*Crinia sloanei*
Smooth Toadlet	*Uperoleia laevigata*
Wrinkled (Eastern) Burrowing Toadlet	*Uperoleia rugosa*

Data source for Tables 2-5: CSU Johnstone Centre Report No.93, June 1997 "ANM Ltd - Ettamogah Forest Fauna Study 1994-1996"

TABLE 6: FISH

Most of the fish were introduced by ANM as fingerlings purchased from a commercial hatchery. The introduced mosquito fish is common throughout Australia in most permanent fresh waters.

Common Name	*Species name*
Mosquito Fish*	*Gambusia holbrooki*
Golden Perch**	*Macquaria ambigua*
Silver Perch**	*Bidyanus bidyanus*
Murray Cod**	*Mccullochella peeli*
Catfish**	*Tandanus tandanus*

* introduced   ** stocked

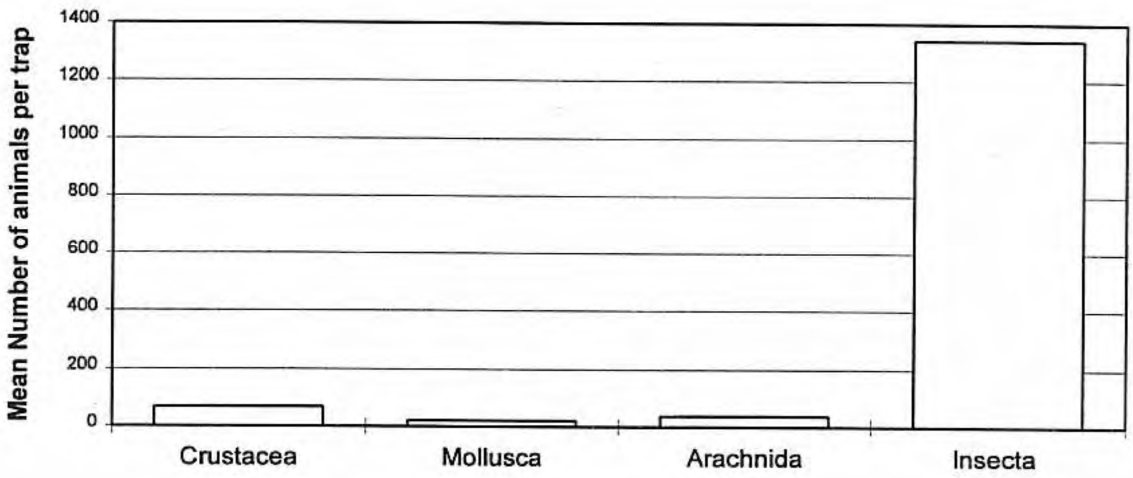
INVERTEBRATES

TABLE 7: Invertebrate fauna identified from the lake (aquatic) includes 24 species:

Number of species	Class of Animal
16	Insects
7	Crustaceans
1	Arachnid

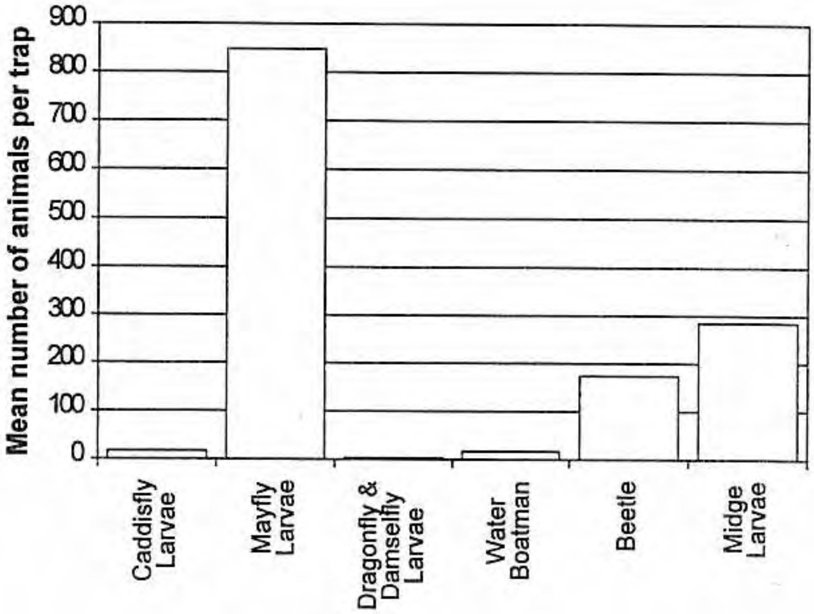
There are large numbers of these invertebrates. Some feed on algae (eg. molluscs and small crustaceans), some on decaying plant and animal material (eg. shrimp, yabbies and some insects) and many of the insects are predators feeding on other smaller invertebrates. As part of the many **food chains**, they in turn are food for some of the vertebrates. The aquatic invertebrates collected from the lake using artificial habitat traps can be divided into the four major groups shown in the following graph. **Insects** (invertebrates with 3 pairs of legs) are the most common group of these aquatic animals.

Graph 1: Summer Invertebrate Collections 1998



The insects can be futher separated into the six subgroups shown in the following figure. Mayflies were the most common insect present in these samples collected in summer. At other times of the year they may not be as common in comparison with the other groups as most of the insects have seasonal life cycles.

Graph 2: Summer Insect Collections 1998



Mayflies occur in large numbers in ANM's dam, living most of their life in the water as larvae, where they eat and grow. Their flying adult stage emerges on spring/summer evenings and lives for only a few days to mate before laying their eggs in the water.

Midge larvae are commonly known as bloodworms and live on the bottom sediments. Their adult stage looks like a mosquito but does not bite.

Aquatic **beetles** and **water boatmen** (bugs) are air-breathers like their terrestrial relations and many adults can live underwater by taking small bubbles of air down with them when they dive from the surface.

Caddisfly larvae often live on the bottom surfaces underwater in a case made of sticks, leaves or sand grains. They carry this case around with them with only their head and long legs sticking out. The flying adults look like delicate moths, not seen much during the day, but will swarm around lights at night.

Dragonfly and **damselfly larvae** are the larger of the insect predators and live underwater for many months. The adults are easily seen and may be brightly coloured. They are swift fliers often seen skimming along near the surface of the water feeding on adult midges or other small flying insects.

TABLE 8: INVERTEBRATES

Common Name	*Species name*
Class: Insecta (Aquatic)	
Caddisfly Larvae	Oecetis sp.
Caddisfly Larvae	*Econmus continentalis*
Caddisfly Larvae	*Econmus pansus*
Caddisfly Larvae	*Ecnomus turgidus*
Caddisfly Larvae	Hydrobiosidae
Mayfly Larvae	Cloen sp.
Mayfly Larvae	Caenidae Genus B.
Dragonfly Larvae (mudeye)	*Hemicordulia tau*
Damselfly Larvae	*Austrolestes annulosus*
Damselfly Larvae	*Xanthagrion erythroneurum*
Damselfly Larvae	*Austroagrion watsoni*
Water Boatmen	*Micronecta annae*
Water Boatmen	*Micronecta robusta*
Backswimmer	Enithares sp.
Scavenger Water Beetle	Berosus sp.
Bloodworm (Non Biting Midge Larvae)	Chironomidae
Class: Crustacea	
Water Flea	Chydoridae
Water Flea	*Daphinia carinata*
Water Flea	Moinia sp.
Water Flea	Calanoida sp.
Seed Shrimp	Newnhamia sp
Freshwater Shrimp	*Parataya australiensis*
Yabby	*Cherax destructor*
Class: Arachnida	
Water mite	Acariformes

Invertebrate and small fish sampled using light traps, plankton trawls and artificial substrates in ANM's Lake Ettamogah January to April 1998

1997

The Murray-Darling Freshwater Research Centre

5 December, 1997

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Jeff Lassman
Australian Newsprint Mills Limited
Private Bag
LAVINGTON NSW 2641

Dear Jeff,

1997 ANNUAL REPORT - BIOLOGICAL AND CHEMICAL MONITORING

Please find enclosed an unbound copy of the 1996 Annual Report of Chemical and Biological Monitoring for Australian Newsprint Mills Limited, undertaken by The Murray-Darling Freshwater Research Centre. This Annual Report complies with Licence Condition W16 on the ecotoxicological and bioaccumulation monitoring and the river environment monitoring surveys.

Please do not hesitate to contact me on 582355 for any additional information.

Wishing you and your staff a Merry Christmas and a Happy New Year.

Yours sincerely

Helen King

Scientific Officer

Enc. 1997 Annual Report.

Research for safe, efficient management of water resources.

Ellis Street, Thurgoona, N.S.W. Telephone: (060) 43 1002
P.O. Box 921, Albury 2640. Telex: AA 56978
Facsimile: (060) 43 1626

The Murray-Darling Freshwater Research Centre

CHEMICAL AND BIOLOGICAL MONITORING

1997 ANNUAL REPORT

FOR

AUSTRALIAN NEWSPRINT MILLS Ltd ALBURY

H King & D Baldwin

The Murray-Darling Freshwater Research Centre

Research for safe, efficient management of water resources.

Ellis Street, Thurgoona, N.S.W. Telephone: (060) 43 1002
P.O. Box 921, Albury 2640. Telex: AA 56978

TABLE OF CONTENTS

PAGE

1.0 AIMS

To undertake biological and chemical monitoring of ANM's wastewater discharged to the River Murray in accordance with New South Wales Environment Protection Agency Licence No.01272; Sections W10 (Ecotoxicological and Biological Monitoring) and W11 (River Environment Monitoring Surveys) to April 1997; and, Sections W9 (Long term bioaccumulation monitoring using fish) and W10 (Microbial oxidation of manganese on artificial substrates) for May 1997 to April 1998. The null hypothesis tested in all cases "that there is no difference between control water and wastewater treatments." Some of the work is incomplete at this stage and will be finalised by June 30 1998, for inclusion in the 1998 Annual Report.

2.0 METHODS

2.1 Ecotoxicological Monitoring [W10]

2.1.1 Sample Preparation

All waters were collected as grab samples in 10L buckets on the morning of the test following ASTM (1990) guidelines. The dilution/control water was obtained from the Lake Hume Resort boat ramp at the Hume Dam on the River Murray upstream of ANM's discharge. The receiving water sample was taken from the River Murray approximately 2 km downstream of the wastewater discharge. The wastewater samples were collected on site at ANM from three locations; the final outfall, the 4-day holding pond and the inlet to the 4-day holding pond. All waters were sieved to 180 um to remove macro and micro fauna that could interfere with the tests, whilst still retaining the samples as close as possible to actual field conditions. The temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity of all samples were measured prior to use (USEPA 1991 pp 44-46). The control and downstream river sample were tested undiluted (USEPA 1991 p47). The three on-site wastewater samples were routinely prepared at three concentrations 100%, 10% and 1%, diluted with control water and aliquots of these were distributed between replicates (ASTM 1990). The laboratory temperature was maintained at 20 ± 5 Celsius throughout the year.

Acute Toxicity Tests

Acute toxicity testing procedures were formulated from ASTM's "Standard Guide for Conducting Toxicity Tests on Aqueous Effluents with Fishes, Macroinvertebrates and Amphibians" (ASTM 1990) and USEPA's "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (USEPA 1991), but in some cases these have been modified slightly to accommodate the local organisms used in this monitoring program.

Acute toxicity tests were designed to obtain information on the immediate effects on test organisms following short term exposure to wastewaters under laboratory conditions. Results of these tests can be used to predict the likely effects of the wastewater on aquatic organisms in receiving waters. The use of locally occurring species ensures greater accuracy of these predictions. The organisms selected for this program occupy different functional groups: *Daphnia carinata* is a pelagic microcrustacean and obligate filter feeder; *Chironomus tepperi* is a benthic midge larva which feeds on detritus. *D.carinata* and *C.tepperi* can be reliably cultured in the laboratory in sufficient numbers for the testing program.

Acute toxicity tests were conducted monthly. Test chambers used for both organisms were 60 mL clear round glass jars (resin acids, potential toxic components of paper mill effluent may be adsorbed onto plastic surfaces), approximately 40 mm high to ensure an adequate surface area to volume ratio for gas exchange. Test solutions were prepared in a single batch and apportioned between three replicates positioned randomly.

Daphnid tests were conducted using neonates (less than 24 hr old) from laboratory cultures. The neonates were collected by combining broodstock culture solutions in a 5L aquarium after the adults were transferred to fresh culture solutions. Neonates required for the test were carefully captured using a wide mouthed disposable pipette and released under the surface of the test solutions to minimise trauma due to handling. The neonates were distributed randomly between treatments and replicates so that there were 10 animals per jar. (ASTM 1990 pp 758-760, USEPA 1991 pp 49-51).

Chironomid tests were conducted using final instar larvae from laboratory cultures. Chironomid larvae were sieved from their culture solution and final instars carefully transferred to test solutions using flexible forceps to minimise trauma. The chironomids were distributed randomly between treatments so that there were ten animals per jar (ASTM 1990 pp 758-760). A small strip of facial tissue was added to each jar as a substrate to help prevent clumping of animals.

The organisms were not fed for the duration of the test as faecal matter and undigested food can reduce the dissolved oxygen level and reduce the biological activity of some test materials (ASTM p761). The numbers of dead animals were counted at 24 hours, and again at 48 hours, when the tests were terminated. Death of invertebrates is often difficult to determine, so immobilisation, lack of response to stimuli and opaque colouration or loss of colour were the symptoms interpreted as "effect" (ASTM p761). The results of these tests were reported as EC50 values (the concentration of effluent which results in the "effect" observed for 50% of the organisms), provided sufficient number of organisms were affected. "Calculation of an EC50 is considered unacceptable if either or both of the following occurred: No treatment other than a control treatment killed or affected less than 37% of the test organisms exposed to it; No treatment killed or affected more than 63% of the organisms exposed to it." also if more than 10% of the controls exhibited signs of disease, stress or death (ASTM p762 , USEPA p55).

Results were reported quarterly to ANM and a summary of significant results is provided in this Annual Report.

Chronic Toxicity Tests

Chronic toxicity testing procedures for a local cladoceran, *Daphnia carinata* were adapted from ASTM's "Standard Guide for Conducting Renewal Life-Cycle Toxicity Tests with *Daphnia magna*" (1991) and USEPA's "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (1989) which contain methods based on *Daphnia magna* and *Ceriodaphnia dubia*.

Chronic toxicity tests were designed to provide information to permit the prediction of the possible long term effects of wastewaters on the test organism in receiving waters. These tests were primarily concerned with sublethal effects which may not have been expressed in the short term tests. The cladoceran tests are life cycle tests, in which an animal is assessed for survival, growth and reproduction.

Chronic toxicity tests were conducted at two monthly intervals using *D.carinata*. Test chambers for these cladocerans were clear glass 60 mL jars. Test solutions were prepared in bulk (as for the acute tests) and apportioned between ten replicates. Daphnia neonates were obtained as for the acute tests. The neonates were distributed randomly between treatments and replicates so that there was one animal per jar. (ASTM 1990 p771, USEPA 1989 p106). The cladocerans were fed a daily dose of blended food solution made up of yeast and trout feed (ASTM 1990 p775) and transferred to fresh solutions three times per week (USEPA 1989 p110). Observations of survival, stress and reproduction/number of live young produced were noted at each transfer. The tests continued for a maximum of 21 days (*D.carinata*). The results were considered acceptable if survival of the controls was at least 80% and each surviving control animal had achieved at least three broods. Results rejected if ephippia (desiccation resistant eggs produced in response to environmental stress) were produced in any of the controls. (USEPA 1989 p122, ASTM 1990 p 774).

Results were analysed in quarterly reports to ANM providing a summary of reproductive statistics for the duration of the tests. The mean number of young produced in each treatment were compared with the control using t-tests to determine their significance @ $p< 0.05$. A summary of the results for tests conducted this year is provided in this Annual Report.

2.2 Bioaccumulation Monitoring

Bioaccumulation trials were conducted to determine the levels of bioaccumulation of metals from ANM's final outfall wastewater using a crustacean (yabby, *Cherax destructor*) and a fish species (carp gudgeon *Hypseleotris spp.*).

2.2.1 Yabby *(Cherax destructor)*

Yabby trials were conducted on site at ANM using three preconditioned 8-9m^3 concrete flow-through tanks each containing ~90 pieces of PVC pipe as hides. Two control tanks were fed by sand filtered river water and the test tank was fed by 50% final outfall wastewater diluted with sand filtered river water. 300 male yabbies of approximately equal size (70 to 80 mm total length) were purchased from a commercial yabby farm. These yabbies were distributed randomly between the tanks to achieve a stocking density of 19/m^2. A subsample (5%) was measured and nine animals (three from each tank) were retained as initial control samples for metals analysis. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity were measured fortnightly and 10-20 animals from each tank were measured (weight and length) monthly, and a smaller subsample (3) removed, frozen and freeze dried every three months and at the termination of the trial. One animal from each tank was separated into its three major components; shell + gastrolith; tail + claw muscle and viscera. These samples were then submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP metals analysis.

Mean growth data were analysed using t-tests to determine differences between the control and test treatments. These results were presented in quarterly reports to ANM. The results of the metals assays were compared for each treatment using the means of the three subsamples. A summary of these results is provided in this Annual Report.

2.2.2 Carp Gudgeon (*Hypseleotris spp*).

Bioaccumulation studies using adult Carp Gudgeon spp. (primarily Western Carp Gudgeon (*Hypseleotris klunzingeri,* Ogilby) with some Lake's Carp Gudgeon (*Hypseleotris* sp.5, undescribed) and Midgley's Carp Gudgeon (*Hypseleotris* sp.4, undescribed)) were conducted in November 1996, using fish captured from a local billabong during the breeding season. The fish were contained in six 90L preconditioned polypropylene flow through tanks ('Nally' Tubs) containing filter boxes with aeration and artificial weed. Three tanks were randomly assigned to each treatment. The control tanks were fed by river water filtered to 1 micron, sterilised by Ultra Violet radiation and adjusted to 1000μS conductivity using stock feed grade salt, and the test tanks were fed by final outfall wastewater. Low stocking densities were used to reduce the impact of territoriality on the fish. Approximately 40 fish were added to each tank and maintained on a diet of frozen tubificid worms and trout pellets. Whole fish samples were collected at the termination of the trial for metals assays. Fish were anaesthetised using 1 mL/L of 'Benzocaine' stock solution (5g/100 mL alcohol) prior to being measured and were killed by overdose with 'Benzocaine' prior to being frozen and freeze dried in preparation for metals analysis. Samples were then submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP analysis. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity were measured in each tank fortnightly.

The results of the metals assays were compared for each treatment and the feed using the means of the three subsamples. A summary of these results is provided in this Annual Report.

2.2.3 Golden Perch from ANM's Holding Ponds

Following approval from NSW Fisheries and Charles Sturt University Animal Care and Ethics Committee, bioaccumulation monitoring for metals in fish will be conducted by surveying the golden perch population released into the 50ML (4-day holding pond) or Lake Ettamogah as fingerlings. Two surveys will be conducted in summer of 1997/98 using nets or electrofishing. The number of fish assessed will depend on the variability in size and representation of sex. The fish will be anaesthetised and killed using benzocaine™ and assessed for size, age (using otoliths), diet and gonad development. Flesh samples will be removed from behind the head, frozen, freezedried and homogenised then acid digested in preparation for assay of metals (Al, As, Cd, Cu, Fe, Mn, Pb, and Zn) by ICP at Australian Government Chemical Laboratories (AGAL).

2.2.4 Microbially Mediated Manganese Bioaccumulation

Artificial Substrates

Small pieces of inert plastic were used as artificial substrates in two flow through tanks, one river water (control) and one wastewater (treatment) in conjunction with a crustacean trial. 10 pieces of plastic 50mm x 80mm, bent in half to facilitate Mn extraction, were attached using fine cord to a piece of polythene pipe through a small hole so that both sides were available for biofilm deposition. The substrates were then lowered to a depth of 1.2m so that they were off the floor of the tank but as deep as possible to minimise fouling by filamentous green algae. A further six substrates were immersed in deionised water in glass conical flasks sealed with parafilm to prevent evaporation acting as blanks. Physico-chemical water quality data (temperature (minimum/maximum), dissolved oxygen conductivity, pH, hardness and alkalinity) was collected every fortnight. After six weeks exposure the substrates were carefully removed. Three substrates were randomly selected from each treatment and transferred to 50mL screw capped polyethylene centrifuge tubes. 30mL 1.0M HCl was added to each tube and the tubes were placed horizontally on a shaker table over night to facilitate Mn dissolution. Mn in the HCl extracts was determined by AAS and expressed per unit area of substrate. Triplicates of each treatment measured. These results are included in this Annual Report.

Isolation of Manganese Oxidising Bacteria

Samples of wastewater and small permanently inundated rocks from ANM's 4-day holding pond and irrigation dam (Lake Ettamogah) were collected for culture. Pedomicrobium (PC) agar (Tyler and Marshall 1967) plates containing agar, yeast extract and $MnSO_4$ were innoculated with either wastewater or rock biofilm. These were then cultured at 27°C and kept under observation for the presence of colonies which turned brownish/black as Mn oxide formed. These colonies were subcultured onto fresh media until a pure growth was obtained. These results are included in this Annual Report.

2.3 River Environment Monitoring Surveys

2.3.1 Water

Sample Collection and Handling.

Grab samples were taken at three locations on the river on a monthly basis. Site 1 samples were taken from Mungabarena Reserve (approximately 4 km upstream of the outfall). Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

5 samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were "ANALAR" grade or better and, clean polyethylene gloves were worn at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of water samples.

All metal analyses were performed by NATA registered :-

EML (Chem) Pty Ltd

425 -427 Canterbury Road

Surrey Hills Vic 3127

Concentrations of recoverable aluminium, cadmium, cobalt, chromium, copper, iron, manganese, mercury, lead and zinc were determined.

Physical and nutrient analyses were performed at the Murray-Darling Freshwater Research Centre (MDFRC). Turbidity, colour, specific conductance, total filterable solids, ammonia, oxides of nitrogen (NO_x), organic nitrogen, and total phosphorus were determined according to the methods outlined in the MDFRC Chemistry laboratory's methods manual.

2.3.2 Sediment.

Sample Collection and Handling.

A series of forty sediment samples were taken in May 1997. Sediment samples were collected from three deposition zones on the River Murray. Deposition site A was located at Doctor's Point (about 2 km upstream of ANM's outfall). Deposition sites B and C were approximately equidistant (*ca* 500 m upstream and *ca* 500 m downstream respectively) of ANM's outfall. Samples were collected at 10 meter intervals along the 60 cm depth contour (approximately 2 meters from, and parallel to, the river bank). A total of 20 samples were taken from each deposition zone.

Approximately the top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5% HCl) and repeatedly rinsed with Milli-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimise the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analysis were performed only on the sieved fraction (Grimshaw 1989).

Analysis of Acid Extractable Metals.

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1989). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5% HCl and extensively rinsed with MILLI - Q water). 25 mL of 0.1 M "ARISTAR" grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a "Ratek" orbital shaking table for one hour. The samples were allowed to settle overnight and, subsequently filtered through acid washed Whatman GF/C filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5% HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to :-

Australian Government Analytical Laboratories (AGAL)
1 Suakin St
PYMBLE NSW 2073,

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury.

Approximately 10 g of air dried sample was placed in clean polyethylene bags and dispatched to AGAL for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen.

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9 % NaOH, 4.0 % $K_2S_2O_4$) and 20 mL of Milli-Q water was added to each tube. The tubes were sealed and subsequently heated in an autoclave for one hour. The solution was the analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et al* 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus.

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et al* 1989).

2.3.3 Macroinvertebrates

Monitoring of the macroinvertebrate fauna above and below the ANM wastewater discharge was performed using artificial substrate samplers as described in "Macroinvertebrates of the River Murray (Survey and Monitoring: 1980-1985)", (Bennison *et al* 1989). This standard sampling technique was used to obtain results that were directly comparable with respect to both temporal and spatial characteristics. The sampler, placed in an aquatic ecosystem acts as an artificial substrate so that colonisation by benthic organisms can be assessed.

Each sampler consists of a cylinder of black plastic "gutterguard" (mesh size ~ 10 mm^2) approximately 180 mm high x 180 mm diameter, the cylinder is closed on one end by a round piece of "gutterguard" and contains two knitted onion bags as complex substrate and a couple of small rocks as ballast. The top of the sampler is pinched and tied closed with a length of nylon cord which is attached to the limb of an overhanging tree. The sampler sits on the bed of the river for ~ 4 weeks before being retrieved using a 500 μm net.

Artificial substrate samplers were set at three paired sites - the 'controls' opposite Grey's farm approximately 500m above ANM's wastewater discharge; 'mixing zone' near the railway bridge 200m below the discharge; and 'downstream' at Union Bridge 2 km below the discharge. Ten samplers were set monthly at each of the three sites and after a minimum of four weeks, six of these were collected using a fine mesh net and all ten replaced with clean samplers. This allowed for the possible loss of four samplers each month due to disturbance ensuring that sufficient samples were collected. The samples were sieved to 500 μm to remove silt and the remaining portion retained and preserved in 70% alcohol. Samples were sorted using a stereo microscope and identified with reference to MDFRC's taxonomy collection.

Site data were analysed statistically to ascertain similarity/dissimilarity in community structure between site pairs using multivariate techniques developed at Plymouth Marine Laboratories, England (Clarke 1993, Clarke and Warwick 1994). The Bray Curtis metric was used to compute similarity and construct a dendogram linking samples based on their similarity to each other. Hypothesis testing of predefined groups was performed using ANOSIM (analysis of similarity), which is analogous to the univariate ANOVA (analysis of variance). SIMPER (similarity percentages) were calculated to determine the proportional contribution of species to the dissimilarity between the predefined groups of samples.

Comparisons of the community structure data for a) location relative to ANM's wastewater discharge, and b) pre and post changes to the wastewater discharge, from 1 January 1997 were assessed with reference to flow and season. These resulted are presented in this Annual Report.

2.3.4 Fish

Following consultation with NSW Fisheries, and approval by ANM, NSW Environment Protection Authority and NSW Fisheries, fish surveys were no longer required as part of this monitoring program.

2.4 Reporting

Quarterly reports containing all test results and observations including physico-chemical data were submitted to ANM. This Annual Report containing a summary of results from the monitoring program was submitted to ANM for incorporation as an appendix to their annual report to fulfil their requirements for Condition W16 of Licence No.01272 issued by the NSW Environment Protection Authority.

3.0 RESULTS AND DISCUSSION

3.1 Ecotoxicological and Bioaccumulation Monitoring

3.1.1 Acute and Chronic Toxicity tests

Chironomid Acute Toxicity Tests

Three valid chironomid EC50 tests were conducted between January and July 1997, using three sources of ANM wastewater (final outfall, 4-day pond and pond inlet respectively). No significant mortalities (>20%) were recorded.

Daphnid Acute Toxicity Tests

Seven valid daphnid EC50 tests were conducted between January and July 1997. Figures 1a-c provide a summary of acute toxicity results for the daphnid tests conducted using three sources of ANM wastewater (final outfall, 4-day pond and pond inlet respectively) in 1997. Significant mortalities (>20%) were recorded for the final outfall sample in January (Figure 1a). No significant mortalities were recorded for the 4-day pond wastewater (Figure 1b) or the pond inlet wastewater (Figure 1c).

Daphnid ChronicToxicityTests

Four valid daphnia survival/maturation/reproduction tests were conducted between January and July 1997. A summary of these chronic toxicity test results using t-test values to compare the mean number of young produced in each treatment, compared with the control is provided in Figure 2. A 't value that exceeds +2.1 ($\alpha = 0.05$) denotes a significant reduction in the number of young produced, and conversely, a 't' value that exceeds -2.1 ($\alpha = 0.05$) denotes a significant increase in the number of young produced. A significant reduction in the number of young produced by daphnids exposed to ANM's treated wastewater occurred in the January test for the 4-day pond and pond inlet wastewater samples at all concentrations an in the May test for the pond 100% and pond inlet 100% concentrations. A significant increase in the number of young produced by daphnids exposed to ANM's treated wastewater occurred in the May test for 4-day pond and pond inlet wastewaters at 10% concentrations.

Given that the final concentration of ANM final outfall wastewater in the River Murray would not exceed 1% concentration, there is no evidence to suggest any acute or chronic toxicity to riverine invertebrates from ANM's discharge, based on the sensitivity of these cladoceran crustacean tests.

3.1.2 Bioaccumulation Studies

Yabby

A four month *C.destructor* trial commenced in November 1996, terminating in March 1997. There was no significant difference in the length measurements between treatments, but the animals living in ANM's wastewater were significantly heavier than those living in river water (reported in the first quarter report to ANM, dated 5 April 1997).

The results (mean of three subsamples) for the eight metals assayed (aluminium, arsenic, cadmium, copper, iron, lead, manganese and zinc) are presented in Figures 3a-h. At each sampling date there are two control sample results and one test (wastewater) sample result. There was no consistent difference in the concentrations of aluminium (Figure 3a), arsenic (figure 3b), copper (Figure 3d), iron (Figure 3e), lead (Figure 4f), manganese (figure 3g), or zinc (Figure 3h) between treatments. Cadmium (Figure 3c) was higher in the wastewater treatment. Iron (figure 3e) was higher for control tank 1, possibly due to contamination from rusting overhead grating. The lead and cadmium concentrations were below 0.5 mg/kg. Arsenic levels (Figure 3b) remained below 1.2 mg/kg. Zinc concentration was variable ranging from 94 (initial) to 233 mg/kg (control 1 final). Aluminium levels ranged from 27 mg/kg (waste 3 final) to 247 mg/kg (initial). Copper levels ranged from 58 (control 1 final) to 92 mg/kg (initial). Iron levels ranged from 61 (waste 3 final) to 299 (Control 1 final). Manganese ranged from 84.2 (Control 1 final) to 394 mg/kg (initial).

The concentrations of metals from the yabby samples at the termination of the trial, separated into three major body components are depicted in figures 4a-h. The greater proportion of the metals Al, As, Cd, Cu, Fe and Zn were found in the viscera; Pb in the tail + claw muscles; and Mn in the shell/carapace. The primary location of manganese in the shells is a further indication that the possible mode of manganese accumulation via bacterial biofilm adhering to the surface of the carapace which oxidise manganese in solution, (Ehrlich 1990, Tyler 1970, Tyler and Marshall 1967a & 1967b).

Carp Gudgeon

The 5 week Carp Gudgeon (*Hypseleotris spp*) trial was conducted in November-December 1996. No significant difference in growth between control and wastewater treatments was recorded and mortalities in the wastewater treatments were significantly lower than those in the controls (reported in the first quarter report to ANM, dated 20 January 1997).

The results (mean of three subsamples) for the eight metals assayed; aluminium, arsenic, cadmium, copper, iron, lead, manganese and zinc, are presented in Figures 5a-h. The data for one initial sample, three replicate control samples and three replicate test (wastewater) samples are plotted on the figure, and the final column depicts the commercial trout pellet feed used throughout the trial.

Aluminium (Figure 5a) and Manganese (Figure 5g) concentrations were slightly higher in wastewater treatments, although this is not considered significant when the variability between replicates is taken into account. Arsenic (Figure 5b) and Cadmiun (Figure 5c) concentrations were less than 1mg/kg, slightly higher in controls than the test replicates. Copper (Figure 5d), Iron (Figure 5e), Lead (Figure 5f) and Zinc (Figure 5h) and lead (Figure 5e) concentrations were consistently higher in controls compared with treatments.

Apart from inconsistent higher concentrations for Al and Mn, it appears that the wastewater treatment actually results in lower metals concentrations in these fish. The commercial pellets were higher in most metals (Al, As, Cd, Cu, Fe, Pb and Mn) assayed, compared with the fish samples but were much lower than the feed assayed in the previous years trial.

These bioaccumulation studies have demonstrated little effect from exposure to 50 - 100% ANM wastewater. The longer term yabby trial show increased growth and some bioaccumulation of manganese (the latter, probably due to the presence of a surficial bacterial biofilm on the the animals). The short term carp gudgeon trial showed that overall, metals concentrations in the fish living in ANM's wastewater were lower than those living in the river water controls.

Golden Perch from ANM's Holding Ponds

Sampling for this assessment is sheduled for December 1997 and January 1998 and will be reported in full in the 1998 Annual Report.

Microbial Oxidation of Manganese using Artificial Substrates

The concentrations of manganese for the two control treatments and two wastewater treatments with errors shown by standard deviation are depicted as box plots in Figure 6. The control substrates contained 20.5 to 34.5mg/m^2 Mn, and the wastewater substrates 90.0 to 91.9 mg/m^2 Mn. t-Tests showed no difference between the two wastewater treatments ($t = 0.2$, t crit = 2.8 $\alpha = 0.05$) permitting their aggregation. There were however, significant differences between the shallow and deep control samples ($t = -0.3$, t crit = 2.8 $\alpha = 0.05$); but more importantly between the shallow control and combined wastewater samples ($t = -12.6$, t crit = 2.4 $\alpha = 0.05$); and the deep control and combined wastewater samples($t = -9.1$, t crit = 2.4 $\alpha = 0.05$).

Manganese Oxidising Bacteria

Isolation of manganese oxidising bateria from submerged rock biofilm was successful on agar in the laboratory. Work on these bacteria continues and may be published. Indications for ANM are that the holding ponds are active in reducing the concentration of manganese in wastewater and further supports the theory that Mn accumulation in yabbies is microbially mediated.

3.2 River Environment Monitoring Surveys

3.2.1 Water

A summary of the water quality data is presented in Figure 7. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.) All the water-quality data accumulated since the commencement of the monitoring program (January 1992) has also been included for purpose of comparison. The figure does not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.006 mg/L), chromium (0.01 mg/L), lead (0.03 mg/L) and mercury (0.0005 mg/L) were not detected in any of the samples (detection limits in brackets). Copper (detection limit of 0.004 mg/L) was detected on only two occasions - site 1, 2 and 3 on 9/12/96 (concentrations of 0.009, 0.007 and 0.006 mg Cu /L respectively) and at site 1 on 26/5/97 (0.005 mg Cu /L).

Generally, most of the data show little (if any) variation between sites although, there may be significant variation over time (seasonal effects). The only observed difference of any significance was an elevated value of organic N at site 2 in the April 1997 sample relative to the other sites. The origin of this increased value are unknown but may simply reflect the semi-rural nature of the surrounding riparian zone. It is of note that the effects of the peak observed in June and July in many of the analytes particularly turbidity, Fe, Al, Organic N and total P (discussed in last years annual report) had dissipated by the time the August 1996 sample was taken.

3.2.2 Sediments

Mercury, tin, molybdenum, and silver (all with detection limits of 0.01 mg/kg) were not detected in any of the sediment samples.

The results for the sediment analyses for total persulfate nitrogen (N), exchangeable phosphorus (P) and acid extractable arsenic, aluminium, boron, barium, cadmium, chromium, cobalt, copper, iron, lanthanum, lead, manganese, nickel, strontium, vanadium and yttrium are summarised in Figure 8. For each analyte a box plot showing the analytes distribution for samples taken at Doctors Point (marked A on Fig 8), directly above the outfall (B) and below the outfall (c) are presented. The solid horizontal lines of the box plot represent the 10^{th}, 25^{th}, 50^{th}, 75^{th} and, 90^{th} percentiles of the data - the box itself represents the 25^{th} to 75^{th} percentile. All data outside the 10^{th} and 90^{th} percentiles are shown as open circles on the plots. The mean of the data is represented by a dotted line. From the figure it is clear that all of the samples from the 2 upstream deposition zones have a s greater range and mean concentration than those of the down stream sites. Indeed it can be seen that both the highest means and ranges for all analytes were from the deposition zone at Doctors Point.

In keeping with last years study, 2 upstream depositional sites were sampled - one, some distance upstream of the outfall (site A) and, a second site directly above the outfall (site B). As with last years samples, the sediments from site A contained the same or higher analyte concentration ranges for all the elements examined compared with sediments from directly upstream (site B) or directly downstream (site C) of the outfall. Further, with the exception of Fe (which was higher at site B than C), the analyte concentrations for sediments from sites B and C tended to fall in the same range.

It is of note that the concentrations of analytes at the 3 sites in 1997 were substantially lower than in 1996. This may simply reflect a re-distribution of fine sediments following the floods towards the end of 1996.

3.2.3 Macroinvertebrates

The complete 1995 species list and abundance data for each of three replicate baskets at the 6 sites on the River Murray, presented by month is included in Table 1 (24 pages). The totals and % totals for each species on the last two of these pages show the mayfly (ephemeroptera) larva, Caenid Genus B as most common taxa, contributing 35.7% and the caddisfly (trichoptera) larva, *Ecnomus pansus* as next most common taxa, contributing 13.6% to the total macroinvertebrate abundance. The mean percentage abundance data for each site at each sampling time was analysed using a Bray-Curtis Similarity matrix (Clarke 1993, Clarke and Warwick 1994). These results are displayed in the cluster analysis dendogram (Figure 9). The dendogram groupings for the whole year show no biological differences between sites with limited grouping according to sampling period/season.

Location and Season

Mean abundance data for each site in 1996/97 were compared to elucidate differences in macroinvertebrate community data between locations (relative to ANM's discharge) and seasons. The location MDS ordination (figure 10) a high degree of overlap between the categories. The season MDS (figure 11) showed greater aggregation of categories but again, no real separation and major overlap. ANOSIM (two way nested) results indicated some difference between site groups $R = 0.174$ $\alpha = 0.001$ and a greater difference between season groups $R = 0.741$ $\alpha = 0.001$.

One upstream control (Site 6) repeatedly grouped to one end of the ordinations, possibly the result of inappropriate site selection, as it tended to experience higher water velocities than the other five sites, this interpretation reinforced by the presence of greater abundance and diversity of gripopterygid plecopterans (Williams 1980).

The greater value of the statistical difference between the season groups compared with the site groups and the position of the samples in the ordinations indicate a gradual change between the seasons, but the high degree of overlap implies either another factor is involved or that habitat patchyness has confounded the results and a greater number of replicates may have improved the resolution. Despite the similarity of sites and stratified sampling design large variations in benthic macroinvertebrates between sites and seasons were obseved by Harris et al. (1992) in the La Trobe River. Barmuta (1989) was also concerned with patchyness, he found pronounced seasonal changes confined to erosional habitats, but, overall, temporal and spatial continuity of community structure that did not correspond with easilly identifiable habitats in an upland stream.

Response to Alteration of Discharged Wastewater Quality

The quality of ANM's discharged wastewater is best described by its conductivity for the purposes of this study (figure 12) Conductivity measurements were reliable, reflect hardness and alkalinity, and indicate changes to wastewater processing. Throughout 1996 the conductivity of the water discharged to the Murray was generally between 1400µS and 2100µS (mean 1700µS). Following changes to wastewater processing from January 1997 until the end of the assessment in June, the conductivity of the discharge was 100µS to 650µS (mean 310µS). The mean conductivity of the River over both periods was stable at 60µS, the influence of the discharge on the physico-chemical parameters undetectable even at low flow periods.

Mean abundance data for each site from January to May were compared for all sites in 1996 (pre change) and 1997 (post change) to limit seasonal influences that could confuse interpretation. The MDS ordination (figure 13) shows little separation, however some general trends are evident, even though there is considerable overlap between treatments. The upstream control samples 5&6 (pre change) and E&F (post change) lie towards positive on both axes, particularly 6 and F (the same site). The mixing zone samples 3&4 (pre change) and more particularly C&D (post change) lie towards negative on the y axis and around zero on the x axis. The downstream samples 1&2 (pre change) and A&B (post change) lie scattered throughout the ordination within the boundaries of the other two treatment categories.

ANOSIM results (one-way) testing for homogeneity of samples (excluding site 6 and F due to its consistent difference from all other sites) pre and post discharge changes, indicated that the mixing zone samples were different ($R = 0.350$ $\alpha = 0.004$) however the upstream controls were also different ($R = 0.381$ $\alpha = 0.040$) but the downstream samples were not different ($R = 0.019$ $\alpha = 0.33$).

Multivariate analyses of macroinvertebrate community structure have been successful in detecting the impact of pulp mill discharges (eg. Thomas and Munteanu 1997) and sewage effluent (eg. Cao *et al.* 1996) in freshwater systems. In this study, no differences were detected in the colonising benthic macroinvertebrates of the Murray River prior to and following the improvement of wastewater quality entering the river, but given the overall quality of this tertiary treated wastewater and its dilution in the River this is not surprising. Harris *et al.* 1992 were also unable to detect any difference in macroinvertebrates of the LaTrobe River in response to tertiary treated pulp and paper effluent despite a 20-25% increase in TDS and conductivity in the river attributable to the Maryvale Mill.

Overall, there was no difference in the macroinvertebrate community structure between river sites for each sampling period, or between first quarter samples for 1996 (whole wastewater - prior to the change in discharged wastewater) and 1997 (cooling water only - following the change in discharged wastewater). Hence, no detected effect of ANM's wastewater discharge on colonising macroinvertebrate communities in the receiving waters of the Murray River.

3.2.4 Fish

Fish surveys were not required following a decision reached at the annual meeting (2 November 1995) and ratified by Allan Lugg from NSW Fisheries (29 January 1996).

4.0 COMMUNICATION

The revised monitoring program entitled "Biological Monitoring Program Proposal for Australian Newsprint Mills Ltd Albury Commencing on 1 January 1997" incorporating modifications to the program following the cessation of wasterwater discharge to the River Murray, submitted to NSW Fisheries and EPA NSW in April 1997, was approved and adopted in June 1997.

A poster titled "Seasonality of Benthic Macroinvertebrates in the River Murray at Albury, and Impact of Newsprint Mill Wastewater" was presented at the Australian Society of Limnology (ASL) Congress in Albury, 26 to 28 September 1997.

A talk titled "Bioaccumulation of Mn in Yabbies - Is It Microbially Mediated?" was presented at the RACI Riverina Branch Meeting, in Albury, 31 October 1997.

The annual review meeting was held on 25 November 1997, with participants from Department of Land and Water Conservation, Environment Protection Authority, Australian Newsprint Mills and The Murray-Darling Freshwater Research Centre.

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APPENDIX 1 (Figures)

Figure 1a-c: Acute toxicity results for eight Daphnia tests exposed to three concentrations of three types of ANM wastewater during 1996. Where a percentage mortality greater than 20% is considered a significant result.

Figure 1a: Daphnia 48 hour EC50 - Final Outfall
(>20% = significant mortality)

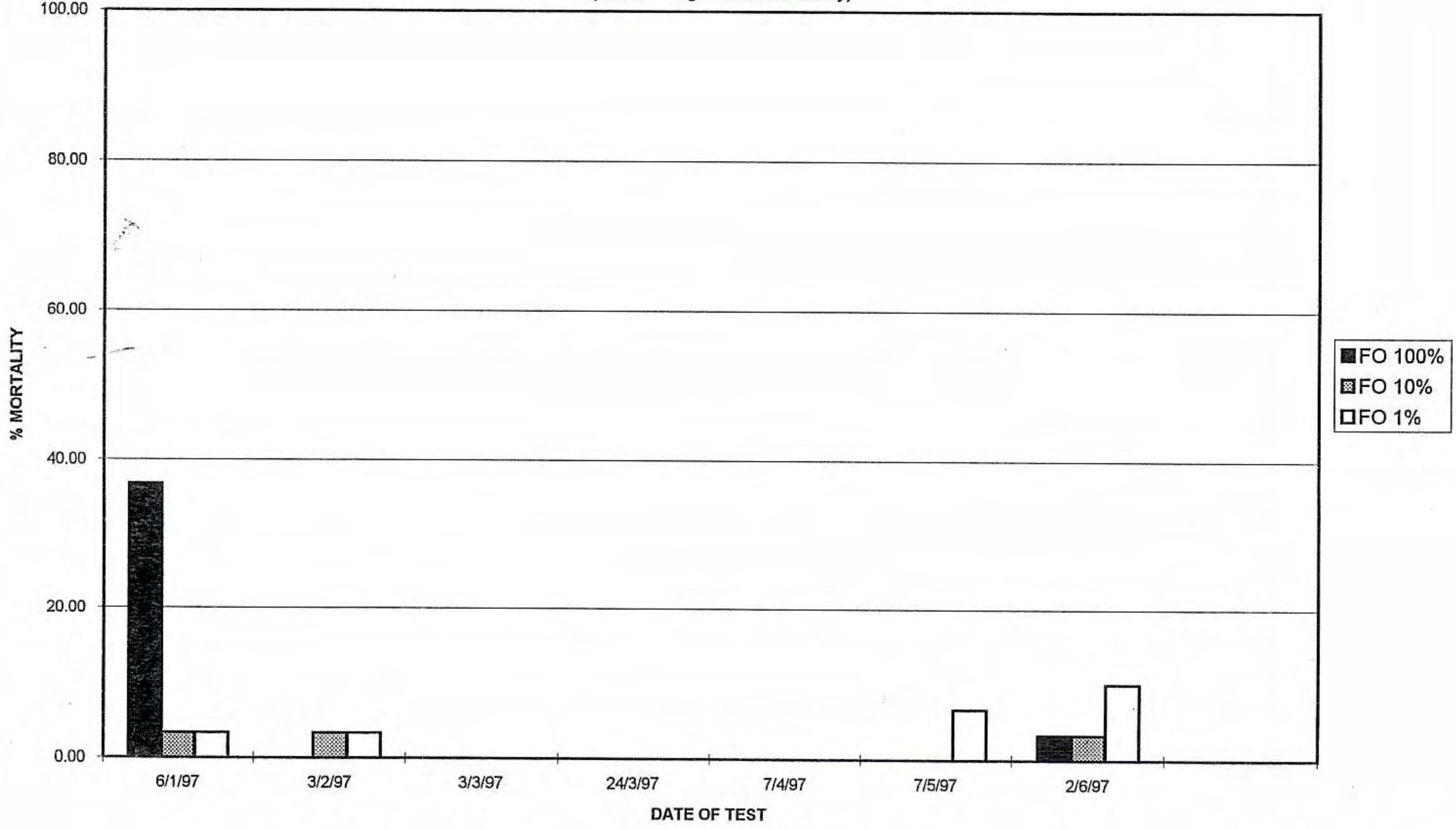


Figure 1b: Daphnia 48 hour EC50 - 4 Day Pond
(>20% = significant mortality)

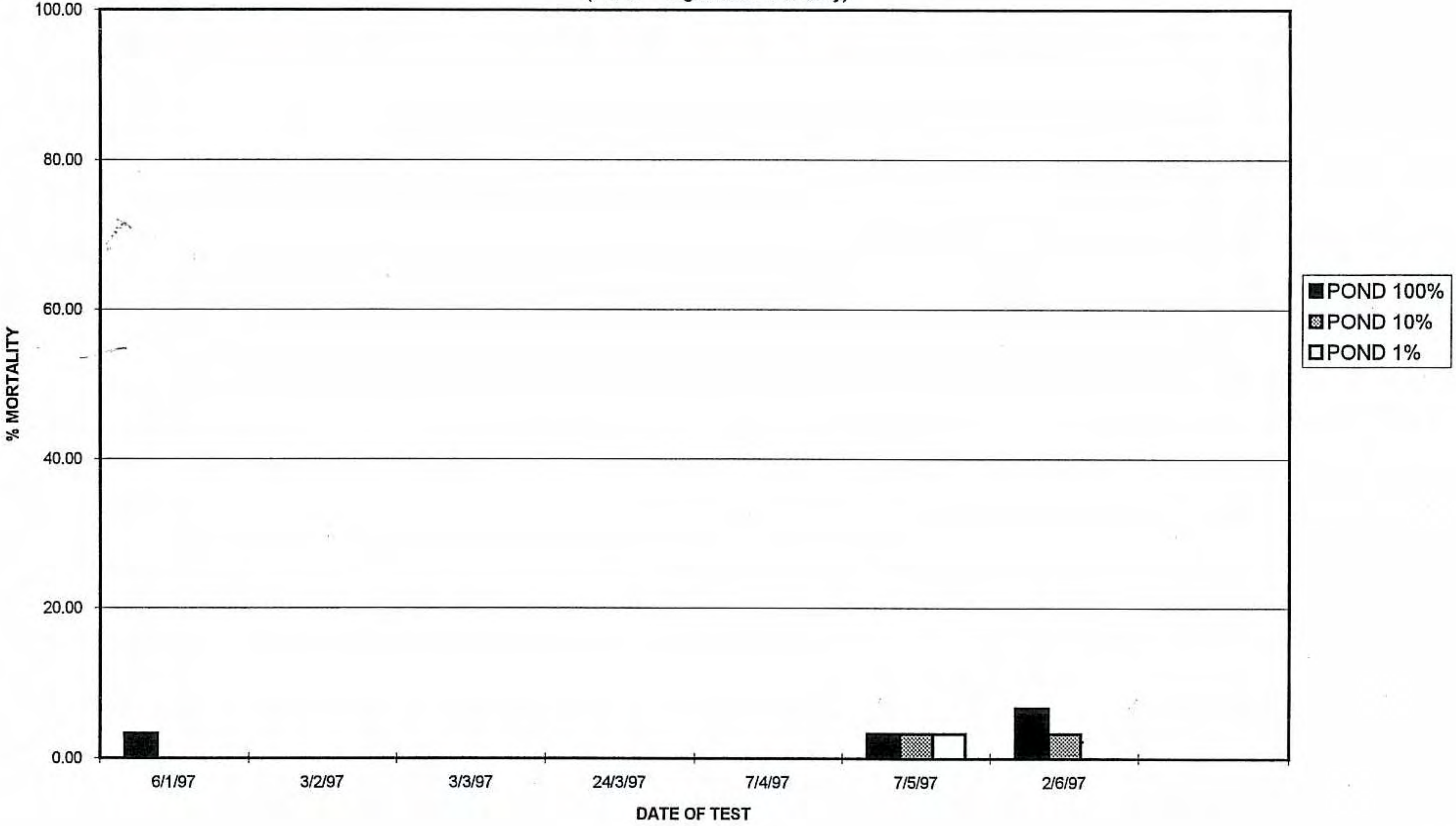


Figure 1c: Daphnia 48 hour EC50 - Pond Inlet
(>20% = significant mortality)

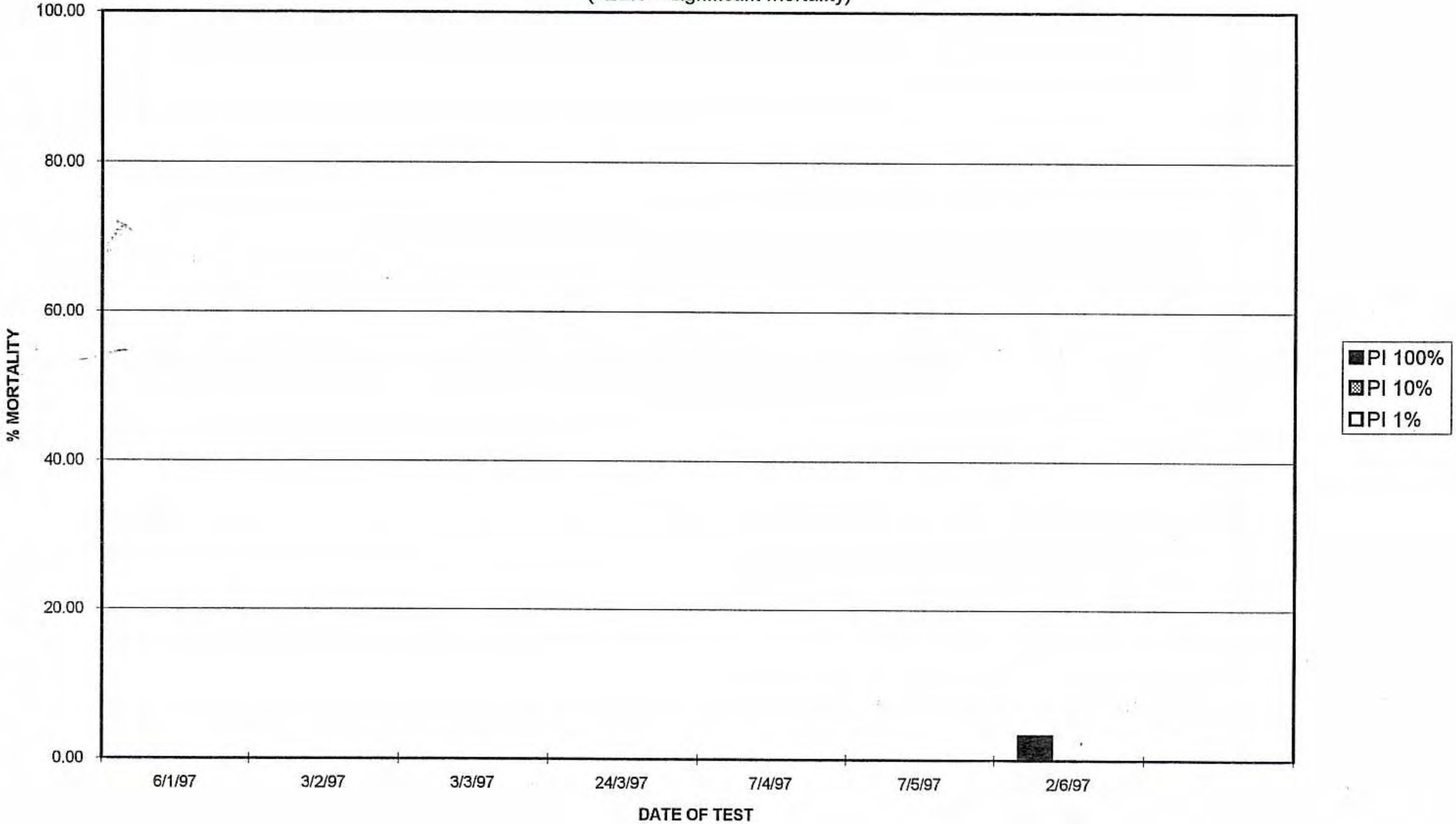


Figure 2: Chronic toxicity results for four Daphnia tests exposed to three concentrations of three types of ANM wastewater during 1996. Where the mean number of young produced by the animals in each treatment is compared, using "t-tests" with the control. A "t" value greater than ±2.1 is considered a significant difference, the +ve exceedences indicate a reduction and the -ve exceedence indicates an increase in the abundance of young produced.

Figure 2: Daphnia 21 Day Chronic Toxicity Test - Statistical Significance of Young Production, (t-test results where > +/- 2.1 is significant)

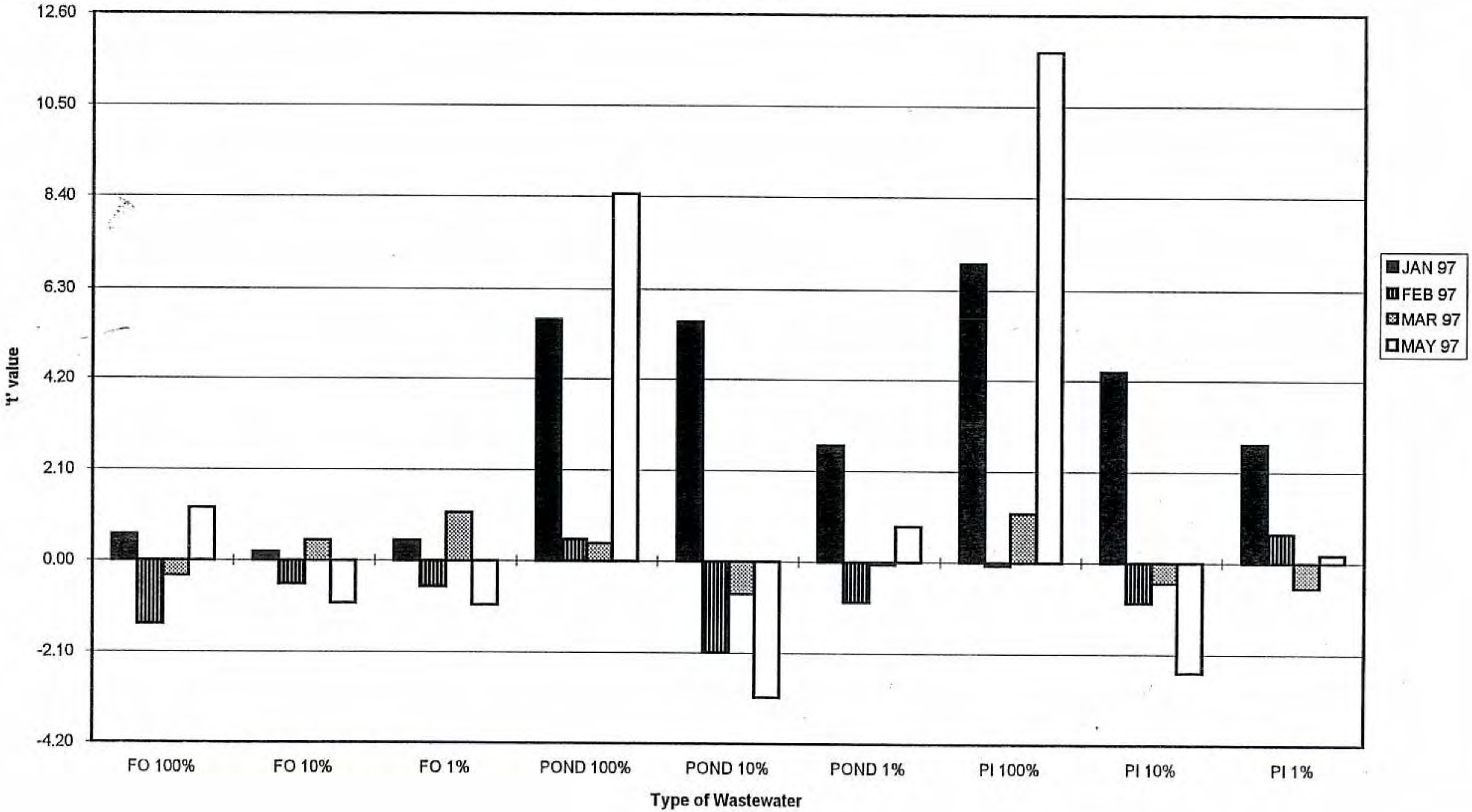
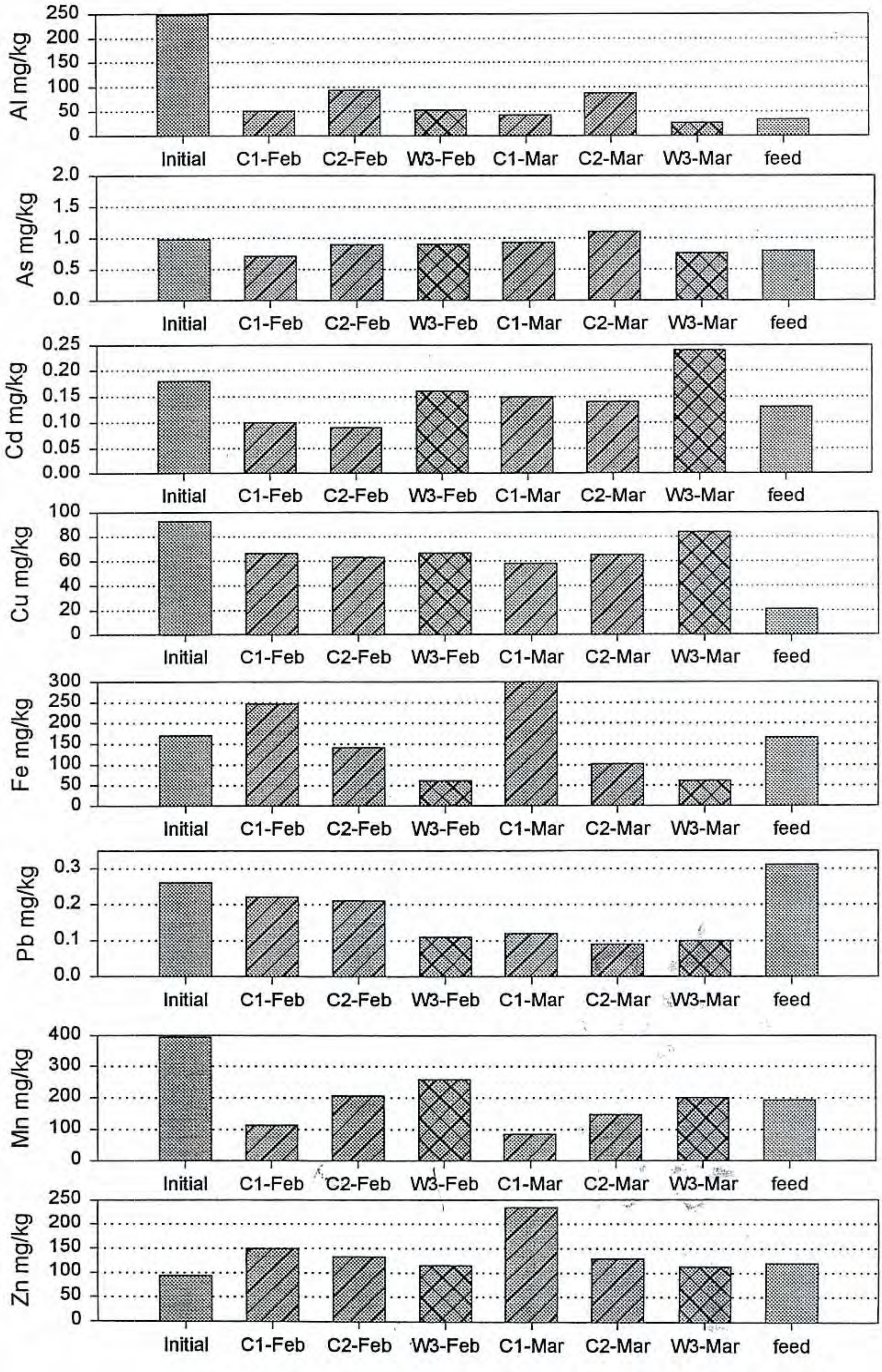


Figure 3a-h: Metals Bioaccumulation in Yabbies - Al, As, Cd, Cu, Fe, Pb, Mn and Zn (C=control, W=wastewater)



Figures 4a-h: Distribution of Metals in Shell, Muscle and Viscera of Yabbies
Al, As, Cd, Cu, Fe, Pb, Mn and Zn (C=control, W=wastewater)

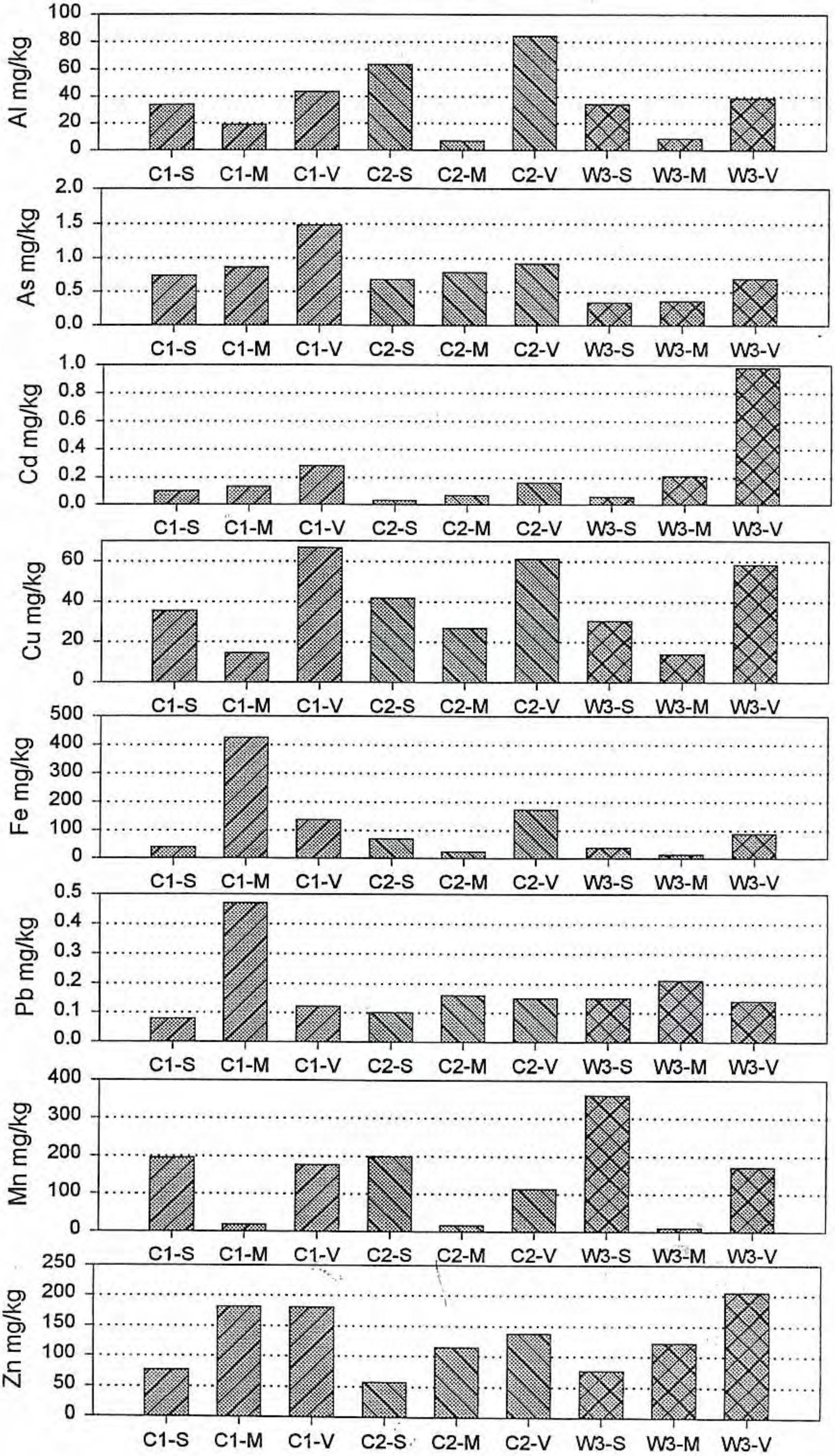


Figure 5a-h: Metals Bioaccumulation in Carp Gudgeon Al, As, Cd, Cu, Fe, Pb, Mn and Zn (C=control, W=wastewater)

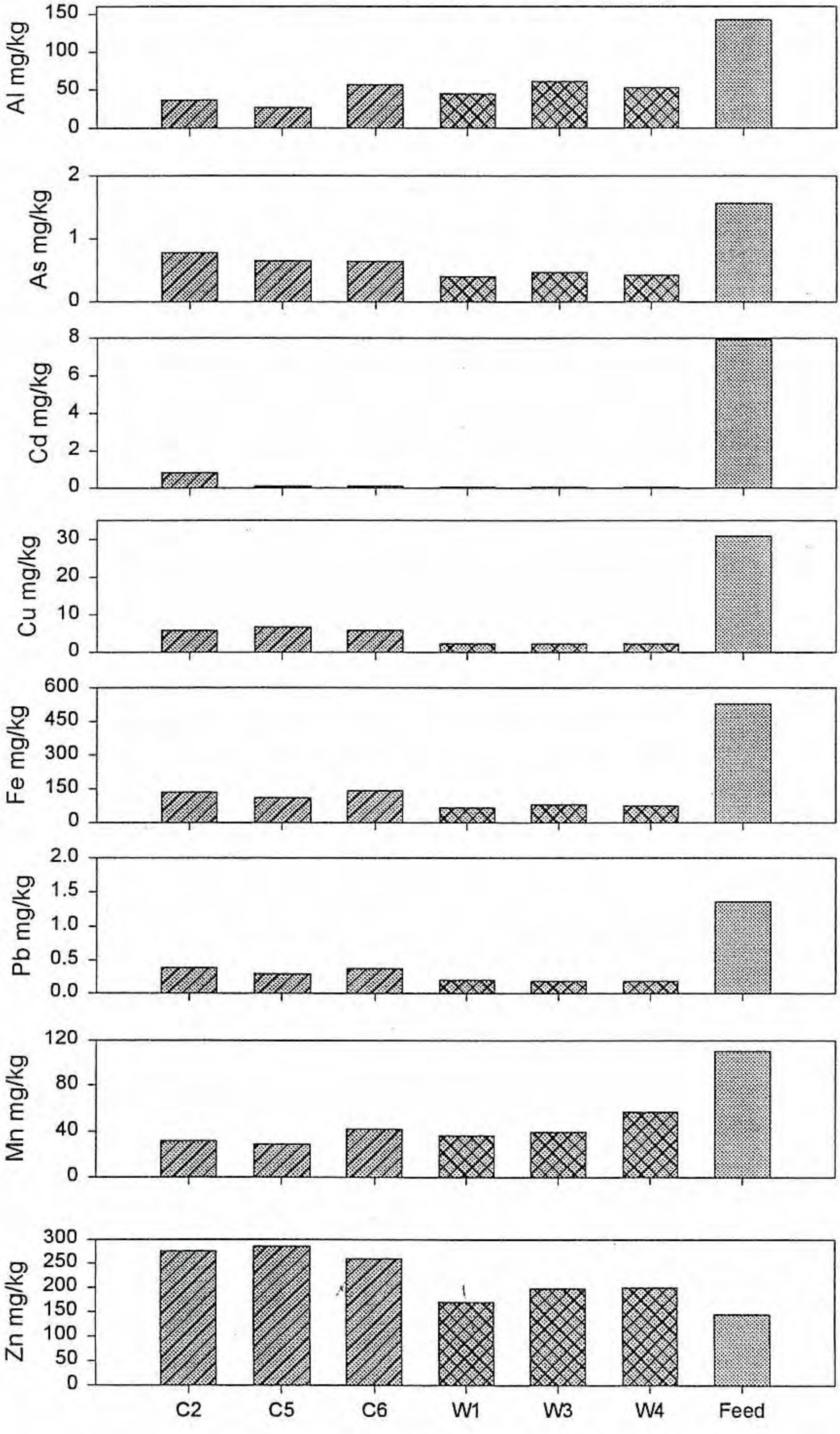


Figure 6 : Box Plots of Manganese Extracted from Artificial Substrates Exposed to River Murray Control Water and ANM 4-Day Holding Pond Wastewater Treatments - solid line = median values and dashed line = mean values (where Treatment 1 = Control 1.2m, 2 = Control 1.8m, 3 = Wastewater 1.2m and 4 = Wastewater 1.8m)

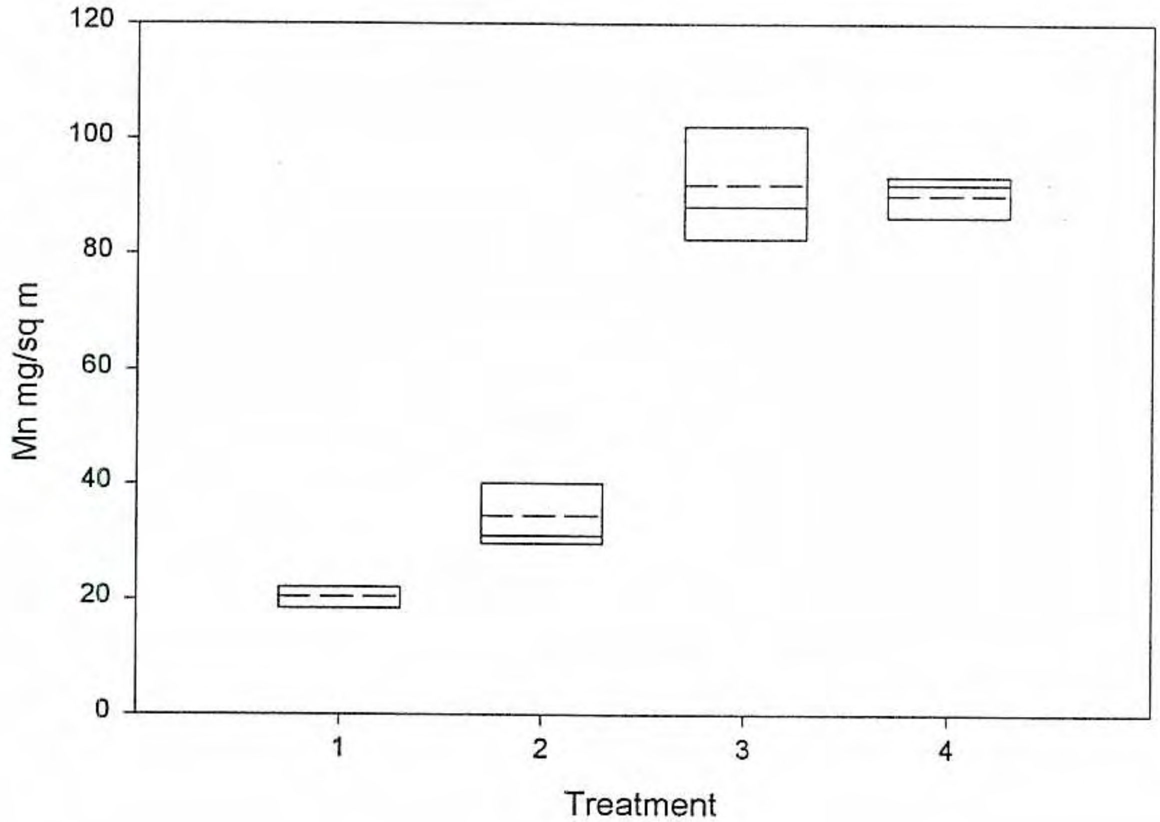
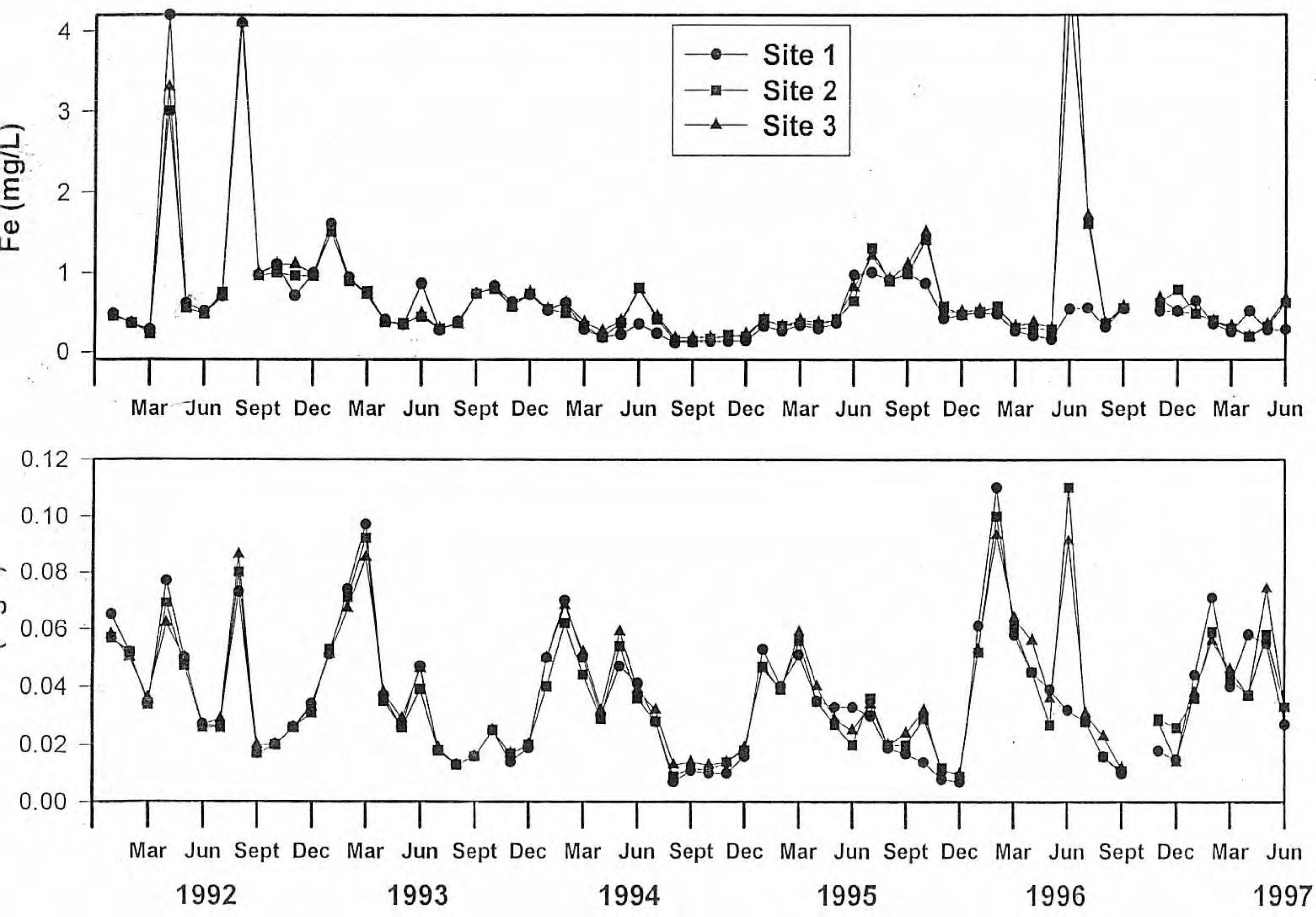
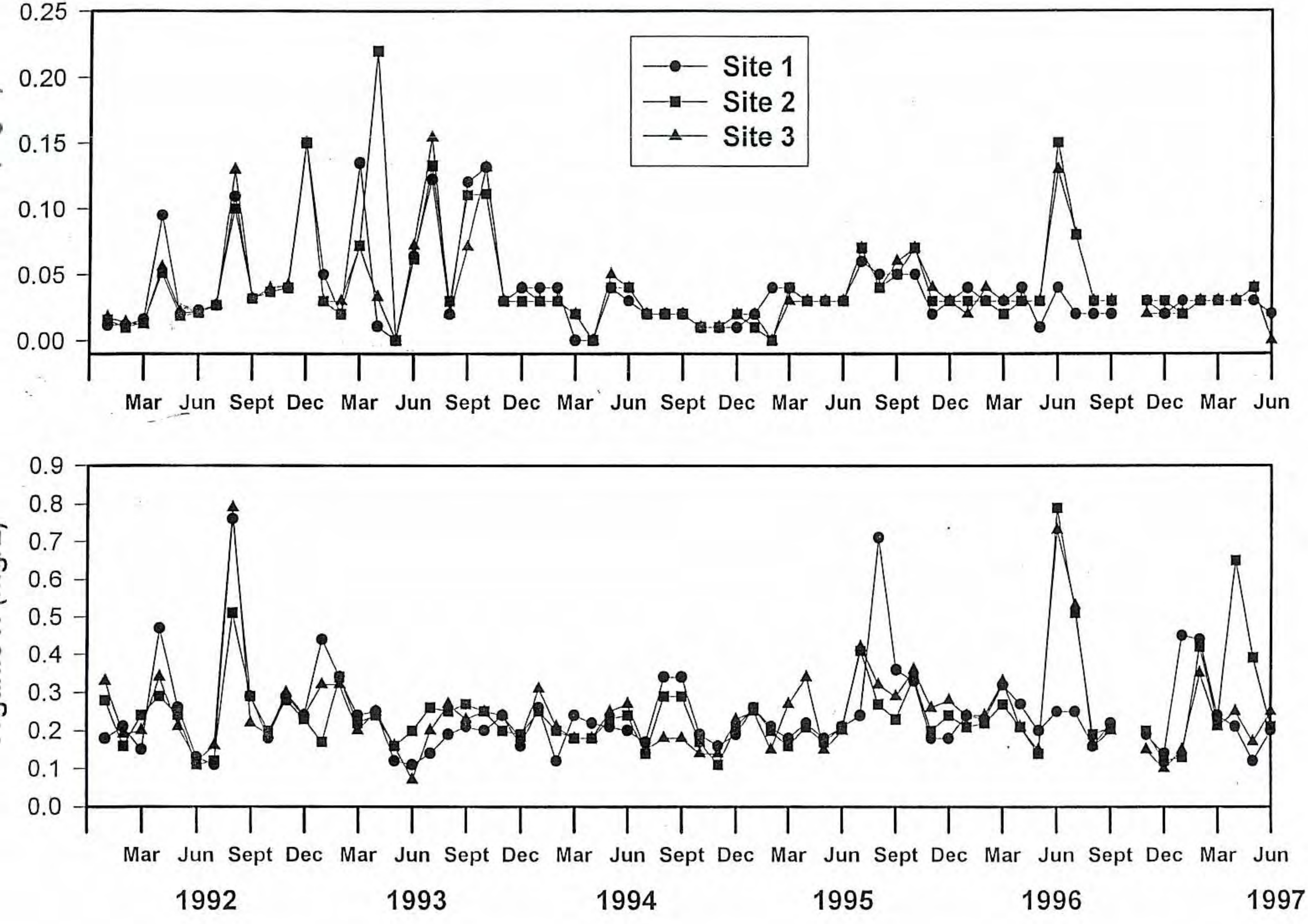
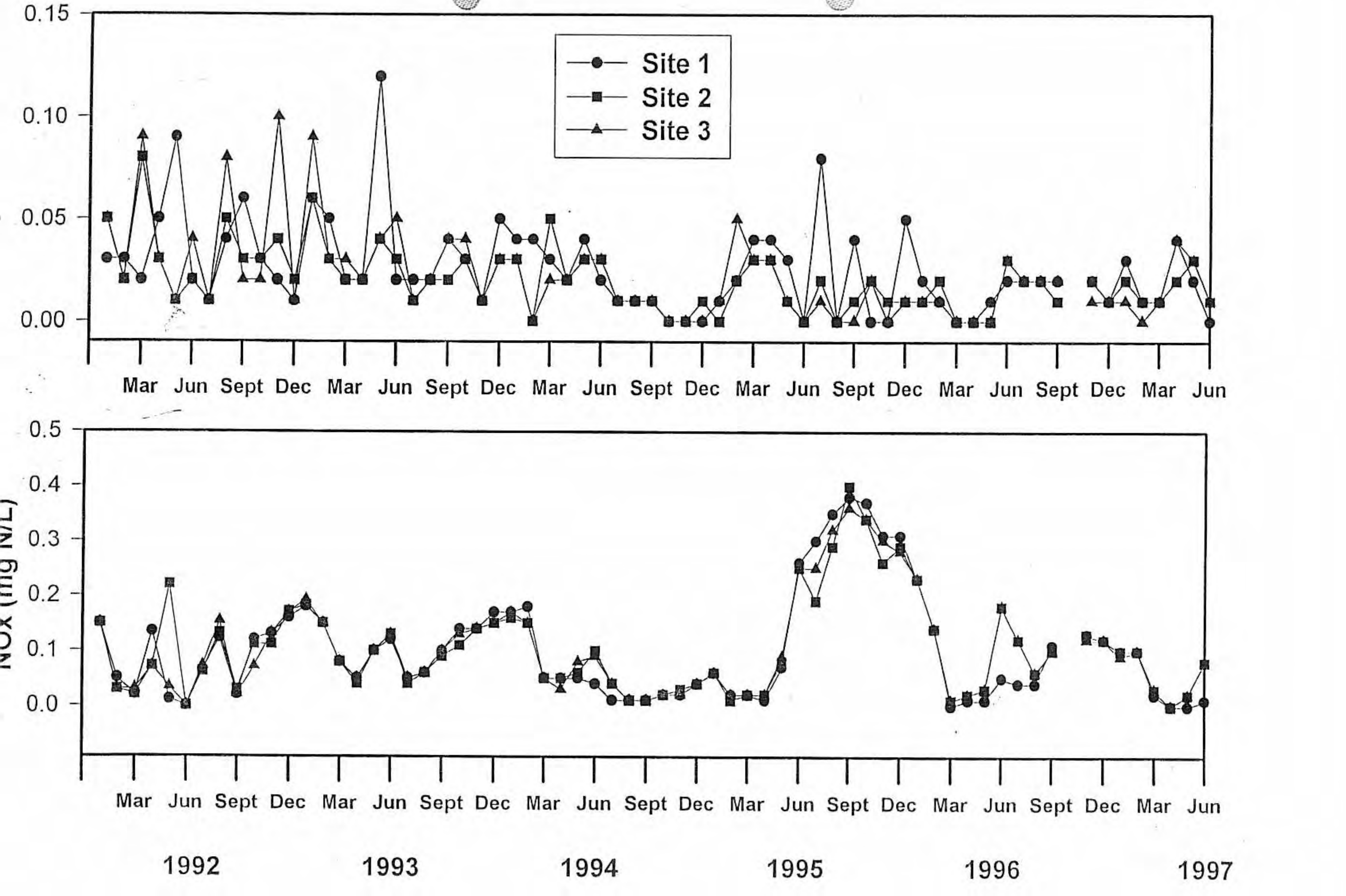


Figure 7: A summary of the water quality data for 1992 to 1996. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.)

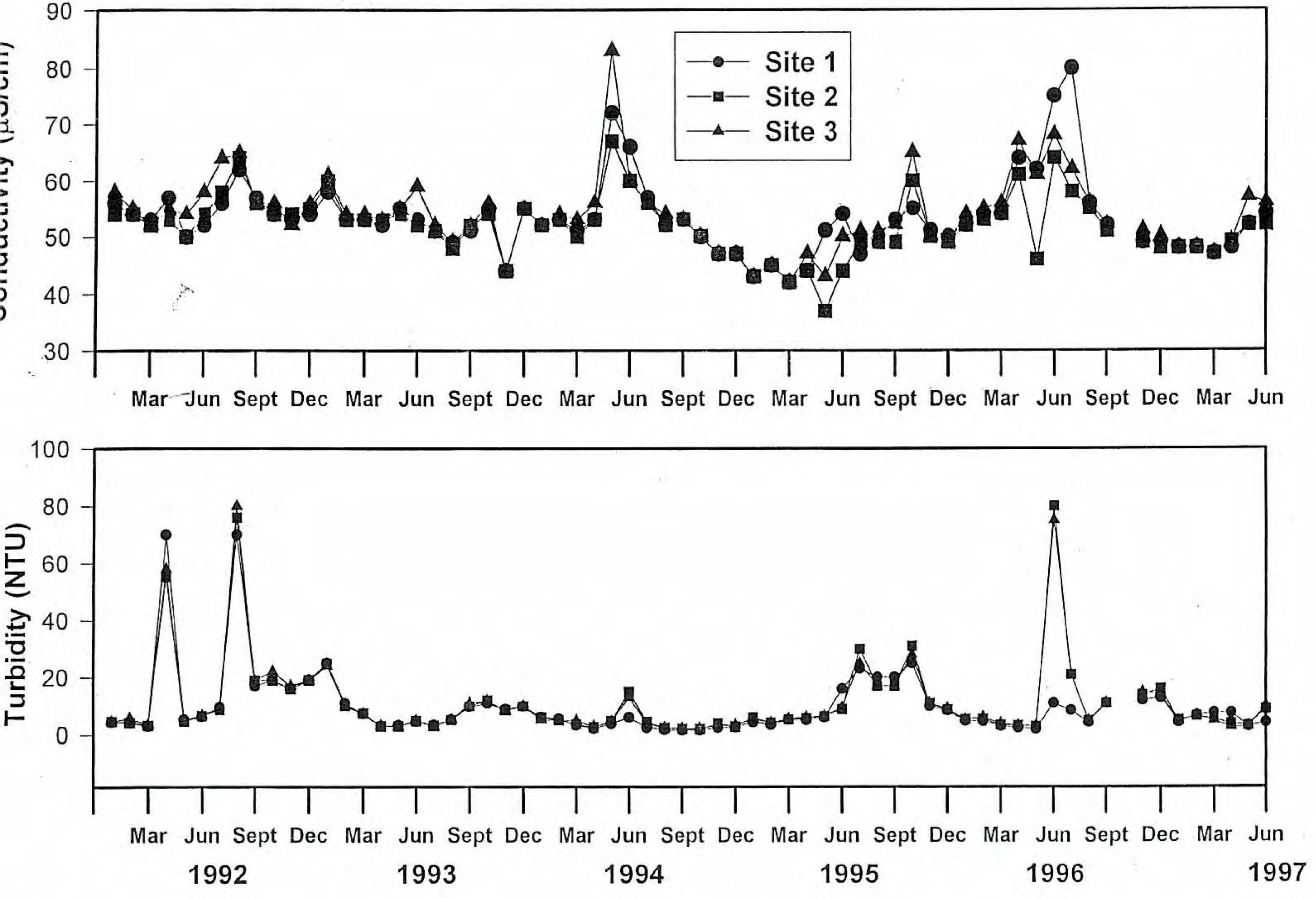

Site 1
Site 2
Site 3
Fe (mg/L)
0
1
2
3
4
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
1992
1993
1994
1995
1996
1997

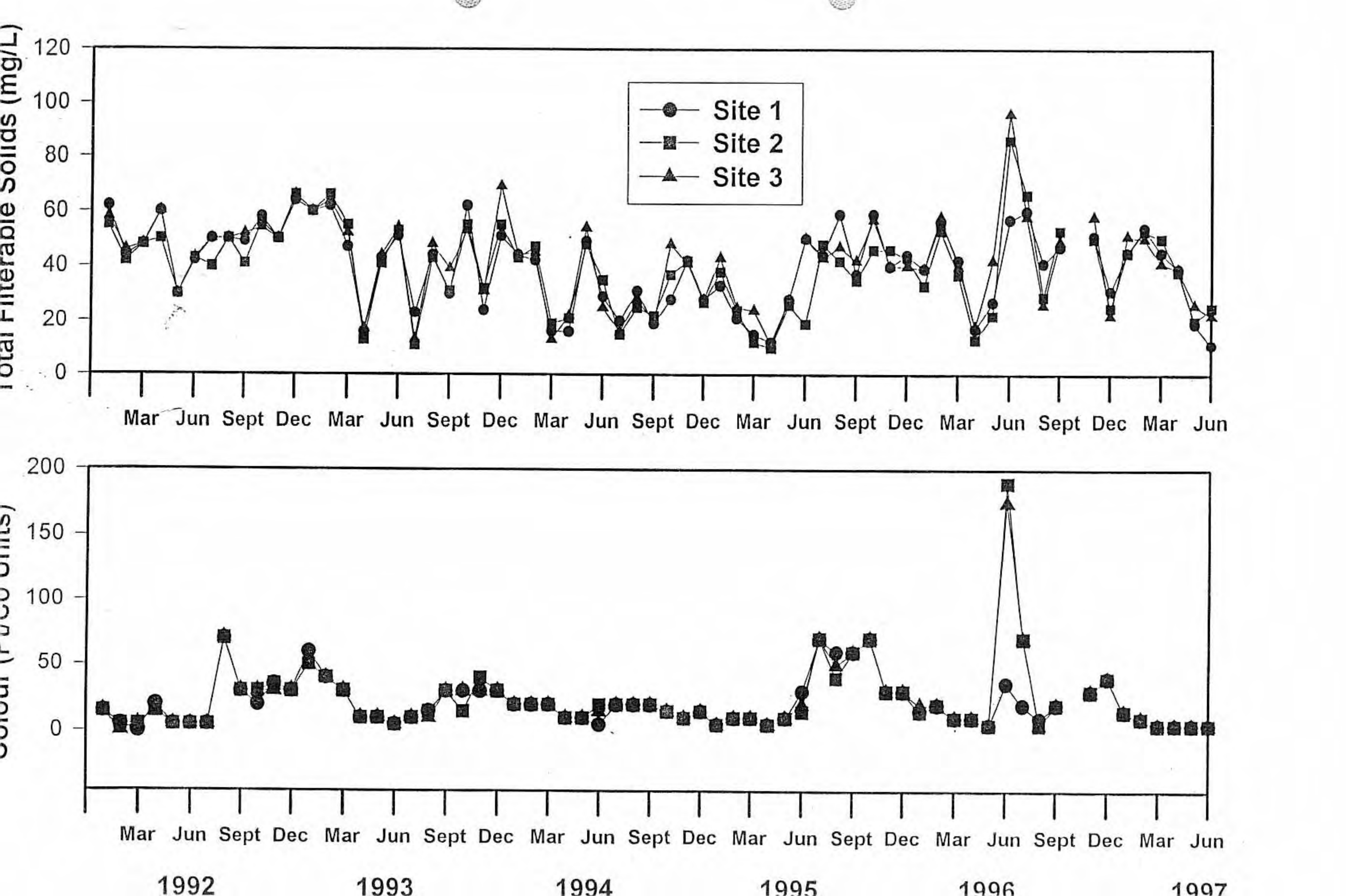


Site 1
Site 2
Site 3
0.25
0.20
0.15
0.10
0.05
0.00
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
1992
1993
1994
1995
1996
1997



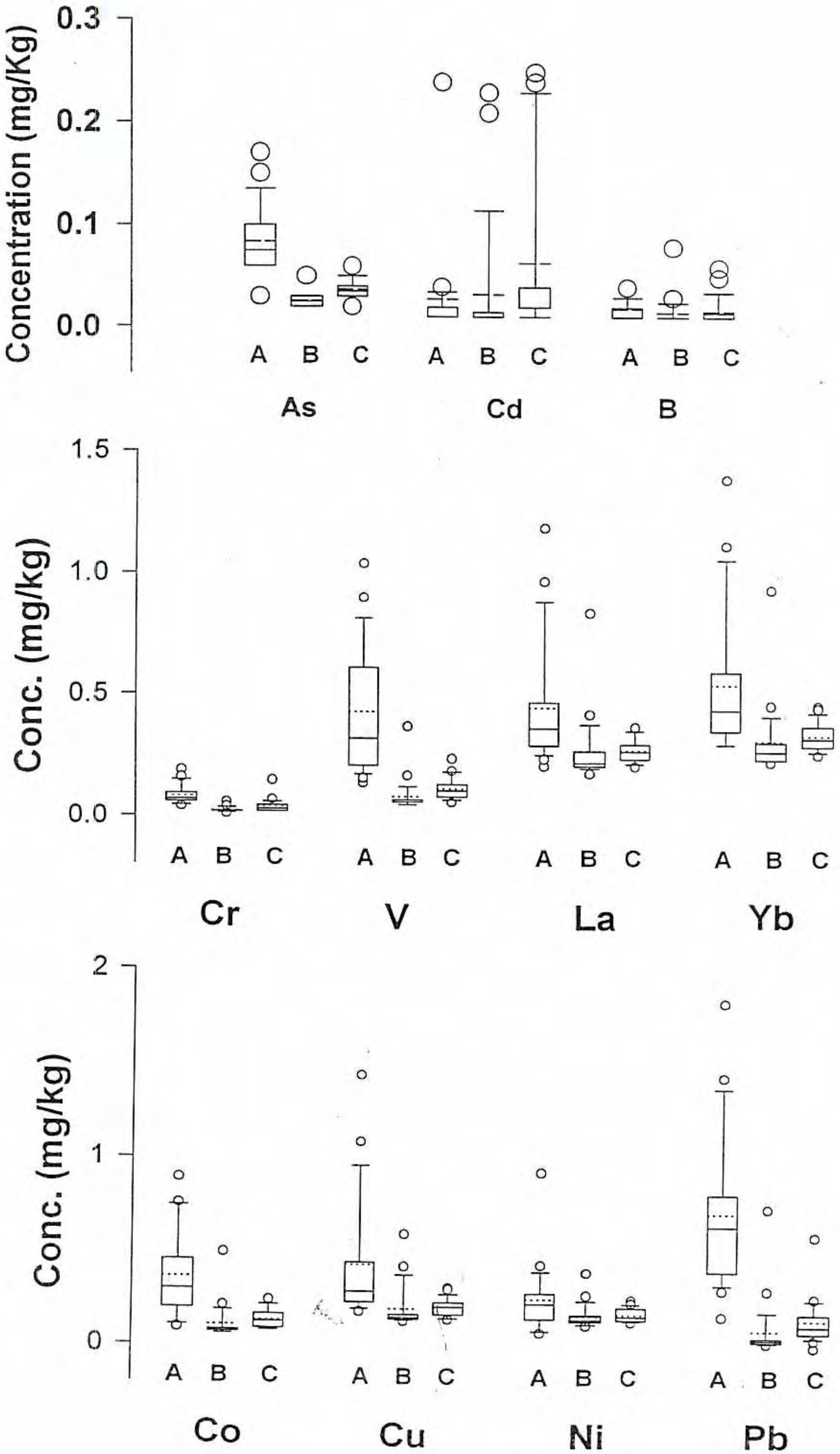
Site 1
Site 2
Site 3
0.15
0.10
0.05
0.00
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
NOx (mg N/L)
0.5
0.4
0.3
0.2
0.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
1992
1993
1994
1995
1996
1997


Conductivity (µS/cm)
90
80
70
60
50
40
30
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
Turbidity (NTU)
100
80
60
40
20
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
1992
1993
1994
1995
1996
1997

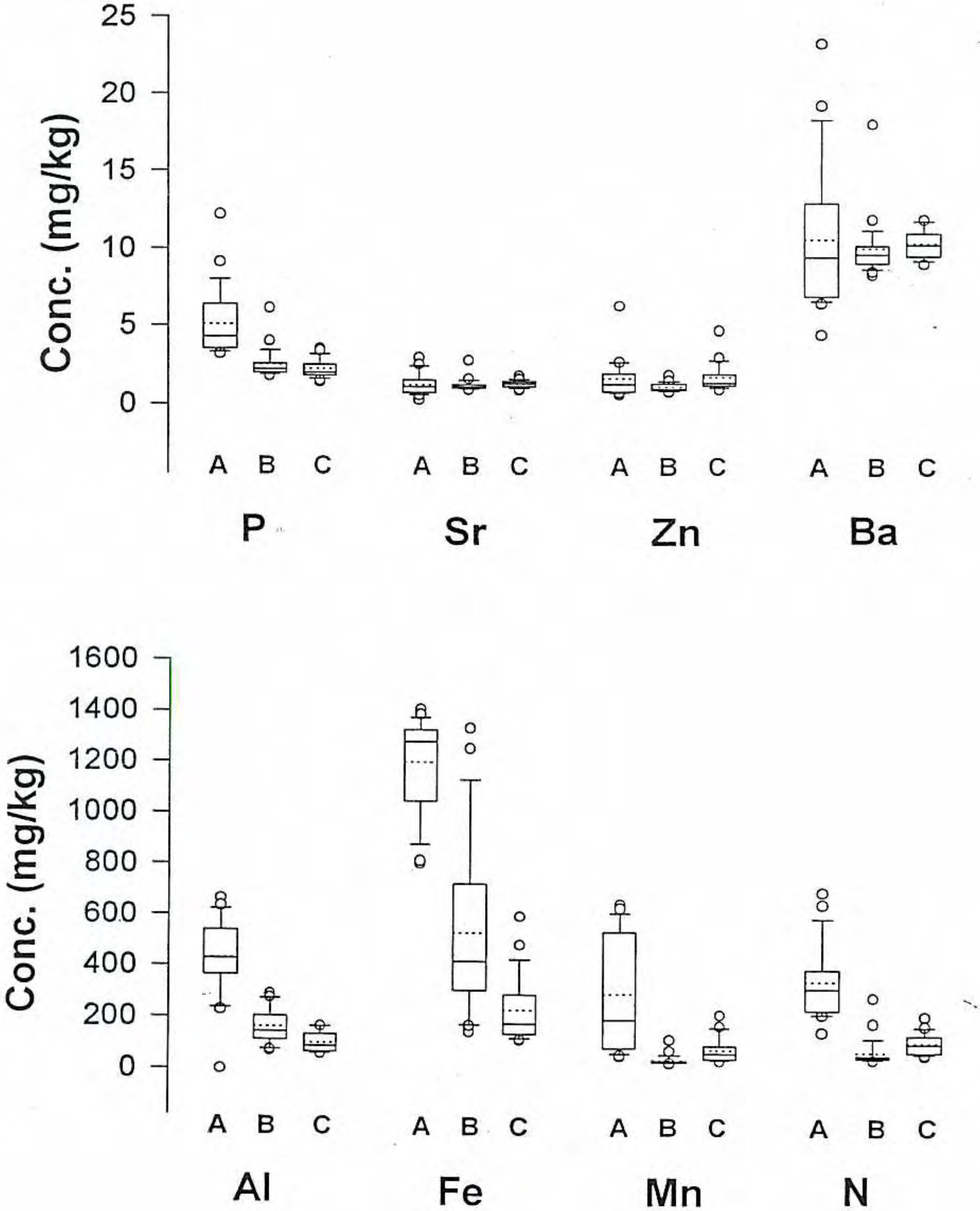


Total Filterable Solids (mg/L)
120
100
80
60
40
20
0
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
Colour (Pt/Co Units)
200
150
100
50
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun
1992
1993
1994
1995
1996
1997

Figure 8: Box plots for the distribution of elements from deposition sites A (Doctor's Point), B (directly above the outfall) and C (directly beneath the outfall).



