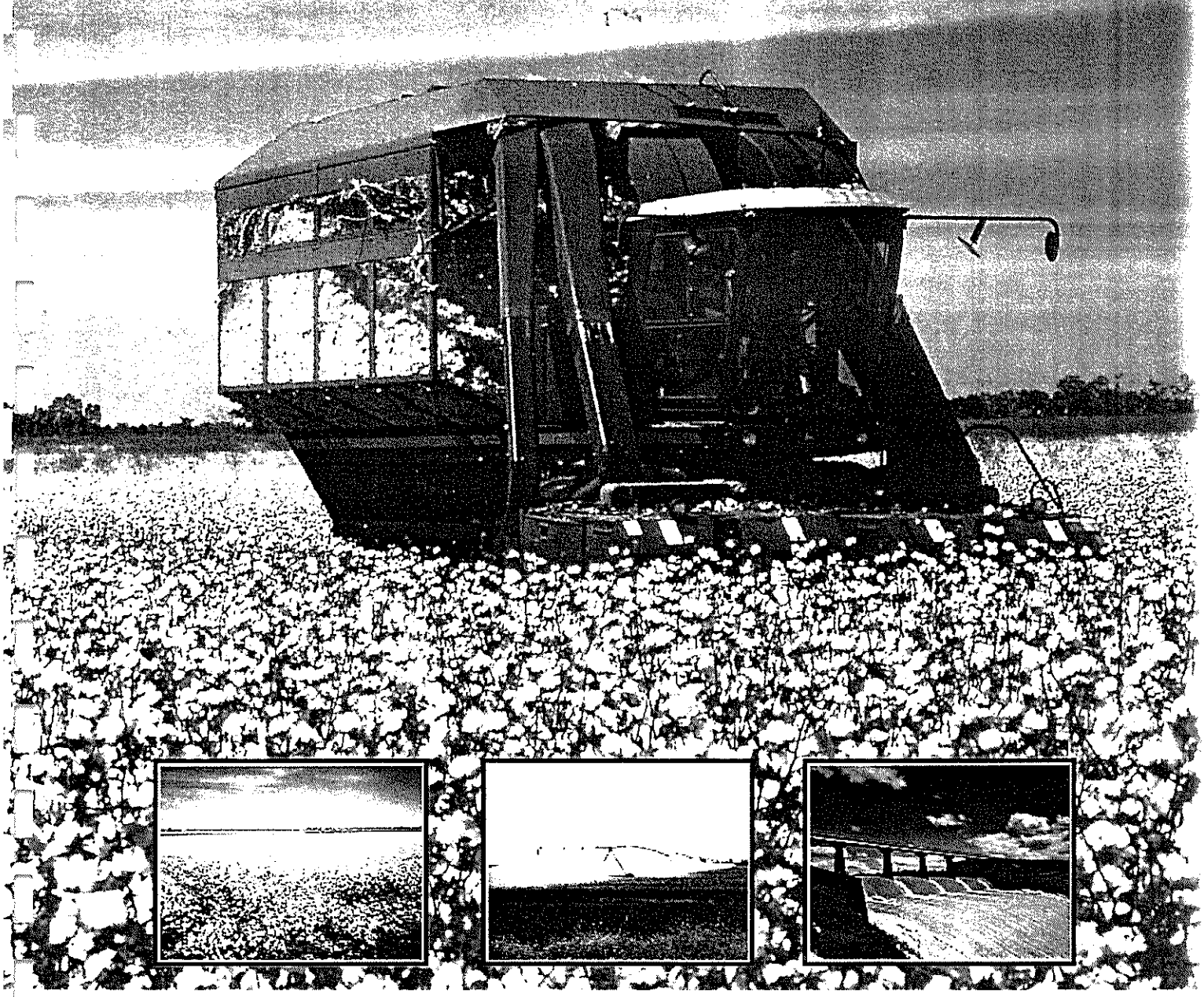
emerald irrigation area

DRAINAGE MANAGEMENT STUDY

PROJECT REPORT



QUEENSLAND GOVERNMENT

NATURAL RESOURCES

NATIONAL LANDCARE PROGRAM

February 1998

N Kelly DNR
PO Box 796
Rockhampton 4

NATIONAL LANDCARE PROJECT

EMERALD IRRIGATION AREA DRAINAGE MANAGEMENT STUDY

PROJECT REPORT

FEBRUARY 1998

Department of Natural Resources
Queensland

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NATURAL RESOURCES Queensland Government

NATIONAL LANDCARE PROGRAM

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Department of Natural Resources
GPO Box 2454
Brisbane Qld 4001

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EXECUTIVE SUMMARY

The Emerald Irrigation Area is a major cotton growing area located in the Central Highlands of Queensland. The town of Emerald has a population of around 12 000 people and is partially surrounded by cotton farms.

Cotton Fields in Emerald Irrigation Area.

Water from Fairbairn Dam on the Nogoa River supplies domestic, irrigation and industry needs along the Nogoa and parts of the Mackenzie River.

The objective of the Emerald Irrigation Area Drainage Management Study was to investigate, design and construct works to reduce tail and stormwater runoff from cotton farms and reduce non-point pollution of the receiving river system.

Issues addressed included the quantity and quality of tailwater and stormwater runoff from farms, the volume of this water that is being recovered for reuse and identifying the potential for further recovery.

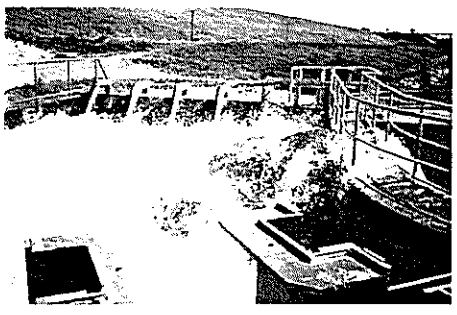
The value of this project relates to the potential for farm savings from water reuse or availability for additional farm development, any pollutants can be recirculated on the farm thus protecting the river system and collection of accurate data will assist the cotton industry.

Benefits include more beneficial use of water and keeping rivers clean thus gaining community confidence. It will also assist the cotton industry from an environmental and economic respect, in particular reducing hazards and increasing productivity. Cost benefits will result from the more beneficial use of water and a reduced possibility of river pollution.

Of the 70 farms in the Emerald Irrigation Area, 52 now have some form of a water recycling scheme. As the number of recycling schemes increased, flows in the drainage system have decreased, however water harvesting will continue to make these installations worthwhile. Prevailing dry climatic conditions over the 3 seasons of the project period and falling volumes in Fairbairn Dam resulted in reduced announced allocations. This circumstance influenced the installation of recycling systems. A total of 17,300 megalitres of water normally lost to the system was recycled with the potential for another 5,600 megalitres to be recycled. Given that channel water costs around $22.35 per megalitre the recycled water was worth $0.39M or in terms of cotton production $7.80M.

Standard specifications and plans for recycling structures which can be built without a detrimental effect on the performance of the drain have been developed by the Department of Natural Resources. Assistance was provided to landholders in designing new tailwater and stormwater recovery systems.

The quality of water leaving Fairbairn Dam, deteriorates as it progresses through the irrigation area. Physical chemical indicators, nutrients and pesticide levels are increased well above the source water. Irrigation farm drainage water consistantly exceeds ANZECC environmental guidelines for total nitrogen and some pesticides. Significantly water quality in the Nogoa River at Duckponds where the stream is heavily diluted with release water from Fairbairn Dam remains poorer than the



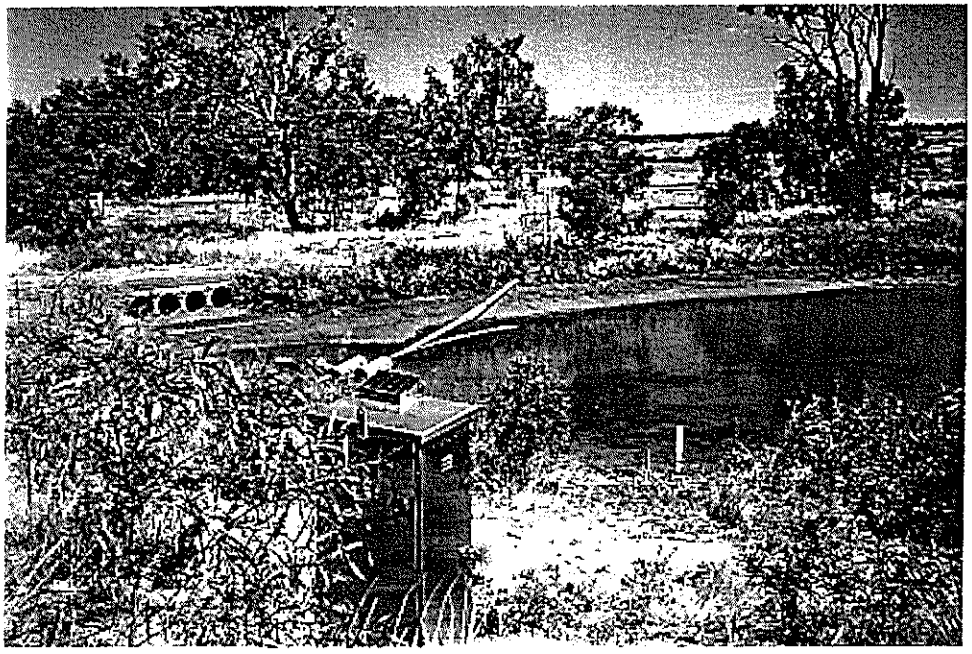
Release from Fairbairn Dam

source water. Of the cations, sodium and magnesium concentrations were higher and of the anions, bicarbonate, chloride, nitrate and sulphate concentrations were higher. Of the nutrients, average total P remained within the ANZECC environmental guidelines but average total N was frequently above the ANZECC environmental guidelines. Of the pesticides, endosulfan exceeded the ANZECC environmental guidelines in 3 of 6 samplings and traces of Diuron, Methomyl, Fluometuron and Prometryn were detected at this site.

Civil works installed as part of the study have resulted in improved water management techniques, efficiencies and water conservation. These works including automated stream gauging stations and flow measuring structures, will remain operative.

Survey results show that a large number of farmers within the Emerald Irrigation Area have future plans or ideas to contain tailwater on their farms before it enters the drainage network. Many also consider there is a potential to extract more water from the drains for their own irrigation purposes, with a significant proportion indicating the potential for flood harvesting.

Recycling systems have resulted in economic benefits through increased productivity and environmental benefits by helping to keep rivers clean. Continued encouragement is required to ensure all farm drainage water is retained or recycled on farm.



Automated Stream Gauging Installation On LN1 Drain.

1.0 Project Administration Summary

1.1 Title

Emerald Irrigation Area Drainage Management Study.

1.2 Organisational Funding

Joint funding for the project was provided by the Department of Natural Resources and the National Landcare Program under Schedule 1, Clean Rivers and Well Managed Catchments. See Appendix A.

1.3 Project Duration

The project commenced in November 1993 and continued for three years, until the end of the 1995/96 cotton irrigation season.

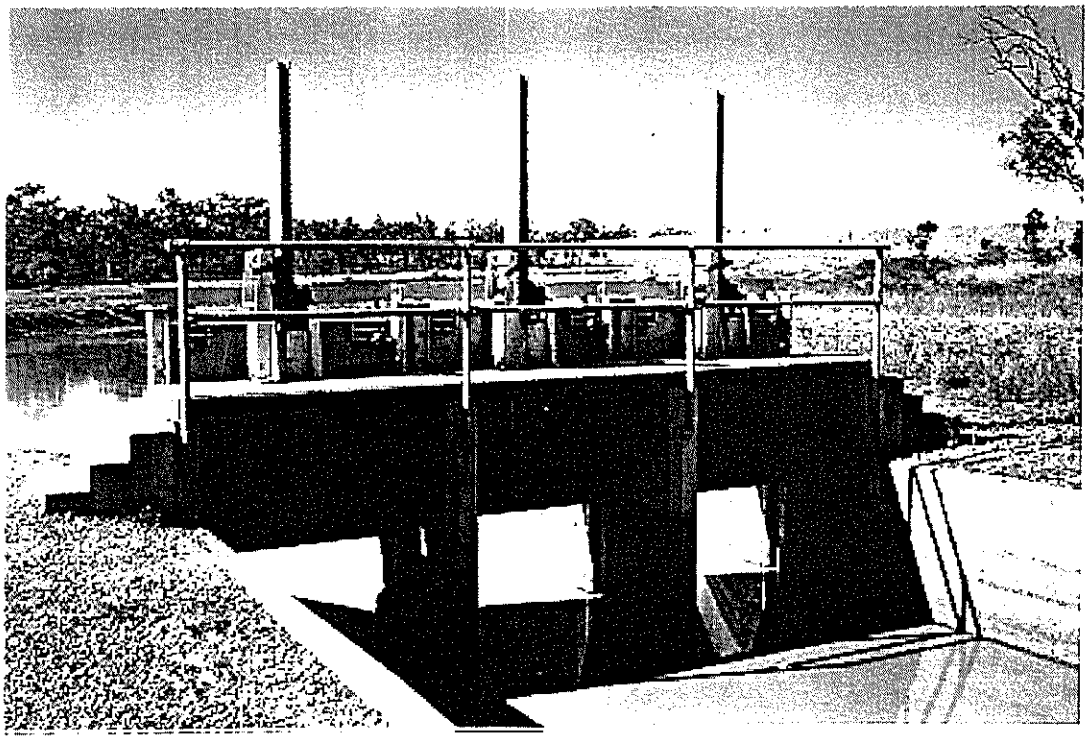
1.4 Project Management

The project was managed by State Water Projects, a business unit within the Department of Natural Resources . The project leader was the Acting Regional Manager for State WaterProjects, Central Region, Dave Tardrew. The project team has consisted of :

- Nigel Kelly, Supervising Hydrographer, Resource Management, Rockhampton
- Peter Voltz, Senior Hydrographer, Rockhampton
- Jim Cook, District Manager, SWP, Emerald
- Steven Bengtson, Engineer, SWP, Emerald
- Mark Mossop, Engineer, SWP, Emerald
- Russell Paton, Engineer , SWP, Emerald
- Michael Artlett, Scientist, ex Resource Management, Emerald.

1.5 Capital Assets

Six permanent stream gauging stations and associated works are located on appropriate drains and at the ends of Selma and Weemah channels where water overflows into the drainage system.



Gates on Selma Channel

2.0 Abstract

The objective of the Emerald Irrigation Area Drainage Management Study project was to investigate, design and construct works to reduce tail and stormwater runoff from cotton farms and non-point pollution of the receiving river system.Issues being addressed are:

(1) the quantity and quality of tailwater and stormwater runoff from farms
(2) the volume of this water that is being recovered for reuse and
(3) identifying the potential for further recovery.

The value of this project relates to:

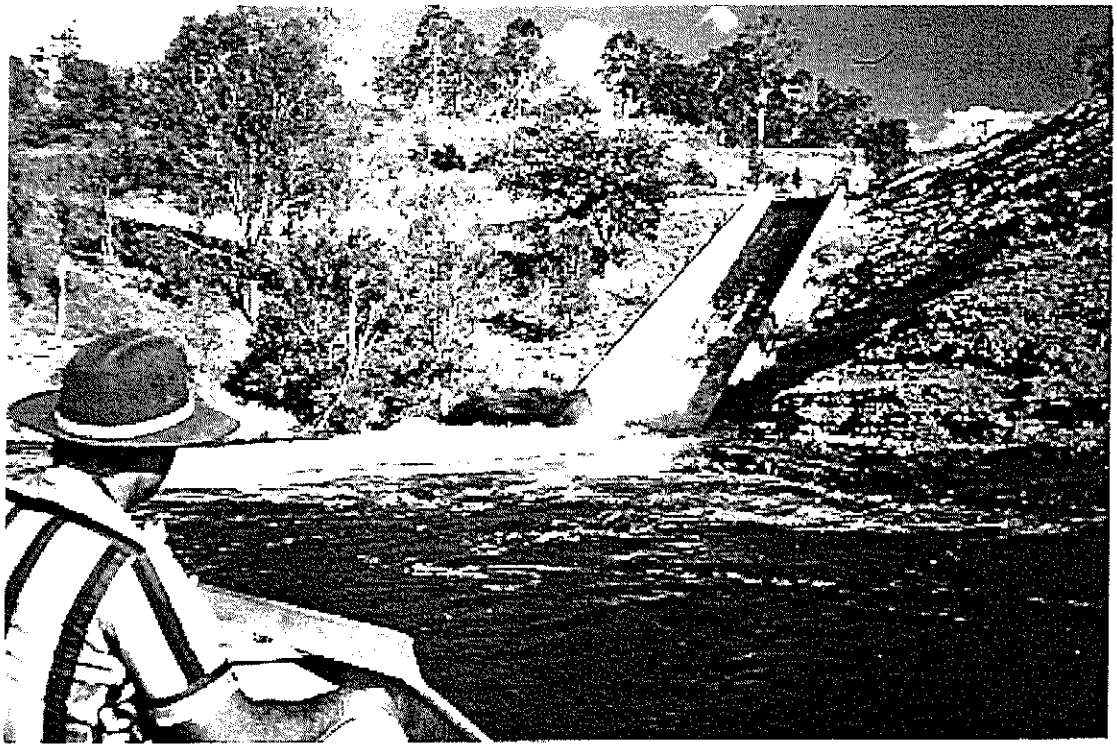
(1) the potential for farm savings from water reuse or availability for additional farm development
(2) any pollutants can be recirculated on the farm thus protecting the river system and collection of accurate data will assist the cotton industry.

Benefits include better use of water and keeping rivers clean thus gaining community confidence. It will also assist the cotton industry from an environmental and economic respect, in particular reducing hazards and increasing productivity.

Cost advantages will result from more beneficial use of water and a reduced possibility of river pollution.

Consultation has included Cotton Growers, Queensland Irrigators, other irrigation schemes and Emerald Shire Council.

Outcomes will result in improved management and water conservation practices in the Emerald Irrigation Area.



Release Outlet for Fairbairn Dam into the Nogoa River.

3.0 Methodology

The effectiveness of tailwater and stormwater recovery systems will be assessed by determining performance against design.

The volume of water that leaves the farm areas despite tail and stormwater runoff structures will be measured by automatic stream gauging stations for major drains and manual readings for minor drains.

Representative water quality data will be collected from the drainage system to determine general water quality and levels of pesticides, and nutrients.

Assistance will be provided to landholders in designing new tail water and stormwater recovery systems.

Release Channel from Fairbairn Dam into the Nogoa River

4.0 Climatic Conditions

4.1 Introduction.

Rainfall in Central Queensland is generally low and variable in nature. Permanent streams are few and extended dry periods are commonly followed by major floods. Stream flows are therefore variable in quantity and quality and unpredictable in occurrence. Temperatures, although not as variable as rainfall, are extreme and range from hot summers to frosts in winter.
Mean monthly evaporation is higher than the mean monthly rainfall in each month, indicating that moisture is quickly lost. Spring and early summer are when the greatest deficit between rainfall and evaporation occurs.
The climate can be generally described as sub-tropical, sub-humid with summer dominated rainfall.

4.2 Rainfall during the project period 1993 - 1996

Rainfall during the study period was generally well below average throughout the Fitzroy Basin . Some areas experiencing the driest seasons since records were kept. Annual totals for seven representative rainfall stations in the Fitzroy Basin are shown in Table 4.1 for the period 1993 to 1996.

Seven tropical cyclones had the potential to strongly influence rainfall during the study period. Only the remnants of one, 'Barry', which originated in the Gulf of Carpentaria, in January 1996, delivered widespread rainfall to the Fitzroy Basin.

Other significant rainfall events during the study period occurred in :

- February 1994, welcome falls along the coast and around Emerald.
- March 1994, heavy widespread falls, 100-240mm, throughout the Dawson and Central Highlands, especially around Capella.
- November 1995, some widespread falls in parts of the Dawson, Mackenzie and Comet catchments.
- April May 1996, widespread falls over the southern part of the catchment with falls up to 400mm being recorded.

Historical rainfall records reveal the extent of the dry period not only for the Fitzroy Basin but for large areas of Queensland. Conditions improved for some parts of the basin in the latter part of 1995 and early 1996.