Concentration (mg/Kg)
0.3
0.2
0.1
0.0
A B C A B C A B C
As Cd B
Conc. (mg/kg)
1.5
1.0
0.5
0.0
A B C A B C A B C A B C
Cr V La Yb
Conc. (mg/kg)
2
1
0
A B C A B C A B C A B C
Co Cu Ni Pb



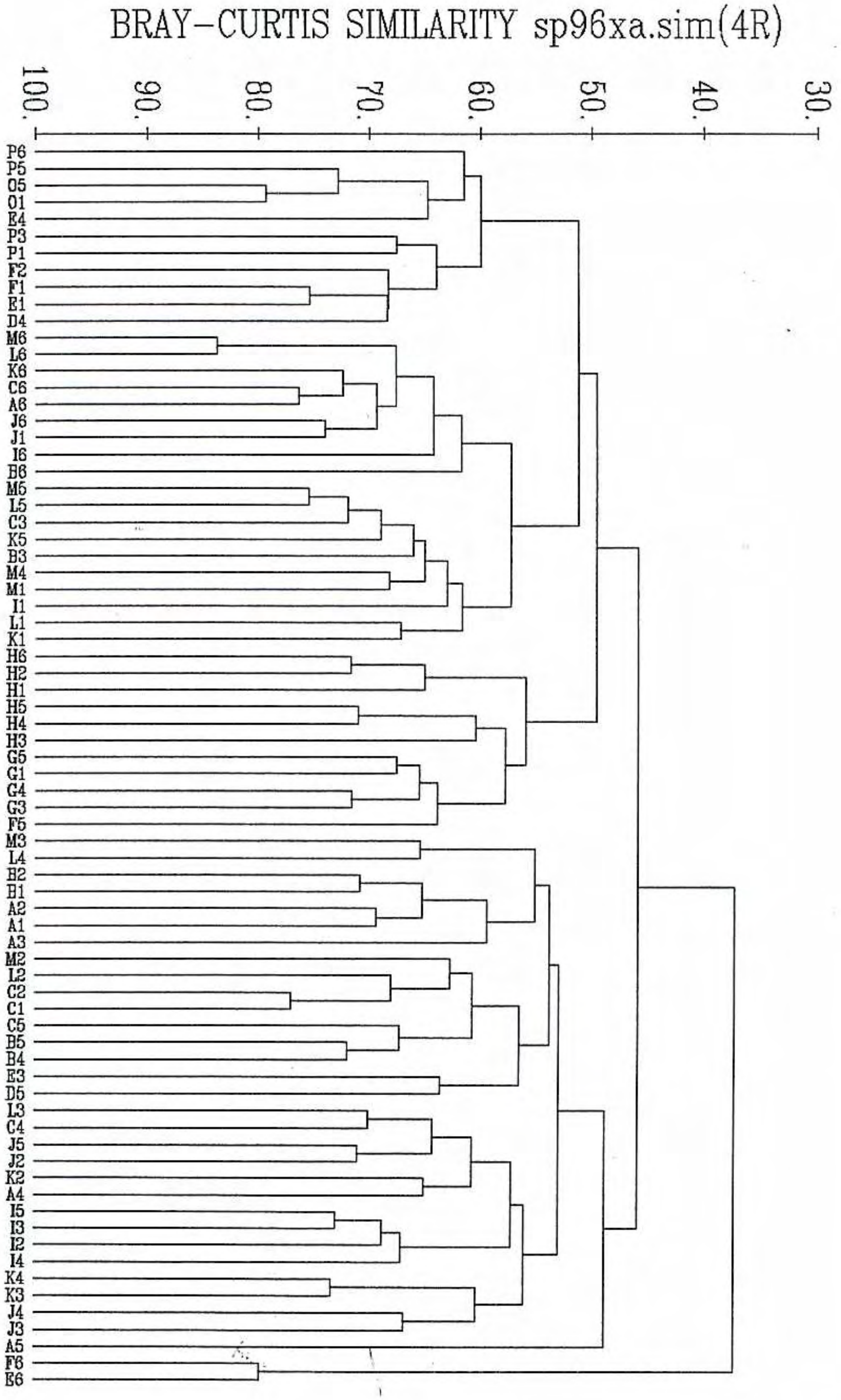
Conc. (mg/kg)
25
20
15
10
5
0
A B C
P
A B C
Sr
A B C
Zn
A B C
Ba
Conc. (mg/kg)
1600
1400
1200
1000
800
600
400
200
0
A B C
Al
A B C
Fe
A B C
Mn
A B C
N

Figure 9: Dissimilarity classification dendogram of ANM river monitoring sites using macroinvertebrate species abundance for 1995. Where:

Sites 1 and 2 = 'downstream' - 2km below the discharge

Sites 3 and 4 = 'mixing zone' - immediately downstream of discharge

Sites 5 and 6 = 'control' - upstream of the discharge.



BRAY-CURTIS SIMILARITY sp96xa.sim(4R)
100.
90.
80.
70.
60.
50.
40.
30.
P6
P5
O5
O1
E4
P3
P1
F2
F1
E1
D4
M6
L6
K6
C6
A6
J6
J1
I6
B6
M5
L5
C3
K5
B3
M4
M1
I1
L1
K1
H6
H2
H1
H5
H4
H3
G5
G1
G4
G3
F5
M3
L4
B2
B1
A2
A1
A3
M2
L2
C2
C1
C5
B5
B4
E3
D5
L3
C4
J5
J2
K2
A4
I5
I3
I2
I4
K4
K3
J4
J3
A5
F6
E6

Figure 10: River Murray Benthic Macroinvertebrate MDS 1996/97 - Location Relative to ANM's Wastewater Discharge
Where; Upstream, Mixing zone and Downstream
Stress =0 .19, Anosim: R = 0.174 α = 0.001

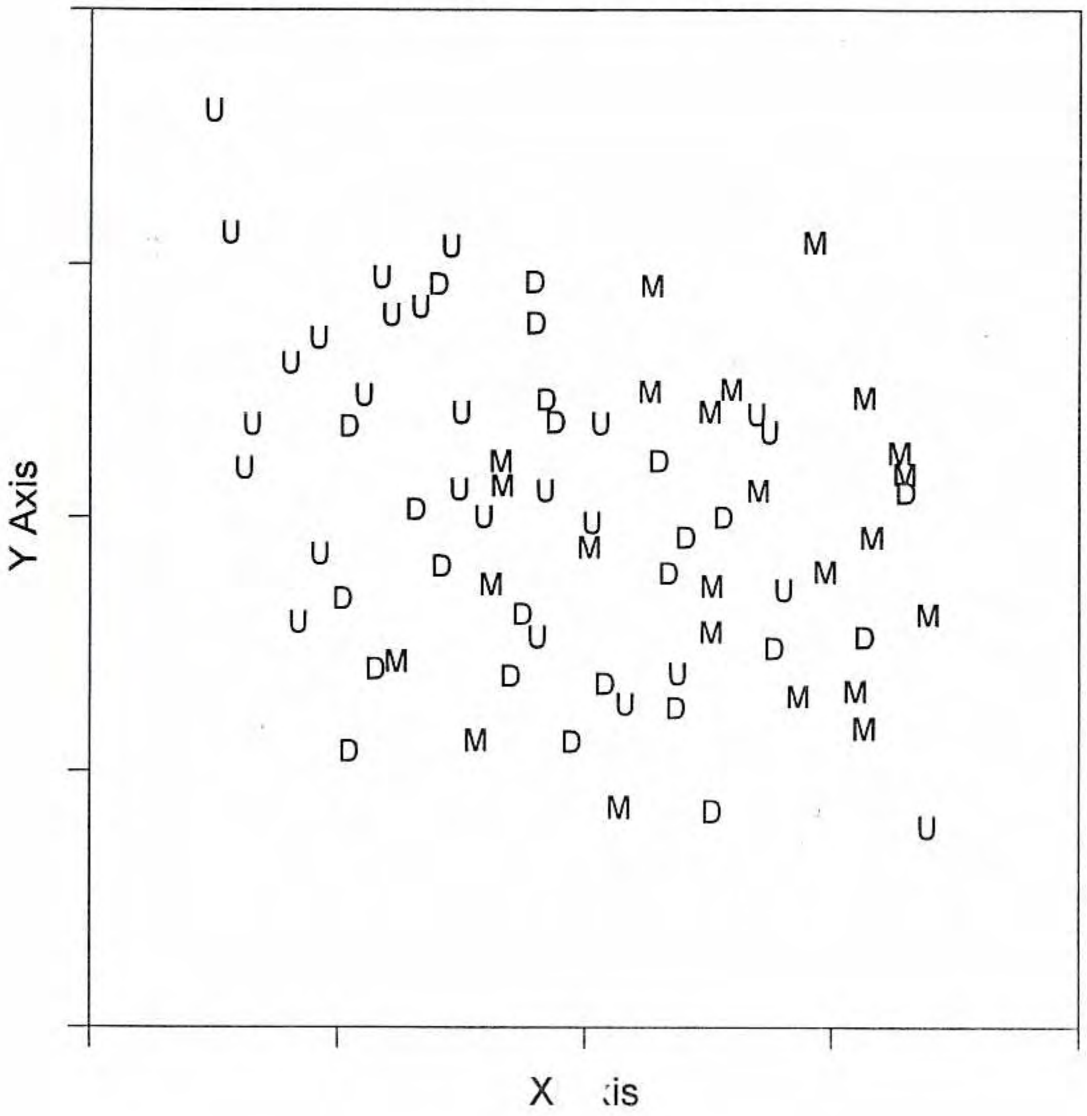


Figure 11: River Murray Benthic Macroinvertebrate MDS 1996/97 - Season
Where; Summer, Autumn, Winter and sPring
Stress = 0.19, Anosim: R = 0.714, α = 0.001

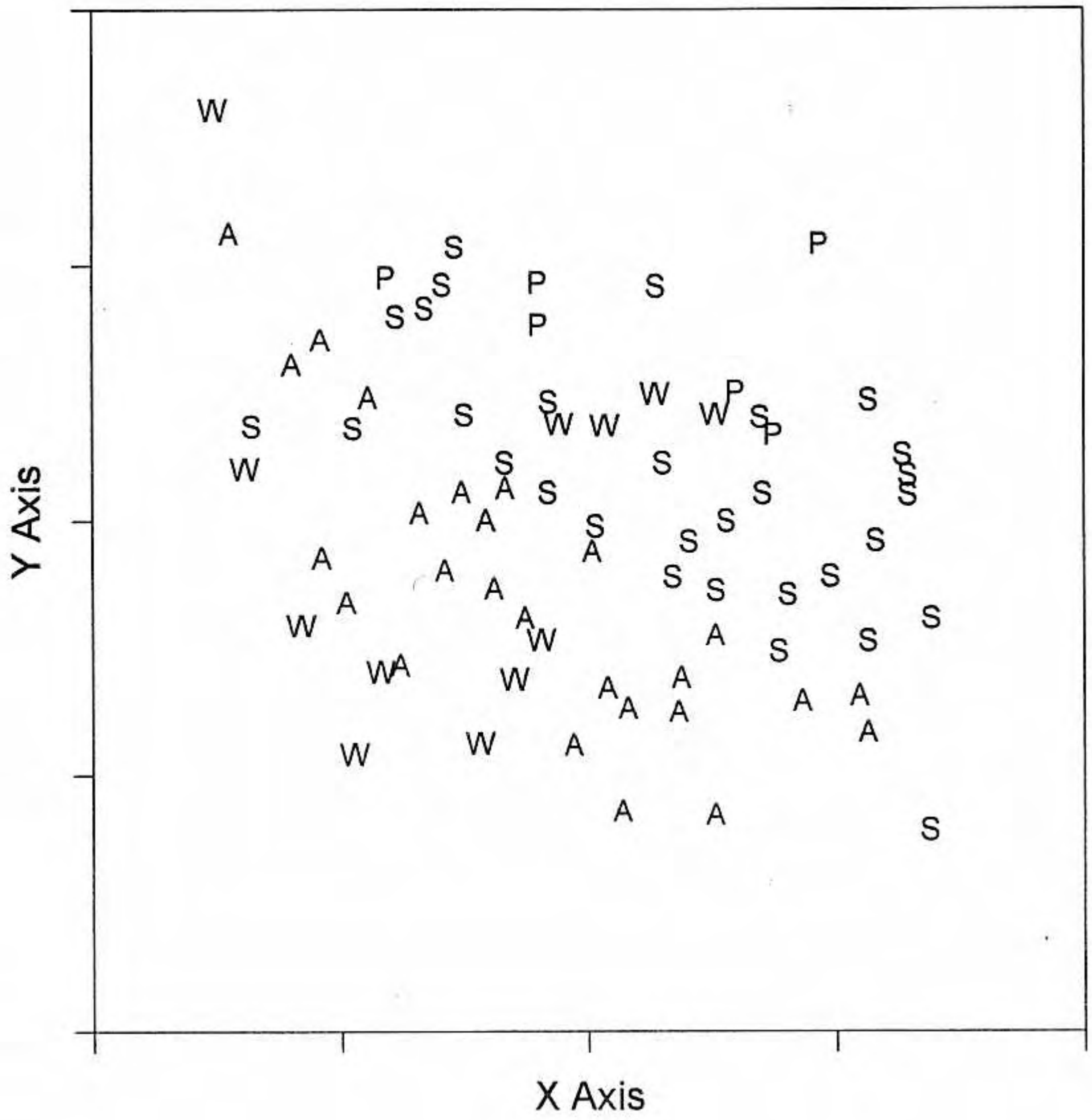


Figure 12: ANM's Final Outfall Discharge to Murray River, Conductivity 1996 - 1997

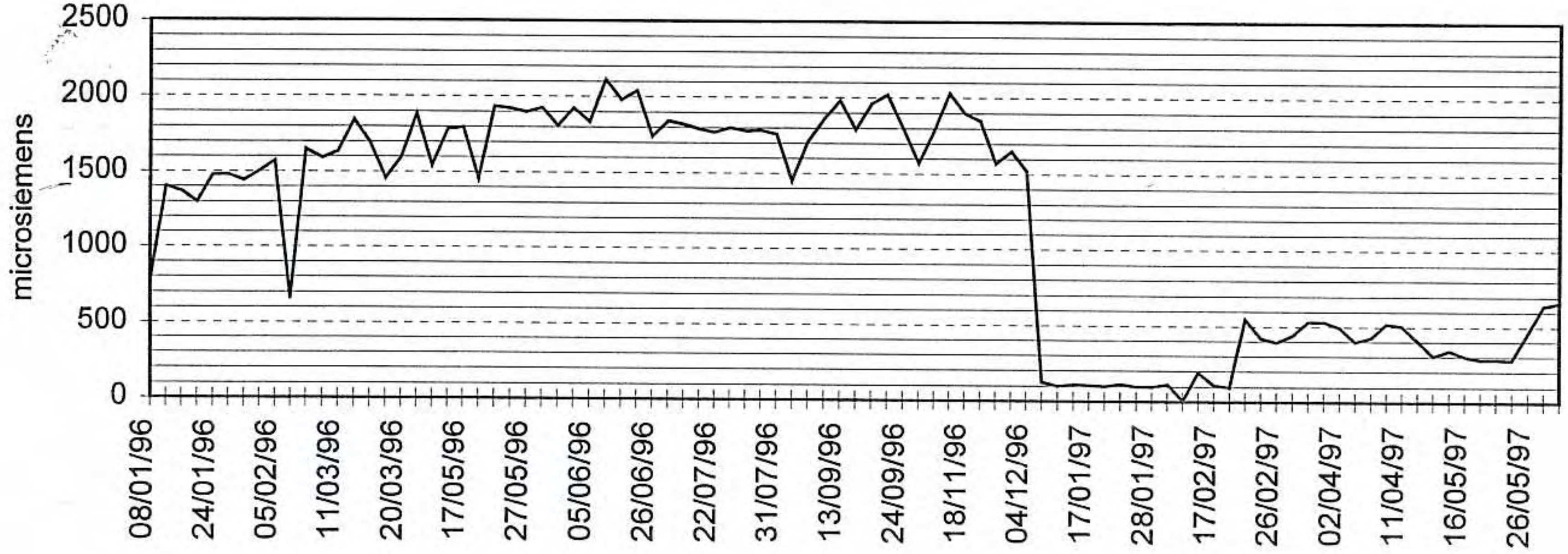


Figure 13: River Murray Benthic Macroinvertebrate MDS 1996/97

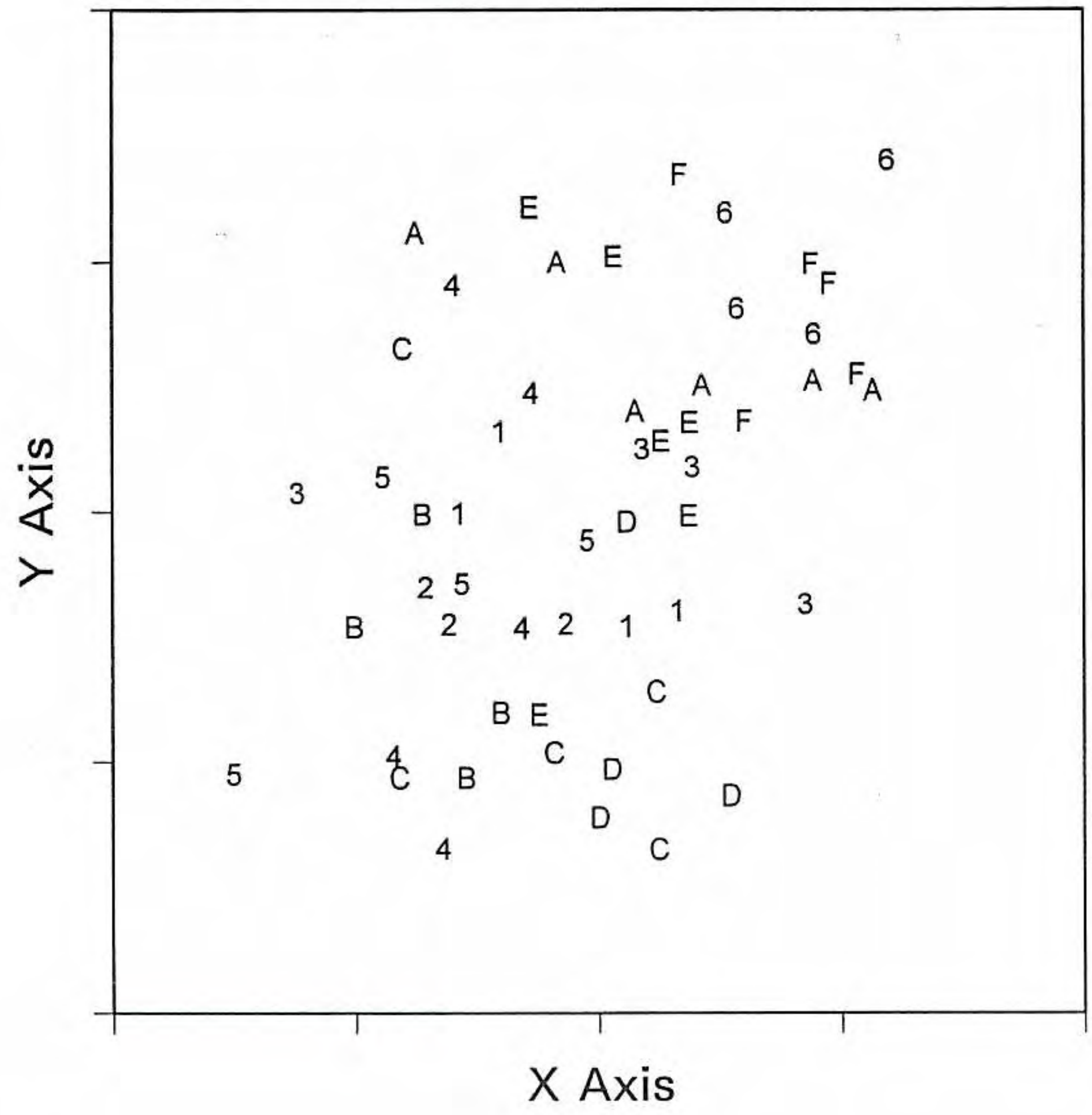
Pre and Post Changes to ANM's Wastewater Discharge

Where 1-6 = downstream to upstream sites prior to changes (Jan - Jun 1996)

and A-F = downstream to upstream sites post changes (Jan - Jun 1997).

Stress = 0.16   Anosim: Control R = 0.381, α = 0.040;

Mixing zone R = 0.350, α = 0.004; Downstream R = 0.019, α = 0.33



APPENDIX 2 (Tables)

Table 1: 1996/7 macroinvertebrate species list and abundance data for three replicate samplers at the six paired ANM river monitoring sites:

Sites 1 and 2 = 'downstream' - 2km below the discharge

Sites 3 and 4 = 'mixing zone' - immediately downstream of discharge

Sites 5 and 6 = 'control' - upstream of the discharge.

River Environment Monitoring for Australian Newsprint Mills Lt

Macroinvertebrate collections form artificial substrates (rock baskets) set in the River Murray for approximately one month

Data = Total number of indivuals collected from each sampler

Sites 1 & 2 - 1.5 to 2 km below discharge (downstream)

Sites 3 & 4 - 100 to 300 m below discharge (mixing zone)

Sites 5 & 6 - 100 to 300 m above discharge (control)

CLASS	ORDER	SPECIES	SITE	JAN1-1	JAN1-2	JAN1-3	JAN2-1	JAN2-2	JAN2-3	0	JAN3-2	JAN3-3	JAN4-1	JAN4-2	JAN4-3	JAN5-1	JAN5-2	JAN5-3	JAN6-1	JAN6-2	JAN6-3
			DATE	25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96		
		Hydridae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*		1	3	13	24	0	2	0	0	1	0	25	20	25	29	9	0	1	3
Temnocephalida		*Temnocephalid sp*		0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Oligochaete		*Tubificidae sp*		2	3	23	10	9	3	0	1	2	0	5	3	1	6	1	0	0	3
Hirudinea		*Hirudinea sp*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*		0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
		Physa acuta		0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0
		Isidorella sp		0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0
		Gyraulus sp		0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
		Helicorbis sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*		0	0	0	1	0	0	0	1	0	0	27	22	1	2	3	0	0	0
		Unionicola sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*		3	1	3	0	4	0	0	2	0	0	1	0	2	0	2	2	1	9
	Amphipoda	*Amphipoda: Neoniphargidae sp*		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Cherax destructor		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0
		Syncaridae: Koonungidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*		11	13	2	2	0	0	0	22	18	0	3	2	0	0	0	60	17	38
		Chaematopsyche sp.		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	6
		Hydrobiosidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
		Oecetis sp		1	3	1	0	1	1	0	0	0	0	1	5	3	0	1	1	3	1
		Triaenodes sp		3	3	6	9	0	3	0	1	2	0	0	0	1	0	0	0	0	3
		Triplectides australicus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Triplectides volda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Hydroptilidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
		Neboissophlebia sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B		10	10	6	7	14	3	0	12	14	0	0	0	0	1	1	28	11	32
		Caenidae Genus C		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Baetis sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		Coloburiscoides sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*		1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	3	5
		Neumanoperla thoreyi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Odonata	*Austroargiolestes icteromelas*		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Ischnura heterosticta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	SITE	JAN1-1	JAN1-2	JAN1-3	JAN2-1	JAN2-2	JAN2-3	0	JAN3-2	JAN3-3	JAN4-1	JAN4-2	JAN4-3	JAN5-1	JAN5-2	JAN5-3	JAN6-1	JAN6-2	JAN6-3
			DATE	25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96			25 JAN 96		
		Nososticta solida		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudagrion aureofrons		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		Austroaeschna u unicornis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
		Austrogomphus ochraceus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Cordulephya pygmaea		0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Dytiscidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	23	15	12
		Simulidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5
		Tipulidae sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
		Chironominae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.		0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	3	1	1
		Dicrotendipes sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladopelma sp		3	1	2	0	0	0	0	4	11	0	0	0	0	0	0	3	2	1
		Paratanytarsus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp		0	0	0	2	2	0	0	0	3	0	0	1	0	0	0	0	0	1
		Rheotanytarsus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	4
		Riethia sp		8	8	4	4	0	0	0	15	18	0	0	4	0	0	0	11	7	29
		Stenochironomus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp		4	2	6	0	0	1	0	5	6	0	1	5	0	0	0	10	2	8
		Stictocladius sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp		2	10	4	4	2	0	0	6	7	0	6	6	2	1	0	11	2	3
		Djalmabatista sp		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Larsia sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp		1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
		Apsectrotanypus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
		Nanocladius sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Parakiefferiella sp		1	1	1	2	1	0	0	1	2	0	0	0	0	0	0	2	4	5
		Rheocricotopus sp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0
		Stictochironomus sp		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae		3	3	0	0	0	0	0	2	5	0	0	0	0	0	0	10	4	2
		TOTAL	TOT	54	62	74	66	37	18	0	76	93	0	77	72	36	44	20	190	89	182

			27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96		
CLASS	ORDER	SPECIES	FEB1-1	FEB1-2	FEB1-3	FEB2-1	FEB2-2	FEB2-3	FEB3-1	FEB3-2	FEB3-3	FEB4-1	FEB4-2	FEB4-3	FEB5-1	FEB5-2	FEB5-3	FEB6-1	FEB6-2	FEB6-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	4	11	4	9	1	12	1	5	4	18	27	21	4	30	16	8	5	5
Temnocephalida		*Temnocephalid sp*	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	4	13	6	8	22	12	5	1	12	5	1	8	0	3	4	5	2	5
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0
		Gyraulus sp	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	1	0	0	1	0	0	3	13	3	0	3	1	0	0	0
		Unionicola sp	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tertarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	1	1	1	1	0	1	0	0	1	0	1	0	6	4	4	5	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	10	1	0	8	4	13	39	48	42	1	3	2	1	3	9	43	89	96
		Chaematopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	58	24	22
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2
		Oecetis sp	1	0	2	4	4	3	11	13	17	3	7	2	0	8	5	13	15	18
		Triaenodes sp	1	3	0	0	0	3	2	2	3	1	0	0	0	2	1	5	9	1
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	5	3
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	40	20	13	27	20	32	65	81	115	6	8	5	9	9	10	175	159	132
		Caenidae Genus C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	1	0	1	2	2	0	0	2	1	1	1	9	17	6
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	0	0	0	0	0	1	1	2	4	4	0	0	1	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96			27 FEB 96		
			FEB1-1	FEB1-2	FEB1-3	FEB2-1	FEB2-2	FEB2-3	FEB3-1	FEB3-2	FEB3-3	FEB4-1	FEB4-2	FEB4-3	FEB5-1	FEB5-2	FEB5-3	FEB6-1	FEB6-2	FEB6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	0
		Austroaeschna u unicornis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	2	1	1	0	0	0	0	1	1	15	10	4
		Simuliidae sp	0	0	0	0	0	0	0	0	0	1	0	0	0	1	5	6	27	8
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	2	0	1	0	0	1	0	0	0	0	0
		Parachironomus sp	4	1	2	10	0	3	6	7	7	5	5	4	1	2	5	0	0	0
		Paracladopelma sp	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	2	0	0	0	0	1	0	1	0	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
		Riethia sp	4	3	0	0	0	0	8	11	15	0	0	0	0	0	0	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	4	0	1	1	0	4	30	34	37	0	3	0	2	0	1	0	0	0
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	21	21	24	3	5	17	6	9	8	10	8	14	4	10	10	0	0	0
		Djalmabatista sp	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	1	1	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	0	1	0	0	3	1	1	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	2	1	0	3	0	5	15	13	16	1	0	0	0	1	6	13	14	6
		TOTAL	97	82	57	80	60	110	205	235	286	60	84	69	24	80	89	360	391	312

CLASS	ORDER	SPECIES	MAR1-1	MAR1-2	MAR1-3	MAR2-1	MAR2-2	MAR2-3	MAR3-1	MAR3-2	MAR3-3	MAR4-1	MAR4-2	MAR4-3	MAR5-1	MAR5-2	MAR5-3	MAR6-1	MAR6-2	MAR6-3
			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96		
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	4	3	17	13	13	5	2	1	4	13	12	6	15	11	14	11	11	8
Temnocephalida		*Temnocephalid sp*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	6	5	0	8	10	7	3	3	3	8	3	16	6	5	60	6	3	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	1	2	4	2	0	1	0	15	12	114	0	3	3	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	1	0	0	0	1	0	0	0	0	2	6	2	0	1	1
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	1	0	3	0	1	2	0	0	0	0	0	0	0	0	1	1	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	1	9	1	11	0	7	55	14	24	2	0	4	1	1	0	75	87	92
		Chaematopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	117	74	56
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	5	6
		Oecetis sp	2	5	15	9	8	9	9	14	15	2	4	1	1	5	0	33	16	31
		Triaenodes sp	9	3	16	2	9	0	1	0	3	2	0	0	0	1	1	6	6	1
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	2	0	5	0	0	0	2	0	0	0	0	0	0	1	1	2	1	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Caenidae Genus B	15	24	26	12	4	5	20	9	21	1	4	0	7	5	1	72	70	90
		Caenidae Genus C	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	3	4	3
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	6	4	10
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riekoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96			26 MAR 96		
CLASS	ORDER	*SPECIES*	MAR1-1	MAR1-2	MAR1-3	MAR2-1	MAR2-2	MAR2-3	MAR3-1	MAR3-2	MAR3-3	MAR4-1	MAR4-2	MAR4-3	MAR5-1	MAR5-2	MAR5-3	MAR6-1	MAR6-2	MAR6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	1	2	2
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
		Austrogomphus ochraceus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Micronecta annae	0	4	1	1	2	3	1	0	2	0	0	0	1	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	16	6	11
		Simuliidae sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	0	0
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	1	0	2	1	1	9	4	5	0	1	0	1	1	1	2	0	1
		Paracladopelma sp	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	9	11
		Riethia sp	0	0	0	0	0	0	1	2	3	0	0	0	0	0	0	4	7	4
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	1	0	0	0	0	0	13	6	10	0	0	0	0	0	0	13	13	2
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	17	24	21	23	21	9	17	19	20	10	12	7	21	9	1	23	20	39
		Djalmabatista sp	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		Parakiefferiella sp	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	2	2	1
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	1	2	2	0	1	12	4	10	0	2	1	1	1	0	9	7	3
		TOTAL	63	81	113	88	76	53	158	88	125	53	51	155	60	50	87	440	359	377

CLASS	ORDER	SPECIES	23 APR 9	23 APR 96			23 APR 96		
			APR3-1	APR4-1	APR4-2	APR4-3	APR5-1	APR5-2	APR5-3
		Hydridae sp	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	5	52	19	47	14	9	8
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	1	0
Oligochaete		*Tubificidae sp*	30	3	4	0	0	3	13
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	2	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	1	0	0	0	0	0	2
		Physa acuta	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	2	0	0	0	0	0
Arachnida		*Peza ops*	2	1	1	1	8	7	9
		Unionicola sp	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	17	0	0	2	2	1	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	1	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	1	1	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0
		Euastacus armatus	0	0	1	0	2	5	4
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	0	4	3	2	1	0
		Chaematopsyche sp.	0	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0
		Oecetis sp	0	2	15	22	6	9	0
		Triaenodes sp	11	19	15	23	35	60	8
		Triplectides australicus	0	0	0	0	0	1	1
		Triplectides australis	0	0	0	0	2	1	0
		Triplectides volda	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	2	9	2	3
		Hydroptilidae sp	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	0	1	0	0	0	0
		Neboissophlebia sp	0	0	0	0	0	0	0
		Caenidae Genus B	13	18	67	85	52	42	36
		Caenidae Genus C	0	1	3	8	0	0	0
		Baetis sp	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0
		Neumanoperla thoreyi	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	2	7	7	4	9	7	2
		Ischnura heterosticta	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	23 APR 9	23 APR 96			23 APR 96		
			APR3-1	APR4-1	APR4-2	APR4-3	APR5-1	APR5-2	APR5-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	1	3	2	0	0	0
		Austrogomphus ochraceus	1	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	1	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0
		Micronecta annae	0	4	1	10	1	4	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	1	0
		Gyrinidae sp	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0
		Hydrophilidae sp	0	1	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	1	0
		Simulidae sp	0	0	0	0	0	0	0
		Tipulidae sp	0	0	0	0	0	0	0
		Chironominae	0	0	0	1	0	0	0
		Chironomus sp	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0
		Paracladopelma sp	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0
		Polypedilum sp	0	1	0	0	0	0	0
		Rheotanytarsus sp	0	0	1	0	0	0	0
		Riethia sp	0	0	3	3	1	1	0
		Stenochironomus sp	0	0	0	0	0	0	0
		Tanytarsus sp	0	1	3	1	0	0	0
		Stictocladius sp	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0
		Ablabesmyia sp	2	0	4	12	7	8	4
		Djalmabatista sp	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0
		Cricotopus sp	0	0	1	0	0	0	0
		Nanocladius sp	0	0	2	0	0	0	0
		Orthoclad sp2	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	3	0	1	1	0
		Rheocricotopus sp	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0
		chironomid pupae	0	3	1	4	1	1	1
		TOTAL	85	116	160	231	153	168	91

			21 MAY 96			21 MAY 96		21 MAY 96		21 MAY 9	21 MAY 96		
CLASS	ORDER	SPECIES	MAY1-1	MAY1-2	MAY1-3	MAY3-1	MAY3-2	MAY4-1	MAY4-2	MAY5-1	MAY6-1	MAY6-2	MAY6-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	7	3	2	4	12	19	44	56	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	4	4	2	16	2	2	3	1	0	0	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	1	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	1	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	1	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	1	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	1	0	1	0	0	0	0	0
		Physa acuta	0	0	0	0	0	1	0	0	0	0	0
		Isidorella sp	0	0	0	1	0	0	0	0	0	0	0
		Gyraulus sp	0	1	0	0	0	0	0	1	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	2	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	1	4	0	0	0	1
Arachnida		*Peza ops*	2	1	1	12	8	13	1	11	0	0	0
		Unionicola sp	0	0	0	0	0	0	1	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	1	0	0	1	5	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	2	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	0	0	0	0	1	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	1	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	19	3	2	0	0	1	7	1	8	4	18
		Chaematopsyche sp.	0	0	0	2	0	0	0	0	255	192	32
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	4	2	1
		Oecetis sp	7	4	1	0	6	8	24	3	2	1	9
		Triaenodes sp	12	6	14	0	78	59	28	37	1	0	2
		Triplectides australicus	0	0	0	0	0	1	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	1	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	1	1	0	1	4	3	0	1	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	2	0	2
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	1	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	1	0	0	0	0	0	2	0	0	2	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	151	43	24	3	55	42	121	7	275	101	268
		Caenidae Genus C	5	3	1	0	0	0	18	0	16	4	14
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	1	0	0	19	7	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	1	2	0	65	35	59
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0
		Riekoperla montana	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	1	0	0	1	4	2	5	0	0	0
		Ischnura heterosticta	0	0	0	0	2	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	7	0	3	0	0	0

			21 MAY 96			21 MAY 96		21 MAY 96		21 MAY 9	21 MAY 96		
CLASS	ORDER	SPECIES	MAY1-1	MAY1-2	MAY1-3	MAY3-1	MAY3-2	MAY4-1	MAY4-2	MAY5-1	MAY6-1	MAY6-2	MAY6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	3	0	0	0	0	0
		Apocordulia macrops	1	0	0	0	1	0	0	0	0	0	0
		Austroaeschna u unicornis	0	1	2	0	1	0	0	1	0	0	0
		Austrogomphus ochraceus	1	1	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	3	0	0	1	0	1	1	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	1	1	0
		Dytiscidae sp	0	0	0	0	1	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	1
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	2	0	0	0	0	0	0	0	3	3	2
		Simulidae sp	0	0	0	0	0	0	0	0	5	46	0
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	1	0	3	0	0	0	0	0	1	1	1
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	2	6
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	1	0	1	0	3	0	2	2	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	10	7	2
		Riethia sp	0	0	0	0	0	0	0	0	1	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	1	0	1	0	0	1	5	0	1	1.	4
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	7	1	1	0	2	1	3	1	0	0	2
		Djalmabatista sp	0	0	1	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	1	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	1	0	0	0	2	0	0	0	0
		Procladius sp	0	0	0	0	1	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	5	0	1	3	6
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	5	1	4
		Parakiefferiella sp	2	1	2	0	0	4	5	1	6	1	7
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	2	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	0	0	0	6	0	4	0	6	3	4
		TOTAL	231	74	59	43	190	175	287	134	687	419	445

SPEC96

CLASS	ORDER	SPECIES	2 JULY 96 JUL1-1	JUL1-2	JUL1-3	2 JULY 96 JUL2-1	JUL2-2	JUL2-3	2 JULY 96 JUL5-1	JUL5-2	JUL5-3	2 JULY 96 JUL6-1	JUL6-2
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	3	1	3	0	2	0	4	3	0	0	1
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	2	4	2	5	3	13	1	1	0	0	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	1	1	2	2	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	1	0	0	0	0	0	1	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	1	0	1	0	0	1	0	0	0	0	0
Arachnida		*Peza ops*	8	0	1	0	0	0	5	0	1	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	1	0	0	0	0	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	1	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	0	0	1	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	1	4	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	1	0	0	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	2	2	0	2	4	2	0	6	1	3
		Chaematopsyche sp.	0	0	0	0	0	0	0	0	0	200	248
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	3	5
		Oecetis sp	2	6	1	4	7	5	3	10	1	0	4
		Triaenodes sp	21	10	11	39	30	25	17	5	5	0	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	9	3	4	0	4	7	3	1	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	1	4
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	1	3	1	2	0	0	0	0	0	0	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	56	63	101	11	84	105	32	27	23	63	88
		Caenidae Genus C	2	3	4	1	9	1	0	3	0	8	6
		Baetis sp	0	0	0	0	0	1	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	16	17
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	2	1	74	42
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	5	12
		Reikoperla montana	0	0	0	0	0	0	0	0	0	1	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	1	0	1	0	0	6	0	0	0	0
		Ischnura heterosticta	2	0	0	1	1	0	1	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	2	0	0	0	0

CLASS	ORDER	SPECIES	2 JULY 96 JUL1-1	JUL1-2	JUL1-3	2 JULY 96 JUL2-1	JUL2-2	JUL2-3	2 JULY 96 JUL5-1	JUL5-2	JUL5-3	2 JULY 96 JUL6-1	JUL6-2
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	1	1	0	2	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	1	0	0	1	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	1	1	1	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	2	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	1	0	0
		Micronecta annae	0	0	0	6	6	17	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	1
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	1	0	0	0	0	0
		Empididae sp	0	0	0	0	0	1	0	1	0	2	8
		Simulidae sp	0	0	0	0	2	0	0	0	0	8	8
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	1	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	1	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	0	2
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	1	0	0	0	0	0	0	1
		Rheotanytarsus sp	0	0	0	0	0	0	0	2	1	3	12
		Riethia sp	0	0	0	0	0	0	0	0	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	1	1	0	0	0	2	2	1	1	0	4
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	3	1	8	0	2	6	3	2	2	0	0
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	2	1	1	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	1	0	1	0	1	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	2	0	0	2	0	0	0	0	0	0	7
		Nanocladius sp	0	0	0	1	0	1	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	2	10
		Parakiefferiella sp	2	1	0	3	1	1	2	3	2	1	8
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	0	0	0	0	0	0	1	0	4	5
		TOTAL	117	105	143	80	161	195	88	64	47	392	496

CLASS	ORDER	SPECIES	20 AUG 96 AUG1-1	AUG1-2	AUG1-3	20 AUG 96 AUG3-1	AUG3-2	AUG3-3	20 AUG 96 AUG4-1	AUG4-2	AUG4-3	20 AUG 96 AUG5-1	AUG5-2	AUG5-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	9	0	3	1	0	2	2	8	5	2	4	9
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	16	1	10	14	19	19	12	8	24	10	5	11
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	1	1	0	1	0
Nematoda		*Nematode sp*	0	0	0	0	0	4	7	3	5	0	0	1
Collembola		*Hypogasturidae sp*	2	0	2	3	1	1	1	7	3	3	4	3
		Dicyrtomidae sp	0	0	0	0	1	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	1	1	0	1	1	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	1	0	0	0	0	0	0
		Physa acuta	1	0	0	0	0	0	1	0	1	0	0	0
		Isidorella sp	0	0	0	0	0	1	0	0	1	0	0	0
		Gyraulus sp	0	0	0	0	0	0	1	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	1	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	2	0	1	6	21	48	60	72	147	18	3	8
		Unionicola sp	0	0	0	0	0	0	0	1	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	5	0	0	1	1	0	1	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	1	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	1	0	0	0
		Euastacus armatus	0	0	0	0	0	0	0	0	0	1	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	10	0	7	4	1	5	0	0	3	1	3	1
		Chaematopsyche sp.	0	0	2	0	0	1	1	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	2	2	2	1	3	0	0	1	2	1	5	3
		Triaenodes sp	9	0	1	1	3	3	2	7	5	3	4	3
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	12	0	6	0	0	1	2	2	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	0	0	0	0	0	0	0	0	0	0	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	150	21	64	40	30	25	25	26	30	43	83	30
		Caenidae Genus C	2	0	2	0	0	1	0	0	0	0	1	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	1	0	3	0	0	0	0	0	1	2	1	2
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	1	0	0	1	0	0	0	0	0	0	1
		Ischnura heterosticta	0	0	0	0	1	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	1	0	0	0	0	0	0

CLASS	ORDER	SPECIES	20 AUG 96			20 AUG 96			20 AUG 96			20 AUG 96		
			AUG1-1	AUG1-2	AUG1-3	AUG3-1	AUG3-2	AUG3-3	AUG4-1	AUG4-2	AUG4-3	AUG5-1	AUG5-2	AUG5-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	1	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	1	0	0	0	0	0	1	0	0	1	0	0
		Cordulephya pygmaea	2	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	1	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	1	0	0	0	0	1
		Empididae sp	0	0	0	0	0	0	0	0	0	1	0	0
		Simulidae sp	0	0	1	1	0	0	0	0	0	1	0	0
		Tipulidae sp	0	0	0	0	0	1	0	0	0	1	0	1
		Chironominae	0	0	0	1	1	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	1	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	0	0	1	1	0	1	0	1	0	2	3
		Paratanytarsus sp	1	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	1	0	1	1	0	1	0	0	0
		Rheotanytarsus sp	2	1	0	0	0	1	0	0	0	0	0	0
		Riethia sp	1	1	1	1	1	1	1	0	0	0	2	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	3	0	2	4	0	2	0	2	2	1	6	1
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	6	0	7	9	11	3	5	11	6	6	5	2
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	1	1
		Larsia sp	4	0	1	2	4	2	2	1	1	1	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	4	0	0	0	0	0	0	0	0	1	0	0
		Procladius sp	0	0	1	2	6	3	3	1	1	2	1	1
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	1	0
		Cricotopus sp	2	0	1	2	0	0	0	0	1	0	0	0
		Nanocladius sp	0	0	0	0	0	0	1	0	0	0	0	0
		Orthoclad spZ	0	0	1	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	11	1	8	3	0	1	0	3	0	0	2	5
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	1	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	2	0	1	1	2	1	1	0	3	0	0	2
		TOTAL	262	28	127	99	111	130	132	156	246	99	135	89

			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96	
CLASS	ORDER	SPECIES	SEP1-1	SEP1-2	SEP1-3	SEP2-1	SEP2-2	SEP2-3	SEP3-1	SEP3-2	SEP3-3	SEP4-1	SEP4-2	SEP4-3	SEP5-1	SEP5-2	SEP5-3	SEP6-1	SEP6-2
		Hydridae sp	0	0	0	51	7	13	1	2	2	3	10	14	8	6	9	14	2
Turbellaria		*Turbellaria sp*	1	0	1	0	2	1	4	1	3	2	10	4	4	9	9	5	1
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	0	6	5	7	18	6	0	0	0	2	20	10	4	4	5	9	7
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	2	0	0	6	9	11	0	2	1	0	0
Collembola		*Hypogasturidae sp*	1	3	1	0	0	1	1	0	1	1	1	1	0	1	3	1	1
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	1	2	0	0	0	1	12	2	3	3	10	6	0	2	0	1	0
		Unionicola sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	10	2	2	8	1	1	3	1	2	1	1	1	0	2	1	14	18
		Chaematopsyche sp.	5	0	3	2	0	0	0	0	1	0	0	0	0	0	0	40	39
		Hydrobiosidae sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	2
		Oecetis sp	0	1	0	0	1	0	1	0	0	0	0	1	1	1	2	2	0
		Triaenodes sp	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	76	34	60	93	66	45	14	19	35	19	30	26	24	16	23	258	189
		Caenidae Genus C	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6	2
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	Plecoptera	*Leptoperla sp*	3	0	4	2	2	1	1	0	0	1	0	0	0	0	0	6	4
		Neumanoperla thoreyi	7	0	3	7	1	0	0	0	0	0	0	0	0	0	0	5	2
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Dinotoperla sp	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1
	Odonata	*Austroargiolestes icteromelas*	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96			17 SEP 96	
CLASS	ORDER	SPECIES	SEP1-1	SEP1-2	SEP1-3	SEP2-1	SEP2-2	SEP2-3	SEP3-1	SEP3-2	SEP3-3	SEP4-1	SEP4-2	SEP4-3	SEP5-1	SEP5-2	SEP5-3	SEP6-1	SEP6-2
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Empididae sp	4	0	1	3	0	1	0	0	0	0	0	0	0	1	0	14	11
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladopelma sp	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1
		Polypedilum sp	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0
		Rheotanytarsus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	3	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	2
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	2	0	2	3	3	1	0	0	2	2	0	2	4	0	0	4	1
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	1	0	2	3	2	3	3	0	4	1	3	3	1	2	1	0	2
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
		Procladius sp	0	1	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	1	1
		Nanocladius sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1
		Parakiefferiella sp	2	2	10	5	6	6	5	3	5	4	0	2	6	0	0	6	5
		Rheocricotopus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	3	0	0	0	1	2	0	0	0	1	2	0	0	0	0	5	2
		TOTAL	121	52	101	143	107	78	49	29	59	47	90	67	47	44	48	400	304

			12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96		
CLASS	ORDER	*SPECIES*	DEC1-1	DEC1-2	DEC1-3	DEC2-1	DEC2-2	DEC2-3	DEC3-1	DEC3-2	DEC3-3	DEC4-1	DEC4-2	DEC4-3	DEC5-1	DEC5-2	DEC5-3	DEC6-1	DEC6-2	DEC6-3
		Hydridae sp	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	1	1	1	11	3	3	2	5	1	0	0	4	17	6	3	0	3	3
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	2	2	12	27	5	14	9	10	13	15	0	15	4	8	5	1	2	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Nematoda		*Nematode sp*	0	0	0	1	1	6	2	37	8	23	50	67	2	4	1	1	1	9
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	3	1	0	1	0	2	0	1	0
		Physa acuta	0	0	0	6	4	8	14	7	8	2	4	6	4	2	5	1	0	0
		Isidorella sp	0	0	0	1	1	0	4	4	3	0	0	1	4	2	0	0	0	0
		Gyraulus sp	0	0	0	1	1	3	1	1	4	0	1	1	9	0	4	0	0	1
		Helicorbis sp	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arachnida		*Peza ops*	0	0	0	8	4	5	5	5	4	1	8	11	3	5	2	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	1	7	1	10	0	3	1	1	1	1	1	0	1	0	0	1
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Euastacus armatus	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	21	4	7	0	0	0	2	1	0	2	0	1	1	0	2	0	10	4
		Chaematopsyche sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	11	7
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1
		Oecetis sp	3	3	5	5	1	2	4	1	0	2	0	0	3	4	3	0	9	5
		Triaenodes sp	1	0	0	1	0	0	1	1	2	0	0	0	0	0	1	0	1	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	0	0	2	3	0	1	1	0	0	1	2	1	1	1	0	0	1
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	16	36	22	23	23	13	12	10	10	17	20	22	9	13	13	12	12	36
		Caenidae Genus C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Plecoptera	*Leptoperla sp*	6	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	20	13
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96			12 DEC 96		
			DEC1-1	DEC1-2	DEC1-3	DEC2-1	DEC2-2	DEC2-3	DEC3-1	DEC3-2	DEC3-3	DEC4-1	DEC4-2	DEC4-3	DEC5-1	DEC5-2	DEC5-3	DEC6-1	DEC6-2	DEC6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	1	0	0	0	0	0	0	2	0	0	1	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
		Dytiscidae sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1
		Simulidae sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	3
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	2
		Dicrotendipes sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	7	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladopelma sp	0	3	12	0	1	0	3	0	4	0	0	1	1	1	0	1	3	3
		Paratanytarsus sp	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
		Riethia sp	0	3	2	0	1	0	0	1	1	0	0	0	0	1	4	1	0	3
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	4	1	2	0	1	0	2	0	0	0	0	0	4	1	4	0	8	3
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Coelopynia sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	2	3	2	6	5	1	9	5	3	3	6	9	2	2	3	4	1	1
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
		Procladius sp	0	1	0	0	0	0	3	0	4	1	0	0	0	0	1	0	0	0
		Apsectrotanypus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	11	2
		Nanocladius sp	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
		Parakiefferiella sp	2	2	1	0	0	0	1	0	1	0	1	0	1	1	0	0	13	16
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	3	7	3	0	0	0	1	1	0	1	1	0	0	0	1	0	7	6
		TOTAL	75	77	84	103	58	67	76	93	70	75	99	145	67	56	63	27	157	135

			14 JAN 97		14 JAN 97			14 JAN 97			14 JAN 97			14 JAN 97			14 JAN 97		
CLASS	ORDER	SPECIES	JAN97-1-1	JAN97-1-2	JAN97-2-1	JAN97-2-2	JAN97-2-3	JAN97-3-1	JAN97-3-2	JAN97-3-3	JAN97-4-1	JAN97-4-2	JAN97-4-3	JAN97-5-1	JAN97-5-2	JAN97-5-3	JAN97-6-1	JAN97-6-2	JAN97-6-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	0	0	14	11	8	2	1	4	4	2	8	2	9	3	6	1	21
Temnocephalida		*Temnocephalid sp*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	2	0	6	5	2	8	11	6	12	0	0	0	11	2	12	20	11
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	1	3	0	0	17	10	5	19	0	7	1	1	0	2	0	2
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	1	2	0	0	0	0	0	0	0	1	1	0	0	0
		Physa acuta	0	0	1	1	0	1	0	1	2	4	1	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	1	4	2	1	2	0	7	0	2	0	0	0	0
		Gyraulus sp	0	0	4	3	1	3	0	0	0	0	1	0	2	2	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	1	0	0	2	1	2	0	2	0	0	0	0	1	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	2	8	1	8	0	0	0	0	0	0	0	0	1	5	2	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	338	440	4	4	7	8	19	4	21	23	14	21	8	10	181	170	248
		Chaematopsyche sp.	0	3	0	0	0	0	0	0	0	0	0	0	0	0	4	5	4
		Hydrobiosidae sp	1	3	0	0	0	0	0	0	0	0	0	0	0	0	10	0	1
		Oecetis sp	14	33	6	2	2	0	0	0	0	0	1	0	1	1	4	8	7
		Triaenodes sp	1	0	0	0	1	0	0	0	0	0	0	1	0	0	5	0	3
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Triplectides australis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	2	2	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	82	105	13	23	15	3	3	5	4	4	6	1	3	2	121	58	135
		Caenidae Genus C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Baetis sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	9	7	0	0	0	0	0	0	0	0	0	0	0	0	8	9	13
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	14 JAN 97		14 JAN 97			14 JAN 97			14 JAN 97			14 JAN 97			14 JAN 97		
			JAN97-1-1	JAN97-1-2	JAN97-2-1	JAN97-2-2	JAN97-2-3	JAN97-3-1	JAN97-3-2	JAN97-3-3	JAN97-4-1	JAN97-4-2	JAN97-4-3	JAN97-5-1	JAN97-5-2	JAN97-5-3	JAN97-6-1	JAN97-6-2	JAN97-6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	1	5
		Empididae sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0
		Parachironomus sp	4	1	0	0	0	1	0	0	0	0	0	1	0	0	7	16	10
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Polypedilum sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1
		Rheotanytarsus sp	2	1	0	0	0	0	0	0	1	0	0	2	0	0	13	13	19
		Riethia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stenochironomus sp	6	20	0	0	0	0	1	0	0	4	1	0	0	0	28	23	48
		Tanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	6	11	6	2	7	0	5	1	3	0	3	1	2	4	6	6	6
		Ablabesmyia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	0
		Procladius sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	2	2
		Cricotopus sp	0	2	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0
		Nanocladius sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	1	4	0	0	0	1	0	0	0	0	0	0	0	0	12	8	7
		Parakiefferiella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3
		Rheocricotopus sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	6	2	1	0	0	0	1	0	0	1	0	5	0	0	7	10	12
		chironomid pupae																	
		TOTAL	478	643	66	59	63	52	56	28	73	41	55	37	44	28	457	360	562

SPEC96

			10 FEB 97		10 FEB 97			10 FEB 97			10 FEB 97			10 FEB 97			10 FEB 97		
CLASS	ORDER	SPECIES	FEB97-1-1	FEB97-1-2	FEB97-2-1	FEB97-2-2	FEB97-2-3	FEB97-3-1	FEB97-3-2	FEB97-3-3	FEB97-4-1	FEB97-4-2	FEB97-4-3	FEB97-5-1	FEB97-5-2	FEB97-5-3	FEB97-6-1	FEB97-6-2	FEB97-6-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	0	1	4	11	13	6	5	5	0	6	3	4	2	5	7	19	7
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	1	1	35	9	9	20	29	24	46	15	21	1	3	0	18	2	90
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	1	1	0	1	1	2	0	0	0	2	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	3	0	1	0	0	2	0	0	0	0	0	0
		Gyraulus sp	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	1	0	2	0	0	0	0	1	0	0	0	0	1	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	79	103	6	7	16	10	4	15	15	10	10	9	10	16	121	116	84
		Chaematopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	2	9
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		Oecetis sp	13	7	0	5	2	2	3	0	0	0	0	8	2	5	4	2	1
		Triaenodes sp	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	5	1
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	2
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	445	285	33	55	119	6	5	12	21	10	12	42	66	43	150	121	78
		Caenidae Genus C	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Baetis sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	6	1	0	0	0	0	0	0	1	0	0	0	1	0	2	0	2
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	0	1	1	2	2	2	1	0	2	1	2	2	1	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	10 FEB 97		10 FEB 97			10 FEB 97			10 FEB 97			10 FEB 97			10 FEB 97		
			FEB97-1-1	FEB97-1-2	FEB97-2-1	FEB97-2-2	FEB97-2-3	FEB97-3-1	FEB97-3-2	FEB97-3-3	FEB97-4-1	FEB97-4-2	FEB97-4-3	FEB97-5-1	FEB97-5-2	FEB97-5-3	FEB97-6-1	FEB97-6-2	FEB97-6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	11	6	0	0	0	0	0	0	0	0	0	1	0	0	5	4	0
		Austroaeschna u unicornis	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
		Austrogomphus ochraceus	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
		Simuliidae sp	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	2	3
		Tipuliidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	7
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0
		Paracladopelma sp	1	1	0	0	0	1	1	0	0	0	1	1	0	0	3	3	1
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	3	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	8	7	0	0	0	0	0	0	0	0	0	4	2	0	11	15	13
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	7	8	0	1	0	0	1	0	0	0	1	14	11	1	4	14	2
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	3	6	14	4	7	4	4	8	13	10	3	0	3	4	12	35	13
		Djalmabatista sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	2
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
		Nanocladius sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	3	2	0	0	1	0	0	0	0	0	0	3	0	5	1	0	4
		TOTAL	582	435	100	94	171	60	60	74	98	54	59	96	104	82	355	353	332

CLASS	ORDER	SPECIES	13 MAR 97 MAR97-1-1	MAR97-1-2	MAR97-1-3	13 MAR 97 MAR97-2-1	MAR97-2-2	MAR97-2-3	13 MAR 97 MAR97-3-1	MAR97-3-2	MAR97-3-3	13 MAR 97 MAR97-4-1	MAR97-4-2	MAR97-4-3	13 MAR 97 MAR97-5-1	MAR97-5-2	13 MAR 97 MAR97-6-1	MAR97-6-2
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	4	2	1	1	5	4	4	1	3	10	0	2	4	5	4	4
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	2	2	1	21	36	23	10	2	7	2	1	9	2	2	3	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissia sp	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	2	2	0	0	0	0	0	0	2	1	1	0	0	2	3
Arachnida		*Peza ops*	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	1	2	1	1	0	0	0	0	0	0	0	1	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	95	80	139	0	2	0	1	0	1	3	2	4	65	98	141	90
		Chaematopsyche sp.	0	0	0	0	0	0	0	0	0	0	0	0	3	4	143	81
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1
		Oecetis sp	16	8	16	4	2	5	1	0	1	1	1	1	10	10	26	10
		Triaenodes sp	6	7	8	1	3	1	1	0	1	0	0	1	11	8	5	11
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	1	1	0	0	0	0	0	0	0	1	2	1
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	1	2	0	0	0	0	0	0	0	0	0	0	1	1	1
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	30	31	36	2	4	3	0	0	2	1	0	1	26	33	135	89
		Caenidae Genus C	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
		Baetis sp	0	1	1	0	0	0	0	0	0	0	0	0	0	0	10	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	1	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	1	1	1	0	0	1	0	1	0	0	0	0	1	1	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nososticta solida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	13 MAR 97			13 MAR 97			13 MAR 97			13 MAR 97			13 MAR 97		13 MAR 97	
			MAR97-1-1	MAR97-1-2	MAR97-1-3	MAR97-2-1	MAR97-2-2	MAR97-2-3	MAR97-3-1	MAR97-3-2	MAR97-3-3	MAR97-4-1	MAR97-4-2	MAR97-4-3	MAR97-5-1	MAR97-5-2	MAR97-6-1	MAR97-6-2
		Pseudagrion aureofrons	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	13	2	10	0	0	0	0	0	0	0	0	0	6	8	20	13
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	2
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	49	14
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	7	5	7	2	0	1	1	0	0	1	2	2	1	3	0	0
		Paracladopelma sp	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	3
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
		Polypedilum sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheotanytarsus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	4	13	3
		Riethia sp	5	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	0	0	0	0	0	0	0	0	2	1	0	4	18	7	2
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	16	6	3	3	4	5	5	4	5	4	2	3	7	9	7	4
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Parakiefferiella sp	1	0	1	0	0	0	0	0	0	0	0	0	1	4	5	1
		Rheocricotopus sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	6	5	6	0	0	0	0	0	0	2	1	0	5	9	10	9
		TOTAL	204	158	241	42	59	45	23	10	26	28	12	27	148	225	611	347

SPEC96

CLASS	ORDER	SPECIES	10 APR 97			10 APR 97			10 APR 97			10 APR 97			10 APR 97			10 APR 97		
			APR97-1-1	APR97-1-2	APR97-1-3	APR97-2-1	APR97-2-2	APR97-2-3	APR97-3-1	APR97-3-2	APR97-3-3	APR97-4-1	APR97-4-2	APR97-4-3	APR97-5-1	APR97-5-2	APR97-5-3	APR97-6-1	APR97-6-2	APR97-6-3
		Hydridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	4	2	0	4	7	3	3	8	5	13	5	1	2	0	2	0	1	2
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	0	3	4	9	14	4	2	2	2	5	7	7	1	1	9	0	0	7
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	1	0	0	1	1	2	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	3	3	0	0	0	1	0	0	3	1	0	0	0	0	8	2	2
Arachnida		*Peza ops*	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	2	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	10	25	9	3	0	7	0	0	1	6	1	1	8	6	5	52	52	80
		Chaematopsyche sp.	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	147	115	118
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	5
		Oecetis sp	0	7	0	4	3	1	4	1	2	2	5	4	2	1	2	13	16	21
		Triaenodes sp	0	5	0	2	0	2	1	0	0	5	6	5	7	1	3	5	6	7
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	1	0	0	1	0	0	0	0	1	0	0	2	0	4	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Notalina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	5	8	5	2	2	8	1	1	1	1	5	0	11	11	4	86	45	79
		Caenidae Genus C	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	7	7	10
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	2
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	1	0	0	0	0	2	1	0	0	1	0	0	0	4	0	0	0
		Ischnura heterosticta	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		Nososticta solida	0	0	3	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0

CLASS	ORDER	SPECIES	10 APR 97			10 APR 97			10 APR 97			10 APR 97			10 APR 97			10 APR 97		
			APR97-1-1	APR97-1-2	APR97-1-3	APR97-2-1	APR97-2-2	APR97-2-3	APR97-3-1	APR97-3-2	APR97-3-3	APR97-4-1	APR97-4-2	APR97-4-3	APR97-5-1	APR97-5-2	APR97-5-3	APR97-6-1	APR97-6-2	APR97-6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	5	1	0	0	1	0	0	0	0	0	1	3	2	0	17	21	15
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	6
		Simulidae sp	1	0	0	0	0	0	0	0	0	0	0	0	4	3	1	7	14	37
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	11	7	4	1	2	8	0	0	0	5	13	2	14	3	2	5	4	7
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	1
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	4	9
		Polypedilum sp	1	0	0	0	0	2	1	0	0	0	2	0	0	0	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	0	1	0	0	0	0	2	0	0	0	2	1	4	0	0	3	3	9
		Stenochironomus sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	1	7	0	1	0	0	3	2	0	2	4	1	20	4	0	24	6	17
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	4	4	1	3	2	2	2	4	2	3	0	2	5	2	3	0	8	2
		Djalmabatista sp	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0	1	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Procladius sp	0	0	0	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	1	0	0	0	0	0	0	0	0	1	3	0	1	1	2
		Nanocladius sp	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	2	0	2
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	4	3	5
		Rheocricotopus sp	3	6	3	0	0	0	0	1	0	0	1	1	4	0	1	44	26	48
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	7	3	2	0	0	0	0	0	1	0	2	4	7	3	0	7	8	21
		TOTAL	57	91	38	37	36	45	25	25	14	52	59	38	103	42	42	461	354	519

SPEC96

CLASS	ORDER	SPECIES	13 MAY 97			13 MAY 97		
			MAY97-1-1	MAY97-1-2	MAY97-1-3	MAY97-5-1	MAY97-5-2	0
		Hydridae sp	0	0	0	0	0	0
Turbellaria		*Turbellaria sp*	3	9	22	20	10	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	1	1	3	3	0	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0
Bivalvia		*Pisidium sp*	0	9	10	1	0	0
Arachnida		*Peza ops*	2	0	1	1	0	0
		Unionicola sp	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	1	0	0	0	0	0
	Decapoda	*Paratya australiensis*	4	0	2	0	4	0
		Caridina mccullochi	0	0	0	0	2	0
		Macrobrachium sp	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0
		Euastacus armatus	2	0	0	0	0	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	3	7	6	11	22	0
		Chaematopsyche sp.	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0
		Oecetis sp	15	19	25	11	15	0
		Triaenodes sp	44	5	18	48	36	0
		Triplectides australicus	0	0	0	0	0	0
		Triplectides australis	0	2	1	2	1	0
		Triplectides volda	0	0	0	0	0	0
		Anisocentropus sp	0	6	17	0	2	0
		Hydroptilidae sp	0	0	0	0	1	0
		Notalina sp	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	0	1	2	1	3	0
		Neboissophlebia sp	0	0	0	0	0	0
		Caenidae Genus B	194	237	296	190	163	0
		Caenidae Genus C	14	13	9	3	13	0
		Baetis sp	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	42	3	0	2	24	0
		Neumanoperla thoreyi	0	0	0	0	0	0
		Riekoperla montana	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	0	0	1	0	0
		Ischnura heterosticta	2	0	0	0	1	0
		Nososticta solida	20	3	3	12	8	0

arm macroinvertebrate samples

CLASS	ORDER	SPECIES	13 MAY 97 MAY97-1-1	MAY97-1-2	MAY97-1-3	13 MAY 97 MAY97-5-1	MAY97-5-2	0
		Pseudagrion aureofrons	0	0	0	0	0	0
		Rhadinosticta simplex	0	1	1	0	0	0
		Apocordulia macrops	0	8	4	5	5	0
		Austroaeschna u unicornis	0	1	0	2	1	0
		Austrogomphus ochraceus	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	1	0	0
		Micronecta annae	1	1	0	1	33	0
	Coleoptera	*Coleoptera sp*	1	1	1	1	3	0
		Austrolimnius sp	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0
		Gyrinidae sp	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0
		Empididae sp	0	0	2	1	1	0
		Simulidae sp	0	1	0	0	1	0
		Tipulidae sp	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	1	1	1	0
		Dicrotendipes sp	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0
		Parachironomus sp	4	0	0	6	5	0
		Paracladapelma sp	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0
		Polypedilum sp	0	0	0	2	1	0
		Rheotanytarsus sp	0	0	0	0	0	0
		Riethia sp	1	1	1	12	5	0
		Stenochironomus sp	0	0	0	0	0	0
		Tanytarsus sp	2	1	0	10	2	0
		Stictocladius sp	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0
		Ablabesmyia sp	1	1	0	2	0	0
		Djalmabatista sp	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0
		Procladius sp	1	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0
		Cricotopus sp	0	0	0	1	0	0
		Nanocladius sp	0	0	0	2	1	0
		Orthoclad spZ	0	0	0	0	0	0
		Parakiefferiella sp	2	2	3	5	2	0
		Rheocricotopus sp	0	0	0	1	0	0
		Thienemanniella sp	0	0	0	0	0	0
		Stictochironomus sp	0	0	0	0	0	0
		chironomid pupae	2	1	0	9	6	0
		TOTAL	362	334	428	368	372	0

CLASS	ORDER	SPECIES	10 JUN 97 JUN97-1-1	JUN97-1-2	JUN97-1-3	10 JUN 97 JUN97-3-1	JUN97-3-2	JUN97-3-3	10 JUN 97 JUN97-5-1	JUN97-5-2	JUN97-5-3	10 JUN 97 JUN97-6-1	JUN97-6-2	JUN97-6-3
		Hydridae sp	0	0	0	0	0	0	0	3	1	0	0	0
Turbellaria		*Turbellaria sp*	0	2	0	11	14	9	2	15	7	1	1	1
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Tubificidae sp*	0	3	0	1	8	10	0	0	0	15	88	21
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	1	0	1	0	1	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	1	0	0	1	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Planorbidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	1	0	0	0	0	0
Bivalvia		*Pisidium sp*	3	0	0	0	0	0	1	1	0	3	2	3
Arachnida		*Peza ops*	1	0	0	10	15	4	0	2	5	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tartarothyas sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	1	0	0	0	0	0	0	0	0	0	0
	Amphipoda	*Amphipoda: Neoniphargidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Amphipoda: Perthiidae sp	0	0	0	0	0	0	0	0	2	0	0	0
	Decapoda	*Paratya australiensis*	2	0	5	0	5	0	0	0	0	0	1	3
		Caridina mccullochi	0	0	0	0	0	2	0	1	0	0	0	0
		Macrobrachium sp	0	0	1	0	0	0	0	0	0	0	0	1
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0
		Euastacus armatus	0	0	0	0	0	2	0	1	1	1	1	0
		Syncaridae: Koonungidae sp	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	1	1	1	0	1	0	9	19	8	7	10	16
		Chaematopsyche sp.	0	0	0	0	0	0	0	2	4	9	22	33
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	2
		Oecetis sp	5	10	7	3	4	5	10	14	14	11	19	27
		Triaenodes sp	15	7	9	23	18	15	25	58	44	9	10	10
		Triplectides australicus	0	1	0	0	0	0	1	3	0	0	1	3
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	1	1	0	0	0	0	0	0
		Anisocentropus sp	12	7	0	0	3	0	3	2	3	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	3
		Notalina sp	0	0	1	1	0	0	0	1	2	0	2	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera	*Atalophlebia sp 9*	1	0	1	0	0	1	0	1	1	1	1	0
		Neboissophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	108	116	69	65	100	140	91	316	485	195	103	293
		Caenidae Genus C	8	12	7	1	0	2	2	17	12	7	12	23
		Baetis sp	0	0	0	0	0	0	0	0	0	0	1	1
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	2	0	0	0	9	10	1	60	52	71
		Neumanoperla thoreyi	0	0	0	0	0	0	0	0	0	0	0	0
		Reikoperla montana	0	0	0	0	0	0	0	0	0	0	0	0
		Dinotoperla sp	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Austroargiolestes icteromelas*	0	1	0	1	2	3	0	5	1	0	0	0
		Ischnura heterosticta	1	0	0	0	1	0	0	1	0	0	0	0
		Nososticta solida	5	3	3	14	9	7	11	71	32	0	3	1

CLASS	ORDER	SPECIES	10 JUN 97			10 JUN 97			10 JUN 97			10 JUN 97		
			JUN97-1-1	JUN97-1-2	JUN97-1-3	JUN97-3-1	JUN97-3-2	JUN97-3-3	JUN97-5-1	JUN97-5-2	JUN97-5-3	JUN97-6-1	JUN97-6-2	JUN97-6-3
		Pseudagrion aureofrons	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	2	0	0	0	0	0	1	2	1	0	0	0
		Apocordulia macrops	0	2	0	0	1	1	5	4	2	0	0	2
		Austroaeschna u unicornis	1	0	2	0	1	0	2	3	1	2	3	6
		Austrogomphus ochraceus	0	0	0	0	0	1	0	0	0	0	1	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0
		Eusynthemis virgula	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	18	25	44	7	5	6	3	1	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	1	0	0
		Gyrinidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Heteroceridae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrophilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	1	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	1	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	5	1	0	0	0	0	2
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	1	6	3
		Riethia sp	0	0	0	0	0	1	0	0	1	0	1	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	0	0	0	1	1	0	1	2	1	5	4
		Stictocladius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	1	0	0	2	5	2	0	1	3	0	1	0
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	0	1	0	0	0	0	0	0
		Apsectrotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	6	7	15
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	1	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	1
		Parakiefferiella sp	0	1	0	1	0	0	0	2	8	2	3	2
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	1
		Stictochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	0	0	0	0	0	0	2	2	2	8	7
		TOTAL	166	168	109	152	214	259	181	560	649	337	367	555

SPEC96

CLASS	ORDER	SPECIES	1996/7 TOTAL	sp.tot/tot fauna %
		Hydridae sp	150	
Turbellaria		*Turbellaria sp*	1425	8.427
Temnocephalida		*Temnocephalid sp*	8	0.047
Oligochaete		*Tubificidae sp*	1640	9.699
Hirudinea		*Hirudinea sp*	6	0.035
Nematoda		*Nematode sp*	353	2.088
Collembola		*Hypogasturidae sp*	55	0.325
		Dicyrtomidae sp	4	0.024
		Entomobryidae sp	5	0.030
		Sminthuridae: Katianna sp	1	0.006
Gastropoda		*Glyptophysa sp*	25	0.148
		Physa acuta	99	0.585
		Isidorella sp	57	0.337
		Gyraulus sp	58	0.343
		Helicorbis sp	3	0.018
		Planorbidae sp	2	0.012
		Ferissa sp	21	0.124
Bivalvia		*Pisidium sp*	82	0.485
Arachnida		*Peza ops*	886	5.240
		Unionicola sp	5	0.030
		Tromboidea sp	2	0.012
		Tartarothyas sp	4	0.024
		Hydracarina sp	1	0.006
Malacostraca	Isopoda	*Heterias sp*	177	1.047
	Amphipoda	*Amphipoda: Neoniphargidae sp*	6	0.035
		Amphipoda: Perthiidae sp	3	0.018
	Decapoda	*Paratya australiensis*	41	0.242
		Caridina mccullochi	5	0.030
		Macrobrachium sp	12	0.071
		Cherax destructor	12	0.071
		Euastacus armatus	54	0.319
		Syncaridae: Koonungidae sp	1	0.006
Insecta	Trichoptera	*Ecnomus pansus*	4497	26.595
		Chaematopsyche sp.	2130	12.597
		Hydrobiosidae sp	113	0.668
		Oecetis sp	1118	6.612
		Triaenodes sp	1281	7.576
		Triplectides australicus	14	0.083
		Triplectides australis	12	0.071
		Triplectides volda	2	0.012
		Anisocentropus sp	184	1.088
		Hydroptilidae sp	13	0.077
		Notalina sp	8	0.047
		Trichoptera pupae	2	0.012
	Ephemeroptera	*Atalophlebia sp 9*	78	0.461
		Neboissophlebia sp	1	0.006
		Caenidae Genus B	11343	67.083
		Caenidae Genus C	330	1.952
		Baetis sp	33	0.195
		Coloburiscoides sp	63	0.373
	Plecoptera	*Leptoperla sp*	787	4.654
		Neumanoperla thoreyi	42	0.248
		Reikoperla montana	2	0.012
		Dinotoperla sp	5	0.030
	Odonata	*Austroargiolestes icteromelas*	135	0.798
		Ischnura heterosticta	16	0.095
		Nososticta solida	226	1.337

CLASS	ORDER	SPECIES	1996/7 TOTAL	sp.tot/tot fauna %
		Pseudagrion aureofrons	1	0.006
		Rhadinosticta simplex	16	0.095
		Apocordulia macrops	222	1.313
		Austroaeschna u unicornis	62	0.367
		Austrogomphus ochraceus	24	0.142
		Cordulephya pygmaea	15	0.089
		Eusynthemis virgula	3	0.018
		Hemicordulia tau	10	0.059
		Micronecta annae	218	1.289
	Coleoptera	*Coleoptera sp*	7	0.041
		Austrolimnius sp	12	0.071
		Dytiscidae sp	8	0.047
		Gyrinidae sp	1	0.006
		Heteroceridae sp	1	0.006
		Hydrophilidae sp	1	0.006
	Diptera	*Ceratopogonidae sp*	7	0.041
		Empididae sp	237	1.402
		Simulidae sp	300	1.774
		Tipulidae sp	25	0.148
		Chironominae	5	0.030
		Chironomus sp	3	0.018
		Cladotanytarsus sp	5	0.030
		Cryptochironomus sp.	41	0.242
		Dicrotendipes sp	1	0.006
		Kiefferulus sp	7	0.041
		Parachironomus sp	253	1.496
		Paracladopelma sp	155	0.917
		Paratanytarsus sp	35	0.207
		Polypedilum sp	63	0.373
		Rheotanytarsus sp	118	0.698
		Riethia sp	401	2.372
		Stenochironomus sp	1	0.006
		Tanytarsus sp	686	4.057
		Stictocladius sp	1	0.006
		Coelopynia sp	1	0.006
		Ablabesmyia sp	1167	6.902
		Djalmabatista sp	22	0.130
		Larsia sp	27	0.160
		Nilotanypus sp	2	0.012
		Paramerina sp	26	0.154
		Procladius sp	66	0.390
		Apsectrotanypus sp	2	0.012
		Orthocladinae	1	0.006
		Cricotopus sp	117	0.692
		Nanocladius sp	39	0.231
		Orthoclad sp2	36	0.213
		Parakiefferiella sp	321	1.898
		Rheocricotopus sp	160	0.946
		Thienemanniella sp	18	0.106
		Stictochironomus sp	1	0.006
		chironomid pupae	506	2.992
		TOTAL	16909	100.000

1996

file copy

6 December, 1996

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Ralph Coghill
Technical Services Manager
Australian Newsprint Mills Limited
Private Bag
LAVINGTON NSW 2641

Dear Ralph

1996 ANNUAL REPORT - BIOLOGICAL AND CHEMICAL MONITORING

Please find enclosed an unbound copy of the 1996 Annual Report of Chemical and Bio ical Monitoring for Australian Newsprint Mills Limited, undertaken by The Murray-Darling Freshwater Research Centre. This Annual Report complies with Licence Condition W16 on the ecotoxicological and bioaccumulation monitoring and the river environment monitoring surveys.

Please do not hesitate to contact me on 582355 for any additional information.

Wishing you and your staff a Merry Xmas and a Happy New Year.

Yours sincerely

Helen King

Scientific Officer

Enc. 1996 Annual Report.

1996 ANNUAL REPORT OF CHEMICAL AND BIOLOGICAL MONITORING FOR

AUSTRALIAN NEWSPRINT MILLS Ltd ALBURY

H King & Dr D Baldwin
The Murray-Darling Freshwater Research Centre

TABLE OF CONTENTS

1.0 AIM

To undertake biological and chemical monitoring of ANM's wastewater discharge to the River Murray in accordance with New South Wales Environment Protection Agency licence No.01272 sections W10 (Ecotoxicological and Biological Monitoring) and W11 (River Environment Monitoring Surveys).

The null hypothesis tested in all cases "that there is no difference between control water and wastewater treatments."

2.0 METHODS

2.1 Ecotoxicological Monitoring [W10]

2.1.1 Sample Preparation

All waters were collected as grab samples in 10L buckets on the morning of the test following ASTM (1990) guidelines, the dilution/control water was obtained from the Lake Hume Resort boat ramp at the Hume Dam on the River Murray upstream of the discharge; the receiving water sample was taken from the River Murray approximately 2 km downstream of the wastewater discharge. The wastewater samples were collected on site at ANM from three locations; the final outfall, the 96 hr holding pond and the inlet to the 96 hr holding pond. All waters were sieved to 180 um to remove macro and micro fauna that could interfere with the test, whilst still retaining the samples as close as possible to actual field conditions. The temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity of all samples were measured prior to use (USEPA 1991 pp 44-46). The control and downstream river sample were tested undiluted (USEPA 1991 p47). The three on-site wastewater samples were routinely prepared at three concentrations 100%, 10% and 1%, diluted with control water and aliquots of these were distributed between replicates (ASTM 1990). The laboratory temperature was maintained at 20 ± 5 Celsius throughout the year.

Acute Toxicity Tests

Acute toxicity testing procedures are formulated from ASTM's "Standard Guide for Conducting Toxicity Tests on Aqueous Effluents with Fishes, Macroinvertebrates and Amphibians" (ASTM 1990) and USEPA's "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (USEPA 1991) but in some cases have been modified slightly to accommodate the local organisms in this program.

Acute toxicity tests are designed to obtain information on the immediate effects on test organisms following short term exposure to effluents under laboratory conditions. Results of these tests can be used to predict the likely effects of the effluent on aquatic organisms in receiving waters. The use of locally occurring species ensures greater accuracy of these predictions. The organisms selected for this program occupy different functional groups:

Daphnia carinata is a pelagic microcrustacean and obligate filter feeder; *Chironomus tepperi* is a benthic midge larva which feeds on detritus. *D.carinata* and *C.tepperi* can be reliably cultured in the laboratory in sufficient numbers for the testing program.

Acute toxicity tests were conducted monthly. Test chambers used for both organisms were 60 mL clear round glass jars (resin acids, potential toxic components of paper mill effluent may be adsorbed onto plastic surfaces), approximately 40 mm high to ensure an adequate surface area to volume ratio for gas exchange. Test solutions were prepared in a single batch and apportioned between three replicates positioned randomly.

Daphnid tests were conducted using neonates (less than 24 hr old) from laboratory cultures. The neonates were collected by combining broodstock culture solutions in a 5L aquarium after the adults were transferred to fresh culture solutions. Neonates required for the test were carefully captured using a disposable pipette and released under the surface of the test solutions to minimise trauma due to handling. The neonates were distributed randomly between treatments and replicates so that there were 10 animals per jar. (ASTM 1990 pp 758-760, USEPA 1991 pp 49-51).

Chironomid tests were conducted using final instar larvae from laboratory cultures. Chironomid larvae were sieved from their culture solution and final instars carefully transferred to test solutions using flexible forceps to minimise trauma. The chironomids were distributed randomly between treatments so that there were ten animals per jar (ASTM 1990 pp 758-760). A small strip of facial tissue was added to each jar as a substrate to help prevent clumping of animals.

The organisms were not fed for the duration of the test as faecal matter and undigested food can reduce the dissolved oxygen level and reduce the biological activity of some test materials (ASTM p761). Observations were made at 24 hours, and finalised at 48 hours. Death of invertebrates is often difficult to determine, so immobilisation, lack of response to stimuli and opaque colouration or loss of colour are the symptoms interpreted as "effect" (ASTM p761). The results of these tests were reported as EC50 values (the concentration of effluent which results in the "effect" observed for 50% of the organisms) provided sufficient number of organisms were affected. "Calculation of an EC50 is considered unacceptable if either or both of the following occurred: No treatment other than a control treatment killed or affected less than 37% of the test organisms exposed to it; No treatment killed or affected more than 63% of the organisms exposed to it." also if more than 10% of the controls exhibited signs of disease, stress or death (ASTM p762 , USEPA p55).

Results were reported quarterly to ANM and a summary of significant results is provided in this Annual Report.

Chronic Toxicity Tests

Chronic toxicity testing procedures for a local cladoceran, *Daphnia carinata* were adapted from ASTM's "Standard Guide for Conducting Renewal Life-Cycle Toxicity Tests with *Daphnia magna*" (1991) and USEPA's "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (1989) which contain methods based on *Daphnia magna* and *Ceriodaphnia dubia*.

Chronic toxicity tests are designed to provide information to permit the prediction of the possible long term effects of effluents on the test organism in receiving waters. These tests are primarily concerned with sublethal effects which may not be expressed in the short term. The cladoceran tests are life cycle tests, in which an animal is assessed for survival, growth and reproduction.

Chronic toxicity tests were conducted at two monthly intervals using *D. carinata*. Test chambers for these cladocerans were clear glass 60 mL jars. Test solutions were prepared in bulk and apportioned between ten replicates. Daphnia broodstock were transferred to a fresh solution and the neonates (less than 24 hours old) remaining were bulked in a 5L aquarium. Neonates required for the test were carefully captured using a disposable pipette and released under the surface of the test solutions to minimise handling trauma. The neonates were distributed randomly between treatments and replicates so that there was one animal per jar. (ASTM 1990 p771, USEPA 1989 p106). The cladocerans were fed a daily dose of blended food solution made up of yeast and trout feed (ASTM 1990 p775) and transferred to fresh solutions three times per week (USEPA 1989 p110). Observations of survival, stress and reproduction/number of live young produced were noted at each transfer. The tests continued for a maximum of 21 days (*D.carinata*). The results were considered acceptable if survival of the controls was at least 80% and each surviving control animal had achieved at least three broods. Results rejected if ephippia (desiccation resistant eggs produced in response to environmental stress) were produced in any of the controls. (USEPA 1989 p122, ASTM 1990 p 774).

Results were analysed in quarterly reports to ANM providing a summary of reproductive statistics for the duration of the tests. The mean number of young produced in each treatment were compared with the control using t-tests to determine their significance @ $p < 0.05$. A summary of the results for tests conducted this year is provided in this Annual Report to ANM.

2.2 Bioaccumulation Monitoring [W10]

Bioaccumulation trials were conducted to determine the levels of bioaccumulation of metals from ANM's final outfall wastewater using a crustacean (yabby, *Cherax destructor*) and two fish species (silver perch, *Bidyanus bidyanus* and carp gudgeon *Hypseleotris spp.*).

2.2.1 Yabby *(Cherax destructor)*

Yabby trials were conducted on site at ANM using three preconditioned 8-9m^3 concrete flow-through tanks each containing ~90 pieces of PVC pipe as hides. Two control tanks were fed by sand filtered river water and the test tank was fed by 50% final outfall wastewater diluted with sand filtered river water. 300 male yabbies of approximately equal size (70 to 80 mm total length) were purchased from a commercial yabby farm. These yabbies were distributed randomly between the tanks to achieve a stocking density of 19/m^2. A subsample (5%) was measured and nine animals (three from each tank) were retained as initial control samples for metals analysis. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity were measured fortnightly and 10-20 animals from each tank were measured (weight and length) monthly, and a smaller subsample (3) removed, frozen and freeze dried every three months or at the termination of the trial in preparation for metals analysis. Samples were then submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP analysis.

Mean growth data were analysed using 't'-tests to determine differences between the control and test treatments. These results were presented in quarterly reports to ANM. The results of the metals assays were compared for each treatment using the means of the three subsamples. A summary of these results is provided in this Annual Report to ANM.

2.2.2 Silver Perch *(Bidyanus bidyanus*, Mitchell)

Perch trials were conducted following the breeding season in April 1996. The fish tanks were housed in the laboratory on site at ANM to minimise fluctuations in temperature known to adversely affect the health of fish. The fish were contained in six 90L preconditioned polypropylene flow through tanks ('Nally' Tubs) containing filter boxes with aeration and artificial weed. Three tanks were randomly assigned to each treatment. The control tanks were fed by river water filtered to 1 micron, sterilised by Ultra Violet radiation and adjusted to 1000µS conductivity using commercial sodium chloride, and the test tanks were fed by final outfall wastewater. Fingerlings of approximately equal size (60-80 mm total length) and similar history were purchased from a local hatchery. About 150 fish were added to each tank after treatment with methylene blue and salt to prevent infection resulting from damage during transport and transfer. The fish were fed daily on commercial fish pellets. A subsample of fish from each tank was measured weekly. Fish were anaesthetised using 1 mL/L of 'Benzocaine' stock solution (5g/100 mL alcohol) prior to being measured, then revived in fresh water and treated with methylene blue and salt before being returned to the tanks. Animals further subsampled for chemical analysis were killed by overdose with 'Benzocaine' prior to being frozen and freeze dried in preparation for metals analysis. Samples were then submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP analysis. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity were measured in each tank fortnightly.

Mean growth data were analysed using 't' tests to determine differences between the control and test treatments. These results were presented in quarterly reports to ANM. The results of the metals assays were compared for each treatment and the feed using the means of the three subsamples. A summary of these results is provided in this Annual Report to ANM.

2.2.3 Carp Gudgeon (*Hypseleotris spp*).

Bioaccumulation studies using adult Carp Gudgeon spp. (primarily Western Carp Gudgeon (*Hypseleotris klunzingeri,* Ogilby) with some Lake's Carp Gudgeon (*Hypseleotris* sp.5, undescribed) and Midgley's Carp Gudgeon (*Hypseleotris* sp.4, undescribed)) were conducted in November 1996, using fish captured from a local billabong during the breeding season. The trial was conducted using the 6 polypropylene flow through tanks in the laboratory at ANM. Three tanks were assigned as controls (river water filtered to 1 micron and UV sterilised) and three tanks assigned as wastewater treatments (ANM's final outfall wastewater). Low stocking densities were used to reduce the impact of territoriality on the fish. ~40 fish were added to each tank and maintained on a diet of frozen tubificid worms and trout pellets. Whole fish samples were collected at the termination of the trial for metals assays (as for silver perch above). This trial is still underway. The results will be included in the 1997 Annual Report.

2.3 River Environment Monitoring Surveys [W11]

2.3.1 Water

Sample Collection and Handling.

Grab samples were taken at three locations on the river on a monthly basis. Site 1 samples were taken from Mungabarena Reserve (approximately 4 km upstream of the outfall). Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

5 samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were "ANALAR" grade or better and, clean polyethylene gloves were worn

at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of water samples.

All metal analyses were performed by NATA registered :-

EML (Chem) Pty Ltd
425 -427 Canterbury Road
Surrey Hills Vic 3127

Concentrations of recoverable aluminium, cadmium, cobalt, chromium, copper, iron, manganese, mercury, lead and zinc were determined.

Physical and nutrient analyses were performed at the Murray-Darling Freshwater Research Centre (MDFRC). Turbidity, colour, specific conductance, total filterable solids, ammonia, oxides of nitrogen (NO_x), organic nitrogen, and total phosphorus were determined according to the methods outlined in the MDFRC Chemistry laboratory's methods manual and all except colour approved by NATA.

2.3.2 Sediment.

Sample Collection and Handling.

A series of forty sediment samples were taken on the 2nd of May 1996. Sediment samples were collected from three deposition zones on the River Murray. Deposition site A was located at Doctor's Point (about 2 km upstream of ANM's outfall). Deposition sites B and C were approximately equidistant (*ca* 500 m upstream and *ca* 500 m downstream) of ANM's outfall. Samples were collected at 10 meter intervals along the 60 cm depth contour (approximately 2 meters from, and parallel to, the river bank). A total of 20 samples were taken from each deposition zone.

Approximately the top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5% HCl) and repeatedly rinsed with Milli-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimise the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analysis were performed only on the sieved fraction (Grimshaw 1989).