Station Name	Station Number	Period of Record	Mean Annual Rainfall mm	Annual Rainfall mm 1993	Annual Rainfall mm 1994	Annual Rainfall mm 1995	Annual Rainfall mm 1996
Rockhampton	039083	1938-94	841	590	518	787	739
Marlborough	033050	1869-94	880	454	470	538	902
Nebo	033054	1869-94	758	485	326	442	570
Clermont	035019	1869-94	669	403	551	524	504
Emerald	**035027**	**1882-92**	**640**	**425**	**458**	**487**	**703**
Springsure	035065	1864-94	681	449	380	629	826
Taroom	035070	1869-4	677	593	504	755	646

Source information: Compiled from Bureau of Meteorology daily rainfall readings.
Table 4.1 Rainfall Statistics Fitzroy River Basin 1993 - 1996

5.0 Recycling Water in the Emerald Irrigation Area

5.1 Introduction

There are currently 70 farms in the Emerald Irrigation Area (EIA) of which 58 have drainage diversion agreements and some form of recycling scheme. Development of on-farm tailwater recycling schemes has been steadily occurring over the last decade, with a boom in construction during 1983-1991. The number of recycling schemes in the EIA is starting to reach a stagnation point. Response to the 1994/95 survey indicated that 15 farms acknowledged they had potential to prevent more tailwater from entering the drainage system.

Fairbairn Dam is now fully committed and announcing allocations above 100% will be rare in the future. Consequently farmers are entering a new era of farm management where their irrigation practice and efficient use of their yearly allocation of water will largely determine their profitability.

For the first time in the history of Fairbairn Dam and the Emerald Irrigation Area, an announced allocation of less than 100% was experienced. The 30% announced allocation for the 1995/96 water year and a 10 % announced allocation for part of the 1996/97 water year emphasises the importance of additional recycled water for maximised cropping yields.

The EIA was originally designed for irrigation of pastures and lucerne, but over the years has evolved to become a major cotton producer. As the supply system was not designed for the peak water demands of a cotton crop, the channel capacities cannot keep up with irrigation demand during peak watering periods.

5.2 Recycling Systems - Why?

There are three main catalysts for the development of recycling systems in the Emerald Irrigation Area.

(1) Meeting peak irrigation requirements
Cotton has a much higher peak irrigation need than pastures. The system is unable to supply the peak irrigation needs of all the farms and it is general for supply to be restricted during the peak of summer. Construction of a tailwater recycling system provides a secondary supply during these peak periods, enabling crop areas and returns to be maximised.

(2) Additional Development
A high proportion of irrigation farms have undeveloped areas which were previously deemed as unsuitable for irrigation because of soil types, flooding, elevation, etc. Increased crop returns, better irrigation practices, and different crops are making it viable to develop these areas. Tailwater recycling schemes are providing the additional water for this development.

(3) Sediment Trap
Recycling schemes can double as silt traps in many instances. The need for silt traps was heightened by the amount of silt deposited into State Water Projects drains during the March 1994 rainfall event. The economic cost of desilting and reinstating drains amounted to $230,000 in the 1993/94 water year. Silt traps reduce the amount of sediment entering the drainage system during irrigation and runoff events. Reduced silt entering water systems reduces maintenance and improves water quality.

In addition to these catalysts there are now external pressures mounting to encourage the retention and re-use of tailwater "on-farm," eg The Department of Environment, Environmental Protection Act. 1994.

5.3 Types of Recycling Schemes

The basis of a tailwater recycling system is some form of storage at the lower end of the farm which collects tailwater and storm runoff. This can then be pumped back to the top of the farm for future irrigation use.

A variation to this system is the additional extraction of water from the EIA drainage system. This water is runoff from other catchments and upstream farmers not retaining their tailwater, along with the numerous sub-surface drainage outfalls in the area.

5.3.1 Sub-surface Drainage Outfalls

The Emerald Subsurface Drainage Project was implemented to ensure the agricultural sustainability of the Emerald Irrigation Area.

Soon after the start of irrigation in the Selma section of the Irrigation Area, rising groundwater table problems were reported on several farms. The size and number of affected areas steadily increased, with large tracts of formerly productive land being rendered useless due to waterlogging and salinity.

Investigations revealed that the predominant factor contributing to the problem was a midslope change in soil profile. This soil boundary typically impeded the flow of seepage water, resulting in localised rises in groundwater levels. The sources of seepagewater include channel leakage and excess applied irrigation water.

The project involved the installation of almost 48 km of subsurface drainage pipe and associated outlet pipe. Approximately 500 ha of previously waterlogged and salinised land has now been reclaimed in an energy efficient and low maintenance way.

The outflow from the drainage pipes is variable depending on the natural recharge and level of irrigation. A photograph of an operating subsurface drainage outlet pipe located on drain RR4 is shown in Figure 5-1. Seepage water is picked up by downstream farmers who have drainage diversion agreements.

Figure 5-1: Subsurface drainage outlet pipe located on drain RR4

5.3.2 Drainage Diversions

Farmers can apply for a drainage diversion agreement which allows them to divert water out of the drainage system into their on farm storages or to be directly pumped back to the top of the farm for further irrigation. This water is charged at 25% of the channel supply rate. Two methods of diversion have been employed; gravity diversion and pumped diversion.

Gravity diversion exists where a farmer has constructed a diversion facility in a State Water Projects drain which can be fed under gravity, see Figure 5-2.

Pumped diversion consists of a pump suction located in the drain, see Figure 5-3.

Figure 5-3 : Pumped diversion arrangement

For diversion facilities to operate efficiently, a number of weir type obstructions have been built in the drainage system by irrigators.

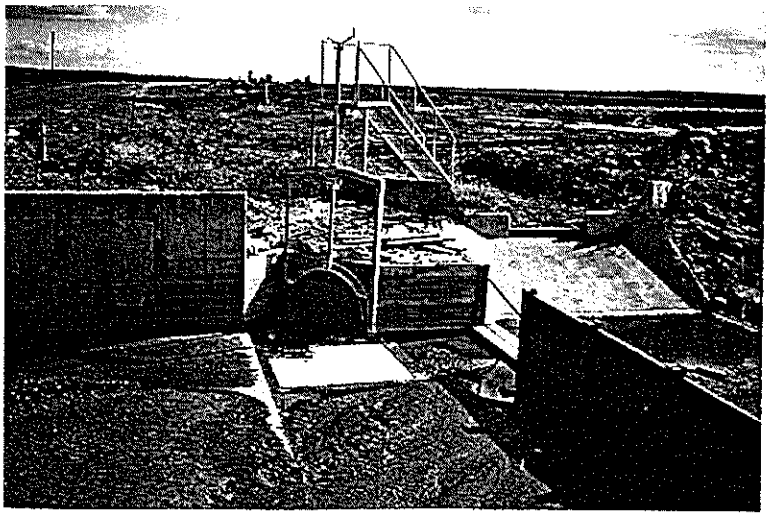


Figure 5-2 : Gravity diversion arrangement

The function of these quasi-weirs is to provide a pumping pool or to maintain a level at which gravity diversion can be maintained. An example of these structures is shown in Figure 5-4.

system will be made up of mostly outfall water. The poorer quality water when used for subsequent irrigation, impacts on crop growth and reduces yield. However, water harvesting will continue

Discussion of these results will be covered in Section 8. 34 irrigators responded to the survey- last 2 years from Selma and Weemah

Figure 5-4 : Obstruction in the drainage system

Until recently, State Water Projects did not have a clear set of guidelines on what would be allowed to be built in the drainage system. To ensure existing and future structures did not create detrimental backwater effects on the drainage sustem. An analysis of drain design flow determined 0.45m as the critical height above bed level for weirs in specific drains. Drawings of the standard specifications are included in Appendix B.

Initially the drainage diversion was an economical way of picking up low cost water. As the number of tailwater recycling schemes increase and more water is retained on-farm, the flows in the drainage

to make these installations a worthwhile exercise, subject to weather patterns. Section 8 will discuss the availability of further water for recycling.

5.4 Survey of Current Recycling Systems

A survey of farmers operating recycling systems commenced in 1993/94 as part of this project. In 1994 a brief survey of those irrigators adjacent to the drains which have gauging facilities installed was carried out. A similar survey was issued for the 1994/95 and 1995/96 water year to all irrigators in the Emerald Irrigation Area. A copy of the survey form and survey results is included in Appendix C.

5.5 Recycling - The Future ?

The number of farms retaining their tailwater has increased during the study period. Community concern over the pesticide content of drainage flows, may result in a requirement to restrict discharges of tailwater into river systems. The Department of Environments' Environmental Protection Act states in Part 2-Environmental Duties, Section 36.(1) A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or

minimise the harm (the "general environmental duty")

The stream gauging facilities constructed will help to quantify the magnitude of drainage flows and identify the potential for greater recovery. This will ultimately lead to the following economic and environmental benefits:

- access to improved quality of re-use water
- farmers having extra water to meet peak demand
- sediment transport in the drainage system is minimised
- pesticide and nutrient transport into the river system is minimised.

6.0 Emerald Irrigation Area Streamflow Records

6.1 Site Selection and civil works.

Eleven monitoring sites were chosen on streams, channels and drains, within and around the Emerald Irrigation Area. The location of these sites is shown in Appendix D. These sites provide a quantitative understanding of drainage and recycling volumes in this system. Eight of the sites are automatic stream gauging stations providing continuous discharge record and three are manually read staff gauges. Following is a brief description of these sites and the civil works undertaken follows.

GS130220A LN1 Drain at Emerald.
LN1 is a major drain to the west of Emerald. This site captures the majority of water entering the LN1 drainage system. Access is good in all weather conditions. An automatic stream gauging station and a concrete crump profile measuring weir was installed; see Figure 6-1.

LN1 Drain at Frisch's Farm.
LN1 drain enters a large wetland area at its end. Drainage water rarely passes beyond this point unless influenced by considerable rainfall runoff. A manually read staff gauge was installed.

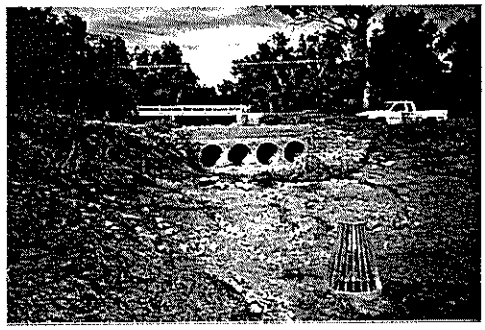


Figure 6-2 : Gauging station on culverts on LN3 drain, EIA

GS130221A LN3 Drain at Selma Road.
LN3 is a major drain to the south west of Emerald. Drainage water is collected here and pumped to LN1. However in rainfall runoff events water discharges directly into the Nogoa River. Although the low flows are measured at LN1, monitoring here allows total and proportional discharges to be determined. Access is good in all weather conditions. An automatic stream gauging station and a concrete measuring pad upstream of the overflow culverts was installed; see Figure 6-2.

GS130222A RR4 Drain at Emerald.
RR4 is also a major drain to the west and north of Emerald. Drainage water passing this point flows into Retreat Creek. This site captures the majority of the RR4 drainage system. Access is limited to fine weather conditions. An elevated automatic stream gauging station,and a concrete crump profile measuring weir were installed; see Figure 6-3.

Figure 6-3 : Gauging station on RR4 drain, EIA

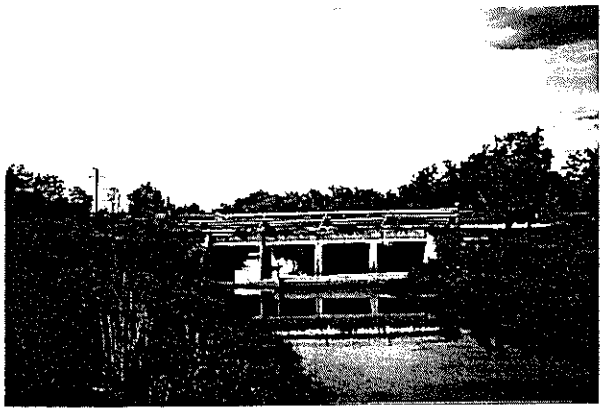


Figure 6-1: Concrete crump measuring weir on LN1 drain, EIA

GS130225A Selma Main Channel at Ford Creek.
Excess channel water reaching Ford Creek Overflow, west of Emerald, is diverted into Ford Creek which is a tributary of Retreat Creek. This site quantifies the amount of overflow and improves system management. Access is good in all weather conditions.
An automatic stream gauging station was installed.

GS130226A Selma Main Channel at Wills Road.
Excess channel water can be lost from the end of Selma Channel. This water overflows into Retreat Creek via RR7/3 and RR7 drains. This site quantifies the amount of overflow and improves system management. Access is good in all weather conditions.
An automatic stream gauging station was installed.

GS130227A Weemah Main Channel at 52 km.
Excess channel water overflows into LW4 drain, east of Emerald, then into Winton Creek. This site quantifies the amount of overflow and improves management techniques. Access is good in most weather conditions. An automatic stream gauging station was installed.

RN6 Drain at Blacks Gully.
RN6 drains a section of the Weemah channel area to the south east of Emerald. Drainage water passing this point flows into Blacks Gully a tributary of Winton Creek. A manually read staff gauge was installed.

RN6/1 Drain at Capricorn Highway.
RN6/1 also drains a section of the Weemah channel area. Drainage water passing this point flows toward Winton Creek. A manually read staff gauge was installed.

GS130206A Retreat Creek at Main Road.
This is an existing stream gauging station and water quality monitoring site, north of Emerald, which is of value to this project. This site measures drainage water entering Retreat Creek to the East of the Gregory Highway. Access is good in most weather conditions.

GS130219A Nogoa River at Duckponds.
This is also an existing stream gauging station and water quality monitoring site which is of value to this project. All water leaving the Emerald irrigation area passes this point. Access is fair in most conditions. Water quality at this site can be compared with water quality at Fairbairn Dam for an overall appreciation of change.

6.2 Instrumentation

The six new automatic stream gauging stations were equipped with the following instrumentation:-

- Hydromace TRS data logger
- Druck pressure transducer (3 sites)
- Mobile telephone telemetry
- Float well encoder (3 sites)
- Gas purge system (3 sites)
- Solar charging power supply
- Aluminium instrument shelter

Remote real-time data access was possible via Hydronet, utilising a telephone and computer modem link for data transfer. Figure 6.4 shows the instrumentation in one of the aluminium instrument shelters. Instrumentation was serviced regularly by DNR hydrometric services.

6.3 Stage-Discharge Relationship

Current meter measurements were undertaken by DNR hydrometric services at each automatic stream gauging site whenever the opportunity arose. This was necessary to establish the stream stage-discharge relationship over a range of flows to calculate streamflow volumes. Theoretical formulas were used for stable controls and measuring structures.

6.4 Streamflow Records Storage and Retrieval

Streamflow records have been processed and stored on Hydsys, the Departments proprietary streamflow data base in Rockhampton. Information can be retrieved in graphical or tabular format. Discussion of the streamflow data gathered will be covered in Section 8.

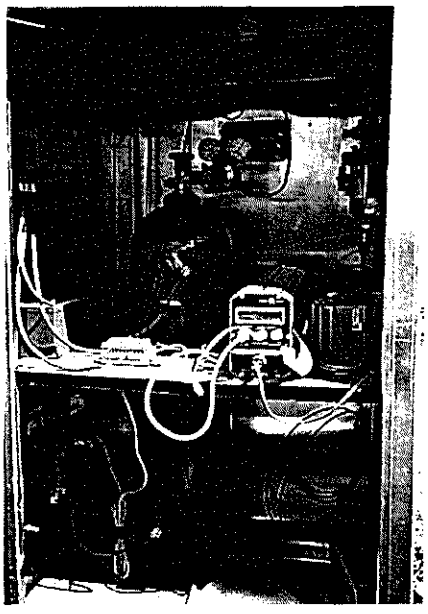


Figure 6-4 : Instrument shelter and data logging equipment

7.0 Water Quality

7.1 Site Selection

Seven sites were selected for water quality sampling. The sites were;

- the two irrigation supply channels, Weemah and Selma, at their source, Fairbairn Dam,
- three major drains in the Emerald Irrigation Area LN1, RR4, LN3
- and the receiving streams, Retreat Creek and the Nogoa River downstream of the EIA.

Sites are shown on the map in Appendix D. Each sampling site was located at a stream gauging station.
Discussion of results obtained are presented in Section 8.

7.2 Sampling Frequency

All sites were sampled on a monthly basis. Outside of the cotton season, irrigation supply channels and drains were not normally flowing. Pesticide sampling was based on three samples per cotton season, September to February. Timing problems were encountered due to the highly intermittent flow regimes occurring in the drains.

7.3 Parameters Measured

Measurements taken were;

- pH
- Conductivity
- Turbidity
- Dissolved Oxygen
- Temperature.

Stream height and discharge were also recorded at the time of sampling.

Bottled samples were forwarded to Queensland Health, Government Chemical Laboratory, Brisbane, for laboratory analysis.
Parameters measured were:

- *Major Ions :* samples were taken at all sampling points
- *Nutrients :* samples were taken at all sampling sites. Two samples were taken, filtered and unfiltered to determine total N and P and oxides of N.
- *Heavy Metals :* samples were taken at all sites. The irrigation supply channels were sampled six monthly.
- *Pesticides :* samples were taken at all sites except the irrigation supply channels three times a year during the cotton season.
- *Mercury* : Occasional samples were taken at all sites.

7.4 Sample Dispatch

Sample collection and preservation were undertaken in accordance with standards and procedures adopted by the Department of Natural Resources and the Department of Environments' Water Quality Sampling Manual. Samples were packed in insulated containers at required temperatures to preserve the integrity of the samples and sent by same day express courier to the Queensland Health, Government Chemical Laboratory in Brisbane, for analysis.

7.5 Data Storage & Retrieval

Water quality records are stored on HYDSYS / WQ the Departments proprietary water quality data management software. This is a system for managing discrete water quality data as it is generated, when water samples are analysed for a variety of chemical, physical and biological properties. DNR samples are in the process of being entered onto this database. Once stored on the data base, a variety of graphical outputs and summary reports will be available to assist data interpretations.

8.0 Emerald Irrigation Area Irrigation Water Recycling Results

8.1 Recycling Results

Summarised responses to the questionaire are shown for 1994/95 and 1995/96 in Appendix C

8.1 .1 Recycling Results 1993 / 1994 Water Year

The response to the 1993/94 survey was excellent with all but two survey forms returned. The survey indicated that :

- 3,050 ML of water was extracted from the drainage system
- 2,225 ML of water was recycled on the farm before it entered the drainage system
- 370 ML of water was recycled through storm events

The percentage of irrigation water lost was equal to :

$$\frac{\text{Drainage into Nogoa \& Retreat}}{\text{Total Releases from Dam}} \times 100\%$$

$$= \frac{\text{LN3, RR4, LN1, Retreat}}{\text{Selma \& Weemah}} \times 100\%$$

$$= \frac{10{,}993}{95{,}490} \times 100\%$$

$$= 11.5\ \%$$

The total amount of water extracted from the drainage system was approximately 3,050 ML + 370 ML = 3,420 ML.
The tailwater that was retained on farm before entering the drainage system was ignored in the following discussion.

From the stream gauging network, the 1993/94 flows measured in drains LN1, LN3, and RR4 were:

- LN1 1,070 ML fully consumed by users downstream of the gauging station
- LN3 283 ML no users downstream of this gauging station
- RR4 1,143 ML no users downstream of this gauging station

Therefore there was potential for a further recycling of 1,426 ML of water in 1993/94 The 1993/94 year was particularly dry, hence water harvesting opportunities were limited. Under average weather patterns, water harvesting opportunities should increase.

8.1.2 Recycling Results 1994 / 1995 Water Year

The 1994/95 survey indicated that:

- 2,690 ML of water was extracted from the drainage system
- 5,398 ML of water was recycled on the farm before it entered the drainage system
- 1,156 ML of water was recycled through storm events

The percentage of irrigation water lost was equal to :

$$\frac{\text{Drainage into Nogoa \& Retreat}}{\text{Total Releases from Dam}} \times 100\%$$

$$= \frac{\text{LN3, RR4, LN1, Retreat}}{\text{Selma \& Weemah}} \times 100\%$$

$$= \frac{9{,}624}{103{,}296} \times 100\%$$

$$= 9.3\ \%$$

The total amount of water extracted from the drainage system was approximately 2,690 ML + 1,156 ML = 3,846 ML.
Again the tailwater that was retained on farm before entering the drainage system was ignored in the following discussion.

From the stream gauging network, the 1994/95 flows measured in drains LN1, LN3, and RR4 were:

- LN1 1,013 ML fully consumed by users downstream of the gauging station
- LN3 988 ML no users downstream of this gauging station
- RR4 2,262 ML no users downstream of this gauging station

Therefore there was potential for a further recycling of 3,250 ML of water in 1994/95. The 94/95 year was also particularly dry, hence water harvesting opportunities were limited.

8.1.3 Recycling Results 1995 / 1996 Water Year

The 1995/96 survey indicated that :

- 932 ML of water was extracted from the drainage system
- 5,188 ML of water was recycled on the farm before it entered the drainage system
- 2,761 ML of water was recycled through storm events

The percentage of irrigation water lost was equal to :

$$= \frac{\text{Drainage into Nogoa \& Retreat}}{\text{Total Releases from Dam}} \times 100\%$$

$$= \frac{\text{LN3, RR4, LN1, Retreat}}{\text{Selma \& Weemah}} \times 100\%$$

$$= \frac{2414}{57158} \times 100\%$$

$$= 4.2\ \%$$

The total amount of water extracted from the drainage system was approximately 932 ML + 2,761 ML = 3,693 ML. The tailwater that was retained on farm before entering the drainage system was ignored in the following discussion.

From the stream gauging network, the 1995/96 flows measured in drains LN1, LN3, and RR4 were:

- LN1 1,456 ML fully consumed by users downstream of this gauging station
- LN3 943 ML no users downstream of this gauging station
- RR4 5 ML no users downstream of this gauging station

Therefore there was potential for a further recycling of 948 ML in 1995/96. As in the previous two years, the 1995/96 year was particularly dry, hence water harvesting opportunities were limited. Under average weather patterns, water harvesting opportunities should increase.

8.2 Streamflow

Streamflows gathered from each gauging station for the study period are presented in Table 8.1(a) , Table 8.1(b) , and Table 8.1(c).

Each data set extends from September to February, which covers the major watering periods for cotton.

GS 130222A RR4 Drain @ Emerald

Gauging Station	Sep	Oct	Nov	Dec	Jan	Feb	Total
GS130223A Selma @ Dam	6,559	7,317	2,599	18,002	22,825	8,338	65,640
GS130224A Weemah @ Dam	1,877	3,189	2,513	7,826	10,780	3,665	29,850
GS130216A Nogoa R @ Dam	4,146	6,641	5,411	13,301	17,144	5,217	51,860
LN1 Drain at Frisch's	0	0	0	0	0	0	0
GS130220A LN1 Drain	89.3	195	254	131	138	262	1069
GS130221A LN3 Drain	40	40	N.A.	57	56	90	283
GS130222A RR4 Drain	N.A.	N.A.	N.A.	291	315	537	1143
GS130225A Selma @ Ford Ck	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
GS130226A Selma @ Wills	8	8	8	8	8	8	48
GS130227A Weemah @ 52 km	5	5	5	5	5	5	30
RN6 Drain @ Blacks Gully	8	8	8	8	9	9	50
RN6/1 Drain @ Cap HWY	0	0	0	0	0	0	0
GS130206A Retreat Ck @ MR	728	213	5,911	1,356	494	948	9,650
GS130219A Nogoa R @ Duckponds	4,300	1,794	10,797	6,091	4,481	5,411	32,874
Emerald Rainfall (mm)	52.8	21	106.2	15.2	24.6	59.6	279.4

Table 8.1(a) : Stream gauging stations and their corresponding flows for the 1993/94 cotton watering season. Volume in megalitres.

Gauging Station	Sep	Oct	Nov	Dec	Jan	Feb	Total
GS130223A Selma @ Dam	15,282	5,756	10,110	20,639	17,303	2,167	71,257
GS130224A Weemah @ Dam	5,746	2,436	5,718	8,910	7,698	1,522	32,030
GS130216A Nogoa R @ Dam	11,001	9,906	13,402	23,143	14,357	1,938	73,747
LN1 Drain at Frisch's	0	0	0	0	0	0	0
GS130220A LN1 Drain	172	193	46	128	311	163	1,013
GS130221A LN3 Drain	73	209	36	21	281	368	988
GS130222A RR4 Drain	287	544	230	146	554	501	2,262
GS130225A Selma @ Ford Ck	N.A.	N.A.	N.A.	37.6	69.4	21.0	128
GS130226A Selma @ Wills	0	0	N.A.	N.A.	391	45.3	436
GS130227A Weemah @ 52 km	0	0	N.A.	99.4	180	107	386
RN6 Drain @ Blacks Gully	0	0	0	0	0	0	0
RN6/1 Drain @ Cap HWY	0	0	0	0	0	0	0
GS130206A Retreat Ck @ MR	131	664	106	73	475	5,361*	6,810
GS130219A Nogoa R @ Duckponds	6,221	5,496	6,033	12,235	13,015	32,168	75,168
Emerald Rainfall (mm)	0.4	34.0	23.8	14.6	128.7	105.4	306.9

* Amended for runoff from Theresa Creek

Table 8.1(b) : Stream gauging stations and their corresponding flows for the 1994/95 cotton watering season. Volume in megalitres.

Gauging Station	Sep	Oct	Nov	Dec	Jan	Feb	Total
GS130223A Selma @ Dam	9,904	947	6,482	12,963	6,923	5,668	42,887
GS130224A Weemah @ Dam	2,382	1,152	2,159	3,925	2,097	2,556	14,271
GS130216A Nogoa R @ Dam	4,606	2,033	6,570	10,581	2,774	3,613	30,177
LN1 Drain at Frisch's	0	0	0	0	0	0	0
GS130220A LN1 Drain	53	0.4	41	26	1,316	20	1,456.4
GS130221A LN3 Drain	0	0	0	0	943	0	943
GS130222A RR4 Drain	4.4	0.8	NA	NA	NA	NA	5.2
GS130225A Selma @ Ford Ck	34	3	60	60	14	18	189
GS130226A Selma @ Wills	44	80	80	170	141	235	750
GS130227A Weemah @ 52 km	133	145	198	311	311	262	1,360
RN6 Drain @ Blacks Gully	0	0	0	0	0	0	0
RN6/1 Drain @ Cap HWY	0	0	0	0	0	0	0
GS130206A Retreat Ck @ MR	0	0	0	0	155,600	9	155,609
GS130219A Nogoa R @ Duckponds	5,364	6,189	4,355	5,418	243,348	1,090	265,764
Emerald Rainfall (mm)	8.4	52.0	45.2	62.2	179.2	8.0	355

* The majority of flow at GS130206A and GS130219A was rainfall runoff.

Table 8.1(c) : Stream gauging stations and their corresponding flows for the 1995/96 cotton watering season. Volume in megalitres

8.3 Water Quality

Water quality information used in this report was collected as part of the ' Emerald Irrigation Area Drainage Management Study' and the Department of Natural Resources, 'Irrigation Area and Storages Water Quality Monitoring Project'. Information presented excludes samplings obtained during storm runoff conditions.

Reference Material
'Australian Water Quality Guidelines for Fresh and Marine Waters', ANZECC Nov. 1992, and 'Australian Drinking Water Guidelines'. 1996 NHMRC.
The current Guidelines do not have quantitative levels for all parameters, and other levels are indicative only.

8.3.1. Physical -Chemical Parameters.

Major ion sample results from Queensland Health, Government Chemical Laboratories (GCL) and hand held instrument measurements have been reviewed and the following observations made. Mean cation and anion concentrations for each of the seven sites are presented in Figure 8.3.1. Irrigation drainage water can be compared with water released from Fairbairn Dam via Selma and Weemah main channels.
Of the cations, sodium and magnesium, are higher in the water leaving the irrigation area. Of the anions, bicarbonate, chloride, nitrate and sulphate concentrations are higher in the water leaving the irrigation area . Ion

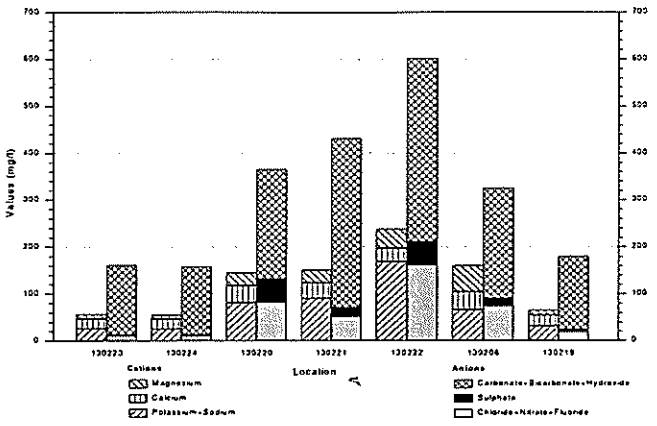


Figure 8.3.1 Emerald Irrigation Area, mean major ion concentrations September 1993 to November 1996

concentration levels at Duckponds are lower than the irrigation area due to the dilution effect of river releases from Fairbairn Dam, but remain slightly higher than Selma and Weemah channel water.

GS130223A Selma Main Channel at Fairbairn Dam
Water released from Fairbairn Dam via the main channels is generally well oxygenated and of good quality. Occasionally turbidity and pH exceeds Drinking Water Guidelines (DWG). It is suitable for all crops and stock.

GS130224A Weemah Main Channel at Fairbairn Dam
Water released from Fairbairn Dam via the main channels is generally well oxygenated and of good quality. Occasionally turbidity and pH exceeds Drinking Water Guidelines (DWG). It is suitable for all crops and stock.

GS130220A LN1 Drain at Emerald
Colour, turbidity and pH frequently exceed Drinking Water Guidelines. Due to the conductivity level, the water is not suited to all crops.

GS130221A LN3 Drain at Emerald
Turbidity, pH, colour and nitrate (once) occasionally exceed the drinking water guidelines. Due to the conductivity level and Sodium Adsorption Ratio (SAR) the water is marginal for some crops but suitable for all stock.

GS130222A RR4 Drain at Emerald
Turbidity and pH occasionally exceeded drinking water guidelines. Due to the conductivity level, SAR and Residual Alkalinity (RA), the water was marginal for some crops on occasions but remained suitable for stock.

GS130206A Retreat Creek at Main Road
Turbidity, colour and manganese (once) exceeded the Drinking Water Guidelines on occasions. Due to the level of conductivity and SAR the water was marginal for some crops but was suitable for stock.

GS130219A Nogoa River at Duckponds
Turbidity, colour pH and aluminium (once) exceed the Drinking Water Guidelines. The water is suitable for most crops and all stock.

Details of major ion samples are shown in Appendix E.

8.3.2 Nutrients

Results of nutrient samples, analysed by Queensland Health, Government Chemical Laboratories have been summarised in Figure 8.3.3. Water being released from Fairbairn Dam has a total phosphorous and total nitrogen load within indicative concentrations outlined in the ANZECC "Australian Water Quality Guidelines for Fresh and Marine Waters", Nov 1992.
These concentrations are :

- Total p 10-100µg/L
- Total n 100-750µg/L

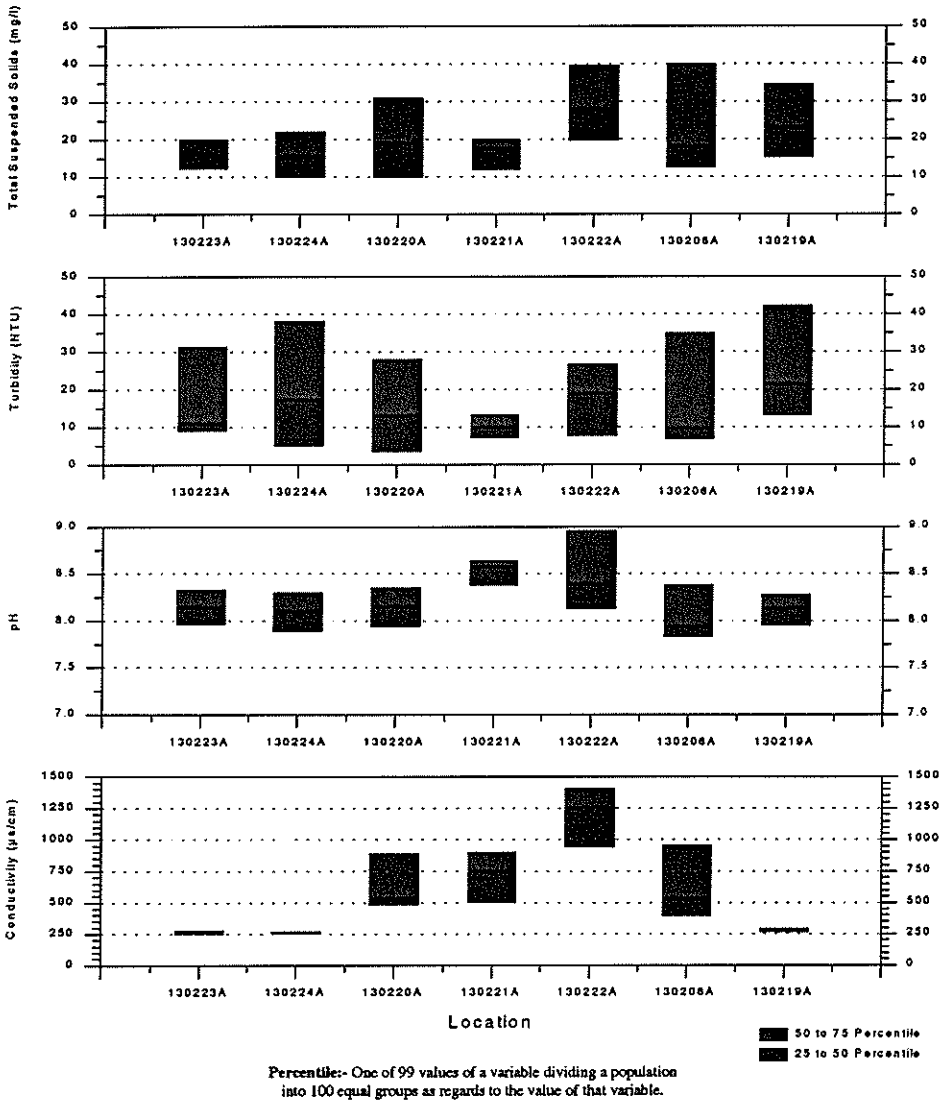


Figure 8.3.2 Emerald Irrigation Area, 25, 50 and 75 PercentilesTotal Suspended Solids, Turbidity, pH and Conductivity September 1993 to November 1996

Sample results show that once in the irrigation area, total phosphorus concentrations are occasionally higher and total nitrogen concentrations are consistantly higher than the indicative environmental guidelines.

Total phosphorus and total nitrogen concentrations are reduced upon leaving the irrigation area by subsequent dilution from Fairbairn Dam releases. At the Nogoa River at Duckponds the total phosphorous remained within the environmental guidelines but the total nitrogen was frequently above the environmental guidelines. Sample results are shown in Appendix F.

8.3.3 Pesticides

Due to the staggered timing of crop irrigation, and the short runoff duration, flows in the drainage system were extremely irregular. This along with the late inclusion of RR4 drain, meant the number of samples was lower than desired and varied from site to site.
Sample results and ANZECC guideline levels are shown in Appendix G.

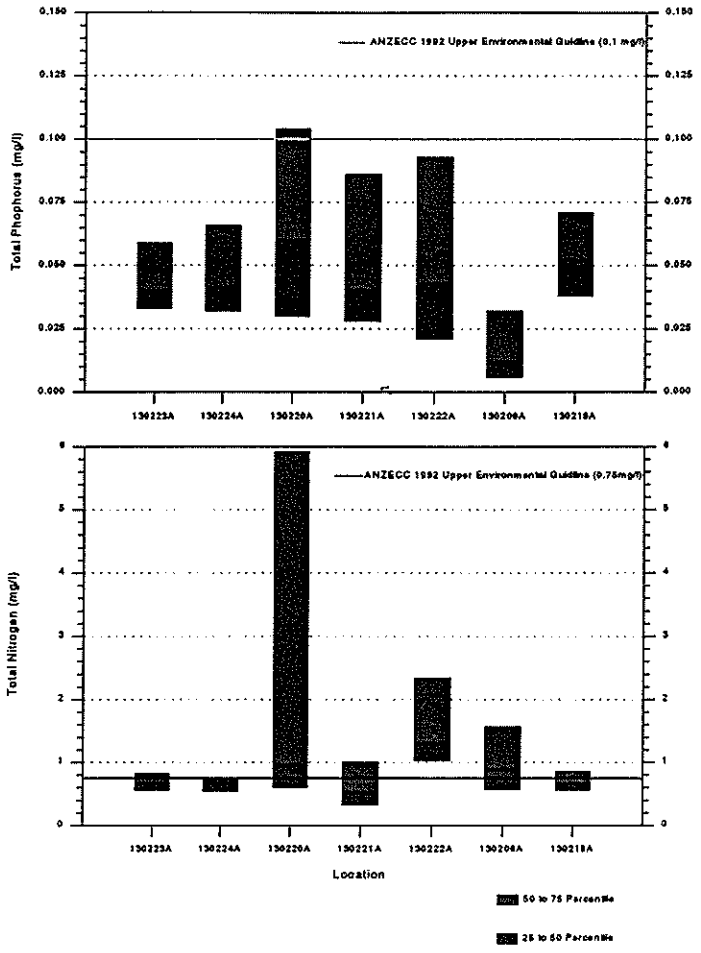


Figure 8.3.3 Emerald Irrigation Area 25, 50 and 75 Percentiles Total N and Total P September 1993 to November 1996

GS130221A LN3 Drain at Emerald

- Endosulfan exceeded the Environmental Guidelines (EG) in 6 out of 8 water samples.
- Endosulfan exceeded the Drinking Water Guidelines (DWG) in the one sediment sample taken.
- DDE exceeded the EG in the one sediment sample taken.
- Traces of Methomyl, Parathion methyl, DDE, Diuron, Fluometuron Endosulfan and Prometryn were also often detected in water samples at this site.

GS130220A LN1 Drain at Emerald

- Diuron exceeded the DWG in 1 out of 6 water samples (Jan 1994).
- Endosulfan exceeded the EG in 5 out of 6 water samples.
- Endosulfan exceeded the DWG in the 1 sediment sample taken.
- Traces of Trifluralin, Fluometuron, Prometryn, Methomyl, Endosulfan and Diuron were often detected at this site.

GS130222A RR4 Drain at Emerald

- Endosulfan exceeded the EG in 1 out of 3 water samples.
- Endosulfan exceeded the DWG in the one sediment sample taken.
- DDE exceeded the DWG in the one sediment sample taken.
- Traces of Diuron, Atrazine, Endosulfan, Fluometuron, Prometryn have been detected at this site.

GS130206A Retreat Creek at Main Road

- Fluometuron exceeded the DWG in 1 out of 8 water samples (Dec 1994).
- Diuron was close to the DWG in 2 out of 8 water samples.
- Endosulfan exceeded the EG in 5 out of 8 water samples.
- Endosulfan exceeded the EG in the one sediment sample taken.
- Traces of Endosulfan, Diuron, Fluometuron, Prometryn and Methomyl were regularly detected at this site.

GS130219A Nogoa River at Duckponds

- Endosulfan exceeded the EG in 3 out of 6 water samples.
- Endosulfan exceeded the EG in the 1 sediment sample taken.
- Traces of Endosulfan, Methomyl, Diuron, Fluometuron, Prometryn have been detected at this site.

Nogoa River at Selma Weir

- Profenofos exceeded the DWG in the one sample taken (February 1995).
- Endosulfan exceeded the EG in the same sample.
- Dead fish sampled at this time showed traces of Endosulfan and Profenofos in flesh and gills.
- DDE and Parathion methyl were also detected in water and fish samples.

Nogoa River at Main Road Bridge

- Profenofos exceeded the DWG in 2 samples taken in February 1995.
- Endosulfan exceeded the EG in both of these samples as well.
- Methomyl and Parathion methyl were also detected.

8.3.4 Heavy Metals

Heavy Metal results were based on a limited number of samples, three in the dam and channels and two in the irrigation area.

- GS130216A Nogoa River at Fairbairn Dam
- GS130223A Selma Main Channel at Fairbairn Dam
- GS130224A Weemah Main Channel at Fairbairn Dam

Water in and being released from Fairbairn Dam met all heavy metal EG requirements. Iron has been measured above the DWG, relative to aesthetic appearance.

GS130220A LN1 Drain at Emerald

All tested parameters were below EG at this site. Iron exceeded the DWG on one occasion.

GS130221A LN3 Drain at Emerald

All tested parameters were below EG at this site.

GS130222A RR4 Drain at Emerald

All tested parameters (except Copper on 1 occasion) were below EG at this site.