Particle Size Analysis and Loss on Ignition (LOI)

Approximate particle fractionation was carried out on all samples. Fractionation was by the method described by Grimshaw (1989). Essentially, that portion of the sample which was retained by a 2 mm sieve was considered gravel. The portion of the sample that passed through a 2 mm sieve was considered a mixture of silt, clay and sand.

The percentage of silt + clay in this fraction was determined by the 4 minute 48 second hydrometer method described by Grimshaw (1989). The sand content was estimated by difference. No distinction between silt and clay content, or fine sand and coarse sand content was attempted.

Loss on ignition was determined gravimetrically after firing up to 20 g of dried sediment at 550 °C for 2 hours (Grimshaw 1989).

Analysis of Acid Extractable Metals.

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1989). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5% HCl and extensively rinsed with MILLI - Q water). 25 mL of 0.1 M "ARISTAR" grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a "Ratek" orbital shaking table for one hour. The samples were allowed to settle overnight and, subsequently filtered through acid washed Whatman GF/C filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5% HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to :-

Australian Government Analytical Laboratories (AGAL)
1 Suakin St
PYMBLE NSW 2073,

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury.

Approximately 10 g of air dried sample was placed in clean polyethylene bags and dispatched to AGAL for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen.

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9 % NaOH, 4.0 % $K_2S_2O_4$) and 20 mL of Milli-Q water was added to each tube. The tubes were sealed and subsequently heated in an autoclave for one hour. The solution was the analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et al* 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus.

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et al* 1989).

2.3.3 Macroinvertebrates

Monitoring of the macroinvertebrate fauna above and below the ANM wastewater discharge was performed using artificial substrate samplers as described in "Macroinvertebrates of the River Murray (Survey and Monitoring: 1980-1985)", (Bennison *et al* 1989). This standard sampling technique was used to obtain results that were directly comparable with respect to both temporal and spatial characteristics. The sampler, placed in an aquatic ecosystem acts as an artificial substrate so that colonisation by benthic organisms can be assessed.

Each sampler consists of a cylinder of black plastic "gutterguard" (mesh size ~ 10 mm^2) approximately 180 mm high by 180 mm diameter, the cylinder is closed on one end by a round piece of "gutterguard" and contains two knitted onion bags as complex substrate and a couple of small rocks as ballast. The top of the sampler is pinched and tied closed with a length of nylon cord which is attached to the limb of an overhanging tree. The sampler sits on the bed of the river for ~ 4 weeks before being retrieved using a net.

Artificial substrate samplers were set at three paired sites - the controls opposite Grey's farm approximately 500m above ANM's discharge; mixing zone near the railway bridge 200m below the discharge and downstream at Union Bridge 2 km below the discharge. Ten samplers were set monthly at each of the three sites and after a minimum of four weeks, six of these were collected using a fine mesh net and all ten replaced with clean samplers. This allows for the possible loss of four samplers each month due to disturbance ensuring that sufficient samples are collected. The samples were sieved to 500 μm to remove silt and the remaining portion retained and preserved in 70% alcohol. Samples were sorted using a stereo microscope and identified with reference to MDFRC's taxonomy collection.

Site data were analysed statistically to ascertain similarity/dissimilarity in community structure between site pairs using multivariate techniques developed at Plymouth Marine Laboratories, England (Clarke 1993, Clarke and Warwick 1994). The Bray Curtis metric is used to compute similarity and construct a dendogram linking samples based on their similarity to each other. Hypothesis testing of predefined groups is performed using

ANOSIM (analysis of similarity), which is analogous to the univariate ANOVA (analysis of variance). SIMPER (similarity percentages) were calculated to determine the proportional contribution of species to the dissimilarity between the predefined groups of samples.

Comparisons of the community structure data were summarised for inclusion in this Annual Report to ANM.

2.3.4 Fish

Following consultation with NSW Fisheries, and approval by ANM, NSW Environment Protection Authority and NSW Fisheries, fish surveys were no longer required as part of this monitoring program.

2.4 Reporting

Quarterly reports containing all test results and observations including physico-chemical data were submitted to ANM. This annual report containing a summary of results from the monitoring program was submitted to ANM for incorporation as an appendix to their annual report to fulfil their requirements for Condition W16 of Licence No.01272 issued by the NSW Environment Protection Authority.

3.0 RESULTS AND DISCUSSION

3.1 <u>Ecotoxicological and Bioaccumulation Monitoring</u> [W10]

3.1.1 Acute and Chronic Toxicity tests

Chironomid acute toxicity tests

Seven valid chironomid EC50 tests were conducted between January and September 1996. Figures 1a-c provide a summary of acute toxicity results for the chironomid tests conducted using three sources of ANM wastewater (final outfall, 4-day pond and pond inlet respectively), in 1996. No significant mortalities (>20%) were recorded.

Daphnid acute toxicity tests

Eight valid daphnid EC50 tests were conducted between January and September 1996. Figures 2a-c provide a summary of acute toxicity results for the daphnid tests conducted using three sources of ANM wastewater (final outfall, 4-day pond and pond inlet respectively), in 1996. No significant mortalities (>20%) were recorded for the final outfall sample (Figure 2a). In Figure 2b (4 day pond wastewater), significant mortalities were recorded for the April sample at 100% concentration and for the June 1% concentration. In Figure 2c (pond inlet wastewater), significant mortalities were recorded for the April and July samples at 100% concentration.

Daphnid chronic toxicity tests

Four valid daphnia survival/maturation/reproduction tests were conducted between January and September 1996. A summary of these chronic toxicity test results using "t" values to compare the mean number of young produced in each treatment, compared with the control is provided in Figure 3. A "t" value that exceeds +2.1 ($p > 0.05$)denotes a significant reduction in the number of young produced, and conversely, a "t" value that exceeds -2.1 ($p>0.05$) denotes a significant increase in the number of young produced. A significant reduction in the number of young produced by daphnids exposed to ANM's treated wastewater occurred; in January, for final outfall 100% and 10%, pond 10% and pond inlet 100% and 1% concentrations; in March, for pond 100% and pond inlet 1%

concentrations; in July, for pond 10%, pond inlet 100% and 1% concentrations; and in September, for final outfall 100% and pond 100% concentrations.

Given that the final concentration of ANM final outfall wastewater in the River Murray would not exceed 1% concentration, there is no evidence to suggest any acute or chronic toxicity to riverine invertebrates from ANM's discharge, based on the sensitivity of these cladoceran crustacean tests.

3.1.2 Bioaccumulation Studies

Yabby

A nine month *C.destructor* trial commenced in September 1995, terminating in May 1996. There was no significant difference in the length measurements between treatments, but the animals living in ANM's wastewater were significantly heavier than those living in river water (reported in the second quarter report to ANM, dated 8 July 1996).

The results (mean of three subsamples) for the eight metals assayed (aluminium, arsenic, cadmium, copper, iron, lead, manganese and zinc) are presented in Figures 4a-h. At each sampling date there are two control sample results and one test (wastewater) sample result. There was no consistent difference in the concentrations of aluminium (Figure 4a), cadmium (Figure 4c), copper (Figure 4d), iron (Figure 4e), lead (Figure 4f), or zinc (Figure 4h) between treatments. The lead and cadmium concentrations were below 0.5 mg/kg, and the zinc concentration was variable ranging from 77-109 mg/kg, with the control 1 sample in February 1996, an outlier at 354 mg/kg. Aluminium levels ranged from 134 mg/kg (test 3 in February 1996) to 748 mg/kg (control 1 initial sample in September 1995). Copper levels ranged from 42-63 mg/kg. Iron levels ranged from 80-262 mg/kg, the control 1 sample from February 1996, again an outlier at 1646 mg/kg.

Arsenic levels (Figure 4b), showed a higher concentration for test animals compared with control animals, although these concentrations remained below 1.6 mg/kg, significantly lower than last years levels which peaked at 9 mg/kg. In last year's Annual Report, the possibility of contamination of the test with arsenic was discussed due to unexpected levels.

The pellet feed used for both year's trials was tested along with the animal samples and found to contain arsenic at ~0.6 mg/kg.

Manganese concentrations (Figure 4g), were consistently higher in samples from the test tanks, peaking at 450 mg/kg in November, compared with the controls at ~200 mg/kg at the same time, and of similar magnitude to last years results. The concentration in test animals dropped to ~ 260 mg/kg in February. This peak and fall is probably the result of the yabbies growing and moulting the carapace they have carried through the winter in November/December as the water temperatures and daylength increase. These old carapaces are discoloured and may be covered by a type of bacterium which oxidises manganese, resulting in high concentrations of manganese attached to the surface (Ehrlich 1990, Tyler 1970, Tyler and Marshall 1967a & 1967b). A short trial to determine the validity of this theory is presently underway, and will be reported in the 1997 Annual report.

Silver perch

The 4 week Silver Perch (*Bidyanus bidyanus*) trial was conducted in April 1996. No significant difference in growth between control and wastewater treatments was recorded. (reported in the second quarter report to ANM, dated 8 July 1996).

The results (mean of three subsamples) for the seven metals detected; aluminium, arsenic, copper, iron, lead, manganese and zinc, are presented in Figures 5a-g (cadmium levels were below the detection limit). The data for one initial sample, three replicate control samples and three replicate test (wastewater) samples are plotted on the figure, and the final column depicts the commercial trout pellet feed used throughout the trial. Aluminium levels (Figure 5a) decreased in the controls and increased in two of the test replicates. Arsenic (Figure 5b) increased similarly in all control and test replicates. Iron (Figure 5d) and lead (Figure 5e) increased slightly in two of the test replicates. Zinc and Copper decreased similarly in all control and test replicates. This variation fails to indicate any consistent difference for any of the metals tested between control fish and treatment fish. The trial was confounded by the presence of metals in the feed. The commercial pellets were high in most metals (Mn, Pb, Fe, and Cu) assayed, compared with the fish samples, including ~2.6 mg/kg arsenic (figure 5b). The manufacturer was notified and the matter is currently under investigation. The pellet feed was discarded and a new feed was used for the carp gudgeon bioaccumulation trial presently underway.

These bioaccumulation studies have demonstrated little effect from exposure to 50 -100% ANM wastewater. The longer term yabby trial show increased growth and some bioaccumulation of manganese (the latter, probably due to bacterial action on the carapaces of the animals). The short term perch trial showed no consistent difference between treatments. Over a longer period the high metals levels in the feed would reduce the sensitivity of this type of trial. Fish may grow more rapidly in the warmer wastewater, consuming more feed and consequently more metals. Therefore, even if differences between control and treatment were detected it would be inaccurate to attribute this to the ANM wastewater.

3.2 River Environment Monitoring Surveys [W11]

3.2.1 Water

A summary of the water quality data is presented in Figure 6. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.) All the water-quality data accumulated since the commencement of the monitoring program (January 1992) has also been included for purpose of comparison. The figure does not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.006 mg/L), chromium (0.01 mg/L), lead (0.03 mg/L) and mercury (0.0005 mg/L) were not detected in any of the samples (detection limits in brackets). Copper (detection limit of 0.004 mg/L) was detected on only three occasions - site 1 on the 20/5/96 (0.006 mg/L), sites 1, 2 and 3 on the 44/6/96 (0.006, 0.010 and 0.008 mg/L respectively) and at site 2 on the 22/7/96 (0.005 mg/L).

Generally, most of the data show little (if any) variation between sites although there may be significant variation over time (seasonal effects). The exceptions to this generality are the water samples taken in June and July of 1996. From the figure it can be seen that many of the analytes show a peak in June/July for sites 2 and 3 but not for site 1. While it is not possible to definitively identify the cause of this increase, it is possible to speculate on its nature. From Figure 6 it can be seen that the peak corresponds to a large increase in the particulate load (turbidity) at sites 2 and 3 but not site 1. Indeed the increase at these two sites is primarily in analytes normally associated with particulates (eg. Fe, Al, P, organic N) but not in analytes normally found in the dissolved phase (conductivity, TDS, NH_3 or NO_x). This strongly suggests that the peak was caused by an increase in particulate matter rather than as a result of discharge from ANM's outfall. The source of the increased particulate load at sites 2 (above the outfall) and 3 (below the outfall) is not known but may relate to remedial earthworks at Hume Dam or inputs from a tributary stream.

3.2.2 Sediments

Mercury, tin, molybdenum, and silver (all with detection limits of 0.05 mg/kg) were not detected in any of the sediment samples. Arsenic, cadmium and barium was found in samples from above the outfall at low levels but not from samples taken below the outfall. Arsenic was detected in all of the sediments from site A (range 0.05 - 0.15 mg/kg) and 8 of the samples from site B (range 0.05 - 0.25 mg/kg). Cadmium was found in seven of the sample from site A (range 0.05 - 0.15 mg/kg) and 3 samples from site B (0.05 - 0.25 mg/kg) while barium was found in 4 samples from site A (0.05 - 0.25 mg/kg) and 8 samples from site B (0.05 - 0.10 mg/kg).

The results for the sediment analyses for total persulfate nitrogen (N), exchangeable phosphorus (P) and acid extractable aluminium, calcium, copper, iron, lanthanum, lead, magnesium, manganese, nickel, silica, strontium, yttrium and zinc are summarised in Figure 7. For each analyte a box plot showing the analytes distribution for samples taken at Doctors Point (marked A on Figure 7), directly above the outfall (B) and below the outfall (c) are presented. The solid horizontal lines of the box plot represent the 10^{th}, 25^{th}, 50^{th}, 75^{th} and, 90^{th} percentiles of the data - the box itself represents the 25^{th} to 75^{th} percentile. All data outside the 10^{th} and 90^{th} percentiles are shown as open circles on the plots. The mean of the data is represented by a dotted line. From the figure it is clear that all of the samples from the two upstream deposition zones have a greater range and mean concentration than those of the down stream sites. Indeed it can be seen that both the highest means and ranges for all analytes were from the deposition zone at Doctors Point.

An extensive series of elements was determined including total persulfate nitrogen, exchangeable phosphorus and acid extractable aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. Unlike previous years it can be seen that the upstream sediments tend to have a greater distribution in the concentration of analytes than the down sites and further that the mean concentration for the upstream sites (A and B) tend to be significantly higher than for the downstream site (C). It is also of note that the sediments taken from Doctor's Point consistently have a significantly higher concentration of elements than the other sites.

The question remains as to whether discharge from ANM's outfall is having a measurable effect on sediment quality in the river Murray. The data presented in this and previous reports clearly show that the sediment composition found downstream of the outfall falls within the range found along this stretch of the river Murray. Data were presented in the 1995 annual report to show that for many elements there was a good relationship between the organic carbon content of the sample (determined by the surrogate measure of Loss on ignition - LOI) and the analyte of interest. With the exception of Cu, samples from upstream and downstream of the outfall tended to fall on the same continuum - indicating that the same processes were operating above and below the outfall. A similar (albeit weaker) correlation between LOI and some of the analytes of interest was also observed in this year's data (including the deposition zone from Doctors point) - Figure 8. The correlation between LOI and analyte concentration coupled with the observation that these correlations are mostly independent of site supports the proposition that variations in sediment composition is a function of the geomorphology of the particular deposition zones being studied - the more that finer material and organic material could be trapped in a deposition zone , the higher the analyte concentration found in those samples.

3.2.3 Macroinvertebrates

The complete 1995 species list and abundance data for each of three replicate baskets at the 6 sites on the River Murray, presented by month is included in Table 1 (24 pages). The totals and % totals for each species on the last two of these pages show the mayfly (ephemeroptera) larva, Caenid Genus B as most common taxa, contributing 40% and the caddisfly (trichoptera) larva, *Ecnomus pansus* as next most common taxa, contributing 7.5% to the total macroinvertebrate abundance. The mean percentage abundance data for each site at each sampling time was analysed using a Bray-Curtis Similarity matrix (Clarke 1993, Clarke and Warwick 1994). These results are displayed in the cluster analysis dendogram (Figure 9). The dendogram groupings for the whole year show no biological differences between sites with limited grouping according to sampling period/season.

In an attempt to increase the sensitivity of the analyses the cluster analysis was also performed on smaller portions of the data set, separated by season and sampling date, and, by reducing the number of species used in the analyses, focussing on common groups. None of these analyses produced any clearer groupings of samples and as such, are not included in this report.

The complete mean percentage abundance data set was tested for statistically significant difference using a 2-way nested ANOSIM (Clarke 1993, Clarke and Warwick 1994), with factor one as river flow (high/low) and factor two as site classification (upstream/mixing zone/downstream). 12 to 13 high flow samples and 4 to 8 low flow samples were tested for each site classification. (High flow conditions on the River Murray are sustained during the irrigation season - September to March. During the winter the flow/depth of the river at the sites is dramatically reduced). These results (Table 2) showed that the different site classifications with respect to ANM's wastewater discharge contributed only 11.5% to the variation, whereas the difference in flow conditions contributed 77.8% to the variation between the samples. Therefore, the influence of site is insignificant compared with the influence of flow, and correspondingly season, on the variation in macroinvertebrate community composition.

A breakdown of dissimilarity between the ANOSIM groups using SIMPER (Clarke 1993, Clarke and Warwick 1994) is depicted in Table 3. The most similar (48.4% dissimilar) groups were high flow downstream and low flow downstream groups. The least similar (69.4% dissimilar) groups were high flow downstream and low flow up stream groups. This continues to highlight the spatial and temporal variability, with no correlation to position in relation to ANM's discharge.

Table 4 follows on from Table 3 and highlights the main species that contribute in total 50% of the difference between the groups tested. In all cases, 4 to 6 taxa out of a total of 100, contributed to this proportion of the variation. The dominant taxa; Caenidae Genus B (mayfly), *Ecnomus pansus* (caddisfly), Turbellaria spp. (flatworm), *Peza ops* (mite) and Oligochaete spp. (worm) generally contributed the greatest proportion of the difference. This pattern reflects the seasonal dominance of the macroinvertebrates which have aquatic larval stages and emphasises the overall dominance of seasonal effects in these data.

Overall, there was no difference in the macroinvertebrate community structure between river sites for each sampling period, and therefore, no detected effect of ANM's wastewater discharge.

The samples for 1996 are currently being identified and analysed for inclusion in the 1997 annual report.

3.2.4 Fish

Fish surveys were not required following a decision reached at the annual meeting (2 November 1995) and ratified by Allan Lugg from NSW Fisheries (29 January 1996).

4.0 COMMUNICATION

The revised monitoring program entitled "Biological Monitoring Program Proposal for Australian Newsprint Mills Ltd Albury" incorporating changes to the program since its inception in 1991, submitted to NSW Fisheries and EPA NSW in May 1995, was approved and adopted in January 1995.

The annual review meeting was held on 12 November 1996, with participants from Department of Land and Water Conservation, Environment Protection Authority, Australian Newsprint Mills and The Murray-Darling Freshwater Research Centre.

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APPENDIX 1 (Figures)

Figure 1a-c: Acute toxicity results for seven chironomid tests exposed to three concentrations of three types of ANM wastewater during 1996. Where a percentage mortality greater than 20% is considered a significant result.

Figure 1a: Chironomid 48hour EC50 - Final Outfall
(>20% = significant mortality)

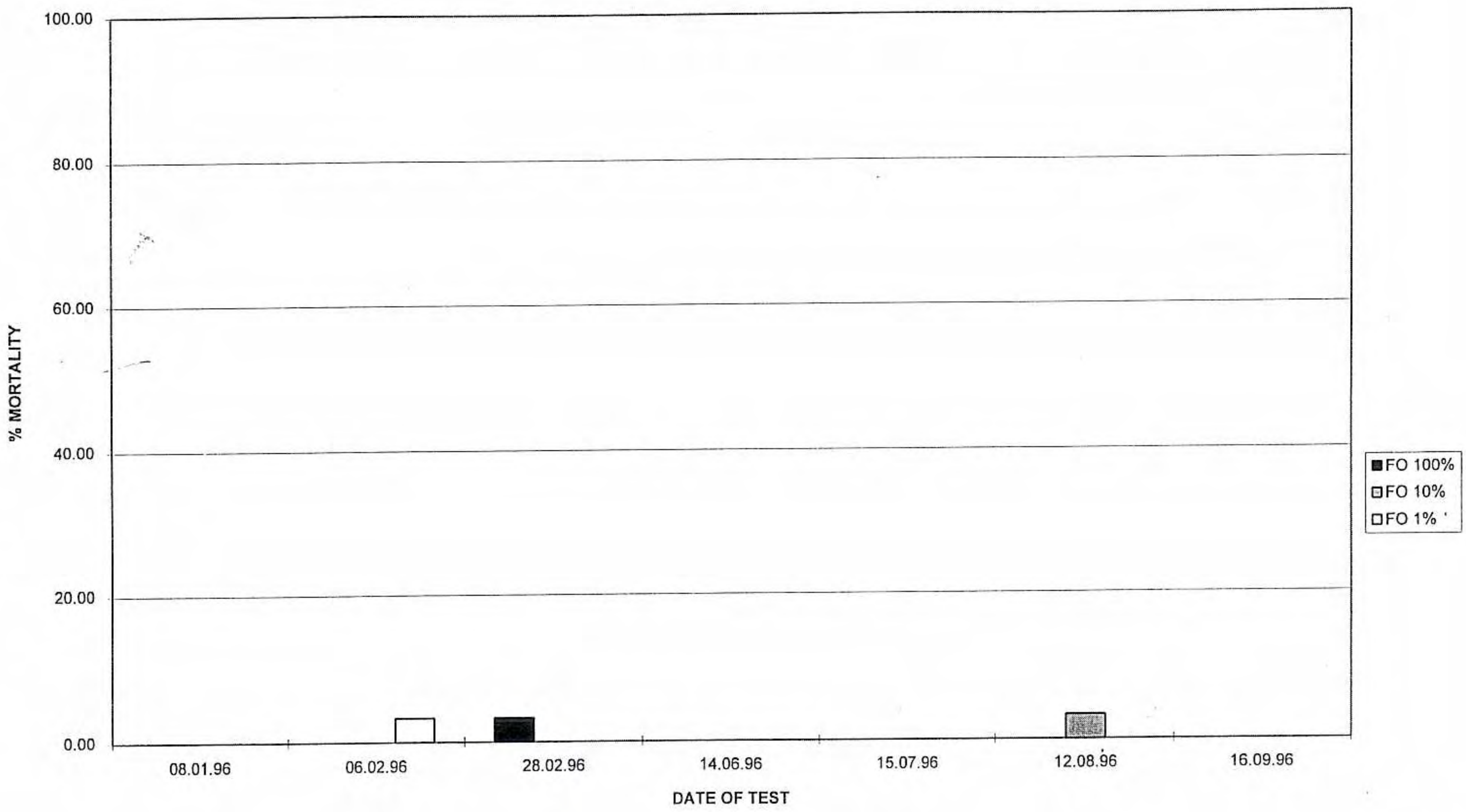


Figure 1b: Chironomid 48hour EC50 - 4 Day Pond
(>20% = significant mortality)

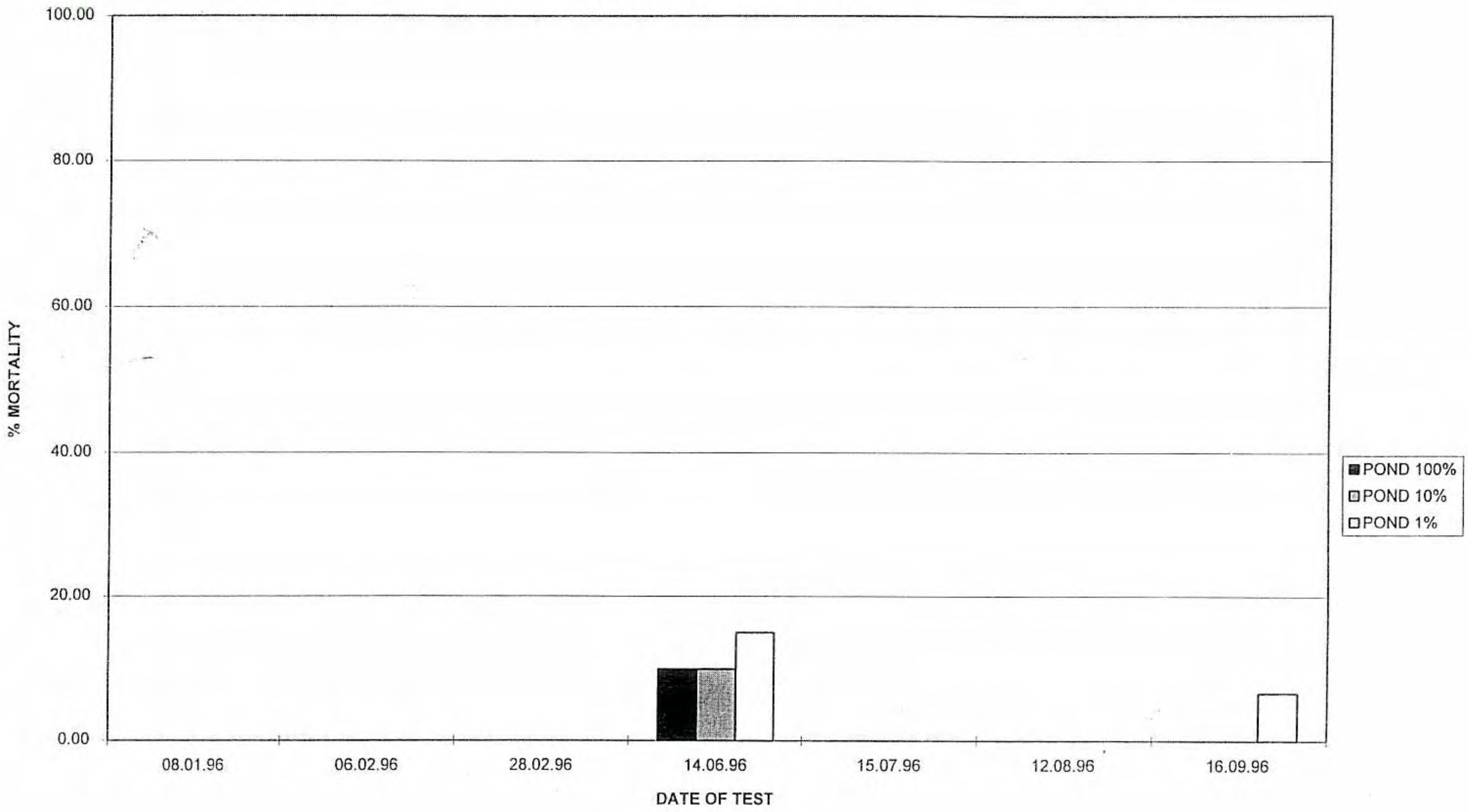


Figure 1c: Chironomid 48hour EC50 - Pond Inlet
(>20% = significant mortality)

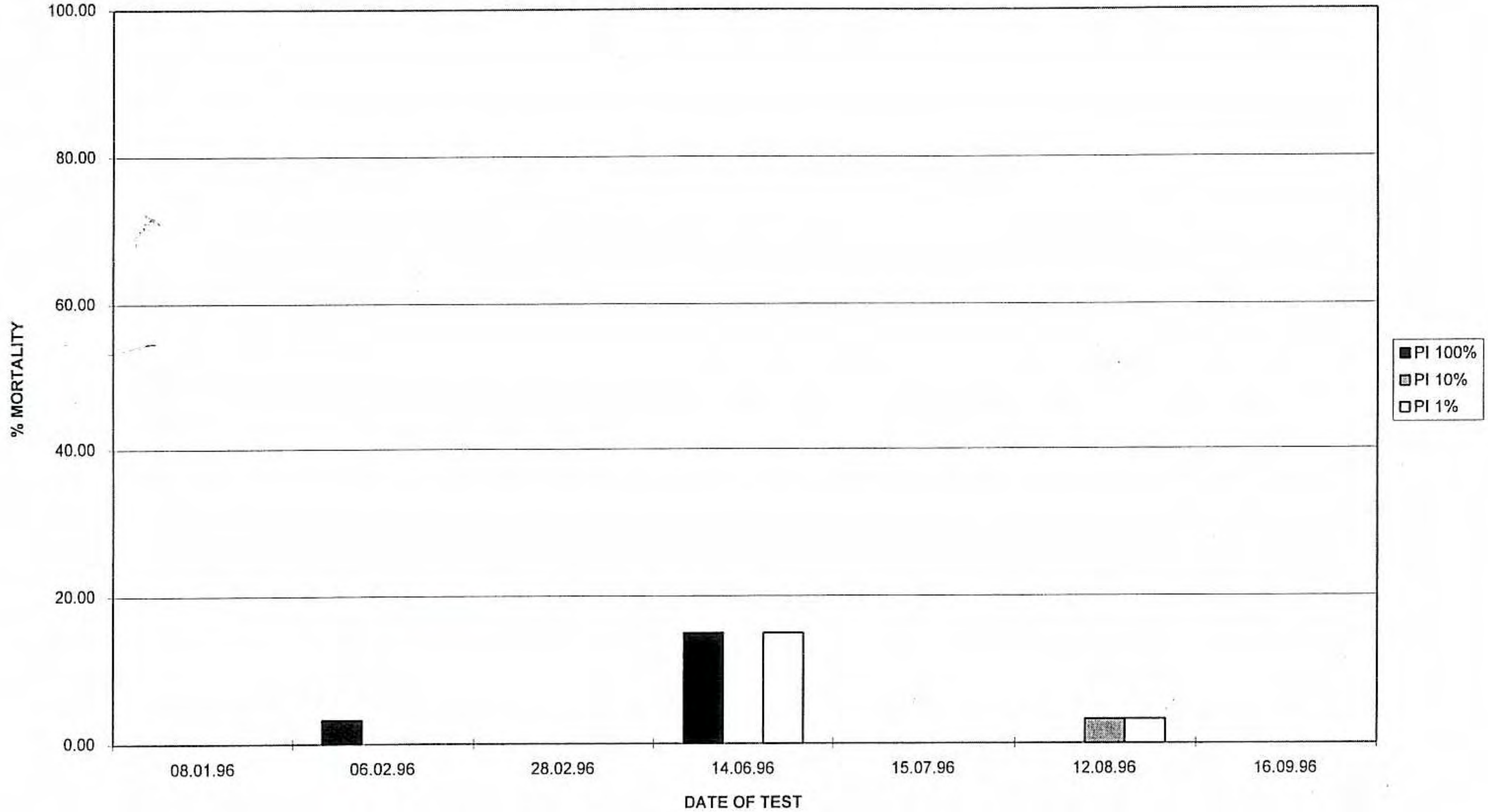


Figure 2a-c: Acute toxicity results for eight Daphnia tests exposed to three concentrations of three types of ANM wastewater during 1996. Where a percentage mortality greater than 20% is considered a significant result.

Figure 2a: Daphnia 48 hour EC50 - Final Outfall
(>20% = significant mortality)

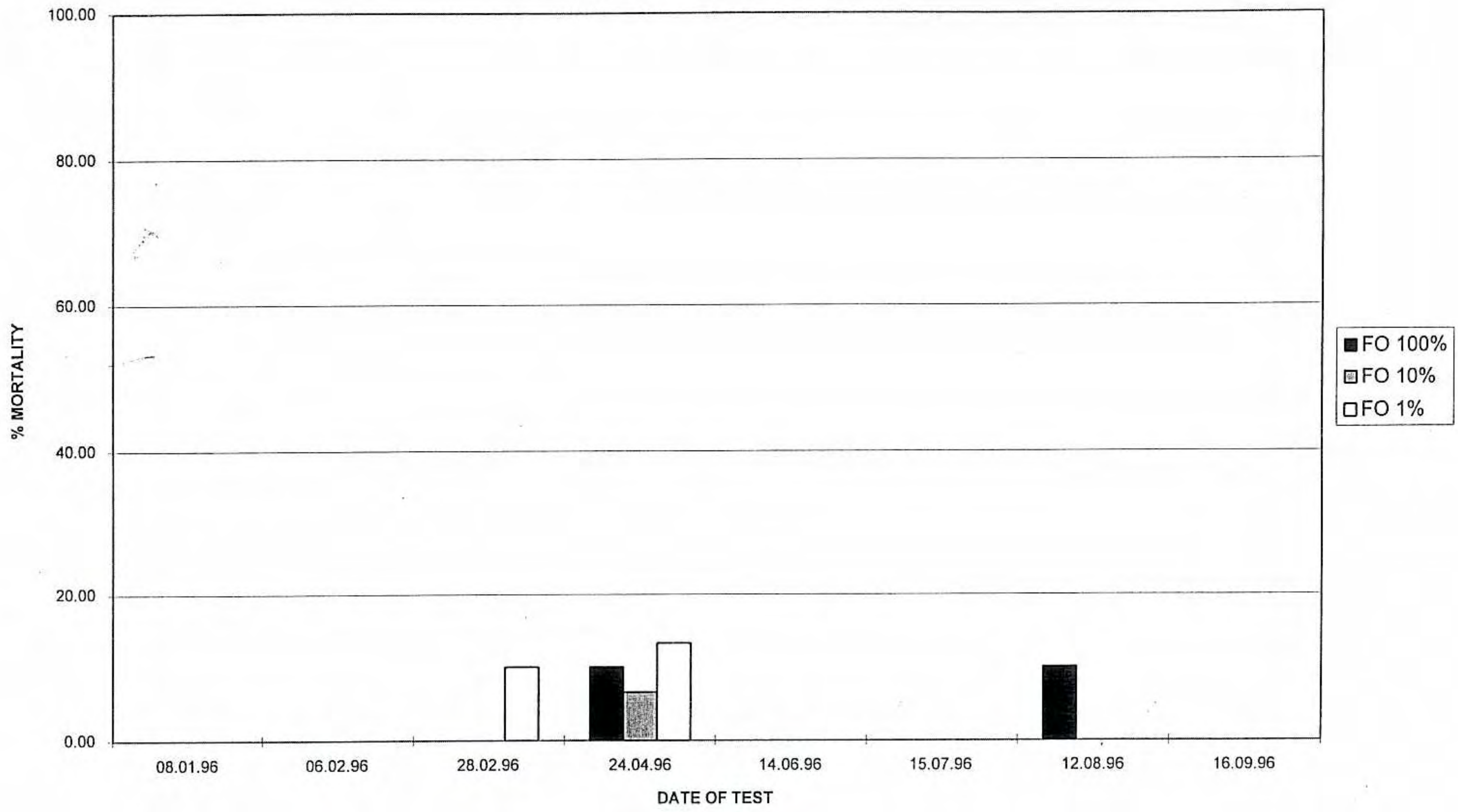


Figure 2b: Daphnia 48 hour EC50 - 4 Day Pond
(>20% = significant mortality)

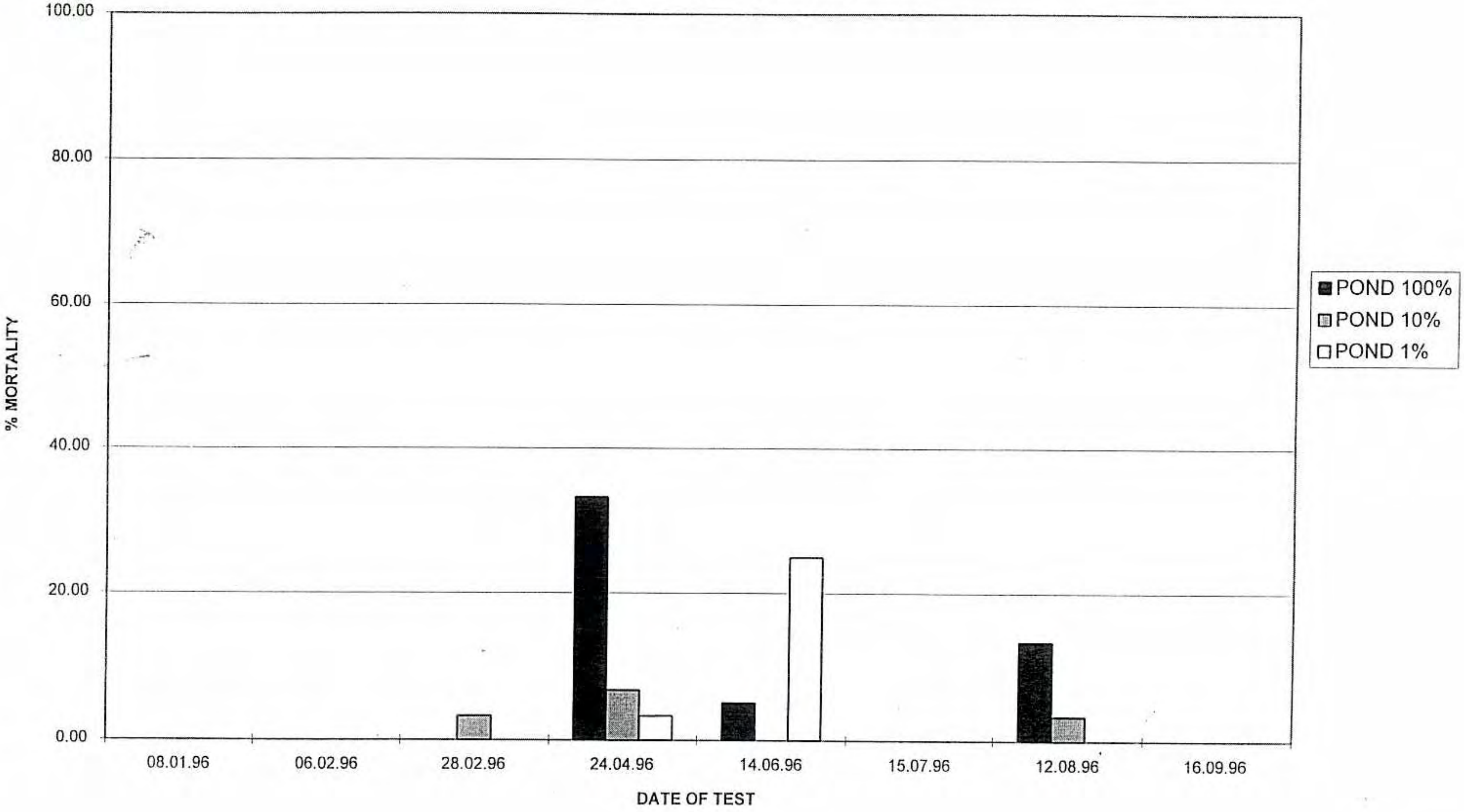


Figure 2c: Daphnia 48 hour EC50 - Pond Inlet
(>20% = significant mortality)

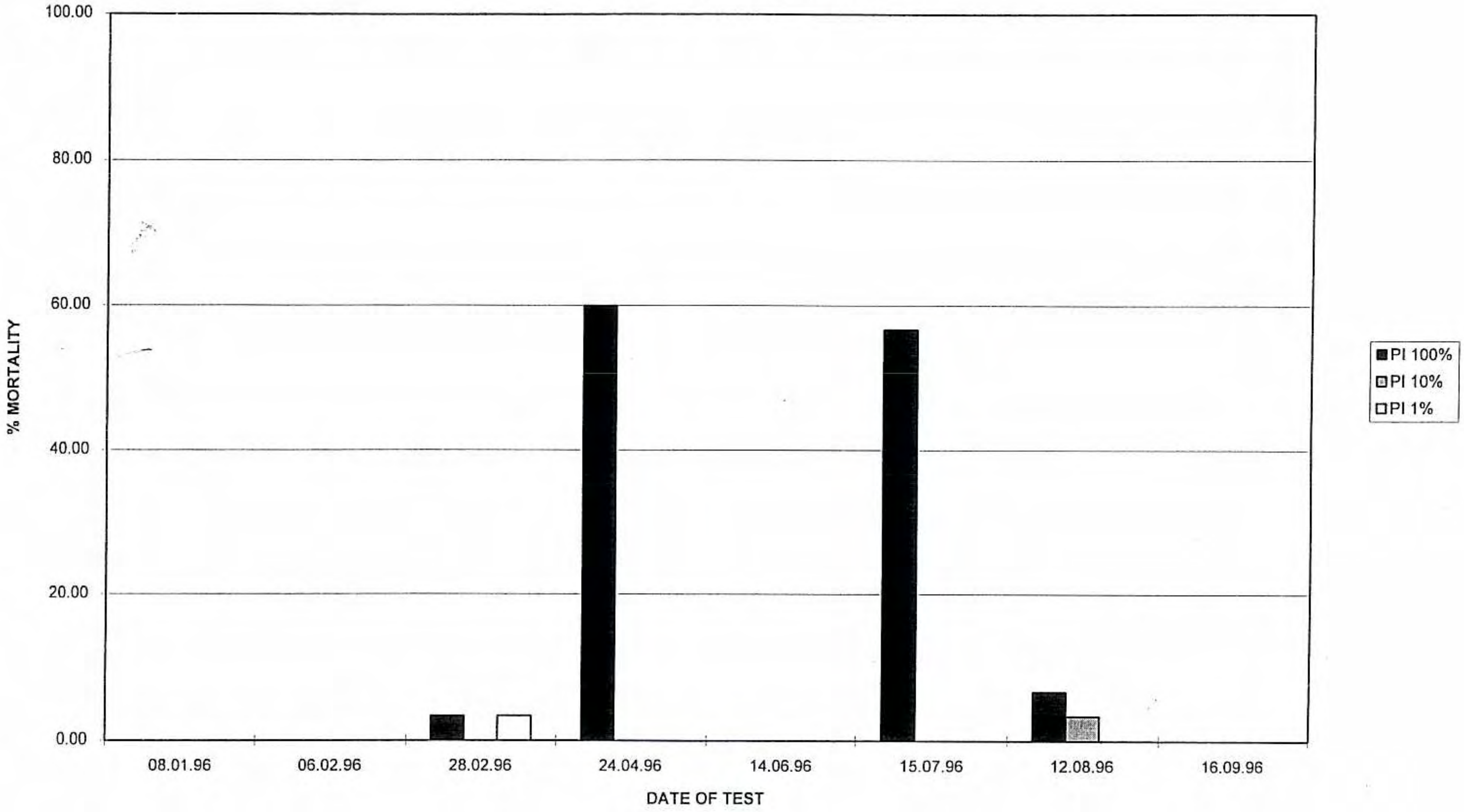


Figure 3: Chronic toxicity results for four Daphnia tests exposed to three concentrations of three types of ANM wastewater during 1996. Where the mean number of young produced by the animals in each treatment is compared, using "t-tests" with the control. A "t" value greater than ±2.1 is considered a significant difference, the +ve exceedences indicate a reduction and the -ve exceedence indicates an increase in the abundance of young produced.

Figure 3: Daphnia 21 Day Chronic Toxicity Test - Statistical Significance of Young Production, (t-test results where > +/- 2.1 is significant)

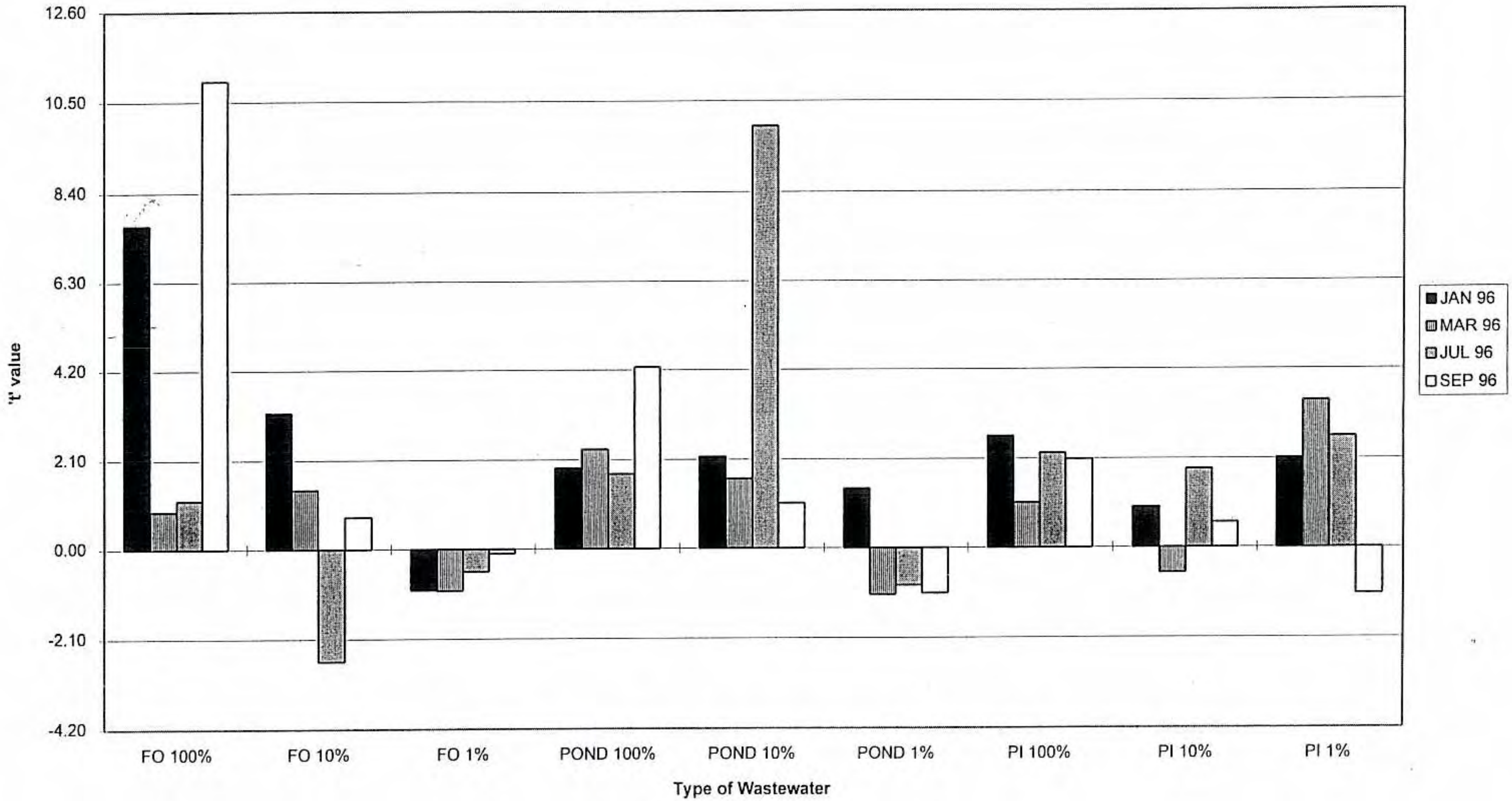


Figure 4a-h: Mean concentrations (3 subsamples) of eight metals (aluminium, arsenic, cadmium, copper, iron, lead, manganese and zinc) in pellet feed and whole yabby samples, taken at three month intervals for two controls and one test treatment exposed to ANM wastewater during the 1995/1996 bioaccumulation trial.

Figure 4a: Yabby Aluminium Concentration

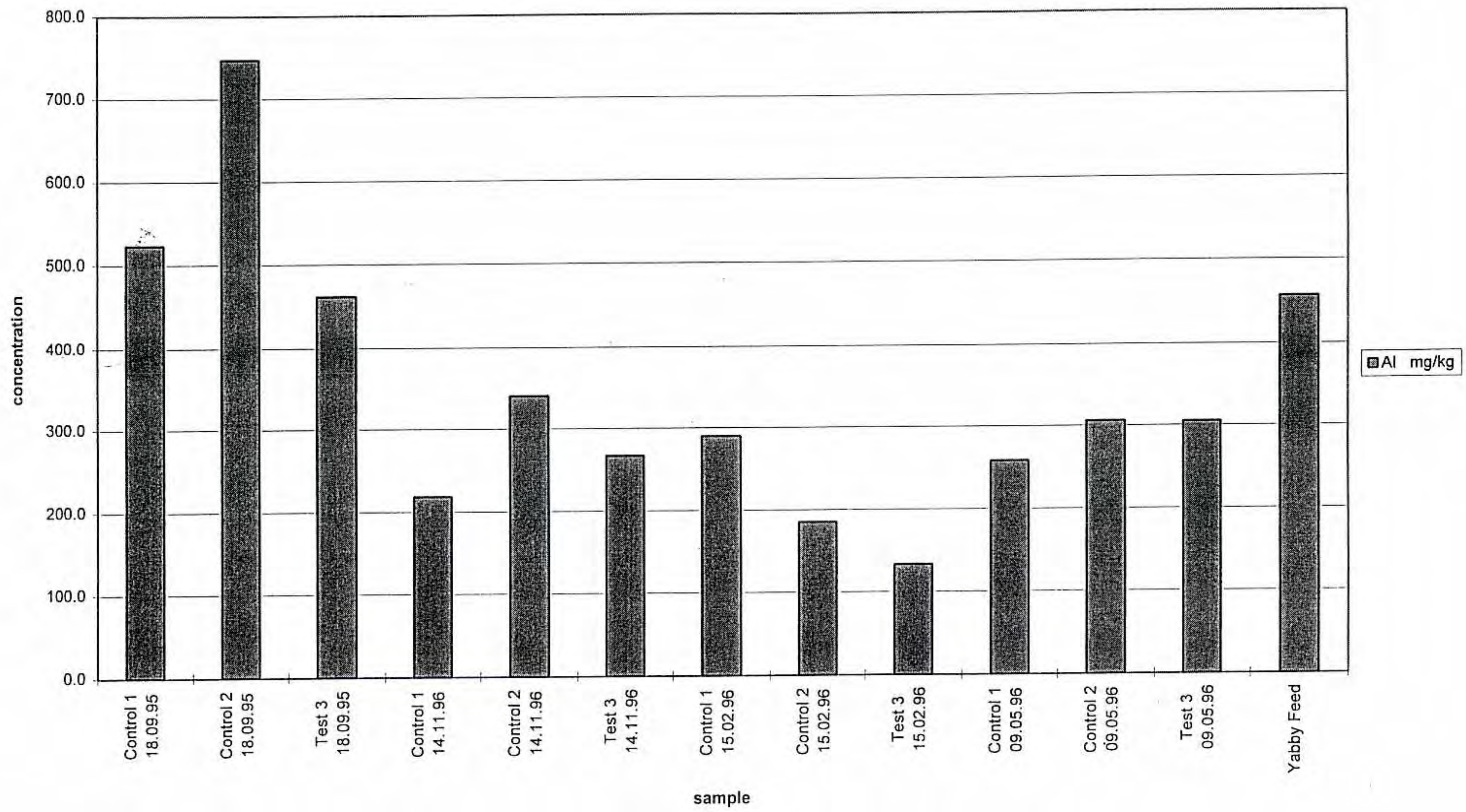


Figure 4b: Yabby Arsenic Concentration

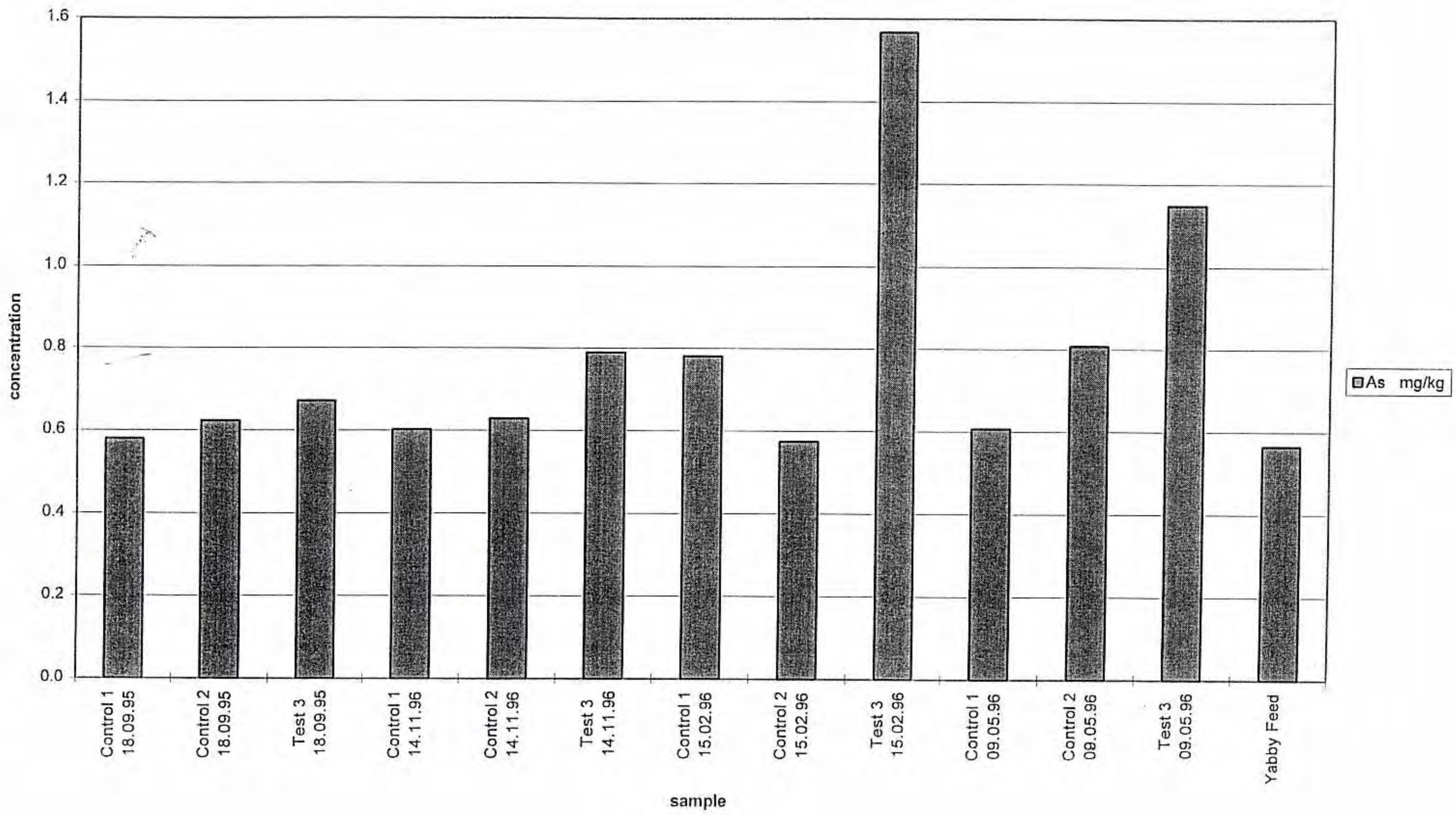


Figure 4c: Yabby Cadmium Concentration

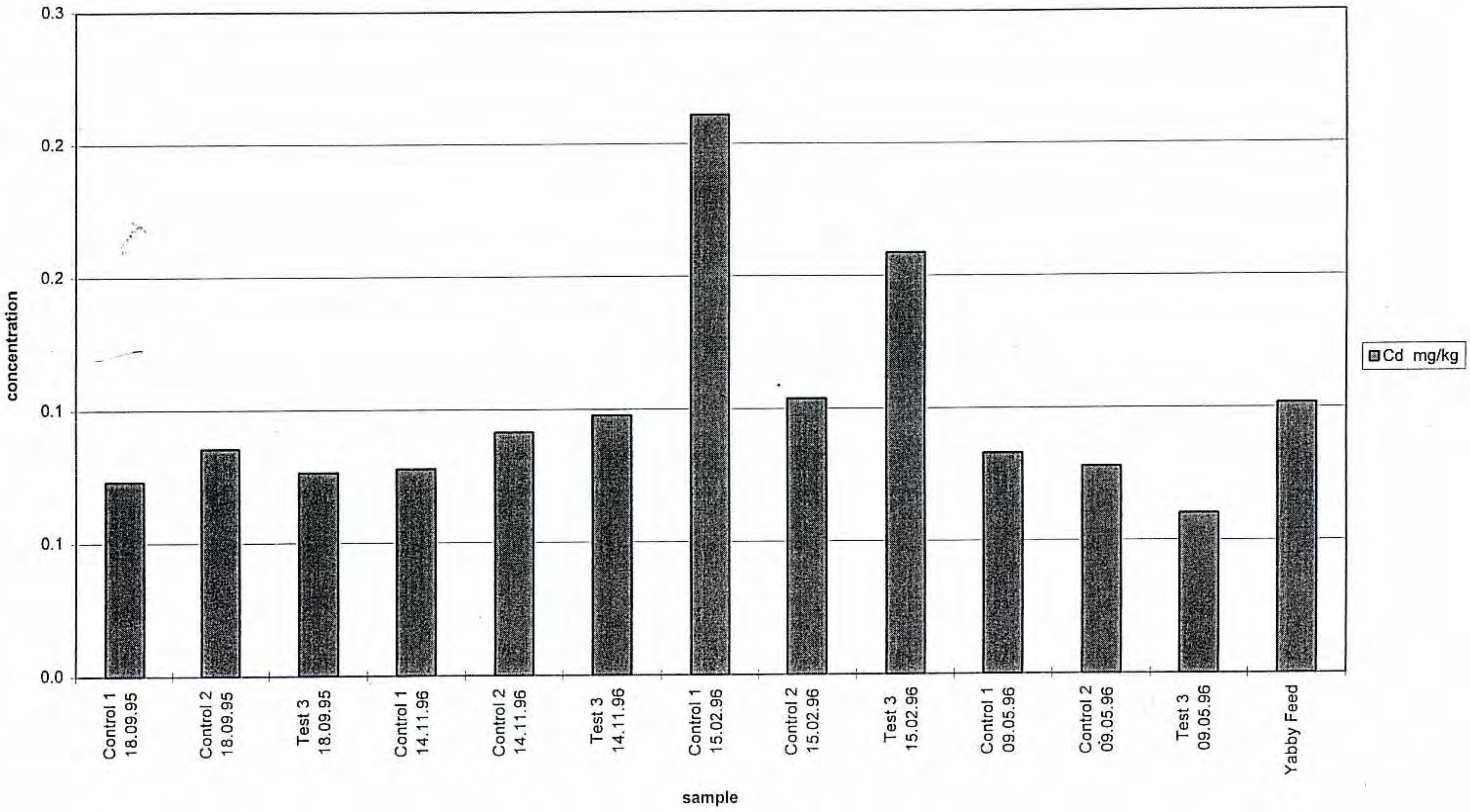


Figure 4d: Yabby Copper Concentration

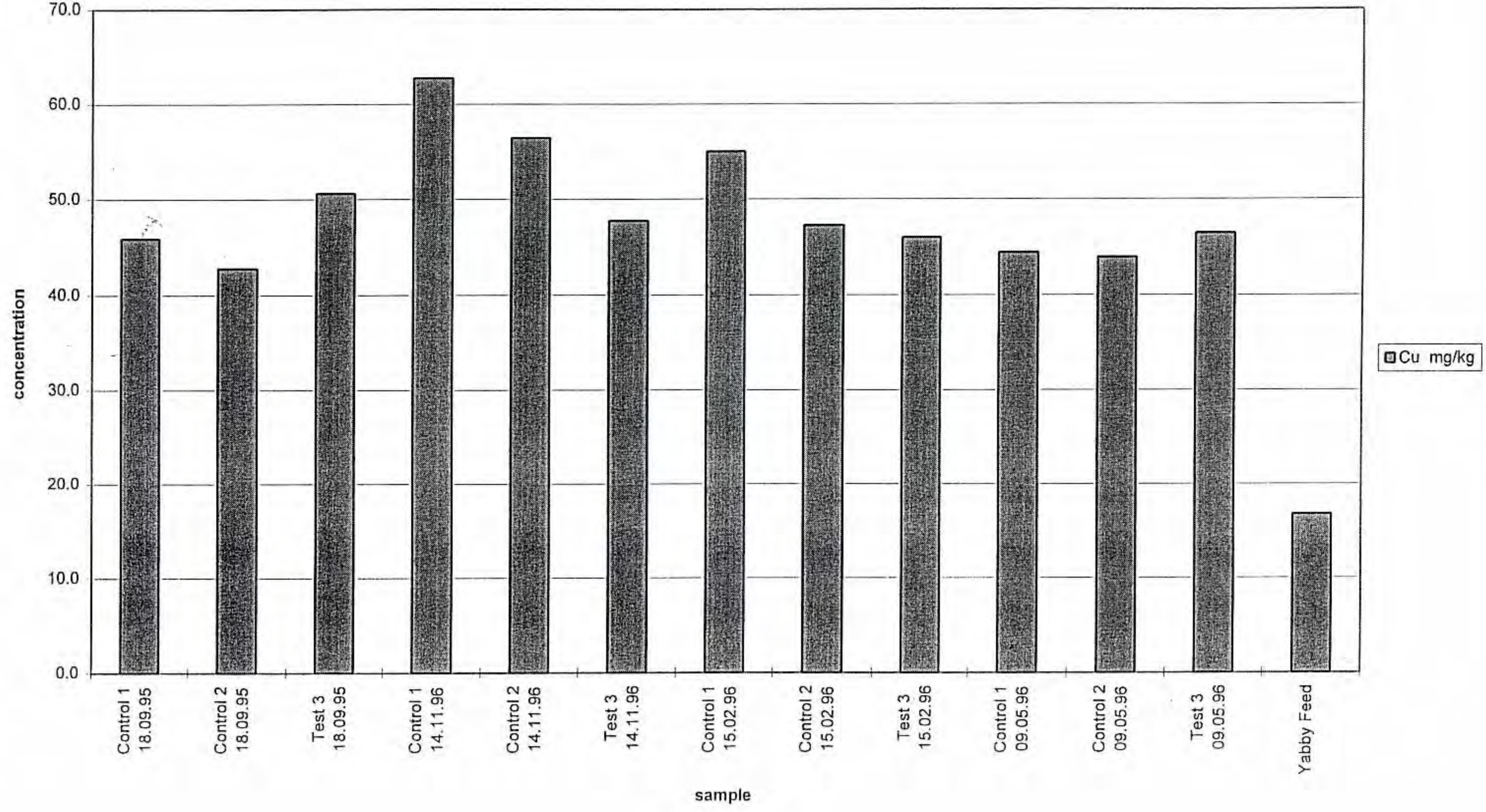


Figure 4e: Yabby Iron Concentration

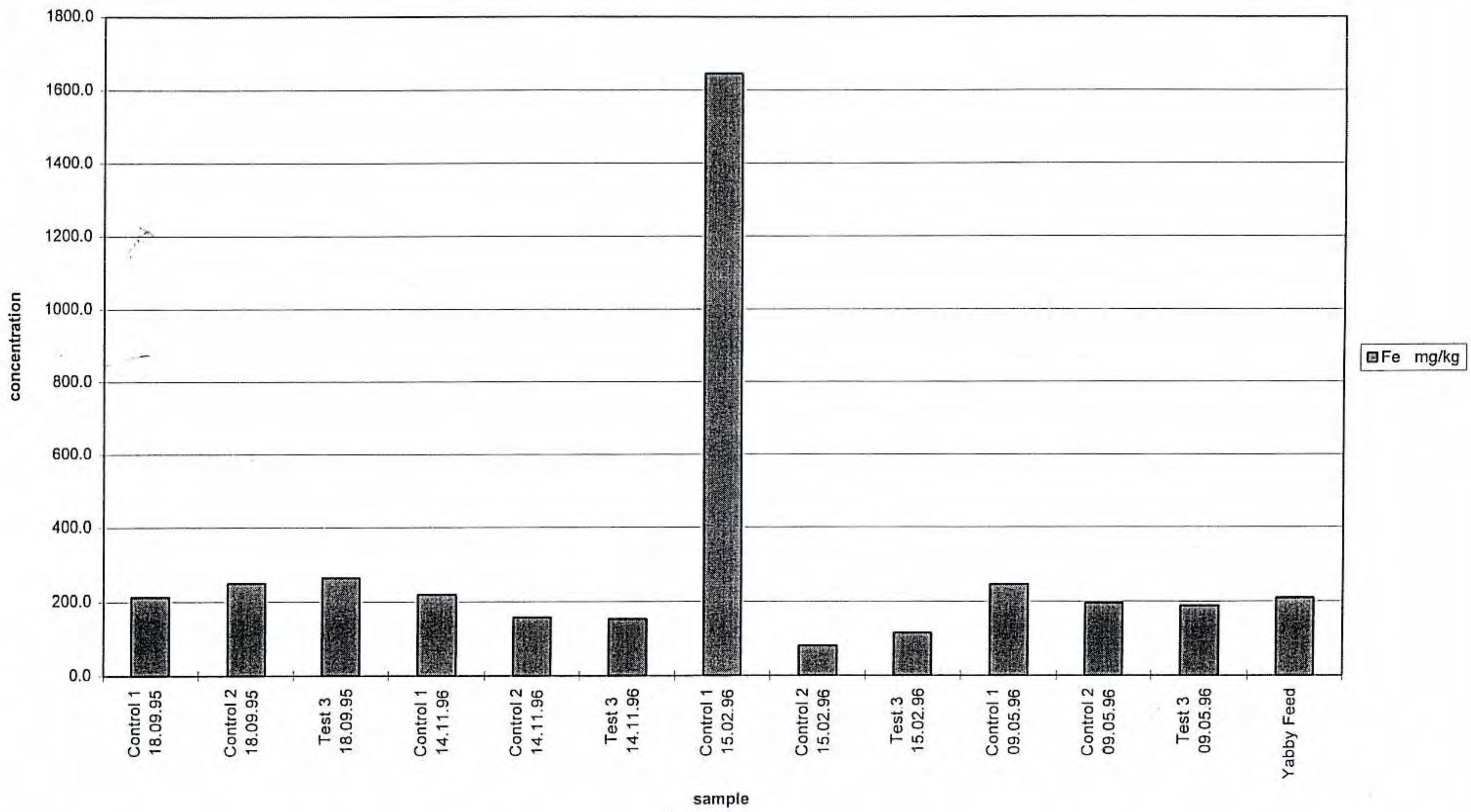


Figure 4f: Yabby Lead Concentration

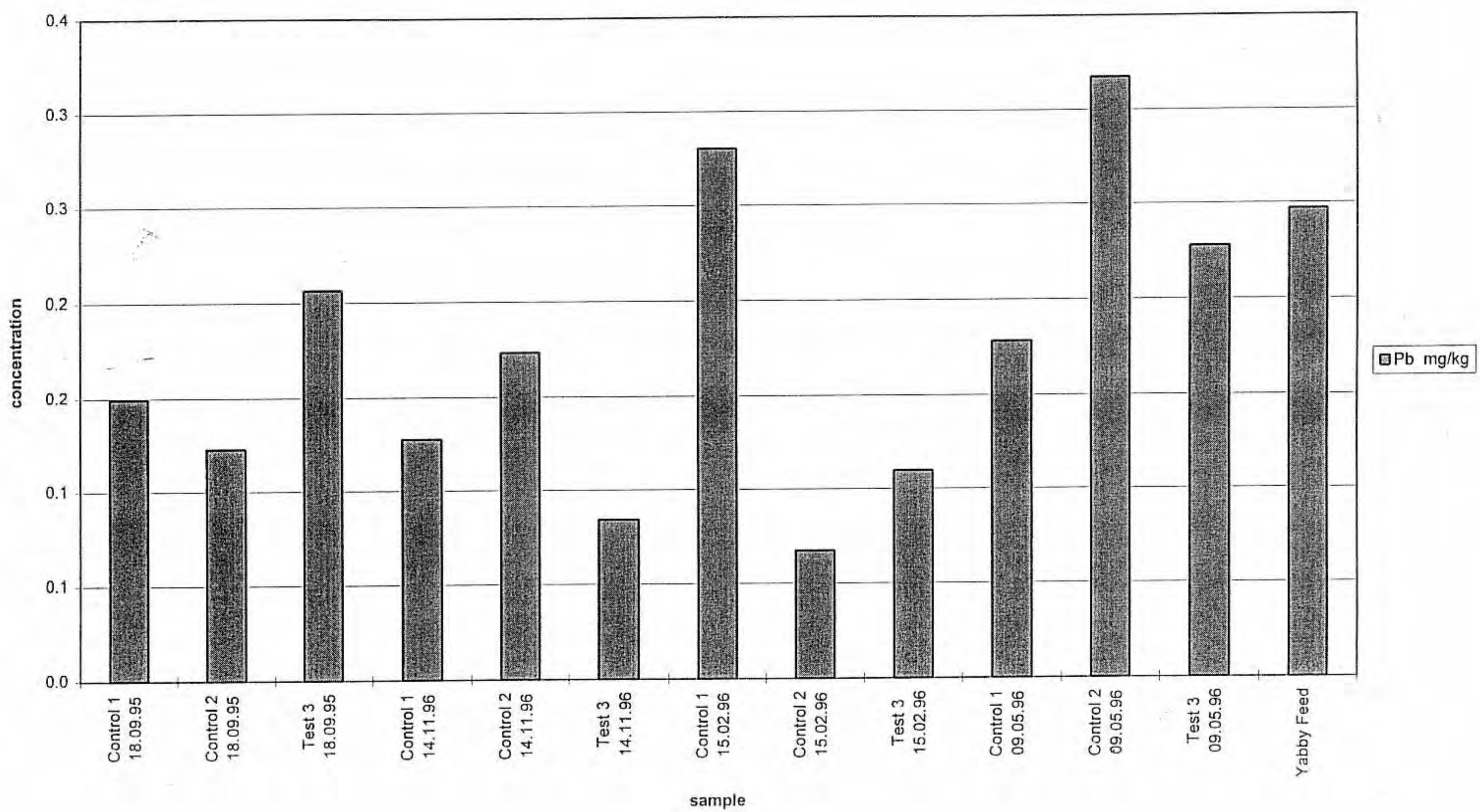


Figure 4g: Yabby Manganese Concentration

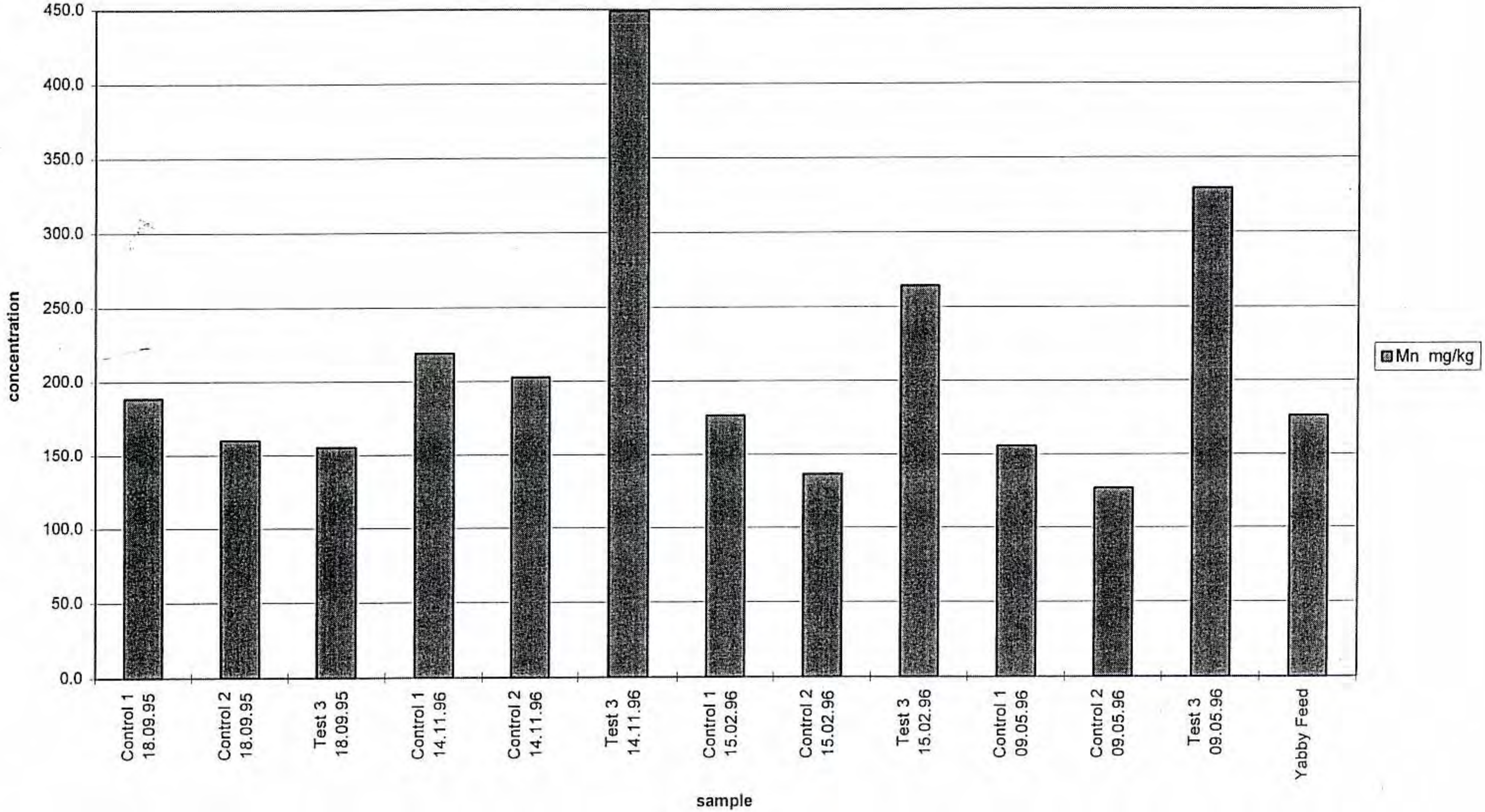


Figure 4h: Yabby Zinc Concentration

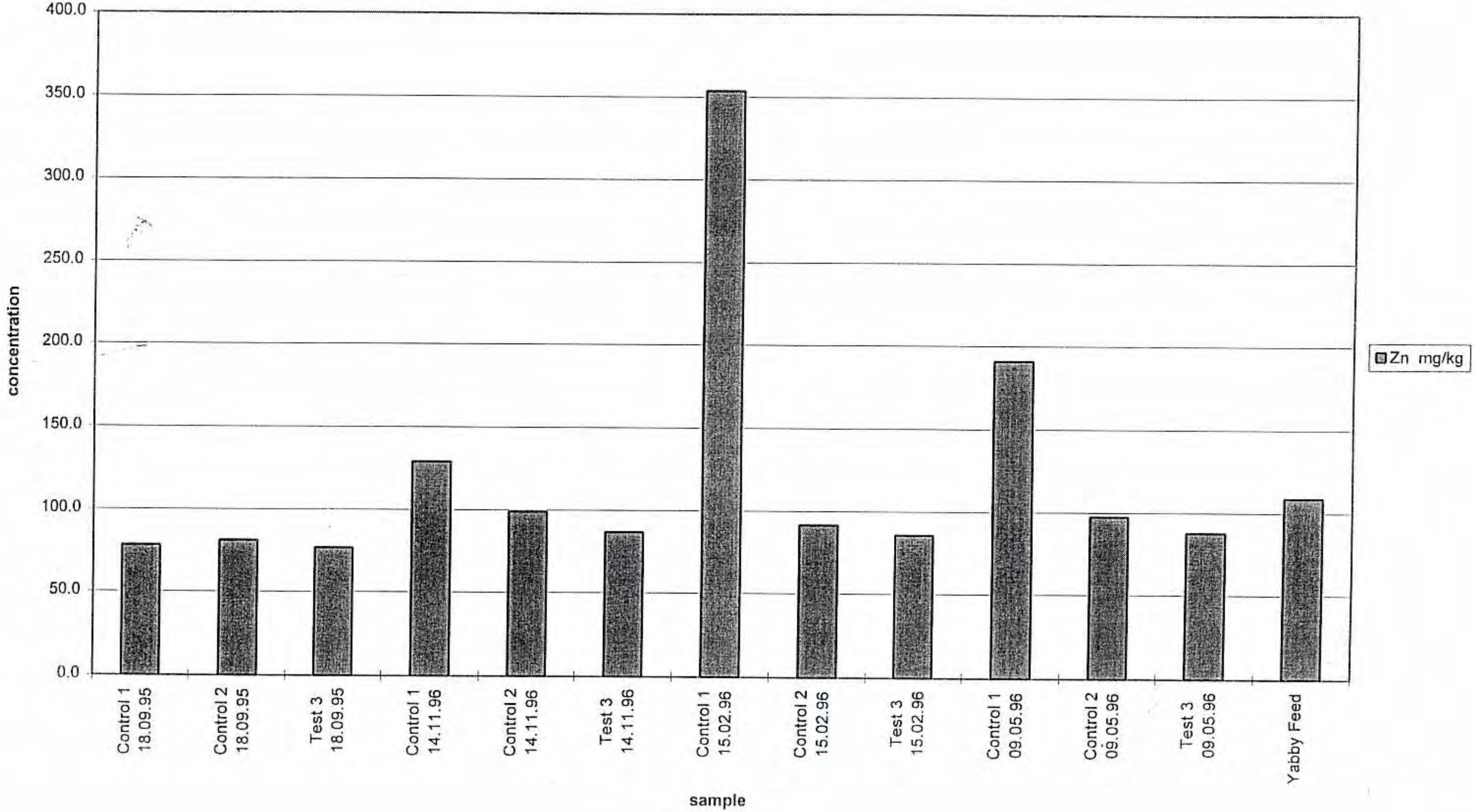


Figure 5a-h: Mean concentrations (3 subsamples) of seven metals detected (aluminium, arsenic, copper, iron, lead, manganese and zinc) in pellet feed, and whole perch samples at day 27, for three controls and three test treatments exposed to ANM wastewater during the 1996 bioaccumulation trial.