GS130206A Retreat Creek at Main Road

Copper (twice), Cadmium, Chromium and iron have exceeded the EG at this site.

GS130219A Nogoa River at Duckponds

Copper, Chromium and Iron have exceeded the EG on one occasion. Nickel has exceeded the DWG on one occasion.

Sample results for heavy metals are shown in Appendix H.

Mercury results were based on a limited number of samples, three in the dam and channels and one in the irrigation area. All samples remained within Environmental Guidline and Drinking Water Guideline requirements.
Sample results for mercury are shown in Appendix I.

8.4 WATER QUALITY SUMMARY

Physical chemical parameters of the water generally deteriorated after leaving Fairbairn Dam and progressing through the irrigation area. Salinity and the Sodium Adsorption Ratio rose and pH became more alkaline. Colour and turbidity were consistently high.
The water is marginal for some crops but remains suitable for stock. By the time the EIA drainage water reaches Duckponds on the Nogoa River, it has been diluted by the receiving stream which carries releases from Fairbairn Dam. Water at this point still exceeds drinking water guidelines for turbidity, colour and pH but is suitable for most crops and all stock.

Nutrient loading occurred within the irrigation area. At Duckponds the Total Phosphorus remained within, and Total Nitrogen frequently above, the environmental indicative concentrations.

Pesticide loading also occurred within the irrigation area. Samples frequently exceeded drinking water and environmental guidelines.
In the Nogoa River at Duckponds, Endosulfan exceeded the environmental guidelines on 3 out of 6 occasions. Traces of Diuron, Methomyl, Fluometuron and

Prometryn have also been detected at this site. Significantly Duckponds marks the end of the Irrigation area drainage water inflow and water here is heavily diluted by water released from Fairbairn Dam.

Although the number of heavy metal samples taken is small, the traces of copper, cadmium, chromium and nickel found at Retreat Creek, and in particular the Nogoa River at Duckponds, suggest further investigation is warranted.

Storage profiling of physio-chemical parameters has taken place in Fairbairn Dam over a three year period. Results confirm that the storage can become weakly stratified. The stratification pattern is influenced by seasonal strong winds and local climate conditions.

Profiling Site in Fairbairn Dam

9.0 PROJECT SUMMARY

Of the 70 farms in the Emerald Irrigation Area, 52 now have some form of a recycling scheme. As the number of recycling schemes increased, flows in the drainage system have decreased, however water harvesting will continue to make these installations worthwhile. Prevailing dry climatic conditions over the 3 seasons of the project period and falling volumes in Fairbairn Dam resulted in reduced announced allocations. This circumstance influenced the installation of recycling systems. A total of 17,300 megalitres of water normally lost to the system was recycled with the potential for another 5 600 megalitres to be recycled. Given that channel water costs around $22.35/megalitre the recycled water was worth $0.39M or in terms of cotton production $7.80M.

Standard specifications and plans for recycling structures which can be built without a detrimental effect on the performance of the drain have been developed by DNR. Assistance was provided to landholders in designing new tailwater and stormwater recovery systems.

The quality of water leaving Fairbairn Dam, deteriorates as it progresses through the irrigation area. Conductivity, pH, turbidity, major ions, nutrients and pesticide levels are increased well above the source water.

Significantly water quality in the Nogoa River at Duckponds where the stream is heavily diluted with release water from Fairbairn Dam remains poorer than the source water. Of the cations, sodium and magnesium concentrations were higher and of the anions, bicarbonate, chloride, nitrate and sulphate concentrations were higher.
Of the nutrients, average total P remained within the environmental guidelines but average total N was frequently above the environmental guidelines.
Of the pesticides, endosulfan exceeded the environmental guidelines in 3 of 6 samplings and traces of Diuron, Methomyl, Fluometuron and Prometryn have also been detected at this site.

Traces of the heavy metals, copper, cadmium, chromium and nickel were found in Retreat Creek and the Nogoa River.

Civil works installed as part of the study have resulted in improved water management techniques, efficiencies and water conservation. These works will remain operative.

Recycling systems have resulted in economic benefits through increased productivity and environmental benefits by helping keep rivers clean.

Survey results show that a large number of farmers within the Emerald Irrigation Area have future plans/ideas to contain tailwater on their farms before it enters the drainage network. Many also consider there is a potential to extract more water from the drains for their own irrigation purposes, with a significant proportion indicating that there is only potential for flood harvesting.

References.

Bureau of Meteorology, Daily Rainfall Records.
CMPS&F. (1992) Rockhampton Flood Management Study. Water Resources Commission.
Davies B, Willcocks J, Climate Variability in the Fitzroy Catchment, Fitzroy Catchment Symposium Proceedings.
Department of Natural Resources. Queensland streamflow records. Hydrometric Services

Appendices

NATIONAL LANDCARE PROGRAM (NLP)

Project Application - 1995/96

(COMMONWEALTH/STATE COMPONENT OF NLP)

NATIONAL LANDCARE PROGRAM

Proponent Ref No.	
NLP Ref No. (to be added by State for new project)	

Is this project?: New ☐ Continuing ☑

1 PROJECT TITLE (in 8 words or less): EMERALD IRRIGATION AREA DRAINAGE MANAGEMENT STUDY

2 SUBMITTING AGENCY/ ORGANISATION: Department of Primary Industries Water Resources

3

	PROJECT LEADER CONTACT	ADMIN CONTACT
Name	Mr David Tardrew (Acting Regional Manager)	Mr Jim Cook (District Manager)
Address	DPI Water Resources, PO Box 1834	DPI Water Resources, Locked Mail Bag 6
	ROCKHAMPTON QLD Postcode: 4700	EMERALD QLD Postcode: 4720
Phone	(079) 319 016 Fax (079) 319 007	(079) 828 800 Fax (079) 823 459

4 PROJECT LOCATION DETAILS

Statewide				
Region or Catchment				
Distance and direction to nearest Town	EMERALD			
Site	Lat:		Long:	
Grid Ref:				

5 PROJECT FUNDING DURATION (36 mths max)

Start date	November 1993	Completion date	October 1996

6 PROJECT OBJECTIVES (Briefly outline what the project is intended to achieve in a strategic sense)

The objectives of the project are the investigation, design and construction of works to reduce tail and stormwater runoff from cotton farms in the Emerald Irrigation Area (EIA) and consequently reduce non-point pollution of the receiving river system and more efficient use of water resources.

The project addresses the quantity and quality of tailwater and stormwater runoff from farms within the EIA and the current and potential level of recovery and reuse of runoff.

The desired outcomes of the project are:-

Proportion of water available to be recovered on farm and potential economic benefits;
Proportion of water currently being recovered in the EIA and the potential for greater recovery;
Proportion of recovery systems operating as expected;
Accurate data on the quality of water in the EIA drainage system;
Improved management & conservation of water resources in the EIA and downstream river system;
Extension of results to promote the results obtained above.

Project milestones include:

Installation of stream gauging and water quality monitoring equipment;
Undertake a survey of irrigators to determine level of recovery & reuse and effectiveness of schemes;
Quantification of the volume of water recovered in, and leaving the EIA;
preparation of an initial draft report for Year 1 of the project; and,
Preparation of a final project report and extension paper.

7 Budget Summary * adjusted for unspent NLP funds in current year (taken from Q 11)

YEAR	PROPONENT FUNDING	THIRD PARTY FUNDING	NLP FUNDING SOUGHT*	TOTAL PROJECT COSTS
Year 1 1994/95	$50,000	Nil	$50,000	$100,000
Year 2 1995/96	$50,000	Nil	$50,000	$100,000
Year 3 1996/97				
Year 4 1997/98				
Project Total	$100,000	Nil	$100,000	$200,000

8 PROJECT DESCRIPTION (Attach additional pages if necessary)

Briefly describe project (including a site diagram where appropriate), identifying main issues addressed , methodologies employed, organisations involved and their role. Also outline anticipated outputs, outcomes and expected milestones and those responsible for achieving them. Identify key beneficiaries.

The Emerald Irrigation Area is located adjacent to the town of Emerald in Central Queensland. The attached plan shows the general location of the projects.

The project addresses the issues of quantity and quality of tailwater and stormwater runoff from farms within the EIA and the current and potential level of recovery and reuse of runoff.

The desired outcomes of the project are:-

- Proportion of water available to be recovered on farm and potential economic benefits;
- Proportion of water currently being recovered in the EIA and the potential for greater recovery;
- Proportion of recovery systems operating as expected;
- Accurate data on the quality of water in the EIA drainage system;
- Improved management & conservation of water resources in the EIA and downstream river system;

Extension of results to promote the results obtained above.

The project employs the following general methodologies:-

Collection and analysis of streamflow and water quality data. The results of this can then be tied in to research being undertaken into transport of pesticides, herbicides and nutrients. The results of these activities will provide for quantification of non-point pollution from the EIA through the correlation of streamflow and pollutant transport and application across the irrigation area.

The results of the project will be applied to both water management and extension of recovery and reuse systems.

9. FUNDING 1995/96 For ALL work to be actually undertaken this year

COST ITEM	DETAILS	Proponent Contribution	Third Party Contributions	NLP funds required	TOTAL
EMPLOYMENT SALARIES/WAGES (Incl. positions & names). Tardrew (RM) Kelly TO4, Krueger TO3 Artlett PO3, Mossop PO2 Neubecker AO4	Engineering 35% $18,000 Technical 65% $30,000	$40,000		$8,000	$48,000
CONSULTANTS					
OTHER					
ON-COSTS (Not to exceed 25%.)		$10,000		$2,000	$12,000
SUB-TOTAL: EMPLOYMENT COSTS					
OPERATING TRAVEL & VEHICLE HIRE				$ 9,500	$ 9,500
INFORMATION PROCESSING				$5,000	$5,000
SAMPLE PROCESSING ANALYSIS & HANDLING				$2,500	$2,500
EQUIPMENT HIRE/LEASE				$5,000	$5,000
DATA RECORDING COMPONENT REPLACEMENT				$1,000	$1,000
LNI AND WEEMAH CHANNEL AUTO RECORDER - MOBILE PHONE COSTS				$1,000	$1,000
EXTENSION MATERIAL & ACTIVITIES				$5,000	$5,000
ADMINISTRATION				$1,000	$1,000
OTHER					
SUB-TOTAL: OPERATING COSTS				$30,000	$30,000
CAPITAL Upgrade control structure RR4 drain - install stabilisation work	Further stabilisation of control structures (2 off)			$10,000	$10,000
SUB TOTAL				$10,000	$10,000
ESTIMATED CARRY OVER AT 30 JUNE 1994					
TOTAL FUNDING SOUGHT 1995/96		$50,000		$50,000	

10 BUDGET JUSTIFICATION

Brief reason as to why expenditure indicated in Budget is required including any cost increases over original submission and justification of proposed cost-sharing arrangements (where NLP funds sought exceed total State contributions)

Operating

Travel and vehicle hire associated with data collection, equipment maintenance, water quality sampling and extension.

Information processing on computer based and telemetry systems including streamflow and extension data.

Water sample analysis and handling, pesticide major ion, nutrient. Equipment hire/base of specialist hydrographic equipment.

Data Recording component replacement of expendable items.

Mobile phone costs for Telemetry station at LN1.
Extension material and activities including land holder surveys and interaction, result reporting and analysis.

Administration of funds and activities.

Capital

Stabilize control structures to sensitise flow measuring capabilities. Structures with stable height discharge relationships are necessary.

11 NLP FUNDS UNSPENT FROM PREVIOUS YEARS (For a Continuing Project)

NLP Funds required in 1995/96 (from Item 9)		50,000
NLP funds carried forward from 1993-94	0	
PLUS NLP Payments received in 1994-95	+ 50,000	
LESS estimated NLP funds spent during 1994-95[1]	- 50,000	
Unspent NLP funds remaining 1994-95	= 0 ⊃	- 0
NLP funding sought for 1995-96		= 50,000

Notes: [1] Actual expenditure where known, otherwise estimate to end of the financial year.

12 FORWARD ESTIMATES 1996/97 (NB: Funding in future years is not guaranteed)

COST ITEM	PROPONENT'S CONTRIBUTION	THIRD PARTY CONTRIBUTION	NLP FUNDS SOUGHT 1996/97	PROJECT COSTS 1996/97
EMPLOYMENT				
OPERATING				
CAPITAL				
TOTALS 1996/97				

13 FORWARD ESTIMATES 1997/98

COST ITEM	PROPONENT'S CONTRIBUTION	THIRD PARTY CONTRIBUTION	NLP FUNDS SOUGHT 1997/98	PROJECT COSTS 1997/98
EMPLOYMENT				
OPERATING				
CAPITAL				
TOTALS 1997/98				

14 FORWARD ESTIMATES 1998/99

COST ITEM	PROPONENT'S CONTRIBUTION	THIRD PARTY CONTRIBUTION	NLP FUNDS SOUGHT 1998/99	PROJECT COSTS 1998/99
EMPLOYMENT				
OPERATING				
CAPITAL				
TOTALS 1998/99				

15 LINK WITH NLP PARTNERSHIP AGREEMENT

Indication of how project relates to State natural resources management strategies/ partnership agreement including details on complementary measures as outlined in relevant partnership strategies. (eg. water allocation policy, water quality guidelines, vegetation management strategies)]

The Emerald Irrigation Area Drainage Management Study project is consistent with the Draft *Agreement Between Commonwealth of Australia and State ____ Under the Natural Resource Management (Financial Assistance) Act 1992 for The Provision of Financial Assistance for Projects Relating to Natural Resource Management,* August 1993 in that it provides for:

Promoting community, industry and government partnership in the management of natural resources through encouraging efficient and sustainable water resource use and management; and,

- Contributing to enhancement of long term productivity of water resources;

The project is also consistent with the Draft *Guide to Project Funding Under the Commonwealth/State Component of the National Landcare Program,* DPIE 1994. This guide specifically refers to the objectives of the Draft

Agreement above and consequently the statements above can be applied. The project also demonstrates:

- A focus on outcomes and achieving changes in water management practices and policies and addressing the contributing causes of water resource degradation rather than the symptoms;
- Catchment based planning with the project examining a specific issue identified as impacting on the catchment unit;
- Increased economic efficiency and cost effectiveness, including more efficient resource allocation and use; and,

- The use of water resources within their capability while providing a variety of options for future resource use.

Specifically the project is a venture which aims to reduce irrigation tailwater and stormwater runoff from farms in the EIA and consequently increase water use efficiency and reduce non-point pollution of receiving water.

The project is consistent with the following Queensland State Water Conservation Strategy which includes the following strategies:

"Best practices will be encouraged to ensure that development with catchments follows the principles of ecologically sustainable development, and acceptable standards of water quality are maintained"; and,

The State Water conservation Strategy also provides the link to the National Strategy for Ecologically Sustainable Development and is referred to as a framework for the planning, development and management of water resources "in accordance with the principles of the Commonwealth National Strategy for Ecologically Sustainable Development".

The National Strategy for Ecologically Sustainable Development (ESD) states that the challenge of Water Resource Management is "to develop mechanisms for water resource management which aim to maintain ecological systems while meeting economic, social and community needs."

16 CONSULTATION Identify those involved in the project, stakeholders and form of consultation undertaken

The project principal is the DPI Water Resources, however consultation has taken place with other Business Groups of the Department. Siting of stream gauging and water quality monitoring sites has been undertaken to benefit the research project on transport of nutrients and chemicals being undertaken by Chris Carroll (DPI, LU&F).

DPI Water Resources has for some time being promoting water use efficiency through on-farm recovery and reuse schemes and as a result has close contact with irrigators in the EIA. Further to this, a survey of irrigators is to be undertaken to examine the degree and effectiveness of recovery systems.

Consultation has also taken place with the Emerald Irrigators Advisory Committee, cotton growers, other irrigation schemes and the Emerald Shire Council.

Further consultation is expected within the Department to ensure the most beneficial use of the data collected and results obtained.

17 METHODS OF INFORMATION DISSEMINATION

Brief details relating to the method of dissemination and/or adoption of results.

Information stored in the Hydsys database for water quality and streamflow parameters is available for output in tabular and graphical form and statistical analysis of the data can also be undertaken by the Hydsys package.

Results of the project will also be disseminated through a project report and extension paper. The extension paper will be distributed generally and also specifically to Central Queensland irrigators.

18 MONITORING

Processes of monitoring and evaluating the outcome of the project.

The outcomes of the project can be evaluated against the objectives of the project through the quantification of results and dissemination of information in order to facilitate change where required.

19 ENVIRONMENTAL & HERITAGE CONSIDERATIONS

Has or will this project be assessed against State/Territory environmental requirements?

Briefly outline any significant environmental impacts likely to arise from this project.

Improved quality of surfacewater downstream of EIA.

Are you aware if the project is to be carried out at or near a place listed on the Commonwealth Register of the National Estate? If so please specify

20 PROGRESS REPORT CONTINUING PROJECT ONLY:

(Attach additional pages if necessary. Delete/remove this page for new project)

Detail achievements and key milestones to date, including expenditure profile over previous years of the project: is the project on schedule and likely to meet initially specified outcomes?. If not provide a justification .

EIA DRAINAGE MANAGEMENT STUDY PROGRESS REPORT	
Objective • **performance indicator**	Activity • **result to date**
1.1 Quantification of Drainage Flows and Water Quality	1.1 Progress to Date
• Installation of stream gauging equipment	Three new Automatic Gauging stations have been installed in 1994/95 bringing the total to six (6) sites in the EIA. Ongoing maintenance of these sites carried out.
• Discharge Ratings	Ratings have been undertaken at three (3) key sites in the EIA. Development of rating curves for the 3 remaining sites is underway.
• Water quality monitoring	A regular sampling program is now in place. Presticide sample results are being assessed by Water Quality Group.
• Data storage & retrieval	Streamflow information is being stored on the Hydsys database. Hydsys entry of water quality data has commenced, and is 50% complete.
2.1 Quantify the Effectiveness of Existing Recycling Schemes in the EIA	2.1 Progress to Date
• Survey of Schemes Installed	There are currently 70 farms in the EIA of which 52 how have recycling schemes. This compares to 40 in Nov 1992. 16 have also improved their schemes since that time. The survey of schemes will be undertaken at the end of the water year (around May) to determine the efficiency of individual schemes.

• Assessment of Data Collected	Sufficient data collected to date to give preliminary indications of recycled water at the end of the water year (see report for 1993/94).
3.1 Collation & Presentation of Overall Project Results	3.1 Progress to Date
• Collate & analyse data	Sufficient data collected for preliminary analysis at the end of the 1994/95 water year.
• Report of findings and extension material	Report for 1993/94 completed (Copies available on request). Report for 1994/95 will be prepared after the water year. This will include updated water flows and more extensive water quality information.
4.1 Implement of Results	4.1 Progress to Date
Feedback from extension and number of new/improved schemes	To be monitored as project progresses.

General Comments:

The monitoring network has been established. Along with the ongoing monitoring will be a review of the appropriateness of each site and improvement if required.

The 1994/95 season has been characterised by an extended dry period which produced limited tailwater discharges and minor drainage runoff. Some farms experienced minor runoff from isolated storm events.

PROJECT CERTIFICATION

(State NLP contact or delegate to complete)

I certify that this application is eligible under Commonwealth/State partnership agreement/natural resource management strategy and is suitable to be forwarded to State Assessment Panels for assessment.

Signature

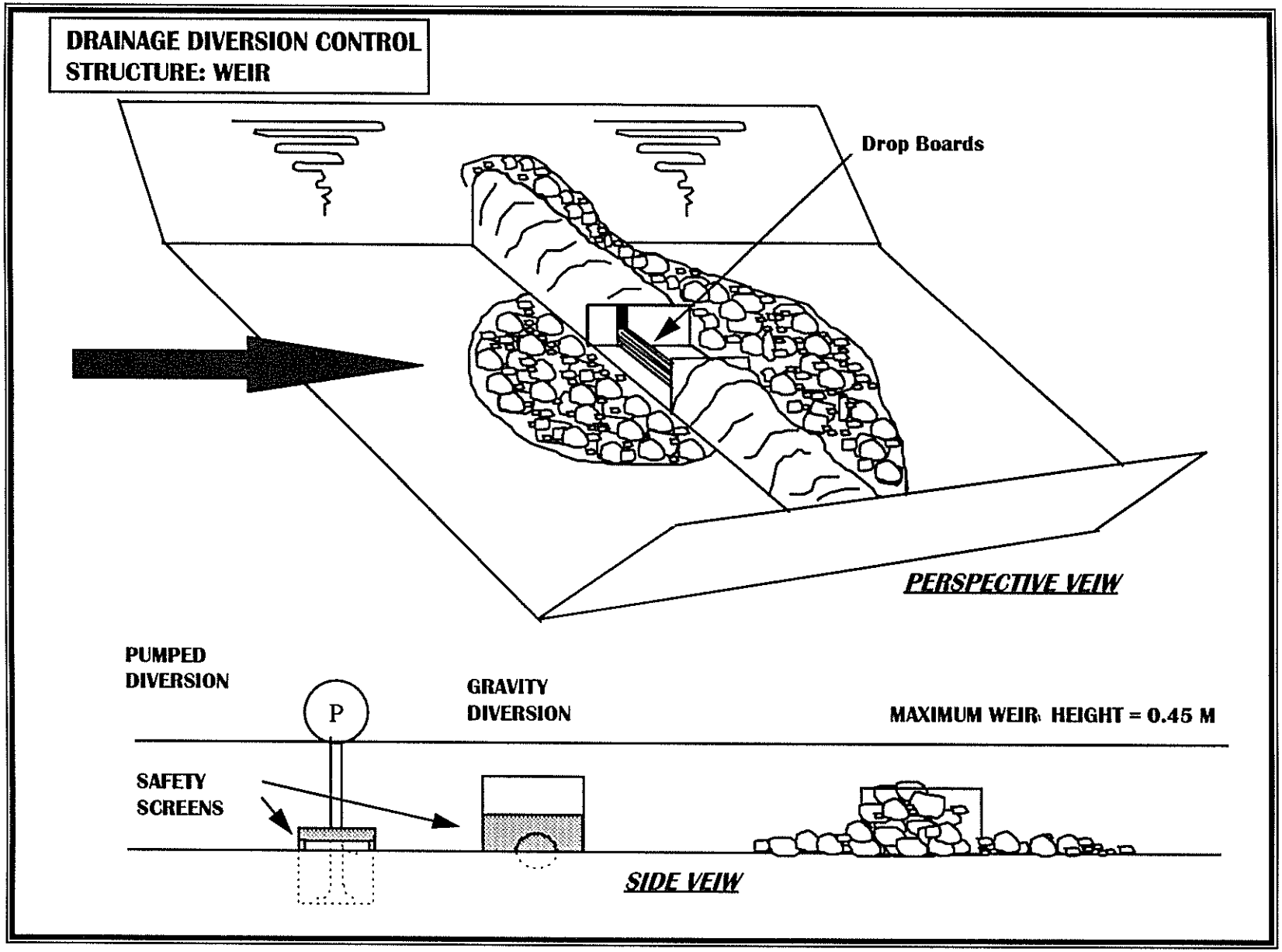
Name: Mr D J. TARDREN

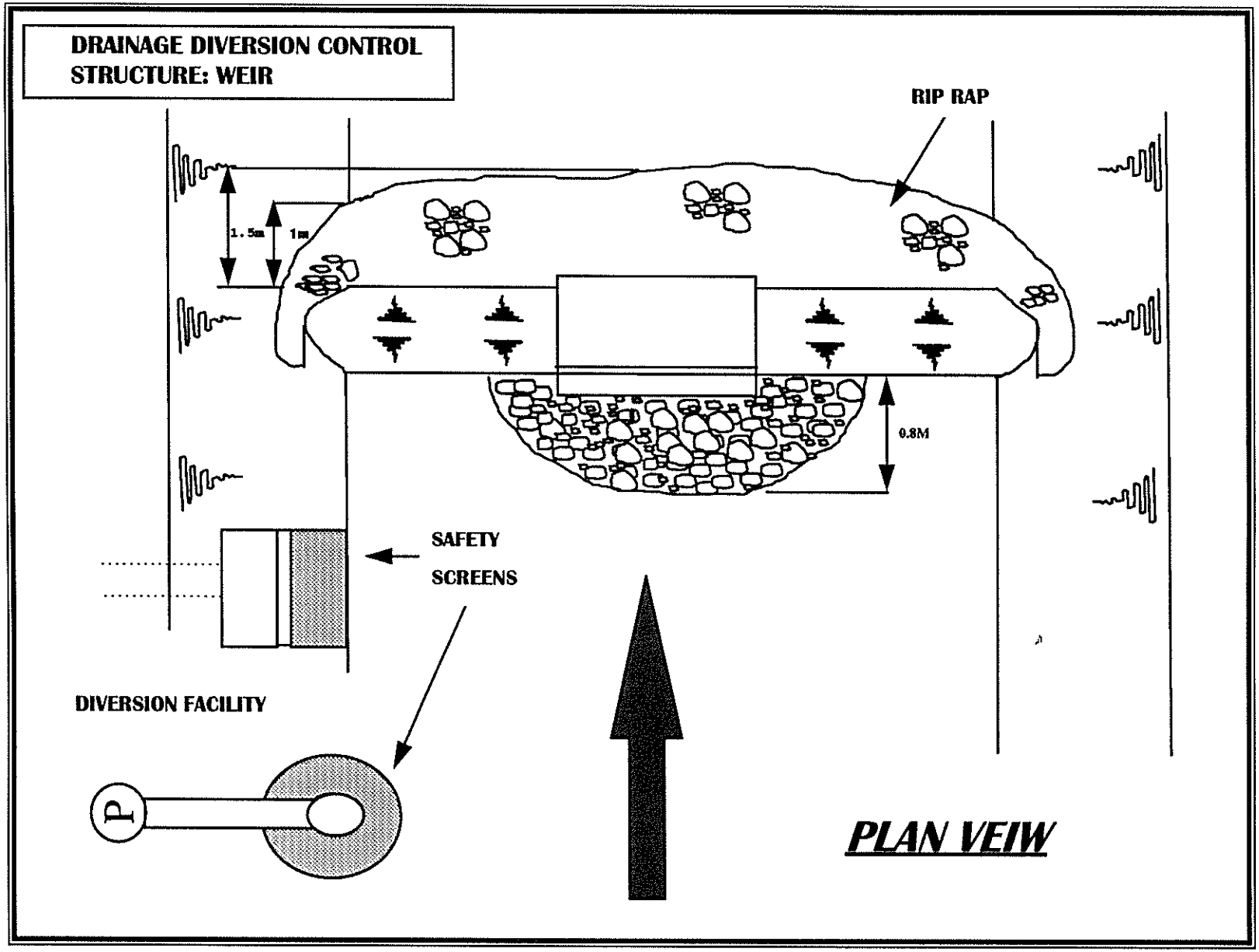
Position: REGIONAL MANAGER, D.P.I. (Water Resources), CENTRAL REGION

Date: 24 MARCH 1995.

STATE ASSESSMENT PANEL COMMENTS

(To be completed if the SAP has particular comments concerning the project that it wishes to have recorded)


DRAINAGE DIVERSION CONTROL
STRUCTURE: WEIR
Drop Boards
PERSPECTIVE VEIW
PUMPED
DIVERSION
P
GRAVITY
DIVERSION
MAXIMUM WEIR HEIGHT = 0.45 M
SAFETY
SCREENS
SIDE VEIW


DRAINAGE DIVERSION CONTROL
STRUCTURE: WEIR
RIP RAP
1.5m
1m
0.8M
SAFETY
SCREENS
DIVERSION FACILITY
P
PLAN VEIW

EIA DRAINAGE MANAGEMENT STUDY - QUESTIONNAIRE 94/95 RESULTS

SELMA SYSTEM

No of Farms	Diverted	Ml	Tailwater	Ml	Storm	Ml	Total Ml	Tailwater Recycle Potential	Drain Extract Potential
2	25%	170	73%	496	2%	14	680	y	y
1	0%	0	90%	180	10%	20	200	y	y
1	90%	1029	1%	11	9%	103	1143	y	n
3	60%	720	20%	240	20%	240	1200	y	n
1	0%	0	91%	164	9%	16	180	y	y
1	0%	0	90%	230	10%	26	256	y	y
1	25%	100	65%	260	10%	40	400	n/a	y
1	5%	30	81%	470	14%	80	580	n	y
2	5%	13	60%	150	35%	88	250	n/a	n
3	100%	150	0%	0	0%	0	150	n/a	y
1	36%	101	64%	179	0%	0	280	y	y
1	30%	60	70%	140	0%	0	200	n	n
2	50%	43	50%	43	0%	0	85	y	n
1	40%	196	60%	294	0%	0	490	y	y
1	0%	0	0%	0	0%	0	0	y	y
1	0%	0	0%	0	0%	0	0	y	y
1	0%	0	0%	0	0%	0	0	y	y
1	0%	0	0%	0	0%	0	0	n	n/a
1	0%	0	0%	0	0%	0	0	y	y
1	0%	0	0%	0	0%	0	0	y	n
1	0%	0	0%	0	0%	0	0	y	y
TOTALS		2611		2858		626	6094		
PERCENT		42.8%		46.9%		10.3%	100%		

WEEMAH SYSTEM

No of Farms	Diverted	Ml	Tailwater	Ml	Storm	Ml	Total Ml	Tailwater Recycle Potential	Drain Extract Potential
1	0%	0	85%	340	15%	60	400	n/a	y
2	0%	0	62%	124	38%	76	200	y	n
1	10%	40	80%	320	10%	40	400	n/a	n
1	16%	40	68%	170	16%	40	250	y	n
1	0%	0	90%	36	10%	4	40	y	n
1	0%	0	100%	330	0%	0	330	n/a	n/a
1	0%	0	100%	50	0%	0	50	n	n/a
1	0%	0	70%	210	30%	90	300	n	n
1	0%	0	80%	360	20%	90	450	y	n
1	0%	0	75%	210	25%	70	280	y	n
1	0%	0	90%	270	10%	30	300	n/a	n/a
1	0%	0	80%	120	20%	30	150	n	y
1	0%	0	0%	0	0%	0	0	y	n/a
1	0%	0	0%	0	0%	0	0	n	n
1	0%	0	0%	0	0%	0	0	y	n
1	0%	0	0%	0	0%	0	0	y	n
1	0%	0	0%	0	0%	0	0	n/a	n/a
TOTALS		80		2540		530	3150		
PERCENT		2.5%		80.6%		16.8%	100%		

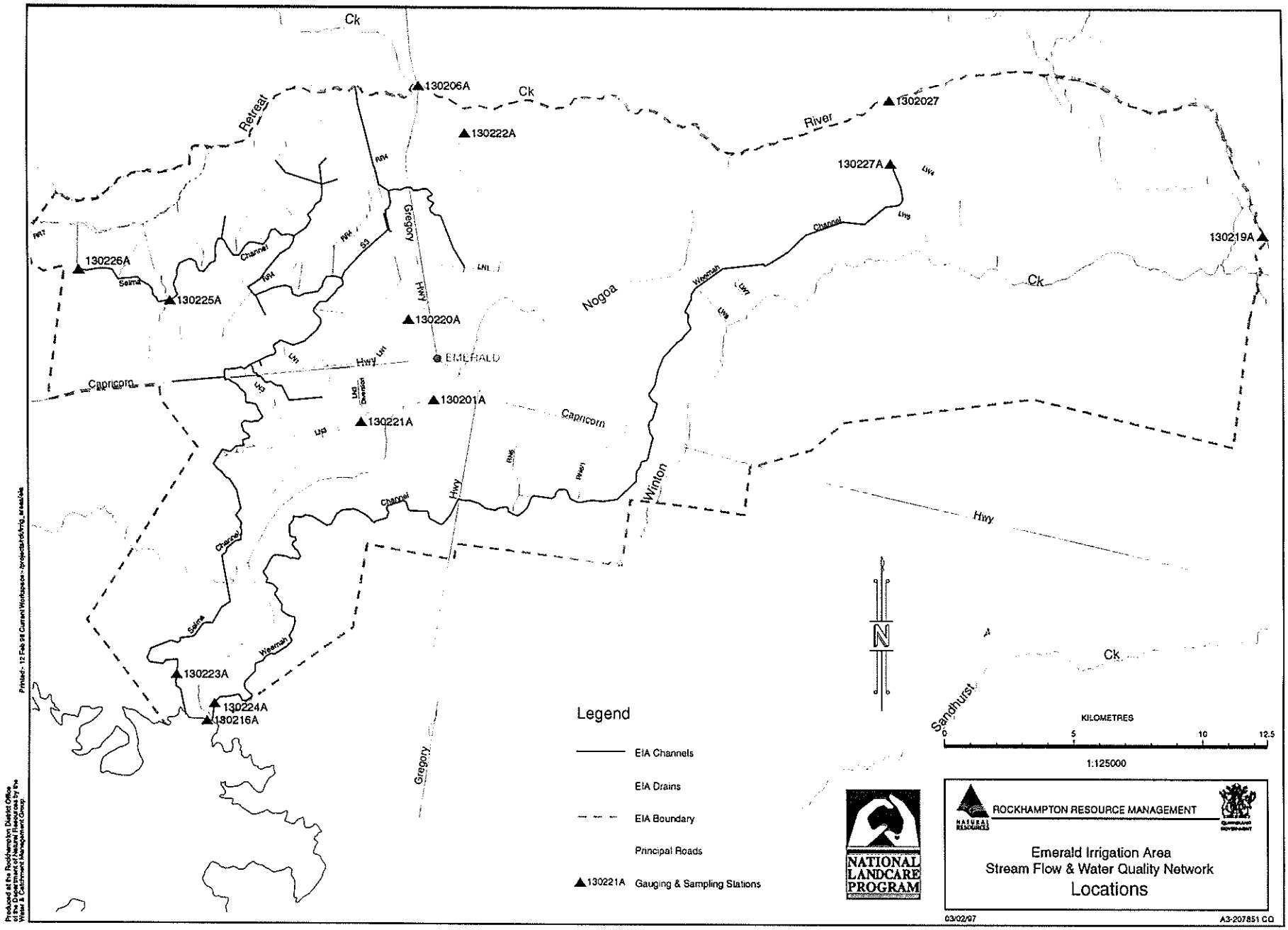
EIA DRAINAGE MANAGEMENT STUDY - QUESTIONNAIRE 95/96 RESULTS

SELMA SYSTEM

No of Farms	Diverted	Ml	Tailwater	Ml	Storm	Ml	Total Ml	Tailwater Recycle Potential	Drain Extract Potential
2	15%	105	70%	490	15%	105	700	y	y
1	50%	90	25%	45	25%	45	180	y	y
1	0%	0	40%	480	60%	720	1200	y	n/a
1	0%	0	0%	0	0%	0	0	y	y
1	0%	0	100%	100	0%	0	100	y	y
3	10%	45	20%	90	70%	315	450	n/a	y
1	0%	0	50%	150	50%	150	300	n/a	n/a
1	100%	50	0%	0	0%	0	50	y	y
1	0%	0	95%	47.5	5%	2.5	50	y	y
1	60%	150	40%	100	0%	0	250	n/a	y
1	0%	0	0%	0	0%	0	0	y	y
2	30%	45	60%	90	10%	15	150	n/a	y
1	0%	0	0%	0	0%	0	0	n/a	y
1	40%	100	15%	37.5	45%	112.5	250	n/a	y
1	0%	0	0%	0	0%	0	0	y	y
4	10%	50	40%	200	50%	250	500	n	n
1	40%	96	40%	96	20%	48	240	n	n
2	45%	99	40%	88	15%	33	220	y	y
3	10%	35	75%	262.5	15%	52.5	350	n	n
TOTALS		865		2277		1849	4990		
PERCENT		17.3%		45.6%		37.0%	100%		

WEEMAH SYSTEM

No of Farms	Diverted	Ml	Tailwater	Ml	Storm	Ml	Total Ml	Tailwater Recycle Potential	Drain Extract Potential
1	0%	0	0%	0	0%	0	0	n/a	n/a
1	0%	0	61%	389	39%	248	637	y	n/a
1	0%	0	80%	830	20%	208	1038	n	n
1	0%	0	50%	125	50%	125	250	n/a	y
1	15%	27	40%	72	45%	81	180	n	n
1	0%	0	0%	0	0%	0	0	n	n
1	0%	0	0%	0	0%	0	0	n	n
2	0%	0	0%	0	0%	0	0	n	y
1	0%	0	98%	294	2%	6	300	y	n
1	0%	0	100%	540	0%	0	540	y	n/a
1	15%	30	80%	160	5%	10	200	y	n
1	30%	45	55%	83	15%	23	150	n	y
1	0%	0	50%	125	50%	125	250	y	n
1	0%	0	0%	0	0%	0	0	n/a	n/a
3	0%	0	80%	557	20%	139	696	y	n
TOTALS		102		3174		965	4241		
PERCENT		2.4%		74.8%		22.7%	100%		



Appendix D Emerald Irrigation Area Map

Key to Major Ion Sample Results

Cations and Anions														
Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µS/cm @ 25°C	pH	NTU	mg/l

Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l $CaCO_3$	meq/l	mg/l	mg/l	mg/l	Hazen

130223A Selma Channel @ Flume

Sample Taken		Cations and Anions														Total Suspended
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Solids
27/10/93	1505	17.50	6.40	23.00	8.70	135.00	2.20	0.10	8.60	0.30	0.50	2.10	270.00	8.45	11.00	20.00
02/12/93	0950	17.00	6.00	22.50	8.50	140.00	1.80	0.00	8.80	0.30	0.70	2.50	255.00	8.35	11.00	20.00
16/12/93		16.50	6.70	22.00	8.80	135.00	1.70	0.00	8.20	0.30	0.50	2.40	240.00	8.30	10.00	10.00
09/02/94	1656	17.00	6.60	20.50	8.60	140.00	2.00	0.00	7.80	0.30	0.80	2.00	250.00	8.40	7.00	10.00
01/07/94	0955	15.50	7.60	20.50	7.60	130.00	1.00	0.00	8.10	0.30	2.10	2.00	240.00	8.15	41.00	20.00
14/12/94	1750	17.40	6.80	21.90	8.40	152.45	0.55	0.01	9.08	0.28	0.62	2.43	244.60	7.80	7.60	8.00
21/04/95	1230	18.30	7.40	20.90	8.50	139.40	0.95	0.02	8.74	0.27	1.77	2.15	240.00	8.10	42.00	36.00
12/09/95	1830	20.00	7.30	24.10	9.60	154.03	1.54	0.03	9.65	0.33	0.47	2.49	270.70	8.24	8.70	13.00
01/11/95	0956	21.60	7.50	24.50	9.80	166.40	0.82	0.01	10.58	0.33	1.64	2.87	299.00	7.93	13.60	20.00
03/12/95	0950	20.70	7.30	24.10	10.40	163.32	2.11	0.04	11.52	0.36	0.71	2.69	288.90	8.34	8.30	16.00
06/01/96	1300	22.80	7.80	21.90	10.30	161.93	1.31	0.03	14.24	0.34	1.58	3.61	326.00	8.12	10.80	12.00
01/02/96	0820	19.70	7.50	19.40	8.90	142.06	0.61	0.01	9.90	0.32	1.40	2.80	263.00	7.88	65.00	19.00
06/03/96	1456	20.70	8.30	20.50	9.00	148.19	0.95	0.02	10.20	0.34	1.50	2.90	277.00	8.05	36.00	27.00
01/04/96	0845	20.60	7.90	20.60	9.40	149.52	0.26	0.00	9.52	0.33	0.78	3.08	281.00	7.49	17.60	24.00

Sample Taken									Total		Total Dissolved	Total Dissolved	
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Alkalinity	Silica	Ions	Solids	Colour
27/10/93	1505	0.00	0.00	0.00	0.00	0.00	0.11	93.00	115.00	7.00	210.00	140.00	10.00
02/12/93	0950	0.00	0.00	0.00	0.00	0.00	0.00	91.00	115.00	7.00	210.00	140.00	5.00
16/12/93		0.00	0.00	0.00	0.00	0.00	0.00	91.00	115.00	6.00	200.00	140.00	5.00
09/02/94	1656							87.00	120.00		210.00	130.00	5.00
01/07/94	0955	0.02	0.00	0.00	0.00	0.10	0.05	83.00	105.00	9.00	190.00	140.00	5.00
14/12/94	1750	0.00	0.00	0.00	0.00	0.00	0.00	89.18	125.90	7.10	219.92	149.53	0.00
21/04/95	1230	0.01	0.00	0.02	0.02	0.00	0.04	87.10	115.90	7.60	208.40	145.14	5.00
12/09/95	1830	0.02	0.00	0.01	0.01	0.10	0.08	99.60	128.90	5.00	229.53	156.24	9.00
01/11/95	0956	0.01	0.00	0.03	0.05	0.10	0.08	101.42	137.80	5.80	246.05	167.27	5.00
03/12/95	0950	0.00	0.00	0.05	0.00	0.00	0.04	102.89	137.50	6.10	243.25	166.33	7.00
06/01/96	1300	0.00	0.00	0.01	0.01	0.10	0.04	96.99	135.00	4.30	245.84	167.83	4.00
01/02/96	0820	0.00	0.00	0.00	0.01	0.00	0.04	85.00	117.50	5.50	212.61	145.90	7.00
06/03/96	1456	0.04	0.00	0.01	0.08	0.10	0.02	88.15	123.10	7.00	222.59	154.27	13.00
01/04/96	0845	0.02	0.00	0.01	0.00	0.10	0.01	90.05	123.00	6.40	221.99	152.39	9.00