Figure 5a: Perch Aluminium Concentration - Day 27

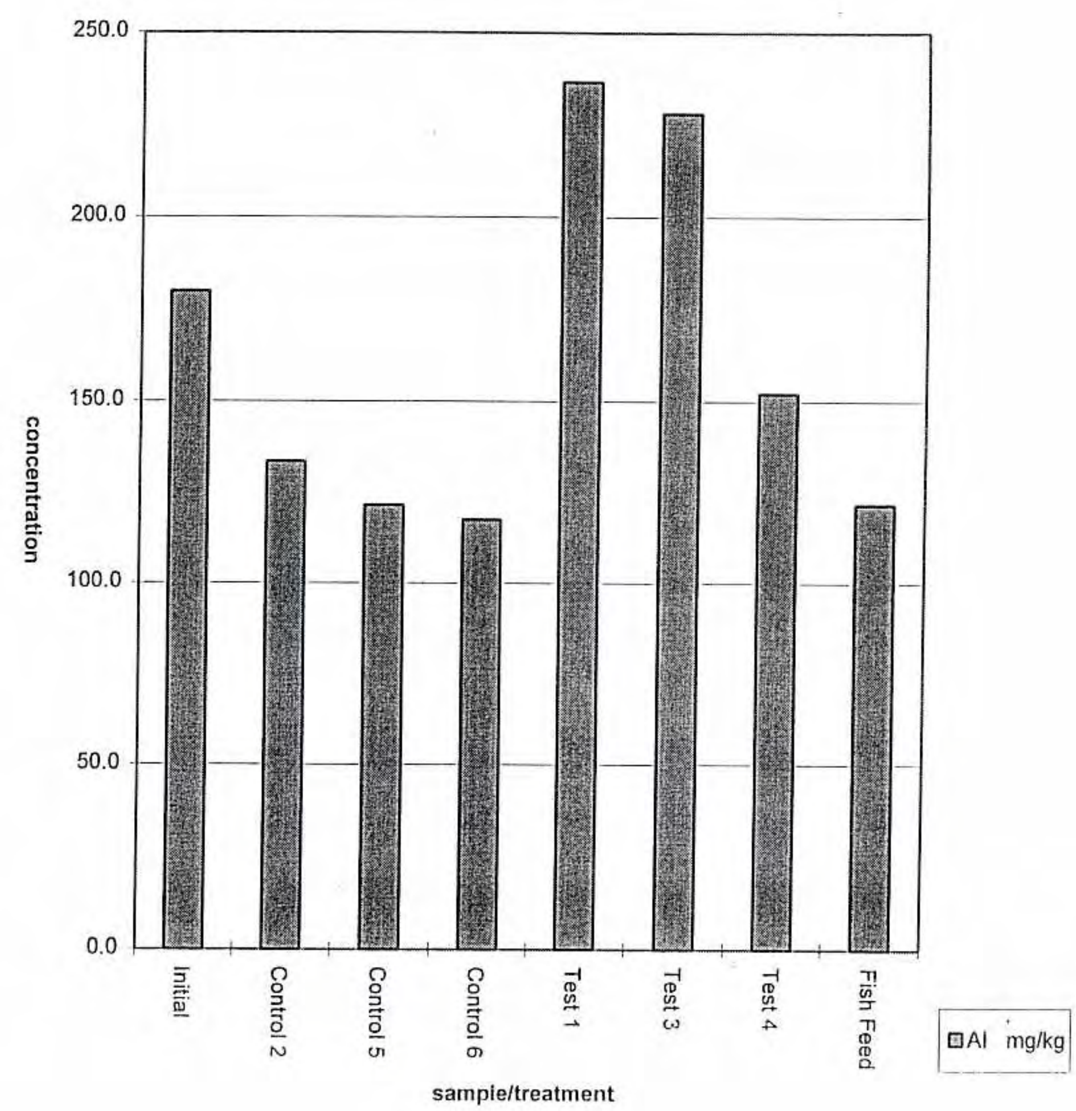


Figure 5b: Perch Arsenic Concentration - Day 27

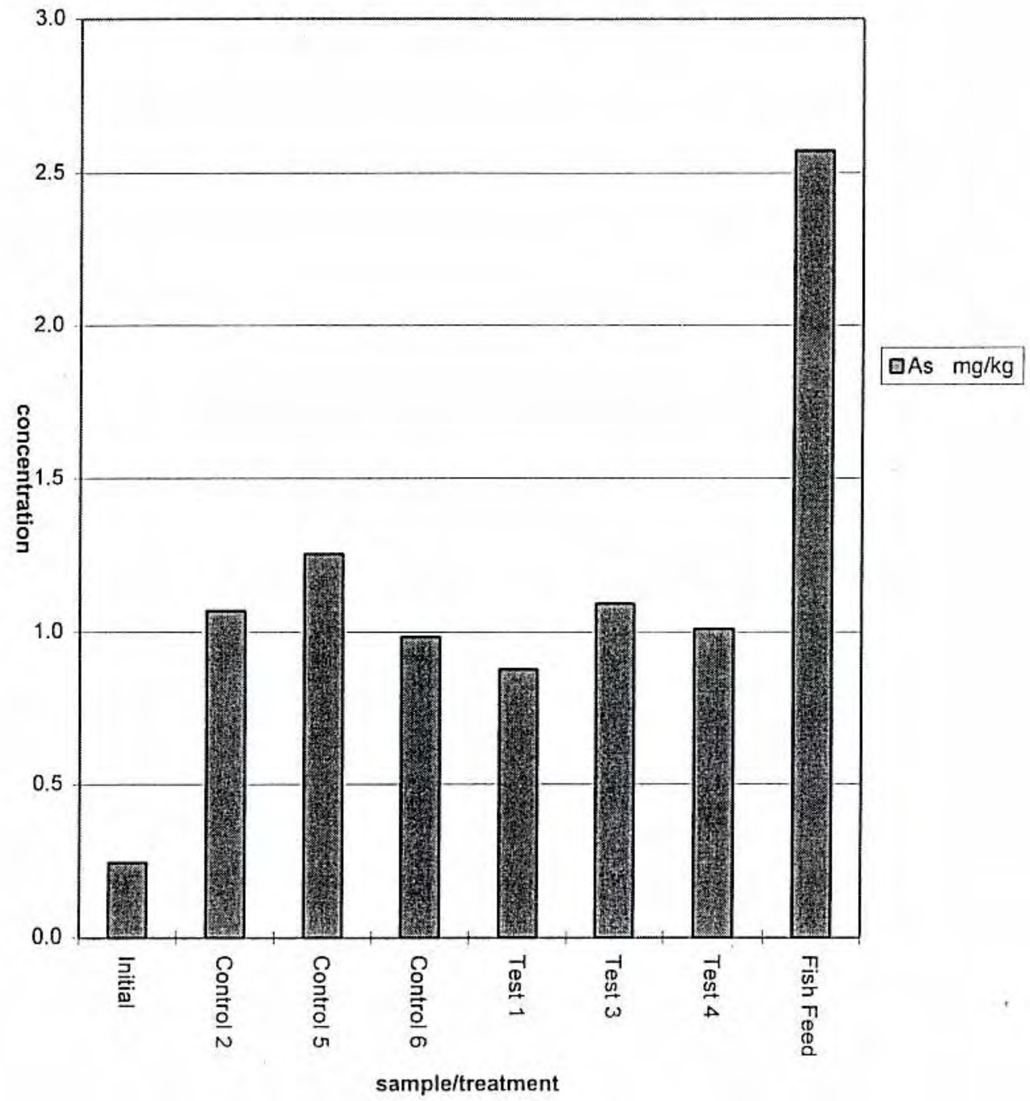


Figure 5c: Perch Copper Concentration - Day 27

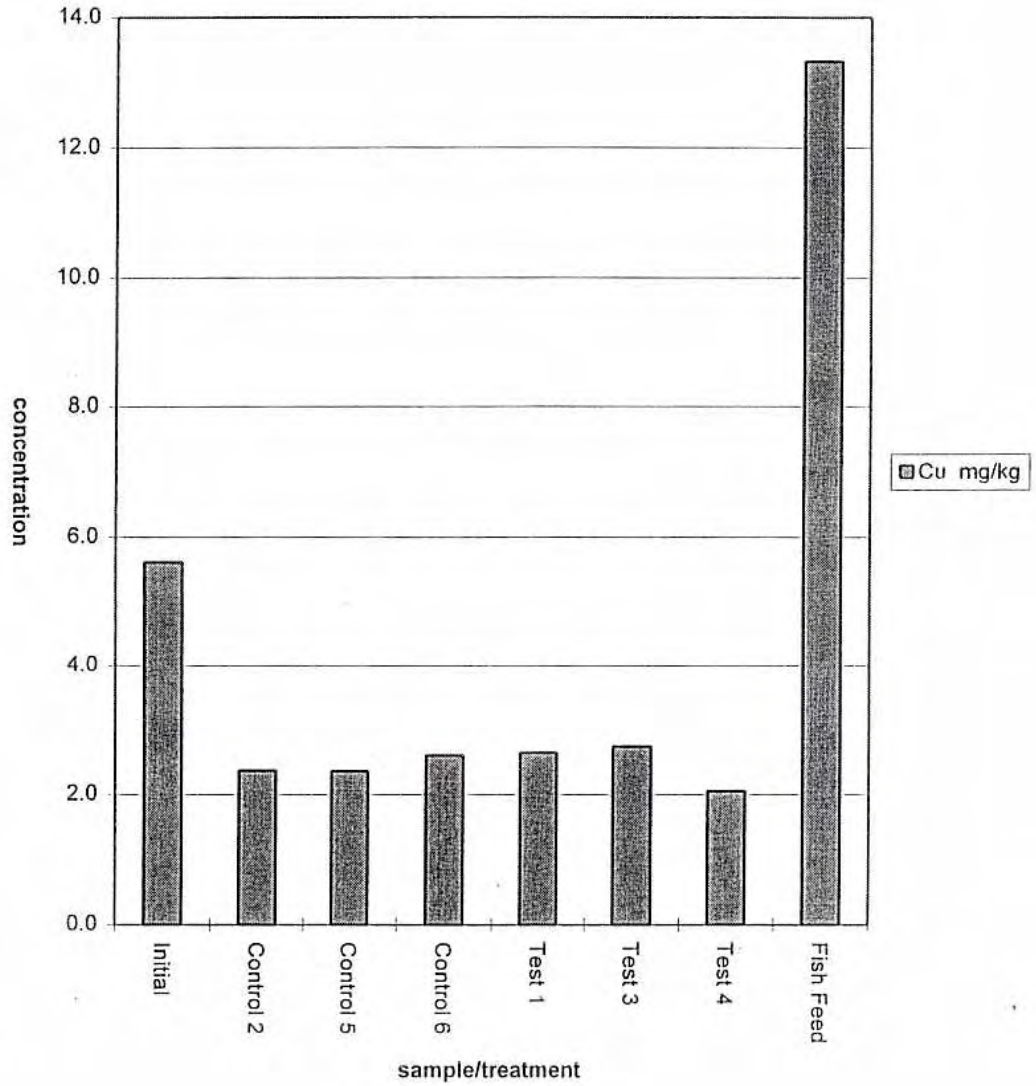


Figure 5d: Perch Iron Concentration - Day 27

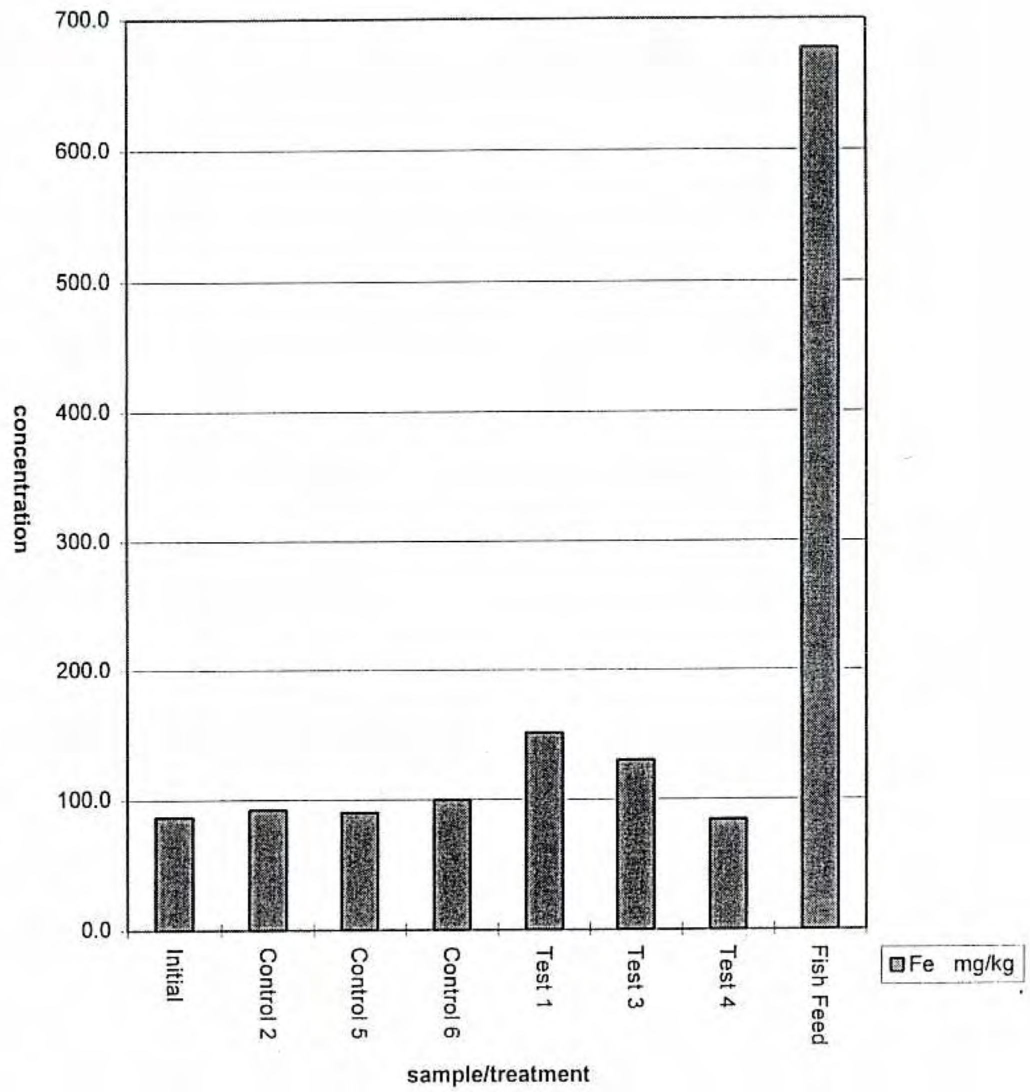


Figure 5e: Perch Lead Concentration - Day 27

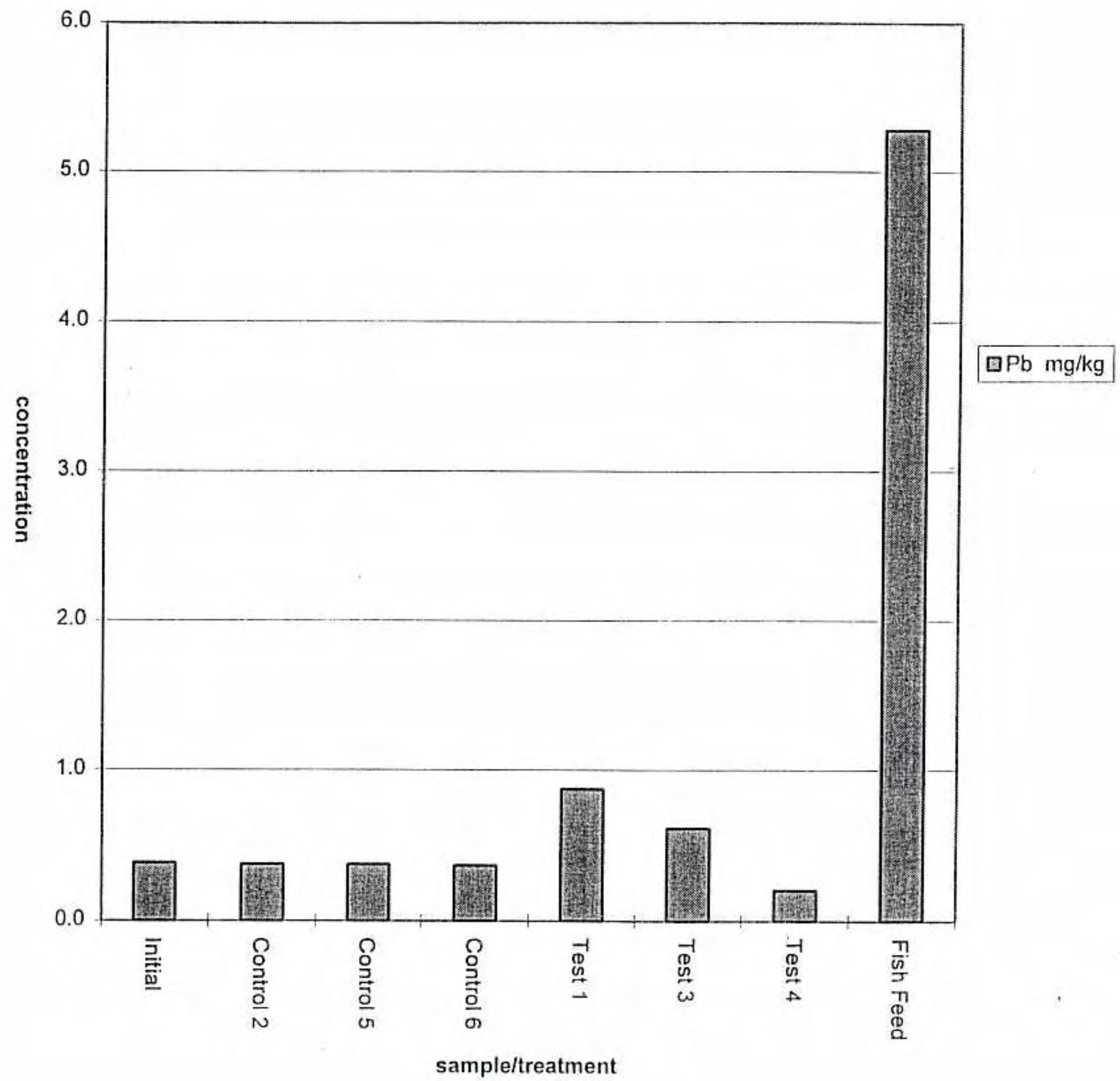


Figure 5f: Perch Manganese Concentration - Day 27

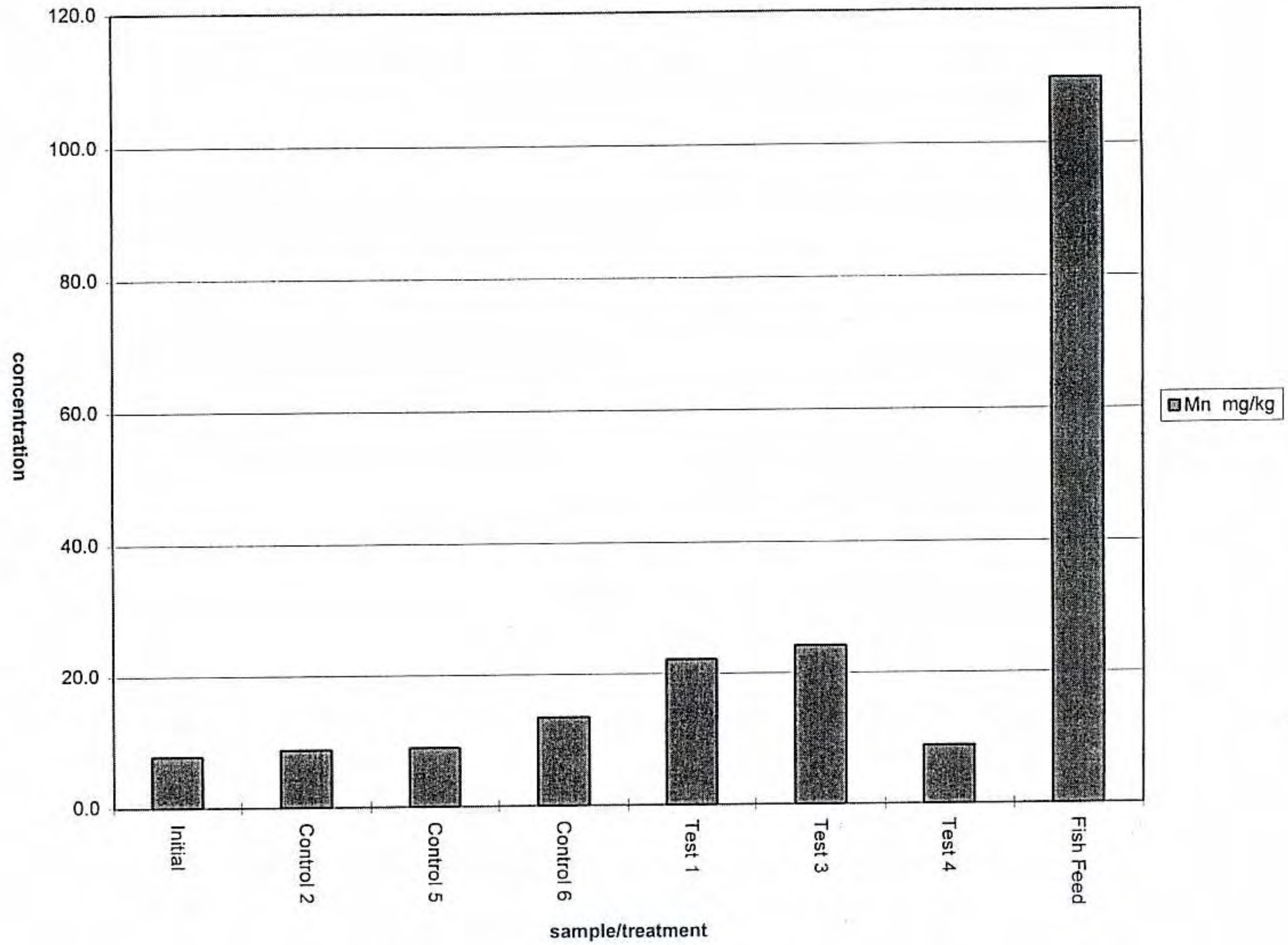


Figure 5g: Perch Zinc Concentration - Day 27

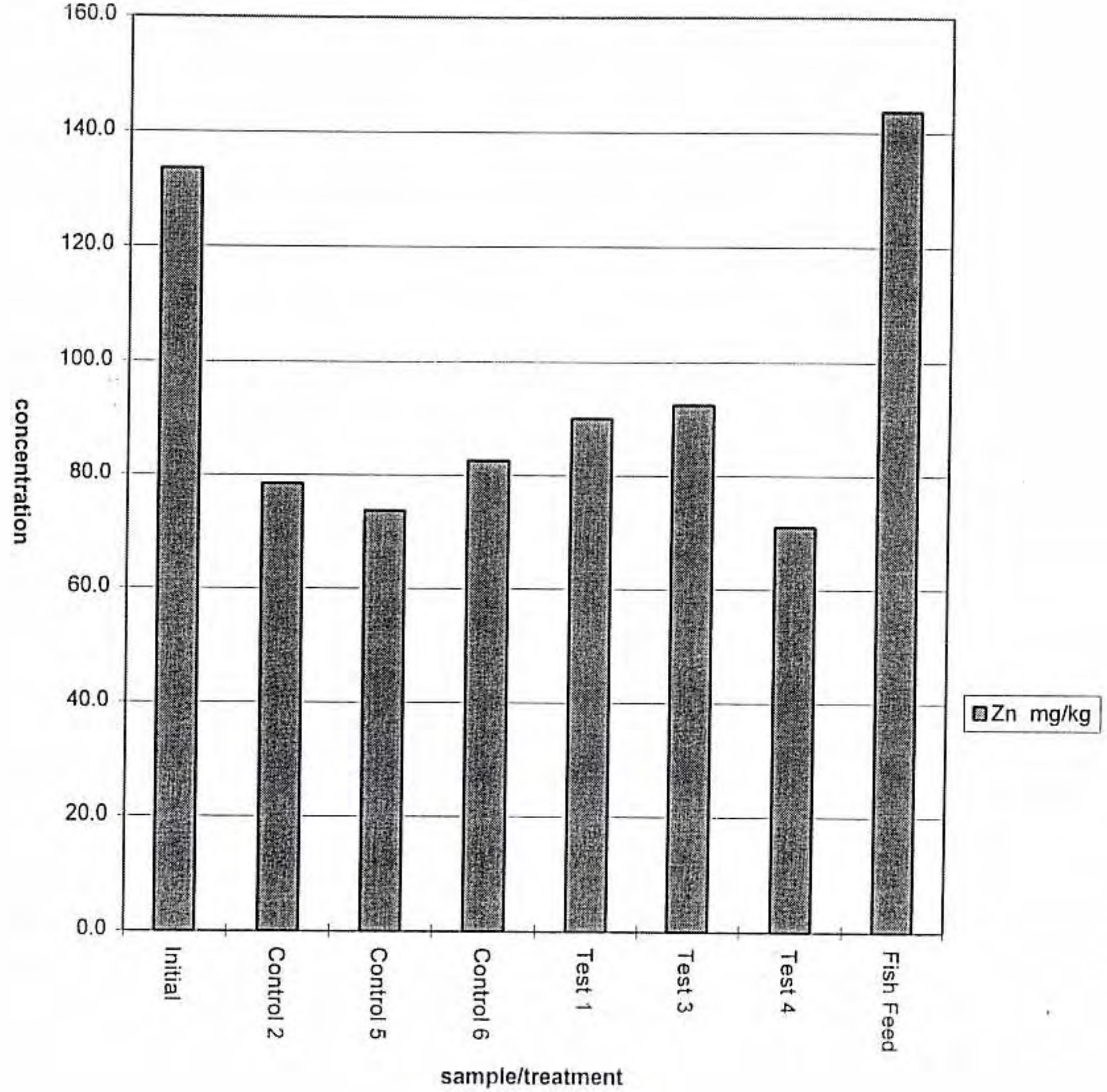
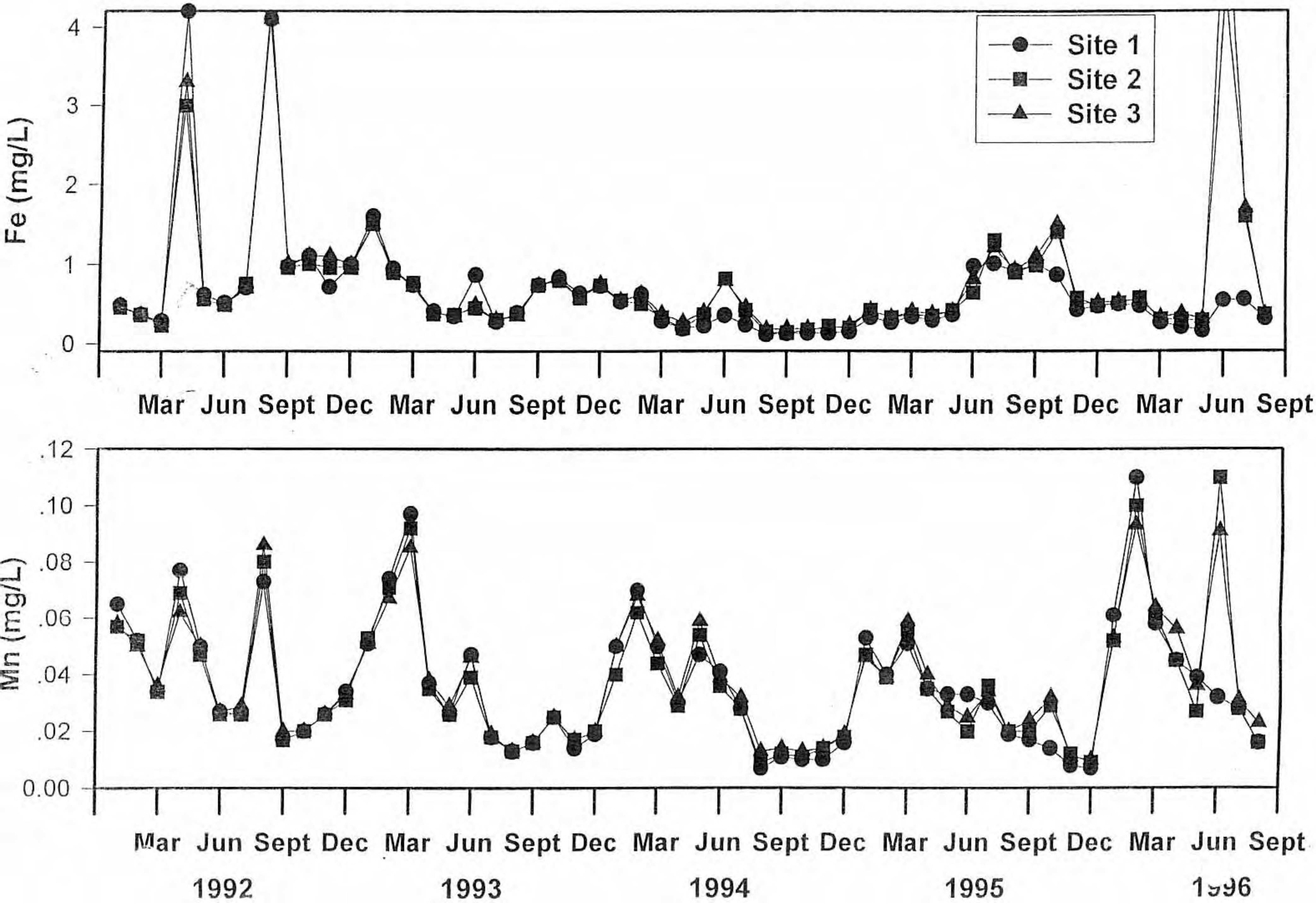
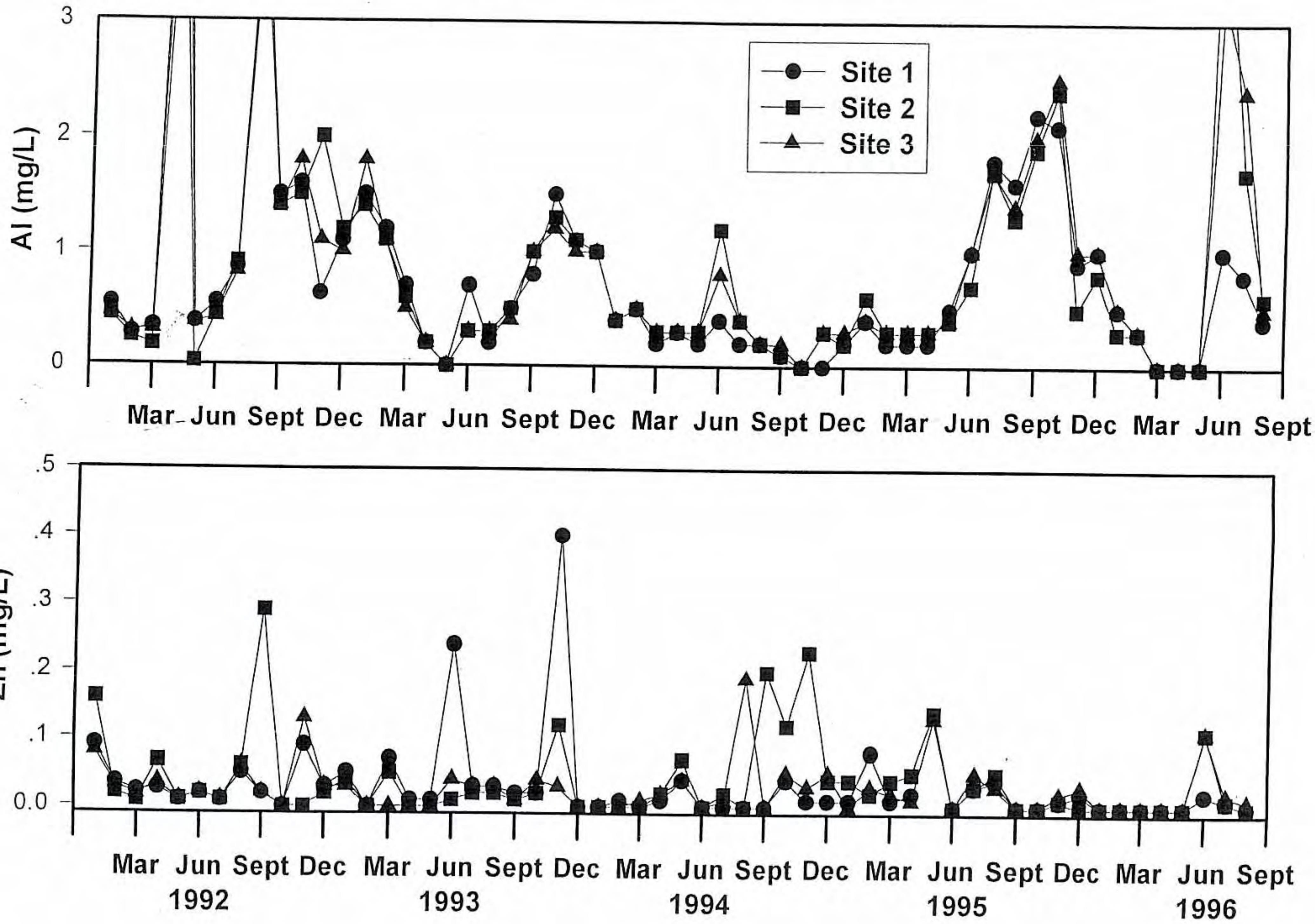


Figure 6: A summary of the water quality data for 1992 to 1996. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.)


Fe (mg/L)
0
1
2
3
4
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
Mn (mg/L)
0.00
.02
.04
.06
.08
.10
.12
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
1992
1993
1994
1995


Al (mg/L)
3
2
1
0
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
Zn (mg/L)
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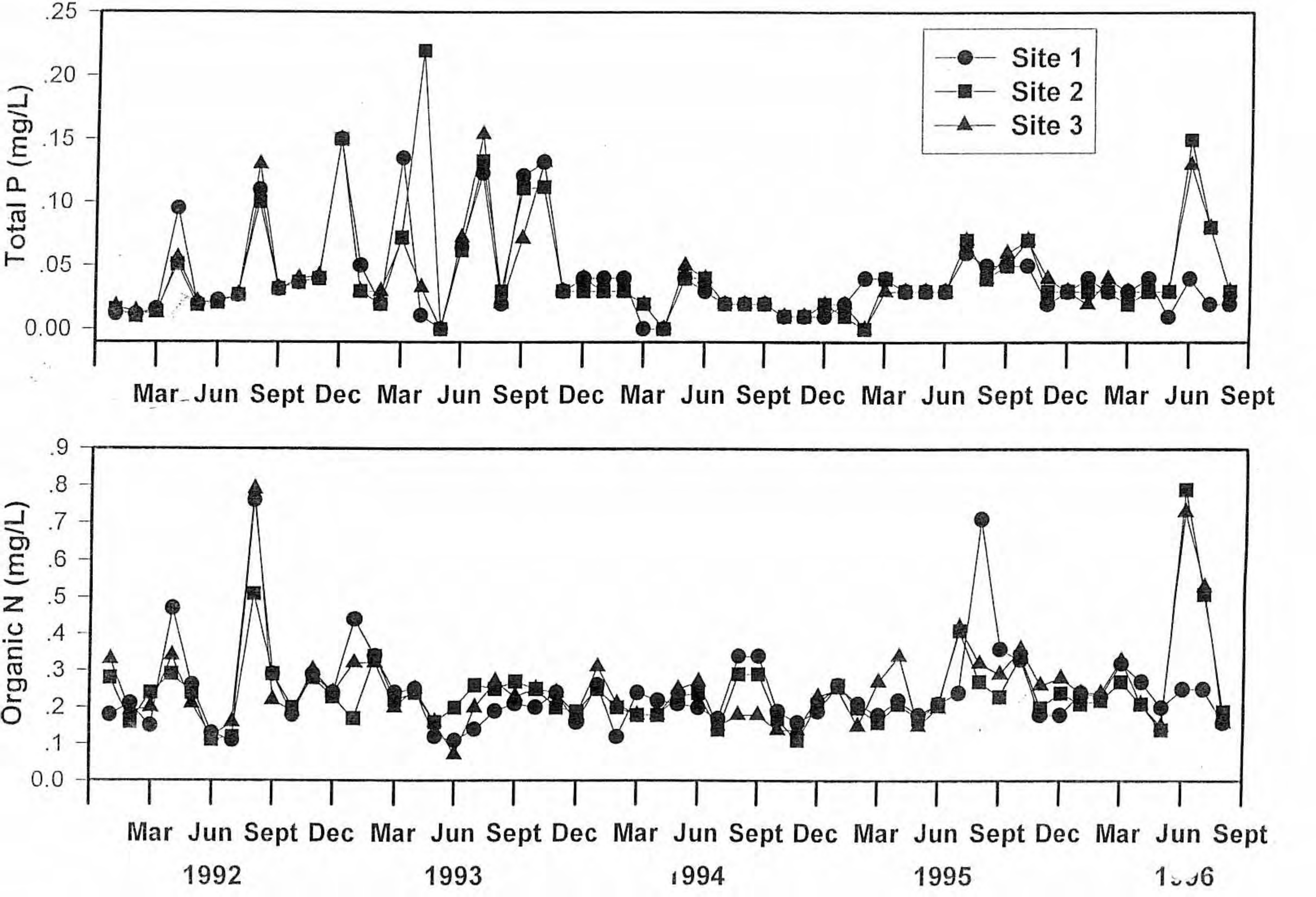

Total P (mg/L)
.25
.20
.15
.10
.05
0.00
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
Organic N (mg/L)
.9
.8
.7
.6
.5
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.3
.2
.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
1992
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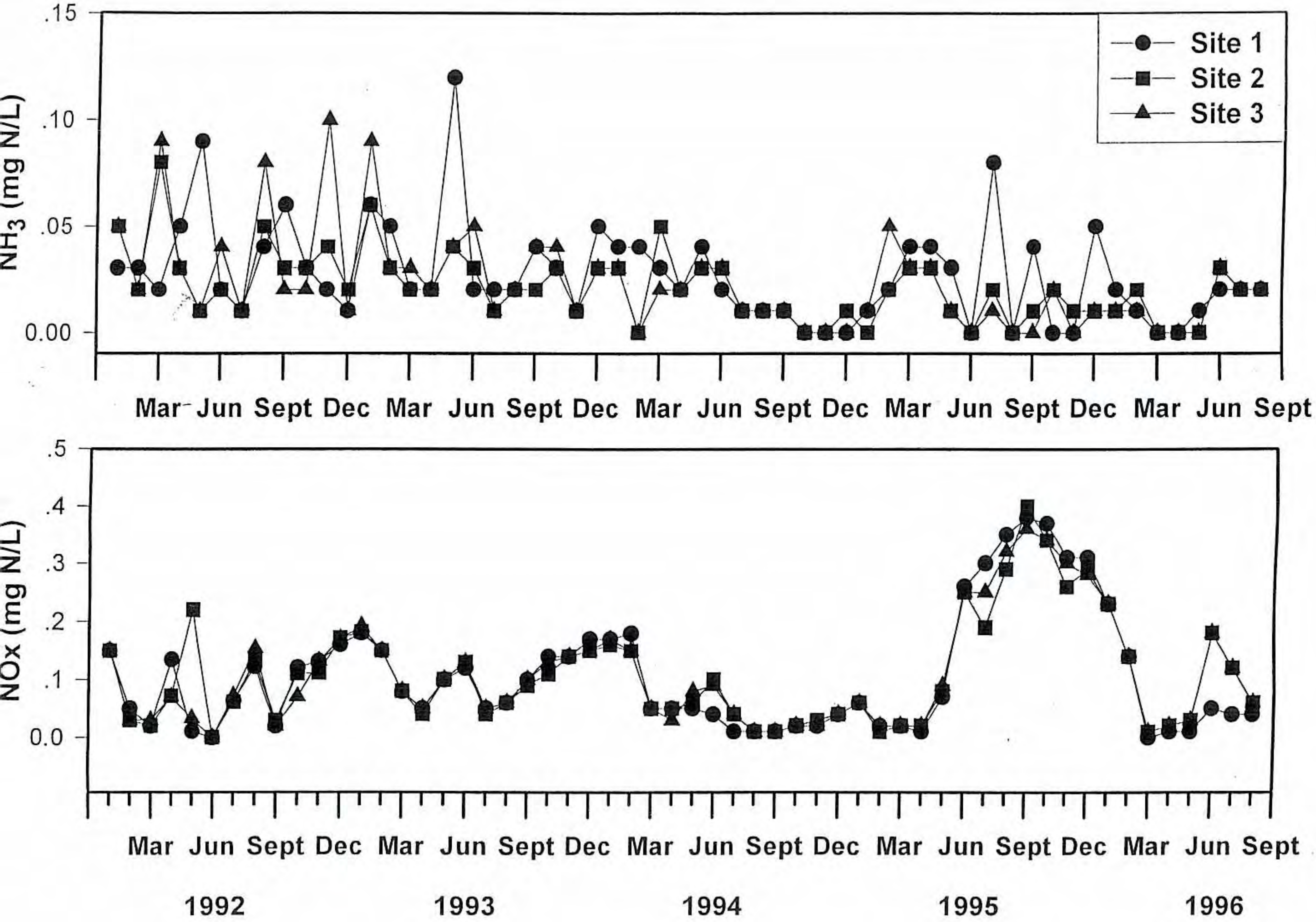
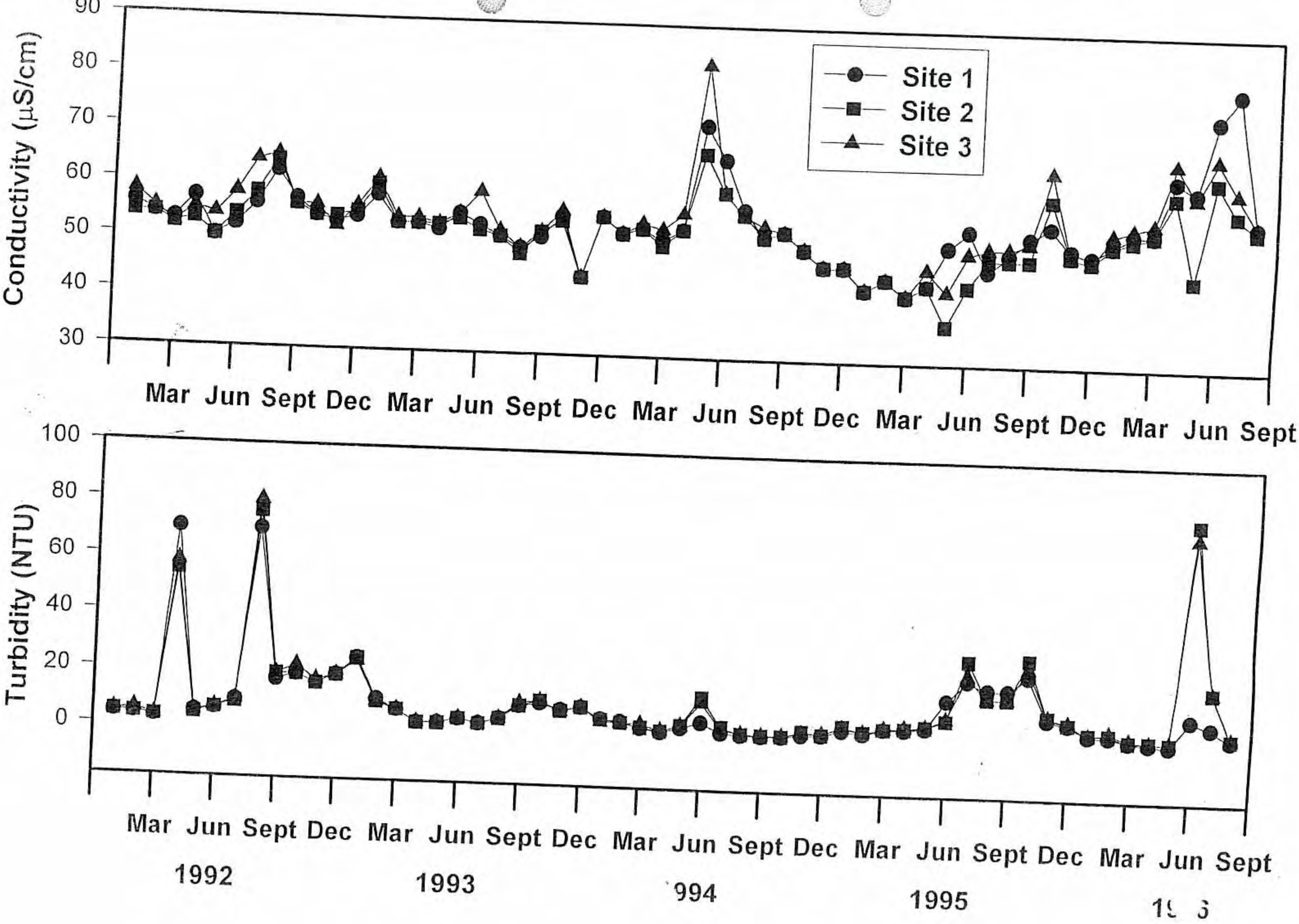


Site 1
Site 2
Site 3
NH3 (mg N/L)
.15
.10
.05
0.00
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
NOx (mg N/L)
.5
.4
.3
.2
.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
1992
1993
1994
1995
1996



Conductivity (µS/cm)
90
80
70
60
50
40
30
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
Turbidity (NTU)
100
80
60
40
20
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
1992
1993
994
1995

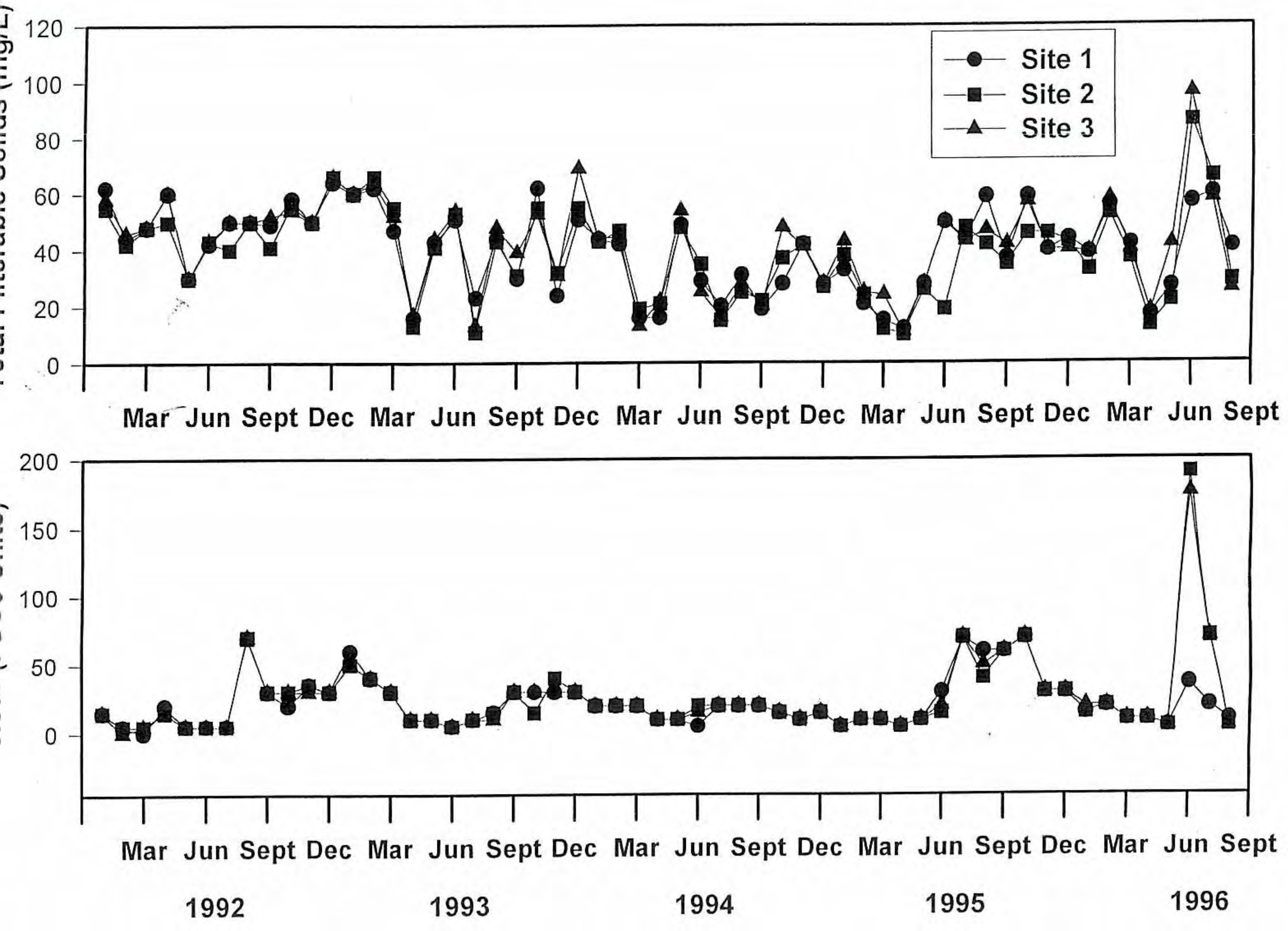
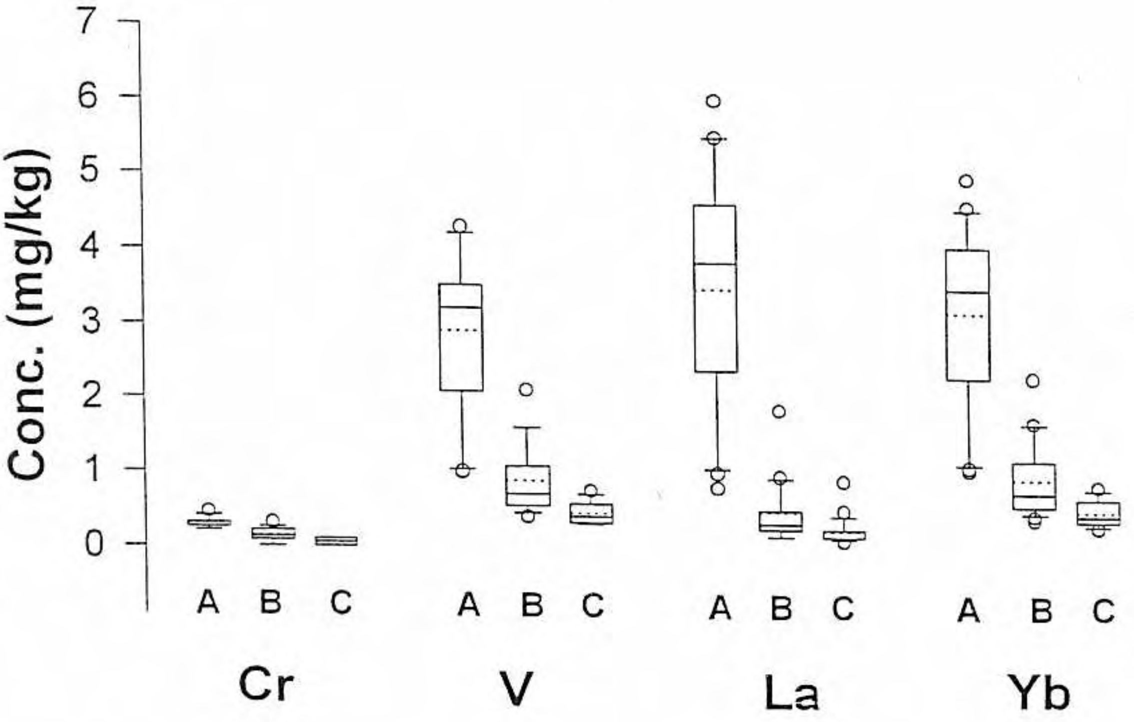
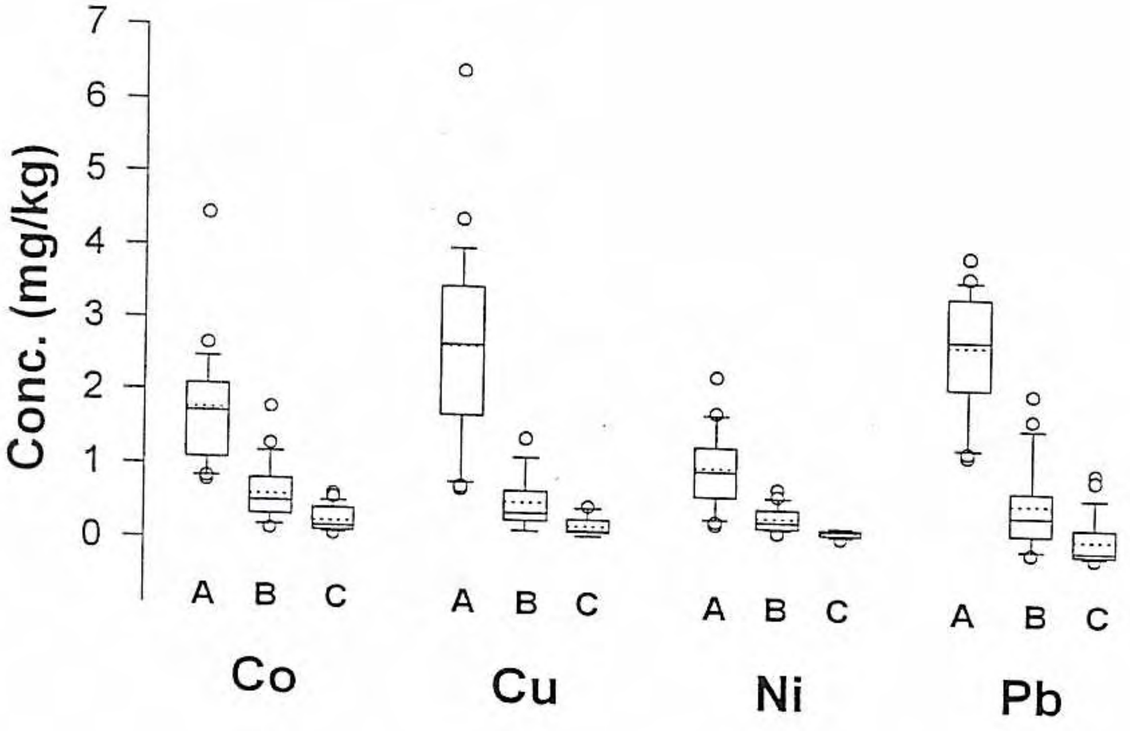

Site 1
Site 2
Site 3
120
100
80
60
40
20
0
200
150
100
50
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept
1992
1993
1994
1995
1996

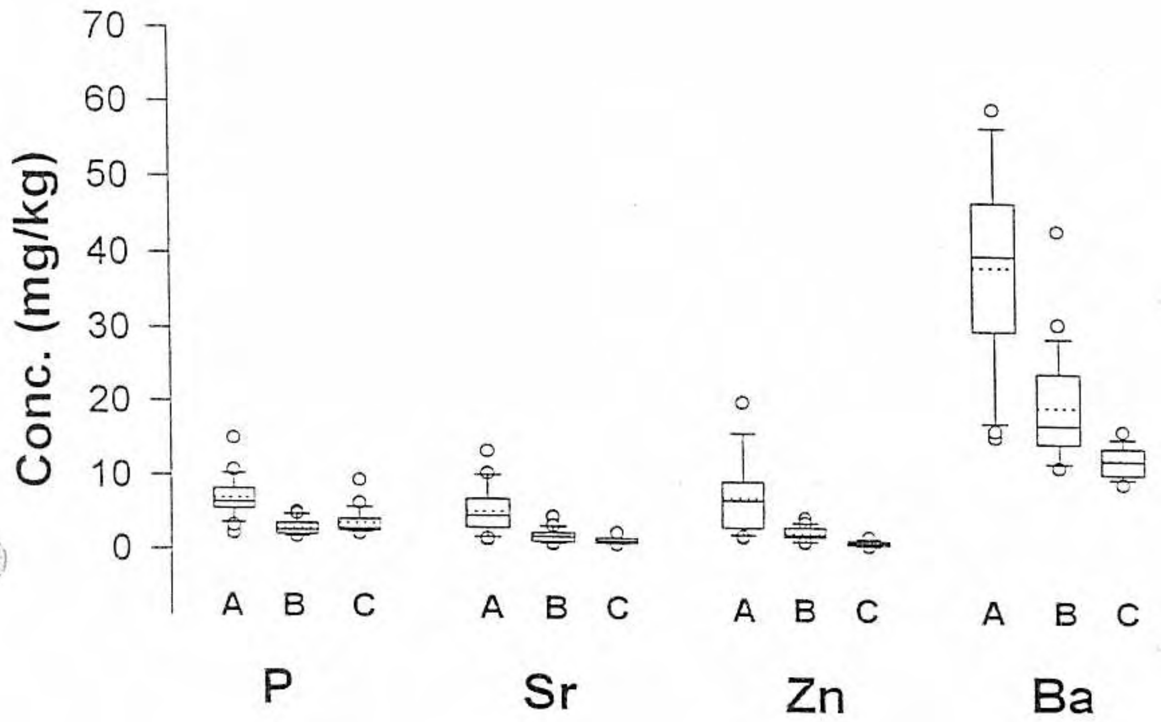
Figure 7: Box plots for the distribution of elements from deposition sites; A (Doctor's Point), B (directly above ANM's outfall) and C (directly beneath ANM's outfall).



Conc. (mg/kg)
0
1
2
3
4
5
6
7
A B C
A B C
A B C
A B C
Cr
V
La
Yb



Conc. (mg/kg)
0
1
2
3
4
5
6
7
A B C
A B C
A B C
A B C
Co
Cu
Ni
Pb


Conc. (mg/kg)
70
60
50
40
30
20
10
0
A B C
P
A B C
Sr
A B C
Zn
A B C
Ba

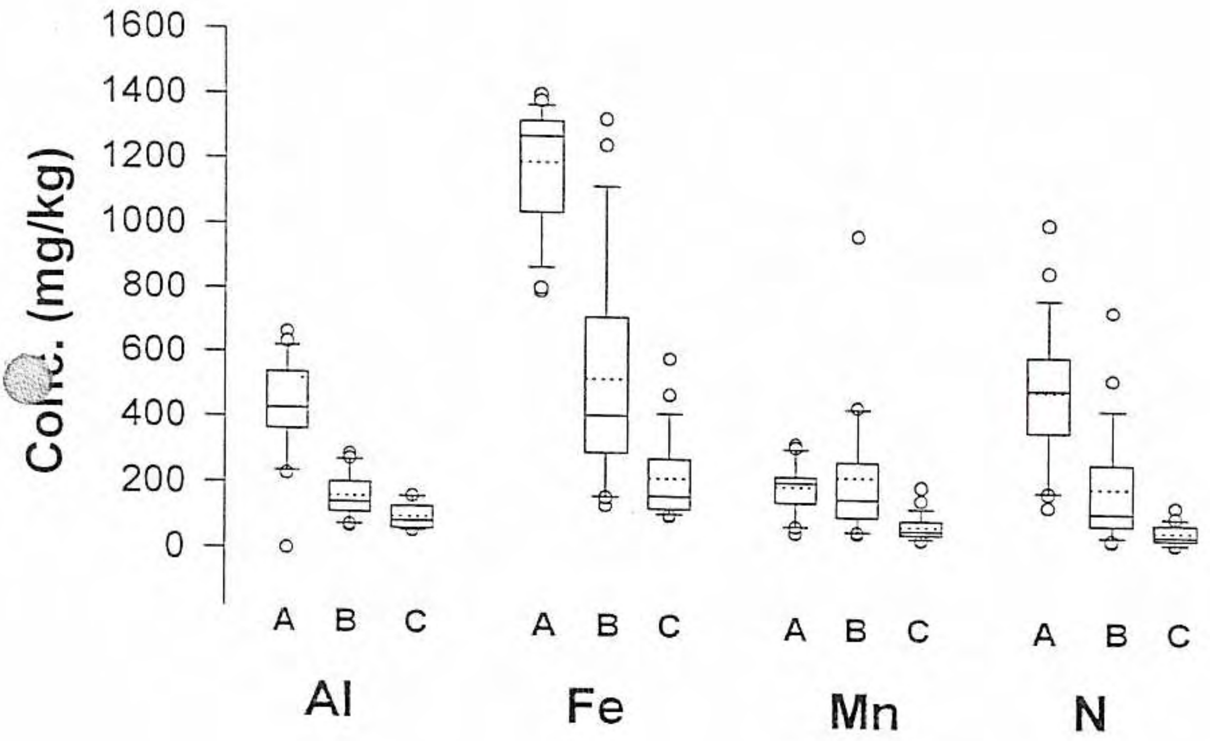
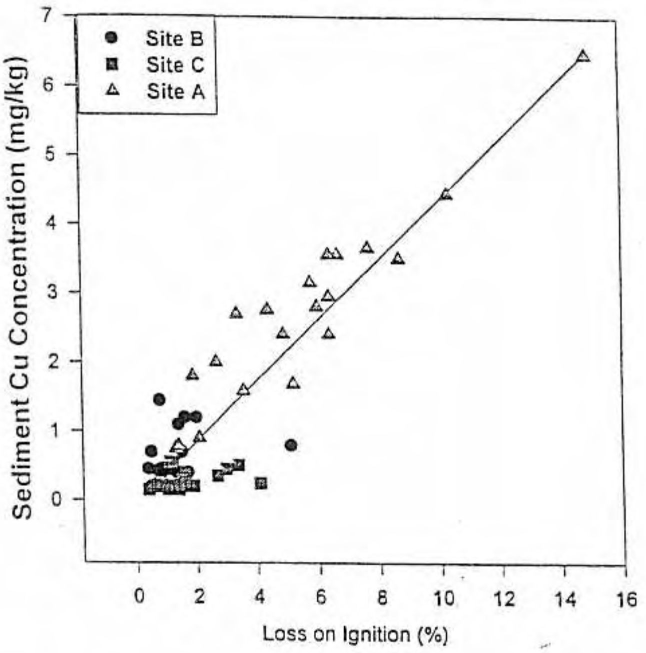
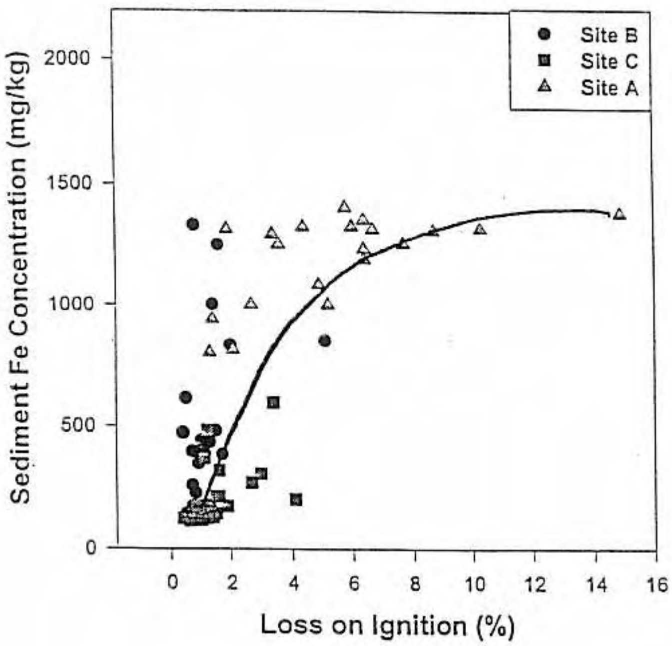

Conc. (mg/kg)
1600
1400
1200
1000
800
600
400
200
0
A B C
Al
A B C
Fe
A B C
Mn
A B C
N

Figure 8: Variation of Zn, Fe and Cu for the sediments taken from deposition sites A (Doctor's Point), B (directly above ANM's outfall) and C (directly beneath ANM's outfall) as a function of Loss on ignition.

R^2=0.84

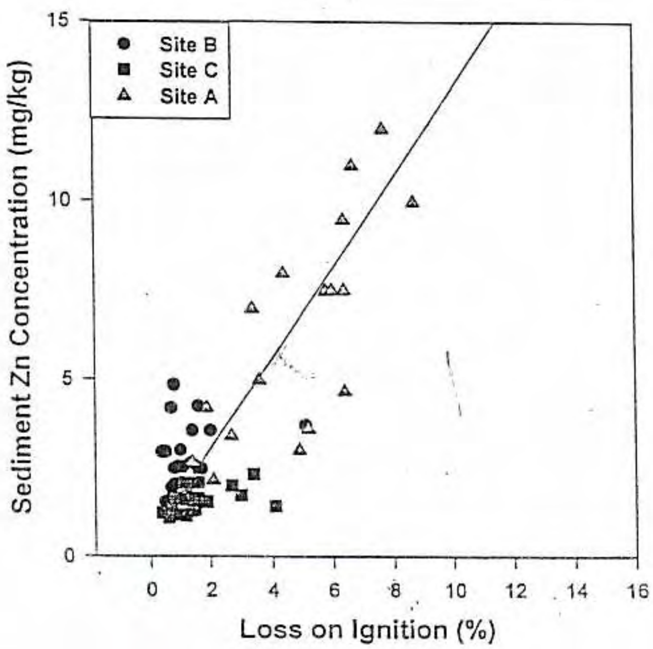


Site B
Site C
Site A
Sediment Cu Concentration (mg/kg)
Loss on Ignition (%)



Site B
Site C
Site A
Sediment Fe Concentration (mg/kg)
Loss on Ignition (%)

R^2=0.78



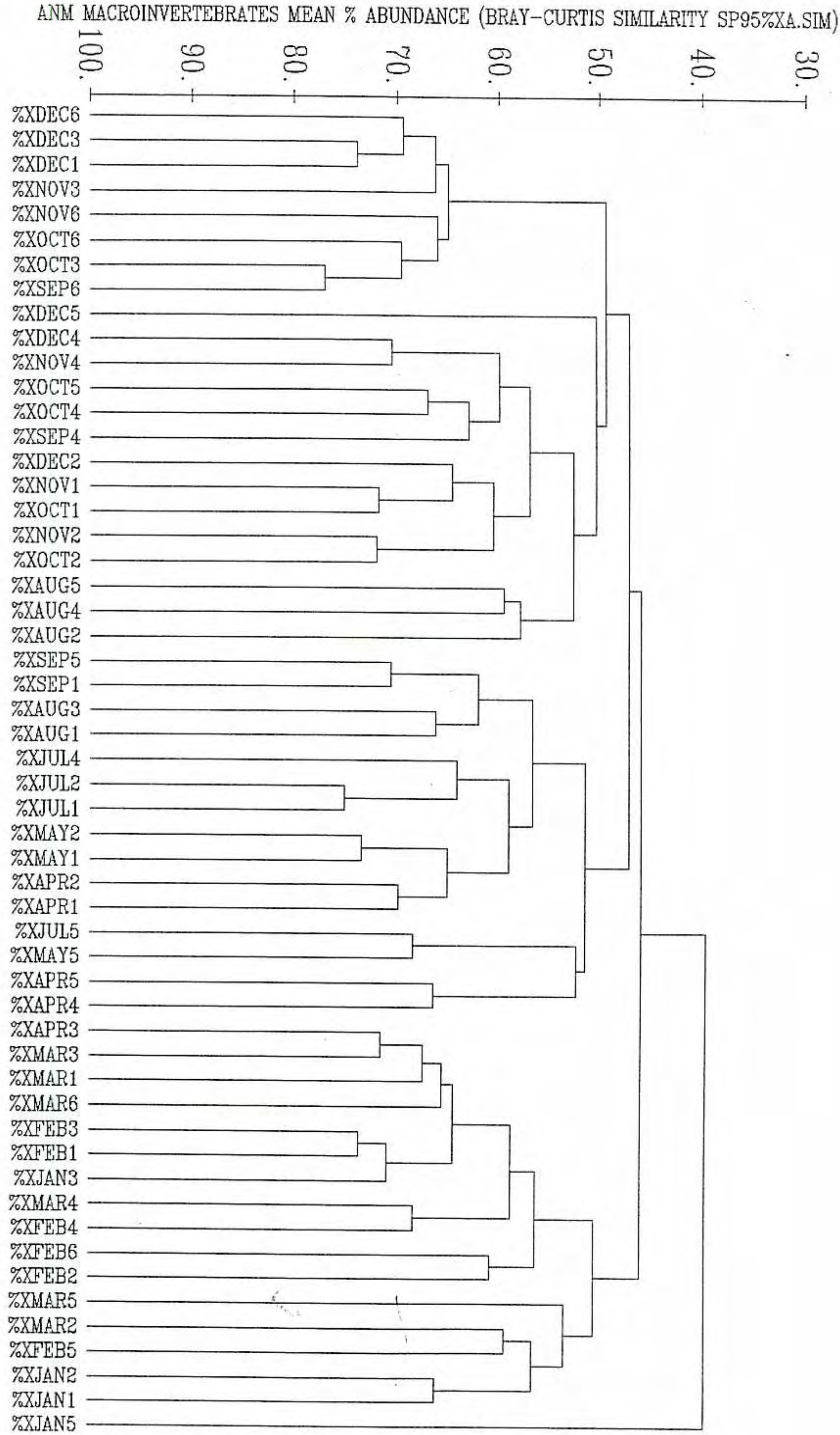
Site B
Site C
Site A
Sediment Zn Concentration (mg/kg)
Loss on Ignition (%)

Figure 9: Dissimilarity classification dendogram of ANM river monitoring sites using macroinvertebrate species abundance for 1995. Where:

Sites 1 and 2 = 2km downstream of the discharge

Sites 3 and 4 = immediately downstream of discharge in the mixing zone

Sites 5 and 6 = controls - upstream of the discharge.


ANM MACROINVERTEBRATES MEAN % ABUNDANCE (BRAY-CURTIS SIMILARITY SP95%XA.SIM)
100.
90.
80.
70.
60.
50.
40.
30.
%XDEC6
%XDEC3
%XDEC1
%XNOV3
%XNOV6
%XOCT6
%XOCT3
%XSEP6
%XDEC5
%XDEC4
%XNOV4
%XOCT5
%XOCT4
%XSEP4
%XDEC2
%XNOV1
%XOCT1
%XNOV2
%XOCT2
%XAUG5
%XAUG4
%XAUG2
%XSEP5
%XSEP1
%XAUG3
%XAUG1
%XJUL4
%XJUL2
%XJUL1
%XMAY2
%XMAY1
%XAPR2
%XAPR1
%XJUL5
%XMAY5
%XAPR5
%XAPR4
%XAPR3
%XMAR3
%XMAR1
%XMAR6
%XFEB3
%XFEB1
%XJAN3
%XMAR4
%XFEB4
%XFEB6
%XFEB2
%XMAR5
%XMAR2
%XFEB5
%XJAN2
%XJAN1
%XJAN5

APPENDIX 2 (Tables)

Table 1: 1995 macroinvertebrate species list and abundance data for three replicate samplers at the six paired ANM river monitoring sites:

Sites 1 and 2 = 2km downstream of the discharge

Sites 3 and 4 = immediately downstream of discharge in the mixing zone

Sites 5 and 6 = controls - upstream of the discharge.

CLASS	ORDER	SPECIES	24 JAN 95 JAN1-1	AN1-2	AN1-3	24 JAN 95 JAN2-1	AN2-2	AN2-3	24 JAN 95 JAN3-1	AN3-2	AN3-3	24 JAN 95 JAN5-1	AN5-2	AN5-3
Turbellaria		*Turbellaria sp*	2	0	0	0	4	1	0	2	0	1	1	0
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	2	2	2	0	0	1	0	0	0	4	8	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	1	2	0
		Physa acuta	0	0	0	0	0	0	0	0	0	1	0	0
		Isidorella sp	0	0	0	0	0	0	0	1	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	1	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	0	0	0	1	0	0	1	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	0	0	0	0	0	1	0	0
	Amphipoda	*Amphipoda sp*	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	2	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	4	1	1	0	0	2	0	0	0	0	2	1
Insecta	Trichoptera	*Ecnomus pansus*	1	7	0	17	24	11	123	61	81	0	0	0
		Chaematopsyche sp 6	0	0	0	0	0	0	0	1	3	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	1	4	3	6	3	5	5	5	11	1	0	1
		Triaenodes sp	4	21	8	0	0	1	0	1	0	1	0	1
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	1	0	0	1	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	1	0	0
		Anisocentropus sp	0	0	1	1	0	0	0	2	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	1	0	0	0	1	0	0	0	0	0	0
		Caenidae Genus B	19	36	8	16	19	42	50	96	75	0	3	2
		Caenidae Genus C	0	0	0	0	0	0	1	1	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	1	0	0	0	0
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	1	1	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	1	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	0	0	0	1	1	0	0	0	0
		Cordulephya pygmaea	0	0	0	4	0	1	0	0	0	1	0	1
		Apocordulia macrops	0	0	0	0	0	0	0	1	1	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	24 JAN 95 JAN1-1	AN1-2	AN1-3	24 JAN 95 JAN2-1	AN2-2	AN2-3	24 JAN 95 JAN3-1	AN3-2	AN3-3	24 JAN 95 JAN5-1	AN5-2	AN5-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	1	0	0	0	0
		Dytiscidae sp	1	0	1	0	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	1	1	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	1	0
		Tipuliidae sp	0	0	0	0	0	0	0	1	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	0	0	0	0	0	3	1	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	1	0	0	0	0	1	4	8	0	0	1
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	0	3	2	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	0	1	0	0	0	0	12	38	35	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	1	0	0	0	0	0	7	23	20	0	0	0
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	8	13	4	2	6	11	3	8	6	1	2	0
		Djalmabatista sp	0	0	0	0	0	0	0	1	1	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	1	1	0	0	1	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	0	1	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	5	0	0	0	0	4	5	9	0	0	0
			45	93	29	47	57	77	210	262	254	15	20	7
		Note: *Caenidae Genus B* formerly *T.tonnoiri* and *Caenidae Genus C* formerly *T.arcuata*												

			21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95		
CLASS	ORDER	SPECIES	FEB1-1	FEB1-2	FEB1-3	FEB2-1	FEB2-2	FEB2-3	FEB3-1	FEB3-2	FEB3-3	FEB4-1	FEB4-2	FEB4-3	FEB5-1	FEB5-2	FEB5-3	FEB6-1	FEB6-2	FEB6-3
Turbellaria		*Turbellaria sp*	0	2	0	0	3	4	0	4	1	0	1	2	0	5	5	1	1	1
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	0	0	0	0	0	0	0	0	0	0	0	0	6	2	1	0	0	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	2
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Amphipoda	*Amphipoda sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	23	16	3	7	3	0	40	42	65	0	1	3	1	0	2	72	66	175
		Chaematopsyche sp 6	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	3
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
		Oecetis sp	1	4	3	3	6	1	6	5	5	2	0	1	0	0	1	27	16	42
		Triaenodes sp	0	5	2	0	3	3	2	0	0	0	1	1	1	0	1	5	1	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	113	35	23	39	40	38	114	92	177	6	3	5	2	6	5	115	132	220
		Caenidae Genus C	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	5	1
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	4	3
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	0	1	0	1	1	3	0	0	0	0	0	0	0	0	1
		Cordulephya pygmaea	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	1	0	0	0	0	1	1	3	2	0	0	0	0	0	0	4	4	10
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0

CLASS	ORDER	SPECIES	21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95			21 FEB 95		
			FEB1-1	FEB1-2	FEB1-3	FEB2-1	FEB2-2	FEB2-3	FEB3-1	FEB3-2	FEB3-3	FEB4-1	FEB4-2	FEB4-3	FEB5-1	FEB5-2	FEB5-3	FEB6-1	FEB6-2	FEB6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Tipulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	3	4	3	0	1	1	5	7	6	1	0	5	1	0	2	11	11	14
		Paracladapelma sp	1	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	1	1	1	0	0	0	1	4	1	2	0	0	0	0	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	2	1	3	0	1	0	6	1	6	1	2	7	0	0	0	1	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	2	0	3	1	0	0	2	2	13	2	5	9	0	0	0	0	2	1
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	6	6	7	2	1	7	4	15	4	2	2	3	0	17	0	0	3	5
		Djalmabatista sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	1	0	0	0	0	2	0	1	1	0	0	0	1	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1	0
		Nanocladius sp	0	1	0	0	2	0	0	0	1	0	0	1	0	0	0	0	1	1
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Parakiefferiella sp	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	6	3	2	0	0	0	0	2	6	4	0	4	0	0	0	6	6	3
			160	80	52	55	63	58	190	184	309	22	17	43	12	35	19	248	254	488
		Note: *Caenidae Genus B* formerly *T.to*																		

			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95		
CLASS	ORDER	*SPECIES*	MAR1-1	AR1-2	AR1-3	MAR2-1	AR2-2	AR2-3	MAR3-1	AR3-2	AR3-3	MAR4-1	AR4-2	AR4-3	MAR5-1	AR5-2	AR5-3	MAR6-1	AR6-2	AR6-3
Turbellaria		*Turbellaria sp*	3	2	5	1	3	0	0	3	1	4	0	1	7	14	5	3	2	1
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	8	2	3	4	4	8	2	0	0	4	0	0	1	0	7	0	0	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	1	1	1	0	1	7	1	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Amphipoda	*Amphipoda sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	—	*Macrobrachium sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
Insecta	Trichoptera	*Ecnomus pansus*	0	5	10	2	3	3	18	25	18	0	0	1	2	0	0	52	7	26
		Chaematopsyche sp 6	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	1	5	8	4	6	19	18	23	20	1	2	2	0	1	0	20	6	11
		Triaenodes sp	3	14	7	2	16	18	15	7	17	0	1	0	1	1	0	4	11	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	1	0	0	0	0	3	0	0	0	0	0	1	3	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	4	7	1	2	4	2	8	22	18	0	0	1	0	1	0	6	9	9
		Caenidae Genus C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	1	0	1
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	3	0	0	0	6	2	6	0	0	0	6	1	3	4	1	1
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95			21 MAR 95		
CLASS	ORDER	*SPECIES*	MAR1-1	AR1-2	AR1-3	MAR2-1	AR2-2	AR2-3	MAR3-1	AR3-2	AR3-3	MAR4-1	AR4-2	AR4-3	MAR5-1	AR5-2	AR5-3	MAR6-1	AR6-2	AR6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	6	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
		Tipuliidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	1	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	1	1
		Cryptochironomus griseidorsum	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	2	2	7	0	2	0	3	1	1	0	0	0	0	0	0	6	4	14
		Paracladapelma sp	2	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	4	1	0	0	2	2	0	0	0	3	0	5
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Riethia sp	1	4	20	1	0	2	13	8	9	2	10	5	0	0	0	4	3	4
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	16	6	19	0	0	0	26	10	11	1	8	4	0	0	0	8	13	17
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	1	3	6	4	7	4	12	5	0	1	1	0	2	1	0	5	7	4
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	1	0	0	2	1	1	0	0	0	1	0	0	2	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0
		Parakiefferiella sp	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		chironomid pupae	6	2	2	1	0	1	9	6	6	0	0	2	0	0	0	3	3	10
			50	61	98	23	50	59	151	133	111	15	25	19	21	25	22	122	69	109
		Note: *Caenidae Genus B* formerly *T.to*																		

CLASS	ORDER	SPECIES	28 APR 95			28 APR 95			28 APR 95			28 APR 95			28 APR 95		
			APR1-1	APR1-2	APR1-3	APR2-1	APR2-2	APR2-3	APR3-1	APR3-2	APR3-3	APR4-1	APR4-2	APR4-3	APR5-1	APR5-2	APR5-3
Turbellaria		*Turbellaria sp*	1	2	0	18	20	24	13	15	13	1	16	11	20	35	3
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	7	2	2	0	2	7	7	5	1	0	2	4	9	7	9
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1
Bivalvia		*Bivalve sp*	0	0	5	0	2	4	8	6	6	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	0	0	2	0	0	0	0	0	3	12	5	1
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	4	0	0	0	1	0	0	0	0	0	0	1	0
	Amphipoda	*Amphipoda sp*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	2	0	0	1	1	0	0	0	0	0	0	1	0	0
		Caridina mccullochi	1	0	1	0	0	0	0	0	0	2	0	1	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	4	0	1	0	1	0	0	2	1	2	0	3
Insecta	Trichoptera	*Ecnomus pansus*	3	1	4	2	1	0	40	23	47	0	0	0	2	0	0
		Chaematopsyche sp 6	0	0	0	0	0	0	20	0	1	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	1	4	1	9	9	13	16	4	5	0	1	0	7	6	6
		Triaenodes sp	3	1	8	35	94	48	9	9	8	7	6	3	14	11	8
		Triplectides australicus	0	1	2	0	0	0	0	0	0	0	3	2	1	1	2
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	10	0	18	5	3	7	1	1	1	0	4	2	13	11	5
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	1	1	1	0	3	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	17	30	40	60	67	65	43	19	25	3	3	0	9	11	5
		Caenidae Genus C	0	1	1	2	2	4	5	1	8	0	0	0	0	1	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Leptoperla primitiva	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
		Ischnura heterosticta	0	0	0	0	2	1	0	0	0	3	0	3	1	0	0
		Austroargiolestes icteromelas	0	0	0	0	1	0	0	0	0	0	0	12	1	1	1
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	2	0	2	0	0	1	0
		Austroaeschna u unicornis	2	3	0	1	3	1	2	6	2	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	1	0	0	0	4	1	0	0	0	0	0	0	0
		Hemicordulia tau	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	1	1	1	0	0	1	0	0	9	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	28 APR 95 APR1-1	APR1-2	APR1-3	28 APR 95 APR2-1	APR2-2	APR2-3	28 APR 95 APR3-1	APR3-2	APR3-3	28 APR 95 APR4-1	APR4-2	APR4-3	28 APR 95 APR5-1	APR5-2	APR5-3
	Hemiptera	*Corixidae sp*	0	1	0	0	0	0	0	0	0	1	25	7	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tipuliidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	1	0	0	2	0	0	1	0	0	1	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	1	1	1	0	1	1	1	1	0	0	1	2	1	4
		Paracladapelma sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	10	3	7	1	5	4	5	9	5	1	0	1	2	0	2
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	3	0	1	0	2	1	13	15	6	5	1	3	1	0	8
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	5	3	8	4	4	2	4	3	2	1	1	1	4	2	4
		Djalmabatista sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1
		Orthoclad spZ	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	0	0	1	1	1	0	3	0	0	0	1	1	1
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	1	0	0	2	0	2	4	8	2	1	1	1	1	3	1
		TOTAL	65	59	108	145	226	191	201	133	139	30	81	57	104	101	67
		Note: *Caenidae Genus B* formerly *T.to*															

CLASS	ORDER	SPECIES	30 MAY 95 MAY1-1	AY1-2	AY1-3	30 MAY 95 MAY2-1	AY2-2	AY2-3	30 MAY 95 MAY4-1	AY4-2	AY4-3	30 MAY 95 MAY5-1	AY5-2	AY5-3
Turbellaria		*Turbellaria sp*	4	11	8	27	36	22	81	0	0	24	20	29
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	4	4	2	4	7	3	0	0	0	4	28	4
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	3	0	0	0	0	1	0	0	0	10	4	0
		Dicyrtomidae sp	2	0	0	0	0	1	0	0	0	5	3	4
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	1	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	1
		Physa acuta	0	0	0	0	0	0	0	0	0	0	3	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	3	2	3
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	1	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	1	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	2	2	12	1	0	0	0	0	0	1	0	0
Arachnida		*Peza ops*	1	2	0	1	4	8	15	0	0	14	16	14
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	2	0	0	0	0	0	0	7	1
	Amphipoda	*Amphipoda sp*	0	1	1	1	0	1	0	0	0	2	2	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	1	0
Insecta	Trichoptera	*Ecnomus pansus*	8	1	4	14	3	6	0	0	0	1	0	0
		Chaematopsyche sp 6	3	0	0	0	0	1	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	11	15	3	3	2	11	0	0	0	2	0	0
		Triaenodes sp	63	66	63	24	18	43	10	0	0	19	3	10
		Triplectides australicus	1	0	0	2	1	1	0	0	0	1	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	1	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	4	14	7	0	0	6	5	0	0	2	0	2
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	1	0	1	2	1	3	0	0	0	0	0	0
		Caenidae Genus B	135	89	80	222	63	330	6	0	0	4	0	11
		Caenidae Genus C	23	9	5	4	4	13	0	0	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	1	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	4	4	1	0	0	2	1	0	0	1	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	17	3	16
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	3	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	5	6	1	2	3	4	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	1	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	1	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	2	1	0	1	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	30 MAY 95 MAY1-1	AY1-2	AY1-3	30 MAY 95 MAY2-1	AY2-2	AY2-3	30 MAY 95 MAY4-1	AY4-2	AY4-3	30 MAY 95 MAY5-1	AY5-2	AY5-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	5	6	0	0	0	1	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	1	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	2	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	1	0	0	0	0	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tipuliidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	0	0	0	0	0	0	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	0	1	0	0	0	0	0	0	0	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	0	1	0	0	1	1	0	0	0	0	0	1
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	1	0	0	0	0	0	0	0	0	0	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	1	0	0	0	0	0	0	0	0	0	0
		TOTAL	274	230	191	314	145	463	124	0	0	112	96	96
		Note: *Caenidae Genus B* formerly *T.lo*												

			18 JULY 95			18 JULY 95			18 JULY 95			18 JULY 95		
CLASS	ORDER	*SPECIES*	JUL1-1	UL1-2	UL1-3	JUL2-1	UL2-2	UL2-3	JUL4-1	UL4-2	UL4-3	JUL5-1	UL5-2	UL5-3
Turbellaria		*Turbellaria sp*	3	8	2	1	3	6	17	17	0	11	8	15
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	1	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	2	4	8	3	5	8	18	10	0	26	23	6
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	1	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	2	2	2	0	0	0	0	0	1	6	2
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	1
		Entomobryidae sp	0	2	1	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	1	0
		Isidorella sp	0	0	0	0	0	0	0	1	0	5	5	3
		Gyraulus sp	0	0	0	0	0	0	0	0	0	1	1	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	1	2	0	0	0	2	12	6	0	27	23	49
		Unionicola sp	0	1	0	0	0	0	1	0	0	1	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	1
Malacostraca	Isopoda	*Heterias sp*	2	5	5	1	0	9	1	0	0	0	0	1
	Amphipoda	*Amphipoda sp*	0	0	1	5	0	4	0	0	0	1	0	3
	Decapoda	*Paratya australiensis*	2	1	1	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	1	0	2
		Macrobrachium sp	0	1	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	6	10	5	7	9	8	1	0	1	0	1
		Chaematopsyche sp 6	0	0	0	0	0	0	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	2	4	2	5	2	4	3	0	0	0	1	0
		Triaenodes sp	14	9	9	19	5	6	31	0	0	1	16	11
		Triplectides australicus	0	0	0	0	0	0	0	1	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	1	0	0
		Anisocentropus sp	3	3	2	4	3	0	2	1	0	0	0	2
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	2	0	0	0	0	0	0	0
		Caenidae Genus B	9	31	28	45	26	21	27	0	0	2	9	9
		Caenidae Genus C	0	2	0	0	0	1	1	0	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	1	1	0	0	0	0	0	0	0	1
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	1	0	0	0	0	0
		Ischnura heterosticta	0	0	1	0	0	1	5	0	0	0	1	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	2	1
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	1	1	1	0	0	0	0	0
		Austroaeschna u unicornis	1	1	0	0	2	1	1	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	1	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	1	0	0	1	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	18 JULY 95 JUL1-1	UL1-2	UL1-3	18 JULY 95 JUL2-1	UL2-2	UL2-3	18 JULY 95 JUL4-1	UL4-2	UL4-3	18 JULY 95 JUL5-1	UL5-2	UL5-3
	Hemiptera	*Corixidae sp*	3	3	10	0	0	1	0	0	0	2	0	1
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	1	0	0	0	0	0	0	0	0	0	0	1
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	1	0	0	0	0	0	0	1	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tipuliidae sp	0	0	1	0	0	0	1	1	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	1	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	0	0	0	0	0	1	0	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	1	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	0	0	0	0	0	0	0	0	1	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Riethia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	1	0	1	2	0	0	1	0	3	4	1
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	1	0	0	3	1	0	0	3	0	0	1	0
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	1	0	0	1	0	2	0	0	0	1
		Procladius sp	1	0	0	0	3	0	0	2	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	1	0	0	0	0	0	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	0	0	0	0	0	0	0	0	0	1	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	0	0	0	0	0	0	0	0	0	1	0
		TOTAL	46	86	85	96	62	78	131	48	0	87	104	112
		Note: *Caenidae Genus B* formerly *T.to*												

CLASS	ORDER	SPECIES	22 AUG 95			22 AUG 95			22 AUG 95			22 AUG 95			22 AUG 95		
			AUG1-1	UG1-2	UG1-3	AUG2-1	UG2-2	UG2-3	AUG3-1	UG3-2	UG3-3	AUG4-1	UG4-2	UG4-3	AUG5-1	UG5-2	UG5-3
Turbellaria		*Turbellaria sp*	5	14	2	2	14	4	2	1	1	22	33	36	8	2	2
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3
Oligochaete		*Oligochaete sp*	11	12	16	4	4	12	3	5	5	2	6	3	2	11	2
Hirudinea		*Hirudinea sp*	0	0	0	0.	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	22	31	30	3	4	4	1	5	3	0	0	0	9	17	8
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	6	1	0	0	1	3	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		Gyraulus sp	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Arachnida		*Peza ops*	1	2	0	0	1	6	1	2	3	0	10	17	6	14	9
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	Amphipoda	*Amphipoda sp*	0	0	0	25	1	1	0	0	1	0	0	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	—	*Macrobrachium sp*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Insecta	Trichoptera	*Ecnomus pansus*	5	5	2	0	1	12	14	7	15	0	1	0	1	1	0
		Chaematopsyche sp 6	0	2	0	0	0	0	9	9	14	0	0	0	0	0	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	0	0	2	0	2	1	0	1	0	0	0	0	2	0	0
		Triaenodes sp	7	3	1	1	2	0	1	4	1	1	1	0	0	0	1
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0
		Caenidae Genus B	70	79	48	9	66	55	158	115	143	7	26	17	38	20	11
		Caenidae Genus C	1	0	0	0	0	0	1	1	3	0	0	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
	Plecoptera	*Leptoperla sp*	1	0	0	0	1	1	8	9	8	0	0	0	0	0	0
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Ischnura heterosticta	2	1	0	0	0	0	0	1	2	0	0	0	0	1	1
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	1	0	0	2	3	0	0	0	0	1	1
		Austroaeschna u unicornis	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
		Cordulephya pygmaea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	22 AUG 95			22 AUG 95			22 AUG 95			22 AUG 95			22 AUG 95		
			AUG1-1	UG1-2	UG1-3	AUG2-1	UG2-2	UG2-3	AUG3-1	UG3-2	UG3-3	AUG4-1	UG4-2	UG4-3	AUG5-1	UG5-2	UG5-3
	Hemiptera	*Corixidae sp*	6	0	1	7	1	12	0	0	0	13	14	3	1	0	1
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Austrolimnius sp	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
		Psychodidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Simulidae sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Tipuliidae sp	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Cladotanytarsus sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
		Paracladapelma sp	0	3	0	1	0	1	1	4	2	0	2	1	0	1	1
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	0	2	1	1	0	1	0	0	1
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Riethia sp	1	1	0	0	2	0	3	5	1	0	0	1	0	0	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0
		Tanipodinae	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	4	6	4	2	5	12	7	12	9	1	4	3	7	1	0
		Djalmabatista sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	1	1	0	2	1	0	0	0	0	0	0	0
		Procladius sp	1	5	3	2	8	2	1	2	7	3	4	6	3	5	2
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		Parakiefferiella sp	0	1	2	0	4	0	2	1	2	0	3	3	3	1	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	0	0	0	0	1	2	4	5	3	0	0	2	0	0	0
		TOTAL	137	171	114	60	124	128	231	201	240	53	110	100	89	85	47
		Note: *Caenidae Genus B* formerly *T.to*															

			28 SEP 95			28 SEP 95			28 SEP 95			28 SEP 95		
CLASS	ORDER	*SPECIES*	SEP1-1	SEP1-2	SEP1-3	SEP4-1	SEP4-2	SEP4-3	SEP5-1	SEP5-2	SEP5-3	SEP6-1	SEP6-2	SEP6-3
Turbellaria		*Turbellaria sp*	2	2	2	7	14	11	5	8	5	4	2	0
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	1	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	9	2	2	12	16	19	4	8	7	5	15	0
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	5	4	4	2	0	0	3	9	20	5	1	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	1	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	1	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	1	0	0	0	0	0	0
		Physa acuta	0	0	0	1	1	1	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	1	1	0	0	0	0
		Gyraulus sp	0	0	0	1	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	0	1	0	0
Arachnida		*Peza ops*	4	2	2	70	42	46	31	47	48	1	0	0
		Unionicola sp	0	0	0	0	1	0	0	1	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	1	1	0	0	3	10	1	2	0	1	0	0
	Amphipoda	*Amphipoda sp*	1	1	0	0	0	0	0	2	0	0	0	0
	Decapoda	*Parataya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	2	2	1	3	0	0	2	1	0	2	3	0
		Chaematopsyche sp 6	0	0	0	0	0	0	0	0	0	8	2	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Oecetis sp	0	2	1	1	0	0	2	1	0	2	2	0
		Triaenodes sp	6	1	4	10	5	3	2	3	10	1	0	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	1	0	1	0	1	1	2	1	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	1	3	0	2	0	0	1	1	0	0	0	0
		Caenidae Genus B	156	215	118	69	25	26	137	88	109	305	95	0
		Caenidae Genus C	0	6	1	0	0	0	0	1	0	0	1	0
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	1	0	0	0	0	0	0	0	0	5	6	0
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	1	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	1	1	1	1	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	1	0	0
		Austroaeschna u unicornis	0	0	0	0	0	0	0	0	0	0	0	0
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	1	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	1	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	28 SEP 95 SEP1-1	SEP1-2	SEP1-3	28 SEP 95 SEP4-1	SEP4-2	SEP4-3	28 SEP 95 SEP5-1	SEP5-2	SEP5-3	28 SEP 95 SEP6-1	SEP6-2	SEP6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	1	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	1	0	0	0	0	1	1	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	0	0	0	0	0	2	6	0
		Psychodidae sp	1	0	0	0	0	0	0	0	0	1	1	0
		Simulidae sp	0	0	0	0	0	0	0	1	0	9	2	0
		Tipuliidae sp	0	1	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	1	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	0	0	0	0	0	0	1	0	0	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	1	0	0	0	0	0
		Paracladapelma sp	0	0	0	0	0	0	1	1	0	1	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	1	0	0	0	1	0	0	1	1	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	0	0	0	1	0
		Riethia sp	0	0	0	1	0	0	0	0	0	0	1	0
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	0	0	0	1	1	4	0	0	0	3	3	0
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	1	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	4	1	0	2	2	1	0	0	2	2	0	0
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	1	0	0
		Larsia sp	0	0	0	0	0	0	1	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	1	0	3	0	1	1	3	0	1	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	1	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	1	0	0	3	1	1	1	0	1	23	42	0
		Nanocladius sp	0	0	0	2	0	2	0	0	0	0	1	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	1	0
		Parakiefferiella sp	3	1	0	0	3	6	1	0	4	5	9	0
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	2	0
		Rheocricotopus sp	0	0	0	1	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	1	0	0	0	0	0	0	0	0	1	0
		chironomid pupae	1	0	1	4	0	1	3	0	0	6	2	0
		TOTAL	200	249	139	196	120	134	200	179	211	396	203	0
		Note: *Caenidae Genus B* formerly *T.to*												

CLASS	ORDER	SPECIES	26 OCT 95 OCT1-1	CT1-2	CT1-3	26 OCT 95 OCT2-1	CT2-2	CT2-3	26 OCT 95 OCT3-1	CT3-2	CT3-3	26 OCT 95 OCT4-1	CT4-2	CT4-3	26 OCT 95 OCT5-1	CT5-2	CT5-3	26 OCT 95 OCT6-1	CT6-2	CT6-3
Turbellaria		*Turbellaria sp*	2	1	4	1	4	0	0	0	4	12	4	6	28	4	10	0	1	0
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Oligochaete		*Oligochaete sp*	3	0	6	5	7	15	0	0	3	10	30	24	17	18	9	3	1	3
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	3	1	0	1	2	0	0	5	0	7	1	2	2	3	3	0	1	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	1	0	0	1	0	2	0	0	0	25	44	3	14	2	1	1	0	1
		Unionicola sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	1	0	0	3	5	0	0	2	0	1	0	0	1	1	0	0	0	0
	Amphipoda	*Amphipoda sp*	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
	Decapoda	*Paratya australiensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Cherax destructor	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	0	0	0	1	0	0	4	2	1	1	0	0	0	0	1	2	1
		Chaematopsyche sp 6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	2	0
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
		Oecetis sp	0	0	1	0	0	0	2	0	1	0	0	0	0	1	1	0	0	0
		Triaenodes sp	1	0	1	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
		Caenidae Genus B	44	23	21	26	48	6	88	106	96	10	15	10	37	6	12	85	104	55
		Caenidae Genus C	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	3	1
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	3	4	1
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	2	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			26 OCT 95			26 OCT 95			26 OCT 95			26 OCT 95			26 OCT 95			26 OCT 95		
CLASS	ORDER	*SPECIES*	OCT1-1	CT1-2	CT1-3	OCT2-1	CT2-2	CT2-3	OCT3-1	CT3-2	CT3-3	OCT4-1	CT4-2	CT4-3	OCT5-1	CT5-2	CT5-3	OCT6-1	CT6-2	CT6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0
		Dytiscidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	0	0	1	0	0	2	2	0	0	0	0	0	0	0	2	2	0
		Psychodidae sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
		Simulidae sp	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	3	5	6
		Tipuliidae sp	2	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Cryptochironomus griseidorsum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	1	0	2	0	0	1	1	3	9	0	0	0	1	0	1	2	0	0
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	1
		Polypedilum sp	0	0	0	1	0	0	1	1	0	1	0	0	0	0	1	3	1	0
		Rheotanytarsus sp	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	8	4	2
		Riethia sp	1	0	0	0	0	1	4	4	1	1	0	0	1	0	1	0	2	1
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	4	2	6	0	0	1	6	3	6	2	6	5	1	1	6	20	12	13
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	0	0	0	0	1	0	1	0	1	0	1	0	1	0	0	0	1	0
		Djalmabatista sp	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0
		Larsia sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		Procladius sp	0	0	1	3	2	0	0	0	1	4	0	0	1	2	1	1	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
		Coryoneura sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	2	0	0	1	2	10	7	7	1	2	1	1	0	3	50	44	34
		Nanocladius sp	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	5	6	1
		Parakiefferiella sp	3	4	4	3	2	3	24	24	10	5	1	2	1	3	6	19	10	10
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		chironomid pupae	7	4	3	0	1	1	4	8	2	0	2	1	3	1	0	16	13	9
		TOTAL	77	41	50	49	97	34	153	179	155	87	112	61	118	49	58	234	231	147
		Note: *Caenidae Genus B* formerly *T.to*																		

CLASS	ORDER	SPECIES	23 NOV 95 NOV1-1	OV1-2	OV1-3	23 NOV 95 NOV2-1	OV2-2	OV2-3	23 NOV 95 NOV3-1	OV3-2	OV3-3	23 NOV 95 NOV4-1	OV4-2	OV4-3	23 NOV 95 NOV6-1	OV6-2	OV6-3
Turbellaria		*Turbellaria sp*	2	1	4	1	1	2	1	0	1	9	6	12	0	0	1
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	5	9	4	12	6	30	7	6	8	4	2	4	0	0	1
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	1	1	1	0	3	1	1	0	0	0	1	1	0	0	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
		Gyraulus sp	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	1	0	0	3	1	1	0	0	0	10	13	3	0	0	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	1	8	5	2	0	0	0	0	2	1	0	0	0
	Amphipoda	*Amphipoda sp*	1	0	0	10	25	2	1	0	0	0	0	0	0	1	0
	Decapoda	*Parataya australiensis*	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Cherax destructor	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	0	0	1	1	0	1	3	3	0	0	0	6	5	2
		Chaematopsyche sp 6	0	0	0	0	0	0	0	1	1	0	0	0	6	4	6
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1
		Oecetis sp	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0
		Triaenodes sp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	44	31	40	75	34	29	54	48	55	10	6	2	81	103	76
		Caenidae Genus C	0	0	0	0	1	0	2	0	1	0	0	0	1	0	1
		Baetis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	3	2	2
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	0	0	0	0	0	1	0	1	0	0	0	5	6	2
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus australis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	0	1	0	0	0	0	0	0	0	0	3	1	1
		Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

			23 NOV 95			23 NOV 95			23 NOV 95			23 NOV 95			23 NOV 95		
CLASS	ORDER	SPECIES	NOV1-1	OV1-2	OV1-3	NOV2-1	OV2-2	OV2-3	NOV3-1	OV3-2	OV3-3	NOV4-1	OV4-2	OV4-3	NOV6-1	OV6-2	OV6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Dytiscidae sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
		Empididae sp	0	0	0	0	1	1	1	2	0	0	0	0	5	3	2
		Psychodidae sp	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1
		Tipuliidae sp	1	0	0	1	1	0	0	0	0	0	0	0	0	2	0
		unknown diptera	0	0	0	0	1	1	0	0	0	0	0	0	2	1	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chironomus sp	0	1	2	0	3	2	0	0	0	0	0	0	0	0	3
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	0	0	1	0	0	1	2	0	0	0	0	2	2	1
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0
		Paracladapelma sp	3	2	0	2	3	0	2	0	2	0	0	0	2	0	5
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0
		Rheotanytarsus sp	1	0	0	1	0	1	0	0	0	0	0	0	7	4	6
		Riethia sp	2	4	4	5	11	5	4	10	8	4	1	1	0	5	2
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	3	1	3	0	0	1	1	1	2	4	0	3	1	0	1
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	0	3	0	1	6	9	0	0	0	2	0	5	1	1	1
		Djalmabatista sp	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Procladius sp	0	0	2	1	2	5	0	1	0	2	7	0	0	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	1	0	0	0	0	0	1	0	2	0	0	1	2	2	2
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
		Parakiefferiella sp	14	4	19	23	16	15	18	12	16	17	17	17	30	33	21
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		chironomid pupae	6	1	3	4	3	2	4	2	4	3	0	0	4	5	6
		TOTAL	86	59	86	153	129	119	104	93	106	65	62	50	171	183	149
		Note: *Caenidae Genus B* formerly *T.to*															

			21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95		
CLASS	ORDER	*SPECIES*	DEC1-1	EC1-2	EC1-3	DEC2-1	EC2-2	EC2-3	DEC3-1	EC3-2	EC3-3	DEC4-1	EC4-2	EC4-3	DEC5-1	EC5-2	EC5-3	DEC6-1	EC6-2	EC6-3
Turbellaria		*Turbellaria sp*	0	2	1	2	2	1	6	3	1	7	4	4	5	7	6	0	0	1
		Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temnocephalida		*Temnocephalid sp*	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaete		*Oligochaete sp*	4	4	1	2	7	7	1	6	2	3	0	7	4	4	10	5	9	9
Hirudinea		*Hirudinea sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda		*Nematode sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola		*Hypogasturidae sp*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Dicyrtomidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Entomobryidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Neonuridae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda		*Glyptophysa sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physa acuta	0	0	0	0	0	0	0	0	0	1	2	9	0	0	0	0	0	0
		Isidorella sp	0	0	0	0	0	0	0	0	0	1	0	2	0	1	1	0	0	0
		Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicorbis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ferissa sp	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia		*Bivalve sp*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida		*Peza ops*	0	0	0	1	0	1	0	0	0	2	1	23	0	0	0	0	1	0
		Unionicola sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tromboidea sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydracarina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Isopoda	*Heterias sp*	0	0	0	14	9	0	1	2	0	0	0	0	0	0	0	0	2	1
	Amphipoda	*Amphipoda sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Decapoda	*Parataya australiensis*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cherax destructor	1	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0
Insecta	Trichoptera	*Ecnomus pansus*	0	0	1	0	0	0	1	1	2	0	0	0	0	0	0	3	6	1
		Chaematopsyche sp 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1
		Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	2
		Oecetis sp	0	0	0	0	2	0	1	0	1	0	0	0	1	0	0	2	1	1
		Triaenodes sp	0	4	0	2	0	0	2	2	1	0	0	0	1	0	0	0	3	0
		Triplectides australicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Triplectides volda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anisocentropus sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichoptera pupae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeropter	*Atalophlebia sp 9*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
		Caenidae Genus B	27	46	38	30	5	17	30	24	36	4	1	3	14	9	2	24	29	23
		Caenidae Genus C	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
		Baetis sp	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	2	0
		Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tasmanophlebia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Plecoptera	*Leptoperla sp*	0	2	3	0	0	0	0	1	4	0	0	0	0	0	0	4	6	2
		Leptoperla primitiva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata	*Nososticta solida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		Austroargiolestes icteromelas	0	0	0	0	0	0	0	0	0	0	0	0	2	2	3	0	0	0
		Austrogomphus australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Austrogomphus ochraceus	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		Austroaeschna u unicornis	0	0	2	0	1	0	0	0	2	0	0	0	0	0	0	3	0	2
		Cordulephya pygmaea	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		Apocordulia macrops	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0
		Hemicordulia tau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hemigomphus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coenagrionidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLASS	ORDER	SPECIES	21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95			21 DEC 95		
			DEC1-1	EC1-2	EC1-3	DEC2-1	EC2-2	EC2-3	DEC3-1	EC3-2	EC3-3	DEC4-1	EC4-2	EC4-3	DEC5-1	EC5-2	EC5-3	DEC6-1	EC6-2	EC6-3
	Hemiptera	*Corixidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Micronecta annae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleoptera	*Coleoptera sp*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
		Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Dytiscidae sp	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	2	0
	Megaloptera	*Archichauloides sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diptera	*Ceratopogonidae sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Empididae sp	0	1	3	1	1	1	0	2	1	0	0	0	0	0	0	2	6	10
		Psychodidae sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		Simulidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
		Tipuliidae sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		unknown diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
		Chironominae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		Chironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladopelma sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cryptochironomus griseidorsum	0	1	0	1	0	0	1	3	0	0	0	0	0	0	0	1	2	1
		Dicrotendipes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus martini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Kiefferulus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Parachironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paracladapelma sp	0	6	1	1	3	1	8	8	0	0	0	1	0	0	0	6	4	3
		Paratanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polypedilum sp	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	0	0	0
		Rheotanytarsus sp	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	5	2	8
		Riethia sp	3	7	0	1	0	0	5	10	4	2	1	1	2	0	0	2	7	5
		Stenochironomus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tanytarsus sp	2	3	6	0	0	2	2	1	2	0	0	4	0	0	0	5	4	4
		Tanipodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coelopynia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia notabilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ablabesmyia sp	0	1	0	2	6	3	0	1	0	4	1	4	0	0	0	0	3	1
		Djalmabatista sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Larsia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nilotanypus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Paramerina sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		Procladius sp	0	0	0	1	1	0	0	0	0	1	0	4	0	1	1	1	0	0
		Orthocladinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coryoneura sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cardiocladus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Cricotopus sp	0	2	3	1	0	0	0	0	0	0	0	0	1	0	0	1	6	5
		Nanocladius sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orthoclad spZ	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	2
		Parakiefferiella sp	3	4	6	1	5	0	6	0	5	2	0	0	2	0	0	9	11	11
		Paralimnophyes sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rheocricotopus sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thienemanniella sp	0	0	0	0	0	0	1	16	0	0	0	0	0	0	0	0	1	1
		chironomid pupae	4	3	0	0	0	1	2	4	1	0	1	2	1	0	0	7	11	9
		TOTAL	46	89	68	64	46	35	72	92	64	30	12	68	37	24	24	85	136	104
		Note: *Caenidae Genus B* formerly *T.to*																		

			1995	
CLASS	ORDER	*SPECIES*	TOTAL	sp.tot/tot fauna %
Turbellaria		*Turbellaria sp*	1025	5.689703025
		Turbellaria sp2	0	0
		Planaria sp	0	0
Temnocephalida		*Temnocephalid sp*	12	0.066611157
Oligochaete		*Oligochaete sp*	842	4.673882875
Hirudinea		*Hirudinea sp*	3	0.016652789
Nematoda		*Nematode sp*	2	0.01110186
Collembola		*Hypogasturidae sp*	266	1.476547322
		Dicyrtomidae sp	21	0.116569525
		Entomobryidae sp	10	0.055509298
		Neonuridae sp	1	0.00555093
		Sminthuridae: Katianna sp	0	0
Gastropoda		*Glyptophysa sp*	12	0.066611157
		Physa acuta	35	0.194282542
		Isidorella sp	39	0.216486261
		Gyraulus sp	12	0.066611157
		Helicorbis sp	1	0.00555093
		Pseudosuccinea columella	0	0
		Ferissa sp	9	0.049958368
Bivalvia		*Bivalve sp*	65	0.360810436
Arachnida		*Peza ops*	747	4.146544546
		Unionicola sp	6	0.033305579
		Tromboidea sp	2	0.01110186
		Hydracarina sp	4	0.022203719
Malacostraca	Isopoda	*Heterias sp*	126	0.699417152
	Amphipoda	*Amphipoda sp*	115	0.638356925
	Decapoda	*Paratya australiensis*	16	0.088814876
		Caridina mccullochi	10	0.055509298
		Macrobrachium sp	4	0.022203719
		Cherax destructor	43	0.238689981
Insecta	Trichoptera	*Ecnomus pansus*	1354	7.515958923
		Chaematopsyche sp 6	110	0.610602276
		Hydrobiosidae sp	20	0.111018596
		Oecetis sp	505	2.803219539
		Triaenodes sp	973	5.401054677
		Triplectides australicus	19	0.105467666
		Triplectides australis	3	0.016652789
		Triplectides volda	3	0.016652789
		Anisocentropus sp	176	0.976963641
		Hydroptilidae sp	2	0.01110186
		Trichoptera pupae	6	0.033305579
	Ephemeropter	*Atalophlebia sp 9*	35	0.194282542
		Caenidae Genus B	7216	40.0555093
		Caenidae Genus C	130	0.721620871
		Baetis sp	6	0.033305579
		Coloburiscoides sp	7	0.038856508
		Tasmanophlebia sp	2	0.01110186
	Plecoptera	*Leptoperla sp*	105	0.582847627
		Leptoperla primitiva	1	0.00555093
	Odonata	*Nososticta solida*	7	0.038856508
		Ischnura heterosticta	48	0.266444629
		Austroargiolestes icteromelas	70	0.388565085
		Austrogomphus australis	1	0.00555093
		Austrogomphus ochraceus	37	0.205384402
		Austroaeschna u unicornis	86	0.477379961
		Cordulephya pygmaea	15	0.083263947
		Apocordulia macrops	85	0.471829031
		Hemicordulia tau	1	0.00555093
		Hemigomphus sp	1	0.00555093
		Rhadinosticta simplex	19	0.105467666
		Coenagrionidae sp	2	0.01110186

			1995	
CLASS	ORDER	*SPECIES*	TOTAL	sp.tot/tot fauna %
	Hemiptera	*Corixidae sp*	127	0.704968082
		Micronecta annae	2	0.01110186
	Coleoptera	*Coleoptera sp*	6	0.033305579
		Austrolimnius sp	21	0.116569525
		Dytiscidae sp	17	0.094365806
	Megaloptera	*Archichauloides sp*	1	0.00555093
	Diptera	*Ceratopogonidae sp*	6	0.033305579
		Empididae sp	68	0.377463225
		Psychodidae sp	11	0.061060228
		Simulidae sp	47	0.2608937
		Tipuliidae sp	18	0.099916736
		unknown diptera	9	0.049958368
		Chironominae	3	0.016652789
		Chironomus sp	13	0.072162087
		Cladopelma sp	2	0.01110186
		Cladotanytarsus sp	10	0.055509298
		Cryptochironomus griseidorsum	42	0.233139051
		Dicrotendipes sp	0	0
		Kiefferulus martini	1	0.00555093
		Kiefferulus sp	1	0.00555093
		Parachironomus sp	140	0.777130169
		Paracladapelma sp	131	0.727171801
		Paratanytarsus sp	9	0.049958368
		Polypedilum sp	63	0.349708576
		Rheotanytarsus sp	60	0.333055787
		Riethia sp	408	2.264779351
		Stenochironomus sp	0	0
		Tanytarsus sp	472	2.620038857
		Tanipodinae	4	0.022203719
		Coelopynia sp	2	0.01110186
		Ablabesmyia notabilis	0	0
		Ablabesmyia sp	424	2.353594227
		Djalmabatista sp	11	0.061060228
		Larsia sp	11	0.061060228
		Nilotanypus sp	0	0
		Paramerina sp	13	0.072162087
		Procladius sp	136	0.75492645
		Orthocladinae	2	0.01110186
		Coryoneura sp	2	0.01110186
		Cardiocladus sp	0	0
		Cricotopus sp	274	1.52095476
		Nanocladius sp	23	0.127671385
		Orthoclad spZ	33	0.183180683
		Parakiefferiella sp	541	3.003053011
		Paralimnophyes sp	3	0.016652789
		Rheocricotopus sp	5	0.027754649
		Thienemanniella sp	22	0.122120455
		chironomid pupae	348	1.931723564
		TOTAL	18015	100
		Note: *Caenidae Genus B* formerly *T.to*		

Table 2: 1995 macroinvertebrate analyses for Australian Newsprint Mills River Monitoring. Testing for differences between groups of samples (selected *apriori*) using 2 way nested ANOSIM (Bray-Curtis Matrix). Where: High flow (>2m at Albury) includes the summer and spring months of January, February, March, September, October, November and December; and low flow (<2m at Albury) includes the autumn and winter months of April, May, July and August.