130224A Weemah Channel @ Flume

Sample Taken		Cations and Anions														
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
09/09/93	1345	18.00	6.50	23.00	8.90	145.00	1.70	0.00	8.20	0.10	0.50	2.00	260.00	8.30	3.00	10.00
27/10/93	1524	17.50	6.50	23.00	8.70	140.00	1.80	0.00	8.40	0.30	0.50	2.20	270.00	8.35	10.00	10.00
02/12/93	0930	16.50	6.00	22.00	8.50	140.00	1.90	0.00	8.70	0.30	0.70	2.40	255.00	8.40	5.00	10.00
16/12/93		16.50	6.60	22.00	8.70	135.00	1.70	0.00	7.70	0.30	0.50	2.30	250.00	8.35	11.00	10.00
09/02/94		17.00	6.70	21.00	8.80	140.00	1.90	0.00	8.50	0.30	0.80	2.30	255.00	8.40	2.00	10.00
31/03/94	0840	15.00	6.40	19.50	7.40	120.00	0.40	0.00	7.50	0.30	1.30	2.00	210.00	7.75	79.00	50.00
01/07/94	0935	15.20	7.60	20.60	7.60	128.13	0.91	0.02	8.05	0.28	2.22	2.20	239.00	8.10	45.00	18.00
14/12/94	1805	17.30	6.80	22.00	8.40	147.16	0.45	0.01	9.40	0.30	0.61	2.38	244.30	7.73	4.00	6.00
15/03/95	1645	17.00	6.60	19.10	7.90	135.88	1.46	0.03	8.04	0.26	1.42	2.52	234.40	8.30	105.00	77.00
21/04/95	1205	18.90	7.30	21.00	8.60	144.61	0.97	0.02	9.14	0.27	2.11	2.06	249.00	8.09	41.00	24.00
01/06/95	0920	18.00	7.20	21.30	8.80	144.69	0.99	0.02	9.79	0.31	1.50	2.48	259.30	8.10	27.00	30.00
29/06/95	1325	19.20	7.20	21.80	9.10	149.10	0.98	0.02	10.92	0.32	1.19	3.03	268.80	8.08	21.00	22.00
12/09/95	1900	20.10	7.30	24.00	9.50	154.95	1.74	0.03	9.45	0.33	0.16	2.55	270.70	8.29	13.50	17.00
01/11/95	0922	21.40	7.90	24.50	9.80	171.68	0.69	0.01	10.42	0.32	1.14	2.63	298.00	7.84	5.30	12.00
02/12/95	1645	20.50	7.70	23.90	10.40	163.30	0.90	0.02	11.58	0.35	0.65	2.44	287.40	7.97	2.70	9.00
01/02/96	0845	19.50	7.20	19.30	8.80	140.76	0.59	0.01	9.70	0.32	1.80	2.80	263.00	7.87	67.00	14.00
06/03/96	1409	20.80	8.40	20.60	9.00	145.57	0.74	0.01	10.50	0.33	1.90	3.10	277.00	7.95	30.00	18.00
01/04/96	0950	20.60	7.90	20.50	9.40	149.02	0.44	0.01	10.47	0.33	0.50	3.11	280.00	7.72	25.90	22.00

Sample Taken									Total		Total Dissolved	Total Dissolved	
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Alkalinity	Silica	Ions	Solids	Colour
09/09/93	1345	0.00	0.00	0.00	0.00	0.00	0.05	94.00	120.00	7.00	210.00	150.00	5.00
27/10/93	1524	0.00	0.00	0.00	0.00	0.00	0.10	93.00	120.00	8.00	210.00	150.00	10.00
02/12/93	0930	0.00	0.00	0.00	0.00	0.00	0.00	90.00	115.00	7.00	210.00	140.00	5.00
16/12/93		0.00	0.00	0.00	0.00	0.00	0.00	90.00	115.00	6.00	200.00	140.00	5.00
09/02/94								89.00	115.00		210.00	140.00	5.00
31/03/94	0840	0.04	0.00	0.00	0.06	0.00	0.00	79.00	100.00	8.00	180.00	130.00	5.00
01/07/94	0935	0.02	0.00	0.00	0.10	0.00	0.02		106.60	9.10	192.81	136.78	5.00
14/12/94	1805	0.00	0.00	0.00	0.00	0.00	0.00	89.43	121.40	7.00	214.81	147.01	0.00
15/03/95	1645	0.01	0.00	0.00	0.02	0.00	0.03	80.14	113.90	6.50	200.21	137.64	5.00
21/04/95	1205	0.02	0.00	0.00	0.03	0.00	0.02	87.76	120.20	7.80	214.98	149.27	5.00
01/06/95	0920	0.01	0.00	0.01	0.01	0.00	0.03	89.33	120.30	7.70	215.08	149.23	5.00
29/06/95	1325	0.01	0.00	0.01	0.01	0.00	0.01	91.81	123.90	7.00	222.86	154.07	5.00
12/09/95	1900	0.02	0.00	0.02	0.00	0.10	0.08	98.94	130.00	5.00	230.11	156.35	9.00
01/11/95	0922	0.01	0.00	0.13	0.04	0.10	0.06	101.42	141.90	5.50	250.49	168.72	6.00
02/12/95	1645	0.00	0.00	0.00	0.00	0.00	0.00	102.39	135.40	6.10	241.74	164.83	8.00
01/02/96	0845	0.00	0.00	0.00	0.00	0.00	0.02	84.34	116.40	5.40	210.79	144.64	4.00
06/03/96	1409	0.04	0.00	0.01	0.08	0.10	0.03	88.40	120.60	6.90	220.96	153.86	13.00
01/04/96	0950	0.02	0.00	0.00	0.00	0.10	0.01	89.80	122.90	6.50	222.28	153.03	11.00

130220A LN1 Drain @ Emerald

Sample Taken		Anions & Cations														
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
27/10/93	1416	54.80	4.10	33.90	20.20	253.80	4.60	0.05	30.50	0.36	1.10	23.30	571.00	8.40	13.00	16.00
02/12/93	1440	125.00	1.10	30.50	35.00	410.00	15.50	0.10	69.00	0.40	0.60	31.00	840.00	8.75	9.00	20.00
16/12/93		38.50	5.30	40.50	16.50	185.00	3.40	0.10	32.50	0.50	32.00	20.50	490.00	8.45	34.00	40.00
09/02/94	1400	115.00	4.00	48.50	42.50	285.00	0.10	0.00	130.00	0.30	3.10	110.00	1100.00	7.00	3.00	10.00
31/03/94	1005	135.00	135.00	34.50	48.50	230.00	2.80	0.00	180.00	0.30	0.00	140.00	1200.00	8.25	3.00	10.00
01/07/94	1120	43.40	5.80	27.50	20.50	195.93	1.05	0.02	35.65	0.30	2.82	35.47	476.90	7.94	22.00	19.00
14/12/94	1415	52.50	5.50	46.20	21.20	213.26	1.93	0.02	48.33	0.38	50.27	34.41	649.30	8.15	40.00	56.00
16/03/93	1535	135.00	1.80	33.00	59.00	330.00	12.00	0.10	145.00	0.30	2.60	110.00	1100.00	8.70	4.00	10.00
09/08/95	1340	40.90	5.40	25.70	20.30	197.75	1.89	0.02	35.53	0.34	0.47	27.19	458.50	8.22	19.80	19.00
12/09/95	1700	39.30	5.60	39.50	22.10	183.21	2.30	0.03	38.48	0.41	46.51	28.09	534.40	8.30	15.00	22.00
30/11/95	1715	45.00	4.40	32.00	20.70	143.75	0.79	0.02	43.05	0.41	75.36	23.61	532.30	7.94	8.80	21.00
06/01/96	1345	79.50	6.80	70.00	30.90	272.18	2.29	0.03	103.14	0.52	13.01	83.99	936.00	8.06	1.60	6.00
01/02/96	1015	53.00	4.10	27.40	20.10	189.27	0.80	0.01	51.30	0.49	0.70	35.10	526.00	7.83	0.90	6.00
06/03/96	1546	32.10	6.30	28.90	16.00	180.16	0.54	0.01	28.60	0.39	10.10	16.70	420.00	7.70	160.00	172.00
02/04/96	1115	31.30	6.10	25.90	14.30	182.29	0.93	0.01	23.71	0.35	0.00	12.87	374.00	7.94	81.60	85.00

Sample Taken													
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
27/10/93	1416			0.01	0.01	0.10	0.13	167.00	215.00	20.20	426.80	318.00	30.00
02/12/93	1440	0.00	0.00	0.00	0.00	0.10	0.00	220.00	365.00	31.00	720.00	540.00	5.00
16/12/93		0.00	0.00	0.00	0.00	0.10	0.00	170.00	160.00	11.00	380.00	290.00	20.00
09/02/94	1400							295.00	235.00		740.00	600.00	23.00
31/03/94	1005	0.00	0.00	0.00	0.00	0.20	0.00	285.00	195.00	4.00	780.00	670.00	5.00
01/07/94	1120	0.00	0.00	0.00	0.00	0.10	0.01	155.00	162.40	11.30	368.44	280.15	10.00
14/12/94	1415	0.00	0.00	0.00	0.00	0.10	0.00	202.44	178.10	10.90	474.01	376.51	5.00
16/03/93	1535	0.00	0.00	0.00	0.00	0.02	0.00	325.00	290.00	7.00	820.00	660.00	20.00
09/08/95	1340	0.00	0.00	0.00	0.00	0.10	0.03	147.59	165.30	3.00	355.49	257.97	0.00
12/09/95	1700	0.01	0.00	0.00	0.00	0.10	0.04	189.42	154.10	8.10	405.53	320.50	23.00
30/11/95	1715	0.00	0.00	0.00	0.00	0.10	0.01	164.96	119.20	8.60	389.09	324.62	22.00
06/01/96	1345	0.00	0.00	0.01	0.00	0.10	0.05	301.71	227.00	12.50	662.36	536.51	32.00
01/02/96	1015	0.01	0.00	0.00	0.00	0.20	0.05	151.01	156.50	9.00	382.27	295.06	21.00
06/03/96	1546	0.00	0.00	0.01	0.00	0.10	0.03	137.90	148.60	12.30	319.80	240.53	4.00
02/04/96	1115	0.01	0.00	0.00	0.00	0.10	0.01	123.42	151.00	7.80	297.76	212.90	13.00

130221A LN3 Drain @ Selma Road

Sample Taken		Cations and Anions											Conductivity	pH	Turbidity	Total Suspended Solids
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate				
09/09/93	1445	135.00	4.30	42.50	35.50	460.00	13.00	0.10	68.00	0.10	0.50	28.00	930.00	8.60	12.00	10.00
27/10/93	1445	70.00	3.20	28.00	22.00	270.00	16.00	0.20	32.50	0.40	0.50	14.00	590.00	9.00	10.00	20.00
02/12/93	1015	115.00	0.10	31.00	37.50	435.00	15.50	0.10	59.00	0.40	0.50	23.50	820.00	8.70	8.00	20.00
16/12/93		26.00	4.80	41.50	14.50	150.00	1.50	0.00	24.00	0.50	56.00	18.00	445.00	8.20	99.00	300.00
09/02/94	1330	44.00	4.50	31.00	17.00	240.00	7.00	0.10	20.50	0.40	0.50	11.50	475.00	8.65	5.00	10.00
31/03/94	0940	115.00	1.10	37.50	37.00	460.00	6.70	0.00	59.00	0.40	0.50	22.50	920.00	8.35	14.00	20.00
28/04/94	1120	84.10	2.30	30.30	28.00	354.33	6.96	0.05	41.03	0.30	0.38	15.63	685.90	8.48	7.00	12.00
01/07/94	1040	115.50	3.10	33.40	38.60	456.91	11.33	0.07	58.34	0.39	0.15	24.32	911.10	8.56	5.00	12.00
14/12/94	1340	44.50	4.90	27.20	15.60	219.08	0.48	0.01	22.83	0.44	20.64	10.47	447.60	7.56	13.80	22.00
20/04/95	1655	121.00	1.30	28.10	38.00	457.10	11.31	0.06	57.39	0.37	0.54	20.59	867.90	8.58	10.00	15.00

Sample Taken		Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
Date	Time												
09/09/93	1445	0.00	0.00	0.00	0.00	0.10	0.07	250.00	400.00	26.00	790.00	580.00	5.00
27/10/93	1445	0.00	0.00	0.00	0.00	0.10	0.00	160.00	245.00	23.00	450.00	340.00	10.00
02/12/93	1015	0.00	0.00	0.00	0.00	0.10	0.00	230.00	385.00	37.00	720.00	540.00	5.00
16/12/93		0.00	0.00	0.00	0.00	0.10	0.00	165.00	125.00	18.00	340.00	280.00	30.00
09/02/94	1330	0.00						150.00	210.00		380.00	260.00	10.00
31/03/94	0940	0.00	0.00	0.00	0.00	0.10	0.00	245.00	390.00	28.80	740.00	540.00	5.00
28/04/94	1120	0.00	0.00	0.00	0.00	0.10	0.03		302.20	28.50	563.39	411.78	10.00
01/07/94	1040	0.00	0.00	0.00	0.00	0.10	0.05		393.60	26.80	742.11	536.66	0.00
14/12/94	1340	0.00	0.00	0.00	0.00	0.10	0.00	132.01	180.40	15.00	366.15	269.79	10.00
20/04/95	1655	0.00	0.00	0.00	0.00	0.10	0.02	226.36	393.70	31.80	735.76	535.22	5.00

130222A RR4 Drain @ Emerald

Sample Taken		Cations and Anions														
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
02/09/94	1258	228.20	0.30	17.70	51.60	388.82	36.00	0.24	216.00	0.49	4.80	61.70	1421.00	9.10	3.40	9.00
14/12/94	1550	128.70	6.60	41.90	23.90	283.21	0.81	0.01	141.50	0.76	32.55	57.75	1004.50	7.62	26.00	30.00
16/03/95	1520	190.00	0.70	23.50	48.50	415.00	24.50	0.20	165.00	0.50	4.90	46.50	1250.00	8.95	8.00	20.00
20/04/95	1430	196.20	1.30	25.70	50.90	472.37	7.68	0.04	175.80	0.46	8.24	49.14	1315.30	8.37	18.00	38.00
02/06/95	0900	210.00	0.60	21.90	52.50	467.26	9.87	0.05	193.90	0.45	3.67	63.14	1406.10	8.48	20.00	30.00
29/06/95	1515	228.80	0.70	22.40	55.10	436.71	32.49	0.17	208.60	0.48	3.42	68.74	1455.20	9.02	29.00	44.00
09/08/95	1456	239.80	1.30	25.50	61.50	413.66	27.31	0.14	260.40	0.50	3.66	92.74	1616.90	8.97	21.10	26.00
03/12/95	1305	35.90	6.30	30.00	16.50	235.90	1.08	0.01	16.07	0.44	2.83	5.94	404.40	7.87	10.30	24.00
06/01/96	0910	175.30	1.30	43.00	44.90	450.64	8.67	0.06	156.26	0.43	11.06	45.72	1254.00	8.40	39.80	53.00
31/01/96	1730	108.00	4.00	23.80	22.10	255.72	2.30	0.02	90.00	0.53	4.20	36.60	760.00	8.14	7.00	19.00
06/03/96	1100	87.80	4.20	29.50	23.10	275.17	3.63	0.04	75.40	0.43	3.90	21.60	692.00	8.31	69.00	57.00
02/04/96	0930	173.40	1.80	27.70	41.90	429.26	3.65	0.02	155.26	0.48	1.44	41.94	1171.00	8.09	1.50	7.00

Sample Taken													
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
02/09/94	1258	0.02	0.01	0.00	0.00	0.20	0.00	256.33	379.40	22.30	1005.85	830.51	15.00
14/12/94	1550	0.00	0.00	0.00	0.00	0.20	0.00	202.81	233.50	9.60	717.68	583.33	40.00
16/03/95	1520	0.00	0.00	0.00	0.00	0.20	0.00	260.00	380.00	30.00	920.00	740.00	5.00
20/04/95	1430	0.01	0.01	0.00	0.00	0.20	0.01	273.41	400.10	39.10	987.83	786.82	5.00
02/06/95	0900	0.01	0.00	0.01	0.00	0.20	0.02	270.51	399.60	34.50	1023.35	820.33	5.00
29/06/95	1515	0.00	0.00	0.00	0.00	0.20	0.01	282.45	412.60	25.80	1057.61	861.43	10.00
09/08/95	1456	0.00	0.00	0.00	0.00	0.20	0.06	316.50	385.00	17.20	1126.51	933.45	13.00
03/12/95	1305	0.00	0.00	0.01	0.00	0.10	0.01	142.70	195.20	21.00	350.97	252.07	18.00
06/01/96	0910	0.00	0.00	0.05	0.00	0.20	0.03	291.91	384.00	38.50	937.34	746.78	6.00
31/01/96	1730	0.01	0.00	0.00	0.02	0.20	0.04	150.25	213.50	15.90	547.27	433.19	16.00
06/03/96	1100	0.00	0.00	0.00	0.00	0.10	0.01	168.59	231.70	21.70	524.76	406.59	10.00
02/04/96	0930	0.01	0.00	0.00	0.00	0.20	0.01	241.40	358.00	32.70	876.85	691.36	15.00

130206A Retreat Creek @ Main Road

Sample Taken		Cations and Anions														
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
09/09/93	1545	20.50	3.90	15.50	8.50	100.00	0.20	0.00	17.00	0.10	1.80	6.30	235.00	7.45	100.00	130.00
27/10/93	1350	40.10	6.00	31.70	18.00	218.30	0.20	0.00	36.60	0.33	0.00	12.80	513.00	7.30	41.00	98.00
01/12/93	1755	21.60	3.20	17.90	7.20	107.80	0.60	0.02	17.10	0.16	2.60	6.00	248.00	8.00	9.00	18.00
16/12/93		47.50	5.90	37.00	14.00	195.00	3.40	0.10	41.00	0.50	18.00	16.50	495.00	8.45	47.00	50.00
09/02/94	1435	39.50	5.00	32.00	14.50	165.00	2.70	0.10	39.00	0.30	10.50	22.50	435.00	8.40	20.00	30.00
30/03/94	1810	49.00	4.50	40.50	15.50	225.00	3.10	0.00	50.00	0.20	1.60	10.00	530.00	8.35	29.00	30.00
16/04/94	1320	132.70	2.70	45.00	30.80	364.83	7.08	0.05	135.60	0.39	0.17	27.73	1040.70	8.45	6.00	24.00
30/06/94	1436	113.90	3.50	46.10	31.20	355.04	6.68	0.05	123.00	0.37	0.14	27.12	978.50	8.44	9.00	11.00
24/08/94	1715	124.80	3.90	36.20	32.60	319.86	8.11	0.07	139.60	0.36	0.29	31.10	999.30	8.57	7.80	11.00
14/12/94	1450	41.20	5.30	30.00	16.90	229.03	0.92	0.01	30.53	0.39	0.28	8.01	437.30	7.82	9.70	17.00
16/03/95	1605	37.00	2.20	18.00	704.00	150.00	1.00	0.00	15.50	0.30	1.60	3.90	280.00	8.10	100.00	260.00
20/04/95	1345	17.40	4.90	21.00	8.10	123.01	0.10	0.00	13.40	0.14	5.04	4.19	231.10	7.18	140.00	109.00
02/06/95	0803	83.30	4.70	60.50	31.00	297.74	1.69	0.01	135.20	0.26	0.25	34.41	953.70	7.94	9.00	17.00
29/06/95	1435	86.80	5.30	59.40	30.50	296.59	1.53	0.01	139.70	0.24	1.26	30.49	955.80	7.90	13.50	24.00
08/08/95	1705	85.80	5.50	52.30	27.90	259.85	1.13	0.01	145.40	0.21	1.17	22.59	894.60	7.84	11.50	13.00
12/09/95	1620	97.40	5.70	53.70	29.80	276.02	3.10	0.03	164.10	0.23	0.00	8.77	978.10	8.22	5.90	12.00
01/02/96	1715	23.70	6.70	34.30	11.10	186.33	0.92	0.01	13.40	0.40	1.00	8.00	360.00	7.92	0.90	4.00
06/03/96	1100	55.40	7.60	49.80	20.30	285.72	1.36	0.01	57.90	0.34	0.10	12.00	635.00	7.87	2.90	13.00
01/04/96	1535	53.60	6.20	44.00	19.50	284.26	1.06	0.01	48.95	0.37	0.00	6.75	600.00	7.78	3.50	11.00

130206A Retreat Creek @ Main Road

Sample Taken													
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
09/09/93	1545	0.06	0.05	0.00	0.00	0.00	0.09	74.00	84.00	12.00	180.00	140.00	0.00
27/10/93	1350	0.02	0.20	0.01	0.01		0.07	153.00	179.00	9.10	364.10	262.00	30.00
01/12/93	1755	0.14		0.02	0.18			74.00	89.00	16.90	184.40	146.00	10.00
16/12/93		0.00	0.00	0.00	0.00	0.10	0.00	150.00	170.00	12.00	380.00	190.00	30.00
09/02/94	1435							140.00	140.00		330.00	250.00	15.00
30/03/94	1810	0.00	0.00	0.00	0.00	0.10	0.00	165.00	190.00	19.00	400.00	300.00	5.00
16/04/94	1320	0.00	0.00	0.00	0.00	0.20	0.01	240.00	311.00	14.00	747.06	575.61	10.00
30/06/94	1436	0.00	0.00	0.00	0.00	0.10	0.04	245.00	302.30	6.80	707.10	533.44	5.00
24/08/94	1715	0.00	0.00	0.00	0.01	0.10	0.00	225.00	275.90	0.60	696.89	534.91	0.00
14/12/94	1450	0.00	0.00	0.00	0.00	0.10	0.00	144.34	189.30	11.80	362.57	257.96	20.00
16/03/95	1605	0.00	0.00	0.00	0.00	0.10	0.00	75.00	125.00	13.00	240.00	170.00	40.00
20/04/95	1345	0.02	0.00	0.03	0.00	0.00	0.02	85.70	101.00	12.10	197.28	146.86	40.00
02/06/95	0803	0.02	0.00	0.01	0.00	0.10	0.02	278.42	246.90	5.90	649.06	503.62	10.00
29/06/95	1435	0.00	0.00	0.01	0.00	0.10	0.01	273.61	245.70	1.20	651.83	502.27	10.00
08/08/95	1705	0.02	0.00	0.00	0.00	0.10	0.06	245.21	214.90	1.10	601.86	470.88	3.00
12/09/95	1620	0.01	0.00	0.08	0.00	0.10	0.05	256.51	231.50	2.50	638.85	501.05	16.00
01/02/96	1715	0.01	0.00	0.00	0.02	0.10	0.02	131.22	154.30	10.70	285.86	201.85	30.00
06/03/96	1100	0.00	0.00	0.01	0.00	0.10	0.03	207.72	236.50	14.10	490.53	359.40	28.00
01/04/96	1535	0.01	0.00	0.00	0.00	0.10	0.01	189.96	234.80	13.60	464.70	333.81	18.00

130219A Nogoa River @ Duckponds

Sample Taken		Cations and Anions														
Date	Time	Sodium	Potassium	Calcium	Magnesium	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Conductivity	pH	Turbidity	Total Suspended Solids
09/09/93	1700	18.40	6.30	20.40	8.50	131.50	0.60	0.02	10.10	0.21	1.50	2.30	254.00	7.90	44.00	23.00
27/10/93	1230	25.40	6.30	23.40	11.00	148.90	4.00	0.08	17.60	0.32	0.60	5.60	329.00	8.60	5.00	11.00
27/10/93	1625	24.70	6.20	22.80	10.90	149.90	3.20	0.06	16.00	0.31	0.60	5.30	329.00	8.50	9.00	16.00
02/12/93	1535	17.40	4.30	15.70	6.10	96.00	0.60	0.02	13.80	0.16	2.20	4.50	215.00	8.00	138.00	158.00
16/12/93	1415	20.30	6.60	23.10	9.70	146.60	2.20	0.05	15.20	0.29	1.90	3.90	281.00	8.40	15.00	10.00
09/02/94	1540	29.80	6.30	28.20	11.60	154.00	2.60	0.05	22.40	0.29	9.50	12.60	353.00	8.40	28.00	40.00
26/04/94	1840	89.80	4.60	34.60	22.30	269.67	3.75	0.04	90.90	0.28	1.43	22.21	746.20	8.33	14.00	27.00
05/05/94	1700	41.10	5.10	26.40	13.30	182.57	2.13	0.03	35.25	0.23	0.84	8.19	396.00	8.29	31.00	29.00
08/06/94	1340	22.00	7.30	21.40	8.80	141.56	0.91	0.02	14.47	0.24	1.50	3.92	263.90	8.05	40.00	37.00
30/06/94	1603	21.50	7.40	21.20	8.80	138.85	2.13	0.04	13.14	0.27	1.23	3.92	258.10	8.43	43.00	33.00
24/08/94	1540	18.90	7.10	20.90	9.00	137.97	1.39	0.03	9.73	0.25	0.59	2.53	263.90	8.25	33.00	28.00
19/10/94	1550	22.50	6.80	21.50	9.50	150.00	0.90	0.00	13.50	0.30	0.50	3.00	280.00	8.05	22.00	20.00
14/12/94	1640	18.10	6.60	21.90	8.80	156.13	0.95	0.02	9.78	0.32	0.00	2.70	262.00	8.03	10.50	15.00
20/04/95	1130	22.10	5.60	21.40	9.40	146.35	0.67	0.01	11.03	0.25	0.56	3.21	258.00	7.91	110.00	112.00
12/05/95	0830	38.30	5.70	24.50	12.50	177.59	1.42	0.02	27.12	0.30	0.24	7.45	371.10	8.15	50.00	49.00
31/05/95	1508	21.30	6.90	22.20	9.70	153.79	1.25	0.02	14.44	0.29	0.24	3.75	282.10	8.18	26.00	7.00
28/06/95	1540	20.50	7.20	23.10	9.50	156.65	1.40	0.02	11.80	0.30	0.00	3.30	289.00	8.21	13.00	7.00
10/08/95	1033	19.70	7.10	23.30	9.30	155.53	1.23	0.02	10.12	0.33	0.53	2.46	274.50	8.17	12.80	17.00
27/08/95	1035	20.80	6.90	22.70	9.50	153.75	0.51	0.01	11.20	0.34	0.00	2.70	280.00	7.75	9.00	11.00
08/09/95	0900	21.00	7.10	24.30	10.20	158.09	1.17	0.02	10.90	0.31	0.00	2.86	279.80	8.11	20.60	27.00
01/11/95	1310	21.80	7.10	22.20	10.00	164.43	1.47	0.03	10.25	0.34	0.00	2.54	292.00	8.19	15.30	21.00
29/11/95	1745	20.80	7.60	24.40	10.60	163.99	0.86	0.02	10.87	0.33	0.83	2.47	288.90	7.95	13.50	23.00
31/01/96	1540	21.20	6.20	23.00	9.60	148.78	0.49	0.01	12.90	0.25	0.50	3.50	293.00	7.76	48.00	35.00
05/03/96	1541	21.40	8.00	22.70	9.80	155.70	0.74	0.01	10.90	0.31	0.00	2.70	293.00	7.92	7.00	15.00
02/04/96	1450	23.00	7.70	22.40	10.20	167.41	0.81	0.01	11.89	0.33	0.15	3.39	298.00	7.93	17.00	23.00
20/05/96	1430	24.00	6.30	21.00	9.20	130.00	0.70	0.00	20.00	0.20	3.00	8.80	285.00	7.95	46.00	60.00

130219A Nogoa River @ Duckponds

Sample Taken													
Date	Time	Iron	Manganese	Zinc	Aluminium	Boron	Copper	Hardness	Total Alkalinity	Silica	Total Dissolved Ions	Total Dissolved Solids	Colour
09/09/93	1700	0.00	0.02				0.04	85.00	109.00	7.60	200.10	140.00	
27/10/93	1230			0.01	0.03		0.10	103.00	129.00	3.30	243.40	171.00	10.00
27/10/93	1625				0.01		0.10	101.00	128.00	3.00	240.20	167.00	10.00
02/12/93	1535	0.19		0.01	0.27			64.00	79.00	12.10	160.80	124.00	50.00
16/12/93	1415			0.01				97.00	124.00	5.50	230.00	161.00	10.00
09/02/94	1540							118.00	130.00		277.60	199.00	5.00
26/04/94	1840	0.00	0.00	0.00	0.00	0.10	0.02		227.40	12.00	539.58	414.50	10.00
05/05/94	1700	0.01	0.00	0.00	0.02	0.10	0.05		153.30	9.70	315.15	232.05	20.00
08/06/94	1340	0.01	0.00	0.00	0.01	0.10	0.04		117.60	7.50	222.12	157.66	10.00
30/06/94	1603	0.01	0.00	0.00	0.02	0.10	0.04		117.50	8.00	218.49	155.91	5.00
24/08/94	1540	0.01	0.00	0.00	0.00	0.00	0.00		115.50	6.30	208.39	144.56	0.00
19/10/94	1550	0.00	0.00	0.00	0.00	0.10	0.00	93.00	125.00	6.00	230.00	160.00	10.00
14/12/94	1640	0.00	0.00	0.00	0.00	0.00	0.00	90.82	129.62	6.80	225.30	152.74	5.00
20/04/95	1130	0.01	0.00	0.00	0.00	0.00	0.01	92.04	121.10	6.80	220.57	152.99	20.00
12/05/95	0830	0.00	0.00	0.00	0.00	0.10	0.01	112.53	148.00	4.10	295.15	208.98	15.00
31/05/95	1508	0.00	0.00	0.01	0.00	0.00	0.03	95.27	128.20	5.10	233.88	160.81	10.00
28/06/95	1540	0.00	0.00	0.00	0.00	0.00	0.01	96.70	130.80	2.60	233.77	156.75	0.00
10/08/95	1033	0.00	0.00	0.00	0.00	0.00	0.04	96.37	129.60	3.40	229.63	153.97	10.00
27/08/95	1035	0.00	0.00	0.00	0.00	0.10	0.05	95.70	126.90	2.80	228.41	153.06	0.00
08/09/95	0900	0.06	0.00	0.01	0.09	0.10	0.10	102.57	131.60	4.30	235.95	159.90	30.00
01/11/95	1310	0.01	0.00	0.01	0.06	0.10	0.04	96.51	137.30	4.10	240.15	160.67	8.00
29/11/95	1745	0.00	0.00	0.01	0.00	0.00	0.03	104.46	135.90	4.50	242.77	163.91	12.00
31/01/96	1540	0.00	0.00	0.00	0.02	0.10	0.06	96.86	122.80	7.60	226.43	158.41	11.00
05/03/96	1541	0.01	0.00	0.01	0.02	0.10	0.03	96.93	128.90	4.80	232.26	157.92	9.00
02/04/96	1450	0.01	0.00	0.00	0.00	0.10	0.01	97.83	138.60	5.70	247.29	167.89	13.00
20/05/96	1430	0.00	0.00	0.00	0.00	0.00	0.00	91.00	0.40	7.00	220.00	160.00	17.00

GS 130206A Retreat Creek @ Main Road

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
09/09/93	0.150	0.072	0.036	0.180	0.700	0.922
27/10/93	1.300	0.016	0.006	0.220	1.300	2.616
01/12/93	0.480	0.060	0.066	0.023	0.080	0.620
16/12/93	4.000	0.055	0.071	0.170	1.200	5.255
09/02/94	1.100	0.038	0.022	0.050	0.800	1.938
30/03/94	0.010	0.008	0.010	0.065	0.400	0.418
30/06/94	0.007	0.036	0.010	0.041	0.400	0.443
24/08/94	0.011	0.002	0.031	0.400	0.011	0.024
09/11/94	0.013	0.005	0.014	0.073	0.700	0.718
14/12/94	0.091	0.009	0.017	0.051	0.754	0.855
16/03/95	0.358	0.011	0.048	0.188	1.074	1.443
20/04/95	0.075	0.032	0.028	0.141	1.168	1.275
02/06/95	0.150	0.028	0.003	0.028	0.235	0.413
29/06/95	0.016	0.015	0.003	0.023	0.401	0.431
08/08/95	0.004	0.013	0.002	0.058	0.775	0.791
12/09/95	10.159	0.017	0.011	0.049	1.454	11.630
06/01/96	0.262	0.032	0.059	1.669	3.069	3.362
01/02/96	0.004	0.011	0.006	0.047	0.987	1.002
06/03/96	0.013	0.027	0.010	0.068	0.951	0.991
01/04/96	0.003	0.005	0.002	0.036	0.800	0.808

GS 130220A LN1 Drain @ Emerald

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
27/10/93	0.220	0.038	0.020	0.060	0.700	0.958
02/12/93	0.006	0.008	0.016	0.040	0.400	0.414
16/12/93	7.000	0.035	0.067	0.150	1.300	8.335
09/02/94	0.500	0.053	0.004	0.030	0.400	0.953
31/03/94	0.002	0.006	0.003	0.024	0.500	0.508
01/07/94	0.410	0.054	0.041	0.072	0.600	1.064
09/11/94	4.700	0.015	0.014	0.110	1.200	5.915
03/02/94	5.600	0.079	0.062	0.180	1.200	6.879
14/12/94	10.600	0.013	0.020	0.104	1.578	12.191
16/03/95	0.440	0.028	0.004	0.027	0.200	0.668
09/08/95	0.011	0.014	0.002	0.014	0.521	0.546
12/09/95	0.002	0.005	0.003	0.039	0.600	0.607
30/11/95	15.170	0.033	0.004	0.048	1.281	16.484
06/01/96	2.438	0.083	0.014	0.068	1.368	3.889
01/02/96	0.003	0.016	0.003	0.025	0.809	0.828
06/03/96	2.085	0.033	0.066	0.228	1.931	4.049
02/04/96	0.012	0.007	0.011	0.071	0.500	0.519

GS 130219A Nogoa River @ Duckponds

Date Taken	Oxide Of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	KJN	Total N
09/09/93	0.300	0.020	0.078	0.140	0.500		0.820
27/10/93	0.002	0.022	0.008	0.040	0.600		0.624
27/10/93	0.086	0.026	0.010	0.050	0.500		0.612
02/12/93	0.310	0.054	0.088	0.250	0.700		1.064
16/12/93	0.410	0.017	0.027	0.070	0.500		0.927
09/02/94	1.200	0.047	0.039	0.070	0.500		1.747
03/03/94	0.280	0.002	0.062	0.850	2.200		2.482
04/03/94	0.170	0.002	0.031	1.900	4.700		4.872
05/03/94	0.040	0.002	0.041	1.400	3.200		3.242
14/03/94	0.059	0.002	0.024	1.200	2.200		2.261
30/03/94	0.073	0.003	0.014	0.110	0.500		0.576
05/05/94	0.110	0.008	0.030	0.072	0.400		0.518
08/06/94	0.280	0.009	0.022	0.051	0.600		0.889
30/06/94	0.270	0.019	0.024	0.058	0.500		0.789
24/08/94	0.180	0.009	0.002	0.064	0.500		0.689
19/10/94	0.180	0.011	0.009	0.059	0.500		0.691
09/11/94	0.009	0.006	0.014	0.047	0.600		0.615
14/12/94	0.042	0.009	0.013	0.051	0.650		0.701
16/03/95	0.472	0.022	0.042	0.247	0.643		1.137
20/04/95	0.074	0.019	0.021	0.078	0.819		0.912
01/05/95	0.014	0.015	0.003	0.033	0.600		0.629
12/05/95	0.004	0.012	0.004	0.039	0.427		0.444
31/05/95	0.014	0.015	0.003	0.033	0.569		0.598
28/06/95	0.005	0.006	0.003	0.021	0.362		0.373
10/08/95	0.007	0.011	0.000	0.016	0.639		0.657
27/08/95	0.005	0.016	0.003				0.021
08/09/95	0.005	0.010	0.005	0.027	0.435		0.449
01/11/95	0.003	0.009	0.006	0.030	0.255		0.267
29/11/95	0.028	0.041	0.004	0.054	0.720		0.788
03/01/96	0.006	0.035	0.005	2.332	7.002		7.043
04/01/96	0.005	0.044	0.003	3.402	4.956		5.005
04/01/96	0.007	0.013	0.003	5.021	14.411		14.430
04/01/96				1.111		2.730	
04/01/96	0.004	0.013	0.003	4.577	5.987		6.004
04/01/96	0.004	0.031	0.004	2.503	4.969		5.004
04/01/96	0.003	0.014	0.003	3.917	14.417		14.433
05/01/96	0.007	0.027	0.004	5.912	5.991		6.025
31/01/96	0.036	0.026	0.021	0.074	0.544		0.606
05/03/96	0.014	0.026	0.007	0.046	0.806		0.846
02/04/96	0.008	0.011	0.005	0.036	0.500		0.519
20/05/96	0.580	0.015	0.010	0.055	0.600		1.195

All results are in mg/l

GS 130221A LN3 Drain @ Selma Road

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
09/09/93	0.021	0.065	0.014	0.090	0.400	0.486
27/10/93	0.079	0.047	0.014	0.040	0.400	0.526
02/12/93	0.004	0.009	0.029	0.030	0.300	0.313
16/12/93	12.000	0.042	0.056	0.026	1.700	13.742
09/02/94	0.019	0.045	0.018	0.050	0.600	0.664
31/03/94	0.008	0.011	0.024	0.031	0.300	0.319
01/07/94	0.011	0.024	0.013	0.019	0.300	0.335
09/11/94	0.013	0.024	0.006	0.081	0.500	0.537
14/12/94	3.855	0.698	0.068	0.127	1.559	6.112
20/04/95	0.023	0.016	0.005	0.020	0.262	0.301
28/05/95	0.460	0.082	0.011	0.150	0.800	1.342

GS 130222A RR4 Drain @ Emerald

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
09/11/94	5.100	0.051	0.009	0.054	0.600	5.751
14/12/94	5.826	0.047	0.016	0.183	2.980	8.853
16/03/95	0.823	0.021	0.006	0.018	0.194	1.038
20/04/95	0.937	0.057	0.005	0.030	0.465	1.460
02/06/95	0.764	0.029	0.005	0.006	0.182	0.974
29/06/95	0.511	0.015	0.005	0.042	0.799	1.324
09/08/95	0.664	0.058	0.007	0.022	0.539	1.261
03/12/95	0.034	0.027	0.030	0.087	0.962	1.023
06/01/96	2.043	0.020	0.006	0.125	1.657	3.720
31/01/96	0.522	0.018	0.003	0.045	0.753	1.293
06/03/96	0.938	0.026	0.037	0.109	0.916	1.880
02/04/96	0.420	0.044	0.420	0.015	0.400	0.864

GS 130223A Selma Channel @ Flume

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
27/10/93	0.050	0.049	0.004	0.030	0.500	0.599
02/12/93	0.015	0.034	0.008	0.030	0.500	0.549
16/12/93	0.018	0.012	0.011	0.050	0.500	0.530
09/02/94	0.046	0.054	0.007	0.040	0.400	0.500
31/03/94	0.140	0.017	0.014	0.110	0.500	0.657
01/07/94	0.270	0.009	0.044	0.078	0.400	0.679
09/11/94	0.011	0.018	0.004	0.033	0.700	0.729
14/12/94	0.083	0.039	0.005	0.044	0.686	0.808
21/04/95	0.166	0.022	0.008	0.037	0.649	0.837
12/09/95	0.013	0.007	0.002	0.022	0.434	0.454
01/11/95	0.071	0.025	0.010	0.033	0.476	0.572
03/12/95	0.010	0.008	0.002	0.032	0.620	0.638
06/01/96	0.098	0.042	0.009	0.051	0.705	0.845
01/02/96	0.243	0.035	0.017	0.067	0.571	0.849
06/03/96	0.288	0.041	0.015	0.069	0.614	0.943
01/04/96	0.243	0.070	0.012	0.074	0.489	0.802