FACTOR 1 **flow/season**	FACTOR 2 **ANM site classification**	SAMPLE SIZE **(n)**
High flow	Upstream (control)	12
High flow	Mixing Zone	12
High flow	Downstream	13
Low Flow	Upstream (control)	4
Low Flow	Mixing Zone	5
Low Flow	Downstream	8

ANOSIM sample statistic for differences between ANM site classification = 0.115 (averaged across all Factor 1 groups). Significance level 0.8%.

ANOSIM sample statistic for differences between flow/season groups = 0.778 (using Factor 2 groups as samples). Significance level 10.0%.

Table 3: 1995 macroinvertebrate analyses for Australian Newsprint Mills River Monitoring. Percentage dissimilarity breakdown between groups of samples using SIMPER. Groups of samples are classified into six samples: one of two flow conditions; High (>2m) and Low (<2m); and one of three site classifications with respect to ANM's wastewater discharge; upstream (control), mixing zone and downstream.

SAMPLES	High/up	High/mixing	High/down	Low/up	Low/Mix	Low/down
High/up	0.0%					
High/mix	62.1%	0.0%				
High/down	57.6%	57.9%	0.0%			
Low/up	66.8%	66.1%	69.4%	0.0%		
Low/Mix	64.3%	63.5%	63.9%	59.0%	0.0%	
Low/down	58.1%	60.2%	48.4%	61.7%	58.2%	0.0%

Table 4: 1995 ANM Macroinvertebrate data. Species contributing 50% of the dissimilarity between samples (flow/site) listed in order of decreasing magnitude. Where; high and low refer to flow conditions, and site is describe with reference to ANM's wastewater discharge.

SAMPLES	High/upstream	High/mixing	High/downstream	Low/upstream	Low/mixing	Low/downstream
High/upstream	0					
High/mixing	Caenid Genus B *Ecnomus pansus* Oligochaete spp. Turbellaria spp. *Peza ops* *Parakieferella spp.*	0				
High/downstream	Caenid Genus B Oligochaete spp. *Ecnomus pansus* Turbellaria spp. *Ablabesmya spp.* *Triaenodes spp.*	Caenid Genus B *Ecnomus pansus* *Peza ops* Oligochaete spp. *Parakiefferella spp.* *Tanytarsus spp.*	0			
Low/upstream	Caenid Genus B *Peza ops* Turbellaria spp. Oligochaete spp. *Triaenodes spp.* *Ecnomus pansus*	Caenid Genus B *Peza ops* Turbellaria spp. Oligochaete spp. *Triaenodes spp.* *Ecnomus pansus*	Caenid Genus B *Peza ops* Turbellaria sp *Triaenodes spp.* Oligochaete sp	0		
Low/mixing	Caenid Genus B Turbellaria spp. Oligochaete spp. *Ecnomus pansus* Corixidae sp *Peza ops.*	Caenid Genus B. Turbellaria spp. *Ecnomus pansus* *Peza ops* Oligochaete sp *Rietha spp.*	Caenid Genus B Turbellaria spp. *Ecnomus pansus* *Triaenodes sp* Oligochaete sp	Caenid Genus B *Peza ops* Turbellaria spp. Oligochaete sp *Ecnomus pansus* Corixidae spp.	0	
Low/downstream	Caenid Genus B *Triaenodes spp.* Turbellaria spp. Oligochaete spp. *Ecnomus pansus* *Hypogasturidae spp.*	Caenid Genus B *Triaenodes spp.* *Peza ops* *Ecnomus pansus* *Rietha spp.* *Tanytarsus spp.*	Caenid Genus B *Triaenodes spp.* *Ecnomus pansus* Oligochaete sp *Ablabesmyia spp.* *Parakieferella spp.*	Caenid Genus B *Peza ops* Turbellaria sp *Triaenodes spp.*	Caenid Genus B Turbellaria spp. *Triaenodes spp.* *Ecnomus pansus* Corididae spp.	0

1995

File copy.

20 December, 1995

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Ralph Coghill
Technical Services Manager
Australian Newsprint Mills Limited
Private Bag
LAVINGTON NSW 2641

Dear Ralph

1995 ANNUAL REPORT - BIOLOGICAL AND CHEMICAL MONITORING

Please find enclosed an unbound copy of the 1995 Annual Report outlining the monitoring undertaken by The Murray-Darling Freshwater Research Centre for Australian Newsprint Mills Limited. This Annual Report complies with Licence Condition W16 on the ecotoxicological and bio-accumulation monitoring and the river environment monitoring surveys.

Please do not hesitate to contact me on 43 1002 for any additional information.

Wishing you and your staff a Merry Xmas and a Happy New Year.

Yours sincerely

Helen King

Scientific Officer

Enc. 1995 Annual Report.

1995 ANNUAL REPORT OF CHEMICAL AND BIOLOGICAL MONITORING FOR

AUSTRALIAN NEWSPRINT MILLS Ltd ALBURY

by

The Murray-Darling Freshwater Research Centre

1.0 AIM

To undertake biological and chemical monitoring of ANM's wastewater discharge to the River Murray in accordance with New South Wales Environment Protection Agency licence No.01272 sections W10 (Ecotoxicological and Biological Monitoring) and W11 (River Environment Monitoring Surveys).

The null hypothesis tested in all cases "that there is no difference between control water and wastewater treatments."

2.0 METHODS

2.1 Ecotoxicological Monitoring [W10]

2.1.1 Sample Preparation

All waters were collected as grab samples in 10L buckets on the morning of the test following ASTM (1990) guidelines, the dilution/control water was obtained from the River Murray upstream of the discharge; the receiving water sample was taken from the River Murray approximately 2 km downstream of the wastewater discharge. The wastewater samples were collected on site at ANM from three locations: the final outfall, the 96 hr holding pond and the inlet to the 96 hr holding pond. All waters were sieved to 180 um to remove macro and micro fauna that could interfere with the test whilst still retaining the samples as close as possible to actual field conditions. The temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity of all sample was measured prior to use (USEPA 1991 pp 44-46). The control and downstream river sample were tested undiluted (USEPA 1991 p47). The three on-site wastewater sample were routinely prepared at three concentrations 100% 10% and 1% diluted with control river water and aliquot's of these was distributed between replicates (ASTM 1990). The laboratory temperature was maintained at 20 $\pm$/- 5 Celsius throughout the year.

Acute Toxicity Tests

Acute toxicity testing procedures are formulated from ASTM's "Standard Guide for Conducting Toxicity Tests on Aqueous Effluents with Fishes, Macroinvertebrates and Amphibians" (ASTM 1990) and USEPA's "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (USEPA 1991) but in some cases have been modified slightly to accommodate the local organisms in this program.

Acute toxicity tests are designed to obtain information on the immediate effects on test organisms following short term exposure to effluents under laboratory conditions. Results of these tests can be used to predict the likely effects of the effluent on aquatic organisms in receiving waters. The use of locally occurring species ensures greater accuracy of these predictions. The organisms selected for this program occupy different functional groups: *Daphnia carinata* and *Ceriodaphnia dubia* are pelagic microcrustacea and obligate filter feeders; *Chironomus tepperi* is a benthic midge larva which feeds on detritus. *D.carinata* and *C.tepperi* can be reliably cultured in the laboratory in sufficient numbers for the testing program and *C.dubia* (USEPA 1991 pp 57 and 131-147)was under investigation.

Acute toxicity tests were conducted monthly. Test chambers was used for both organisms are 60 mL clear round glass jars (resin acids, a potential toxic components of papermill effluent are adsorbed onto to plastic surfaces), approximately 40 mm high to ensure an adequate surface area to volume ratio for gaseous exchange. Test solutions were prepared in a single batch and apportioned between three replicates positioned randomly.

Daphniid broodstock were transferred to a fresh solution and the neonates (less than 24 hours old) remaining were bulked in a 5L aquarium. The neonates were carefully captured using glass pipette and released under the surface of the test solutions to minimise trauma due to handling. The neonates were distributed randomly between treatments and replicates so that there were 10 animals per jar. (ASTM 1990 pp 758-760, USEPA 1991 pp 49-51).

Chironomid larvae were sieved from their culture solution and final instars carefully transferred to test solutions using soft flexible forceps. The chironomids were distributed randomly between treatments so that there were ten animals per jar (ASTM 1990 pp 758-760). A small strip of facial tissue was added to each jar as a substrate to help prevent clumping of animals.

The organisms were not fed for the duration of the test as faecal matter and undigested food can reduce the dissolved oxygen level and reduce the biological activity of some test materials (ASTM p761). Observations were made at 24 hours and finalised at 48 hours. Death of invertebrates is often difficult to determine, so immobilisation, lack of response to stimuli and opaque colouration are the symptoms interpreted as death (ASTM p761). The results of these tests were reported as EC50 values (the concentration of effluent which results in the effect observed for 50% of the organisms) provided sufficient number of organisms were affected. "Calculation of an EC50 is considered unacceptable if either or both of the following occurred: No treatment other than a control treatment killed or affected less than 37% of the test organisms exposed to it; No treatment killed or affected more than 63% of the organisms exposed to it." also if more than 10% of the controls exhibited signs of disease, stress or death (ASTM p762 , USEPA p55).

Results were reported quarterly to ANM and a summary of significant results is provided in this Annual Report.

Chronic Toxicity Tests

Chronic toxicity testing procedures are based on ASTM's "Standard Guide for Conducting Renewal Life-Cycle Toxicity Tests with *Daphnia magna*" (1991) and adapted to suite the local cladoceran *Daphnia carinata* and USEPA's "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (1989) which contains methods based on *Daphnia magna* and *Ceriodaphnia dubia*.

Chronic toxicity tests are designed to provide information to permit the prediction of the possible long term affects of effluents on the test organism in receiving waters. They are primarily concerned with sublethal effects which may not be expressed in the short term. The cladoceran tests are life cycle tests, in which an animal is assessed for survival, growth and reproduction.

Chronic toxicity tests were conducted at two monthly intervals using either *D.carinata* or *C.dubia*. Test chambers for both cladocerans are clear glass jars, 60 mL for *D.carinata* and 30 mL for *C.dubia*. Test solutions must be prepared in bulk and apportioned between ten replicates. Cladoceran broodstock were transferred to a fresh solution and the neonates (less than 24 hours old) remaining bulked in a 5L aquarium. These neonates were carefully captured using a glass pipette and released under the surface of the test solutions to minimise handling. The neonates were distributed randomly between treatments and replicates so that there was one animal per jar. (ASTM 1990 p771, USEPA 1989 p106). The cladocerans were fed a daily dose of blended food solution made up of yeast and trout feed (ASTM 1990 p775) and transferred to fresh solutions three times per week (USEPA

1989 p110). Observations of survival, stress and reproduction/number of live young produced were noted at each transfer. The tests continued for a maximum of 21 days (*D.carinata*) or 7 days (*C.dubia*). For the results to be acceptable, survival of the controls must be at least 80% and each surviving control animal must have achieved at least three broods. Results are unacceptable if ephippia (desiccation resistant eggs produced in response to environmental stress) are produced in any of the controls. (USEPA 1989 p122, ASTM 1990 p 774).

Results were analysed in quarterly reports to ANM providing a summary of reproductive statistics for the duration of the test and the numbers of young produced were compared using t-tests to determine the significance ($p<0.05$) to the reproductive potential of the animals. A summary of the significant results were provided in the Annual Report to ANM.

2.2 Bioaccumulation Monitoring [W10]

Bioaccumulation trials were conducted determine the levels of bioaccumulation of metals from ANM's final outfall using a crustacean (*Cherax destructor*) and fish (*Bidyanus bidyanus*).

2.2.1 Yabby *(Cherax destructor)*

Yabby trials were conducted on site at ANM using two identical preconditioned $8M^3$ concrete flow-through tanks containing 150 pieces of PVC pipe as hides. The control tank was fed by sand filtered river water and the test tank was fed by 50% final outfall wastewater diluted with sand filtered river water. About 150 animals of approximately equal size (70 to 80 mm total length) purchased from a commercial yabby farm were added randomly to each tank. A subsample (10-20%) was measured and a sufficient mass of animals as initial controls retained for metals analysis. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity are was measured fortnightly and 10-20 animals were measured (weight and length) monthly and a smaller subsample removed, frozen and freeze dried every three months or at the termination of the trial in preparation for metals analysis. Samples were then submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP analysis.

Growth data were analysed quarterly or at the termination of a trial to determine differences between the control and test treatments and metals data compared annually. A summary of results is provided in this Annual Report to ANM.

2.2.2 Silver Perch *(Bidyanus bidyanus)*

Perch trials were conducted following the breeding season, in the laboratory on site at ANM to minimise fluctuations in temperature known to adversely affect the health of fish. The fish were contained in six 90L preconditioned polypropylene flow through tanks ('Nally' Tubs) containing filter boxes with aeration and artificial weed. Three tanks were randomly assigned to each treatment. The control tanks were fed by sandfiltered river water and test tanks were fed by final outfall wastewater. Fish of approximately equal size (60-80 mm total length) and similar history were purchased from a local hatchery. About 150 fish were added to each tank after treatment with methylene blue and salt to prevent infection resulting from damage during transport and transfer. The fish were subsampled for measurements and analysis. Fish were anaesthetised using 1 mL/L of 'Benzocaine' stock solution (5g/100 mL alcohol) prior to being measured then revived in fresh water and treated with methylene blue and salt before being returned to the tanks. Animals subsampled for chemical analysis were killed by overdose with 'Benzocaine' prior to being frozen. Temperature, dissolved oxygen, conductivity, pH, hardness and alkalinity should be measured in each tank fortnightly, 10-20 animals were measured (weight and length) monthly and a smaller subsample removed every three months or at the termination of the trial, frozen and freeze dried in preparation for metals analysis. Samples were then be submitted to the MDFRC's chemistry laboratory for acid digestion and shipment to a contract lab for ICP analysis.

The results of the analyses were compared for each treatment using the means of the three replicates.

Growth data were analysed quarterly or at the termination of a trial to determine differences between the control and test treatments and metals data compared annually. A summary of results were provided in the Annual Report to ANM.

2.3 River Environment Monitoring Surveys [W11]

2.3.1 Water

Sample Collection and Handling.

Grab samples were taken at three locations on the river on a monthly basis. Site 1 samples were taken from Mungabarena Reserve (approximately 3 km upstream of the outfall). Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

5 samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were "ANALAR" grade or better and, clean polyethylene gloves were worn at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of water samples.

All metal analyses (except for mercury analyses prior to June 1995) were performed by :-
EML (Chem) Pty Ltd
425 -427 Canterbury Road
Surrey Hills Vic 3127

(Analyses for total mercury prior to June 1995 were performed by :-
Australian Newsprint Mills Ltd
Boyer Tas 7140.)

Concentrations of recoverable aluminium, cadmium, cobalt, chromium, copper, iron, manganese, mercury, lead and zinc were determined.

Physical and nutrient analyses were performed at the Murray-Darling Freshwater Research Centre (MDFRC). Turbidity, colour, specific conductance, total filterable solids, ammonia, oxides of nitrogen (NO_x), organic nitrogen, and total phosphorus were determined according to the methods outlined in the MDFRC Chemistry laboratory's methods manual.

2.3.2 Sediment.

Sample Collection and Handling.

A series of forty sediment samples were taken on the 27th of June 1995. Sediment samples were collected from two deposition zones approximately equidistant (*ca* 500 m upstream and *ca* 500 m downstream) of ANM mills outfall. Samples were collected at 10 meter intervals along the 60 cm depth contour (approximately 2 meters from, and parallel to, the river bank). A total of 20 samples were taken above and 20 samples taken below the outfall.

Approximately the top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5% HCl) and repeatedly rinsed with Milli-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimise the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analysis were performed only on the sieved fraction (Grimshaw 1989).

Particle Size Analysis and Loss on Ignition (LOI)

Approximate particle fractionation was carried out on all samples. Fractionation was by the method described by Grimshaw (1989). Essentially, that portion of the sample which was retained by a 2 mm sieve was considered gravel. The portion of the sample that passed through a 2 mm sieve was considered a mixture of silt, clay and sand.

The percentage of silt + clay in this fraction was determined by the 4 minute 48 second hydrometer method described by Grimshaw (1989). The sand content was estimated by difference. No distinction between silt and clay content, or fine sand and coarse sand content was attempted.

Loss on ignition was determined gravimetrically after firing up to 20 g of dried sediment at 550 °C for 2 hours (Grimshaw 1989).

Analysis of Acid Extractable Metals.

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1989). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5% HCl and extensively rinsed with MILLI - Q water). 25 mL of 0.1 M "ARISTAR" grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a Ratek orbital shaking table for one hour. The samples were allowed to settle overnight and, subsequently filtered through acid washed Whatman GF/C filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5% HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to :-

Amdel Laboratories,
Brown St, Therbaton
South Australia,

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury.

Approximately 10 g of air dried sample was placed in clean polyethylene bags and dispatched to :-

Amdel Laboratories,
Brown St, Therbaton
South Australia,

for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen.

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9 % NaOH, 4.0 % $K_2S_2O_4$) and 20 mL of Milli-Q water was added to each tube. The tubes were sealed and subsequently heated in an autoclave for one hour. The solution was the analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et al* 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus.

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et al* 1989).

2.3.3 Macroinvertebrates

Monitoring of the macroinvertebrate fauna above and below the ANM wastewater discharge was performed using artificial substrate samplers as described in "Macroinvertebrates of the River Murray (Survey and Monitoring: 1980-1985), (Bennison *et al* 1989). Standard sampling techniques were used to obtain results that were directly comparable with respect to both temporal and spatial characteristics. The artificial substrate method meets these requirements and has been proven for sampling large rivers such as the Murray River. The sampler is placed in an aquatic ecosystem so that colonisation by benthic organisms can be assessed.

Each sampler consists of a cylinder of black plastic "gutterguard" (mesh approx. 10 mm^2) approximately 180 mm high by 180 mm diameter, the cylinder is closed on one end by a round piece of "gutterguard" and contains two knitted onion bags as complex substrate and a couple of small rocks as ballast. The top of the sampler is pinched and tied closed and a length of nylon cord is used to anchor the sampler which sits on the bed of the river.

Artificial substrate samplers were set at three paired sites - the controls near Grey's farm approximately 500m above ANM's discharge; mixing zone near the railway bridge 200m below the discharge and downstream at Union Bridge 2 km below the discharge. Ten samplers were set monthly at each of the three sites and after a minimum of four weeks, six of these were collected using a fine mesh net and all ten replaced with clean samplers. This allows for the possible loss of four samplers each month due to disturbance and should ensure that sufficient samples are collected. The samples were sieved to 500 μm to remove silt and the remaining portion retained and preserved in 70% alcohol. Samples were sorted using a stereo microscope and identified in reference to MDFRC's taxonomy collection. Site data were analysed statistically to determine differences in community structure using Bray Curtis Dissimilarity Matrix in Systat for Windows and Statistica. Cluster diagrams depicting average linkage and multidimentional scaling were used to help determine the relationship between sites

Comparisons of the community structure data were summarised for inclusion in this Annual Report to ANM.

2.3.4 Fish

Fish were sampled under both high (summer) and low (winter) flow conditions using commercially available collapsible bait traps. Ten traps were set at each of the paired sites specified in 2.2.1 over night for a minimum of 12 hours using yellow chemical light sticks (P Gehrke pers comm, NSW Fisheries).

Catch data were analysed and presented in the Annual Report to ANM.

2.4 REPORTING

Quarterly reports containing all test results and observations including physico-chemical data were submitted to ANM. This annual report containing a summary of results from the monitoring program was submitted to ANM for incorporation as an appendix to their annual report to fulfil their requirements for Condition W16 of Licence No.01272 issued by the NSW Environment Protection Authority.

3.0 RESULTS AND DISCUSSION

3.1 Ecotoxicological and Bioaccumulation Monitoring [W10]

3.1.2 Acute and Chronic Toxicity tests

A summary of acute toxicity test results in which animals in the test solutions reacted differently to those in the control solutions is provided in Table 1. A summary of chronic toxicity test results in which the reproductive capacity of the animals was significantly different ($p < 0.05$, Students t-Test) when compared with the control is provided in Table 2. Significant adverse reactions ANM's treated wastewater occurred in May/June.

3.1.3 Fish Ventilation Monitor

The fish ventilation monitor, which measures stress on fish by detecting changes in electrical potential between two passive electrodes caused by opercular movement, is operational on eight channels. Extensive validation trials were conducted to determine its sensitivity and reliability. A separate report on this will be submitted to ANM in 1996.

3.1.3 Bioaccumulation Studies

A nine month *C.destructor* trial was commenced in July 1994, terminating in June 1995. There was no difference in the growth of animals living in control water compared with the growth of animals living in ANM treated wastewater (reported in the second quarter report to ANM).

The results of the metals assays are presented in Table 3. Molybdenum, chromium, cadmium, lead, tin, lanthanum, nickel, yttrium and vanadium, were either not detected or at detection limits for all samples. Manganese and copper levels were variable demonstrating no trends associated with the treatment. Arsenic, cobalt, aluminium and boron were consistently higher in the treatment samples exposed to ANM wastewater. Zinc, iron and silicon were consistently lower in these treatment samples.

Arsenic levels in the control samples were 4.5, 3.4 and 3.5 mg/kg compared with 7.0, 9.0 and 7.2 mg/kg for the three treatment samples taken in January, April and June. Zinc levels in the control samples were 90.9, 74.9 and 96.8 mg/kg compared with 85.6, 72.4 and 80.3 mg/kg (slightly lower on each sampling occasion) for the treatment samples. Cobalt levels in the control samples were 6.5, 5.9 and 8.4 mg/kg compared with 5.9, 11.0 and 13.3 mg/kg (slightly higher in the latter samples) in the treatment samples. Iron levels in the control samples were 139, 110 and 141 mg/kg compared with 99, 92 and 79 Mg/kg (lower) in the treatment samples. Manganese levels for the control samples were 366, 208 and 231 mg/kg compared with 317, 402 and 371 mg/kg (higher in April only) in the treatment samples. Copper levels in the control samples were 41.7, 29.8 and 42.0 mg/kg compared with 40.2, 36.4 and 28.6 mg/kg (higher in April and lower in June) in the treatment samples. Aluminium levels in the control samples were 2022, 2418 and 2553 mg/kg compared with 2475, 2950 and 2785 mg/kg (slightly higher on each sampling occasion) in the treatment samples. Boron levels in the control samples were 7.1, 12.0 and 14.6 mg/kg, compared with 11.3, 13.5 and 18.6 mg/kg (slightly higher on each occasion) in the treatment samples. Silicon levels in the control samples were 119.4, 87.2 and 64.2 mg/kg compared with 64.0, 83.3 and 51.2 mg/kg (lower) in the treatment samples. Strontium levels in the control samples were 493, 530 and 473 mg/kg compared with 548, 438 and 491 mg/kg (higher in January and June) in the treatment samples. Barium was recorded above the detection limit only in the January control sample possibly indicating an erroneous result. The levels of arsenic in the samples was unusually high compared with data from previous years. The presence of similar concentrations of As in the controls as well as the test samples tends to indicate a possible source of contamination; either in the animals prior to collection, obtained via their supplementary feed; or following collection, during sample preparation and analysis in the MDFRC or Amdel laboratories. Unfortunately the samples cannot be re-analysed, but samples of the yabby pellet food will be analysed to determine if it is the source of the contamination.

The 10 week Silver Perch (*Bidyanus bidyanus*) trial commenced in March 1995 and terminated in May 1994. Some difference in growth was recorded at the end of the trial, however the difference was due to variation between test replicates and not variation between control and test (wastewater) treatments (reported in the second quarter report to ANM).

Molybdenum, chromium, cadmium, lead, lanthanum, yttrium and vanadium were either not detected or at the detection limit for all samples. The results for the metals detected are presented in Table 4. Zinc, manganese and nickel were the same for control and test (ANM wastewater) treatments. Arsenic, barium, cobalt, iron aluminium strontium and to a lesser extent copper were lower in the treatment samples compared with the control samples. Tin, boron and silicon showed no consistent trends with treatment.

3.2 River Environment Monitoring Surveys [W11]

3.2.1 Water

A summary of the water quality data is presented in Figure 1. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.) All the water-quality data accumulated since the commencement of the monitoring program (January 1992) has also been included for purpose of comparison. The figure does not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.006 mg/L), chromium (0.01 mg/L), lead (0.03 mg/L) and mercury (0.0005 mg/L) were not detected in any of the samples (detection limits in brackets). Copper (detection limit of 0.004 mg/L) was detected on only one occasion- site 1 on the 22/5/95 (0.016 mg/L). Also note, an apparent outlier for zinc (May 1995 site 1, 1.2 mg/L) has also been omitted from the figure.

Generally, most of the data show little (if any) variation between sites although, there may be significant variation over time (seasonal effects). From the figure it is evident that iron, manganese, total phosphorus, turbidity, conductivity, colour, and total filterable solids vary little between sites. The levels of ammonia, oxides of nitrogen and organic nitrogen, seem to be more variable between sites - possibly reflecting variable inputs of organic matter to the river from what is essentially a rural riverine environment.

3.2.2 Sediments

Mercury, (detection limit 0.75 mg/kg), arsenic, tin, molybdenum, and silver (all with detection limits of 0.15 mg/kg) were not detected in any of the sediment samples either upstream or downstream of the outfall. Cadmium and chromium were not detected in any of the upstream samples; cadmium was found in all the downstream samples (range 0.15 -

0.75 mg/kg; average 0.35 mg/kg) while, chromium was found in 3 downstream sample (at 0.3 mg/kg.

The results for the sediment analyses for total persulfate nitrogen (tN), exchangeable phosphorus and acid extractable aluminium, barium, calcium, copper, iron, lanthanum, lead, magnesium, manganese, nickel, silica, strontium, yttrium and zinc are summarised in Figure 2. For each analyte a box plot showing the distribution above (Up) and below (Dn) the outfall is presented. The solid horizontal lines of the box plot represent the 10^{th}, 25^{th}, 50^{th}, 75^{th} and, 90^{th} percentiles of the data - the box itself represents the 25^{th} to 75^{th} percentile. All data outside the 10^{th} and 90^{th} percentiles are shown as open circles on the plots. The mean of the data is represented by a dotted line. From the figure it is clear that all of the downstream samples have a significantly greater range and mean concentration than those of the upstream sites.

An extensive series of elements were determined. These included total persulfate nitrogen, exchangeable phosphorus and acid extractable aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. As in previous years it can be seen that the downstream sediments tend to have a greater distribution in the concentration of analytes than the upstream sites and, the mean concentration for the downstream sites tends to be significantly higher than for the upstream sites.

Figure 3 shows the distribution of iron along the upstream and downstream transects. From the figure it can be seen that the upstream transect has an essentially uniform distribution of iron. This is not the case for the downstream transect. The early stations (closer to the outfall) appear to have a similar range of iron concentrations to that of the upstream transect. However, further along the transect there is a significant rise in the iron concentration which then tapers off - indicative of a strong deposition zone in the downstream transect.

If the downstream transect incorporates a more efficient depositional zone than the upstream transect, it should be able to capture a higher percentage of both silt and clay and, organic carbon (estimated by loss on ignition). As Figure 4 shows, this is indeed the case. The box plots clearly show that there is more silt and clay and significantly more organic matter associated with the downstream site than the upstream site.

The question remains as to whether this difference can account for the variation in the elemental composition between the upstream and downstream sites. In order to answer this question the elemental concentration at any given point on the transects was plotted as a function of the percentage LOI (approximating the amount of organic carbon present in the sediment). If the upstream and downstream sites represented a continuum, differing only on the degree of deposition, the relationship between elemental composition and LOI should be linear, with both upstream and downstream sites falling on the same curve. If on the other hand, other factors are influencing the variation in elemental composition a dislocation in the graph would be expected.

Figure 5(A) shows the concentration of Zn along the transects plotted as a function of LOI.. The upstream sites (open circles) tend to cluster toward the lower end of the graph while the downstream sites show a wider distribution. Nevertheless, all the data points lie on the same line - indeed, nearly 95% of the variability in the zinc concentration can be explained by the variability in the LOI data. Similar patterns were observed for all of the other elements analysed with the exception of iron, manganese and copper. The distribution of iron (Figure 5(B)) and manganese (not shown) as a function of loss on ignition, tended to be linear at low levels of organic matter (again with the upstream sites clustering towards the beginning of the graph), but tended to level off at higher concentrations - which suggests saturation may be occurring. Nevertheless, it is evident that the upstream and downstream sites both fall on the same curve. Only Cu (Figure 5(C)) shows a dislocation in the elemental/LOI curve.

Taken as a whole, the data suggest that the variability between the upstream and downstream sites is due to differences in the degree of deposition as evidenced by difference in the deposition of organic matter.

3.2.3 Biota

Macroinvertebrates

The complete species list for 1994 is included in Table 5. The dendogram groupings for the whole year show no biological differences spatially between sites with limited grouping according to sampling dates (Figure 6). For maximum sensitivity these groupings were then analysed by season (summer, autumn, winter, spring) and flow (high >1m and low <1m, at the RL gauge at Union Bridge). The groupings from the dendogram for the low flow period, May/June/July (Figure 7), (providing the highest possible concentration of ANM wastewater down stream from the discharge) fail to show any relationship between site macroinvertebrate communities and proximity to ANM's wastewater discharge The best grouping using multidimentional scaling shows predominantly the separation of the July samples from those of May and June (Figure 8). The samples for 1995 are currently being identified and analysed.

Fish

Fish surveys of the River Murray in 1995 yielded no data. After discussion at the ANM Monitoring Program Annual Review in 1994 the sampling method was changed from bait nets to cylindrical bait traps for 1995. The cylindrical plastic traps were found to be inappropriate for use in fast flowing waters, so sampling resumed using collapsible mesh bait traps. Discussions with fisheries continued throughout 1995 in an attempt to find a better sampling method and refine the sampling program.

4.0 COMMUNICATION

A draft of the revised monitoring program entitled "Biological Monitoring Program Proposal for Australian Newsprint Mills Ltd Albury" incorporating changes to the program since its inception in 1991 was submitted to NSW Fisheries and EPA NSW for comment and approval in May 1995.

The annual review meeting was held on 2 November 1995, with participants from Department of Land and Water Conservation, Environment Protection Authority NSW, NSW Fisheries, Australian Newsprint Mills and The Murray-Darling Freshwater Research Centre.

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Table 1: 1994 summary of significant results for acute toxicity bioassays. PI = ANM pond inlet; P = ANM pond; PO = ANM pond outlet (final outfall); Murray = River below ANM outfall.

TEST	WATER	MONTH
D.carinata 96h	PI 100% (48h)	March
D.carinata 96h	PI 100% (72h)	April
D.carinata 96h	Murray (24h)	May
D.carinata 96h	PO 100% (48h) PI 100% (72h) P 100% (96h) P 10% (96h)	July
D.carinata 96h	PI 100% (72h) P 100% (72h) Murray (72h) PO 100% (96h)	August

NOTE: No significant results from *C.tepperi* tests.

Table 2: 1994 summary of significant results for *Daphnia carinata* chronic toxicity bioassays. PI = ANM pond inlet; P = ANM pond; PO = ANM pond outlet (final outfall); Murray = River below ANM outfall; < = Inhibitary effect on reproduction potential and > = stimulatory effect on reproductive potential.

TEST	WATER	MONTH
D.carinata 21day	Pond Inlet 100% (<)	January
	Pond 100% (<)	
	Pond 10% (>)	
D.carinata 21day	Pond Outlet 100% (<)	March/April
	Pond Inlet 1% (>)	
	Pond Inlet 0.1% (>)	
	Pond 10% (>)	
	Pond Outlet 1% (>)	
D.carinata 21day	Pond 100% (>)	May
	Pond 10% (>)	
	Pond Outlet 10% (>)	
	Murray (>)	
D.carinata 21day	Pond 100% (>)	July
	Pond 10% (>)	
	Pond Outlet 100% (>)	
D.carinata 21day	Pond Inlet 100% (<)	August/September
	Pond Outlet 100% (<)	
D.carinata 21day	Pond Inlet 1% (>)	October
	Pond 1% (>)	

Table 3: Metals assay data for *C.destructor* 10 month bioaccumulation trial 1994b. c = control, t = test (ANM treated wastewater) and 1,2 or 3 indicate subsample.

BIOACCUMULATION ASSAY FOR METALS - C.destructor 1995

MDFRC Sample - Replicate	Sample Wt. gm	Arsenic mg/kg	Molybdenum mg/kg	Chromium mg/kg	Zinc mg/kg	Cadmium mg/kg
Blank 1	0.0000	<0.8	0.8	0.8	<0.8	<0.8
Blank 1	0.0000	<0.8	0.8	<0.8	<0.8	<0.8
Blank 1	0.0000	<0.8	<0.8	<0.8	<0.8	<0.8
mean	0.00					
std	0.00					
NBS1566a-1	0.5036	25.3	1.5	1.5	715	3.0
NBS1566a-2	0.5168	<1.4	1.5	1.5	758	<1.5
NBS1566a-3	0.5174	<1.4	<1.4	2.9	761	2.9
mean	0.51			1.95	744.47	
std	0.01			0.83	25.71	
YO-1	2.5056	5.1	<3.0	0.3	123	<0.3
YO-2	2.5020	<0.3	<0.3	0.3	117	<0.3
YO-3	2.5126	<0.3	<0.3	0.3	121	<0.3
mean	2.51			0.30	120.17	
std	0.01			0.00	3.18	
JANc-1	5.0254	7.0	<0.1	0.3	85	<0.1
JANc-2	5.0486	3.4	<0.1	0.3	95	0.1
JANc-3	5.0099	3.1	0.4	0.1	93	<0.1
mean	5.03	4.52		0.25	90.94	
std	0.02	2.16		0.09	5.19	
JANt-1	5.0169	4.2	0.1	0.3	83	<0.1
JANt-2	5.0280	9.1	<0.1	0.3	83	0.7
JANt-3	5.0152	7.6	0.4	1.0	90	<0.1
mean	5.02	6.97		0.55	85.56	
std	0.01	2.52		0.43	4.26	
APRc-1	5.0558	2.4	0.1	<0.1	73	<0.1
APRc-2	5.1225	2.9	0.3	0.1	75	<0.1
APRc-3	5.0058	4.8	0.1	0.1	77	0.3
mean	5.06	3.37	0.20		74.89	
std	0.06	1.27	0.08		1.86	
APRt-1	5.0059	13.2	0.3	0.1	71	<0.1
APRt-2	5.0073	6.7	0.1	0.3	76	<0.1
APRt-3	5.0367	7.1	<0.1	0.3	71	<0.1
mean	5.02	9.02		0.25	72.36	
std	0.02	3.61		0.09	2.97	
JUNc-1	5.1018	0.7	0.1	0.1	83	<0.1
JUNc-2	5.0196	5.4	0.1	0.3	106	<0.1
JUNc-3	5.0216	4.5	<0.1	0.1	101	<0.1
mean	5.05	3.53		0.20	96.80	
std	0.05	2.46		0.09	11.72	
JUNt-1	5.0088	7.2	0.4	0.1	80	<0.1
JUNt-2	5.0537	2.7	0.7	0.3	92	<0.1
JUNt-3	5.0568	8.5	0.1	0.3	109	<0.1
mean	5.01	7.19	0.45	0.15	80.26	
std	0.03	3.04	0.30	0.08	14.23	

NOTE: c = control, t = test (50% ANM treated wastewater)

BIOACCUMULATION ASSAY FOR METALS - C.destructor 1995

MDFRC Sample - Replicate	Lead mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg	Manganese mg/kg	Copper mg/kg
Blank 1	4.5	4.5	1.5	0.8	<0.8	0.8
Blank 1	<0.8	1.5	<0.8	6.8	<0.8	1.5
Blank 1	<0.8	5.3	<0.8	8.3	<0.8	0.8
mean		3.75		5.25		1.00
std		1.98		3.97		0.43
NBS1566a-1	<1.5	35.7	14.9	550	8.9	60
NBS1566a-2	<1.5	24.7	8.7	530	10.2	65
NBS1566a-3	<1.4	36.2	10.1	554	10.1	62
mean		32.22	11.25	544.33	9.75	62.40
std		6.54	3.24	12.84	0.70	2.87
YO-1	<0.3	269	9.9	372	548	35.3
YO-2	<0.3	456	6.6	394	629	33.3
YO-3	<0.3	442	7.8	401	609	34.0
mean		388.94	8.08	389.14	595.40	34.21
std		103.76	1.66	15.06	42.51	1.04
JANc-1	<0.1	87	7.6	135	367	37.8
JANc-2	<0.1	71	4.6	136	354	44.7
JANc-3	<0.1	78	7.3	147	377	42.7
mean		78.57	6.52	139.04	365.98	41.71
std		7.65	1.66	6.66	11.89	3.58
JANt-1	<0.1	<0.1	5.7	100	314	37.8
JANt-2	<0.1	<0.1	7.0	98	313	40.3
JANt-3	<0.1	<0.1	5.1	98	323	42.5
mean			5.93	99.00	316.73	40.19
std			0.99	1.00	5.45	2.33
APRc-1	<0.1	<0.1	7.0	120	201	30.7
APRc-2	<0.1	<0.1	5.9	106	210	29.0
APRc-3	<0.1	139	4.8	105	212	29.8
mean			5.87	110.50	207.55	29.84
std			1.09	8.62	6.09	0.86
APRt-1	<0.1	<0.1	10.2	93	381	35.4
APRt-2	<0.1	<0.1	11.7	97	425	36.4
APRt-3	<0.1	<0.1	11.0	85	399	37.5
mean			10.96	91.71	401.67	36.43
std			0.75	5.79	22.53	1.08
JUNc-1	<0.1	<0.1	11.2	127	214	35.9
JUNc-2	<0.1	<0.1	7.5	146	242	45.9
JUNc-3	0.1	<0.1	6.4	151	238	44.4
mean			8.36	141.38	231.44	42.03
std			2.50	12.57	14.86	5.39
JUNt-1	<0.1	<0.1	13.3	79	371	28.6
JUNt-2	<0.1	<0.1	15.7	105	365	35.0
JUNt-3	<0.1	<0.1	13.1	106	383	40.2
mean			13.33	78.91	371.35	28.60
std			1.47	15.27	8.91	5.81

NOTE: c = control, t = test (50% ANM treated wastewater)

BIOACCUMULATION ASSAY FOR METALS - C.destructor 1995

MDFRC Sample - Replicate	Tin mg/kg	Lanthanum mg/kg	Nickel mg/kg	Yttrium mg/kg	Aluminium mg/kg	Boron mg/kg
Blank 1	<0.8	<0.8	0.8	<0.8	59	2.3
Blank 1	<0.8	<0.8	<0.8	<0.8	34.5	<0.8
Blank 1	<0.8	<0.8	1.5	<0.8	39.0	<0.8
mean					44.25	
std					13.18	
NBS1566a-1	<1.5	<1.5	6.0	<1.5	9353	71.5
NBS1566a-2	<1.5	<1.5	1.5	<1.5	5283	27.6
NBS1566a-3	1.4	<1.4	2.9	<1.4	7132	39.1
mean			3.44		7255.66	
std			2.30		2037.90	
YO-1	3.9	<0.3	2.1	0.3	5388	20.1
YO-2	2.7	<0.3	1.5	0.3	4382	17.1
YO-3	<0.3	<0.3	1.5	0.3	4054	51.9
mean			1.70	0.30	4608.00	29.69
std			0.35	0.00	695.18	19.32
JANc-1	0.4	<0.1	0.9	0.1	2307	7.8
JANc-2	0.6	<0.1	0.7	0.1	1489	8.6
JANc-3	<0.1	<0.1	1.0	0.3	2270	4.8
mean			0.90	0.20	2021.77	7.06
std			0.15	0.09	462.19	2.01
JANt-1	2.8	<0.1	0.3	0.1	2497	7.3
JANt-2	1.9	<0.1	0.6	0.1	2819	6.0
JANt-3	1.3	<0.1	0.4	0.1	2109	20.5
mean	2.04		0.45	0.15	2474.79	11.26
std	0.75		0.15	0.00	355.81	8.02
APRc-1	0.6	<0.1	0.4	0.1	2747	11.6
APRc-2	1.9	<0.1	0.6	0.1	2152	14.8
APRc-3	1.9	<0.1	0.6	0.1	2355	9.6
mean	1.48		0.54	0.15	2418.29	11.98
std	0.77		0.09	0.00	302.50	2.62
APRt-1	<0.1	<0.1	<0.1	0.1	3296	16.2
APRt-2	2.4	<0.1	0.1	0.1	2528	15.0
APRt-3	1.6	<0.1	0.4	<0.1	3026	9.2
mean					2950.07	13.46
std					389.46	3.71
JUNc-1	1.0	<0.1	0.9	0.1	2681	11.0
JUNc-2	1.2	<0.1	0.1	0.1	2734	24.7
JUNc-3	1.0	<0.1	0.9	0.1	2243	8.2
mean	1.09		0.64	0.15	2553.00	14.63
std	0.09		0.43	0.00	269.50	8.79
JUNt-1	<0.1	<0.1	<0.1	0.3	2785	18.6
JUNt-2	2.1	<0.1	0.4	0.3	3532	8.0
JUNt-3	2.8	<0.1	0.1	0.1	2851	29.7
mean				0.30	2785.10	18.57
std				0.09	413.65	10.83

NOTE: c = control, t = test (50% ANM treated wastewater)

BIOACCUMULATION ASSAY FOR METALS - C.destructor 1995

MDFRC Sample - Replicate	Silicon mg/kg	Vanadium mg/kg	Strontium mg/kg
Blank 1	12.0	<0.8	<0.8
Blank 1	11.3	<0.8	<0.8
Blank 1	9.8	<0.8	<0.8
mean	11.00		
std	1.15		
NBS1566a-1	92	3.0	10.4
NBS1566a-2	73	2.9	10.2
NBS1566a-3	72	4.3	10.1
mean	79.12	3.41	10.24
std	11.44	0.81	0.16
YO-1	59	0.3	676
YO-2	52	0.3	1295
YO-3	76	0.3	681
mean	62.31	0.30	884.01
std	12.39	0.00	355.91
JANc-1	113	0.1	510
JANc-2	129	0.1	463
JANc-3	116	0.1	506
mean	119.36	0.15	493.30
std	8.62	0.00	25.91
JANt-1	68	0.4	559
JANt-2	40.0	0.4	555
JANt-3	84	0.1	529
mean	64.01	0.35	547.80
std	22.15	0.17	16.08
APRc-1	91	0.1	531
APRc-2	89	0.1	542
APRc-3	82	0.1	518
mean	87.16	0.15	530.40
std	4.80	0.00	11.68
APRt-1	79	<0.1	393
APRt-2	101	<0.1	476
APRt-3	70	0.4	444
mean	83.25		437.53
std	15.84		42.23
JUNc-1	68	0.1	459
JUNc-2	75	0.1	472
JUNc-3	50	0.1	490
mean	64.22	0.15	473.56
std	12.68	0.00	15.66
JUNt-1	51	0.1	491
JUNt-2	59	0.1	451
JUNt-3	65	0.1	392
mean	51.21	0.15	491.14
std	6.97	0.00	50.11

NOTE: c = control, t = test (50% ANM treated wastewater)

Table 4: Metals assay data for *B.bidyanus* two month bioaccumulation trial 1994.

c# = control tank replicate and t# = test tank (ANM treated wastewater) replicate.

BIOACCUMULATION OF METALS DETECTED - B.bidyanus 1995

MDFRC Sample - replicate	Sample Wt. gm	Arsenic mg/kg	Zinc mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg	Manganese mg/kg
MAR INIT	0.47		103.87	116.00	56.56	204.74	15.45
APR C2	0.37	6.04	101.59	58.11	110.31	237.97	12.32
APR C5	0.49		95.29	55.37	413.57	229.58	11.97
APR C6	0.35		80.33	53.72	143.79	233.80	
mean	**0.41**		**92.40**	**55.73**	**222.56**	**233.78**	**12.14**
std	0.07		10.92	2.21	166.27	4.20	0.25
APR T1	0.32		84.25	50.49	122.49	240.20	13.31
APR T3	0.40		93.54	36.92	95.06	222.23	11.21
APR T4	0.41		89.28	51.81	103.89	193.70	8.06
mean	**0.38**		**89.03**	**46.41**	**107.15**	**218.71**	**10.86**
std	0.05		4.65	8.24	14.00	23.45	2.64
MAY C2	0.76	33.66	70.59		18.88	121.19	1.98
MAY C5	2.62	7.27	65.47	117.66	12.73	79.29	6.21
MAY C6	0.69	6.77	77.75	99.38	34.75	170.53	2.90
mean	**1.36**	**15.90**	**71.27**	**108.52**	**22.12**	**123.67**	**3.69**
std	1.09	15.39	6.17	12.92	11.36	45.67	2.22
MAY T1	5.05	1.68	56.69	13.42	14.31	68.27	3.02
MAY T3	5.04	6.99	83.30		9.47	69.76	4.02
MAY T4	5.15	3.29	75.05	18.89	4.53	74.81	4.51
mean	**5.08**	**3.99**	**71.68**	**16.15**	**9.44**	**70.95**	**3.85**
std	0.06	2.72	13.62	3.87	4.89	3.43	0.76

NOTE: c# = control tank, t# = test tank (ANM treated wastewater)

BIOACCUMULATION OF METALS DETECTED - B.bidyanus 1995

MDFRC Sample - replicate	Copper mg/kg	Tin mg/kg	Nickel mg/kg	Aluminium mg/kg	Boron mg/kg	Silicon mg/kg	Strontium mg/kg
MAR INIT	6.99		3.23	11863.80	42.57	66.88	141.84
APR C2	6.09	7.60	3.47	16672.08	18.09	96.76	92.51
APR C5	5.64		2.52	15903.05	13.63	67.31	91.43
APR C6	7.75		3.60	19606.01		101.24	92.91
mean	**6.49**	**7.60**	**3.19**	**17393.71**	**15.86**	**88.44**	**92.28**
std	1.11		0.59	1954.11	3.15	18.43	0.77
APR T1	5.45		3.28	17220.15	27.97	90.65	33.75
APR T3	5.69			14623.44	13.95	72.35	65.89
APR T4	4.32	9.37	3.06	14502.27	21.63	56.26	74.11
mean	**5.15**	**9.37**	**3.17**	**15448.62**	**21.18**	**73.09**	**57.92**
std	0.73		0.16	1535.39	7.02	17.21	21.33
MAY C2	2.30			9975.82	20.04	47.41	117.62
MAY C5	3.25	3.33		3629.52	6.01	84.11	121.46
MAY C6				11197.05	16.65	65.23	127.35
mean	**2.77**	**3.33**		**8267.46**	**14.24**	**65.58**	**122.14**
std	0.67			4062.72	7.32	18.35	4.90
MAY T1	1.53	1.19		2053.15	1.68	87.45	45.20
MAY T3	1.64			1924.77	5.75	89.39	52.36
MAY T4	2.09	1.89		2034.31	3.60	80.10	48.04
mean	**1.75**	**1.54**		**2004.08**	**3.68**	**85.65**	**48.53**
std	0.29	0.50		69.32	2.03	4.90	3.60

NOTE: c# = control tank, t# = test tank (ANM treated wastewater)

BIOACCUMULATION OF METALS DETECTED - B.bidyanus 1995

MDFRC Sample - replicate	Sample Wt. gm	Arsenic mg/kg	Zinc mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg	Manganese mg/kg
MAR INIT	0.47		103.87	116.00	56.56	204.74	15.45
APR C2	0.37	6.04	101.59	58.11	110.31	237.97	12.32
APR C5	0.49		95.29	55.37	413.57	229.58	11.97
APR C6	0.35		80.33	53.72	143.79	233.80	
mean	**0.41**		**92.40**	**55.73**	**222.56**	**233.78**	**12.14**
std	0.07		10.92	2.21	166.27	4.20	0.25
APR T1	0.32		84.25	50.49	122.49	240.20	13.31
APR T3	0.40		93.54	36.92	95.06	222.23	11.21
APR T4	0.41		89.28	51.81	103.89	193.70	8.06
mean	**0.38**		**89.03**	**46.41**	**107.15**	**218.71**	**10.86**
std	0.05		4.65	8.24	14.00	23.45	2.64
MAY C2	0.76	33.66	70.59		18.88	121.19	1.98
MAY C5	2.62	7.27	65.47	117.66	12.73	79.29	6.21
MAY C6	0.69	6.77	77.75	99.38	34.75	170.53	2.90
mean	**1.36**	**15.90**	**71.27**	**108.52**	**22.12**	**123.67**	**3.69**
std	1.09	15.39	6.17	12.92	11.36	45.67	2.22
MAY T1	5.05	1.68	56.69	13.42	14.31	68.27	3.02
MAY T3	5.04	6.99	83.30		9.47	69.76	4.02
MAY T4	5.15	3.29	75.05	18.89	4.53	74.81	4.51
mean	**5.08**	**3.99**	**71.68**	**16.15**	**9.44**	**70.95**	**3.85**
std	0.06	2.72	13.62	3.87	4.89	3.43	0.76

NOTE: c# = control tank, t# = test tank (ANM treated wastewater)

BIOACCUMULATION OF METALS DETECTED - B.bidyanus 1995

MDFRC Sample - replicate	Copper mg/kg	Tin mg/kg	Nickel mg/kg	Aluminium mg/kg	Boron mg/kg	Silicon mg/kg	Strontium mg/kg
MAR INIT	6.99		3.23	11863.80	42.57	66.88	141.84
APR C2	6.09	7.60	3.47	16672.08	18.09	96.76	92.51
APR C5	5.64		2.52	15903.05	13.63	67.31	91.43
APR C6	7.75		3.60	19606.01		101.24	92.91
mean	**6.49**	**7.60**	**3.19**	**17393.71**	**15.86**	**88.44**	**92.28**
std	1.11		0.59	1954.11	3.15	18.43	0.77
APR T1	5.45		3.28	17220.15	27.97	90.65	33.75
APR T3	5.69			14623.44	13.95	72.35	65.89
APR T4	4.32	9.37	3.06	14502.27	21.63	56.26	74.11
mean	**5.15**	**9.37**	**3.17**	**15448.62**	**21.18**	**73.09**	**57.92**
std	0.73		0.16	1535.39	7.02	17.21	21.33
MAY C2	2.30			9975.82	20.04	47.41	117.62
MAY C5	3.25	3.33		3629.52	6.01	84.11	121.46
MAY C6				11197.05	16.65	65.23	127.35
mean	**2.77**	**3.33**		**8267.46**	**14.24**	**65.58**	**122.14**
std	0.67			4062.72	7.32	18.35	4.90
MAY T1	1.53	1.19		2053.15	1.68	87.45	45.20
MAY T3	1.64			1924.77	5.75	89.39	52.36
MAY T4	2.09	1.89		2034.31	3.60	80.10	48.04
mean	**1.75**	**1.54**		**2004.08**	**3.68**	**85.65**	**48.53**
std	0.29	0.50		69.32	2.03	4.90	3.60

NOTE: c# = control tank, t# = test tank (ANM treated wastewater)

Table 5: Complete macroinvertebrate species list for ANM river monitoring sites 1994

Sites 1 and 2 = 2km downstream of the discharge

Sites 3 and 4 = immediately downstream of discharge in the mixing zone

Sites 5 and 6 = controls - upstream of the discharge.

SPEC94

	27 JAN 94						24 FEB 94				
SPECIES SITE	JAN1	JAN2	JAN3	JAN4	JAN5	JAN6	FEB1	FEB2	FEB4	FEB5	FEB6
Turbellaria sp	0	0	1	0	0	4	1	0	0	0	0
Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0
Planaria sp	0	0	0	0	0	0	0	0	0	0	0
Hypogasturidae sp	0	0	0	0	0	0	0	0	0	0	0
Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0
Glyptophysa sp	0	2	0	10	3	0	0	0	3	3	0
Physa acuta	0	0	0	0	0	0	0	0	0	0	0
Isidorella sp	0	0	0	0	1	0	0	0	0	1	0
Gyraulus sp	0	0	0	0	1	0	0	0	0	1	0
Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0
Oligochaete sp	2	4	0	0	12	2	12	18	0	12	0
Acarina:peza ops	0	1	0	10	9	0	0	1	5	5	0
Acarina sp	0	0	0	0	0	0	0	0	0	0	0
Heterias sp	0	0	0	0	2	3	4	1	0	6	0
Amphipoda sp	0	0	0	0	0	0	0	0	0	0	0
Parataya australensis	0	0	0	0	0	0	0	0	0	0	0
Caridina mccullochi	0	0	0	2	0	0	0	0	0	0	0
Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0
Cherax destructor	0	1	3	2	2	1	4	5	0	2	1
Atalophlebia sp 9	0	0	0	0	0	3	0	0	0	0	3
Tasmanocoenis tonnoiri	9	9	47	8	3	184	77	28	8	5	438
Tasmanocoenis arcuata	0	0	0	0	0	1	0	0	0	0	0
Baetis sp	0	0	0	0	0	0	0	0	0	0	0
Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0
Nososticta solida	0	0	0	0	0	0	0	0	2	0	0
Ischnura heterosticta	0	0	0	1	0	0	1	0	0	0	0
Austroargiolestes icteromelas	0	0	0	1	1	0	1	1	0	0	0
Austrogomphus ochraceus	0	0	0	0	0	0	0	0	0	0	0
Austroaeschna u unicornis	0	0	0	0	0	1	2	1	0	0	2
Cordulephya pygmaea	0	0	0	0	1	0	0	0	0	0	0
Apocordulia macrops	0	0	0	0	0	2	0	0	0	0	0
Hemicordulia tau	0	0	0	0	0	0	0	2	0	1	0
Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0
Hemiptera sp	0	0	0	0	0	0	0	0	1	0	0
Coleoptera sp	0	0	0	0	0	0	0	1	0	0	0
Austrolimnius sp	0	0	0	1	0	0	0	0	0	0	0
Ecnomus pansus	33	32	43	25	14	250	21	17	25	9	79
Calamo: Anisocentropus sp	0	0	0	0	2	2	0	1	0	2	0
Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae sp 6	0	0	2	0	0	1	0	0	0	0	0
Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	2

	DATE	27 JAN 94						24 FEB 94				
SPECIES	SITE	JAN1	JAN2	JAN3	JAN4	JAN5	JAN6	FEB1	FEB2	FEB4	FEB5	FEB6
Lept:Oecetis sp		0	3	6	1	1	6	2	3	1	1	5
Lept:Triaenodes sp		6	1	2	0	0	7	4	1	0	2	12
Lept:Triplectides australis		0	0	0	0	0	0	0	0	0	0	0
Lept:Triplectides volda		0	0	0	0	0	0	0	0	0	0	0
Trichoptera pupae		2	0	2	0	0	4	0	0	0	0	0
Leptoperla sp		0	0	0	0	0	0	0	0	0	0	3
Leptoperla primitiva		0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae sp		0	0	0	0	0	0	0	0	0	0	1
Empididae sp		0	3	10	0	0	4	0	0	0	0	0
Psychodidae sp		0	0	0	0	0	0	0	0	0	0	0
Simulidae sp		0	0	0	0	0	0	0	0	0	0	0
Tipuliidae sp		0	0	0	0	0	0	0	0	0	0	0
unknown diptera		0	0	2	0	0	0	0	0	0	0	0
Chironomus sp		0	0	0	0	0	0	0	0	0	0	0
Cladopelma sp		0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus sp		0	0	0	0	0	0	0	0	0	0	1
Cryptochironomus griseidorsum		0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp		0	0	0	0	0	1	0	0	0	0	0
Kiefferulus martini		0	0	0	0	0	0	0	0	0	0	0
Kiefferulus sp		0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp		0	0	0	3	0	0	0	0	0	0	0
Paracladapelma sp		3	7	4	0	0	7	0	2	0	0	7
Paratanytarsus sp		0	0	0	0	0	0	1	0	0	0	0
Polypedilum sp		3	1	0	0	0	1	2	1	0	0	1
Rheotanytarsus sp		0	0	1	2	0	1	0	0	0	0	0
Riethia sp		2	1	3	0	0	2	7	1	2	0	0
Stenochironomus sp		0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp		3	0	8	0	0	18	8	0	0	0	3
Ablabesmyia notabilis		0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia sp		0	1	1	1	0	1	1	1	0	0	0
Djalmabatista sp		0	0	0	0	0	0	0	0	0	0	0
Larsia sp		0	0	0	0	0	0	0	0	0	0	0
Nilotanypus sp		0	0	0	0	0	0	0	0	0	0	0
Paramerina sp		0	0	0	0	0	0	0	0	0	0	0
Procladius sp		0	1	1	0	0	0	0	1	0	0	1
Cardiocladus sp		0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp		0	0	1	1	0	9	0	0	0	0	0
Nanocladius sp		0	0	0	0	0	2	0	0	0	0	0
Orthoclad spZ		0	0	0	0	0	0	0	0	0	0	0
Parakiefferiella sp		0	3	3	0	0	4	0	0	0	0	0
Rheocricotopus sp		0	0	0	0	0	0	0	0	0	0	0
Thienemanniella sp		0	0	1	0	0	1	0	1	0	0	0
chironomid pupae		0	1	5	4	1	14	3	4	1	1	15

	24 MAR 94						28 APR 94				
SPECIES SITE	MAR1	MAR2	MAR3	MAR4	MAR5	MAR6	APR1	APR2	APR3	APR4	APR5
Turbellaria sp	0	0	0	0	0	0	2	2	2	0	6
Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0
Planaria sp	0	0	0	0	0	0	0	0	0	0	0
Hypogasturidae sp	0	0	0	0	0	0	0	0	0	0	0
Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0
Glyptophysa sp	0	0	0	0	7	0	0	0	0	1	0
Physa acuta	0	0	0	0	0	0	0	0	0	0	0
Isidorella sp	0	0	0	3	0	0	0	0	0	4	0
Gyraulus sp	0	0	0	2	1	0	0	0	0	0	0
Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0
Oligochaete sp	10	8	0	0	8	1	1	4	8	4	26
Acarina:peza ops	1	8	5	30	26	1	0	4	6	23	11
Acarina sp	0	0	0	0	0	0	1	0	0	0	0
Heterias sp	1	0	3	3	3	2	3	0	4	3	1
Amphipoda sp	0	0	0	0	0	1	1	0	0	0	0
Parataya australensis	0	0	0	0	0	0	2	6	0	0	0
Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0
Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0
Cherax destructor	2	3	0	2	0	1	4	3	1	1	4
Atalophlebia sp 9	1	0	2	0	0	1	1	0	1	0	0
Tasmanocoenis tonnoiri	84	16	30	8	9	60	100	87	207	16	15
Tasmanocoenis arcuata	2	0	0	0	0	1	1	0	6	0	0
Baetis sp	0	0	0	0	0	0	0	0	1	0	0
Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0
Nososticta solida	0	0	0	0	0	1	0	0	0	0	0
Ischnura heterosticta	3	0	0	0	0	0	1	3	0	0	1
Austroargiolestes icteromelas	1	0	0	2	1	0	0	0	0	0	9
Austrogomphus ochraceus	0	0	0	0	0	0	0	2	0	1	0
Austroaeschna u unicornis	1	0	0	0	0	1	1	2	0	1	0
Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0
Apocordulia macrops	1	0	1	0	0	0	0	0	0	1	0
Hemicordulia tau	0	0	0	0	0	0	0	2	0	0	0
Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0
Hemiptera sp	0	0	0	0	1	0	3	3	2	0	0
Coleoptera sp	0	0	0	0	0	0	0	0	1	0	0
Austrolimnius sp	0	0	0	0	0	0	0	0	0	0	0
Ecnomus pansus	68	8	31	11	8	50	3	7	67	4	4
Calamo: Anisocentropus sp	1	2	1	0	0	2	7	3	2	0	5
Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae sp 6	0	0	1	1	0	0	0	0	4	0	0
Hydroptilidae sp	0	0	1	0	0	0	0	0	0	0	0

	DATE	24 MAR 94						28 APR 94				
SPECIES	SITE	MAR1	MAR2	MAR3	MAR4	MAR5	MAR6	APR1	APR2	APR3	APR4	APR5
Lept:Oecetis sp		11	8	2	0	1	4	5	25	23	8	3
Lept:Triaenodes sp		8	1	1	0	0	9	73	63	16	8	12
Lept:Triplectides australis		0	0	0	0	0	0	0	0	0	0	0
Lept:Triplectides volda		0	0	0	0	0	0	0	0	0	0	0
Trichoptera pupae		0	0	0	0	0	0	0	0	0	0	0
Leptoperla sp		1	1	6	0	0	1	0	0	6	0	0
Leptoperla primitiva		0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae sp		0	0	0	0	0	0	0	0	0	0	0
Empididae sp		1	0	4	0	1	2	1	0	0	0	0
Psychodidae sp		0	0	0	0	0	0	0	0	0	0	0
Simulidae sp		0	0	0	0	0	0	0	0	0	0	0
Tipuliidae sp		0	0	0	0	0	0	1	0	0	0	0
unknown diptera		0	0	0	0	1	0	0	0	0	0	0
Chironomus sp		0	0	0	0	0	0	0	0	1	0	0
Cladopelma sp		0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus sp		0	0	0	1	0	0	0	0	1	0	0
Cryptochironomus griseidorsum		0	0	0	0	0	1	0	0	0	0	0
Dicrotendipes sp		0	0	0	0	0	0	0	0	0	0	0
Kiefferulus martini		0	0	0	0	0	0	0	0	0	0	0
Kiefferulus sp		0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp		6	2	0	0	0	2	9	0	21	4	0
Paracladapelma sp		7	0	2	0	0	1	1	0	3	0	0
Paratanytarsus sp		0	0	0	0	0	0	0	0	0	0	0
Polypedilum sp		1	0	0	1	0	1	1	0	5	1	2
Rheotanytarsus sp		0	0	1	0	0	0	0	0	3	0	0
Riethia sp		9	0	4	0	1	1	2	0	15	0	4
Stenochironomus sp		0	0	0	0	0	0	0	0	0	1	0
Tanytarsus sp		20	1	0	0	1	1	6	0	39	0	0
Ablabesmyia notabilis		0	0	0	2	0	0	1	0	0	0	0
Ablabesmyia sp		1	2	1	0	1	2	0	0	0	0	0
Djalmabatista sp		0	1	2	0	0	0	1	0	0	0	0
Larsia sp		1	1	0	0	0	0	0	0	0	0	0
Nilotanypus sp		0	0	0	1	1	0	0	0	0	0	0
Paramerina sp		0	0	0	0	0	0	0	0	0	0	0
Procladius sp		1	1	0	0	0	0	0	0	1	0	1
Cardiocladus sp		0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp		0	0	0	0	0	1	0	0	3	0	2
Nanocladius sp		0	0	0	0	0	0	0	0	4	1	0
Orthoclad spZ		0	0	0	0	0	0	0	0	1	0	0
Parakiefferiella sp		8	0	0	0	0	3	2	0	18	2	2
Rheocricotopus sp		0	0	0	0	0	0	0	0	1	0	0
Thienemanniella sp		0	0	0	0	0	0	0	0	2	0	0
chironomid pupae		8	0	8	0	3	2	5	0	41	1	5

	26 MAY 94					28 JUN 94					
SPECIES SITE	MAY1	MAY3	MAY4	MAY5	MAY6	JUN1	UN2	UN3	UN4	UN5	UN6
Turbellaria sp	18	25	26	10	0	7	7	6	1	2	1
Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0
Planaria sp	0	0	0	0	0	0	0	0	0	0	0
Hypogasturidae sp	0	0	0	0	0	0	0	0	0	0	0
Sminthuridae: Katianna sp	0	0	0	0	0	0	1	0	0	0	0
Glyptophysa sp	0	0	0	7	0	0	2	0	0	2	0
Physa acuta	0	0	3	0	0	0	0	0	0	0	0
Isidorella sp	0	0	3	5	0	0	0	0	4	3	1
Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0
Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0
Oligochaete sp	2	0	2	20	5	6	20	40	1	50	0
Acarina:peza ops	0	3	20	40	0	4	10	1	22	94	0
Acarina sp	0	0	0	0	0	0	0	0	0	0	0
Heterias sp	2	30	10	76	0	1	12	0	0	10	0
Amphipoda sp	0	1	1	166	0	0	8	0	0	4	0
Parataya australensis	2	3	4	0	0	0	3	1	1	0	1
Caridina mccullochi	0	0	0	0	0	0	0	0	2	0	0
Macrobrachium sp	0	0	0	0	2	0	0	0	0	0	2
Cherax destructor	0	7	10	6	2	0	4	2	0	1	0
Atalophlebia sp 9	2	2	2	2	2	2	1	0	1	0	0
Tasmanocoenis tonnoiri	324	170	63	170	170	238	720	74	29	183	95
Tasmanocoenis arcuata	7	7	1	2	11	5	11	8	0	0	9
Baetis sp	0	0	0	0	0	0	0	0	0	0	1
Coloburiscoides sp	0	0	0	0	1	0	0	0	0	0	3
Nososticta solida	2	1	5	7	0	0	1	0	0	0	0
Ischnura heterosticta	0	0	0	2	4	2	3	0	2	1	0
Austroargiolestes icteromelas	0	4	32	23	1	0	0	0	5	3	0
Austrogomphus ochraceus	0	0	0	0	0	4	1	2	1	2	0
Austroaeschna u unicornis	2	8	1	1	3	2	1	3	4	0	0
Cordulephya pygmaea	0	0	2	0	0	0	0	0	0	1	0
Apocordulia macrops	0	2	0	1	2	0	2	0	1	0	0
Hemicordulia tau	0	0	0	0	0	0	0	0	0	1	0
Rhadinosticta simplex	0	1	0	0	0	0	0	1	0	0	0
Hemiptera sp	2	21	5	25	1	1	6	4	0	3	0
Coleoptera sp	4	2	3	8	0	0	0	0	0	0	0
Austrolimnius sp	0	1	0	1	2	0	1	0	0	2	3
Ecnomus pansus	19	48	7	11	62	28	20	13	2	3	32
Calamo: Anisocentropus sp	13	9	6	20	0	19	36	2	2	6	0
Hydrobiosidae sp	0	0	0	0	12	0	0	0	0	0	0
Hydropsychidae sp 6	0	6	0	0	143	0	1	3	0	3	70
Hydroptilidae sp	0	1	0	0	0	0	0	0	0	0	0

	DATE	26 MAY 94					28 JUN 94					
SPECIES	SITE	MAY1	MAY3	MAY4	MAY5	MAY6	JUN1	JUN2	JUN3	JUN4	JUN5	JUN6
Lept:Oecetis sp		40	45	36	25	74	17	31	17	4	2	41
Lept:Triaenodes sp		196	75	87	85	26	74	176	120	36	14	36
Lept:Triplectides australis		0	0	1	2	0	0	0	0	0	0	2
Lept:Triplectides volda		0	0	0	0	0	0	0	0	0	0	0
Trichoptera pupae		0	0	0	0	1	0	0	0	0	0	0
Leptoperla sp		0	20	0	6	137	8	8	29	0	1	176
Leptoperla primitiva		0	0	0	0	1	0	0	0	0	0	0
Ceratopogonidae sp		0	1	0	0	0	0	0	0	0	0	0
Empididae sp		0	0	1	1	1	0	0	0	0	0	3
Psychodidae sp		0	0	0	0	1	0	0	0	0	0	0
Simulidae sp		0	0	0	0	0	1	0	0	0	0	4
Tipuliidae sp		0	0	0	0	1	0	0	0	0	0	0
unknown diptera		0	0	0	0	0	0	0	0	0	0	0
Chironomus sp		0	2	0	0	1	0	0	0	0	0	0
Cladopelma sp		0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus sp		0	0	0	0	0	0	0	0	0	0	0
Cryptochironomus griseidorsum		0	1	0	0	0	0	0	0	0	0	0
Dicrotendipes sp		0	0	0	0	0	0	0	0	0	0	0
Kiefferulus martini		0	0	0	0	0	0	0	1	0	0	0
Kiefferulus sp		0	1	0	0	0	0	0	0	0	0	0
Parachironomus sp		0	2	0	0	4	0	0	0	0	0	1
Paracladapelma sp		0	0	0	0	0	0	0	0	1	0	0
Paratanytarsus sp		0	0	0	0	0	0	0	0	0	0	0
Polypedilum sp		0	11	0	0	0	1	0	0	0	0	3
Rheotanytarsus sp		2	0	0	0	13	0	0	0	0	0	20
Riethia sp		0	5	0	0	0	0	0	1	0	0	0
Stenochironomus sp		0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp		3	8	0	0	3	0	7	20	4	1	0
Ablabesmyia notabilis		0	0	0	1	0	0	0	0	0	0	0
Ablabesmyia sp		0	1	1	0	1	0	0	0	0	0	0
Djalmabatista sp		0	0	0	0	0	0	0	0	0	0	0
Larsia sp		0	0	0	0	0	0	0	0	0	0	0
Nilotanypus sp		0	0	0	0	0	0	0	0	0	0	0
Paramerina sp		0	0	0	0	0	0	0	0	0	0	0
Procladius sp		0	1	0	0	0	0	0	0	0	2	0
Cardiocladus sp		0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp		0	3	1	0	0	0	1	7	0	1	6
Nanocladius sp		0	0	0	0	1	0	0	0	0	0	0
Orthoclad spZ		0	0	0	0	0	0	0	0	0	0	0
Parakiefferiella sp		0	21	2	1	16	3	2	7	6	0	23
Rheocricotopus sp		0	0	0	0	0	0	0	0	0	0	0
Thienemanniella sp		0	0	0	0	0	0	0	0	0	0	1
chironomid pupae		2	17	1	2	13	1	4	18	2	0	16

SPEC94

	28 JULY 94					25 AUG 94					
SPECIES SITE	JUL1	JUL2	JUL3	JUL4	JUL5	AUG1	AUG2	AUG3	AUG4	AUG5	AUG6
Turbellaria sp	3	3	1	9	0	2	4	1	5	0	2
Turbellaria sp2	0	0	0	0	0	0	0	0	0	0	0
Planaria sp	1	0	0	0	0	0	0	0	0	0	0
Hypogasturidae sp	0	0	0	0	0	0	0	1	0	0	1
Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0
Glyptophysa sp	0	1	0	0	2	0	0	0	0	0	0
Physa acuta	0	0	0	0	0	0	0	0	1	0	0
Isidorella sp	0	0	2	2	0	0	0	0	2	0	0
Gyraulus sp	0	0	0	0	0	0	0	0	0	0	0
Pseudosuccinea columella	0	0	0	0	0	0	0	0	0	0	0
Oligochaete sp	1	10	5	6	3	7	4	0	10	0	1
Acarina:peza ops	2	2	2	8	21	4	0	0	6	6	0
Acarina sp	0	0	0	0	0	0	0	0	0	0	1
Heterias sp	1	1	0	0	5	0	3	0	3	0	0
Amphipoda sp	0	9	0	0	20	0	1	0	0	0	0
Parataya australensis	0	0	10	3	1	1	1	0	0	0	0
Caridina mccullochi	1	0	0	0	0	0	0	0	0	0	0
Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0
Cherax destructor	0	0	0	0	0	0	0	0	0	0	0
Atalophlebia sp 9	0	0	1	0	0	0	0	0	0	0	0
Tasmanocoenis tonnoiri	47	32	10	1	22	102	92	232	85	23	348
Tasmanocoenis arcuata	0	0	1	1	0	3	1	7	1	0	8
Baetis sp	0	0	0	0	0	0	0	0	0	0	0
Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	8
Nososticta solida	0	0	0	0	0	0	0	0	0	0	0
Ischnura heterosticta	0	2	3	0	0	0	1	1	0	0	0
Austroargiolestes icteromelas	0	0	1	8	0	0	0	0	2	0	0
Austrogomphus ochraceus	0	0	0	0	0	0	0	1	2	0	0
Austroaeschna u unicornis	0	2	0	0	0	0	1	0	0	0	0
Cordulephya pygmaea	0	0	0	0	0	0	0	0	0	0	0
Apocordulia macrops	0	0	0	0	0	0	1	1	1	0	2
Hemicordulia tau	0	0	0	0	1	0	0	0	0	0	1
Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0
Hemiptera sp	1	4	0	11	5	0	0	0	0	0	0
Coleoptera sp	0	0	0	0	0	0	0	0	0	0	0
Austrolimnius sp	0	0	0	0	0	0	0	0	1	1	0
Ecnomus pansus	5	3	3	0	5	8	4	12	5	1	61
Calamo: Anisocentropus sp	10	2	1	1	1	6	0	4	1	2	0
Hydrobiosidae sp	0	0	0	0	0	0	2	1	0	0	9
Hydropsychidae sp 6	0	0	1	0	0	0	7	31	2	3	100
Hydroptilidae sp	0	0	0	0	0	0	0	0	0	0	0

SPECIES	DATE / SITE	28 JULY 94 JUL1	JUL2	JUL3	JUL4	JUL5	25 AUG 94 AUG1	AUG2	AUG3	AUG4	AUG5	AUG6
Lept:Oecetis sp		8	17	5	5	1	4	2	13	4	1	12
Lept:Triaenodes sp		47	60	22	17	12	7	5	5	22	5	12
Lept:Triplectides australis		0	0	0	0	0	0	1	1	0	0	0
Lept:Triplectides volda		0	0	0	0	0	0	1	0	0	0	0
Trichoptera pupae		0	0	0	0	0	0	0	0	0	1	0
Leptoperla sp		2	12	11	0	0	0	12	24	5	0	41
Leptoperla primitiva		0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae sp		0	0	0	0	0	0	0	0	0	1	0
Empididae sp		0	0	1	0	0	0	0	12	3	0	16
Psychodidae sp		0	0	0	0	0	0	0	0	0	0	0
Simulidae sp		0	0	0	0	0	0	0	0	0	0	1
Tipuliidae sp		0	0	0	0	0	0	0	0	0	1	1
unknown diptera		0	0	0	0	0	0	0	1	0	0	0
Chironomus sp		0	0	0	0	0	0	0	0	0	0	0
Cladopelma sp		0	0	0	0	0	0	0	1	0	0	0
Cladotanytarsus sp		0	0	0	0	0	1	0	0	0	0	0
Cryptochironomus griseidorsum		0	0	0	0	0	0	0	3	0	1	0
Dicrotendipes sp		0	0	0	0	0	0	0	0	0	0	0
Kiefferulus martini		0	0	0	0	0	0	0	1	0	0	0
Kiefferulus sp		0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp		0	0	0	0	0	0	0	0	0	0	0
Paracladapelma sp		0	0	1	0	0	8	7	32	5	6	1
Paratanytarsus sp		0	0	0	0	0	0	2	0	0	0	0
Polypedilum sp		1	0	3	2	0	0	0	0	3	3	2
Rheotanytarsus sp		0	0	2	0	0	4	3	4	0	0	22
Riethia sp		0	0	0	0	0	10	3	34	21	9	0
Stenochironomus sp		0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp		1	1	8	2	0	6	7	8	10	8	18
Ablabesmyia notabilis		0	0	0	0	0	5	0	0	0	0	0
Ablabesmyia sp		0	0	0	1	0	0	0	3	5	0	4
Djalmabatista sp		0	0	0	0	0	0	0	0	0	0	0
Larsia sp		0	0	0	0	0	1	0	0	0	0	0
Nilotanypus sp		0	0	0	0	0	0	0	0	0	0	0
Paramerina sp		0	0	0	0	0	0	0	0	1	2	0
Procladius sp		0	0	0	0	0	3	0	4	4	1	0
Cardiocladus sp		0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp		0	4	5	2	6	1	4	7	1	2	1
Nanocladius sp		0	0	0	0	0	0	1	1	0	0	1
Orthoclad spZ		0	0	2	0	1	0	1	5	0	2	3
Parakiefferiella sp		0	0	9	3	3	16	20	71	29	21	32
Rheocricotopus sp		0	0	0	0	0	0	0	0	0	0	0
Thienemanniella sp		0	0	1	1	0	3	2	1	0	1	4
chironomid pupae		1	1	15	2	5	3	10	24	8	0	5

SPEC94

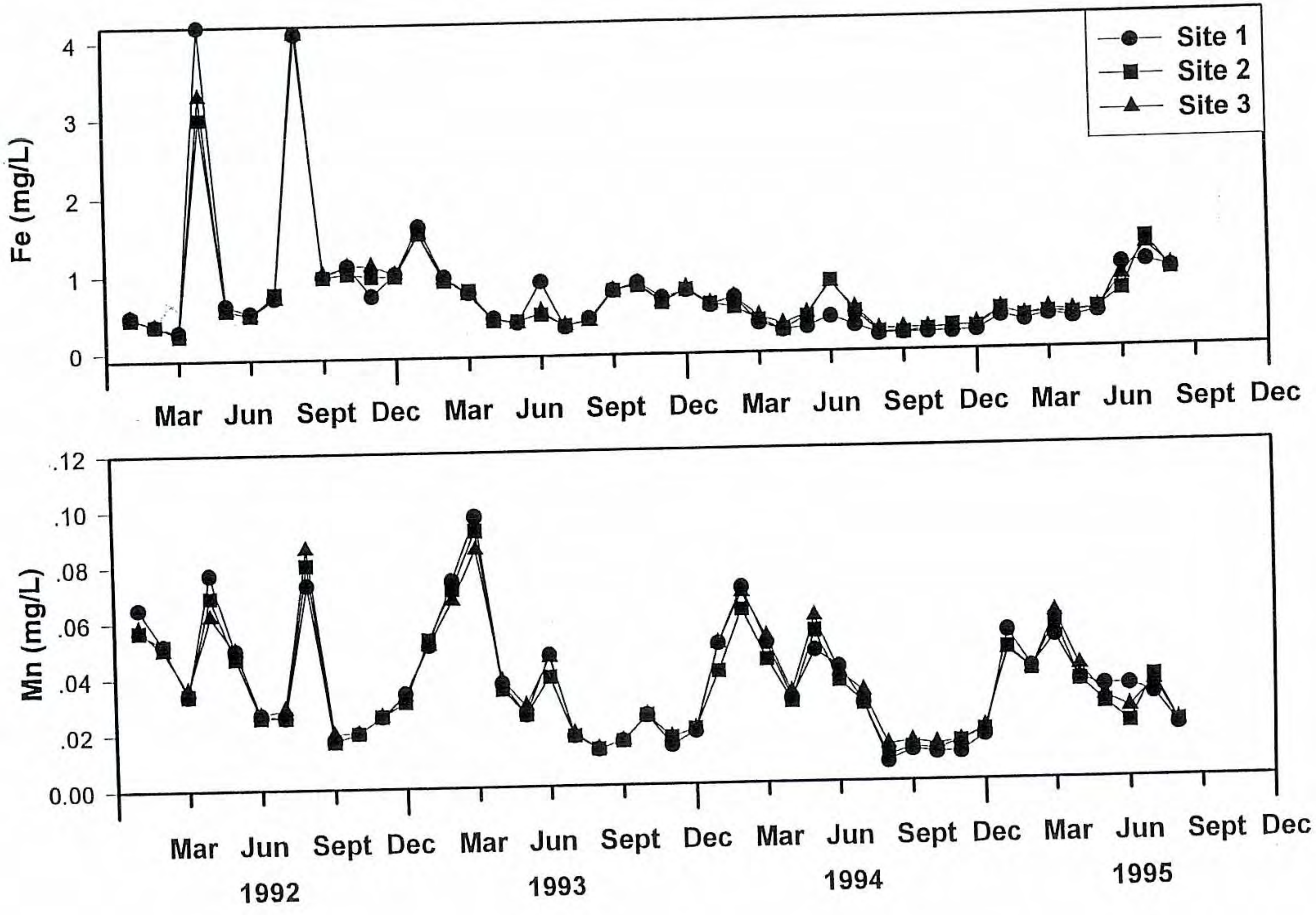
	11 OCT 94						16 NOV 94					
SPECIES SITE	OCT1	OCT2	OCT3	OCT4	OCT5	OCT6	NOV1	NOV2	NOV3	NOV4	NOV5	NOV6
Turbellaria sp	1	1	0	0	0	0	1	0	0	1	0	6
Turbellaria sp2	0	0	0	0	0	1	0	0	0	0	0	0
Planaria sp	0	0	0	0	0	0	0	0	0	0	0	0
Hypogasturidae sp	1	0	3	2	0	0	0	0	1	0	0	1
Sminthuridae: Katianna sp	0	0	0	0	0	0	0	0	0	0	0	0
Glyptophysa sp	0	0	0	0	0	0	0	0	0	0	0	0
Physa acuta	0	0	0	1	0	0	0	0	0	0	0	0
Isidorella sp	0	0	0	1	0	0	0	1	0	5	1	0
Gyraulus sp	0	0	0	0	0	1	0	0	0	0	0	0
Pseudosuccinea columella	0	0	0	0	0	0	0	0	1	0	0	0
Oligochaete sp	10	5	1	4	1	7	1	6	1	0	1	7
Acarina:peza ops	1	1	0	1	0	0	1	0	0	4	3	0
Acarina sp	0	0	0	0	0	0	0	0	0	0	0	0
Heterias sp	1	15	1	1	2	0	2	5	2	0	3	2
Amphipoda sp	0	4	0	1	1	0	0	6	1	1	3	4
Parataya australensis	0	0	0	0	0	0	0	0	0	0	0	0
Caridina mccullochi	0	0	0	0	0	0	0	0	0	0	0	0
Macrobrachium sp	0	0	0	0	0	0	0	0	0	0	0	0
Cherax destructor	0	1	0	0	0	0	1	2	0	0	0	0
Atalophlebia sp 9	0	3	0	2	0	0	1	0	2	2	1	1
Tasmanocoenis tonnoiri	156	165	252	173	17	121	135	146	257	92	30	260
Tasmanocoenis arcuata	1	1	4	3	0	3	1	1	0	0	0	0
Baetis sp	0	0	0	0	0	0	0	1	0	0	0	0
Coloburiscoides sp	0	0	0	0	0	0	0	0	0	0	0	0
Nososticta solida	0	0	0	0	1	0	0	0	0	0	0	0
Ischnura heterosticta	0	0	0	0	0	0	0	0	0	0	0	0
Austroargiolestes icteromelas	0	0	0	1	0	0	0	0	0	0	0	1
Austrogomphus ochraceus	10	0	3	0	1	0	0	0	1	0	0	2
Austroaeschna u unicornis	0	2	0	0	0	3	1	0	1	0	0	2
Cordulephya pygmaea	0	0	0	0	0	0	1	0	0	1	0	0
Apocordulia macrops	0	0	1	1	0	0	0	0	0	0	0	0
Hemicordulia tau	0	0	0	0	0	0	0	0	0	1	0	0
Rhadinosticta simplex	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera sp	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera sp	0	0	0	0	0	0	0	0	0	0	1	0
Austrolimnius sp	0	0	0	0	1	0	0	0	0	1	0	0
Ecnomus pansus	8	2	15	3	0	10	0	1	4	2	0	4
Calamo: Anisocentropus sp	1	1	0	1	1	1	0	1	0	0	0	0
Hydrobiosidae sp	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae sp 6	1	1	5	1	0	2	0	0	1	0	0	0
Hydroptilidae sp	0	0	0	0	0	1	0	0	0	0	0	3

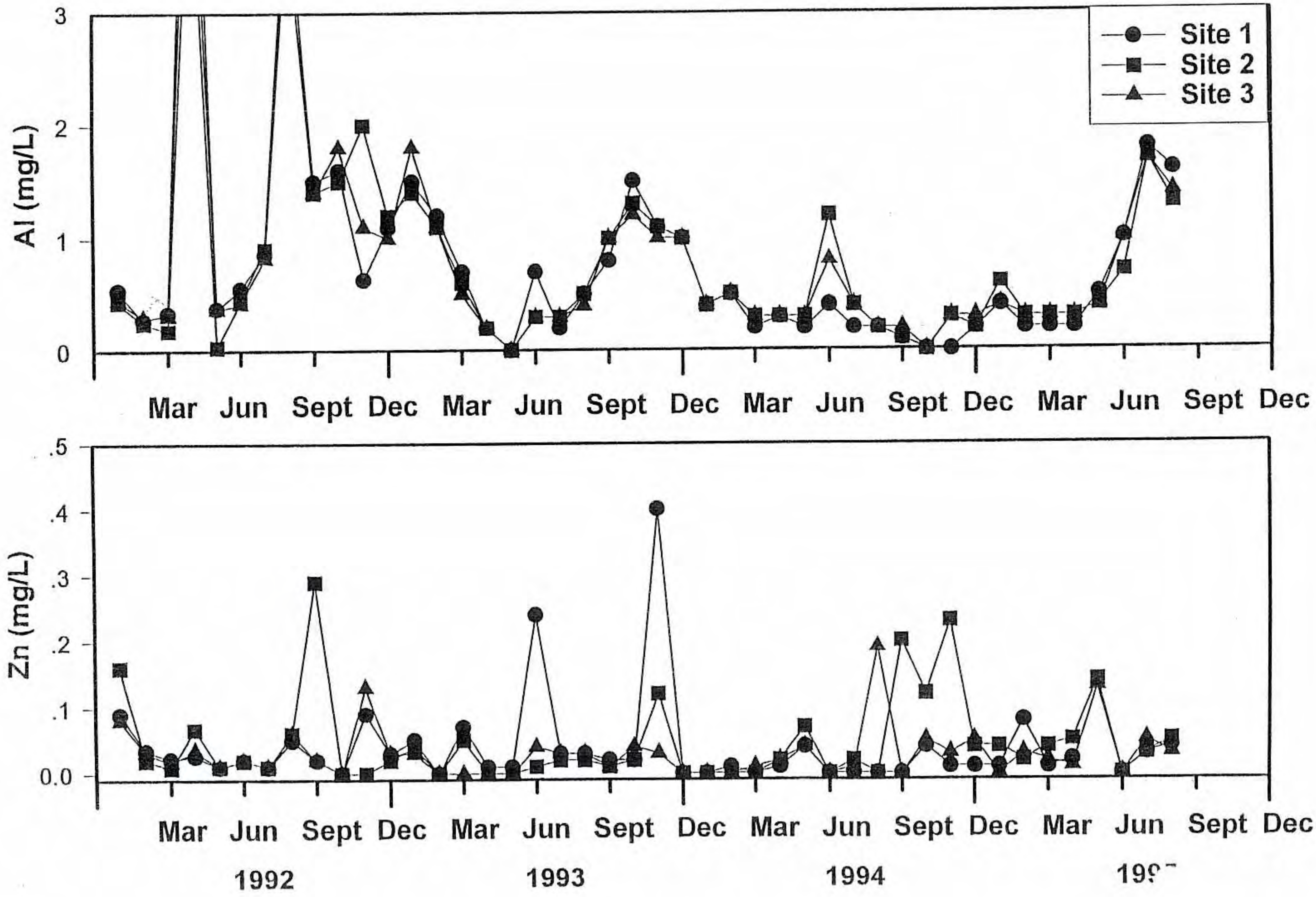
	DATE	11 OCT 94						16 NOV 94					
SPECIES	SITE	OCT1	OCT2	OCT3	OCT4	OCT5	OCT6	NOV1	NOV2	NOV3	NOV4	NOV5	NOV6
Lept:Oecetis sp		5	6	9	5	0	4	0	1	6	0	0	3
Lept:Triaenodes sp		2	8	2	2	3	1	1	1	0	0	0	4
Lept:Triplectides australis		0	0	0	0	0	0	0	0	0	0	0	0
Lept:Triplectides volda		0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera pupae		0	2	3	0	0	0	0	0	1	0	1	1
Leptoperla sp		3	6	3	0	0	7	0	1	0	0	0	0
Leptoperla primitiva		0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae sp		0	0	0	0	0	0	0	0	0	0	0	0
Empididae sp		1	4	6	1	1	3	0	3	1	0	0	1
Psychodidae sp		0	0	0	1	0	0	0	0	1	1	0	1
Simulidae sp		0	0	0	1	0	0	0	1	0	0	0	0
Tipuliidae sp		1	0	0	0	0	0	0	0	1	0	2	1
unknown diptera		0	0	0	0	0	0	0	0	2	1	0	0
Chironomus sp		0	0	0	0	0	0	4	8	3	1	2	0
Cladopelma sp		0	0	0	0	0	0	0	0	0	1	0	0
Cladotanytarsus sp		0	0	0	0	0	0	0	0	0	0	0	1
Cryptochironomus griseidorsum		0	1	1	1	0	0	1	0	1	2	2	2
Dicrotendipes sp		0	0	0	0	0	0	0	0	0	0	0	0
Kiefferulus martini		0	0	0	0	0	0	0	0	0	0	0	0
Kiefferulus sp		0	0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp		2	3	3	0	1	3	8	4	5	5	1	5
Paracladapelma sp		4	3	11	4	0	2	14	8	6	6	2	8
Paratanytarsus sp		0	0	0	0	0	0	0	0	0	0	0	1
Polypedilum sp		4	2	7	6	0	1	0	2	4	0	1	4
Rheotanytarsus sp		0	0	0	0	0	0	1	2	0	0	0	0
Riethia sp		5	10	1	5	0	5	34	30	20	15	16	12
Stenochironomus sp		0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp		5	10	2	1	2	3	12	13	14	10	1	20
Ablabesmyia notabilis		0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia sp		4	0	2	2	1	1	4	1	0	1	0	2
Djalmabatista sp		0	0	0	0	0	0	0	0	0	0	0	0
Larsia sp		0	0	0	0	0	0	0	0	0	0	0	0
Nilotanypus sp		0	0	0	0	0	0	0	0	0	0	0	0
Paramerina sp		0	0	1	0	0	0	0	0	0	0	0	0
Procladius sp		0	2	0	2	0	0	0	3	0	4	0	0
Cardiocladus sp		0	0	0	0	0	0	0	0	0	0	0	0
Cricotopus sp		10	27	31	5	2	93	0	6	8	3	0	51
Nanocladius sp		1	1	4	0	1	4	0	0	0	0	0	0
Orthoclad spZ		0	0	4	2	0	6	0	1	3	0	0	5
Parakiefferiella sp		15	23	11	18	18	9	0	3	0	0	1	6
Rheocricotopus sp		0	0	1	0	0	0	0	0	0	0	0	0
Thienemanniella sp		1	0	0	0	0	0	0	0	0	0	0	0
chironomid pupae		7	6	17	8	0	8	7	4	15	3	3	14

	DATE	22 DEC 94				1994
SPECIES	SITE	DEC1	DEC2	DEC3	DEC5	TOTAL
Turbellaria sp		0	0	1	14	176
Turbellaria sp2		0	0	0	0	1
Planaria sp		0	0	0	0	1
Hypogasturidae sp		0	0	0	0	10
Sminthuridae: Katianna sp		0	0	0	0	1
Glyptophysa sp		0	2	0	4	49
Physa acuta		0	1	0	0	6
Isidorella sp		0	0	0	1	40
Gyraulus sp		0	0	0	0	6
Pseudosuccinea columella		0	0	0	0	1
Oligochaete sp		1	7	0	7	384
Acarina:peza ops		0	1	1	2	406
Acarina sp		0	0	0	0	2
Heterias sp		3	5	1	6	242
Amphipoda sp		0	0	1	0	234
Paratya australensis		1	0	0	0	40
Caridina mccullochi		0	0	0	0	5
Macrobrachium sp		0	0	0	0	4
Cherax destructor		1	0	0	1	80
Atalophlebia sp 9		1	2	1	0	43
Tasmanocoenis tonnoiri		78	32	131	1	6724
Tasmanocoenis arcuata		0	0	0	0	108
Baetis sp		0	0	1	0	4
Coloburiscoides sp		0	0	0	0	12
Nososticta solida		0	0	0	0	20
Ischnura heterosticta		0	0	0	0	31
Austroargiolestes icteromelas		0	0	0	2	100
Austrogomphus ochraceus		0	0	0	1	34
Austroaeschna u unicornis		1	0	0	0	50
Cordulephya pygmaea		0	2	0	0	8
Apocordulia macrops		0	0	0	0	20
Hemicordulia tau		0	0	0	0	9
Rhadinosticta simplex		0	0	0	0	2
Hemiptera sp		0	0	0	0	99
Coleoptera sp		0	3	1	2	26
Austrolimnius sp		0	1	0	0	16
Ecnomus pansus		55	6	131	0	1402
Calamo: Anisocentropus sp		1	1	1	0	180
Hydrobiosidae sp		2	2	0	0	28
Hydropsychidae sp 6		0	0	0	0	390
Hydroptilidae sp		1	0	1	0	10

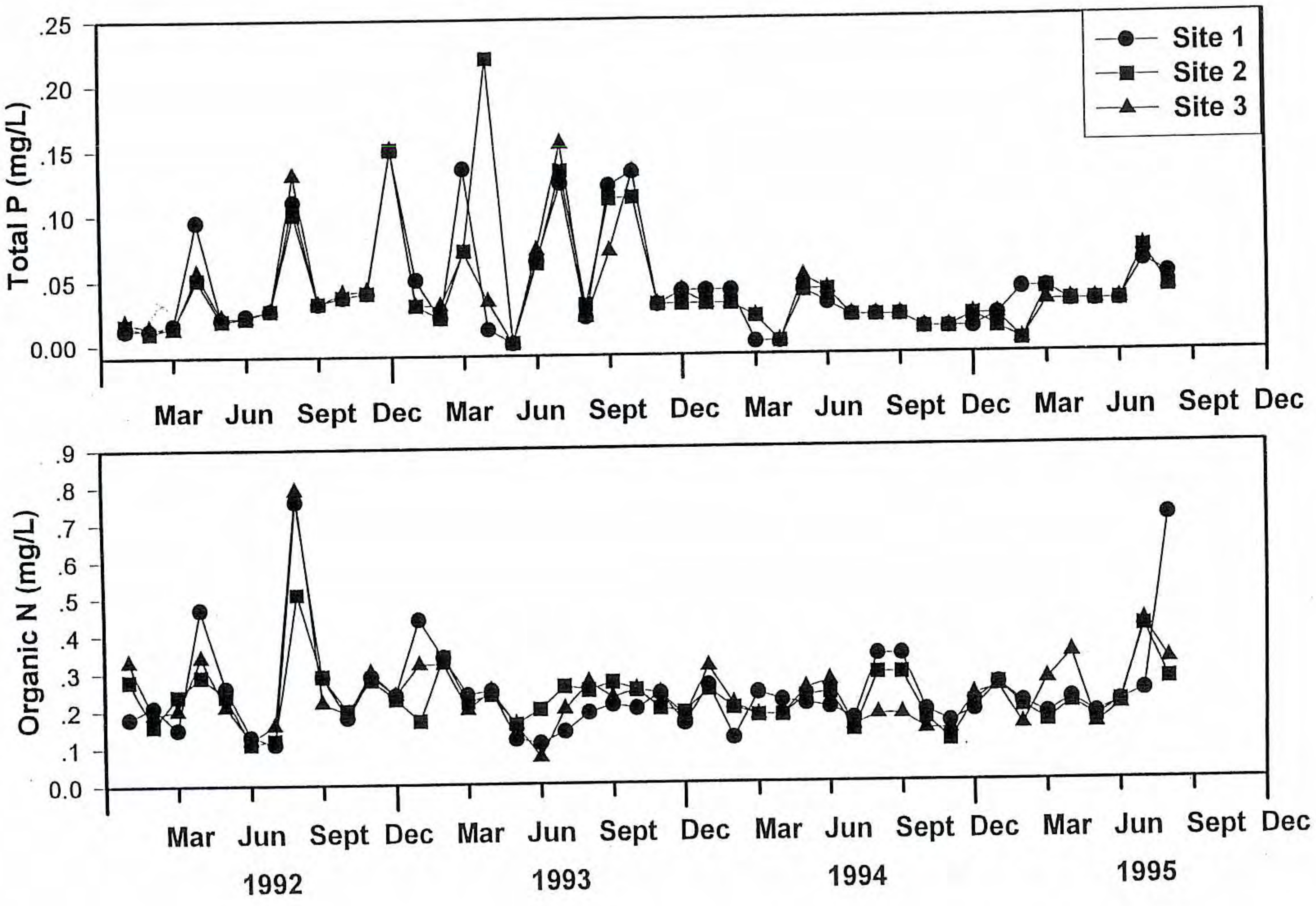
	DATE	22 DEC 94				1994
SPECIES	SITE	DEC1	DEC2	DEC3	DEC5	TOTAL
Lept:Oecetis sp		10	0	20	10	602
Lept:Triaenodes sp		2	1	0	1	1393
Lept:Triplectides australis		0	0	0	3	10
Lept:Triplectides volda		0	0	0	0	1
Trichoptera pupae		0	0	0	0	18
Leptoperla sp		3	2	6	0	541
Leptoperla primitiva		0	0	0	0	1
Ceratopogonidae sp		0	0	0	0	3
Empididae sp		1	0	3	0	89
Psychodidae sp		0	0	1	0	6
Simulidae sp		0	0	1	0	9
Tipulidae sp		0	0	1	2	12
unknown diptera		0	0	1	0	8
Chironomus sp		0	0	1	0	23
Cladopelma sp		0	0	0	0	2
Cladotanytarsus sp		0	0	0	0	5
Cryptochironomus griseidorsum		4	1	2	0	24
Dicrotendipes sp		0	0	0	0	1
Kiefferulus martini		0	0	0	0	2
Kiefferulus sp		0	0	0	0	1
Parachironomus sp		7	0	12	0	113
Paracladapelma sp		13	2	26	1	215
Paratanytarsus sp		0	0	0	0	4
Polypedilum sp		2	6	7	1	97
Rheotanytarsus sp		1	0	1	0	83
Riethia sp		74	9	80	5	458
Stenochironomus sp		0	0	0	0	1
Tanytarsus sp		26	3	33	6	384
Ablabesmyia notabilis		0	0	0	0	9
Ablabesmyia sp		4	2	1	2	56
Djalmabatista sp		0	0	0	0	4
Larsia sp		0	0	0	0	3
Nilotanypus sp		0	0	0	0	2
Paramerina sp		1	0	0	0	5
Procladius sp		3	2	1	3	43
Cardiocladus sp		0	1	0	0	1
Cricotopus sp		4	3	8	1	321
Nanocladius sp		1	0	4	1	28
Orthoclad spZ		1	0	9	0	46
Parakiefferiella sp		3	1	3	1	442
Rheocricotopus sp		0	0	0	0	2
Thienemanniella sp		0	0	0	0	20
chironomid pupae		15	0	22	2	403

Figure 1: A summary of the water quality data for 1992 to 1995. The figure shows the variation of metals (iron, manganese, aluminium, and zinc), nutrients (total phosphorus, organic nitrogen, ammonia and oxides of nitrogen), and, physical parameters (conductivity, turbidity, total filtrable solids and colour) between the three sites over time. (Site 1 samples are represented by circles, site 2 samples are represented by squares and site 3 samples are represented by triangles; lines are included only for clarity and no interpolation between data points is intended.)

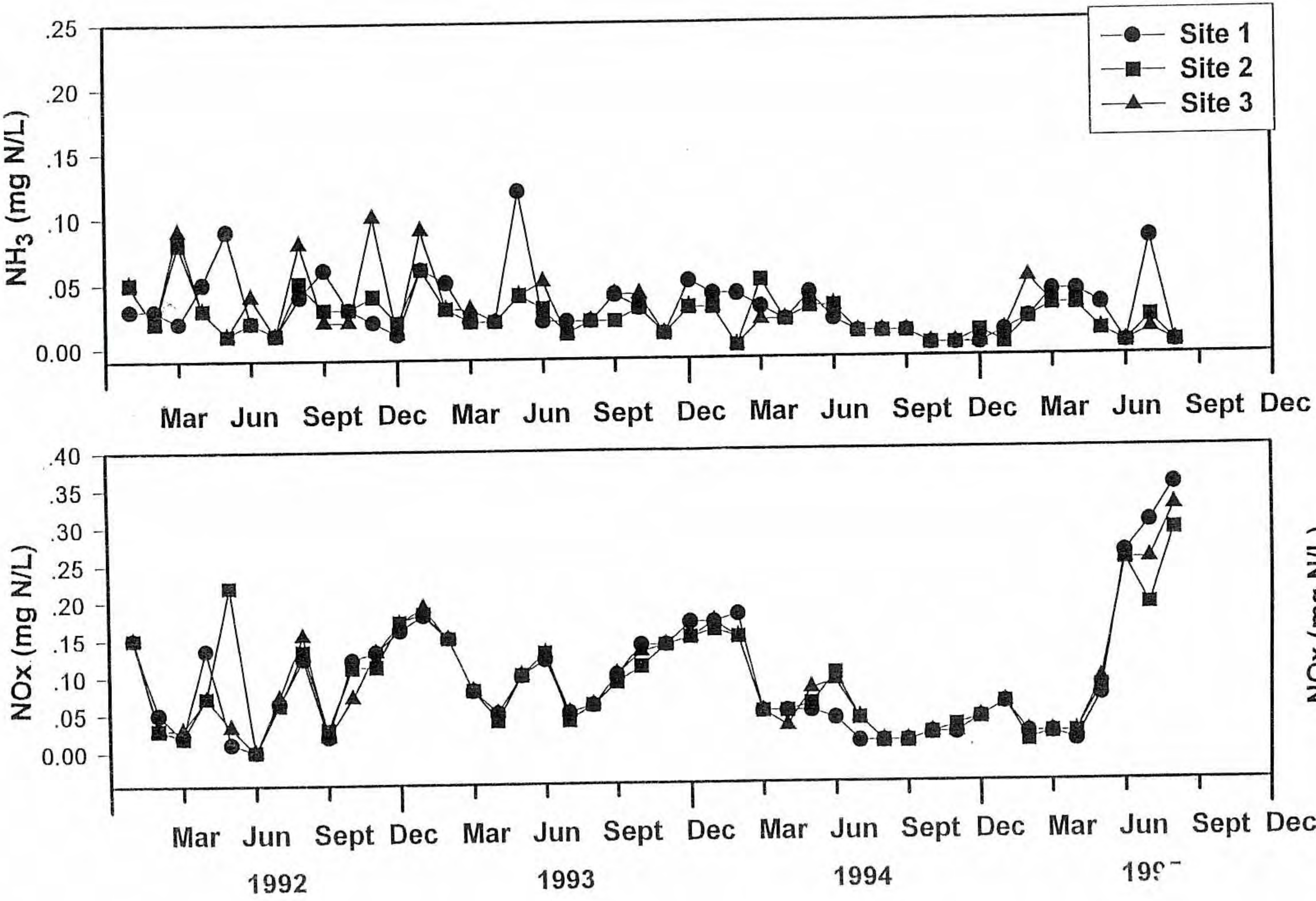

Site 1
Site 2
Site 3
Fe (mg/L)
0
1
2
3
4
Mar
Jun
Sept
Dec
Mn (mg/L)
0.00
.02
.04
.06
.08
.10
.12
1992
1993
1994
1995

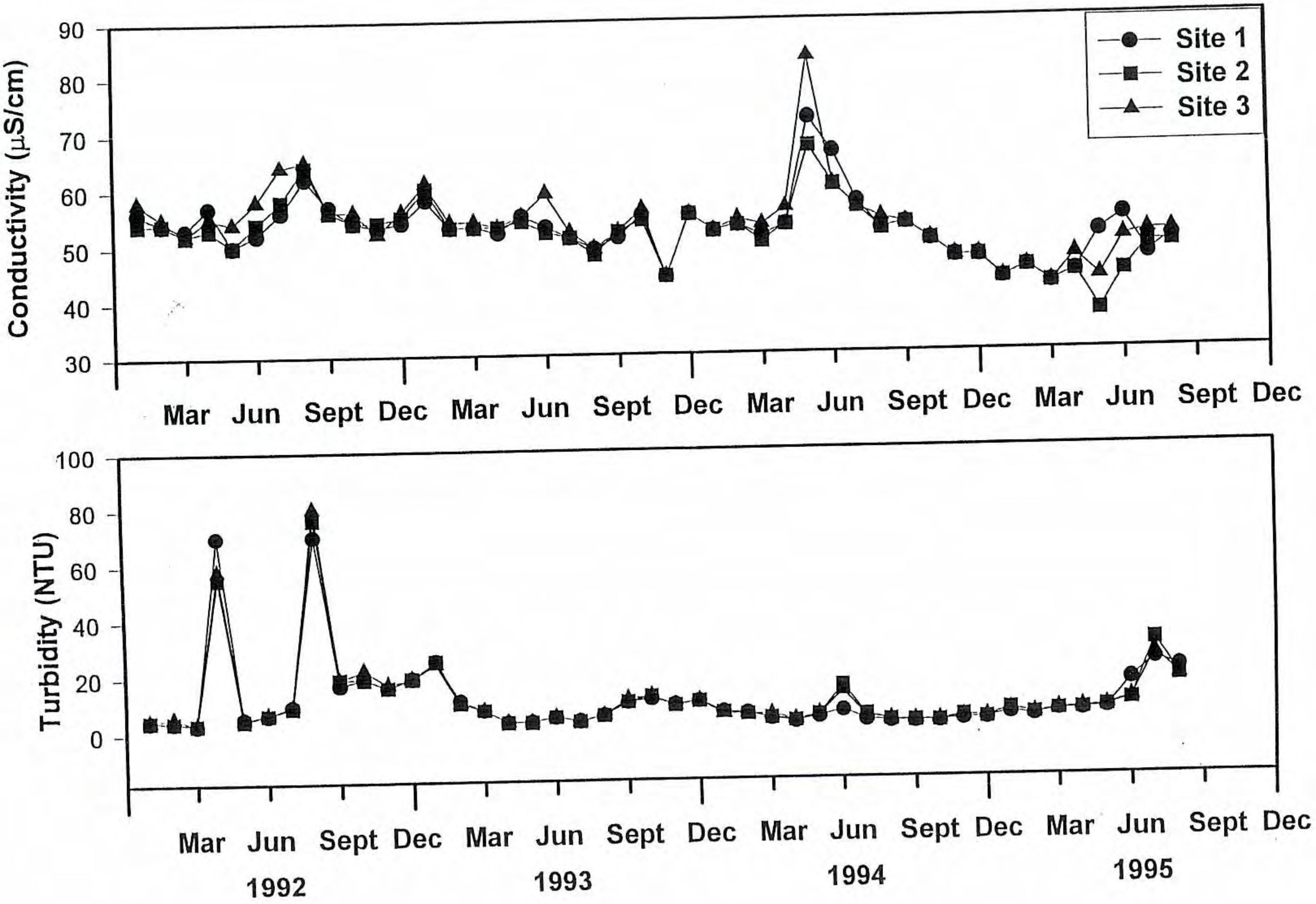


Site 1
Site 2
Site 3
Al (mg/L)
3
2
1
0
Zn (mg/L)
.5
.4
.3
.2
.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
1992
1993
1994



Site 1
Site 2
Site 3
Total P (mg/L)
.25
.20
.15
.10
.05
0.00
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
Organic N (mg/L)
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
1992
1993
1994
1995


Site 1
Site 2
Site 3
NH_3 (mg N/L)
.25
.20
.15
.10
.05
0.00
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
NOx (mg N/L)
.40
.35
.30
.25
.20
.15
.10
.05
0.00
NOx (mg N/L)
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
1992
1993
1994



Site 1
Site 2
Site 3
Conductivity (µS/cm)
90
80
70
60
50
40
30
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
Turbidity (NTU)
100
80
60
40
20
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
1992
1993
1994
1995

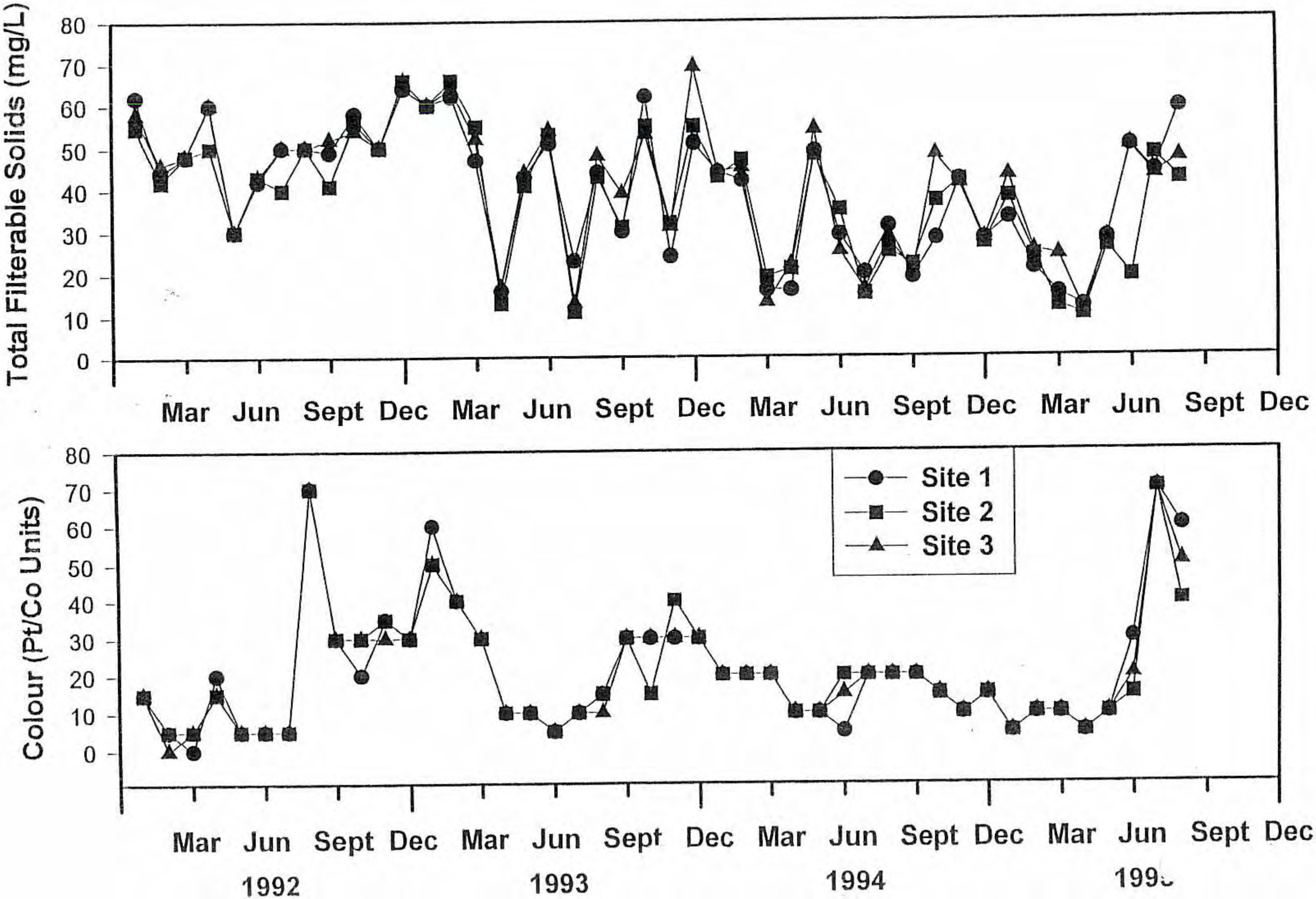
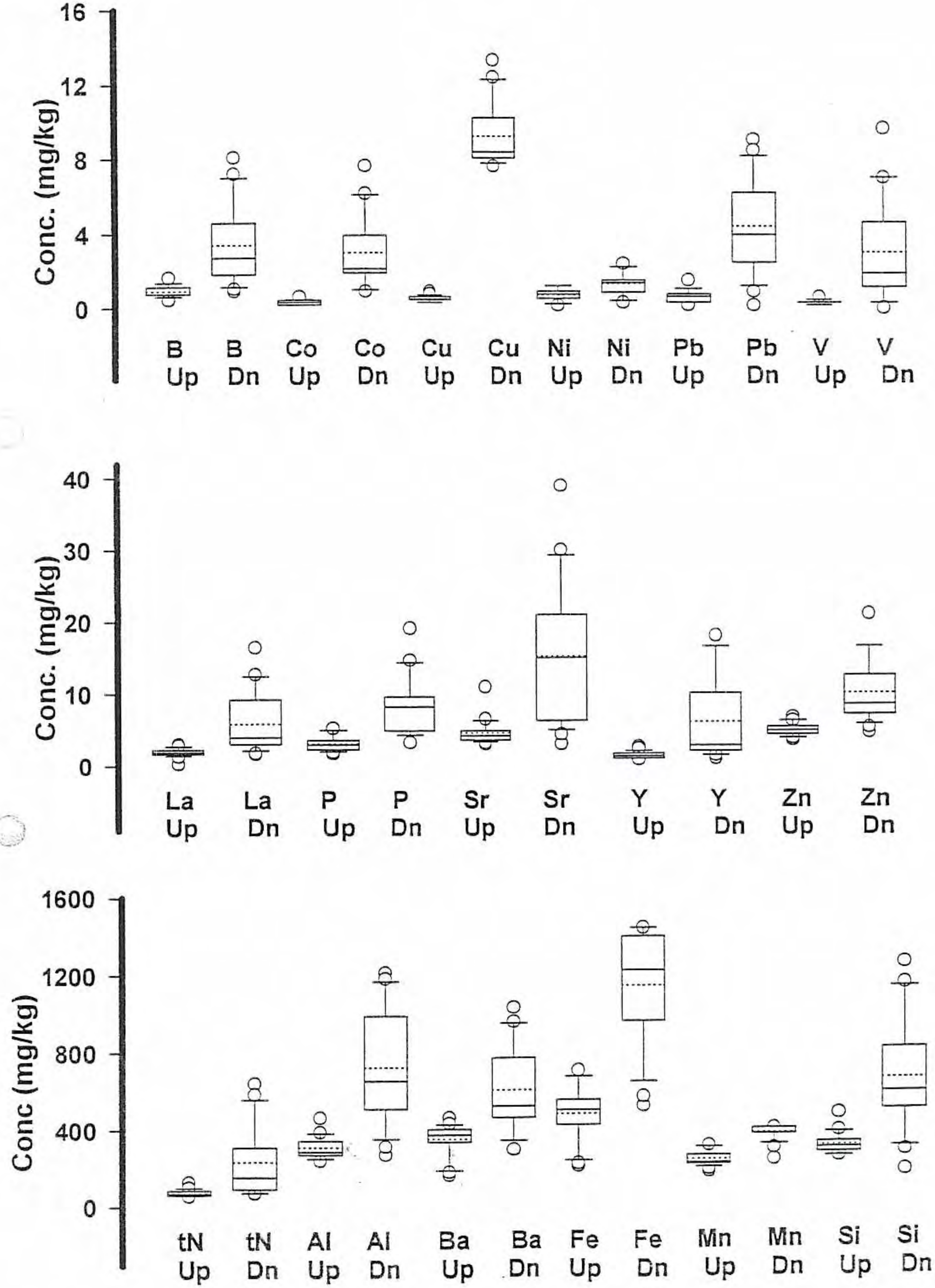

Total Filterable Solids (mg/L)
80
70
60
50
40
30
20
10
0
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
Colour (Pt/Co Units)
80
70
60
50
40
30
20
10
0
Site 1
Site 2
Site 3
Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec Mar Jun Sept Dec
1992
1993
1994

Figure 2: Box plots for the distribution of elements above (Up) and below (Dn) ANM's outfall.



Conc. (mg/kg)
16
12
8
4
0
B Up
B Dn
Co Up
Co Dn
Cu Up
Cu Dn
Ni Up
Ni Dn
Pb Up
Pb Dn
V Up
V Dn
Conc. (mg/kg)
40
30
20
10
0
La Up
La Dn
P Up
P Dn
Sr Up
Sr Dn
Y Up
Y Dn
Zn Up
Zn Dn
Conc (mg/kg)
1600
1200
800
400
0
tN Up
tN Dn
Al Up
Al Dn
Ba Up
Ba Dn
Fe Up
Fe Dn
Mn Up
Mn Dn
Si Up
Si Dn

Figure 3: Distribution of iron along the upstream and downstream transects.

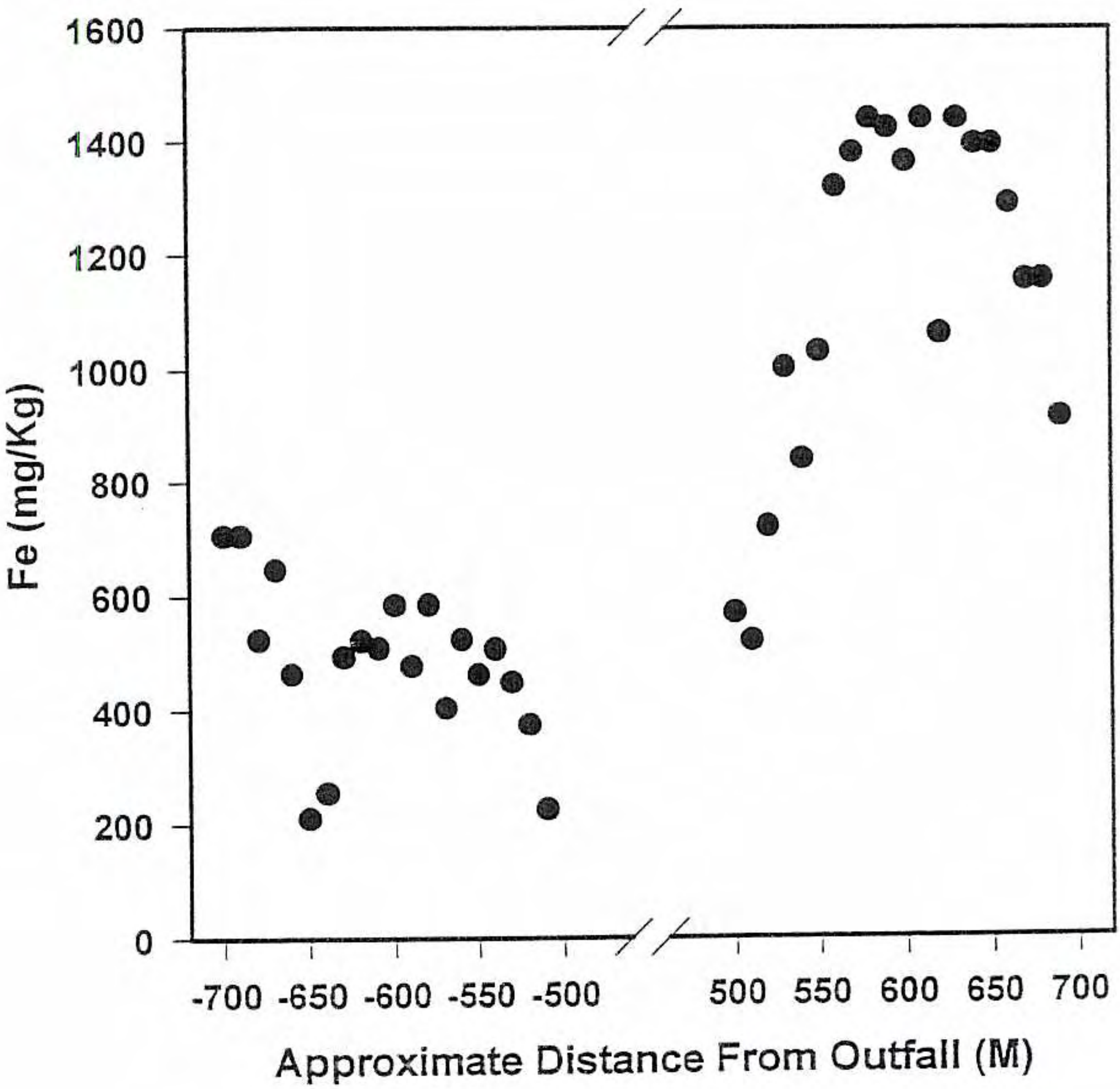

1600
1400
1200
1000
800
600
400
200
0
Fe (mg/Kg)
-700 -650 -600 -550 -500
500 550 600 650 700
Approximate Distance From Outfall (M)

Figure 4: Box plots for the distribution of silt and clay and organic carbon (determined as loss on ignition - LOI) above (Up) and below (Dn) ANM's outfall.

Figure 6: Dissimilarity classification of ANM river monitoring sites using macroinvertebrate species abundance for 1994.

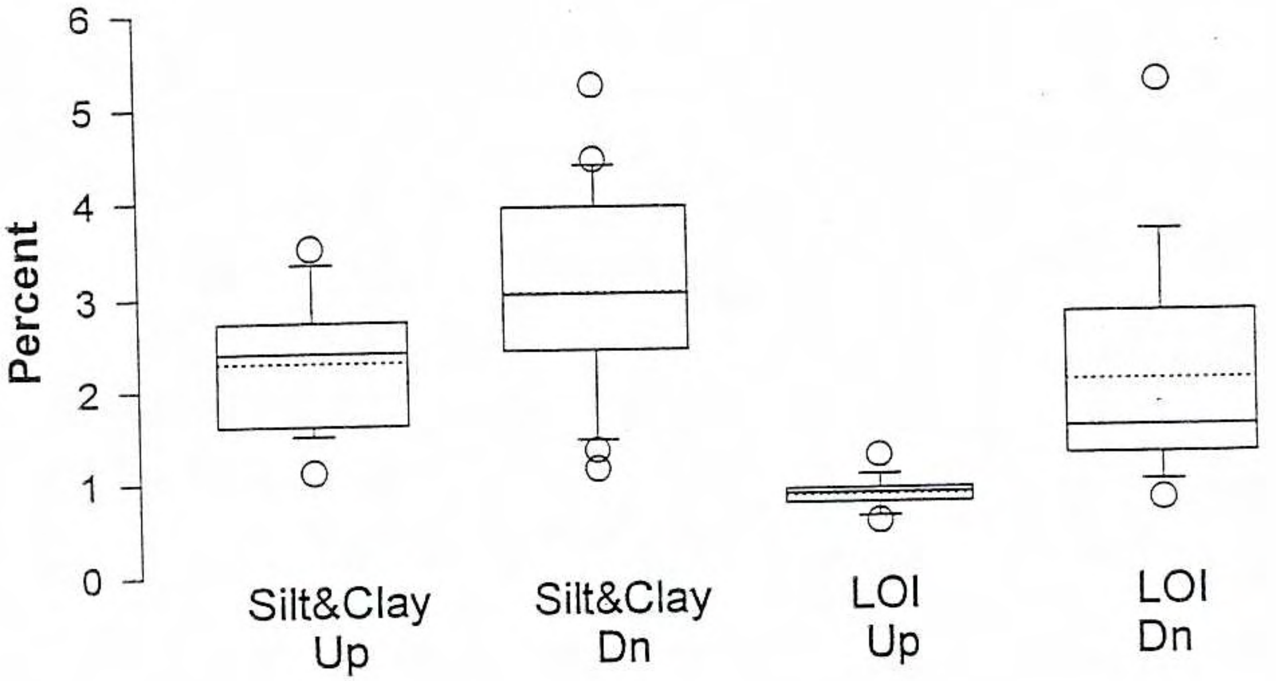

Percent
0
1
2
3
4
5
6
Silt&Clay Up
Silt&Clay Dn
LOI Up
LOI Dn

Figure 5: Variation of Zn (A), Fe (B) and Cu(C) as a function of Loss on ignition.

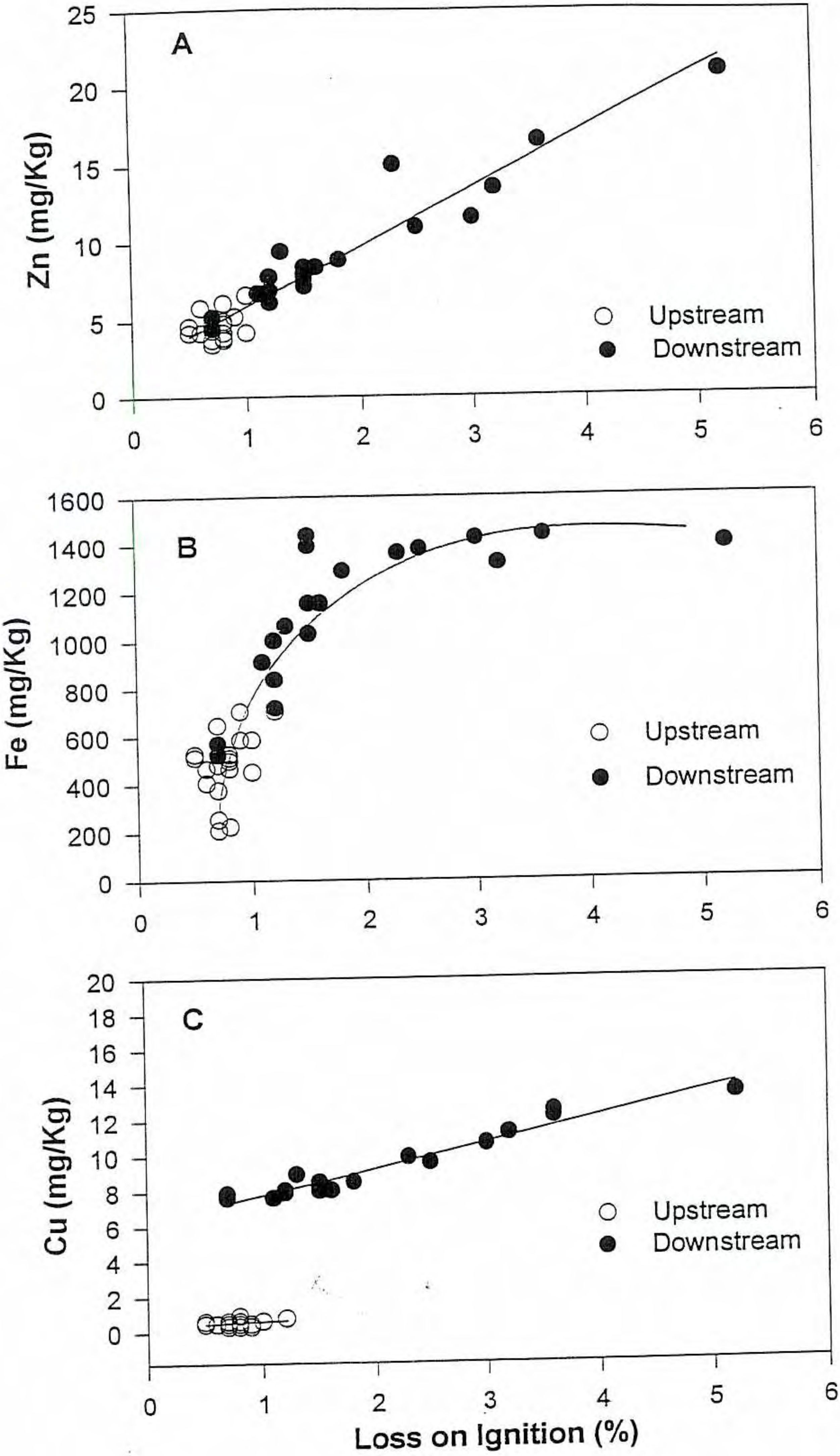

A
Zn (mg/Kg)
Upstream
Downstream
B
Fe (mg/Kg)
Upstream
Downstream
C
Cu (mg/Kg)
Upstream
Downstream
Loss on Ignition (%)

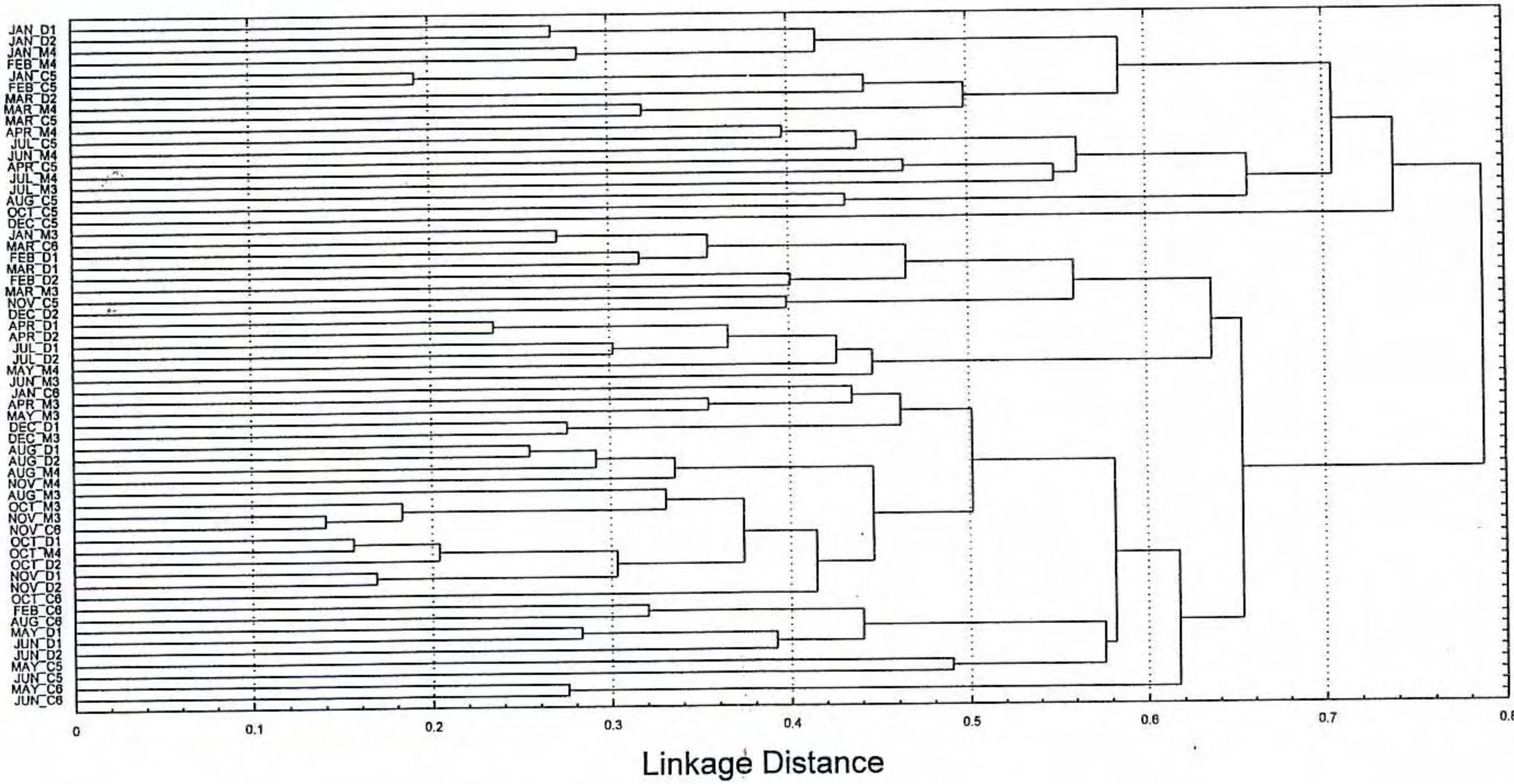
Figure 7: Dissimilarity classification of ANM river monitoring sites using macroinvertebrate species abundance data for the low flow (< 1m) period of 1994

Tree Diagram for ANM River Monitoring Sites 1994

Unweighted pair-group average

Dissimilarities from Bray-Curtis matrix

C = control, M = mixing zone, D = downstream



Tree Diagram for ANM River Monitoring Sites 1994

Unweighted pair-group average

Dissimilarities from Bray-Curtis matrix

C = control, M = mixing zone, D = downstream

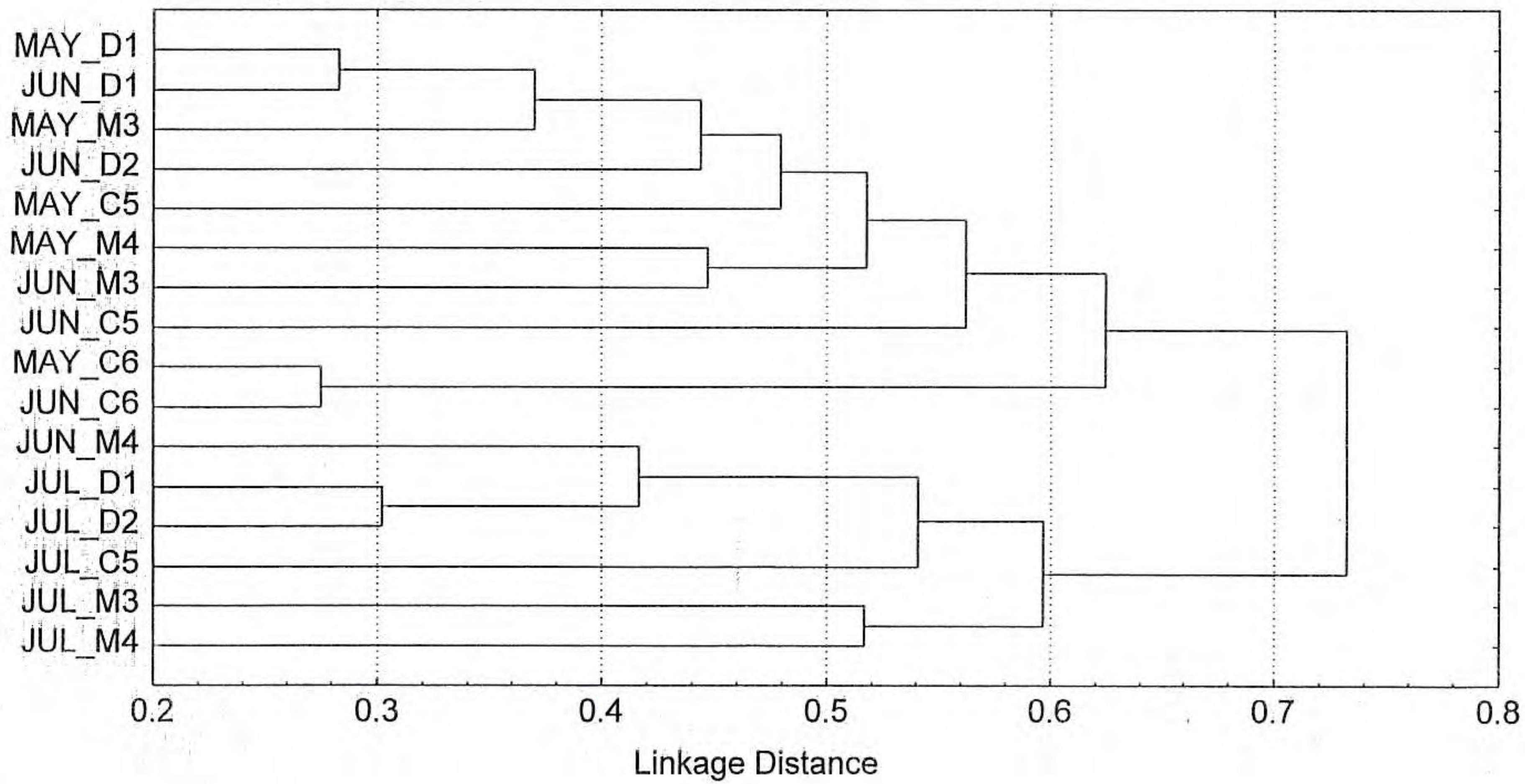
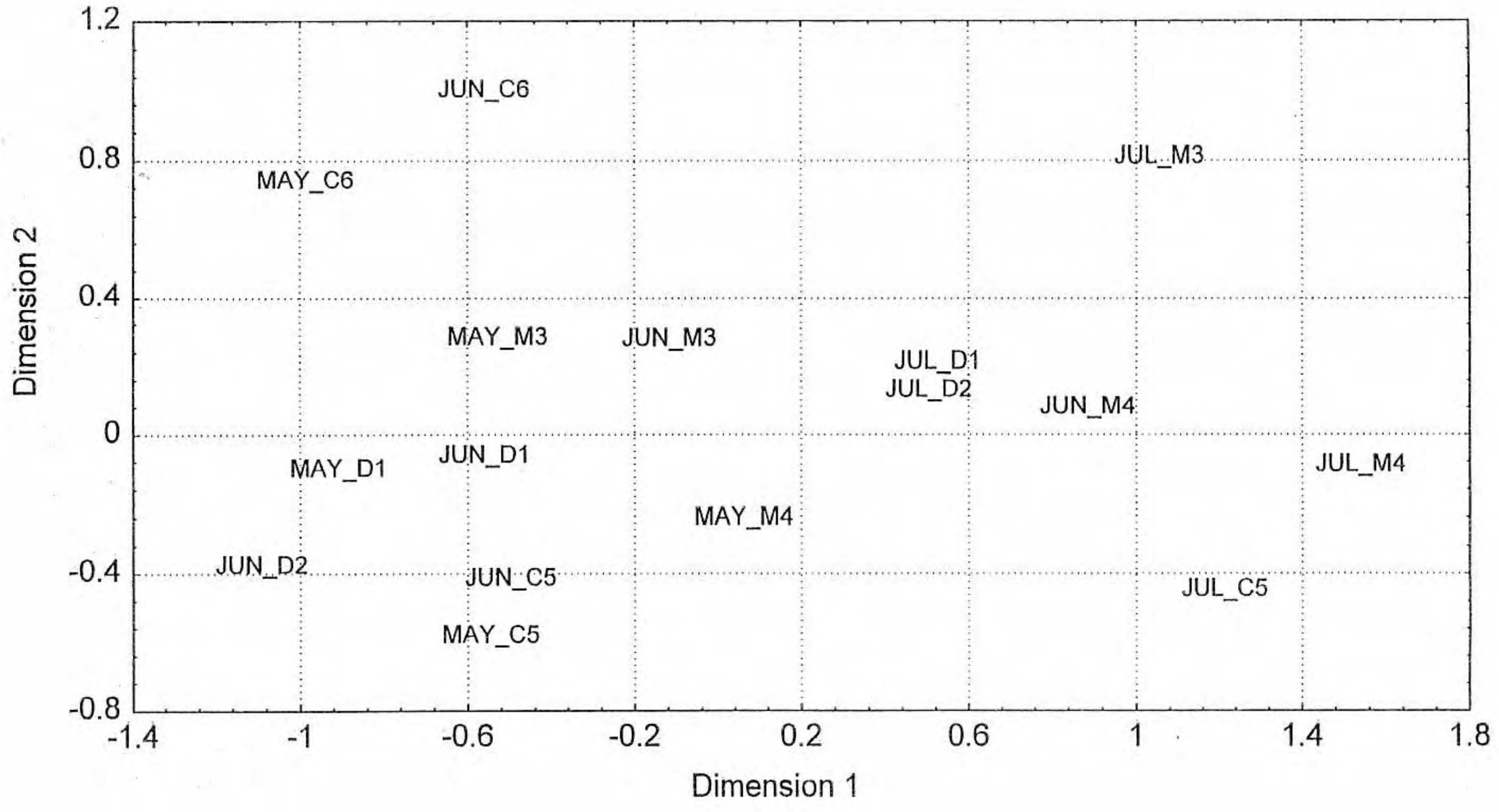


Figure 8: Ordination of ANM river monitoring sites using macroinvertebrate species abundance data for the low flow ($< 1m$) period of 1994

MDS - ANM River Monitoring at Low Flow 1994

Final Configuration, dimension 1 vs. dimension 2

C = control, M = mixing zone, D = downstream



1994

file copy

16 December 1994

Our Ref: YH/6/21/1 and YH/6/21/3

Mr Ralph Coghill
Technical Services Manager
Australian Newsprint Mills Limited
Private Bag
LAVINGTON NSW 2641

Dear Ralph

1994 ANNUAL REPORT - BIOLOGICAL AND CHEMICAL MONITORING

Please find enclosed an unbound copy of the 1994 Annual Report outlining the monitoring undertaken by The Murray-Darling Freshwater Research Centre for Australian Newsprint Mills Limited. This Annual Report complies with Licence Condition W16 on the ecotoxicological and bio-accumulation monitoring and the river environment monitoring surveys.

Please do not hesitate to contact me on 43 1002 for any additional information.

Wishing you and your staff a Merry Xmas and a Happy New Year.

Yours sincerely

H M KING

Scientific Officer

Enc. 1994 Annual Report.

Disk copy of text and Figure captions.

1994 ANNUAL REPORT OF CHEMICAL AND BIOLOGICAL MONITORING FOR AUSTRALIAN NEWSPRINT MILLS Ltd ALBURY

by

The Murray-Darling Freshwater Research Centre

AUSTRALIAN NEWSPRINT MILLS

CHEMICAL AND BIOLOGICAL MONITORING

1994

1.0 INTRODUCTION

The Murray-Darling Freshwater Research Centre was contracted to undertake environmental chemical and biological monitoring of ANM's wastewater and its impact on the River Murray at Albury in accordance with specifications in the SPCC Licence No. 01272 sections W10 and W11 and NSW Department of Planning's 'Instrument of Consent' dated 26 June 1991, Condition 4 'Bioassay Testing and Environmental Monitoring Programmes'.

2.0 METHODS

2.1 ECOTOXICOLOGICAL AND BIO-ACCUMULATION MONITORING [W10]

2.1.1 Bioassay

Bioassay test methods are based on the standard methods defined by APHA (1989), OECD (1981), USEPA (1989) and USEPA (1991).

Laboratory bioassays were conducted on river water below ANM's point of discharge and on treated wastewater from three sources on site at ANM; the point of discharge from the water treatment plant into the four day holding pond (pond inlet), the point of exit from the four day holding pond (pond) and the final discharge, which includes wastewater from the holding pond as well as cooling water and treated sanitary wastewater (pond outlet). Control/dilutant water was obtained from the River Murray upstream of local point souce discharges. All water samples were sieved to 90 micrometres to remove micro crustaceans.

Chironomus tepperi and *Daphnia carinata* acute (96 hour) toxicity tests, were run concurrently each month during 1994, using wastewater at concentrations ranging from 0.1% to 100%. *Daphnia carinata* chronic (21 day) toxicity tests, have been conducted every two months this year, in wastewater concentrations of 1% to 100%. Primary untreated effluent and potassium dichromate (30 - 80 ug/L) were used as reference toxicants.

2.1.2 Bioaccumulation

Bioaccumulation trials on Yabbies (*Cherax destructor*) were conducted using three 8 m^3 concrete tanks on site at ANM. Tank 1 (the control) fed only by river water and Tanks 2 and 3 (test tanks) fed by a mixture of 50% river water and 50% pond outlet wastewater. 100 animals were added to each tank, approximately twenty of these were weighed and measured each month, and a smaller subsample removed every three months for whole body chemical assay. The whole samples were freeze dried then acid digested at The Murray-Darling Freshwater Research Centre's chemistry laboratory.

Bioaccumulation trials on Silver Perch (*Bidyanus bidyanus*) were conducted using six 90L flow through tanks housed in the laboratory. Three tanks fed by river water and three fed by a mixture of 50% river water and 50% wastewater. Sampling was conducted as for *C.destructor* .

The samples were sent to Amdel Laboratories, Thebarton, SA, where three subsamples from each were assayed for metals. Elements assayed for were: aluminium, chromium, barium, iron, zinc, copper, cobalt, nickel, manganese, phosphorus, magnesium, arsenic, cadmium, lanthanum, molybdenum, silver, lead and yttrium.

2.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

2.2.1 Water

Sample Collection and Handling

Grab samples were taken at three locations on the river on a monthly basis. Until 21 February 1994 site 1 samples were taken at a point approximately 1 km upstream of the ANM outfall (locally known as Grey's farm). Site 1 samples collected after this date were taken from Mungabareena Reserve (approximately 3 Km upstream of the outfall. The change in sampling location was necessary because of severe bank erosion at the grey's farm site. Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

5 samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were "ANALAR" grade or better and, clean polyethylene gloves were worn at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of water samples.

All metal analyses (except for mercury analyses) were performed by :-
EML (Chem) Pty Ltd
425 -427 Canterbury Road
Surrey Hills Vic 3127.

The parameters determined were extractable:-
Aluminium, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Lead and Zinc.

Analyses for total Mercury were performed by :-
Australian Newsprint Mills Ltd
Boyer Tas 7140.

Physical and nutrient analyses were performed at the Murray-Darling Freshwater Centre (MDFRC). Turbidity, Colour, Specific Conductance, Total Dissolved Solids, Ammonia, Nitrate, Nitrite, Organic Nitrogen, Total Phosphorus were determined according to the methods outlined in the MDFRC Chemistry laboratory's methods manual.

2.2.2 Sediment.

Sample Collection and Handling.

A series of forty sediment samples were taken on the 9th of June 1994. Sediment samples were collected from two deposition zones approximately equidistant (*ca* 500 m upstream and *ca* 500 m down stream) of ANM mills outfall. Samples were collected at 10 metre intervals along the 60 cm depth contour (approximately 2 metres from, and parallel to, the river bank). A total of 20 samples were taken above and 20 samples taken below the outfall.

Approximately the top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5% HCl) and repeatedly rinsed with Milli-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimise the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analysis were performed only on the sieved fraction (Grimshaw 1989).

Particle Size Analysis.

Approximate particle fractionation was carried out on all samples. Fractionation was by the method described by Grimshaw (1989). Essentially, that portion of the sample which was retained by a 2 mm sieve was considered gravel. The portion of the sample that passed through a 2 mm sieve was considered a mixture of silt, clay and sand.

The percentage of silt + clay in this fraction was determined by the 4 minute 48 second hydrometer method described by Grimshaw (1989). The sand content was estimated by difference. No distinction between silt and clay content, or fine sand and coarse sand content was attempted.

Analysis of Acid Extractable Metals.

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1989). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5% HCl and extensively rinsed with MILLI - Q water). 25 mL of 0.1 M "ARISTAR" grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a Ratek orbital shaking table for one hour. The samples were allowed to settle overnight and, subsequently filtered through acid washed Whatman GF/C filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5% HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to :-

Amdel Laboratories,
Brown St, Therbaton
South Australia,

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury.

Approximately 10 g of air dried sample was placed in clean polyethylene bags and dispatched to :-

Australian Newsprint Mills Ltd
Boyer Tas 7140.

for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen.

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9 % NaOH, 4.0 % $K_2S_2O_4$) was added to each tube. The tubes were sealed and subsequently heated in an autoclave for one hour. The solution was the analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et al* 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus.

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et al* 1989).

2.2.3 <u>Biota</u>

Macroinvertebrates

Macroinvertebrate samples were collected using artificial substrates from six paired sites on the River Murray (Figure 1) according to the method set out in Bennison *et. al.* 1989. Monthly sampling continued in 1994. Samples were sorted into taxonomic groups, counted and compared statistically by site using cluster analysis in "Statistica".

Fish

Fish sampling was conducted bi-annually, under low flow and high flow conditions at the above sites, using 10 bait nets at each site, set for 12 hours and using a chemical light as an attractant.

3.0 RESULTS AND DISCUSSION

3.1 ECOTOXICOLOGICAL AND BIO-ACCUMULATION MONITORING [W10]

3.1.1 Bioassay

A summary of acute toxicity test results in which animals in the test solutions reacted differently to those in the control solutions is provided in Table 1. A summary of chronic toxicity test results in which the reproductive capacity of the animals was significantly different ($p<0.05$, Students t-Test) when compared with the control is provided in Table 2. Significant adverse reactions occurred almost exclusively in 100% wastewater solutions. ANM wastewater was not toxic to *C.tepperi* in any of the tests conducted.

Fish Ventilation Monitoring

The fish ventilation monitor, which measures stress on fish by detecting changes in electrical potential between two passive electrodes caused by opercular movement, is operational on eight channels. Validation of the system was conducted using primary untreated effluent at the EC50 (mortality) concentration for *D.carinata*.

Bioaccumulation

The 1993 Yabby (*Cherax destructor*) bioaccumulation trial commennced in April 1993 and continued through to December 1993. The results of the metals assays are presented in Table 3 for the eight month trial. Arsenic, molybdenum, chromium, cadmium, lead, cobalt, silver, lanthanum, nickel, and yttrium were only recorded at levels close to the detection limit for all samples. Barium and Aluminium data were highly variable both within and between treatments. Zinc, iron, copper and phosphorus data showed no difference between treatments over time, however manganese increased significantly over time in the test animals exposed to 50% ANM wastewater.

The 1994 *C.destructor* trial was conducted from January to July 1994. The results of the metals assays are presented in Table 4 for the six month trial. Arsenic, molybdenum, chromium, cadmium, lead, cobalt, silver, lanthanum, nickel and yttrium were only recorded at levels close to the detection limit for all samples. Barium and aluminium data were highly variable both within and between treatments. Zinc, iron, copper, magnesium and phosphorus data showed no difference between treatments over time, however manganese increased over time in the test animals exposed to 50% ANM wastewater.

A new *C.destructor* trial commenced in July 1994

The 1994 Silver Perch (*Bidyanus bidyanus*) trial commenced in March and was terminated in May 1994. The results of the metals assays for the two month trial are presented in Table 5. Arsenic, molybdenum, cromium, cadmium, lead, cobalt, silver, lanthanum, nickel and yttrium were only recorded at levels close to the detection limit for all samples. Barium, aluminium, manganese, zinc, iron, copper, magnesium and phosphorus data were highly variable both within and between treatments.

The were no differences in growth between treatments for any of the trials (reported in quarterly reports

3.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

3.2.1 Water

A summary of the water quality data is presented in Figure 2. The figure shows the variation of metals (manganese, iron, aluminium, and zinc), nutrients (total phosphorus, ammonia, organic nitrogen and oxides of nitrogen), and, physical parameters (turbidity, conductivity, colour and total dissolved solids) between the three sites over time. (Site 1 samples are represented by open circles, site 2 samples are represented by closed circles and site 3 samples are represented by open triangles; lines are included for only for clarity and no interpolation between data points is intended.) The data for 1993 has also been included for purpose of comparison. The figure does not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.006 mg/L), chromium (0.02 mg/L), lead (0.03 mg/L) and mercury (0.0002 mg/L) were not detected in any of the samples (detection limits in brackets). Copper (detection limit of 0.004 mg/L) was detected on five occasions - site 1 on the 22/11/93 (0.11 mg/L), sites 1 and 3 on the 24/1/94 (0.007 mg/L at both sites), site 2 on the 21/3/94 (0.005 mg/L), and site 3 on the 22/8/94 (0.005 mg/L).

Generally, most of the data show little (if any) variation between sites although, there may be significant variation over time (seasonal effects). From the figure it is evident that iron, manganese, total phosphorus, turbidity, conductivity, colour, total dissolved solids, and oxides of nitrogen (NO_x) vary little between sites. The levels of ammonia and organic nitrogen, seem to be more variable between sites - possibly reflecting variable inputs of organic matter to the river from what is essentially a rural riverine environment. Relatively high levels of zinc were detected at site 1 on the 22/11/9, at site 2 on the 19/9/94 and at site 3 on the 22/8/94. The cause of these spikes is unknown.

3.2.2. Sediments

Arsenic, cobalt, molybdenum and silver were not detected in any of the sediment samples either upstream or downstream of the outfall (detection limit 0.05 mg/kg). Tin, cadmium and boron were not detected in any of the upstream samples; tin was detected in one downstream sample (0.1 mg/kg), boron was found in six downstream samples (range 0.05 - 0.4 mg/kg, average 0.15 mg/kg) and cadmium was found in twelve downstream samples (range 0.05 -0.15 mg/kg, average 0.1 mg/kg). Chromium was present in one upstream sample (0.05 mg/kg) and six downstream samples (range 0.05-0.35 mg/kg, average 0.15 mg/kg). Mercury was present in fourteen of the upstream samples (range 2 - 3 µg/kg, average 2 µg/kg) and eleven downstream samples (range 2 - 6 µg/kg, average 4 µg/kg).

The results for the sediment analyses for total persulphate nitrogen, exchangeable phosphorus and acid extractable aluminium, barium, calcium, copper, iron, lanthanum, lead, magnesium, manganese, nickel, silica, strontium, yttrium and zinc are summarised in Figure 3. For each analyte a box plot showing the distribution above and below the outfall is presented. The solid horizontal lines of the box plot represent the 10^{th}, 25^{th}, 50^{th}, 75^{th} and, 90^{th} percentiles of the data - the box itself represents the 25^{th} to 75^{th} percentile. All data outside the 10^{th} and 90^{th} percentiles are shown as open circles on the plots. The mean of the data is represented by a dotted line. From the figure it is clear that almost all of the downstream samples have analyte concentrations greater than those of the upstream sites. For all of these analytes, with the exception of nickel and strontium, there is a statistically significant difference ($p < 0.05$; Student's t-test) between the mean concentration in the upstream and downstream samples

Sediment characteristics.

The crude sediment characteristics (% gravel, % sand, and % silt and clay,) of the upstream and down stream sample sites are summarised in Figure 3. As in last years survey, the sediments predominantly consisted of sand and gravel with little silt or clay. The level of silt and clay was lower than the level found in the 1992 survey and similar to that found in the 1993 survey.

Chemical characteristics of the sediment.

A summary of the chemical characteristics of the sediment samples taken upstream and down stream of ANM's outfall are also presented in Figure 3. An extensive series of elements were determined. These included total persulfate nitrogen, exchangeable phosphorus and acid extractable aluminium, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, silica, silver, strontium, tin, yttrium and zinc

From the figure it can be seen that the down stream sediments tend to have a greater distribution in the concentration of analytes than the upstream sites and, the mean concentration for the down stream sites tends to be significantly higher than for the upstream sites.

Figure 4 shows the distribution of iron along the upstream and downstream transects. From the figure it can be seen that the upstream transect has an essentially uniform distribution of iron. This is not the case for the downstream transect. The early stations (closer to the outfall) appear to have a similar range of iron concentrations as that of the upstream transect. However, after approximately 90 metres along the transect there is a significant rise in the iron concentration. Most of the other analytes studied show a similar distribution pattern. Unlike last years survey (where the presence of a snag along the transect confounded the data analysis) there is no obvious difference in the physical composition of the sediment (for example more silt and clay or higher gross organic matter content) to account for the observed distribution.

It should be noted that the railway bridge immediately upstream of the start of the lower transect was being painted at the time of sampling. One possible hypothesis to account for the distribution of analytes along the transect is that the rise in concentration represents the beginning of a depositional zone (either water or airborne) for material derived from the bridge. Given the available data it is not possible to test this hypothesis.

3.2.3 Biota

Macroinvertebrates

The 1993 monthly macroinvertebrate data are analysed seasonally in the average linkage dendogram using Euclidean Distance metric (Figure 5) which clusters similar samples by comparing taxonomic data. The dendogram shows no biological differences between sites with limited grouping according to sampling dates. The samples for 1994 are currently being identified and analysed.

Fish

Fish surveys of the River Murray in 1994 yielded no data. After discussion at the ANM Monitoring Program Annual Review, the sampling method has been changed from bait nets to cylindrical bait traps for 1995 and will continue to comprise intensive sampling (10 traps) at the six sites bi-annually, under low flow and at high flow conditions.

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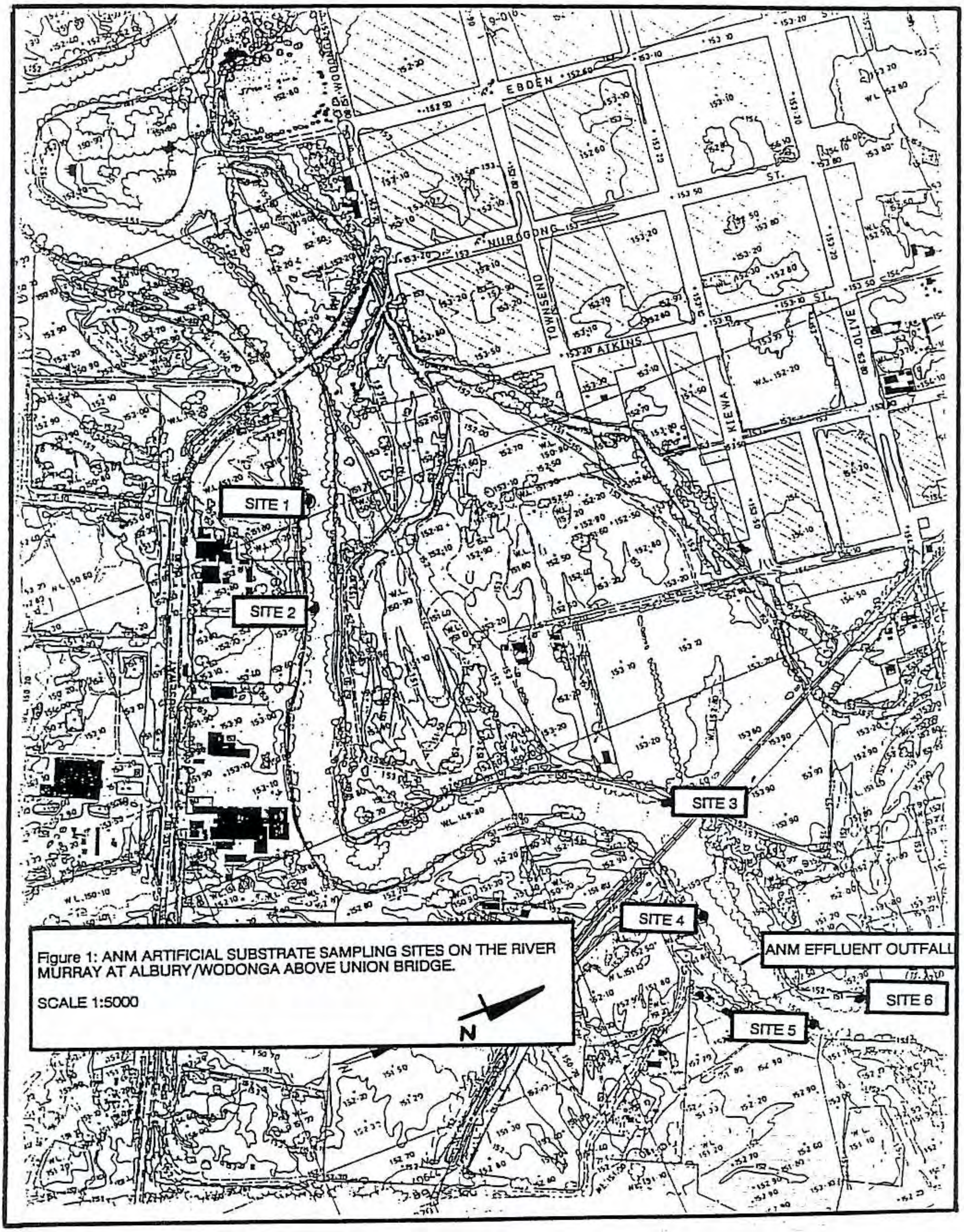
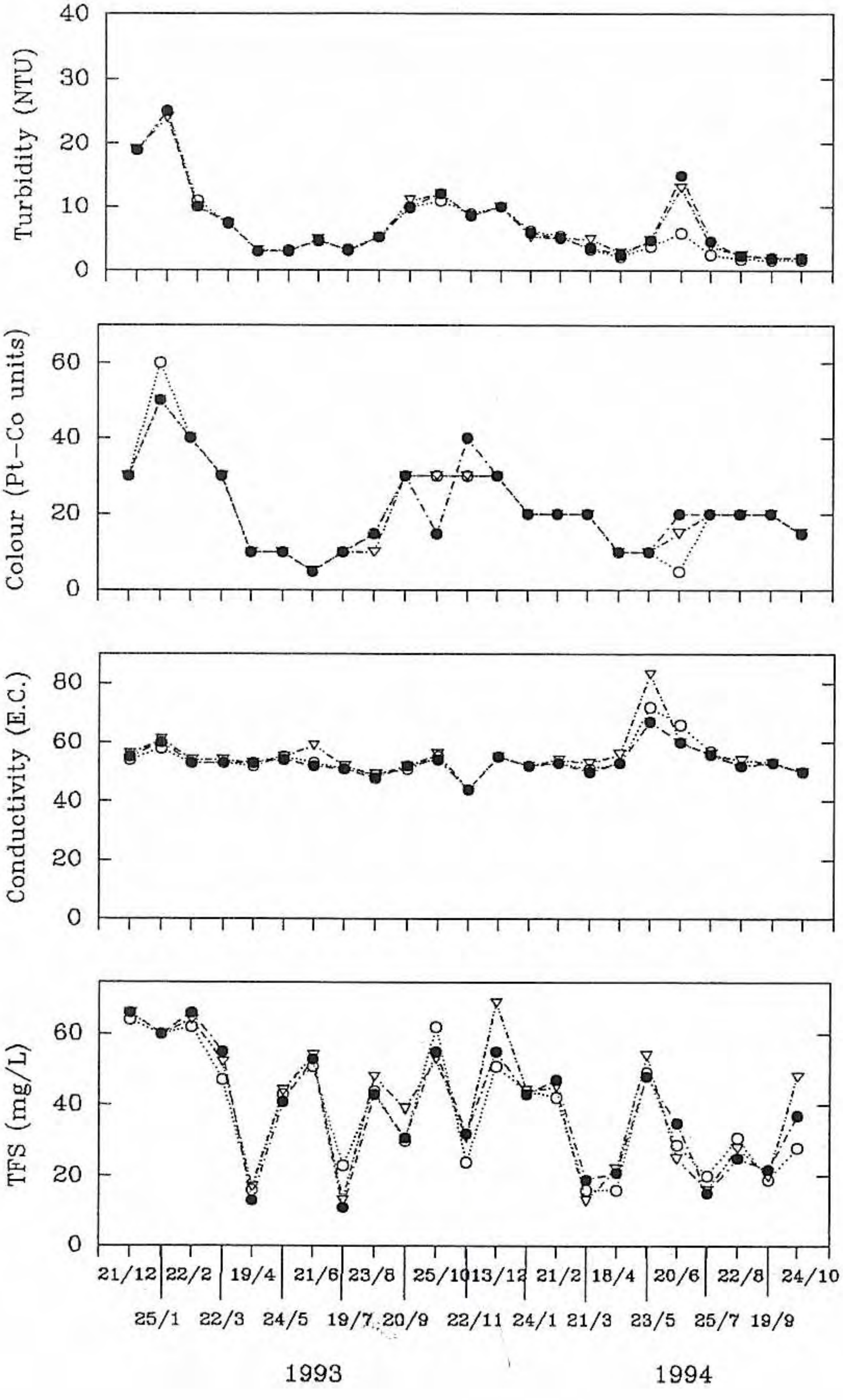
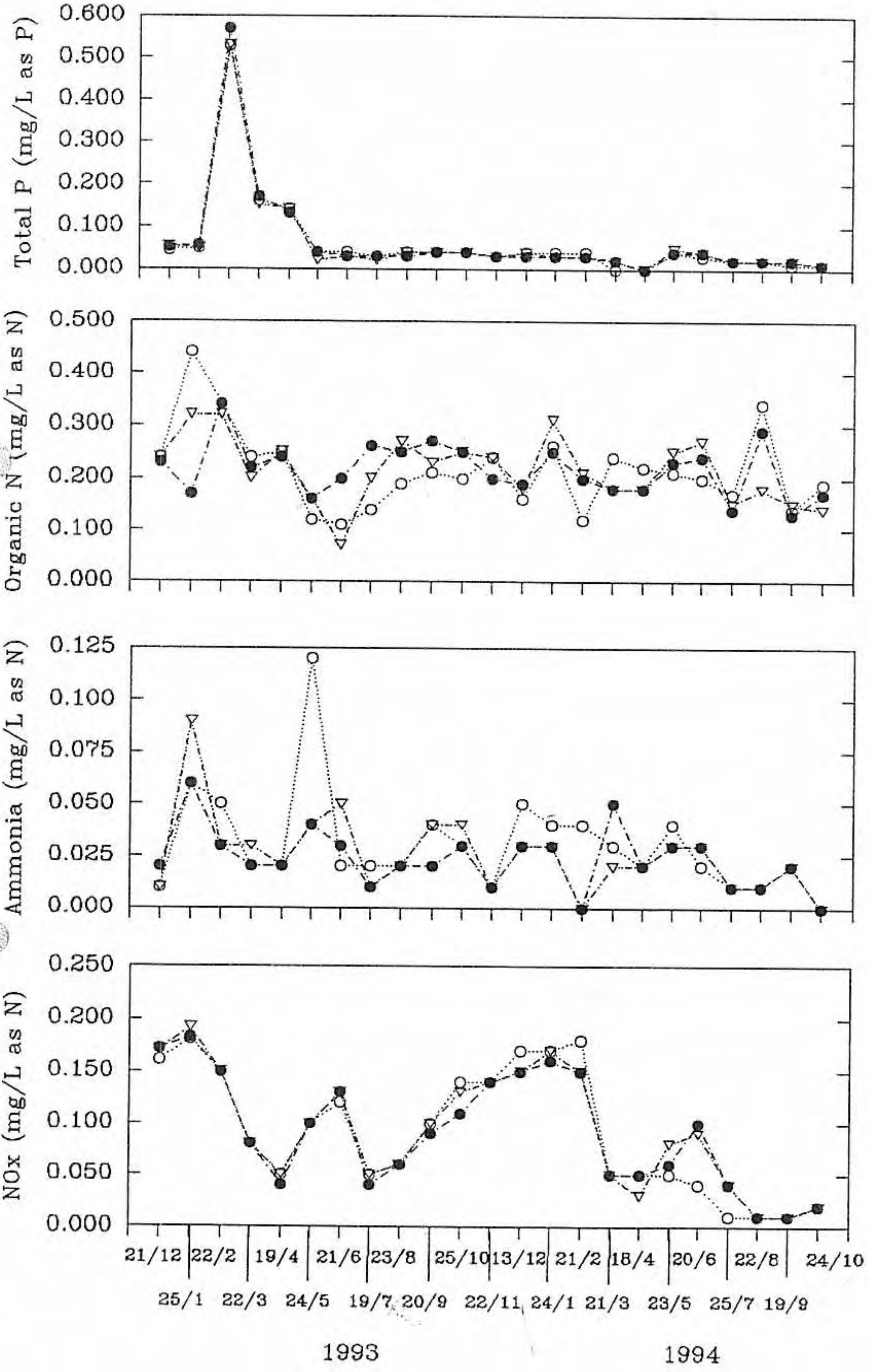


Figure 1: ANM ARTIFICIAL SUBSTRATE SAMPLING SITES ON THE RIVER MURRAY AT ALBURY/WODONGA ABOVE UNION BRIDGE.

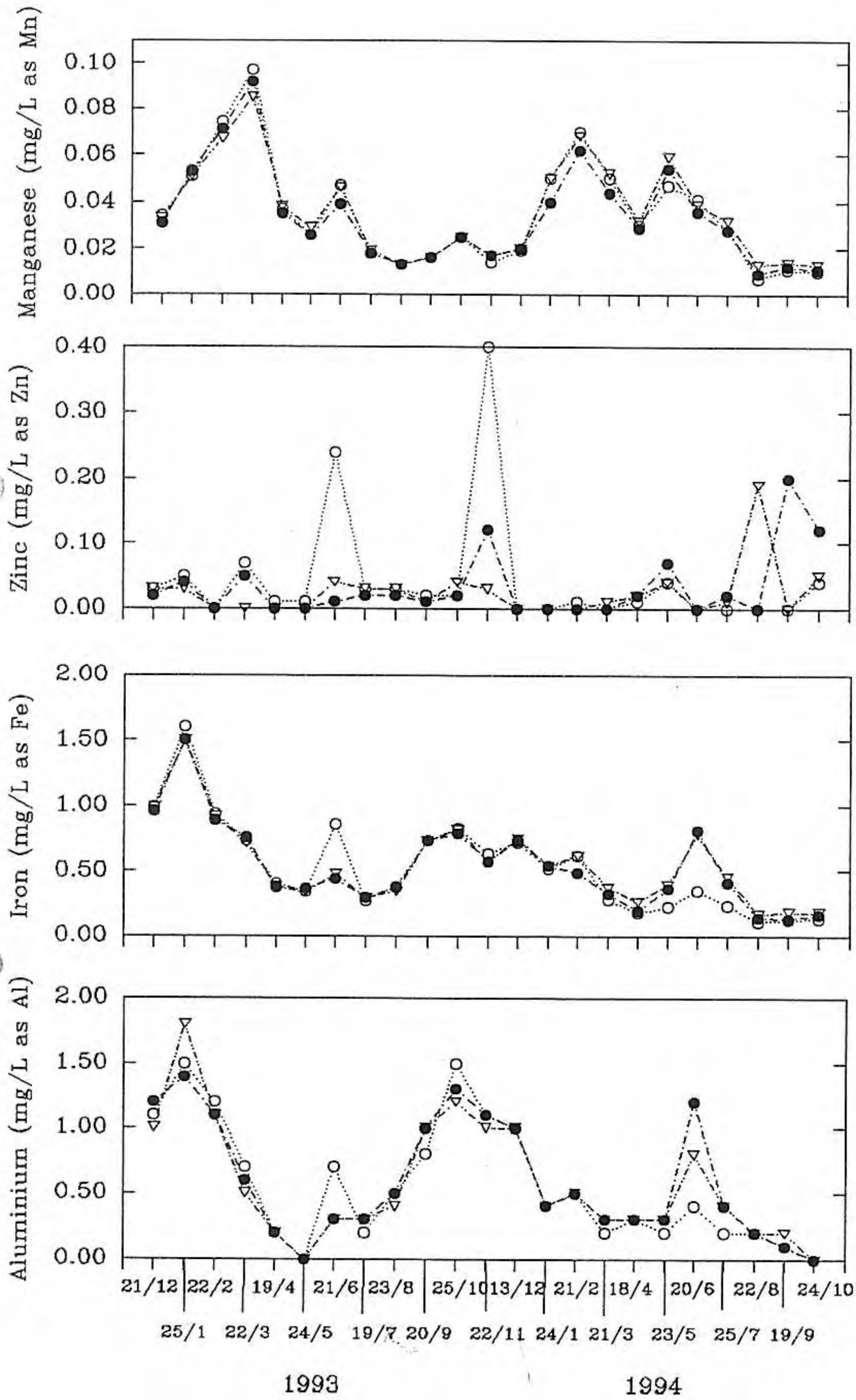
SCALE 1:5000

Figure 2: A summary of the water quality data for 1993 and 1994. The figure shows the variation of metals (manganese, iron, aluminium, and zinc), nutrients (total phosphorus, ammonia, organic nitrogen and oxides of nitrogen), and, physical parameters (turbidity, conductivity, colour and total dissolved solids) between the three sites over time. Site 1 samples are represented by open circles, site 2 samples are represented by closed circles and site 3 samples are represented by open triangles; lines are included for only for clarity and no interpolation between data points is intended.


Turbidity (NTU)
Colour (Pt-Co units)
Conductivity (E.C.)
TFS (mg/L)
21/12 22/2 19/4 21/6 23/8 25/10 13/12 21/2 18/4 20/6 22/8 24/10
25/1 22/3 24/5 19/7 20/9 22/11 24/1 21/3 23/5 25/7 19/9
1993
1994

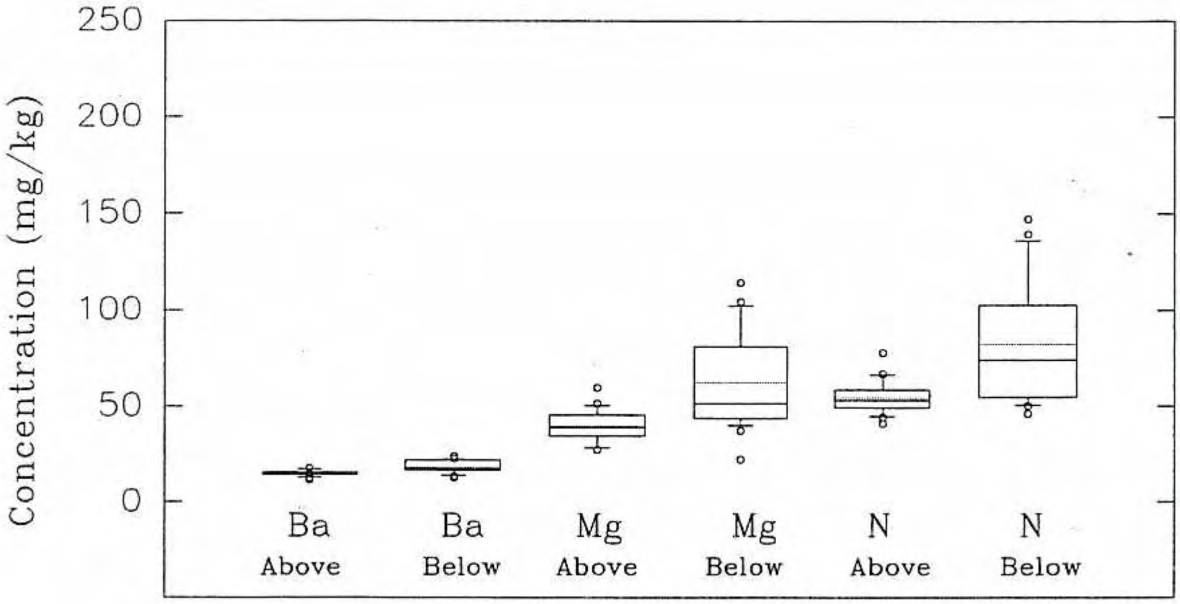


Total P (mg/L as P)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Organic N (mg/L as N)
0.500
0.400
0.300
0.200
0.100
0.000
Ammonia (mg/L as N)
0.125
0.100
0.075
0.050
0.025
0.000
NOx (mg/L as N)
0.250
0.200
0.150
0.100
0.050
0.000
21/12 22/2 19/4 21/6 23/8 25/10 13/12 21/2 18/4 20/6 22/8 24/10
25/1 22/3 24/5 19/7 20/9 22/11 24/1 21/3 23/5 25/7 19/9
1993
1994

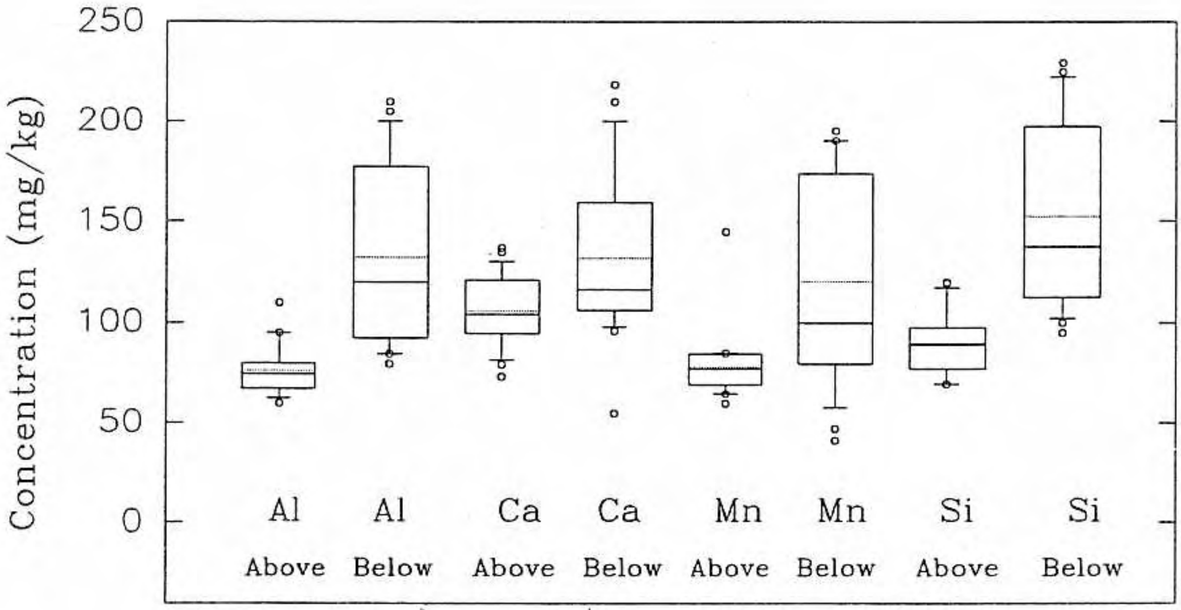


Manganese (mg/L as Mn)
0.10
0.08
0.06
0.04
0.02
0.00
Zinc (mg/L as Zn)
0.40
0.30
0.20
0.10
0.00
Iron (mg/L as Fe)
2.00
1.50
1.00
0.50
0.00
Aluminium (mg/L as Al)
2.00
1.50
1.00
0.50
0.00
21/12 22/2 19/4 21/6 23/8 25/10 13/12 21/2 18/4 20/6 22/8 24/10
25/1 22/3 24/5 19/7 20/9 22/11 24/1 21/3 23/5 25/7 19/9
1993
1994

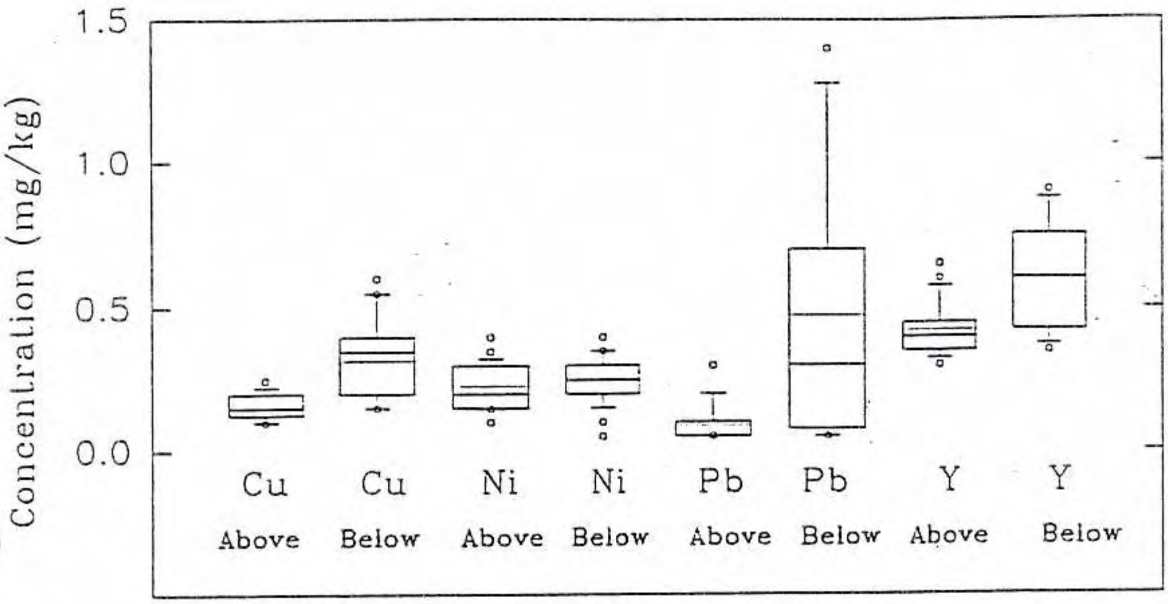
Figure 3: Box plots for the distribution of total persulphate nitrogen, exchangeable phosphorus and acid extractable aluminium, barium, calcium, copper, iron, lanthanum, lead, magnesium, manganese, nickel, silica, strontium, yttrium and zinc in the sediment from transects above and below ANM's outfall.



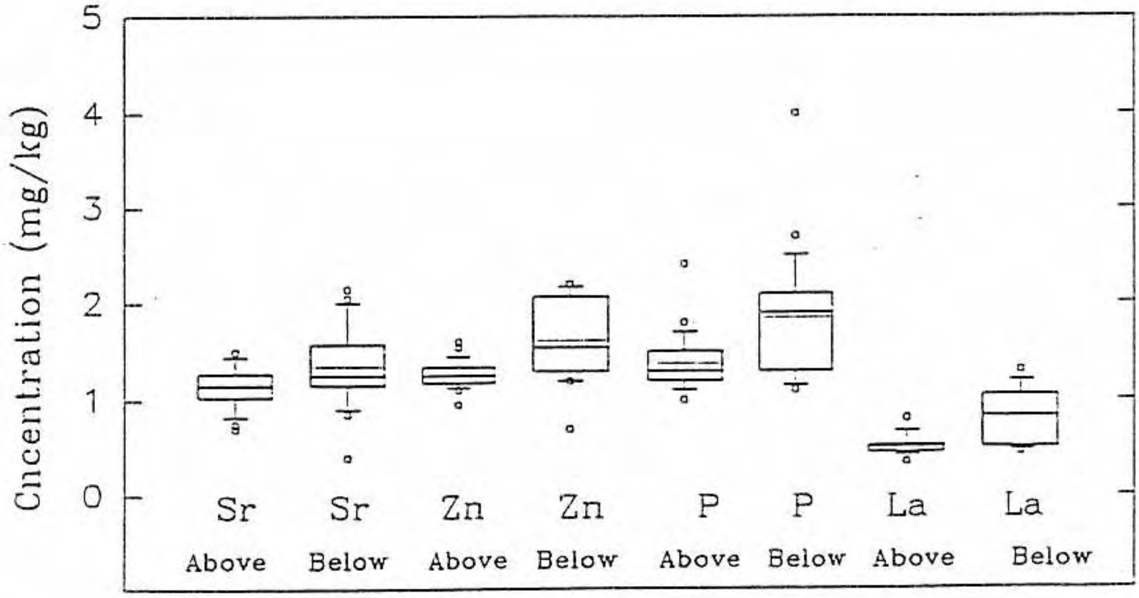
250
200
150
100
50
0
Concentration (mg/kg)
Ba Above
Ba Below
Mg Above
Mg Below
N Above
N Below



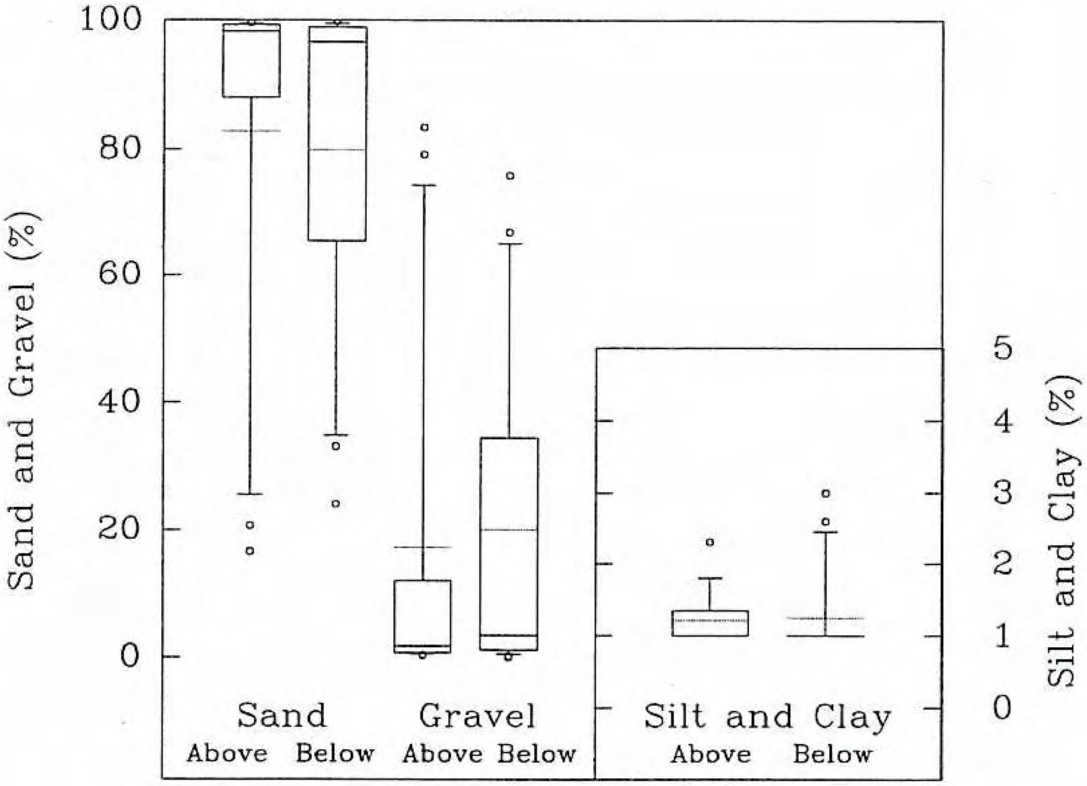
250
200
150
100
50
0
Concentration (mg/kg)
Al Above
Al Below
Ca Above
Ca Below
Mn Above
Mn Below
Si Above
Si Below



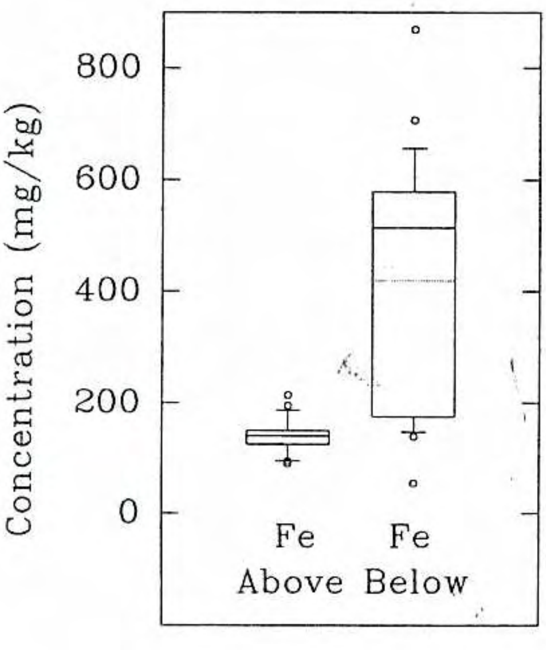
Concentration (mg/kg)
1.5
1.0
0.5
0.0
Cu Above
Cu Below
Ni Above
Ni Below
Pb Above
Pb Below
Y Above
Y Below



Cncentration (mg/kg)
5
4
3
2
1
0
Sr Above
Sr Below
Zn Above
Zn Below
P Above
P Below
La Above
La Below

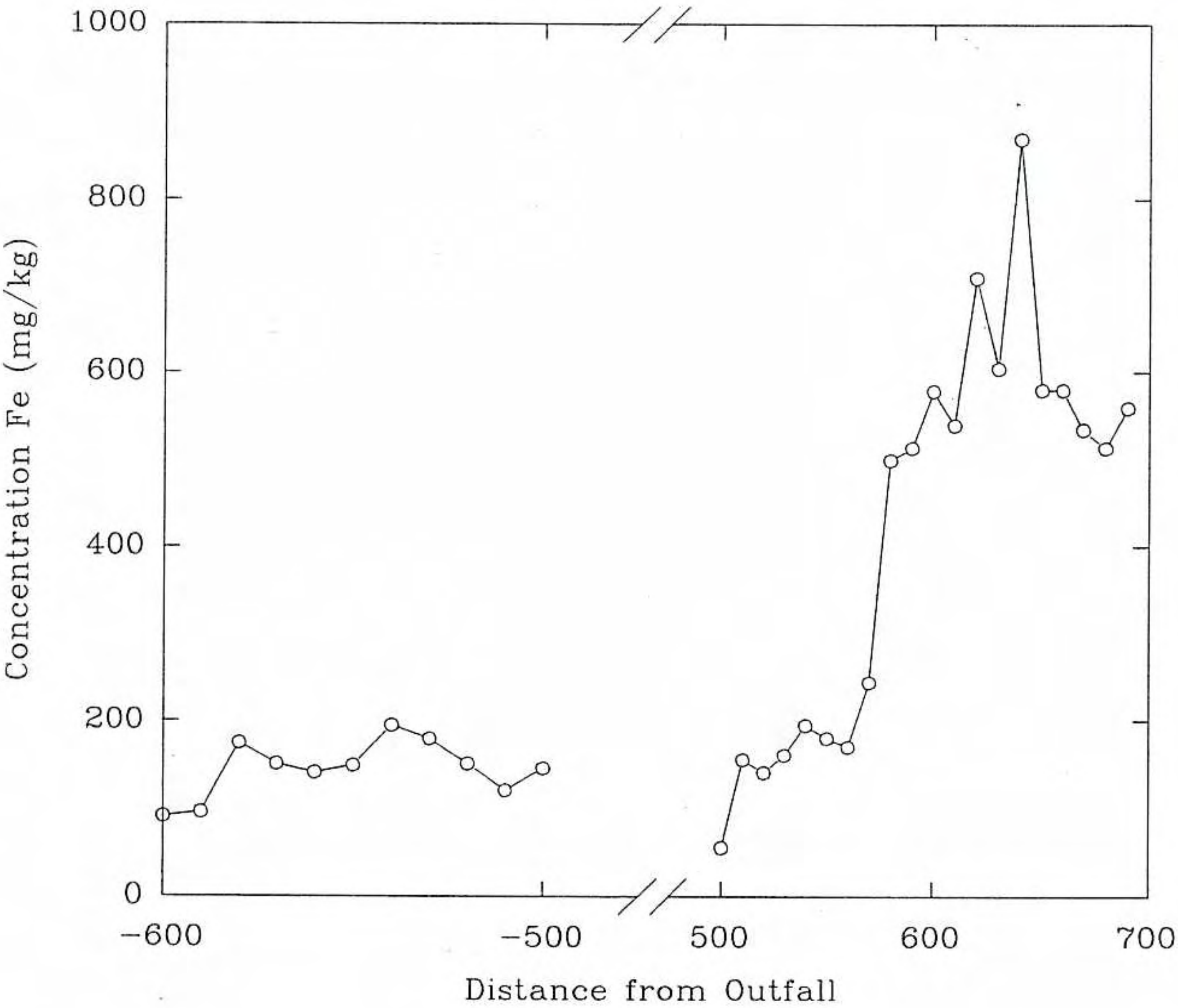


Sand and Gravel (%)
100
80
60
40
20
0
Sand
Above Below
Gravel
Above Below
Silt and Clay
Above Below
Silt and Clay (%)
5
4
3
2
1
0



Concentration (mg/kg)
800
600
400
200
0
Fe
Fe
Above Below

Figure 4: Distribution of Iron along the upstream and downstream transects.