GS 130224A Weemah Channel @ Flume

Date Taken	Oxides of N Filtered	Ammonia, N Filtered	Phosphorous Filtered	Total P	Organic N	Total N
09/09/93	0.004	0.011	0.004	0.030	0.500	0.515
27/10/93	0.033	0.036	0.018	0.030	0.500	0.569
02/12/93	0.017	0.039	0.007	0.030	0.050	0.106
16/12/93	0.022	0.031	0.008	0.050	0.500	0.553
09/02/94	0.065	0.030	0.006	0.040	0.500	0.595
31/03/94	0.170	0.006	0.025	0.084	0.500	0.676
01/07/94	0.380	0.017	0.059	0.070	0.400	0.797
09/11/94	0.031	0.034	0.002	0.038	0.500	0.565
14/12/94	0.037	0.016	0.004	0.043	0.680	0.733
15/03/95	0.252	0.030	0.018	0.083	0.626	0.908
21/04/95	0.221	0.032	0.016	0.036	0.482	0.735
01/06/95	0.190	0.014	0.009	0.037	0.500	0.704
29/06/95	0.109	0.018	0.005	0.034	0.412	0.540
12/09/95	0.005	0.007	0.003	0.024	0.427	0.438
01/11/95	0.014	0.024	0.003	0.031	0.509	0.547
02/12/95	0.014	0.013	0.002	0.042	0.645	0.672
01/02/96	0.238	0.019	0.019	0.069	0.599	0.856
06/03/96	0.311	0.029	0.026	0.068	0.783	1.123
01/04/96	0.249	0.032	0.014	0.060	0.480	0.760

All results are in mg/l

Pesticides	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides
1992 ANZECC Environmental Guidelines	na	na	na	0.010	na	na	na	na	na	na	na
1996 NHMRC Drinking Water Guidelines	na	na	na	30.00	na	50.00	30.00	50.00	na	na	na
1996 NHMRC Drinking Water Guidelines Action Levels	na	na	na	0.05	na	0.10	na	na	na	na	na

GS 130201B Nogoa River @ MR Bridge

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
10/02/95	< 0.01	0.02	0.38	0.40	nt	nt	nt	nt	nt	nt	nt	Water
10/02/95	< 0.01	0.01	0.24	0.25	nt	nt	nt	nt	nt	nt	nt	Water

GS 130205B Nogoa River @ Selma Weir

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
10/02/95	0.01	0.02	0.75	0.78	nt	nt	nt	nt	nt	nt	nt	Water
10/02/95	10.00	20.00	140.00	170.00	nt	nt	nt	nt	nt	nt	nt	Fish Flesh
10/02/95	20.00	70.00	420.00	510.00	nt	nt	nt	nt	nt	nt	nt	Fish Gills
10/02/95	< 10.00	< 10.00	< 10.00	< 10.00	nt	nt	nt	nt	nt	nt	nt	Fish Flesh
10/02/95	30.00	60.00	260.00	350.00	nt	nt	nt	nt	nt	nt	nt	Fish Gills

GS 130206A Retreat Creek @ Main Road

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
25/11/92	nt	nt	nt	0.50	nt	< 0.10	2.50	6.70	26.00	nt	< 0.50	Water
10/03/93	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.10	1.00	< 0.20	< 0.02	nt	< 0.50	Water
01/12/93	< 0.05	0.05	0.70	0.75	nt	< 0.05	0.70	2.00	0.50	nt	nt	Water
16/12/93	0.30	0.10	1.70	2.10	19.00	nt	22.10	3.80	0.60	< 0.50	< 0.50	Water
09/02/94	nt	nt	1.90	1.90	nt	< 0.10	7.00	1.10	< 0.10	< 2.00	< 0.50	Water
14/12/94	< 0.05	< 0.05	0.50	0.50	nt	< 0.10	4.30	0.40	0.70	< 2.00	< 0.50	Water
16/03/95	nt	nt	nt	nt	nt	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.50	Water
21/03/95	< 0.10	< 0.10	12.00	12.00	nt	nt	< 10.00	< 10.00	< 10.00	< 50.00	< 10.00	Sediment
20/04/95	nt	nt	nt	nt	nt	< 0.10	< 0.10	0.20	< 0.10	nt	< 0.50	Water

Key:

Water :- µg/l Sediment :- µg/kg Fish Flesh :- µg/kg Fish Gills :- µg/kg na :- Not Available nt :- Not Tested

GS 130219A Nogoa River @ Duckponds

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
02/12/93	< 0.05	< 0.05	0.40	0.40	nt	nt	0.90	0.50	0.80	nt	nt	Water
16/12/93	< 0.10	< 0.10	0.26	0.26	2.00	nt	4.50	< 0.50	< 0.10	< 5.00	< 0.50	Water
09/02/94	nt	nt	1.10	1.10	nt	< 0.10	4.00	1.00	< 0.10	< 2.00	< 0.50	Water
14/12/94	< 0.05	< 0.05	< 0.05	< 0.05		< 0.10	< 0.10	< 0.10	< 0.10	< 2.00	< 0.50	Water
21/03/95	nt	< 5.00	18.00	18.00	nt	nt	< 10.00	< 10.00	< 10.00	< 50.00	< 10.00	Sediment
20/04/95	nt	nt	nt	nt	nt	< 0.10	< 0.10	< 0.10	< 0.10	< nt	< 0.50	Water

GS 130220A LN1 Drain @ Railway Crossing

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
26/11/92	nt	nt	nt	0.96	nt	0.10	1.10	7.50	53.00	nt	< 0.50	Water
10/03/93	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.10	< 0.50	< 0.20	< 0.20	nt	< 0.50	Water
02/12/93	< 0.05	< 0.05	3.00	0.75	nt	nt	0.30	< 0.05	0.40	nt	nt	Water
16/12/93	1.20	0.10	6.20	7.50	72.00	nt	82.80	6.60	0.30	< 0.50	< 0.50	Water
09/02/94	nt	nt	2.00	2.00	nt	< 0.10	2.80	0.50	< 0.10	< 2.00	< 0.50	Water
14/12/94	0.12	< 0.05	3.30	3.42	nt	0.40	7.40	3.30	1.70	< 2.00	< 0.50	Water
21/03/95	nt	18.00	68.00	86.00	nt	nt	< 10.00	< 10.00	< 10.00	< 50.00	< 10.00	Sediment

GS 130221A LN3 Drain @ Selma Road

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
26/11/92	nt	nt	nt	2.10	nt	0.15	3.60	9.70	72.00	nt	< 0.50	Water
10/03/93	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.10	< 0.50	< 0.20	< 0.20	nt	< 0.50	Water
02/12/93	0.08	< 0.05	1.00	1.08	nt	nt	< 0.05	< 0.05	< 0.05	nt	nt	Water
16/12/93	0.50	0.60	5.50	6.6	24.00	nt	14.60	5.80	0.20	< 5.00	< 0.50	Water
09/02/94	nt	nt	1.40	1.40	nt	< 0.10	0.33	< 0.10	< 0.10	< 2.00	< 0.50	Water
14/12/94	0.15	0.10	2.10	2.35	nt	< 0.10	13.70	2.30	0.90	< 2.00	< 0.50	Water
10/02/95	0.01	0.02	0.49	0.52	nt	nt	nt	nt	nt	nt	nt	Water
21/03/95	nt	13.00	35.00	48.00	nt	nt	< 10.00	< 10.00	< 10.00	< 50.00	< 10.00	Sediment
20/04/95	nt	nt	nt	nt	nt	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.50	Water

GS 130222A RR4 Drain @ Emerald

Date Taken	alpha-Endosulfan	beta Endosulfan	Endosulfan Sulphate	Total Endosulfan	Endo Alcohol	Trifluralin	Diuron	Fluometuron	Prometryn	Synthetic Pyrethroids	Organophosphorus pesticides	Remarks
14/12/94	0.08	< 0.05	2.30	2.38	nt	< 0.10	27.00	52.00	0.60	< 2.00	< 0.50	Water
16/03/95	nt	nt	nt	nt	nt	< 0.10	< 0.40	< 0.10	< 0.10	nt	< 0.50	Water
21/03/95	nt	6	38	44.0	nt	nt	< 10.00	< 10.00	< 10.00	< 10.00	< 10.00	Sediment
20/04/95	nt	nt	nt	nt	nt	< 0.10	< 0.10	< 0.10	< 0.10	nt	< 0.50	Water

Key:

Water :- µg/l Sediment :- µg/kg Fish Flesh :- µg/kg Fish Gills :- µg/kg na :- Not Available nt :- Not Tested

Pesticides	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine
1992 ANZECC Environmental Guidelines	na	na	0.014	0.004	na	na
1996 NHMRC Drinking Water Guidelines	30.00	na	na	100.00	0.30	20.00
1996 NHMRC Drinking Water Guidelines Action Levels	5.00	na	na	0.30	na	0.50

GS 130201B Nogoa River @ MR Bridge

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
10/02/95	12.00	nt	nt	3.00	0.70	nt	Water
10/02/95	9.00	nt	nt	1.90	0.50	nt	Water

GS 130205B Nogoa River @ Selma Weir

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
10/02/95	25.00	nt	< 0.01	2.10	< 0.50	nt	Water
10/02/95	nt	nt	< 10.00	< 10.00	200.00	nt	Fish
10/02/95	nt	nt	10.00	200.00	600.00	nt	Gills
10/02/95	nt	nt	< 10.00	< 100.00	< 100.00	nt	Fish
10/02/95	nt	nt	10.00	200.00	700.00	nt	Gills

GS 130206A Retreat Creek @ Main Road

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
25/11/92	1.10	nt	nt	nt	nt	nt	Water
10/03/93	0.20	nt	nt	nt	nt	nt	Water
01/12/93	0.20	nt	nt	nt	nt	nt	Water
16/12/93	2.80	nt	nt	nt	nt	nt	Water
09/02/94	13.80	nt	nt	nt	nt	< 0.10	Water
14/12/94	< 0.20	< 0.20	nt	nt	nt	nt	Water
16/03/95	< 2.00	nt	< 0.10	nt	nt	0.80	Water
21/03/95	< 50.00	nt	< 5.00	nt	nt	< 10.00	Sediment
20/04/95	< 2.00	nt	nt	nt	nt	< 0.10	Water

Key:

Water :- µg/l Sediment :- µg/kg Fish Flesh :- µg/kg Fish Gills :- µg/kg na :- , Not Available nt :- Not Tested

GS 130219A Nogoa River @ Duckponds

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
02/12/93	0.30	nt	nt	nt	nt	nt	Water
16/12/93	0.70	nt	nt	nt	nt	nt	Water
09/02/94	10.10	nt	nt	nt	nt	< 0.10	Water
14/12/94	< 0.20	< 0.20	nt	nt	nt	nt	Water
21/03/95	< 50.00	nt	< 5.00	nt	nt	< 10.00	Sediment
20/04/95	< 2.00	nt	nt	nt	nt	< 0.10	Water

GS 130220A LN1 Drain @ Railway Crossing

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
26/11/92	0.50	nt	nt	nt	nt	nt	Water
10/03/93	< 0.10	nt	nt	nt	nt	nt	Water
02/12/93	0.70	nt	nt	nt	nt	nt	Water
16/12/93	5.80	nt	nt	nt	nt	nt	Water
09/02/94	1.30	nt	nt	nt	nt	< 0.10	Water
14/12/94	4.00	< 0.20	nt	nt	nt	nt	Water
21/03/95	< 50.00	nt	62.00	nt	nt	< 10.00	Sediment

GS 130221A LN3 Drain @ Selma Road

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
26/11/92	0.40	nt	nt	nt	nt	nt	Water
10/03/93	< 0.10	nt	nt	nt	nt	nt	Water
02/12/93	< 0.20	nt	nt	nt	nt	nt	Water
16/12/93	16.80	nt	nt	nt	nt	nt	Water
09/02/94	2.10	nt	nt	nt	nt	< 0.10	Water
14/12/94	3.00	< 0.20	nt	nt	nt	nt	Water
10/02/95	20.00	nt	< 0.01	1.90	0.60	nt	Water
21/03/95	< 50.00	nt	9.00	nt	nt	< 10.00	Sediment
20/04/95	< 2.00	nt	< 0.10	nt	nt	< 0.10	Water

GS 130222A RR4 Drain @ Emerald

Date Taken	Methomyl	Thiodicarb	DDE	Parathion methyl	Profenofos	Atrazine	Remarks
14/12/94	10.00	< 0.20	nt	nt	nt	nt	Water
16/03/95	< 2.00	nt	< 0.10	nt	nt	0.10	Water
21/03/95	< 50.00	nt	11.00	nt	nt	< 10.00	Sediment
20/04/95	< 2.00	nt	< 0.10	nt	nt	< 0.10	Water

Key:

Water :- µg/l Sediment :- µg/kg Fish Flesh :- µg/kg Fish Gills :- µg/kg na :- Not Available nt :- Not Tested

130206A Retreat Creek @ Main Road

Sample Taken Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
27/10/93	1350	0.100	2.000	3.000	600.000	<1.000	30.000	2.500	5.000
01/12/93	1755	0.100	5.000	5.000	3800.000	<2.000	120.000	5.000	20.000
16/12/93		<0.100	2.000	5.000	1300.000	<2.000	70.000	5.000	10.000
09/02/94	1435	0.100	<1.000	4.000	800.000	<2.000	30.000	8.000	10.000
30/03/94	1810	<0.100	<2.000	3.000	1100.000	<2.000	80.000	5.000	10.000
30/06/94	1436	0.100	1.000	3.000	100.000	<2.000	30.000	<5.000	10.000
24/08/94	1715	2.500	5.000	1.000	30.000	0.050	0.008	0.500	350.000
09/11/94		0.300	1.000	2.000	850.000	<2.000	70.000	<5.000	10.000
14/12/94	1450	<0.100	1.000	2.000	450.000	<2.000	50.000	<5.000	<10.000
16/03/95	1605	4.200	15.000	12.000	6100.000	<2.000	150.000	20.000	40.000
20/04/95	1345	20.000	6.000	8.000	3300.000	<2.000	100.000	5.000	20.000
02/06/95	0803	4.300	1.000	2.000	530.000	<2.000	90.000	<5.000	10.000
08/08/95	1705	44.000	1.000	4.000	500.000	<2.000	210.000	<5.000	30.000
06/03/96	1100	3.500	1.000	5.000	560.000	<2.000	80.000	5.000	30.000

130219A Nogoa River @ Duckponds

Sample Taken Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
27/10/93	1625	0.050	0.050	2.000	360.000	1.000	20.000	2.500	10.000
02/12/93	1535	0.100	5.000	5.000	3600.000	<2.000	120.000	5.000	10.000
16/12/93	1415	<0.100	1.000	2.000	500.000	<2.000	20.000	<5.000	10.000
09/02/94	1540	<0.100	2.000	5.000	900.000	<2.000	30.000	5.000	<10.000
05/05/94	1700	<0.100	1.000	2.000	1000.000	<2.000	40.000	5.000	10.000
30/06/94	1603	0.900	1.000	2.000	500.000	<2.000	20.000	<5.000	10.000
24/08/94	1540	0.100	2.000	2.000	1000.000	1.000	30.000	5.000	5.000
09/11/94	1532	0.300	1.000	1.000	500.000	2.000	30.000	5.000	10.000
14/12/94	1640	0.200	1.000	1.000	400.000	<2.000	30.000	<5.000	<10.000
31/05/95	1508	<0.100	2.000	3.000	1100.000	2.000	20.000	<5.000	10.000
10/08/95	1033	15.000	1.000	3.000	550.000	<2.000	10.000	<5.000	10.000
27/08/95	1035	13.000	<1.000	2.000	850.000	<2.000	20.000	<5.000	30.000
05/03/96	1541	1.400	2.000	4.000	1000.000	<2.000	40.000	5.000	30.000

130220A LN1 Drain @ Emerald

Sample Taken Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
27/10/93	1416	0.050	7.000	4.000	310.000	1.000	20.000	2.500	10.000
02/12/93	1440	<0.100	1.000	1.000	300.000	<2.000	30.000	5.000	10.000
16/12/93		<0.100	2.000	4.000	1100.000	<2.000	40.000	5.000	10.000
09/02/94	1400	<0.100	2.000	2.000	170.000	5.000	10.000	7.000	<10.000
31/03/94		<0.100	<0.100	3.000	300.000	<2.000	20.000	<5.000	110.000
01/07/94	1120	0.300	1.000	4.000	200.000	2.000	30.000	<5.000	10.000
09/11/94	1135	0.800	3.000	3.000	850.000	2.000	190.000	10.000	10.000
14/12/94	1415	<0.100	2.000	3.000	850.000	<2.000	40.000	5.000	<10.000
16/03/95	1535	0.100	2.000	2.000	130.000	<2.000	20.000	<5.000	<10.000
09/08/95	1340	2.600	1.000	9.000	680.000	<2.000	30.000	5.000	20.000
06/01/96	1345	<0.100	<1.000	5.000	150.000	<2.000	60.000	5.000	20.000
06/03/96	1546	1.100	16.000	12.000	8000.000	2.000	160.000	25.000	50.000

All results are in µg/l

130221A LN3 Drain @ Selma Road

Sample Taken									
Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
27/10/93	1445	<0.100	2.000	2.000	370.000	1.000	10.000	2.500	5.000
02/12/93	1015	<0.100	1.000	1.000	290.000	2.000	20.000	5.000	10.000
16/12/93		<0.100	13.000	9.000	5400.000	2.000	280.000	20.000	10.000
09/02/94	1330	<0.100	1.000	3.000	170.000	7.000	<10.000	7.000	<10.000
01/07/94	1040	<0.100	1.000	2.000	100.000	<2.000	10.000	<5.000	10.000
09/11/94		0.200	2.000	2.000	700.000	<2.000	70.000	5.000	10.000
14/12/94	1340	<0.100	2.000	3.000	850.000	<2.000	40.000	5.000	<10.000
20/04/95	1655	20.000	2.000	2.000	360.000	<2.000	20.000	<5.000	<10.000

130222A RR4 Drain @ Emerald

Sample Taken									
Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
09/11/94		1.500	3.000	2.000	1100.000	2.000	80.000	5.000	10.000
16/03/95	1520	1.300	2.000	1.000	170.000	<2.000	20.000	<5.000	<10.000
20/04/95	1430	0.800	5.000	7.000	870.000	<2.000	60.000	5.000	40.000
14/12/94	1550	0.700	2.000	6.000	850.000	<2.000	50.000	10.000	<10.000
20/04/95	1430	0.800	5.000	7.000	870.000	<2.000	60.000	5.000	40.000
02/06/95	900	0.100	1.000	2.000	820.000	<2.000	40.000	<5.000	20.000
09/08/95	1456	2.500	1.000	5.000	640.000	<2.000	50.000	5.000	10.000
06/01/96	1100	7.000	4.000	4.000	1500.000	<2.000	60.000	5.000	10.000
06/03/96	1100	30.000	10.000	7.000	4500.000	<2.000	60.000	10.000	30.000

130223A Selma Channel @ Flume

SampleTaken									
Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
01/07/94	0925	<0.100	1.000	2.000	400.000	<2.000	20.000	<5.000	10.000
06/03/96	1456	2.000	2.000	5.000	1700.000	<2.000	30.000	<5.000	30.000

130224A Weemah Channel @ Flume

Sample Taken									
Date	Time	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
01/07/94	0925	0.200	1.000	2.000	400.000	<2.000	20.000	<5.000	10.000
15/03/95	1645	2.000	2.000	5.000	1320.000	2.000	50.000	<5.000	40.000
01/06/95	0920	0.100	<1.000	3.000	810.000	<2.000	30.000	<5.000	10.000
06/03/96	1409	10.000	2.000	5.000	1700.000	<2.000	30.000	5.000	30.000

All results are in µg/l

Gauging Station	26/11/1992	11/02/1993	05/08/1993	29/03/1994	30/06/1994	01/07/1994
GS130223A Selma Channel @ Flume	0.01		0.10			<0.20
GS130224A Weemah Channel @ Flume	0.03		0.10			<0.20
GS130216A Nogoa River @ Fairbairn Dam		0.10	0.10	<0.20		
GS130206A Retreat Creek @ Main Road			0.10		<0.20	
GS130220A LN1 Drain @ Emerald						<0.20
GS130221A LN3 Drain @ Selma Road			0.10			0.10
GS130219A Nogoa river @ Duckponds					<0.20	

Environmental Guidlines - 0.1µg/l
Drinking Water Guidlines - 1.0µg/l
All results in µg/l