1000
800
600
400
200
0
Concentration Fe (mg/kg)
-600
-500
500
600
700
Distance from Outfall

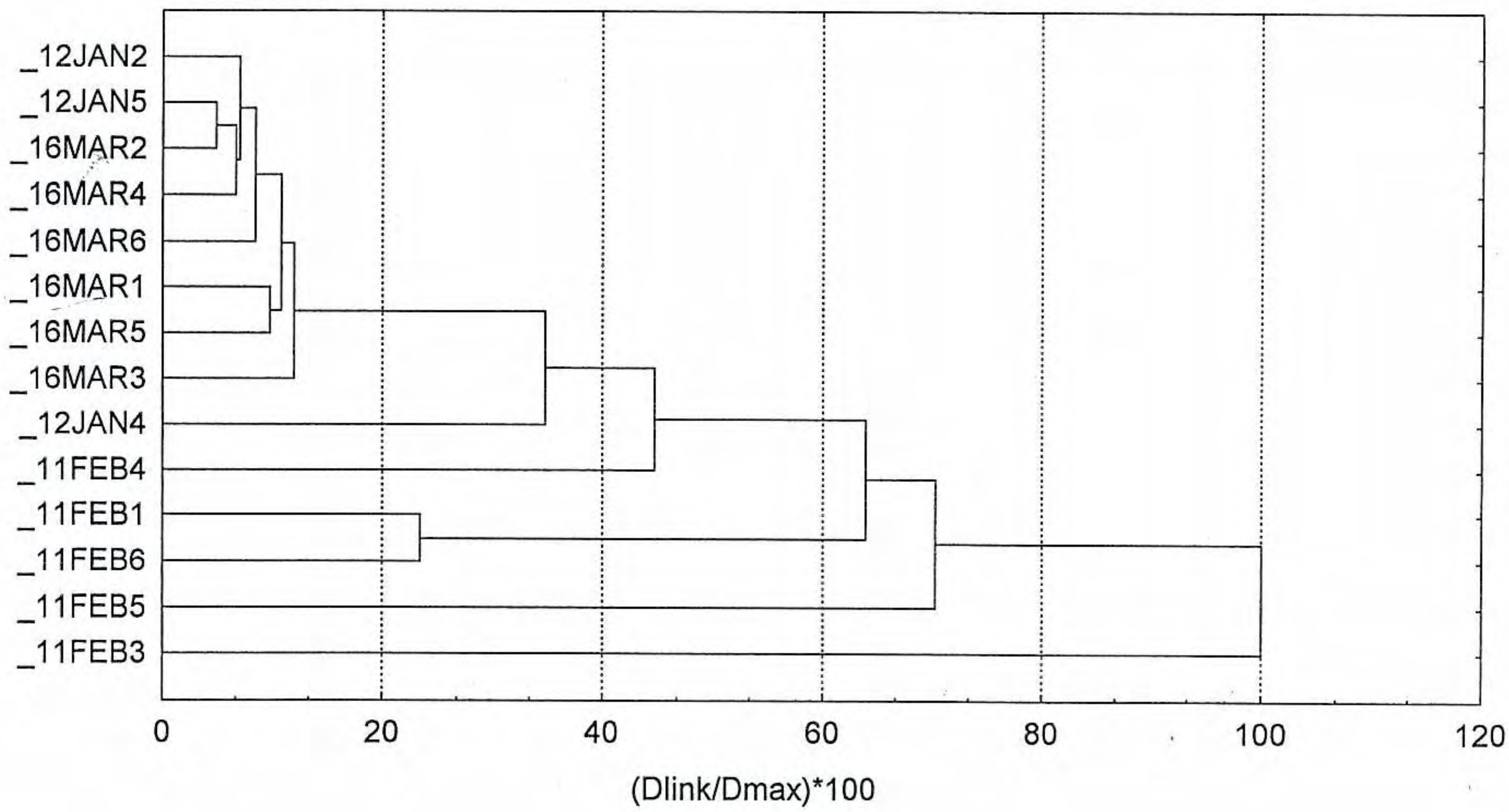
Figure 5: Seasonal analysis of the 1993 monthly macroinvertebrate data in the River Murray from paired sites - sites 1 and 2 downstream, sites 3 and 4 mixing zone and sites 5 and 6 (control) upstream from ANM wastewater discharge.

ANM RIVER ENVIRONMENT MONITORING - SUMMER 1993

Tree Diagram for 14 Variables

Single Linkage

Euclidean distances

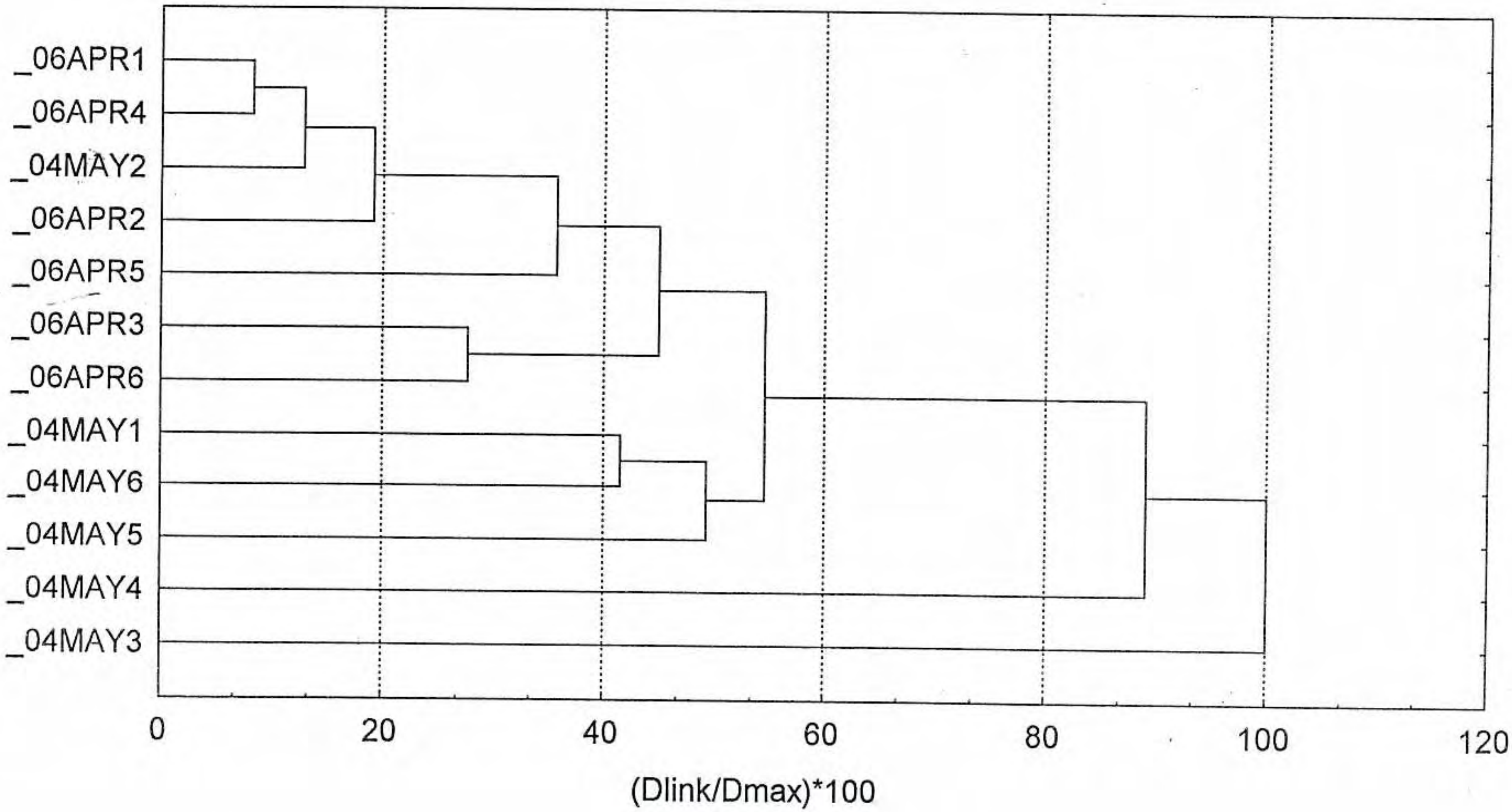


ANM RIVER ENVIRONMENT MONITORING - AUTUMN 1993

Tree Diagram for 12 Variables

Single Linkage

Euclidean distances

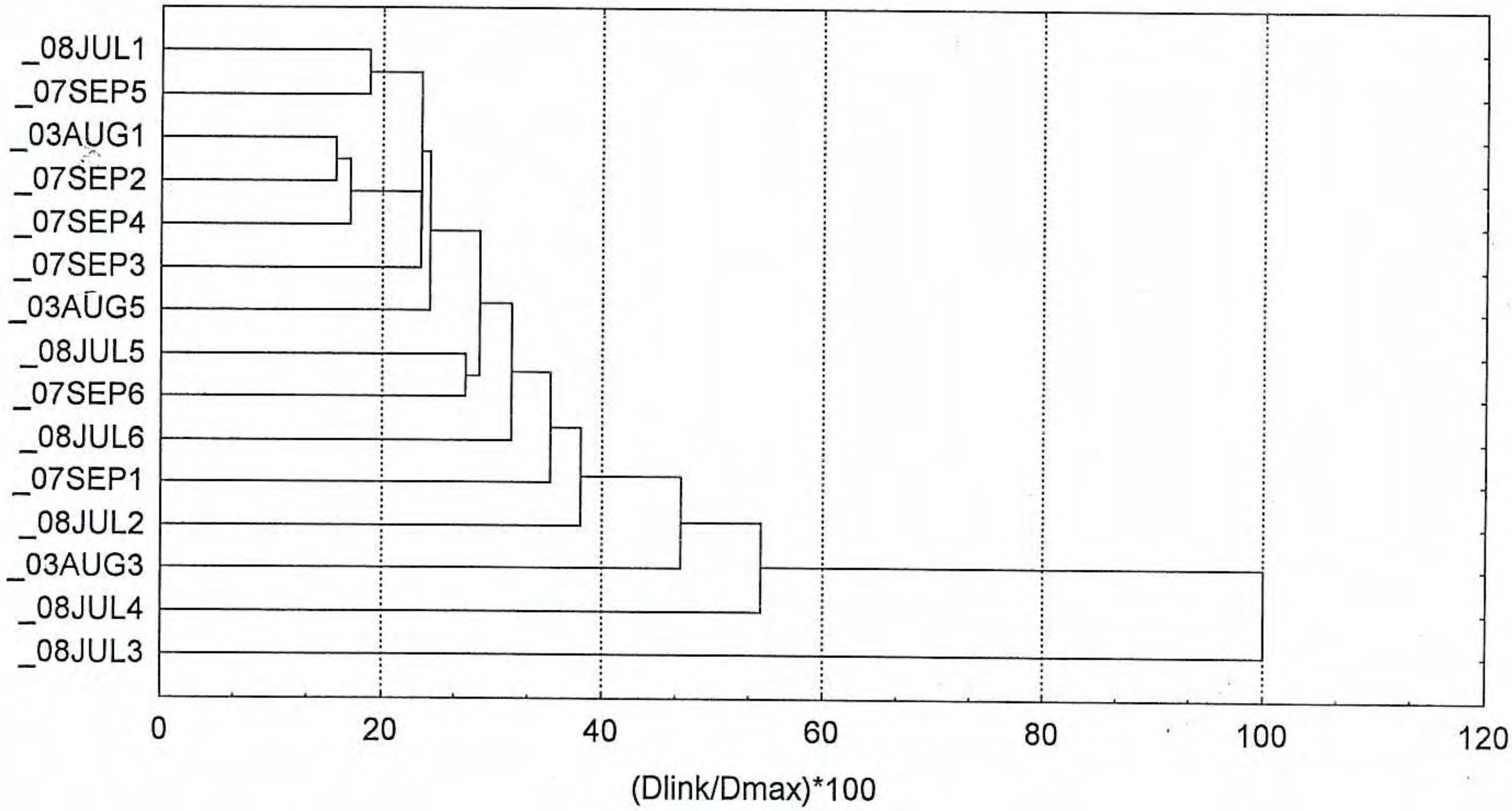


ANM RIVER ENVIRONMENT MONITORING - WINTER 1993

Tree Diagram for 15 Variables

Single Linkage

Euclidean distances



ANM RIVER ENVIRONMENT MONITORING - SPRING 1993

Tree Diagram for 12 Variables

Single Linkage

Euclidean distances

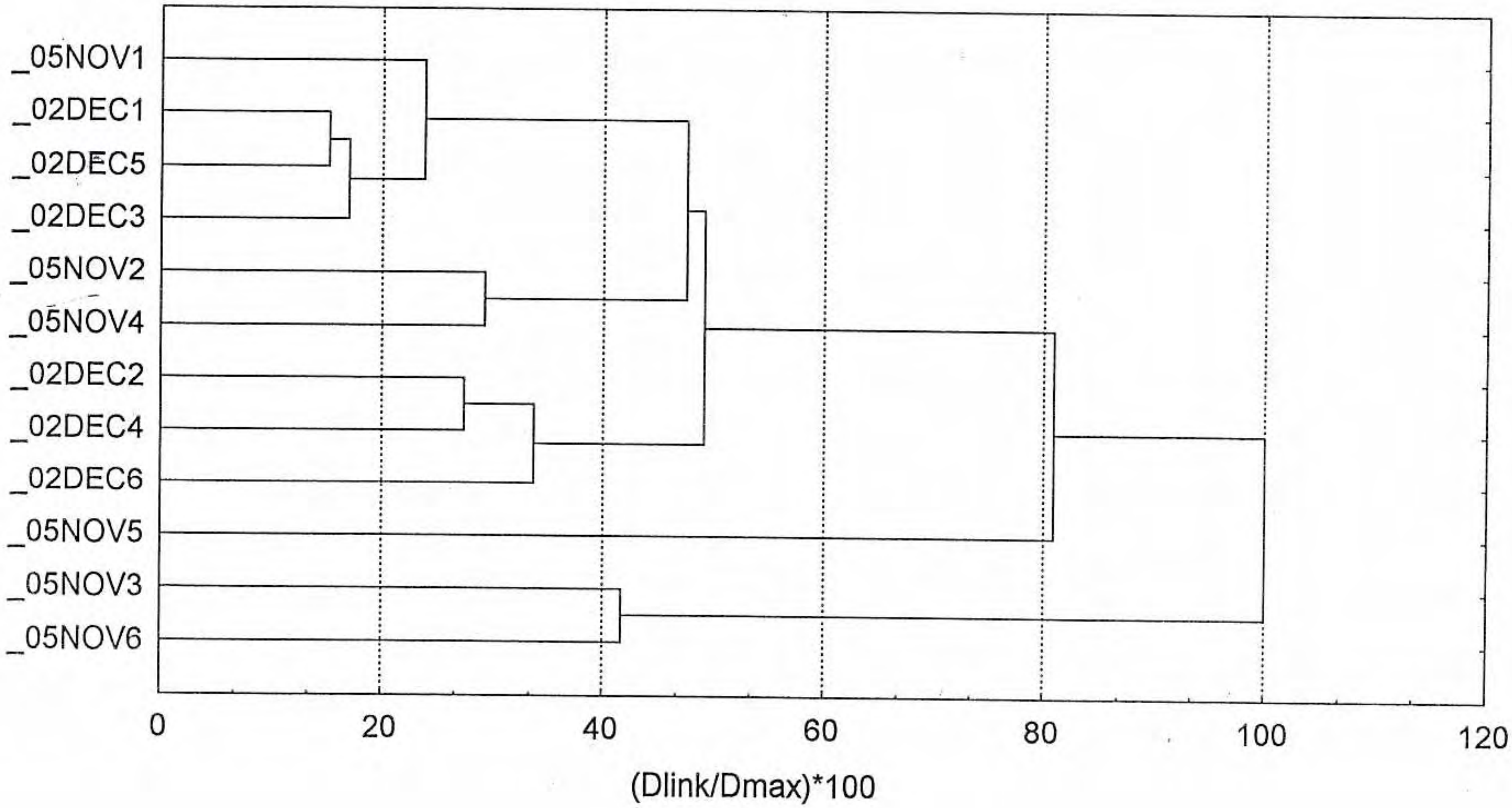


Table 1: 1994 summary of significant results for acute toxicity bioassays where : PI = ANM pond inlet; P = ANM pond; PO = ANM pond outlet (final outfall); Murray = River below ANM outfall.

TEST	WATER	MONTH
D.carinata 96h	PI 100% (48h)	March
D.carinata 96h	PI 100% (72h)	April
D.carinata 96h	Murray (24h)	May
D.carinata 96h	PO 100% (48h) PI 100% (72h) P 100% (96h) P 10% (96h)	July
D.carinata 96h	PI 100% (72h) P 100% (72h) Murray (72h) PO 100% (96h)	August

NOTE: No significant results from *C.tepperi* tests.

Table 2: 1994 summary of significant results for *Daphnia carinata* chronic toxicity bioassays where : PI = ANM pond inlet; P = ANM pond; PO = ANM pond outlet (final outfall); Murray = River below ANM outfall; < = Inhibitary effect on reproduction potential and > = stimulatory effect on reproductive potential.

TEST	WATER	MONTH
D.carinata 21day	PI 100 % (<) P 100% (<) P 10% (>)	January
D.carinata 21day	PO 100% (<) PI 1% (>) PI 0.1% (>) P 10% (>) PO 1% (>)	March/April
D.carinata 21day	P 100% (>) P 10% (>) PO 10% (>) Murray (>)	May
D.carinata 21day	P 100% (>) P 10% (>) PO 100% (>)	July
D.carinata 21day	PI 100% (<) PO 100% (<)	August/September

Table 3: Yabby eight month bioaccumulation trial 1993 - metals assay data; where CON1 = control tank 1, TEST2 = 50% ANM wastewater tank 2 and TEST3 = 50% ANM wastewater tank 3.

YABBY METALS ASSAYS - 1993

DAY OF TRIAL	Sample ID	Sample Wt. gm	Arsenic mg/kg	Molybdenum mg/kg	Chromium mg/kg	Zinc mg/kg
DAY 173	CON1-1	5.0116	1.497	<0.150	0.150	179.583
	CON1-2	5.0094	<1.497	<0.150	0.299	164.690
	CON1-3	5.0157	1.495	<0.150	0.150	194.390
	mean	5.0122				179.5545
	std	0.0032				14.8496
DAY 173	TEST2-1	5.0732	1.478	<0.148	0.148	128.617
	TEST2-2	5.0002	1.500	<0.150	0.300	115.495
	TEST2-3	5.0186	1.494	<0.149	<0.149	106.105
	mean	5.0307				116.7392
	std	0.0380				11.3073
DAY 173	TEST3-1	3.0024	<2.498	<0.250	0.250	122.402
	TEST3-2	3.0029	<2.498	<0.250	<0.250	94.908
	TEST3-3	3.0662	<2.446	<0.245	0.489	124.747
	mean	3.0238				114.0192
	std	0.0367				16.5920
DAY 267	CON1-1	5.0159	4.486	<0.150	<0.150	194.382
	CON1-2	5.0185	2.989	<0.149	<0.149	194.281
	CON1-3	5.0196	2.988	<0.149	<0.149	194.239
	mean	5.0180				194.3005
	std	0.0019				0.0736
DAY 267	TEST2-1	5.0039	<1.499	<0.150	<0.150	112.412
	TEST2-2	5.0479	<1.486	<0.149	<0.149	123.319
	TEST2-3	5.0039	<1.499	<0.150	<0.150	142.389
	mean	5.0186				126.0400
	std	0.0254				15.1725
DAY 267	TEST3-1	5.0114	<1.497	<0.150	<0.150	133.196
	TEST3-2	5.0244	<1.493	<0.149	<0.149	117.925
	TEST3-3	5.0897	<1.474	<0.147	<0.147	128.200
	mean	5.0418				126.4403
	std	0.0420				7.7865

YABBY METALS ASSAYS - 1993

DAY OF TRIAL	Sample ID	Cadmium mg/kg	Lead mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg
DAY 173	CON1-1	<0.150	<0.150	133.191	0.750	139.177
	CON1-2	<0.150	<0.150	143.730	0.599	122.769
	CON1-3	<0.150	<0.150	194.390	0.897	143.549
	mean			157.1037		135.1652
	std			32.7180		10.9556
DAY 173	TEST2-1	<0.148	1.922	57.656	0.444	147.836
	TEST2-2	<0.150	1.650	91.496	0.450	149.994
	TEST2-3	<0.149	2.092	61.272	0.448	127.027
	mean			70.1413		141.6190
	std			18.5819		12.6827
DAY 173	TEST3-1	<0.250	<0.250	274.780	1.998	214.828
	TEST3-2	<0.250	<0.250	274.734	0.999	162.343
	TEST3-3	<0.245	1.711	222.588	1.957	227.480
	mean			257.3673		201.5505
	std			30.1198		34.5389
DAY 267	CON1-1	<0.150	0.299	37.381	0.299	179.429
	CON1-2	<0.149	2.989	239.115	0.149	164.392
	CON1-3	<0.149	1.793	76.201	0.598	179.297
	mean			117.5657		174.3728
	std			107.0394		8.6441
DAY 267	TEST2-1	<0.150	1.199	41.967	<0.150	149.883
	TEST2-2	<0.149	0.743	84.689	<0.149	163.434
	TEST2-3	<0.150	<0.150	56.956	0.300	329.743
	mean			61.2040		214.3534
	std			21.6755		100.1596
DAY 267	TEST3-1	<0.150	1.048	179.591	0.299	239.454
	TEST3-2	<0.149	<0.149	179.126	0.149	223.907
	TEST3-3	<0.147	0.442	176.828	<0.147	162.092
	mean			178.5150		208.4845
	std			1.4794		40.9221

YABBY METALS ASSAYS - 1993

DAY OF TRIAL	Sample ID	Manganese mg/kg	Copper mg/kg	Silver mg/kg	Lanthanum mg/kg	Nickel mg/kg
DAY 173	CON1-1	284.340	34.420	<0.150	<0.152	<0.150
	CON1-2	209.606	26.949	<0.150	<0.150	<0.150
	CON1-3	284.108	34.392	<0.150	<0.150	<0.150
	mean	259.3514	31.9205			
	std	43.0810	4.3052			
DAY 173	TEST2-1	798.313	35.481	<0.148	<0.148	<0.148
	TEST2-2	794.968	31.499	<0.150	<0.150	<0.150
	TEST2-3	777.109	29.889	<0.149	<0.149	<0.149
	mean	790.1300	32.2894			
	std	11.3997	2.8785			
DAY 173	TEST3-1	1199.041	42.466	<0.250	<0.250	<0.250
	TEST3-2	1198.841	32.469	<0.250	<0.250	<0.250
	TEST3-3	1198.552	36.690	<0.245	<0.245	<0.245
	mean	1198.8113	37.2083			
	std	0.2458	5.0188			
DAY 267	CON1-1	328.954	70.277	<0.150	<0.150	0.299
	CON1-2	298.894	73.229	<0.149	<0.149	0.299
	CON1-3	328.711	79.190	<0.149	<0.149	0.299
	mean	318.8532	74.2317			
	std	17.2855	4.5403			
DAY 267	TEST2-1	1124.123	50.960	<0.150	<0.150	0.450
	TEST2-2	1114.325	54.973	0.743	<0.149	0.297
	TEST2-3	1124.123	59.953	0.899	<0.150	0.300
	mean	1120.8570	55.2956			
	std	5.6571	4.5051			
DAY 267	TEST3-1	1272.100	59.864	0.748	<0.150	0.299
	TEST3-2	1268.808	58.216	0.448	<0.149	0.448
	TEST3-3	1252.530	63.363	0.295	<0.147	0.589
	mean	1264.4791	60.4809			
	std	10.4786	2.6286			

YABBY METALS ASSAYS - 1993

DAY OF TRIAL	Sample ID	Yttrium mg/kg	Aluminium mg/kg	Magnesium mg/kg	Phosphorus mg/kg
DAY 173	CON1-1	<0.150	823.090	4205.244	6734.376
	CON1-2	<0.150	524.015	2814.708	5165.289
	CON1-3	<0.150	523.357	4306.478	6953.167
	mean		623.4873	3775.4766	6284.2775
	std		172.8617	833.5879	975.2274
DAY 173	TEST2-1	<0.148	606.126	3193.251	6578.688
	TEST2-2	<0.150	659.974	3449.862	7424.703
	TEST2-3	<0.149	627.665	3452.158	6949.149
	mean		631.2550	3365.0903	6984.1801
	std		27.1026	148.8218	424.0940
DAY 173	TEST3-1	<0.250	1024.181	3697.042	7868.705
	TEST3-2	<0.250	799.227	4071.065	8117.153
	TEST3-3	<0.245	1565.456	3497.815	7582.676
	mean		1129.6212	3755.3073	7856.1780
	std		393.8460	291.0325	267.4590
DAY 267	CON1-1	<0.150	971.909	2661.536	7102.414
	CON1-2	<0.149	657.567	2809.604	7024.011
	CON1-3	<0.149	1045.900	3077.934	7246.593
	mean		891.7921	2849.6918	7124.3396
	std		206.1910	211.0737	112.8993
DAY 267	TEST2-1	<0.150	1199.065	2907.732	7793.921
	TEST2-2	<0.149	1040.036	2748.668	7280.255
	TEST2-3	<0.150	719.439	2742.861	6969.564
	mean		986.1800	2799.7534	7347.9132
	std		244.3064	93.5572	416.3224
DAY 267	TEST3-1	<0.150	897.953	2888.414	8231.233
	TEST3-2	<0.149	1492.716	2507.762	7911.392
	TEST3-3	<0.147	1031.495	2726.094	9666.582
	mean		1140.7211	2707.4235	8603.0689
	std		312.0633	191.0117	934.8095

Table 4: Yabby six month bioaccumulation trial 1994 - metals assay data; where CON1 = control tank 1, TEST2 = 50% ANM wastewater tank 2 and TEST3 = 50% ANM wastewater tank 3.

BIOACCUMULATION ASSAY FOR METALS - 1994

DAY OF TRIAL	Sample ID	Sample Wt. gm	Arsenic mg/kg	Molybdenum mg/kg	Chromium mg/kg	Zinc mg/kg
DAY 0	CON1-1	4.4351	<1.691	<0.169	<0.169	103.154
	CON1-2	4.9033	<1.530	<0.153	<0.153	76.479
	CON1-3	4.2027	<1.785	<0.178	<0.178	115.997
	mean	4.5137				98.5434
	std	0.3569				20.1583
DAY 0	TEST2-1	2.5156	<2.981	<0.298	<0.298	86.460
	TEST2-2	2.5001	<3.000	<0.300	<.0300	95.996
	TEST2-3	2.5007	<2.999	<0.300	<0.300	77.978
	mean	2.5055				86.8116
	std	0.0088				9.0141
DAY 0	TEST3-1	2.5354	<2.958	<0.296	<0.296	109.450
	TEST3-2	2.5195	<2.977	<0.298	<0.298	113.118
	TEST3-3	2.5032	<2.996	<0.300	<0.300	80.896
	mean	2.5194				101.1548
	std	0.0161				17.6398
DAY 98	CON1-1	3.0113	4.981	<0.249	<0.249	134.493
	CON1-2	3.0043	4.993	<0.250	<0.250	177.246
	CON1-3	3.0549	4.910	<0.246	<0.246	135.029
	mean	3.0235				148.9228
	std	0.0274				24.5300
DAY 98	TEST2-1	5.0195	<1.494	<0.149	<0.149	91.145
	TEST2-2	5.0640	<1.481	<0.148	<0.148	99.230
	TEST2-3	5.0040	<1.499	<0.150	<0.150	97.422
	mean	5.0292				95.9322
	std	0.0311				4.2436
DAY 98	TEST3-1	5.0243	<1.493	<0.149	<0.149	111.956
	TEST3-2	5.0015	<1.500	<0.150	<0.150	89.973
	TEST3-3	5.0094	<1.497	<0.150	<0.150	95.820
	mean	5.0117				99.2496
	std	0.0116				11.3857
DAY156	CON1-1	5.0116	<1.497	<0.150	<0.150	122.715
(FINAL)	CON1-2	5.0149	<1.496	<0.150	<0.150	140.581
	CON1-3	5.0302	<1.491	<0.149	<0.149	119.280
	mean	5.0189				127.5253
	std	0.0099				11.4364
DAY156	TEST2-1	5.0081	2.995	<0.150	<0.150	79.371
(FINAL)	TEST2-2	5.0237	5.972	<0.149	<0.149	100.026
	TEST2-3	5.0604	4.446	<0.148	<0.148	100.783
	mean	5.0307				93.3933
	std	0.0269				12.1492

BIOACCUMULATION ASSAY FOR METALS - 1994

DAY OF TRIAL	Sample ID	Cadmium mg/kg	Lead mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg
DAY 0	CON1-1	<0.169	<0.169	145.431	0.676	304.390
	CON1-2	<0.153	<0.153	140.722	0.306	260.029
	CON1-3	<0.178	1.249	153.473	0.714	339.068
	mean			146.5420		301.1622
	std			6.4477		39.6181
DAY 0	TEST2-1	<0.298	<0.298	217.642	<0.298	298.140
	TEST2-2	<0.300	0.900	185.993	<0.300	329.987
	TEST2-3	<0.300	<0.300	197.945	<0.300	287.919
	mean			200.5267		305.3486
	std			15.9817		21.9407
DAY 0	TEST3-1	<0.296	<0.296	198.194	<0.296	278.063
	TEST3-2	<0.298	<0.298	223.259	<0.298	327.446
	TEST3-3	<0.300	<0.300	188.758	<0.300	248.682
	mean			203.4037		284.7301
	std			17.8307		39.8032
DAY 98	CON1-1	<0.249	<0.249	298.874	<0.249	109.587
	CON1-2	<0.250	<0.250	214.692	<0.250	169.757
	CON1-3	<0.246	<0.246	270.058	<0.246	108.023
	mean			261.2080		129.1224
	std			42.7831		35.1990
DAY 98	TEST2-1	<0.149	<0.149	43.331	<0.149	164.359
	TEST2-2	<0.148	<0.148	94.787	<0.148	192.536
	TEST2-3	<0.150	<0.150	77.938	<0.150	179.856
	mean			72.0187		178.9169
	std			26.2337		14.1117
DAY 98	TEST3-1	<0.149	<0.149	37.319	<0.149	131.362
	TEST3-2	<0.150	<0.150	121.464	<0.150	113.966
	TEST3-3	<0.150	<0.150	52.401	<0.150	139.238
	mean			70.3947		128.1885
	std			44.8656		12.9315
DAY156	CON1-1	<0.150	<0.150	209.514	0.299	116.729
(FINAL)	CON1-2	<0.150	<0.150	104.688	0.449	119.643
	CON1-3	<0.149	<0.149	37.275	0.298	95.424
	mean			117.1590		110.5988
	std			86.7941		13.2226
DAY156	TEST2-1	<0.150	<0.150	125.796	<0.150	86.859
(FINAL)	TEST2-2	<0.149	<0.149	62.703	<0.149	110.476
	TEST2-3	<0.148	<0.148	82.997	<0.148	109.675
	mean			90.4987		102.3369
	std			32.2085		13.4100

BIOACCUMULATION ASSAY FOR METALS - 1994

DAY OF TRIAL	Sample ID	Manganese mg/kg	Copper mg/kg	Silver mg/kg	Lanthanum mg/kg	Nickel mg/kg
DAY 0	CON1-1	304.390	28.748	<0.169	<0.169	0.338
	CON1-2	260.029	21.414	<0.153	<0.153	0.765
	CON1-3	339.068	33.907	<0.178	<0.178	1.249
	mean	301.1622	28.0230			
	std	39.6181	6.2778			
DAY 0	TEST2-1	387.581	35.777	0.894	<0.298	1.193
	TEST2-2	359.986	35.999	0.600	<0.300	1.200
	TEST2-3	329.908	32.991	<0.300	<0.300	0.600
	mean	359.1582	34.9220			
	std	28.8458	1.6762			
DAY 0	TEST3-1	384.555	35.497	<0.296	<0.296	1.183
	TEST3-2	506.053	41.675	<0.298	<0.298	0.893
	TEST3-3	329.578	23.969	<0.300	<0.300	0.300
	mean	406.7285	33.7139			
	std	90.3027	8.9865			
DAY 98	CON1-1	273.968	34.869	<0.249	<0.249	0.747
	CON1-2	274.606	47.432	<0.250	<0.250	1.248
	CON1-3	294.609	36.826	<0.246	<0.246	0.491
	mean	281.0610	39.7089			
	std	11.7369	6.7596			
DAY 98	TEST2-1	493.077	31.378	0.299	<0.149	1.046
	TEST2-2	459.123	37.026	0.296	<0.148	0.889
	TEST2-3	494.604	35.971	0.300	<0.150	0.899
	mean	482.2682	34.7916			
	std	20.0587	3.0033			
DAY 98	TEST3-1	656.808	46.275	0.448	<0.149	1.493
	TEST3-2	599.820	38.988	0.450	<0.150	1.350
	TEST3-3	598.874	40.424	0.449	<0.150	0.898
	mean	618.5007	41.8958			
	std	33.1784	3.8599			
DAY156	CON1-1	164.618	37.413	<0.150	<0.150	0.299
(FINAL)	CON1-2	179.465	43.371	0.299	<0.150	0.299
	CON1-3	164.009	34.293	0.447	<0.149	0.596
	mean	169.3642	38.3589			
	std	8.7530	4.6122			
DAY156	TEST2-1	464.248	32.947	0.449	<0.150	0.150
(FINAL)	TEST2-2	447.877	38.816	<0.149	<0.149	0.149
	TEST2-3	459.450	37.052	0.741	<0.148	0.148
	mean	457.1916	36.2717			
	std	8.4158	3.0116			

BIOACCUMULATION ASSAY FOR METALS - 1994

DAY OF TRIAL	Sample ID	Yttrium mg/kg	Aluminium mg/kg	Magnesium mg/kg	Phosphorus mg/kg
DAY 0	CON1-1	<0.169	1437.397	3618.859	6679.669
	CON1-2	<0.153	917.749	3410.968	6500.724
	CON1-3	<0.178	1516.882	4336.498	8209.008
	mean		1290.6761	3788.7749	7129.8005
	std		325.4002	485.5976	938.8944
DAY 0	TEST2-1	<0.298	596.279	3249.722	6111.862
	TEST2-2	<0.300	899.964	2939.882	5549.778
	TEST2-3	<0.300	1199.664	3089.135	5848.362
	mean		898.6358	3092.9131	5836.6675
	std		301.6946	154.9542	281.2244
DAY 0	TEST3-1	<0.296	887.434	2721.464	6803.660
	TEST3-2	<0.298	1190.712	3066.085	7441.953
	TEST3-3	<0.300	898.849	2456.855	5992.330
	mean		992.3318	2748.1346	6745.9809
	std		171.8971	305.4891	726.5307
DAY 98	CON1-1	<0.249	1245.309	2739.681	5977.485
	CON1-2	<0.250	873.748	2421.529	5741.770
	CON1-3	<0.246	859.275	2823.333	6751.448
	mean		992.7774	2661.5142	6156.9011
	std		218.8187	212.0002	528.2095
DAY 98	TEST2-1	<0.149	896.504	2076.900	5379.022
	TEST2-2	<0.148	962.678	1910.545	5553.910
	TEST2-3	<0.150	1049.161	2068.345	4646.283
	mean		969.4473	2018.5968	5193.0716
	std		76.5533	93.6733	481.5390
DAY 98	TEST3-1	<0.149	895.647	2045.061	4776.785
	TEST3-2	<0.150	1274.618	1919.424	4948.515
	TEST3-3	<0.150	1122.889	2350.581	4940.711
	mean		1097.7179	2105.0220	4888.6706
	std		190.7350	221.7443	96.9744
DAY156	CON1-1	<0.150	1646.181	2379.480	5761.633
(FINAL)	CON1-2	<0.150	1345.989	2273.226	5683.064
	CON1-3	<0.149	1341.895	2042.662	5963.978
	mean		1444.6883	2231.7892	5802.8917
	std		174.5097	172.1895	144.9302
DAY156	TEST2-1	<0.150	823.666	2021.725	5840.538
(FINAL)	TEST2-2	<0.149	1119.693	1866.154	5673.109
	TEST2-3	<0.148	1482.096	1926.725	5483.756
	mean		1141.8182	1938.2015	5665.8013
	std		329.7725	78.4176	178.5033

Table 5: Silver perch two month bioaccumulation trial 1994 - metals assay data; where CON2, CON5 and CON6 = control tanks 2, 5 and 6 respectively and TEST1, TEST3 and TEST4 = 50% ANM wastewater tanks 1,3 and 4 respectively.

SILVER PERCH METALS ASSAYS 1994

Sample ID	Sample Wt. gm	Arsenic mg/kg	Molybdenum mg/kg	Chromium mg/kg	Zinc mg/kg	Cadmium mg/kg
INITIAL-1	0.5156	<14.546	<1.455	1.455	189.100	<1.455
INITIAL-2	0.5126	<14.631	<1.463	<1.463	204.838	<1.463
INITIAL-3	0.5575	<13.453	<1.345	<1.345	147.982	<1.345
mean	0.5286				180.6401	
std	0.0251				29.3569	
CON2-1	2.0036	<3.743	<0.374	<0.374	97.325	<0.374
CON2-2	2.0564	<3.647	<0.365	<0.365	80.237	0.729
CON2-3	2.076	<3.613	<0.361	<0.361	93.931	<0.361
mean	2.0453				90.4976	
std	0.0374				9.0463	
CON5-1	0.5123	<14.640	<1.464	<1.464	73.199	<1.464
CON5-2	0.5135	<14.606	<1.461	<1.461	61.344	<1.461
CON5-3	0.5156	<14.546	<1.455	<1.455	56.730	<1.455
mean	0.5138				63.7577	
std	0.0017				8.4959	
CON6-1	0.5145	<14.577	<1.458	<1.458	64.140	<1.458
CON6-2	0.5043	<14.872	<1.487	<1.487	86.258	<1.487
CON6-3	0.5186	<14.462	<1.446	<1.446	75.202	<1.446
mean	0.5125				75.2002	
std	0.0074				11.0591	
TEST1-1	3.1640	<2.370	<0.237	<0.237	75.853	<0.237
TEST1-2	3.1287	<2.397	<0.240	<0.240	79.106	<0.240
TEST1-3	3.1540	<2.378	<0.238	<0.238	80.850	<0.238
mean	3.1489				78.6031	
std	0.0182				2.5359	
TEST3-1	5.0514	<1.485	<0.148	<0.148	47.512	<0.148
TEST3-2	5.0287	<1.491	<0.149	<0.149	47.726	<0.149
TEST3-3	5.1820	<1.447	<0.145	<0.145	57.893	<0.145
mean	5.0874				51.0434	
std	0.0827				5.9326	
TEST4-1	3.0183	<2.485	<0.248	<0.248	67.091	<0.248
TEST4-2	3.0275	<2.477	<0.247	<0.247	69.364	<0.247
TEST4-3	3.0814	<2.434	<0.243	<0.243	73.019	<0.243
mean	3.0545				71.1915	
std	0.0381				2.5842	

SILVER PERCH METALS ASSAYS 1994

Sample ID	Lead mg/kg	Barium mg/kg	Cobalt mg/kg	Iron mg/kg	Manganese mg/kg	Copper mg/kg
INITIAL-1	<1.455	7.273	<1.455	145.462	23.274	4.364
INITIAL-2	<1.463	2.926	<1.463	137.534	21.947	2.926
INITIAL-3	<1.345	4.036	<1.345	125.112	14.798	1.345
mean		4.7450		136.0359	20.0063	2.8785
std		2.2586		10.2571	4.5589	1.5098
CON2-1	<0.374	9.358	5.615	86.095	8.610	1.123
CON2-2	<0.365	8.024	2.553	94.826	10.577	2.188
CON2-3	<0.361	8.671	4.335	126.445	15.173	2.890
mean		8.6843		102.4553	11.4532	2.0671
std		0.6671		21.2294	3.3686	0.8898
CON5-1	<1.464	4.392	<1.464	77.591	2.928	<1.464
CON5-2	<1.461	4.382	<1.461	77.410	2.921	<1.461
CON5-3	<1.455	10.182	<1.455	114.915	4.364	<1.455
mean		6.3187		89.9719	3.4043	
std		3.3457		21.6012	0.8310	
CON6-1	<1.458	16.035	<1.458	65.598	4.373	<1.458
CON6-2	<1.487	4.462	<1.487	107.079	4.462	<1.487
CON6-3	<1.446	5.785	<1.446	73.756	15.908	<1.446
mean		8.7607		82.1444	8.2477	
std		6.3344		21.9761	6.6344	
TEST1-1	<0.237	2.370	1.185	94.817	11.852	3.082
TEST1-2	<0.240	2.877	1.678	110.269	13.664	3.116
TEST1-3	<0.238	2.854	0.951	99.873	13.554	3.091
mean		2.7003		101.6531	13.0234	3.0964
std		0.2863		7.8786	1.0158	0.0179
TEST3-1	<0.148	1.039	<0.148	68.298	3.712	1.039
TEST3-2	<0.149	1.939	0.895	79.046	7.755	1.790
TEST3-3	<0.145	1.303	0.724	73.813	5.789	1.592
mean		1.4270		73.7191	5.7522	1.4737
std		0.4626		5.3748	2.0221	0.3890
TEST4-1	<0.248	1.491	0.248	89.454	7.951	1.988
TEST4-2	<0.247	1.486	1.239	66.887	9.166	1.982
TEST4-3	<0.243	1.460	1.947	70.585	4.868	1.947
mean		1.4730		68.7358	7.0169	1.9645
std		0.0184		2.6148	3.0392	0.0245

SILVER PERCH METALS ASSAYS 1994

Sample ID	Silver mg/kg	Lanthanum mg/kg	Nickel mg/kg	Yttrium mg/kg	Aluminium mg/kg	Magnesium mg/kg
INITIAL-1	<1.455	<1.455	5.818	<1.455	3054.694	1891.001
INITIAL-2	<1.463	<1.463	<1.463	<1.463	1360.710	1902.068
INITIAL-3	<1.345	<1.345	<1.345	<1.345	1479.821	1614.350
mean					1965.0748	1802.4728
std					945.5150	163.0133
CON2-1	<0.374	<0.374	<0.374	<0.374	2021.362	1721.901
CON2-2	<0.365	<0.365	<0.365	<0.365	1531.803	1604.746
CON2-3	<0.361	<0.361	<0.361	<0.361	1661.850	1553.468
mean					1738.3381	1626.7050
std					253.5837	86.3366
CON5-1	<1.464	<1.464	<1.464	<1.464	1903.182	1463.986
CON5-2	<1.461	<1.461	<1.461	<1.461	1898.734	1197.663
CON5-3	<1.455	<1.455	<1.455	<1.455	2472.847	1454.616
mean					2091.5877	1372.0883
std					330.1879	151.1293
CON6-1	<1.458	<1.458	<1.458	<1.458	2040.816	1341.108
CON6-2	<1.487	<1.487	<1.487	<1.487	1397.977	1487.210
CON6-3	<1.446	<1.446	<1.446	<1.446	2603.162	1026.803
mean					2013.9854	1285.0403
std					603.0403	235.2687
TEST1-1	<0.237	<0.237	<0.237	<0.237	1493.363	1682.996
TEST1-2	<0.240	<0.240	<0.240	<0.240	1845.815	1654.042
TEST1-3	<0.238	<0.238	<0.238	<0.238	1807.229	1688.332
mean					1715.4688	1675.1234
std					193.3145	18.4512
TEST3-1	<0.148	<0.148	<0.148	<0.148	1083.858	1143.247
TEST3-2	<0.149	<0.149	<0.149	<0.149	1073.836	1267.723
TEST3-3	<0.145	<0.145	<0.145	<0.145	1099.961	1215.747
mean					1085.8852	1208.9058
std					13.1801	62.5193
TEST4-1	<0.248	<0.248	<0.248	<0.248	944.240	1441.209
TEST4-2	<0.247	<0.247	<0.247	<0.247	966.144	1560.694
TEST4-3	<0.243	<0.243	<0.243	<0.243	827.546	1825.469
mean					896.8448	1693.081
std					98.0034	187.2244

SILVER PERCH METALS ASSAYS 1994

Sample ID	Phosphorus mg/kg
INITIAL-1	20219.162
INITIAL-2	19898.556
INITIAL-3	16816.143
mean	18977.9540
std	1879.0331
CON2-1	19689.559
CON2-2	17360.436
CON2-3	17088.150
mean	18046.0483
std	1429.8182
CON5-1	15811.048
CON5-2	12268.744
CON5-3	13964.313
mean	14014.7018
std	1771.6896
CON6-1	13556.851
CON6-2	15169.542
CON6-3	12437.331
mean	13721.2415
std	1373.5035
TEST1-1	11615.044
TEST1-2	11026.944
TEST1-3	12603.044
mean	11748.3440
std	796.4604
TEST3-1	7572.158
TEST3-2	10365.502
TEST3-3	8611.540
mean	8849.7334
std	1411.8231
TEST4-1	10312.096
TEST4-2	10900.083
TEST4-3	11439.605
mean	11169.8440
std	381.5002

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1.0 INTRODUCTION

The Murray-Darling Freshwater Research Centre was contracted to undertake environmental chemical and biological monitoring of ANM's effluent and its impact on the River Murray at Albury in accordance with specifications in the SPCC Licence No. 01272 sections W10 and W11 and NSW Department of Planning's 'Instrument of Consent' dated 26 June 1991, Condition 4 'Bioassay Testing and Environmental Monitoring Programmes'.

2.0 METHODS

2.1 ECOTOXICOLOGICAL AND BIO-ACCUMULATION MONITORING [W10]

2.1.1 Bioassay

Bioassay test methods are based on the standard methods defined by Clesceri *et. al.* (1989), OECD (1981), USEPA (1989) and USEPA (1991).

Chironomus tepperi and *Daphnia carinata* acute (96 hour) toxicity tests, were run concurrently each month during 1993, using effluent at concentrations ranging from 0.1% to 100%. *Daphnia carinata* chronic (21 day) toxicity tests, have been conducted every two months this year, in effluent concentrations of 1% to 100%.

2.1.2 Bioaccumulation

Bioaccumulation trials were conducted using three 8 m^3 concrete tanks on site at ANM. Tank 1 (the control) fed only by river water and Tanks 2 and 3 (test tanks) fed by a mixture of 50% river water and 50% Pond Outlet effluent water. 100 Yabbies (*Cherax destructor*) and 100 Silver Perch (*Bidyanus bidyanus*) were added to each tank, approximately twenty of these were weighed and measured each month, and a smaller subsample removed every three months for whole body chemical assay.

Chemical analysis was conducted by Amdel Laboratories, Thebarton SA. Elements assayed for were: aluminium, chromium, barium, iron, zinc, copper, cobalt, nickel, manganese, phosphorus, magnesium, arsenic, cadmium, lanthanum, molybdenum, silver, lead and yttrium.

2.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

2.2.1 Water

Sample Collection and Handling

Grab samples were taken at three locations on the river on a monthly basis. Site 1 samples were taken at a point approximately 1 km upstream of the ANM outfall (locally known as Grey's farm). Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

Five samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were "ANALAR" grade or better and, clean polyethylene gloves were worn at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of Water Samples

All metal analyses (except for mercury analyses) were performed by:-

EML (Chem) Pty Ltd
425 - 427 Canterbury Road
Surrey Hills Vic 3127.

The parameters determined were extractable:-
aluminium, cadmium, cobalt, chromium, copper, iron, manganese, lead and zinc.

Analyses for total mercury were performed by:-
Australian Newsprint Mills Ltd
Boyer Tas 7140.

Physical and nutrient analyses were performed at The Murray-Darling Freshwater Centre (MDFRC). Turbidity, colour, Specific Conductance, Total Dissolved Solids, ammonia, nitrate, nitrite, Organic Nitrogen and Total Phosphorus were determined according to the methods outlined in the MDFRC Chemistry Laboratory's Methods Manual.

2.2.2 Sediments

Sample Collection and Handling

A series of 40 sediment samples were taken on 1 June 1993. Sediment samples were collected from two deposition zones approximately equidistant (*ca* 500 m upstream and *ca* 500 m downstream) of ANM mills outfall. Samples were collected at 10 m intervals along the 60 cm depth contour (approximately 2 m from, and parallel to, the river bank). A total of 20 samples were taken above and 20 samples taken below the outfall.

Approximately the top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5% HCl) and repeatedly rinsed with MILLI-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimize the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analyses were performed only on the sieved fraction (Grimshaw 1989).

Particle Size Analysis

Approximate particle fractionation was carried out on all samples. Fractionation was by the method described by Grimshaw (1989). Essentially, that portion of the sample which was retained by a 2 mm sieve was considered gravel. The portion of the sample that passed through a 2 mm sieve was considered a mixture of silt, clay and sand.

The percentage of silt + clay in this fraction was determined by the 4 minute 48 second hydrometer method described by Grimshaw (1989). The sand content was estimated by the difference. No distinction between silt and clay content, or fine sand and coarse sand content was attempted.

Analysis of Acid Extractable Metals

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1982). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5% HCl and extensively rinsed with MILLI-Q water). 25 mL of 0.1 M "ARISTAR" grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a Ratek orbital shaking table for one hour. The samples were allowed to settle overnight and subsequently filtered through acid washed Whatman GF/C filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5% HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to:-

Amdel Laboratories
Brown St
Thebarton SA 5031.

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, molybdenum, nickel, phosphorus, silver, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury

Approximately 10 g of air dried sample was placed in clean polyethylene bags and dispatched to :-

Australian Newsprint Mills Ltd
Boyer Tas 7140.

for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9% NaOH, 4.0% $K_2S_2O_4$) was added to each tube. The tubes were sealed and subsequently heated in an autoclave to approximately 120°C for one hour. The solution was then analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et. al.* 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et. al.* 1989).

2.2.3 Biota

Macroinvertebrates

Macroinvertebrate samples were collected from six paired sites on the River Murray (Figure 1) according to the method set out in (Bennison *et. al.* 1989). Monthly sampling continued in 1993. Samples were sorted into taxonomic groups, counted and compared statistically by site.

Fish

Fish sampling has been conducted monthly at the above sites, using two bait nets at each site, set for 12 hours and using a chemical light as an attractant.

3.0 RESULTS AND DISCUSSION

3.1 ECOTOXICOLOGICAL AND BIO-ACCUMULATION MONITORING [W10]

3.1.1 Bioassay

A summary of this years bioassay results in which animals in the test solutions reacted differently to those in the control solutions is provided in Table 1. Significant adverse reactions occurred almost exclusively in 100% effluent solutions, however, there was weak correlation between the different test organisms.

No daphnia tests were run from April to June due to dietry problems, resulting from a change of food source.

Fish Ventilation Monitoring

The fish ventilation monitor, which measures stress on fish by detecting changes in electrical potential between two passive electrodes caused by opercular movement, is operational on eight channels. The flow through ventilation chambers are fed continuously with Pond Outlet effluent. Investigations into normal tolerances and equipment sensitivity continue.

Fish Egg Survival and Development

Tests on native fish eggs to determine survival and development in ANM effluent waters, continued in January and February using Silver Perch (*Bidyanus bidyanus*), from the New South Wales Fisheries Research Station at Narrandera. The data were highly variable rendering the apparent increase in mean mortality rates at higher concentrations of Pond Outlet effluent statistically not significant.

Bioaccumulation

The 1992 Yabby (*Cherax destructor*) bioaccumulation trial continued through to March 1993. Growth data are presented in Table 2 and chemical data in Tables 3a-b for the nine month trial. There was no difference between treatments.

The 1993 Yabby trial commenced in April 1993. Growth data and chemical data are presented in Tables 4, 5a-b respectively.

The 1993 Silver Perch (*Bidyanus bidyanus*) trial commenced in February 1993, and was terminated in June due to high unexplained losses. The growth and chemical results for the three months of the trial are presented in Tables 6 and 7.

The were no differences in growth between treatments for any of the trials. The chemical analyses yielded 100% recovery and all were within the expected ranges. No differences were apparent as a result of exposure to the ANM effluent.

3.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

3.2.1 <u>Water</u>

A summary of the water quality data is presented in Figure 2. The figure shows the variation of metals (manganese, iron, aluminium, and zinc), nutrients (total phosphorus, ammonia, organic nitrogen and oxides of nitrogen) and physical parameters (turbidity, conductivity, colour and total filterable solids) between the three sites over time. The data for 1992 have also been included for purpose of comparison.

The figure does not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.005 mg/L) and lead (0.04 mg/L) were not detected in any of the samples (detection limits in brackets). Copper (detection limit of 0.004 mg/L) was only detected on one occasion (Site 1 on 19/4/93) and the mercury level exceeded 0.0002 mg/L only on two occasions (0.0003 mg/L at Site 2 on the 25/1/93 and 19/4/93). Likewise, the concentration of chromium only exceeded 0.02 mg/L on three occasions (0.04 mg/L at Site 1 and 0.02 mg/L at Site 2 on the 30/11/92 and 0.05 mg/L at Site 1 on the 21/6/93).

Generally, most of the data show little (if any) variation between sites although, there may be significant variation over time (seasonal effects). From the figure it is evident that iron, manganese, zinc (with the exception of Site 2 on the 6/10/92), total phosphorus (with the exception of Site 1 on 28/4/92), turbidity, conductivity, colour, total filterable solids, organic nitrogen and oxides of nitrogen (NO_X) vary little between sites. The levels of ammonia, seem to be more variable between sites - tending to higher at Site 1 and/or 3 rather than Site 2.

3.2.2 Sediments

The results for the sediment analyses for total persulphate nitrogen, exchangeable phosphorus and acid extractable aluminium, barium, cadmium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, nickel, phosphorus, yttrium and zinc are summarized in Figure 3.

For each analyte a box plot showing the distribution above and below the outfall is presented. The solid horizontal lines of the box plot represent the 10th, 25th, 50th, 75th and 90th percentiles of the data - the box itself represents the 25th to 75th percentile. All data outside the 10th and 90th percentiles are shown as open circles on the plots. The mean of the data is represented by a dotted line.

Silver was not detected (detection limit 0.05 mg/kg) in any of the sediment samples. Arsenic was only detected (detection limit 0.15 mg/kg) in 4 of the downstream samples (concentrations ranging from 0.15 to 0.2 mg/kg), molybdenum (detection limit 0.05 mg/kg) was only detected in two of the downstream samples (with concentrations of 0.15 and 0.05 mg/kg respectively), mercury (detection limit 2 μg/kg) was detected in 8 of the upstream samples (concentrations ranging from 2 to 4 μg/kg) and 7 of the downstream samples (concentrations ranging from 2 to 6 μg/kg).

Sediment Characteristics

The crude sediment characteristics (% gravel, % sand, and % silt and clay) of the upstream and downstream sample sites are summarized in Figure 3. As in last years survey, the sediments predominantly consisted of sand and gravel with little silt or clay. The level of silt and clay was lower than the level found in the 1992 survey. The apparent loss of fine sediments could be due to the flood events which followed last years sampling.

Chemical Characteristics of the Sediment

A summary of the chemical characteristics of the sediment samples taken upstream and downstream of the ANM outfall are also presented in Figure 3. An extensive series of elements were determined. These included total nitrogen, exchangeable and extractable phosphorus, total mercury and, extractable aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lanthunum, lead, molybdenum, magnesium, manganese, nickel, silver, yttrium and zinc.

From the figure it can be seen that the downstream sediments tend to have a greater distribution in the concentration of analytes than the upstream sites and, while generally there is an overlap in the plots, the mean concentration for the downstream sites tends to be higher than the upstream sites. This variation can almost entirely be attributed to the influence of sediments taken on the lee side of a "snag" present in the downstream transect. Figure 4 shows the concentration of nitrogen (a surrogate indicator of organic matter content) and lead along the upstream (open circles) and downstream (closed circles) transects. The influence of the "snag" is clearly shown by the large increase in concentrations of both analytes at 130 m in the downstream transect. The effect of the "snag" is evident for some distance further downstream. The confounding influence of the snag hampers any discussion on the difference in concentration of analytes above and below the outfall.

3.2.3 Biota

Macroinvertebrates

The data for the 1992 macroinvertebrate sampling program were re-analysed this year at greater taxonomic resolution. The results are summarised in the average linkage dendogram using Euclidean Distance metric (Figure 5) which highlights similarities and differences in taxonomic data between samples. The dendogram shows no biological differences between sites with limited grouping according to sampling dates. The samples for 1993 are currently being classified.

Fish

Fish collections from the River Murray in 1993 yielded no substantial data as catches were low and sporadic (Tables 8a-b).

After discussion at the ANM Monitoring Program Annual Review (held on 1 November 1993), the sampling regime has been altered for 1994 and will comprise intensive sampling (10 nets) at the six sites bi-annually, under low flow and at high flow conditions.

4.0 REFERENCES

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USEPA 1991. "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (4th Edition) EPA-600/4-90/027.

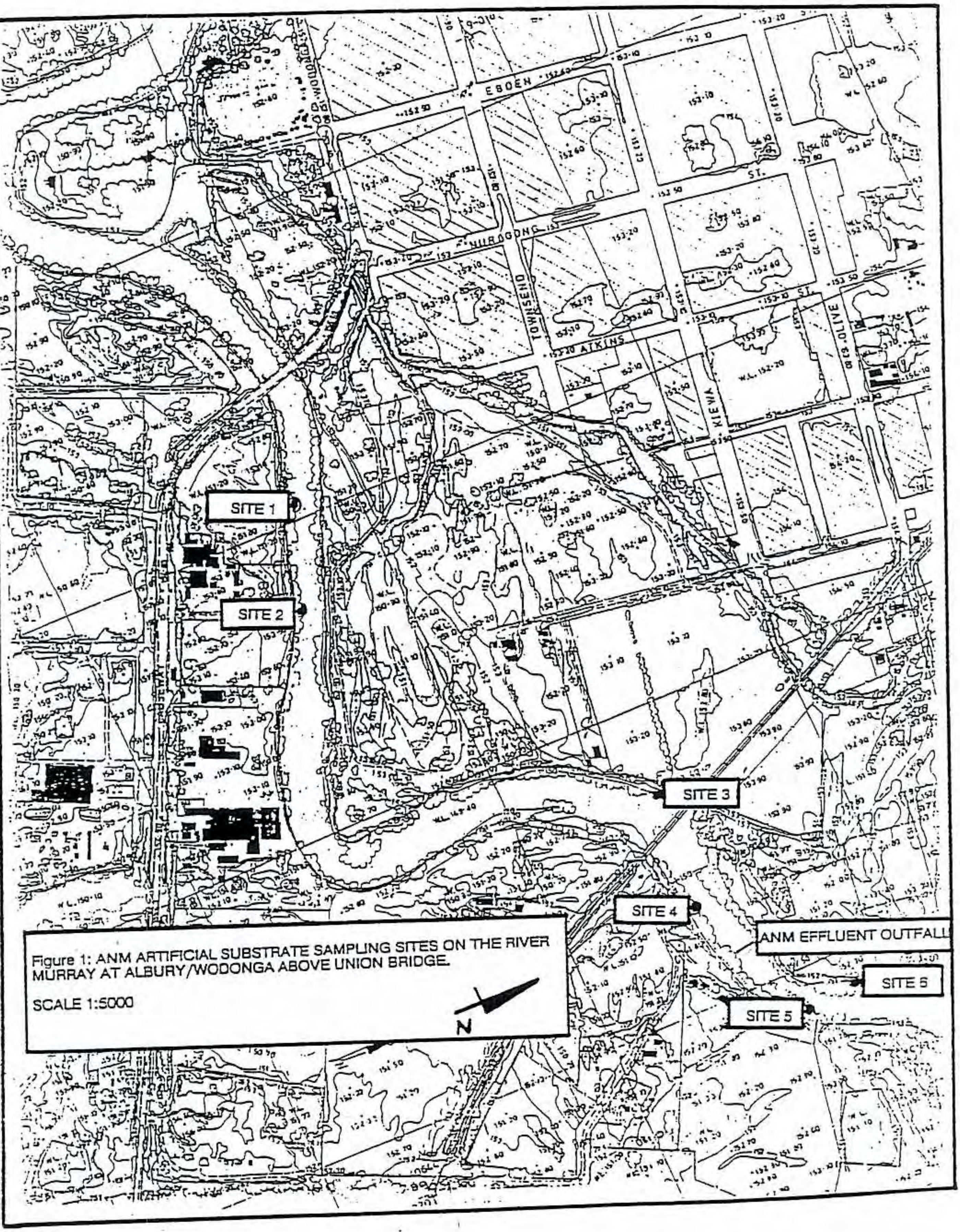


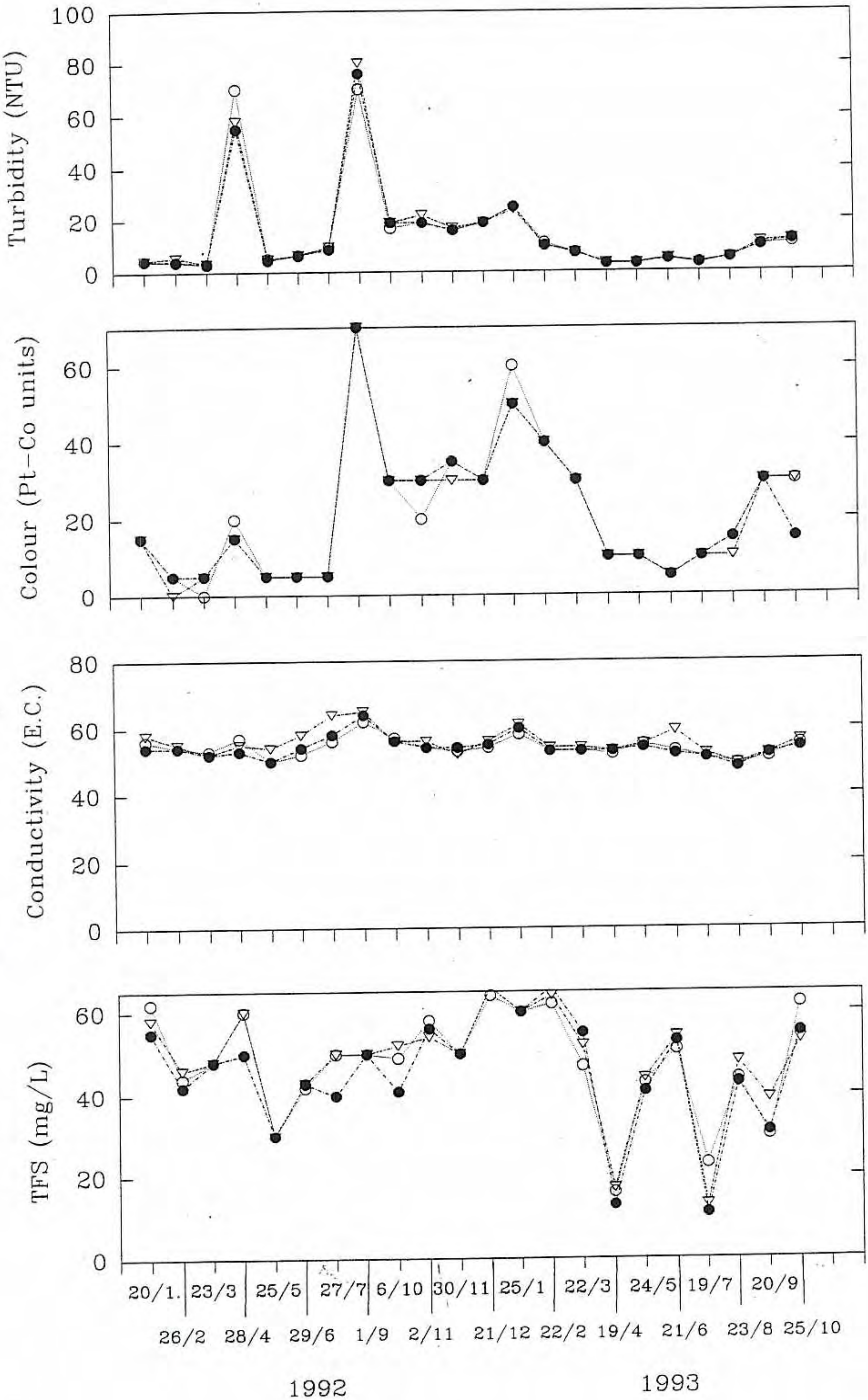
Figure 1: ANM ARTIFICIAL SUBSTRATE SAMPLING SITES ON THE RIVER MURRAY AT ALBURY/WODONGA ABOVE UNION BRIDGE.

SCALE 1:5000

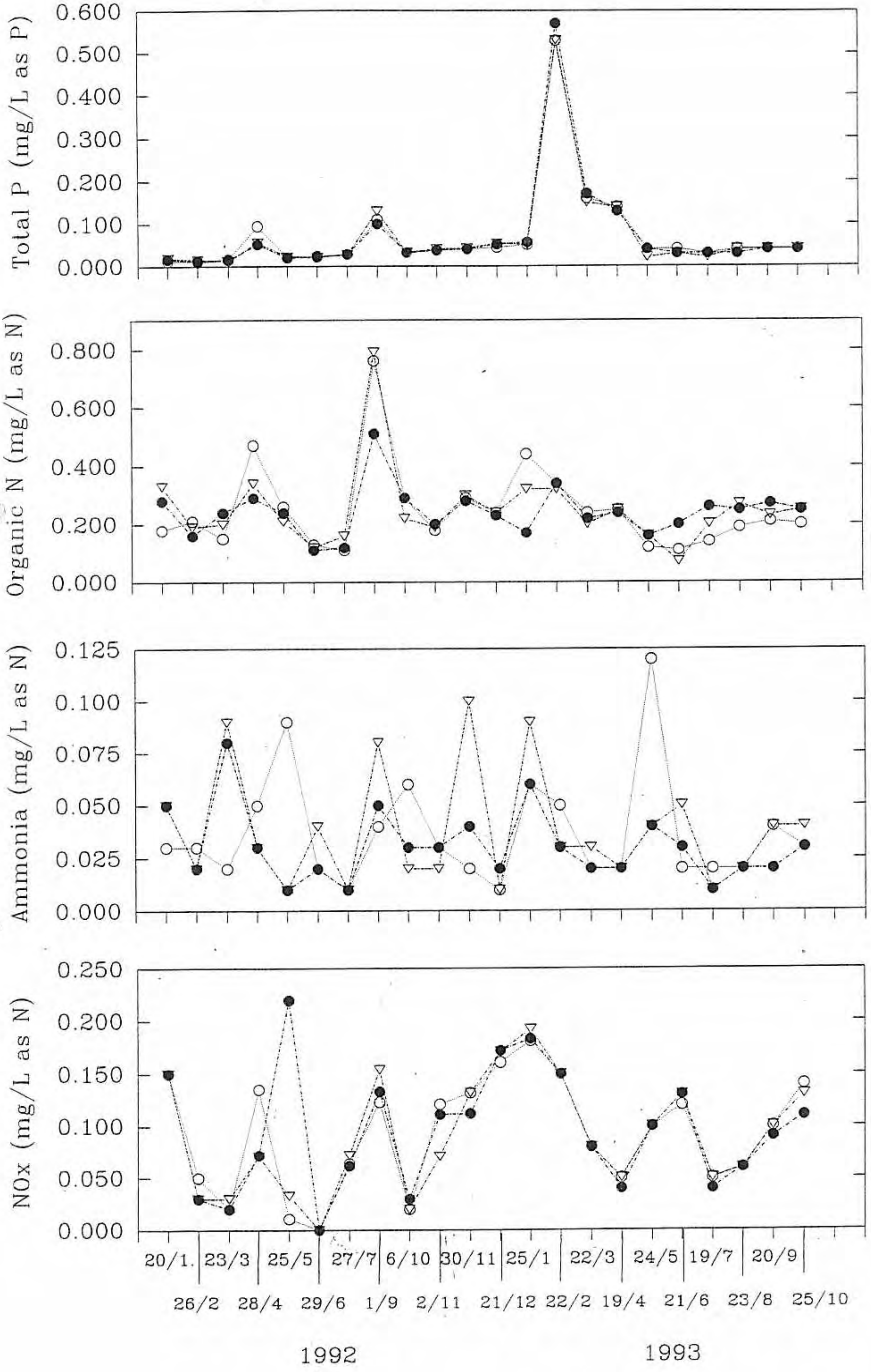
Figure 2.

Concentration of Physical Parameters (Turbidity, Colour, Conductivity and Total Filterable Solids), Nutrients (Total Phosphorus, Organic Nitrogen, Ammonia and Oxides of Nitrogen) and Metals (Manganese, Zinc, Iron and Aluminium) at 3 sites on the River Murray.

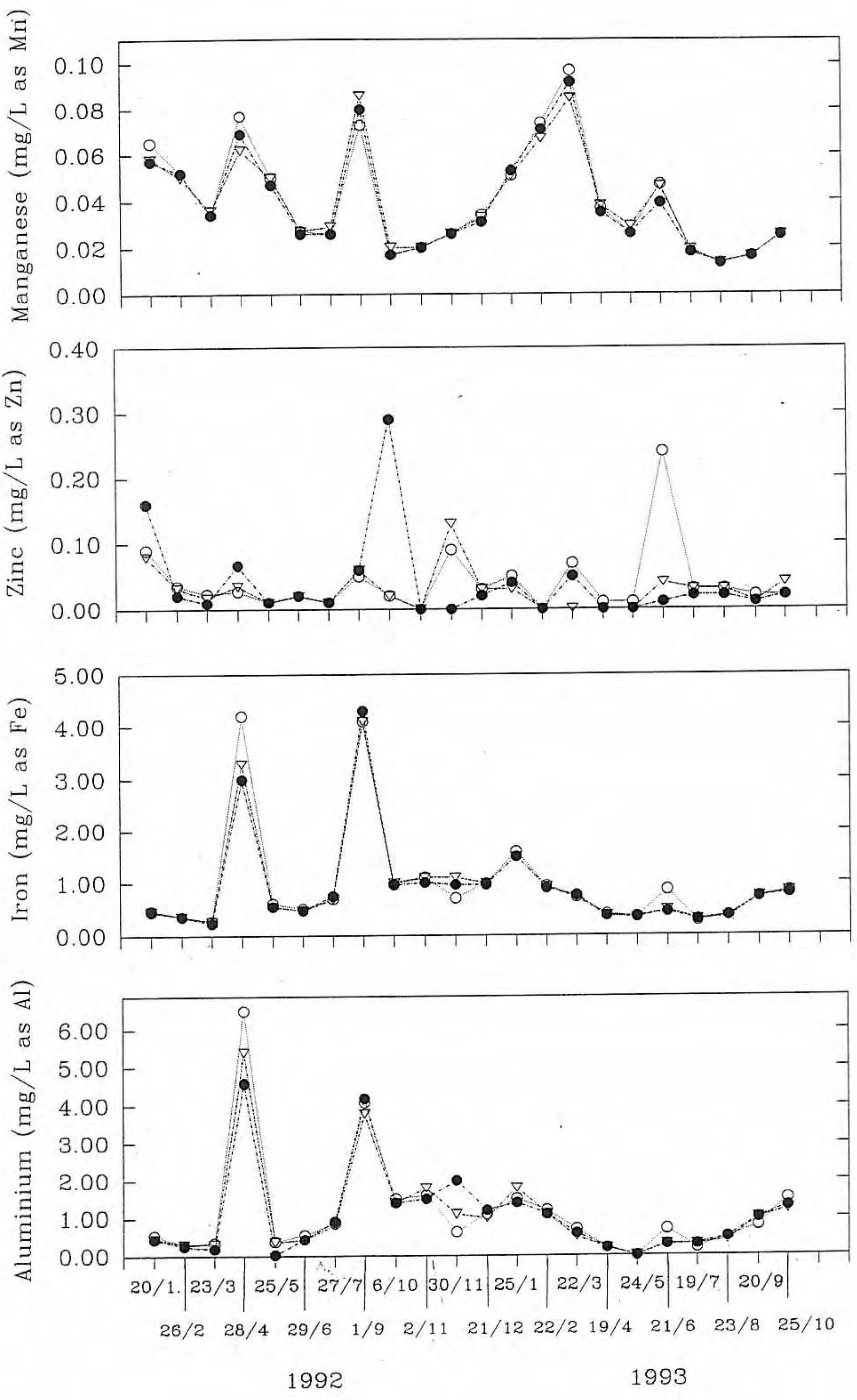
Site 1 samples (open circles) were taken about 1 km upstream of the ANM outfall. Site 2 samples (closed circles) were taken about 200 m downstream of the ANM outfall. Site 3 samples (open triangles) were taken about 1 km downstream of the ANM outfall.



100
80
60
40
20
0
Turbidity (NTU)
60
40
20
0
Colour (Pt-Co units)
80
60
40
20
0
Conductivity (E.C.)
60
40
20
0
TFS (mg/L)
20/1. 23/3 25/5 27/7 6/10 30/11 25/1 22/3 24/5 19/7 20/9
26/2 28/4 29/6 1/9 2/11 21/12 22/2 19/4 21/6 23/8 25/10
1992
1993



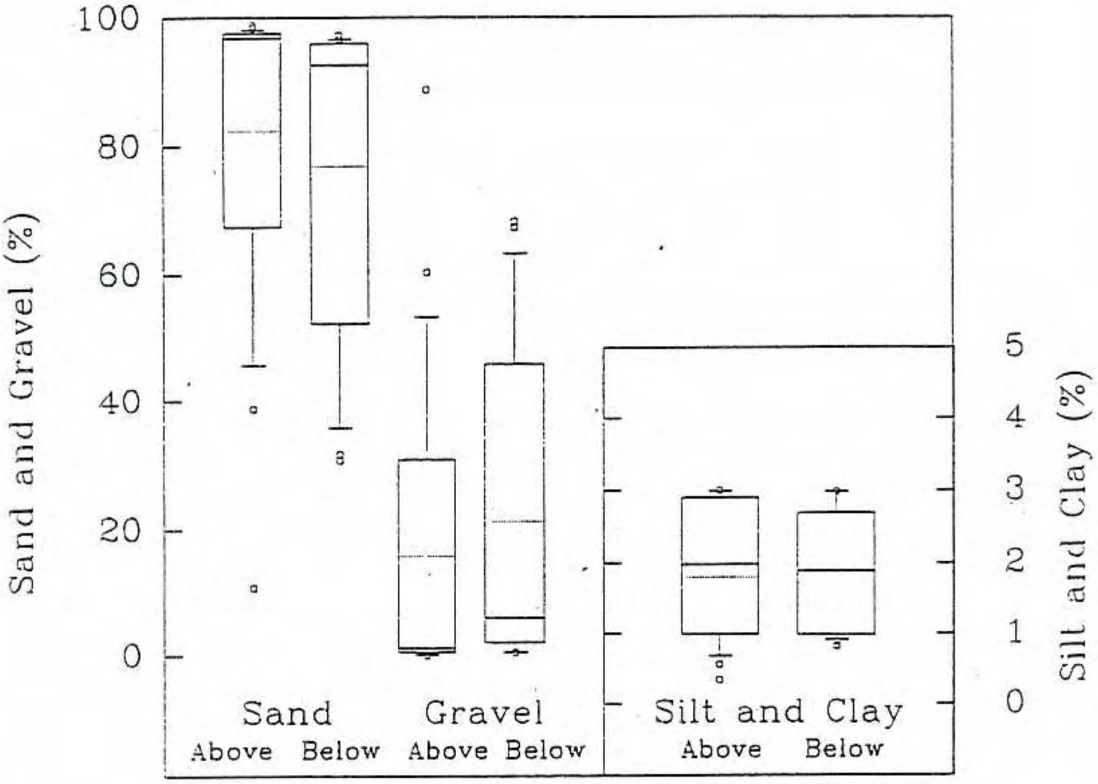
Total P (mg/L as P)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Organic N (mg/L as N)
0.800
0.600
0.400
0.200
0.000
Ammonia (mg/L as N)
0.125
0.100
0.075
0.050
0.025
0.000
NOx (mg/L as N)
0.250
0.200
0.150
0.100
0.050
0.000
20/1.
23/3
25/5
27/7
6/10
30/11
25/1
22/3
24/5
19/7
20/9
26/2
28/4
29/6
1/9
2/11
21/12
22/2
19/4
21/6
23/8
25/10
1992
1993



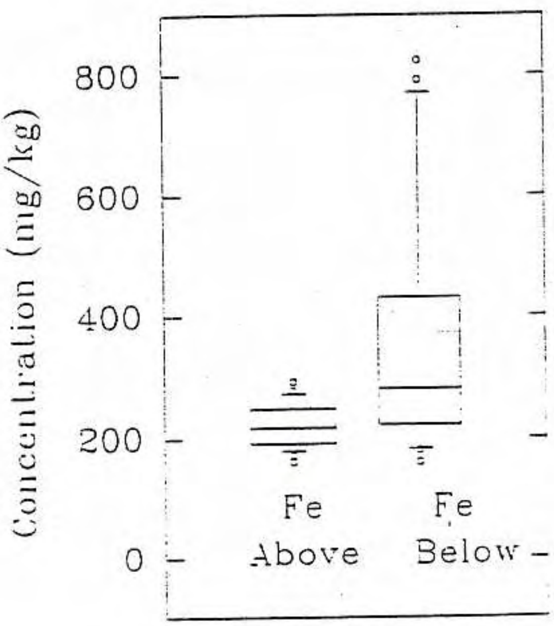
Manganese (mg/L as Mn)
0.10
0.08
0.06
0.04
0.02
0.00
Zinc (mg/L as Zn)
0.40
0.30
0.20
0.10
0.00
Iron (mg/L as Fe)
5.00
4.00
3.00
2.00
1.00
0.00
Aluminium (mg/L as Al)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
20/1. 23/3 25/5 27/7 6/10 30/11 25/1 22/3 24/5 19/7 20/9
26/2 28/4 29/6 1/9 2/11 21/12 22/2 19/4 21/6 23/8 25/10
1992
1993

Figure 3.

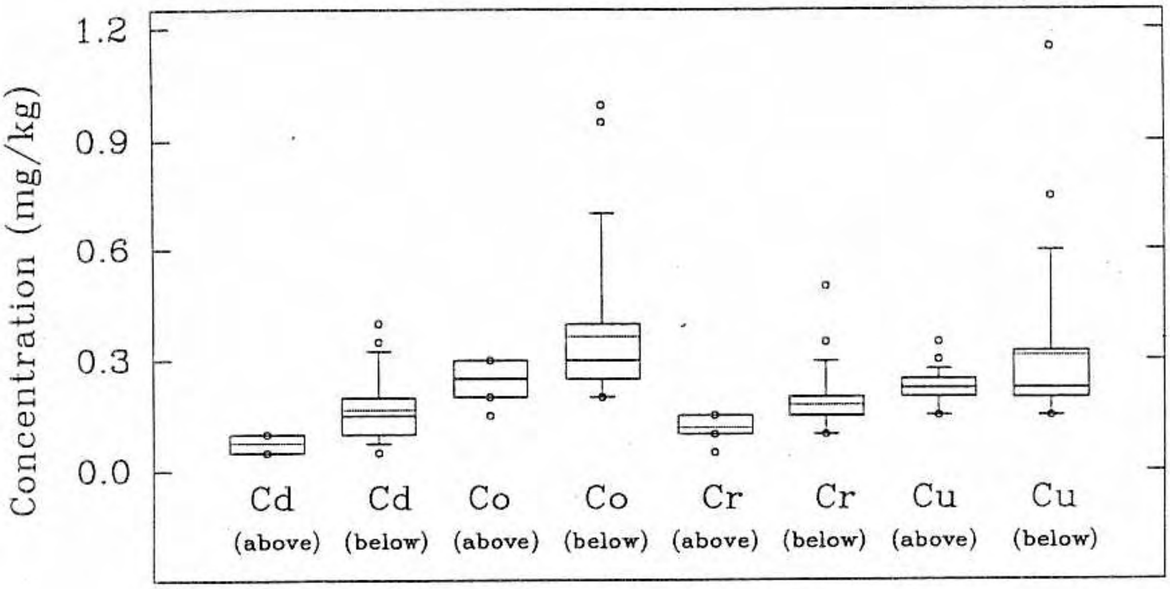
Box plots (see text for explanation) representing the variation of Sand, Gravel, Silt and Clay, total Nitrogen, exchangeable Phosphorus (PEXT) and, extractable Iron, Cadmium, Cobalt, Chromium, Copper, Nickel, Lead, Yttrium, Barium, Lanthanum, Phosphorus, Zinc, Aluminium, Manganese, and Magnesium from sediment samples taken above and below the ANM outfall.

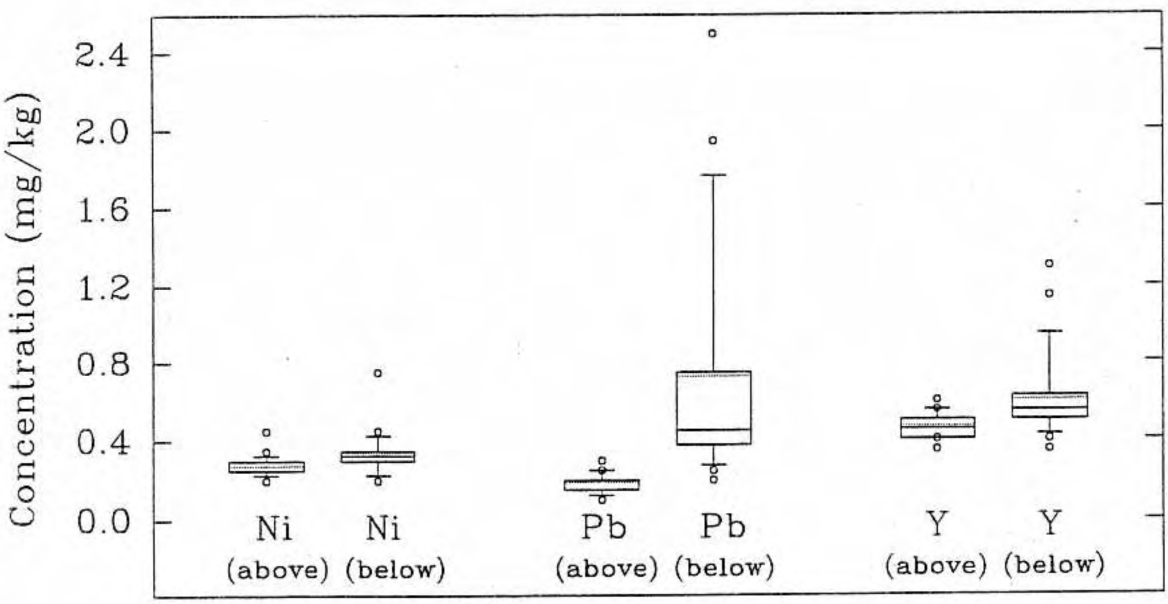


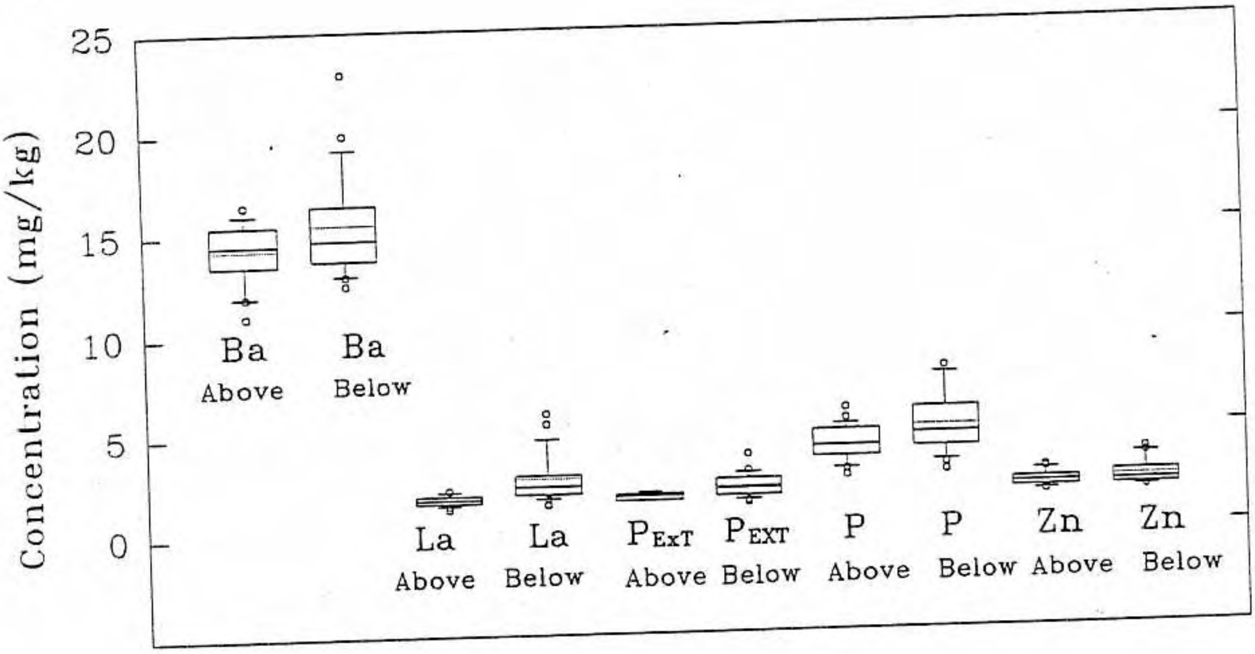
Sand and Gravel (%)
100
80
60
40
20
0
Sand
Above Below
Gravel
Above Below
Silt and Clay
Above Below
5
4
3
2
1
0
Silt and Clay (%)



Concentration (mg/kg)
800
600
400
200
0
Fe
Above
Fe
Below


Concentration (mg/kg)
1.2
0.9
0.6
0.3
0.0
Cd (above)
Cd (below)
Co (above)
Co (below)
Cr (above)
Cr (below)
Cu (above)
Cu (below)


Concentration (mg/kg)
2.4
2.0
1.6
1.2
0.8
0.4
0.0
Ni (above)
Ni (below)
Pb (above)
Pb (below)
Y (above)
Y (below)


Concentration (mg/kg)
25
20
15
10
5
0
Ba Above
Ba Below
La Above
La Below
PEXT Above
PEXT Below
P Above
P Below
Zn Above
Zn Below

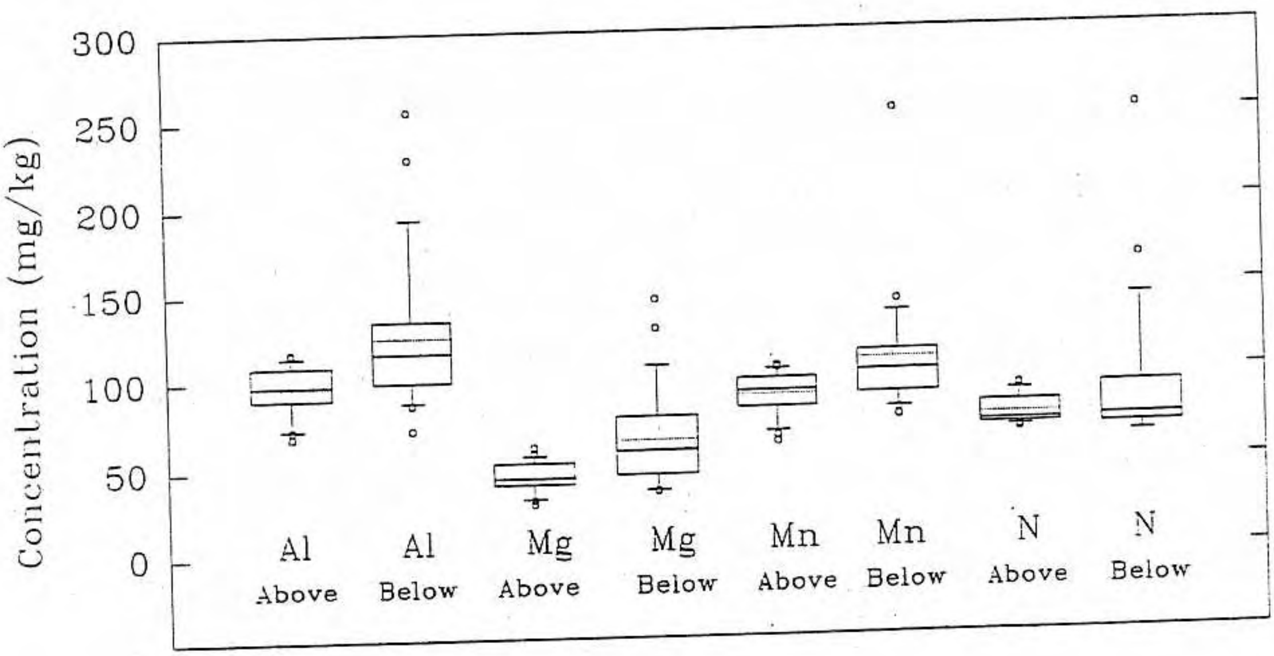
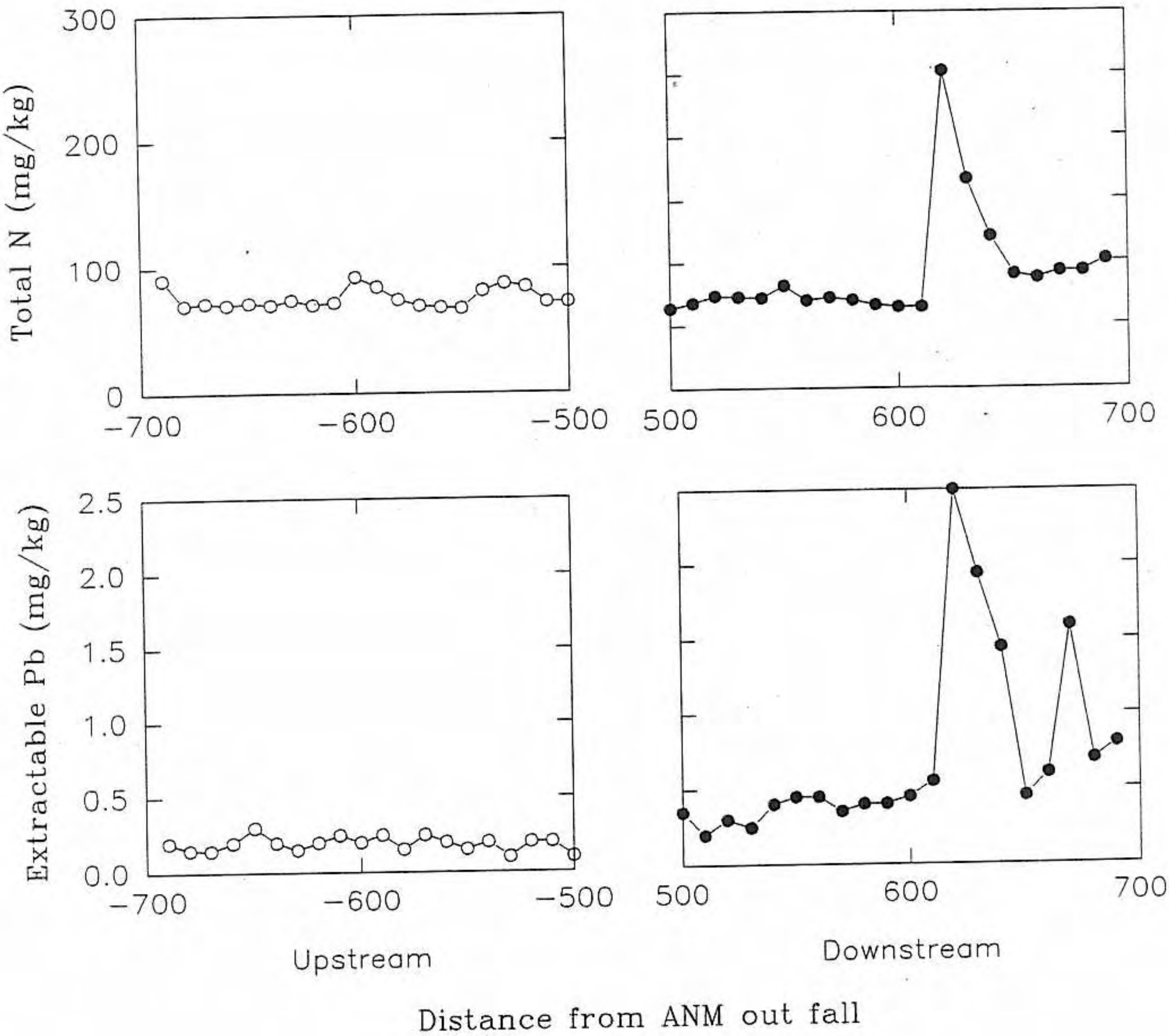

Concentration (mg/kg)
300
250
200
150
100
50
0
Al Above
Al Below
Mg Above
Mg Below
Mn Above
Mn Below
N Above
N Below

Figure 4.

Concentration of Total Nitrogen and Extractable Lead along the transects above (open circles) and below (closed circles) the ANM outfall.


Total N (mg/kg)
300
200
100
0
Extractable Pb (mg/kg)
2.5
2.0
1.5
1.0
0.5
0.0
−700
−600
−500
500
600
700
Upstream
Downstream
Distance from ANM out fall

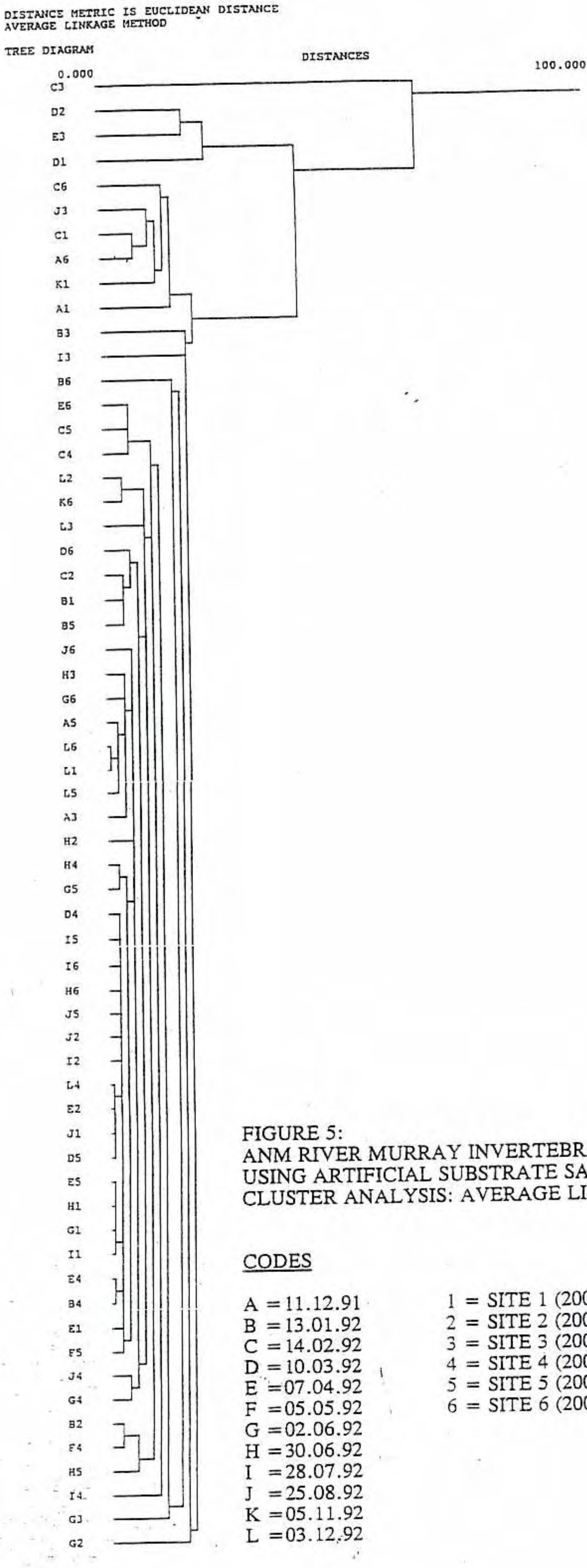


FIGURE 5:
ANM RIVER MURRAY INVERTEBRATE MONITORING
USING ARTIFICIAL SUBSTRATE SAMPLERS.
CLUSTER ANALYSIS: AVERAGE LINKAGE DENDOGRAM.

CODES

A = 11.12.91
B = 13.01.92
C = 14.02.92
D = 10.03.92
E = 07.04.92
F = 05.05.92
G = 02.06.92
H = 30.06.92
I = 28.07.92
J = 25.08.92
K = 05.11.92
L = 03.12.92

1 = SITE 1 (2000m downstream)
2 = SITE 2 (2000m downstream)
3 = SITE 3 (200m downstream)
4 = SITE 4 (200m downstream)
5 = SITE 5 (200m upstream/control)
6 = SITE 6 (200m upstream/control)

TABLE 1

ANM BIOLOGICAL MONITORING

ECOTOXICOLOGY AND BIO-ACCUMULATION MONITORING [W10]

SUMMARY OF 1993 BIOASSAYS IN WHICH ANIMALS IN THE TEST SOLUTIONS REACTED DIFFERENTLY TO THOSE IN THE CONTROL SOLUTIONS

TEST	WATER	MONTH
Daph 96hr	Pond In 100% Pond 100% Pond Out 100% Below Outfall	January
Daph 21day	Pond In 100% Pond 100% Pond Out 100%	January, March
Chir 96hr	Pond 10-100%	July
Chir 96hr	Pond In 100%	September
Daph 96hr	Pond In 100% Pond 100% Pond Out 100%	September
Daph 21day	Pond 0.1-1% Pond Outlet 0.1%	July*
Daph 21day	Pond In 100% Pond 100% Pond Out 100%	August

NOTE: * Stimulation effect, mean number of young produced significantly greater than in the control.

No daphnia tests were run from April to June due to dietry problems

TABLE 2:

ANM BIOACCUMULATION TRIALS 1992 Yabby (Cherax destructor)

DATE		MONTHLY LENGTH MEASUREMENTS (mm)				MONTHLY WEIGHT MEASUREMENTS (g)		
		Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3		Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3
04 JUN 92	Mean	98.00	Initial measurements		Mean	40.41	Initial measurements	
(DAY 0)	St.D	4.31			St.D	7.48		
	n	10.00			n	10.00		
09 JUL 92	Mean	97.50	97.60	98.23	Mean	45.33	45.11	41.97
	St.D	5.90	5.49	5.79	St.D	5.13	6.81	8.06
	n	28.00	30.00	30.00	n	28.00	30.00	30.00
06 AUG 92	Mean	93.57	93.27	93.43	Mean	41.79	42.49	40.56
	St.D	4.74	4.38	5.73	St.D	7.08	6.70	7.71
	n	29.00	29.00	29.00	n	29.00	29.00	29.00
03 SEP 92	Mean	93.67	95.59	94.52	Mean	41.05	39.22	39.38
	St.D	4.15	3.95	2.54	St.D	4.21	5.86	5.14
	n	29.00	28.00	28.00	n	29.00	28.00	28.00
01 OCT 92	Mean	97.31	98.03	97.97	Mean	42.80	44.36	40.96
	St.D	3.90	2.27	5.49	St.D	5.79	5.81	8.96
	n	30.00	30.00	30.00	n	30.00	30.00	30.00
03 NOV 92	Mean	98.44	98.84	98.04	Mean	42.44	43.73	42.52
	St.D	4.50	4.56	4.56	St.D	6.58	6.36	6.09
	n	25.00	25.00	25.00	n	25.00	25.00	25.00
25 NOV 92	Mean	97.05	97.77	99.05	Mean	41.74	46.56	45.72
	St.D	3.62	4.49	3.67	St.D	5.35	7.50	6.83
	n	22.00	22.00	22.00	n	22.00	22.00	22.00
24 DEC 92	Mean	96.65	97.26	98.45	Mean	40.05	42.53	43.01
	St.D	4.98	4.54	5.52	St.D	6.82	7.05	6.69
	n	26.00	23.00	22.00	n	26.00	23.00	22.00
21 JAN 93	Mean	96.00	100.14	100.33	Mean	39.70	45.81	46.94
	St.D	5.25	5.07	5.30	St.D	6.41	6.86	5.64
	n	20.00	14.00	12.00	n	2.00	14.00	12.00
18 FEB 93	Mean	99.38	101.00	99.33	Mean	43.05	45.36	46.79
	St.D	4.38	5.55	7.13	St.D	5.08	6.20	8.84
	n	13.00	5.00	9.00	n	13.00	5.00	9.00
18 MAR 93	Mean	101.22	104.00	101.00	Mean	43.16	42.97	46.97
	St.D	3.76	5.89	4.90	St.D	4.38	10.16	8.56
	n	9.00	3.00	3.00	n	9.00	3.00	3.00

TABLE 3a:

ANM BIOACCUMULATION CHEMICAL ANALYSES 1992

Yabby (Cherax destructor)

Time	Sample	Rep	SAMPLE WT gms	Y mg/kg	Ba mg/kg	Fe mg/kg	Zn mg/kg	Cu mg/kg	Co mg/kg	Al mg/kg	Cr mg/kg	Ni mg/kg
	Blank	1	1.0000	1.5	5.3	3.0	12.0	1.5	0.8	3.8	0.8	1.5
		2	1.0000	1.5	2.3	4.5	4.5	1.5	0.8	3.8	0.8	1.5
6 months	Tank 1	1	5.0089	0.4	426.7	125.8	266.5	56.9	3.0	521.1	1.3	1.5
		2	5.0092	0.4	375.8	.80.9	233.6	50.9	3.0	521.0	1.0	1.2
		3	5.0017	0.6	446.8	103.5	265.4	58.5	3.0	505.3	1.3	1.8
	Tank 2	1	5.0099	0.4	395.2	79.3	140.7	65.9	2.2	323.4	1.3	1.5
		2	5.0064	0.4	308.6	70.4	161.8	73.4	2.2	349.1	1.2	1.5
		3	5.0007	0.4	382.4	90.0	148.5	69.0	2.2	421.4	1.2	1.0
	Tank 3	1	5.0101	0.4	365.3	167.7	181.1	61.4	2.2	747.0	1.3	1.2
		2	5.0098	0.4	320.4	58.4	185.6	58.4	2.2	251.5	1.0	0.7
		3	5.0045	0.4	335.7	155.9	172.3	56.9	2.2	475.1	1.3	0.7
9 months (final)	Tank 1	1	5.0055	0.4	377.6	173.8	241.2	53.9	2.2	431.5	1.3	0.9
		2	5.0033	0.6	532.1	136.4	319.3	75.0	3.0	398.7	1.5	1.3
		3	5.0094	0.6	443.2	119.8	297.9	67.4	3.0	365.3	1.3	1.5
	Tank 2	1	5.0067	0.4	320.6	160.3	169.3	74.9	3.0	477.9	1.3	1.0
		2	5.0050	0.3	293.7	161.8	163.3	70.4	3.0	678.8	1.2	0.9
		3	5.0045	0.4	260.8	121.4	164.9	73.4	3.0	485.6	1.3	0.9
	Tank 3	1	5.0083	0.4	80.9	88.4	170.7	70.4	1.5	329.5	1.3	0.7
		2	5.0025	0.3	323.8	116.9	181.4	75.0	1.5	338.8	1.2	0.7
		3	5.0015	0.3	323.9	106.5	162.0	67.5	1.5	323.9	1.3	0.6

NOTE: *Tank 1 = control*
Tank 2 = 50% Pond Outlet Effluent
Tank 3 = 50% Pond Outlet Effluent

TABLE 3b:

ANM BIOACCUMULATION CHEMICAL ANALYSES 1992

Yabby (Cherax destructor)

Time	Sample	Rep	SAMPLE WT gms	Mn mg/kg	P mg/kg	Mg mg/kg	As mg/kg	Mo mg/kg	Ag mg/kg	Pb mg/kg	Cd mg/kg	La mg/kg
	Blank	1	1.0000	6.0	120.8	7.5	2.3	0.8	0.8	1.5	0.8	1.5
		2	1.0000	1.5	8.3	7.5	2.3	0.8	0.8	1.5	0.8	1.5
6 months	Tank 1	1	5.0089	470.2	9433.2	2545.5	9.0	0.4	0.1	1.9	0.1	6.0
		2	5.0092	362.3	8234.8	2395.6	7.5	0.4	0.1	1.3	0.1	5.2
		3	5.0017	463.3	9446.8	2699.1	9.0	0.6	0.3	2.8	0.1	6.7
	Tank 2	1	5.0099	510.5	10629.0	2395.3	9.0	0.4	0.4	2.1	0.1	6.0
		2	5.0064	434.4	10876.1	2396.9	7.5	0.4	0.4	2.1	0.1	5.2
		3	5.0007	497.9	10348.6	2399.7	7.5	0.4	0.4	1.6	0.1	5.2
	Tank 3	1	5.0101	615.3	10927.9	2395.2	9.0	0.6	0.6	1.6	0.1	6.7
		2	5.0098	332.3	9730.9	2095.9	7.5	0.4	0.4	0.9	0.1	5.2
		3	5.0045	593.5	10340.7	2248.0	7.5	0.4	0.4	0.6	0.1	6.0
9 months (final)	Tank 1	1	5.0055	466.0	11087.8	2547.2	9.0	0.6	0.3	0.6	0.1	6.7
		2	5.0033	427.2	13491.1	2998.0	10.5	0.6	0.4	1.2	0.1	[illegible]
		3	5.0094	368.3	12426.6	2694.9	9.0	0.6	0.3	1.8	0.1	[illegible]
	Tank 2	1	5.0067	367.0	13481.9	2097.2	9.0	0.6	0.7	1.2	0.1	6.0
		2	5.0050	347.7	12137.9	1948.1	7.5	0.4	0.6	1.0	0.1	5.2
		3	5.0045	287.7	13038.3	2098.1	9.0	0.4	0.7	0.9	0.1	5.2
	Tank 3	1	5.0083	197.7	15723.9	2396.0	9.0	0.6	1.0	0.3	0.1	6.0
		2	5.0025	220.4	14992.5	2248.9	7.5	0.6	1.2	0.3	0.1	5.2
		3	5.0015	232.4	14395.7	2249.3	7.5	0.6	1.0	0.3	0.1	5.2

NOTE: *Tank 1 = control*
Tank 2 = 50% Pond Outlet Effluent
Tank 3 = 50% Pond Outlet Effluent

TABLE 4:

ANM BIOACCUMULATION TRIALS *Yabby (Cherax destructor)*

DATE		MONTHLY LENGTH MEASUREMENTS (mm) Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3		MONTHLY WEIGHT MEASUREMENTS (g) Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3
08 APR 93	Mean	94.30	Initial measurements		Mean	37.17	Initial measurements	
(DAY 0)	St.D	3.54			St.D	4.15		
	n	30.00			n	30.00		
06 MAY 93	Mean	94.93	94.63	94.10	Mean	36.07	35.31	34.57
(DAY 28)	St.D	3.83	1.80	3.59	St.D	4.61	1.74	3.96
	n	30.00	30.00	30.00	n	30.00	30.00	30.00
03 JUN 93	Mean	95.48	94.67	93.40	Mean	37.77	35.71	35.21
(DAY 56)	St.D	3.45	3.88	2.57	St.D	4.73	3.88	4.00
	n	23.00	30.00	30.00	n	23.00	30.00	30.00
01 JUL 93	Mean	96.45	96.37	100.00	Mean	36.73	37.46	43.27
(DAY 84)	St.D	6.20	5.44	6.73	St.D	6.12	6.55	8.61
	n	20.00	19.00	20.00	n	20.00	19.00	20.00
29 JUL 93	Mean	99.73	99.50	98.67	Mean	42.31	39.21	42.37
(DAY 112)	St.D	6.55	6.22	3.89	St.D	7.76	7.35	7.44
	n	15.00	16.00	15.00	n	15.00	16.00	15.00
25 AUG 93	Mean	99.25	97.80	100.45	Mean	41.23	38.41	45.16
(DAY 139)	St.D	5.38	6.98	5.18	St.D	7.20	8.04	8.63
	n	20.00	20.00	20.00	n	20.00	20.00	20.00
28 SEP 93	Mean	100.22	99.95	99.30	Mean	41.49	40.70	42.86
(DAY 173)	St.D	5.00	6.42	4.84	St.D	7.43	7.79	9.12
	n	18.00	20.00	20.00	n	18.00	20.00	20.00
21 OCT 93	Mean	101.93	101.29	101.06	Mean	46.09	43.44	45.65
(DAY 196)	St.D	4.61	5.90	3.67	St.D	7.96	8.09	7.20
	n	14.00	14.00	17.00	n	14.00	14.00	17.00

TABLE 5a:

ANM BIOACCUMULATION CHEMICAL ANALYSES 1993

Yabby (Cherax destructor)

Time	Sample	Rep	SAMPLE WT gms	Y mg/kg	Ba mg/kg	Fe mg/kg	Zn mg/kg	Cu mg/kg	Co mg/kg	Al mg/kg	Cr mg/kg	Ni mg/kg
	Blank	1	1.0000	1.5	5.3	3.0	12.0	1.5	0.8	3.8	0.8	1.5
		2	1.0000	1.5	2.3	4.5	4.5	1.5	0.8	3.8	0.8	1.5
0 months	Initial	1	5.0069	0.3	173.8	61.4	86.9	30.0	1.5	221.7	1.0	0.7
		2	5.0039	0.3	148.4	39.0	74.9	25.5	1.5	110.9	0.9	0.7
		3	5.0087	0.3	158.7	55.4	85.4	28.5	1.5	131.8	0.9	0.3
3 months	Tank 1	1	5.0064	0.3	134.8	83.9	163.3	34.5	1.5	181.3	0.9	0.4
		2	5.0146	0.3	145.1	80.8	167.5	35.9	1.5	157.0	0.9	0.3
		3	5.0050	0.3	146.9	70.4	148.4	31.5	1.5	173.8	0.9	0.3
	Tank 2	1	5.0075	0.3	184.2	2.5	115.3	38.9	0.7	43.4	1.2	0.4
		2	5.0046	0.3	83.9	30.0	133.4	43.5	0.7	152.9	1.3	0.3
		3	5.0046	0.3	200.8	37.5	110.9	39.0	0.7	146.9	1.5	0.3
	Tank 3	1	5.0085	0.3	140.8	27.0	97.3	31.4	0.7	205.2	1.0	0.3
		2	5.0006	0.3	145.5	76.5	100.5	33.0	0.7	253.5	1.0	0.3
		3	5.0088	0.3	148.2	59.9	100.3	32.9	0.7	248.6	1.0	0.9

NOTE: Tank 1 = Control
Tank 2 = 50% Pond Outlet Effluent
Tank 3 = 50% Pond Outlet Effluent

TABLE 5b:

ANM BIOACCUMULATION CHEMICAL ANALYSES 1993

Yabby (Cherax destructor)

Time	Sample		SAMPLE WT gms	Mn mg/kg	P mg/kg	Mg mg/kg	As mg/kg	Mo mg/kg	Ag mg/kg	Pb mg/kg	Cd mg/kg	La mg/kg
	Blank	1	1.0000	6.0	120.8	7.5	2.3	0.8	0.8	1.5	0.8	1.5
		2	1.0000	1.5	8.3	7.5	2.3	0.8	0.8	1.5	0.8	1.5
0 months	Initial	1	5.0069	185.7	10335.7	3145.7	7.5	0.4	0.1	0.3	0.1	5.2
		2	5.0039	140.9	8993.0	2847.8	6.0	0.4	0.1	0.3	0.1	4.5
		3	5.0087	169.2	9583.3	2845.0	6.0	0.4	0.1	0.3	0.1	4.5
3 months	Tank 1	1	5.0064	161.8	10037.2	2396.9	6.0	0.4	0.1	0.3	0.1	4.5
		2	5.0146	163.0	10469.4	2542.6	6.0	0.4	0.1	0.3	0.1	4.5
		3	5.0050	152.8	9890.1	2547.5	6.0	0.4	0.1	0.3	0.1	5.2
	Tank 2	1	5.0075	124.3	11682.5	2696.0	7.5	0.4	0.1	0.3	0.1	5.2
		2	5.0046	250.3	12288.7	2697.5	7.5	0.4	0.1	0.3	0.1	5.2
		3	5.0046	335.7	12888.1	2847.4	7.5	0.6	0.1	0.3	0.1	6.0
	Tank 3	1	5.0085	205.2	10781.7	2395.9	6.0	0.4	0.1	0.3	0.1	4.5
		2	5.0006	264.0	11398.6	2549.7	7.5	0.4	0.1	0.3	0.1	5.2
		3	5.0088	230.6	11380.0	2545.5	7.5	0.4	0.1	0.3	0.1	5.2

NOTE: Tank 1 = Control
Tank 2 = 50% Pond Outlet Effluent
Tank 3 = 50% Pond Outlet Effluent

TABLE 6:

ANM BIOACCUMULATION TRIALS *Silver Perch (Bidyanus bidyanus)*

DATE		MONTHLY LENGTH MEASUREMENTS (mm)				MONTHLY WEIGHT MEASUREMENTS (g)				MONTHLY INDEX OF CONDITION		
		Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3		Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3		Control Tank 1	50%Ef'nt Tank 2	50%Ef'nt Tank 3
18 FEB 93	Mean	29.95	Initial measurements		Mean	0.10	Initial measurements		Mean	0.38	Initial measuremen	
(DAY 0)	St.D	2.09			St.D	0.00			St.D	0.08		
	n	20.00			n	20.00			n	20.00		
18 MAR 93	Mean	31.81	34.60	32.55	Mean	0.13	0.55	0.24	Mean	0.37	1.28	0.64
(DAY 28)	St.D	3.53	3.62	3.10	St.D	0.09	0.22	0.15	St.D	0.12	0.36	0.31
	n	20.00	20.00	20.00	n	20.00	20.00	20.00	n	20.00	20.00	20.00
06 MAY 93	Mean	35.12	39.12	35.51	Mean	0.78	1.02	0.74	Mean	1.80	1.70	1.68
(DAY 47)	St.D	2.08	6.90	3.05	St.D	0.09	0.40	0.11	St.D	0.23	0.35	0.29
	n	20.00	20.00	20.00	n	20.00	20.00	20.00	n	20.00	20.00	20.00
03 JUN 93	Mean	35.95	46.32	36.68	Mean	0.71	1.55	0.89	Mean	1.53	1.58	1.84
(DAY 74)	St.D	1.42	7.74	2.61	St.D	0.07	0.51	0.17	St.D	0.09	0.35	0.45
	n	10.00	11.00	13.00	n	10.00	11.00	13.00	n	10.00	11.00	13.00
01 JULY 9	Mean	37.95	No fish surviving		Mean	0.82	No fish surviving		Mean	1.55	No fish surviving	
(DAY 102)	St.D	3.49			St.D	0.17			St.D	0.58		
	n	20.00			n	20.00			n	20.00		

TABLE 7 :

ANM BIOACCUMULATION CHEMICAL ANALYSES 1993

Silver Perch (Bidyanus bidyanus)

Time	Sample	Rep	Sample WT gms	Y mg/kg	Ba mg/kg	Fe mg/kg	Zn mg/kg	Cu mg/kg	Co mg/kg	Al mg/kg	Cr mg/kg	Ni mg/kg
	Blank	1	1.0000	1.50	5.25	3.00	12.00	1.50	0.75	3.75	0.75	1.50
		2	1.0000	1.50	2.25	4.50	4.50	1.50	0.75	3.75	0.75	1.50
0 months	Initial	1	0.6230	2.41	8.43	132.42	144.46	7.22	1.20	1155.70	1.20	2.41
		2	0.7724	1.94	6.80	97.10	126.23	5.83	0.97	1456.50	0.97	1.94
3 months	Tank 2+3	1	0.9617	1.56	10.14	116.98	187.17	3.12	0.78	998.23	1.56	1.56
		2	0.9369	1.60	8.81	112.07	184.12	3.20	0.80	1841.18	3.20	1.60
		3	1.0294	1.46	12.39	167.57	196.72	3.64	0.73	2499.03	1.46	1.46
3 months	Tank 1	1	1.2723	1.18	14.15	112.00	147.37	3.54	0.59	1173.07	0.59	1.18
		2	1.2766	1.17	11.16	99.87	141.00	2.94	0.59	910.62	1.17	1.17

Time	Sample		SAMPLE WT gms	Mn mg/kg	P mg/kg	Mg mg/kg	As mg/kg	Mo mg/kg	Ag mg/kg	Pb mg/kg	Cd mg/kg	La mg/kg
	Blank	1	1.0000	6.00	120.75	7.50	2.25	0.75	0.75	0.00	0.75	1.50
		2	1.0000	1.50	8.25	7.50	2.25	0.75	0.75	0.00	0.75	1.50
0 months	Initial	1	0.6230	9.63	28892.46	1805.78	3.61	1.20	1.20	2.41	1.20	2.41
		2	0.7724	5.83	24274.99	1456.50	2.91	0.97	0.97	1.94	0.97	1.94
3 months	Tank 2+3	1	0.9617	23.40	31974.63	1793.70	2.34	0.78	0.78	1.56	0.78	1.56
		2	0.9369	20.01	34422.03	1921.23	3.20	0.80	0.80	1.60	0.80	1.60
		3	1.0294	21.86	36428.99	2040.02	2.91	0.73	0.73	1.46	0.73	1.46
3 months	Tank 1	1	1.2723	14.74	26821.50	1532.66	1.77	0.59	0.59	1.18	0.59	1.18
		2	1.2766	14.69	27024.91	1527.49	1.76	0.59	0.59	1.17	0.59	1.17

NOTE: Tank 1 = Control
Tank 2 = 50% Pond Outlet Effluent
Tank 3 = 50% Pond Outlet Effluent

TABLES 8a-b

RIVER ENVIRONMENT MONITORING SURVEYS [W11]

FISH COLLECTIONS FROM BAIT NETS SET IN THE RIVER MURRAY OVER NIGHT, ABOVE AND BELOW THE ANM EFFLUENT DISCHARGE POINT.

TABLE 8a: Monthly total catch data for ANM sites.

	ANM SITE NUMBER					
DATE	1	2	3	4	5	6
13 JAN 93	0	0	0	5	0	0
17 FEB 93	0	0	0	0	0	1
17 MAR 93	0	2	0	0	0	0
21 APR 93	1	0	0	0	0	0
07 MAY 93	1	0	0	0	0	0
04 JUN 93	0	0	1	0	0	NR
14 JUL 93	0	0	0	0	0	0
06 AUG 93	0	0	2	1	0	0
16 SEP 93	0	0	0	0	0	0

TABLE 8b: Species list and catch numbers for ANM sites.

	ANM SITE NUMBER					
SPECIES	1	2	3	4	5	6
Perca fluviatilis	0	0	0	5	0	1
Hypseleotris klunzingeri	0	2	1	0	0	0
Gadopsis marmoratus	2	0	0	0	0	0
Cyprinus carpio	0	0	1	0	0	0
Galaxias rostratus	0	0	0	1	0	0
Retropinna semoni	0	0	1	0	0	0

NOTE: SITES 1&2 2km downstream
SITES 3&4 500m downstream
SITES 5&6 500m upstream (control)
NR = No nets recovered.

1992

The Murray-Darling Freshwater Research Centre

15 December 1992

Our Ref: YH/6/21/2 and YH/6/21/3

Mr Ralph Coghill
Technical Services Manager
Australian Newsprint Mills Limited
Private Bag
LAVINGTON NSW 2641

Dear Ralph

1992 ANNUAL REPORT - BIOLOGICAL AND CHEMICAL MONITORING

Please find enclosed the 1992 Annual Report outlining the monitoring undertaken by The Murray-Darling Freshwater Research Centre for Australian Newsprint Mills Limited. This Annual Report complies with Licence Condition W16 on the ecotoxicological and bio-accumulation monitoring and the river environment monitoring surveys.

Please do not hesitate to contact me on 43 2011 for any additional information.

Wishing you and your staff a Merry Xmas and a Happy New Year.

Yours sincerely

Rhonda Sinclair

R L SINCLAIR
Scientific Liaison Officer

Enc. 1992 Annual Report

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Research for safe, efficient management of water resources.

Ellis Street, Thurgoona, N.S.W. Telephone: (060) 43 1002
P.O. Box 921, Albury 2640. Telex: AA 56978

AUSTRALIAN NEWSPRINT MILLS

CHEMICAL AND BIOLOGICAL MONITORING

1.0 INTRODUCTION

The Murray-Darling Freshwater Research Centre was contracted to undertake environmental chemical and biological monitoring of ANM's effluent and its impact on the River Murray at Albury in accordance with specifications in the SPCC Licence No. 01272 sections W10 and W11 and NSW Department of Planning's 'Instrument of Consent' dated 26 June 1991.

2.0 METHODS

2.1 ECOTOXICOLOGICAL AND BIO-ACCUMULATION MONITORING [W10]

2.1.1 Bioassay

Bioassay test methods are based on the standard methods defined by Clesceri *et. al.* (1989) and Anon (1981). USEPA

2.1.2 Bioaccumulation

Bioaccumulation trials were conducted using three $8m^3$ concrete tanks on site at ANM. Tank 1 (the control) is fed only by river water and Tanks 2 and 3 (test tanks) are fed by a mixture of 50% river water and 50% effluent water from the pond outlet flume. 90 Yabbies (*Cherax destructor*) and 30 Silver Perch (*Bidyanus bidyanus*) were added to each tank, subsamples of these have been weighed and measured each month. Flesh samples have been taken for chemical analysis every three months and sent to Amdel Laboratories.

2.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

2.2.1 Water

Sample Collection and Handling

Grab samples were taken at three locations on the river on a monthly basis. Site 1 samples were taken at a point approximately 1 km upstream of the ANM outfall (locally known as Grey's farm). Site 2 samples were taken at a point approximately 200 m downstream of ANM's outfall (adjacent to the railway bridge). Site 3 samples were taken at a point approximately 1 km downstream of ANM's outfall (adjacent to Union Bridge).

Five samples were taken at each location (for analysis of physical parameters, phosphorus, forms of nitrogen, metals and mercury respectively). All samples were collected and preserved in accordance with Australian Standards AS2031.1 and AS2051 - all preservatives were ARISTAR grade and clean polyethylene gloves were worn at all times. Sampling blanks were handled and analysed in a similar manner to the samples.

Analysis of Water Samples

All analyses (except for mercury analyses) were performed by:-

EML (Chem) Pty Ltd
425 - 427 Canterbury Road
Surrey Hills Vic 3127.

The parameters determined were:-

Turbidity, Colour, Specific Conductance, Total Dissolved Solids, Ammonia, Nitrate, Nitrite, Organic Nitrogen, Total Phosphorus, Aluminium, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Lead and Zinc.

Mercury analyses were performed by:-

Australian Newsprint Mills Ltd
Boyer Tas 7140.

2.2.2 <u>Sediments</u>

Sample Collection and Handling

A transect rather than a random sampling protocol was adopted. Because the River Murray is a fast flowing river, the river bed is predominantly gravel. The only areas with sufficiently fine sediments for analysis are the deposition zones on the inside bends of the river. However, at the time of sampling the river was just beginning to rise from its lowest annual level. Therefore, the deposition zones were (most probably) inundated after a brief period of drying. To minimise any effects this drying/wetting process may have had on the sediment characteristics, samples were taken at constant depth (i.e. following a depth contour). It was assumed that such samples would have been subjected to (almost) the same drying/wetting regime. The force of the current was sufficiently strong to preclude the use of a mechanical grab. Therefore, samples were collected by direct scooping into polyethylene bottles. This meant that the depth contour chosen could not be at very great depth. The 60 cm contour represented a compromise between maximum depth (and therefore smallest amount of time exposed to the air) and ease of sampling.

A series of 40 sediment samples were taken on the 7th August 1992. Sediment samples were collected from two deposition zones approximately equidistant (*ca* 500 m upstream and *ca* 500 m downstream) of the ANM outfall. Samples were collected at 10 m intervals along the 60 cm depth contour (approximately 2 m from, and parallel to, the river bank). A total of 20 samples were taken above and 20 samples taken below the outfall.

The top 5 - 10 cm of sediment was directly scooped into 500 mL wide mouthed polyethylene bottles which had previously been acid washed (5 % HCl) and repeatedly rinsed with MILLI-Q water. Sampling was such that every effort was made to completely fill the sampling bottle with sediment. The bottle was sealed while under water to minimize the loss of fine material.

The samples were immediately returned to the laboratory and air dried. The air dried samples were sieved (2 mm) - the fraction retained by the sieve was weighed and then discarded, the fraction passing through the sieve was weighed and then thoroughly mixed. All subsequent analysis were performed only on the sieved fraction (Grimshaw 1989).

Particle Size Analysis

Approximate particle fractionation was carried out on all samples. Fractionation was by the method described by Grimshaw (1989). Essentially, that portion of the sample which was retained by a 2 mm sieve was considered gravel. The portion of the sample that passed through a 2 mm sieve was considered a mixture of silt, clay and sand.

The percentage of silt + clay in this fraction was determined by the 4 minute 48 second hydrometer method described by Grimshaw (1989). The efficiency of the hydrometer method was determined by recovery of known additions - known amounts of commercial Kaolin clay (Sigma chemical Company) were added to a sample of river sand. The sand content was estimated by difference. No distinction between silt and clay content, or fine sand and coarse sand content was attempted.

Moisture Content

Approximately 1 g of air dried sediment was accurately weighed into a pre-dried glass vial. The sample was dried at 105 ^{O}C until it reached constant weight (typically after 12 hours). The loss of weight of the sample was attributed to loss of moisture.

Analysis of Acid Extractable Metals

The fraction of acid extractable metals in the samples was determined by a modification of the method of Anon (1982). 5 g of sediment was accurately weighed into 50 mL polyethylene centrifuge tubes (which had previously been washed with 5 % HCl and extensively rinsed with MILLI-Q water). 25 mL of 0.1 M ARISTAR grade HCl was subsequently added to the sediment. The tubes were then capped and placed on a Ratek orbital shaking table for one hour. The samples were allowed to settle overnight and subsequently filtered through 0.45 μm acid washed millipore filters. The filtrate was placed in 100 mL polyethylene bottles (which had previously been washed with 5 % HNO_3 and repeatedly rinsed with MILLI-Q water) and dispatched to:-

Amdel Laboratories
Brown St
Thebarton SA 5031.

for analysis by Inductively Couple Plasma Atomic Emission Spectroscopy (ICP-AES). The elements assayed for were aluminium, barium, cadmium, chromium, cobalt, copper, iron, lanthanum, lead, magnesium, manganese, nickel, phosphorus, yttrium and zinc. An extraction blank and a standard reference material (Buffalo River sediment - SRM 2707) were processed in exactly the same manner as the samples.

Analysis for Total Mercury

Approximately 10 g of air dried sample was placed in dry, acid washed (5 % HNO_3) polyethylene bags and dispatched to :-

Australian Newsprint Mills Ltd
Boyer Tas 7140.

for digestion and subsequent analysis by Cold Vapour Generation Atomic Absorption Spectroscopy.

Analysis for Total Nitrogen

Total nitrogen was determined by a modification of the technique of Hosmoi and Sudo (1986). Approximately 0.25 g of sediment was accurately weighed into acid washed 50 mL centrifuge tubes. 10 mL of an alkaline persulfate digestion medium (0.9 % NaOH, 4.0 % $K_2S_2O_4$) was added to each tube. The tubes were sealed and subsequently heated in an autoclave for one hour. The solution was then analysed for nitrate by an automated version of the cadmium reduction method (Clesceri *et. al*. 1989). All analyses were done at least in duplicate.

Analysis for Exchangeable Phosphorus

Exchangeable phosphorus was determined by a modification of the method of Anon (1982). About 5 g of sediment was accurately weighed into 50 mL acid washed centrifuge tubes. The sediment was extracted into 25 mL of a 0.5 M sodium bicarbonate solution (pH adjusted to 8.5 with NaOH). The level of soluble reactive phosphate in the extractant was determined by an automated version of the ascorbic acid method (Clesceri *et. al*. 1989).

2.2.3 Biota

Macroinvertebrates

Macroinvertebrate samples have been collected from six paired sites on the River Murray (see Figure 1) according to the method set out in (Bennison *et. al.* 1989). Monthly sampling commenced in December 1991. Samples were sorted into taxonomic groups and counted.

Fish

Fish sampling has been conducted at the above sites since June 1992, using two bait nets at each site, set for 12 hours and using chemical lights as an attractant.

3.0 RESULTS AND DISCUSSION

3.1 ECOTOXICOLOGICAL AND BIOLOGICAL MONITORING [W10]

48 hour Chironomid Effective Concentration (EC) Test

48 hour tests have been carried out on a monthly basis since December 1991. Apart from the test for March 1992 there has been no apparent toxicity associated with the effluent water. In March (Table 1), the effluent water taken from the retention pond outlet, was contaminated with water from the mill cooling system, which had an apparent high H_2S level. This was toxic at 100% concentration. The mill has since rectified this problem.

48 hour Daphnia Effective Concentration (EC) Test

48 hour EC tests have been carried out on a monthly basis since December 1991. Apart from the test carried out in March 1992 there has been no apparent toxicity to Daphnia associated with the effluent water. In March (Table 2), the retention pond outlet water was toxic at concentrations above 10% for the reasons given above.

There is a suggestion that some of the effluent water maybe toxic over a longer period, so the tests are now being extended to 96 hours.

Daphnia 21 day Reproduction Test

Reproduction tests have been conducted monthly since December 1992. The January and August tests were discontinued due to high mortalities in the controls, this is believed to have been due to contaminated control water. A test was not performed in February as we had not solved the problem with the control water. Tabulated results are based on the number of nauplii produced over the 21 day period (Tables 3a-3f). In most tests the effluent from each of the three pond sources significantly inhibited the number of nauplii produced at 100% concentration. In three months, September, October and November, the lower concentrations of effluent significantly enhanced the number of nauplii produced, when compared to the controls. In June, water from Union Bridge, below the outfall, caused significant inhibition of nauplii production. This is believed to be the result of contaminated stormwater runoff. As a result the site has been moved further upstream.

Fish Ventilation Monitoring

The computer system for monitoring ventilation rates and strength of the operculum movement is operational. It however currently only has one channel operational, allowing only one fish to be monitored. A further nine channels are currently being produced.

Fish Egg Survival and Development

Tests on native fish eggs to determine survival and development in effluent water, commenced in October using Murray Cod (*Muccullochella peeli*). Embryo survival (percentage hatch) in ANM effluent was not effected over the 10 day period that the eggs took to hatch (Table 4). Some differences were evident in the figures for the survival of fry exposed to the effluent until the termination of the test at day 30 post-hatch (Table 5), however, the high degree of variability reduces the significance of these results.

Bioaccumulation

Bioaccumulation trials started early in July 1992, using Silver Perch (*Bidyanus bidyanus*) and Yabbies (*Cherax destructor*), measurements of monthly subsamples of the Perch are summarised in Figure 2, demonstrating no difference in the condition of the animals, between the test (50% effluent) tanks and the control tank. Low numbers of Perch have necessitated the termination of this part of the test until more fingerlings are acquired in early 1993. No growth data has been presented for the Yabbies as they have not moulted since the start of the test due to low winter temperatures, however no mortalities have been observed in any of the treatments.

Chemical analysis for bioaccumulation of effluent elements in Silver Perch and Yabbies exposed to 50% effluent for three months was conducted by Amdel Laboratories. Elements assayed for were barium, iron, zinc, copper, cobalt, nickel, manganese, phosphorus, magnesium, arsenic, cadmium and lanthanum. The analyses yielded 100% recovery and all were within the expected ranges (Table 6). No differences were apparent as a result of exposure to the ANM effluent.

3.2 RIVER ENVIRONMENT MONITORING SURVEYS [W11]

3.2.1 Water

A summary of the water quality data is presented in Figures 3a-3c. The figures shows the variation of metals (manganese, iron, aluminium and zinc), nutrients (total phosphorus, ammonia, organic nitrogen and oxides of nitrogen) and physical parameters (turbidity, conductivity, colour and total dissolved solids) between the three sites over time. The figures do not include those analytes not detected in any of the samples or, those whose levels remained very close to their detection limit. Cadmium (0.001 mg/L), cobalt (0.005 mg/L), copper (0.004 mg/L) and lead (0.04 mg/L) were not detected in any of the samples (detection limits in brackets). The mercury level exceeded 0.0005 mg/L on only one occasion (0.0006 mg/L at Site 1 on the 26/2/1992). Likewise, the concentration of chromium only exceeded 0.02 mg/L on six occasions (0.04 mg/L at Site 1 on the 20/1/92), 0.03 mg/L at Sites 1 and 3 on the 28/4/92 and 0.07, 0.05 and 0.03 mg/L at Sites 1, 2 and 3 respectively on the 2/11/92).

Generally, most of the data show little (if any variability) between sites, although there may be significant variation over time. From the figures it is evident that iron, manganese, zinc (with the exception of Site 2 on the 6/10/92), total phosphorus (with the exception of Site 1 on 28/4/92), turbidity, conductivity, colour and total dissolved solids, vary little between sites. The levels of ammonia, oxides of nitrogen (NO_x) and organic nitrogen seem to be more variable between sites - with no clear pattern in the variation.

3.2.2 Sediments

The results for the sediment analyses are summarized in Tables 7a-7d. Included in the tables are the means, standard deviations (S.D.), standard errors (S.E.) and ranges of the analytes detected for both the upstream and downstream sites. Silver and molybdenum were not detected (detection limit 0.05 mg/kg) in any of the sediment samples. Arsenic was only detected (detection limit 0.15 mg/kg) in five of the upstream samples (concentrations ranging from 0.15 to 0.7 mg/kg) and three of the downstream samples (concentrations ranging from 0.15 to 0.4 mg/kg). All results are on an air-dried basis.

Sediment Characteristics

The crude sediment characteristics (% gravel, % sand, % silt and clay, and, % loss on drying) of the upstream and downstream sample sites are summarized in the tables. The sediment samples were highly variable but there is no significant difference ($p < 0.05$) in the sediment characteristics between the sites. Therefore, there is no impediment to comparing the chemical characteristics of the upstream and downstream sediments - although the high variability in sediment characteristics would indicate the possibility of an equally high variability within the chemical properties of the sites (*vide infra*). As can be seen from the tables the sediments in both the upstream and downstream samples (although highly variable) consisted predominantly of sand and gravel. The silt and clay content of the samples tended to be low. As most exchangeable elements are associated with this latter size class (Brymner 1985) the concentration of these analytes would be lower than generally found for sediments.

Chemical Characteristics of the Sediment

A summary of the chemical characteristics of the sediment samples taken upstream and downstream of the ANM outfall are also presented in the tables. An extensive series of elements were determined. These included total nitrogen, exchangeable and extractable phosphorus, total mercury and, extractable aluminium, barium, cadmium, chromium, cobalt, copper, iron, lanthunum, lead, magnesium, manganese, nickel, yttrium and zinc.

As can be seen from the tables there is no significant difference ($p < 0.05$) between the mean of the upstream and downstream sites for any of the elements analysed. However, it should be noted that the chemical characteristic within the sites are highly variable. As noted above, this is (mainly) because of the variability in sediment characteristics (particularly silt and clay content).

3.2.3 Biota

Macroinvertebrates

The results of the macroinvertebrate sampling program are summarised in the average linkage dendogram (Figure 4) which highlights similarities and differences in taxonomic data between samples. The data for the paired sites has been combined to give one result for each treatment, each month. The dendogram indicates that seasonal differences appear stronger than treatment differences. Although the major groups are classified to family/genus level further classification of the minor groups may permit a more meaning full analysis. At this stage the data shows no consistent biological differences between sites.

Fish

Fish collections from the River Murray have yielded no substantial data as fish were only caught on one, out of the seven sampling dates, which coincided with local flooding (Table 8).

4.0 REFERENCES

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Hosmoi, M., and Sudo, R. 1986. Simultaneous determination of total nitrogen and total phosphorus in freshwater samples using persulfate digestion. *Intern. J. Environmental Studies* 27, 267-275.

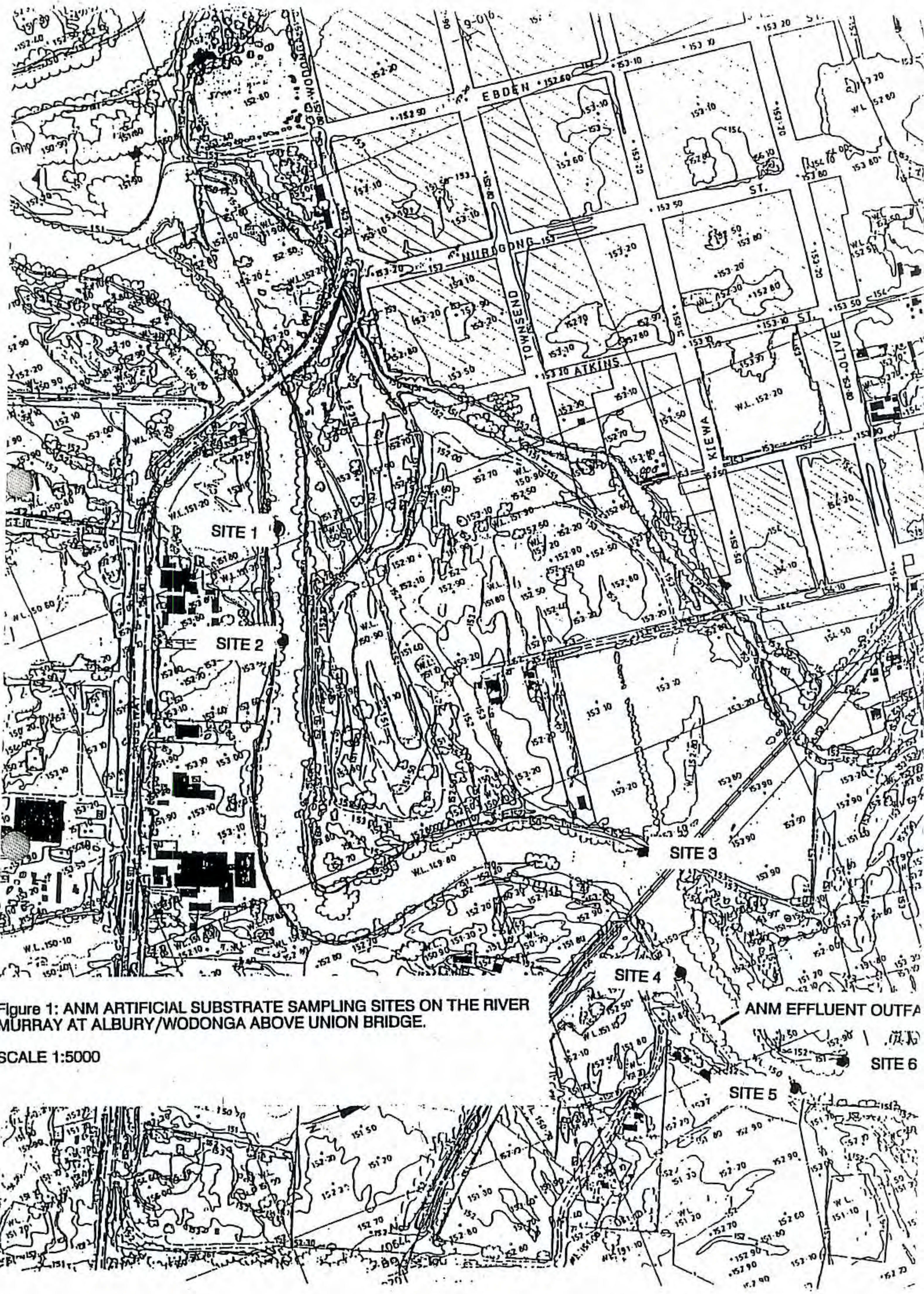
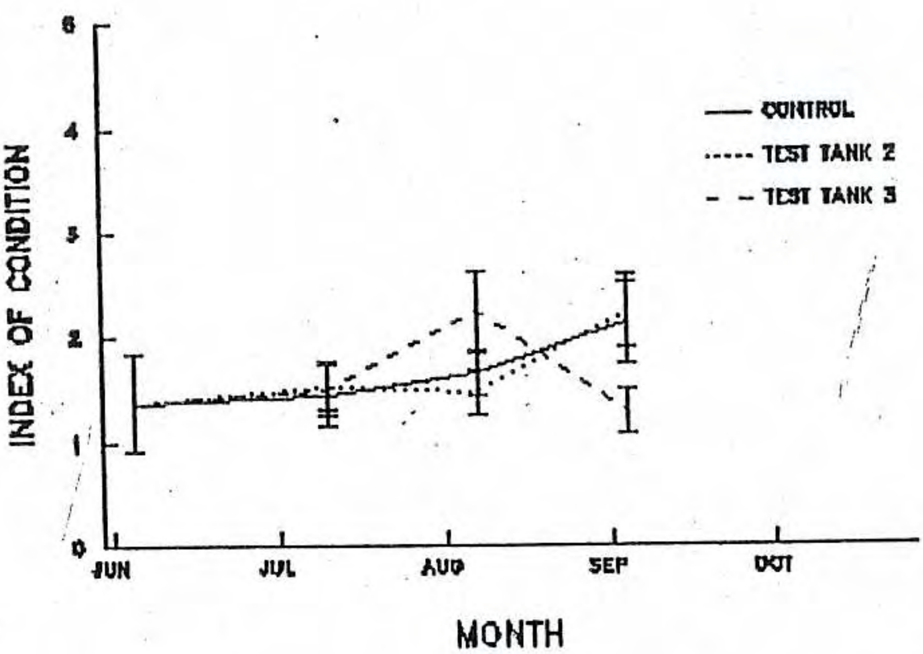


Figure 1: ANM ARTIFICIAL SUBSTRATE SAMPLING SITES ON THE RIVER MURRAY AT ALBURY/WODONGA ABOVE UNION BRIDGE.

SCALE 1:5000

Figure 2: Silver Perch Bioaccumulation, Index of Condition.



The equation usually used is:

$$K = \frac{(W \times 10^5)}{L^3}$$

where:

K = coefficient or index of condition,
W = weight in grams
L = length in millimetres

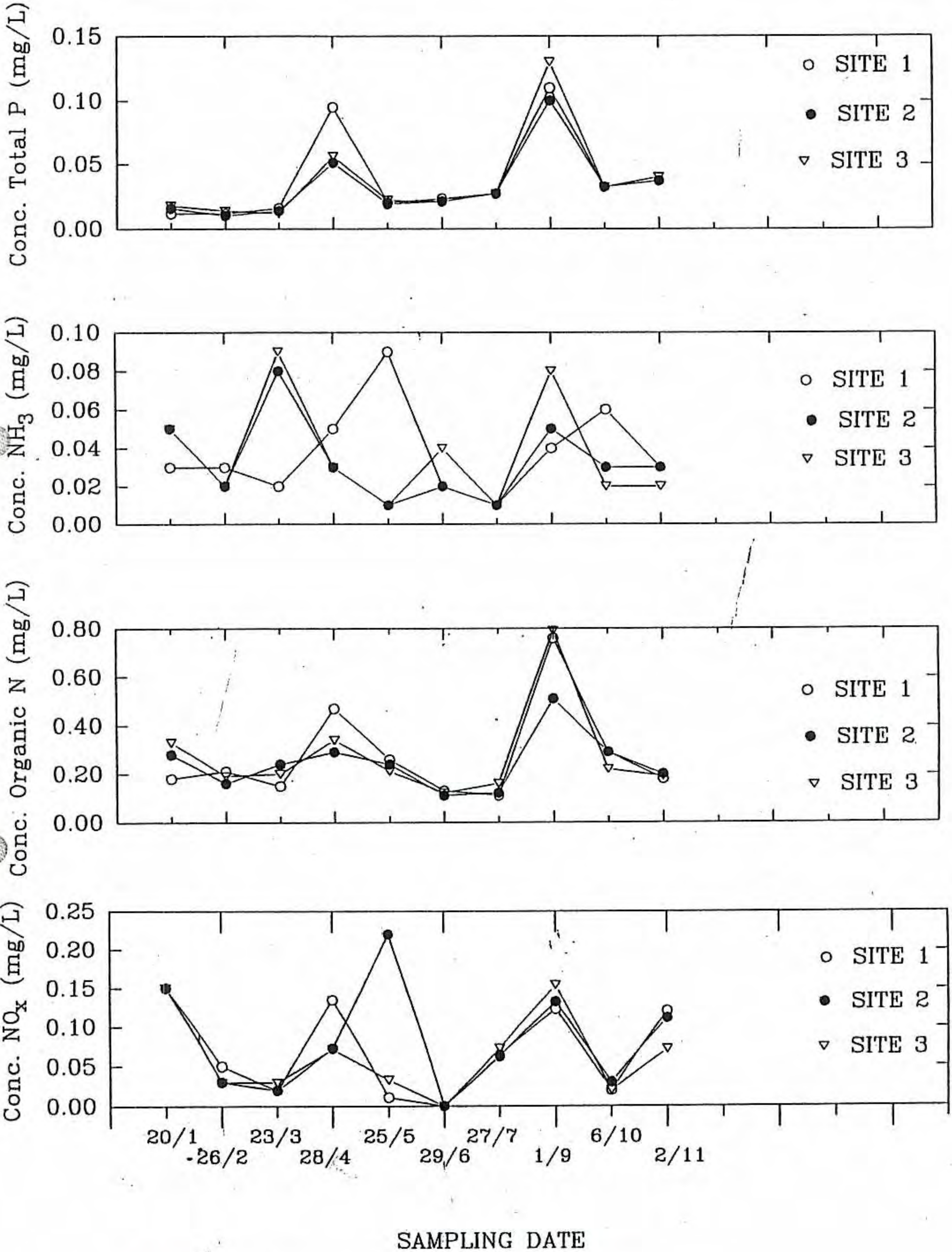


Figure 3a: River Murray water quality

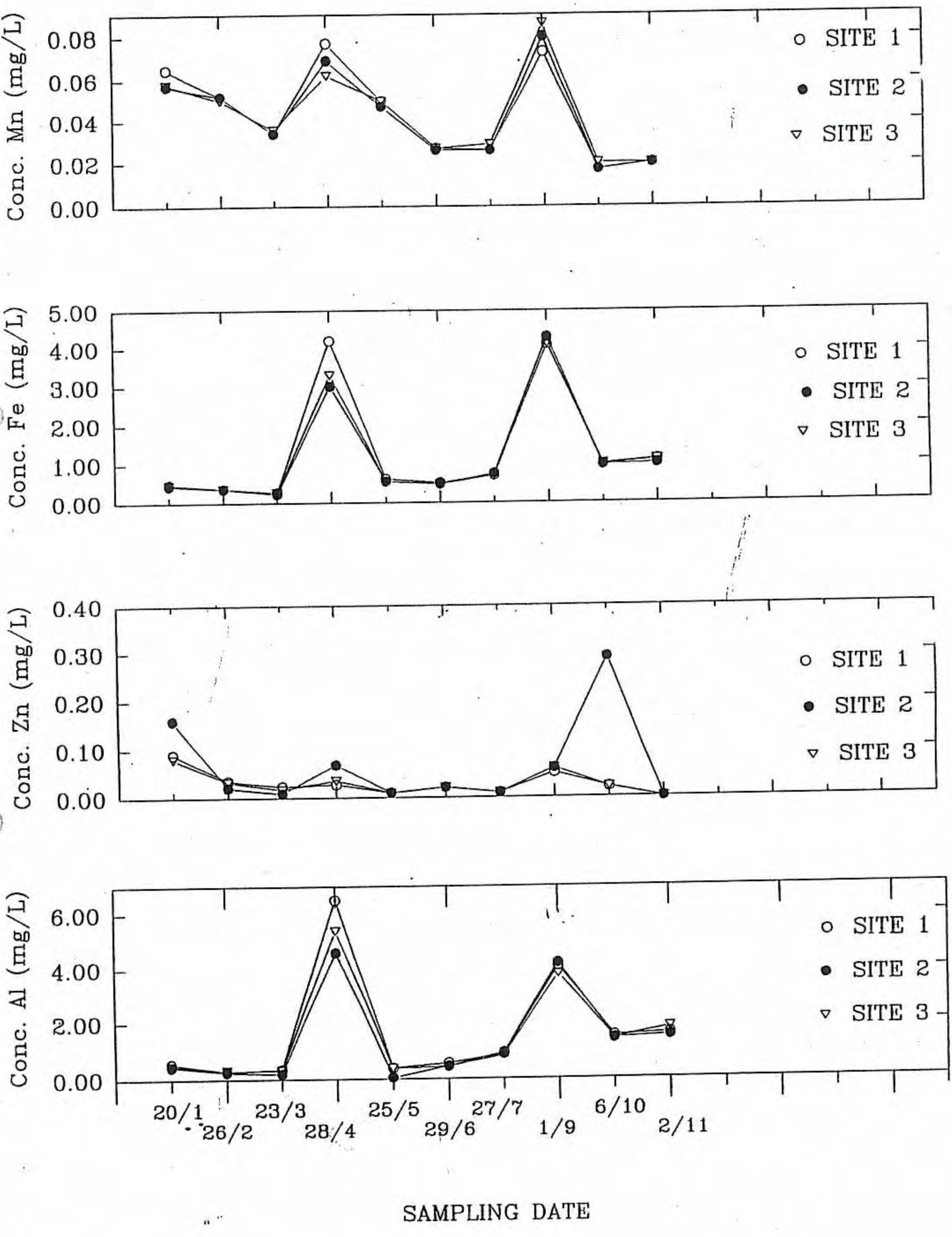


Figure 3b: River Murray water quality

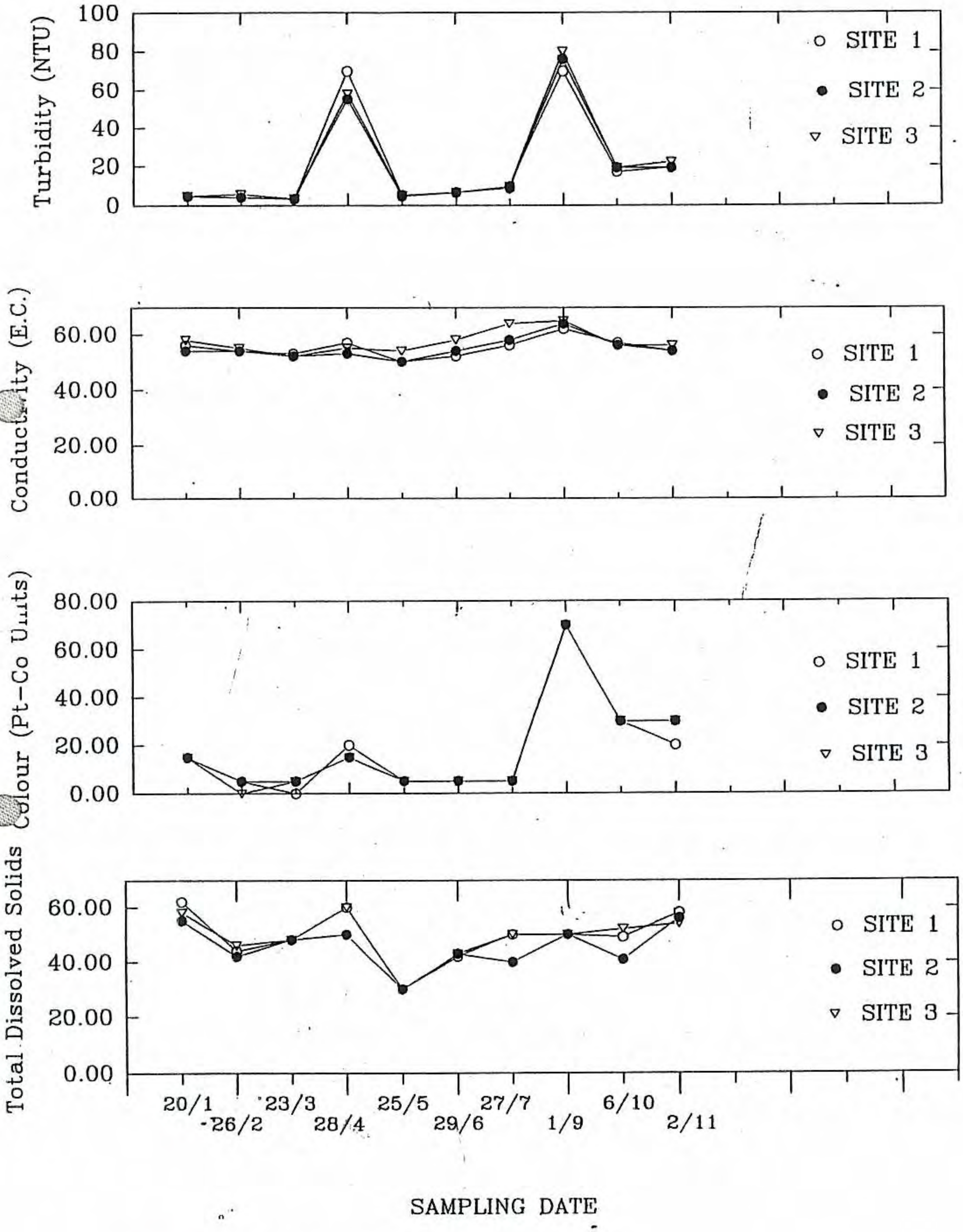


Figure 3c: River Murray water quality

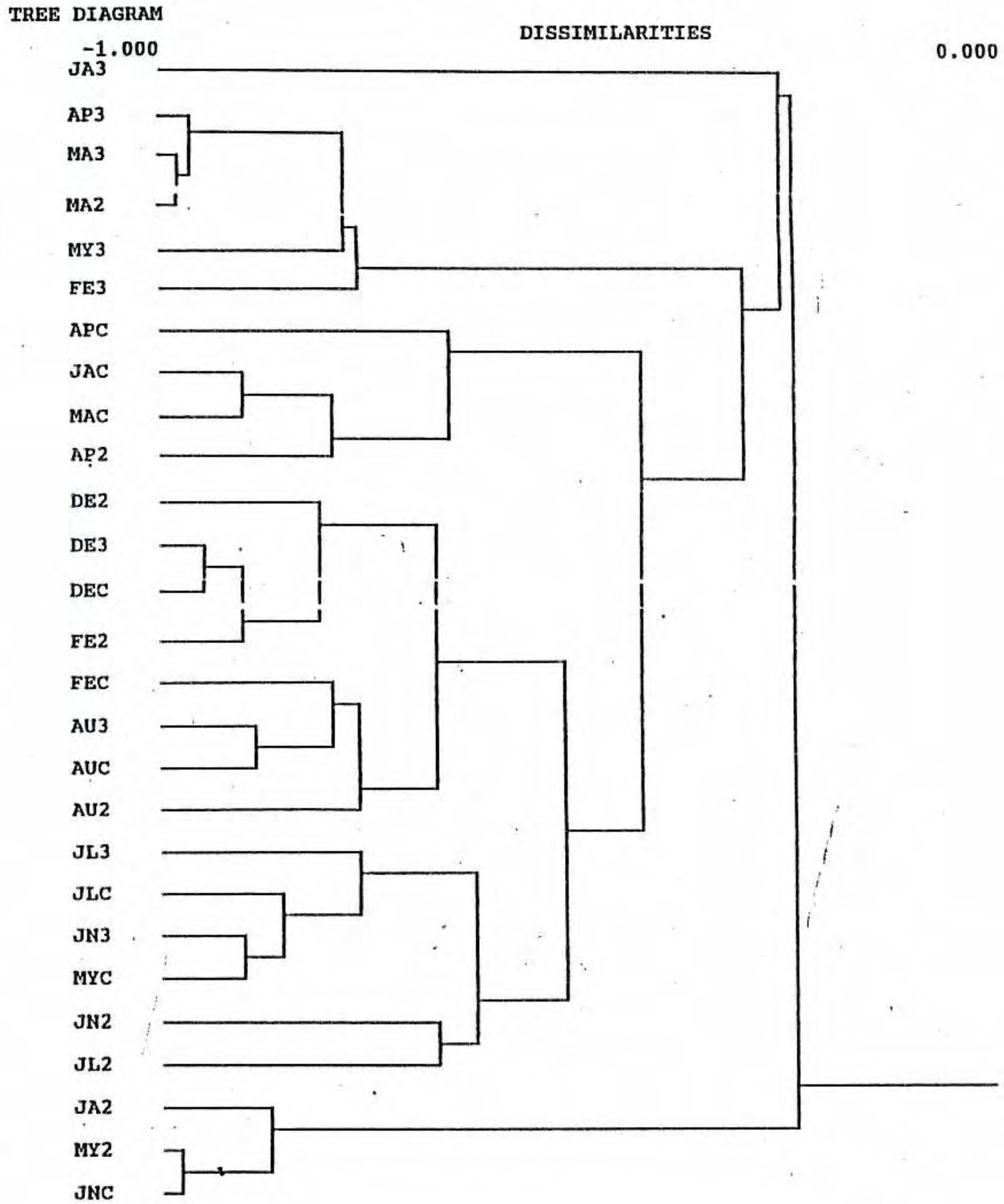


Figure 4: River Murray macro-invertebrate samples
Average Linkage Dendogram.

Months: JA-January, FE-February, MA-March, AP-April, MY-May,
JN-June,JY-July, AU-August.
Sites: C-control, 2-500m dowstream of effluent outfall,
3- 2km downstream of effluent outfall.

Table 1: Chironomid 48 hour EC test
DATE STARTED 4 Mar 1992
DATE FINISHED 6 Mar 1992

N=5

PERCENT MORTALITY

POND INLET

DAY No	REP 1: 1	REP 1: 2	TOTAL
C	20	0	20
0.1	20	0	20
1	0	0	0
10	0	0	0
50	0	0	0
100	0	0	0

DAY No	REP 2: 1	REP 2: 2	TOTAL
C	0	17	17
0.1	20	0	20
1	20	0	20
10	0	0	0
50	0	0	0
100	0	0	0

POND

DAY No	REP 1: 1	REP 1: 2	TOTAL
C	20	0	20
0.1	0	20	20
1	0	0	0
10	0	0	0
50	0	0	0
100	20	0	20

DAY No	REP 2: 1	REP 2: 2	TOTAL
C	0	17	17
0.1	0	0	0
1	0	0	0
10	0	0	0
50	0	20	20
100	0	0	0

POND OUTLET

DAY No	REP 1: 1	REP 1: 2	TOTAL
C	20	0	20
0.1	0	0	0
1	0	0	0
10	0	0	0
50	16	0	16
100	20	80	100

DAY No	REP 2: 1	REP 2: 2	TOTAL
C	0	17	17
0.1	20	0	20
1	0	0	0
10	0	0	0
50	0	20	20
100	80	20	100

BELOW OUTFALL

DAY No	REP 1: 1	REP 1: 2	TOTAL
C	20	0	20
0.1	0	0	0
1	20	40	60
10	0	20	20
50	20	0	20
100	20	0	20

DAY No	REP 2: 1	REP 2: 2	TOTAL
C	0	17	17
0.1	0	0	0
1	0	0	0
10	0	0	0
50	20	0	20
100	0	0	0

NOTE: Dilutions of pond outlet water milky at 50 and 100 percent, caused by contaminated cooling water.

Table 2: Daphnia 48 hour EC test
DATE STARTED 4 March 1992
DATE FINISHED 5 March 1992

N= . 10

PERCENT MORTALITY

	POND INLET			POND			POND OUTLET		
	REP 1		TOTAL	REP 1		TOTAL	REP 1		TOTAL
DAY No	1	2		1	2		1	2	
C	0	44	44	0	44	44	0	44	44
0.1	0	40	40	-	-	0	-	-	0
1	0	55	55	-	-	0	-	-	0
10	0	100	100	10	0	10	60	0	60
50	0	100	100	0	10	10	100	-	100
100	0	80	80	0	20	20	100	-	100
	REP 2		TOTAL	REP 2		TOTAL	REP 2		TOTAL
DAY No	1	2		1	2		1	2	
C	0	44	44	0	44	44	0	44	44
0.1	0	60	60	-	-	0	-	-	0
1	25	63	88	-	-	0	-	-	0
10	0	88	88	0	13	13	44	22	66
50	0	89	89	13	0	13	90	10	100
100	0	78	78	0	11	11	100	-	100

Table 3a: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 29 April 1992

	CONTROL	UB100%	UB50%	UB10%	UB1%
MEAN	62.80	70.20	71.20	70.50	72.30
STD ERR	1.50	8.38	6.57	3.18	4.31
95% CONF	3.40	18.95	14.86	7.20	9.75
n	10.00	10.00	10.00	10.00	10.00
MAX	73.00	89.00	102.00	88.00	94.00
MIN	56.00	0.00	34.00	58.00	49.00
T-TEST					

	PO100%	PO50%	PO10%	PO1%
MEAN	1.10	25.90	41.91	36.10
STD ERR	0.41	6.29	5.35	7.52
95% CONF	0.92	14.22	12.10	17.01
n	10.00	10.00	10.00	10.00
MAX	3.00	64.00	77.00	68.00
MIN	0.00	0.00	18.00	0.00
T-TEST	*	*	*	*

	POND100%	POND50%	POND10%	POND1%
MEAN	0.00	30.30	39.00	58.30
STD ERR	0.00	7.66	4.15	5.58
95% CONF	0.00	17.32	9.39	12.63
n	10.00	10.00	10.00	10.00
MAX	0.00	75.00	69.00	82.00
MIN	0.00	0.00	25.00	21.00
T-TEST	*	*	*	

	PI100%	PI50%	PI10%	PI1%
MEAN	0.00	11.40	54.20	50.00
STD ERR	0.00	6.03	3.85	6.36
95% CONF	0.00	13.65	8.70	14.40
n	10.00	10.00	10.00	10.00
MAX	0.00	49.00	75.00	73.00
MIN	0.00	0.00	37.00	0.00
T-TEST	*	*		

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

Table 3b: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 12 June 1992

	CONTROL	UB100%	UB50%	UB10%	UB1%	UB0.1
MEAN	43.40	20.80	17.40	42.20	41.50	29.10
STD ERR	3.02	7.39	5.91	3.56	5.04	4.39
95% CONF	6.83	16.72	13.38	8.06	11.40	9.92
n	10.00	10.00	10.00	10.00	10.00	10.00
MAX	59.00	58.00	39.00	65.00	59.00	50.00
MIN	24.00	0.00	0.00	21.00	0.00	0.00
T-TEST		*	*			*

	PO100%	PO50%	PO10%	PO1%	PO0.1%
MEAN	54.10	36.70	38.20	30.50	41.00
STD ERR	4.60	4.51	1.90	9.06	6.90
95% CONF	10.41	10.21	4.29	20.51	15.6
n	10.00	10.00	10.00	10.00	10.00
MAX	85.00	54.00	49.00	77.00	58.00
MIN	37.00	0.00	30.00	0.00	0.00
T-TEST					

	POND100%	POND50%	POND10%	POND1%	POND0.1%
MEAN	6.40	51.00	22.80	44.40	42.00
STD ERR	1.20	6.90	6.50	2.49	5.20
95% CONF	2.72	15.62	14.71	5.62	11.70
n	10.00	10.00	10.00	10.00	10.00
MAX	10.00	73.00	47.00	55.00	60.00
MIN	0.00	0.00	0.00	33.00	0.00
T-TEST	*		*		

	PI100%	PI50%	PI10%	PI1%
MEAN	1.40	46.00	37.90	44.40
STD ERR	0.67	7.40	6.98	2.54
95% CONF	1.52	16.74	15.80	5.73
n	10.00	10.00	10.00	10.00
MAX	6.00	62.00	62.00	62.00
MIN	0.00	0.00	0.00	35.00
T-TEST	*			

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

Table 3c: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 15 July 1992

	CONTROL	UB100%	UB50%	UB10%	UB1%
MEAN	45.79	51.80	35.70	46.40	51.60
STD ERR	4.35	8.69	10.25	8.64	7.83
95% CONF	9.15	19.66	23.19	19.55	17.70
n	19.00	10.00	10.00	10.00	10.00
MAX	79.00	71.00	72.00	71.00	83.00
MIN	7.00	0.00	0.00	0.00	10.00
T-TEST					

	PO100%	PO50%	PO10%	PO1%
MEAN	19.60	29.90	32.90	39.40
STD ERR	6.53	10.49	10.52	9.71
95% CONF	14.77	23.73	23.80	21.97
n	10.00	10.00	10.00	10.00
MAX	64.00	89.00	82.00	83.00
MIN	0.00	0.00	0.00	0.00
T-TEST	*			

	POND100%	POND50%	POND10%	POND1%
MEAN	51.40	33.50	35.30	46.00
STD ERR	12.40	12.25	7.52	6.44
95% CONF	28.05	27.72	17.02	14.56
n	10.00	10.00	10.00	10.00
MAX	97.00	95.00	60.00	62.00
MIN	0.00	0.00	0.00	0.00
T-TEST				

	PI100%	PI50%	PI10%	PI1%
MEAN	24.00	38.10	49.30	55.80
STD ERR	6.38	11.62	9.68	6.71
95% CONF	14.43	26.28	21.89	15.19
n	10.00	10.00	10.00	10.00
MAX	53.00	78.00	80.00	75.00
MIN	0.00	0.00	0.00	0.00
T-TEST	*			

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

Table 3d: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 16 September 1992

	CONTROL	UB100%	UB50%	UB10%	UB1%	UB0.
MEAN	36.4	51.60	35.30	49.20	31.50	20.40
STD ERR	8.19	4.67	8.14	7.99	6.90	8.17
95% CONF	18.53	10.56	18.41	18.08	15.62	18.49
n	10.00	10.00	10.00	10.00	10.00	10.00
MAX	60.00	74.00	65.00	69.00	59.00	60.00
MIN	0.00	22.00	0.00	0.00	0.00	0.00
T-TEST						

	PO100%	PO50%	PO10%	PO1%	PO0.1%
MEAN	37.90	15.90	8.00	27.40	34.1
STD ERR	15.71	10.60	7.57	6.57	7.1
95% CONF	35.54	23.98	17.12	15.26	16.1
n	10.00	10.00	10.00	10.00	10.00
MAX	115.00	80.00	76.00	59.00	57.00
MIN	0.00	0.00	0.00	0.00	0.00
T-TEST			*		

	POND100%	POND50%	POND10%	POND1%	POND0.1%
MEAN	14.40	46.30	7.30	36.30	47.90
STD ERR	11.14	12.97	5.38	8.13	3.59
95% CONF	25.20	29.35	12.17	18.39	8.11
n	10.00	10.00	10.00	10.00	10.00
MAX	114.00	111.00	53.00	70.00	62.00
MIN	0.00	0.00	0.00	0.00	29.00
T-TEST			*		

	PI100%	PI50%	PI10%	PI1%	PI0.1%
MEAN	65.70	34.30	74.10	17.00	31.80
STD ERR	12.01	10.62	3.25	7.98	7.42
95% CONF	27.16	24.03	7.35	18.05	16.79
n	10.00	10.00	10.00	10.00	10.00
MAX	105.00	86.00	91.00	65.00	66.00
MIN	0.00	0.00	55.00	0.00	0.00
T-TEST			*		

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

Table 3e: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 19 October 1992

	CONTROL	UB100%
MEAN	11.52	18.50
STD ERR	2.72	4.33
95% CONF	5.76	9.79
n	20.00	10.00
MAX	32.00	36.00
MIN	0.00	0.00
T-TEST		

	PO100%	PO50%	PO10%	PO1%	PO0.1%
MEAN	2.90	2.20	0.00	7.60	12.00
STD ERR	1.93	1.00	0.00	3.20	4.08
95% CONF	4.38	2.26	0.00	7.24	9.24
n	10.00	10.00	10.00	10.00	10.00
MAX	15	8.00	0.00	23.00	28.00
MIN	0.00	0.00	0.00	0.00	0.00
T-TEST	*	*	*		

	POND100%	POND50%	POND10%	POND1%	POND0.1%
MEAN	0.80	24.50	16.80	15.20	16.50
STD ERR	0.70	7.52	6.55	3.67	4.30
95% CONF	1.57.	17.01	14.81	8.31	9.72
n	10.00	10.00	10.00	10.00	10.00
MAX	7.00	66.00	64.00	31.00	33.00
MIN	0.00	0.00	0.00	0.00	0.00
T-TEST	*	*			

	PI100%	PI50%	PI10%	PI1%	PI0.1%
MEAN	0.50	14.70	19.90	14.40	7.90
STD ERR	0.34	7.92	6.34	4.58	3.32
95% CONF	0.77	17.92	14.34	10.36	7.51
n	10.00	10.00	10.00	10.00	10.00
MAX	3.00	76.00	48.00	34.00	25.00
MIN	0.00	0.00	0.00	0.00	0.00
T-TEST	*				

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

Table 3f: Daphnia 21 Day Reproduction Test.
Young Produced per Animal.

Start date: 18 November 1992

	CONTROL	UB100%	UB50%	UB10%	UB1%	UB0.
MEAN	49.39	44.70	52.90	40.10	49.40	49.4
STD ERR	2.15	3.16	3.39	4.74	2.61	3.26
95% CONF	4.55	7.14	7.66	10.72	5.90	7.38
n	18.00	10.00	10.00	10.00	10.00	10.00
MAX	64.00	39.00	67.00	55.00	61.00	69.0
MIN	34.00	34.00	35.00	0.00	38.00	33.0
T-TEST						

	PO100%	PO50%	PO10%	PO1%	PO0.1%
MEAN	28.20	43.00	51.60	48.70	52.9
STD ERR	6.62	2.57	2.39	6.64	2.5
95% CONF	14.97	5.82	5.41	15.03	5.8
n	10.00	10.00	10.00	10.00	10.00
MAX	61.00	55.00	63.00	73.00	71.00
MIN	0.00	33.00	37.00	0.00	42.00
T-TEST	*				

	POND100%	POND50%	POND10%	POND1%	POND0.1%
MEAN	5.50	44.00	60.70	53.00	51.00
STD ERR	1.39	8.37	2.82	3.89	6.39
95% CONF	3.15	18.93	6.38	8.79	14.45
n	10.00	10.00	10.00	10.00	10.00
MAX	12.00	82.00	71.00	70.00	66.00
MIN	0.00	0.00	42.00	26.00	0.00
T-TEST	*		*		

	PI100%	PI50%	PI10%	PI1%	PI0.1%
MEAN	0.70	42.10	52.10	48.70	54.70
STD ERR	0.52	5.34	6.47	4.75	5.89
95% CONF	1.17	12.07	14.64	10.74	13.32
n	10.00	10.00	10.00	10.00	10.00
MAX	5.00	72.00	76.00	65.00	69.00
MIN	0.00	16.00	0.00	18.00	6.00
T-TEST	*				

* Denotes T-test significance at the 0.05 level.
UB = River Murray below outfall
PO = Retention pond inlet.
Pond = Retention pond.
PI = Retention pond outlet.

TABLE 4: PERCENTAGE HATCH FOR MURRAY COD (Mucculochella peeli) EGGS.
% Hatch = (Number hatched/total number of eggs)*100

CONCENTRATION	MEAN % HATCH	STD DEV
control	93.51	2.21
100% pond outlet	96.75	2.49
50% pond outlet	94.52	2.49
20% pond outlet	95.72	0.34
10% pond outlet	95.61	0.08
1% pond outlet	94.44	1.25
100% pond	94.69	2.69
50% pond	96.31	4.37
20% pond	96.86	1.99
10% pond	96.70	1.03
1% pond	95.85	2.52
100% pond inlet	94.41	0
50% pond inlet	96.08	1.55
20% pond inlet	94.44	1.13
10% pond inlet	91.77	6.87
1% pond inlet	95.56	4.51

TABLE 5: CUMMULATIVE PERCENT MORTALITY OF MURRAY COD (Mucculochella peeli) FRY 30 DAYS POST HATCH

CONCENTRATION	MEAN % MORTALITY	STD DEV
control	27	5
100% pond outlet	27.11	9.26
50% pond outlet	34.47	27.74
20% pond outlet	8.24	2.00
10% pond outlet	12.45	8.83
1% pond outlet		
100% pond	36.72	10.41
50% pond	21.34	4.89
20% pond	10.31	1.59
10% pond	7.55	3.12
1% pond		
100% pond inlet	63.53	39.11
50% pond inlet	12.24	0.74
20% pond inlet	10.47	6.71
10% pond inlet	8.11	5.07
1% pond inlet		

(Untitled): Thu, 26-Nov-92 | (Untitled): Thu, 26-Nov-92

CODE	Weight (G)	Vol dilution	multiplier	Ba (mg/Kg)	Fe (mg/Kg)	Zn (mg/kg)	Cu (mg/kg)	Co (mg/Kg)
FO	2.6505	25.0000	9.4322	16.9779	73.5710	122.6184	4.7161	0.9432
F11	0.3006	25.0000	83.1670	8.3167	91.4837	182.9674	8.3167	<0.08
F12	4.4639	25.0000	5.6005	8.9608	78.4068	100.8087	5.0404	0.5600
F13	4.0321	25.0000	6.2002	8.6803	74.4029	99.2039	4.3402	0.6200
M11	1.2046	62.5000	51.8844	31.1307	830.1511	191.9724	20.7538	<0.5
M12	1.2441	62.5000	50.2371	20.0948	1808.5363	130.6165	20.0948	<0.5
ORM	0.9975	125.0000	125.3133	<2.5	513.7845	839.5990	62.6566	<1.3
YOA	5.0097	75.0000	14.9710	131.7444	299.4191	121.2647	47.9071	4.4913
YOB	4.8770	75.0000	15.3783	307.5661	307.5661	115.3373	47.6727	4.6135
YOC	5.0008	75.0000	14.9976	107.9827	299.9520	113.9818	46.4926	4.4993
Y11A	4.9807	75.0000	15.0581	286.1044	271.0462	195.7556	54.2092	4.5174
Y11B	4.9593	75.0000	15.1231	75.6155	272.2158	196.6003	55.9555	4.5369
Y11C	4.9465	75.0000	15.1622	242.5958	257.7580	181.9468	53.0678	3.0324
Y12A	4.9645	75.0000	15.1073	271.9307	166.1799	123.8795	54.3861	4.5322
Y12C	4.9874	75.0000	15.0379	126.3183	225.5684	148.8752	70.6781	4.5114
Y13A	5.0108	75.0000	14.9677	86.8125	209.5474	134.7090	62.8642	4.4903
Y13B	5.0421	75.0000	14.8748	124.9479	208.2466	141.3102	66.9364	4.4624
Y13C	4.9309	75.0000	15.2102	334.6245	228.1531	142.9759	66.9249	4.5631

(Untitled): Thu, 26-Nov-92 | (Untitled): Thu, 26-Nov-92

CODE	Weight (G)	Vol dilution	multiplier	Ni (mg/Kg)	Mn (mg/Kg)	P (mg/Kg)	Mg (mg/Kg)	As (mg/kg)
FO	2.6505	25.0000	9.4322	1.8864	27.3533	27824.9387	1886.4365	0.9432
F11	0.3006	25.0000	83.1670	<1.7	24.9501	28276.7798	1829.6740	<2.5
F12	4.4639	25.0000	5.6005	5.0404	24.6421	23522.0323	1568.1355	0.5600
F13	4.0321	25.0000	6.2002	3.1001	22.9409	23250.9114	1550.0608	0.6200
M11	1.2046	62.5000	51.8844	31.1307	103.7689	7782.6664	1141.4577	15.5653
M12	1.2441	62.5000	50.2371	15.0711	85.4031	7033.1967	904.2681	5.0237
ORM	0.9975	125.0000	125.3133	<2.5	12.5313	6015.0376	1378.4461	12.5313
YOA	5.0097	75.0000	14.9710	5.9884	449.1287	9281.9929	2844.4817	1.4971
YOB	4.8770	75.0000	15.3783	9.2270	461.3492	8919.4177	2814.3121	1.5378
YOC	5.0008	75.0000	14.9976	5.9990	449.9280	8998.5602	2699.5681	1.4998
Y11A	4.9807	75.0000	15.0581	6.0232	511.9762	8733.7121	3011.6249	1.5058
Y11B	4.9593	75.0000	15.1231	16.6354	544.4317	8771.3992	3024.6204	3.0246
Y11C	4.9465	75.0000	15.1622	6.0649	515.5160	8794.0968	2880.8248	1.5162
Y12A	4.9645	75.0000	15.1073	4.5322	453.2178	7251.4855	1963.9440	1.5107
Y12C	4.9874	75.0000	15.0379	6.0152	541.3642	9624.2531	2706.8212	1.5038
Y13A	5.0108	75.0000	14.9677	5.9871	628.6421	9279.9553	2843.8573	1.4968
Y13B	5.0421	75.0000	14.8748	5.9499	624.7397	9519.8429	2826.2034	1.4875
Y13C	4.9309	75.0000	15.2102	6.0841	638.8286	9430.3271	2889.9390	1.5210

(Untitled): Thu, 26-Nov-92 | (Untitled): Thu, 26-Nov-92

CODE	Weight (G)	Vol dilution	multiplier	Pb (mg/Kg)	Cd (mg/kg)	La (mg/Kg)
FO	2.6505	25.0000	9.4322	<0.2	<0.1	<0.2
F11	0.3006	25.0000	83.1670	<0.2	<0.8	<0.8
F12	4.4639	25.0000	5.6005	0.6000	<0.1	<0.2
F13	4.0321	25.0000	6.2002	<0.2	<0.1	<0.2
M11	1.2046	62.5000	51.8844	5.2000	5.2000	<1.0
M12	1.2441	62.5000	50.2371	5.0000	5.0000	<1.0
ORM	0.9975	125.0000	125.3133	<2.5	<1.5	<3.0
YOA	5.0097	75.0000	14.9710	<0.3	<0.2	1.5000
YOB	4.8770	75.0000	15.3783	<0.3	<0.2	<0.3
YOC	5.0008	75.0000	14.9976	<0.3	<0.2	<0.3
Y11A	4.9807	75.0000	15.0581	<0.3	<0.2	1.5000
Y11B	4.9593	75.0000	15.1231	<0.3	<0.2	1.5000
Y11C	4.9465	75.0000	15.1622	<0.3	<0.2	<0.3
Y12A	4.9645	75.0000	15.1073	<0.3	<0.2	<0.3
Y12C	4.9874	75.0000	15.0379	<0.3	<0.2	<0.3
Y13A	5.0108	75.0000	14.9677	<0.3	<0.2	1.5000
Y13B	5.0421	75.0000	14.8748	<0.3	<0.2	<0.3
Y13C	4.9309	75.0000	15.2102	<0.3	<0.2	<0.3

TABLE 6: Chemical analysis of tissue samples from bioaccumulation tanks

FO-fish initial (4 June 1992)
F11-fish control (1 Oct 1992)
F12-fish test (1 Oct1992)
F13-fish test (1 Oct 1992)
M11-mussel (1 Oct 1992)
M12-mussel (1 Oct 1992)
ORM-std reference (Oyster)
YOA,YOB,YOC,-yabby initial (4 June 1992)
Y11A,Y11B,Y11C,-yabby control (1 Oct1992)
Y12A,Y12C-yabby test (1 Oct 1992)
Y13A,Y13B,Y13C-yabby test (1 Oct 1992).

		UPSTREAM SAMPLES	DOWNSTREAM SAMPLES
Gravel Content (%)	Mean[a]	4.6	15.3
	S.D.[b]	15.3	19.1
	S.E.[c]	3.4	4.3
	Range	0-64.9	0-59.1
Sand Content (%)	Mean[a]	91.7	80.3
	S.D.[b]	15.7	18.3
	S.E.[c]	3.5	4.1
	Range	33.3-99.0	39.6-98.7
Silt and clay Content (%)	Mean[a]	3.7	4.4
	S.D.[b]	4.1	4.3
	S.E.[c]	0.9	1.0
	Range	1.0-19.0	1-18.9
Moisture Content (%)	Mean[a]	0.68	0.71
	S.D.[b]	0.38	0.48
	S.E.[c]	0.08	0.11
	Range	0.28-1.88	0.24-2.25
Total Persulfate Nitrogen (mg/kg)	Mean[a]	194	184
	S.D.[b]	124	87
	S.E.[c]	28	14
	Range	48-480	60-390
Exchangeable Phosphorus (mg/kg)	Mean	8.2	7.0
	S.D.[b]	2.8	2.7
	S.E.[c]	0.6	0.6
	Range	4.0-16.0	3.7-14.0

Table 7a: Variation in sediment characteristics between upstream and downstream sample. [a]Mean (n=20) - where a sample contained the analyte at less than the detection limit the analyte's concentration was counted as zero. [b]S.D. =Standard deviation. [c] S.E. = Standard error.

		UPSTREAM SAMPLES	DOWNSTREAM SAMPLES
Total Mercury (mg/kg)	Mean[a]	0.0009	0.009
	S.D.[b]	0.007	0.007
	S.E.[c]	0.002	0.002
	Range	0.002-0.031	0.002-0.032
Extractable Aluminium (mg/kg)	Mean[a]	202	191
	S.D.[b]	101	103
	S.E.[c]	22	23
	Range	109-530	75-428
Extractable Barium (mg/kg)	Mean[a]	19.2	18.4
	S.D.[b]	10.9	7.7
	S.E.[c]	2.4	1.7
	Range	9.0-58.0	9.0-35.6
Extractable Cadmium (mg/kg)	Mean[a]	0.04	0.06
	S.D.[b]	0.07	0.06
	S.E.[c]	0.02	0.01
	Range	<0.05-0.25	<0.05-0.20
Extractable Chromium (mg/kg)	Mean[a]	0.18	0.15
	S.D.[b]	0.15	0.10
	S.E.[c]	0.03	0.02.
	Range	0.05-0.75	<0.05-0.40
Extractable Cobalt (mg/kg)	Mean[a]	0.71	0.56
	S.D.[b]	0.55	0.44
	S.E.[c]	0.12	0.10
	Range	0.15-2.20	0.15-2.00

Table 7b: Variation in sediment characteristics between upstream and downstream sample. [a]Mean (n=20) - where a sample contained the analyte at less than the detection limit the analyte's concentration was counted as zero. [b]S.D. =Standard deviation. [c] S.E. = Standard error.

		UPSTREAM SAMPLES	DOWNSTREAM SAMPLES
Extractable Copper (mg/kg)	Mean[a]	0.77	0.73
	S.D.[b]	0.55	0.59
	S.E.[c]	0.12	0.13
	Range	0.25-2.75	0.15-2.50
Extractable Iron (mg/kg)	Mean[a]	557	446
	S.D.[b]	334	258
	S.E.[c]	77	58
	Range	194-1600	159-1130
Extractable Lanthanum (mg/kg)	Mean[a]	1.41	1.53
	S.D.[b]	0.88	1.12
	S.E.[c]	0.20	0.27
	Range	0.55-4.10	0.30-5.01
Extractable Lead (mg/kg)	Mean[a]	1.1	0.99
	S.D.[b]	0.9	0..84
	S.E.[c]	0.2	0.19
	Range	<0.1-3.7	<0.1-3.08
Extractable Magnesium (mg/kg)	Mean[a]	88	95
	S.D.[b]	37	44
	S.E.[c]	8.3	10
	Range	36-176	34-184
Extractable Manganese (mg/kg)	Mean[a]	125	109
	S.D.[b]	57	45
	S.E.[c]	13	10
	Range	67-292	61-194

Table 7c: Variation in sediment characteristics between upstream and downstream sample. [a]Mean (n=20) - where a sample contained the analyte at less than the detection limit the analyte's concentration was counted as zero. [b]S.D. =Standard deviation. [c] S.E. = Standard error.

		UPSTREAM SAMPLES	DOWNSTREAM SAMPLES
Extractable Nickel (mg/kg)	Mean[a]	0.72	0.74
	S.D.[b]	0.59	1.08
	S.E.[c]	0.13	0.24
	Range	0.15-2.90	0.15-5.00
Extractable Phosphorus (mg/kg)	Mean[a]	6.7	5.5
	S.D.[b]	3.7	3.6
	S.E.[c]	0.8	0.8
	Range	3.1-20.4	2.5-19.8
Extractable Yttrium (mg/kg)	Mean[a]	1.1	1.1
	S.D.[b]	0.6	0.7
	S.E.[c]	0.1	0.2
	Range	0.5-3.1	0.4-3.1
Extractable Zinc (mg/kg)	Mean[a]	2.7	2.4
	S.D.[b]	1.7	1.2
	S.E.[c]	0.4	0.3
	Range	1.4-9.0	1.2-6.5

Table 7d: Variation in sediment characteristics between upstream and downstream sample. [a]Mean (n=20) - where a sample contained the analyte at less than the detection limit the analyte's concentration was counted as zero. [b]S.D. =Standard deviation. [c] S.E. = Standard error.

TABLE 8: FISH COLLECTIONS FROM BAIT NETS IN THE RIVER MURRAY ABOVE AND BELOW THE ANM DISCHARGE POINT.

	SITE					
DATE	1	2	3	4	5	6
05 JUN 92	NR	0	0	0	0	0
30 JUN 92	0	0	0	0	0	0
28 JUL 92	0	0	0	0	0	0
25 AUG 92	0	0	0	0	0	0
29 SEP 92	0	0	0	0	0	0
08 OCT 92	0	0	0	0	0	0
18 NOV 92	1	18	2	0	1	4

NOTE: SITES 1&2 2km downstream
3&4 500m downstream
5&6 500m upstream (control)
NR = No nets recovered.

TABLE 2: SPECIES LIST AND CATCH NUMBERS
18 NOV 1992

	SITE					
SPECIES	1	2	3	4	5	6
Retropinna semoni	1	15	1	0	0	0
Hypseleotris klunzingeri	0	1	1	0	0	0
Philypnodon grandiceps	0	0	0	0	1	0
Carassius auratus	0	0	0	0	0	4
Percichthyidae (juvenile)	0	2	0	0	0	0