South Taranaki District Council
Eltham Wastewater Treatment Plant
Monitoring Programme
Annual Report 2008-2009

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Executive summary

The South Taranaki District Council which operates the Eltham municipal wastewater treatment system located to the east of Eltham in the Mangawhero catchment holds resource consents to allow it to discharge treated wastewater to the Mangawhero Stream and emissions into the air. This report for the period July 2008 to June 2009 describes the monitoring programme implemented by the Taranaki Regional Council to assess the environmental performance during the period under review, and the results and effects of the consent holder's activities. It also records the state of riparian planting and channel improvement initiatives in the lower Mangawhero catchment.

The reviewed water resource consent includes a total of 13 special conditions, and the air consent 11 special conditions, setting out the requirements that the South Taranaki District Council must satisfy.

The Council's monitoring programme included inspections, odour surveys, wetlands wastewater analyses and physicochemical and biological surveys of the receiving waters of the Mangawhero Stream and Waingongoro River.

During the 1993-94 monitoring period the consent holder appointed consultants to investigate waste loadings on the existing oxidation pond system and report on options for upgrading of the system and disposal of the combined industrial and domestic treated wastes. The upgrade option, permitted by consent 0160, has for a variety of reasons failed to meet timeframes and design standards. As a result, Council reviewed the consent in late 1999 and imposed conditions requiring improved reporting and progress with a modified upgrade (as proposed by new consultants appointed by the consent holder in conjunction with the major industrial users of the system) which would achieve a suitable standard of effluent quality for discharge to the Mangawhero Stream, by 31 March 2002. Progress since then has been confined to natural re-vegetation of the wetlands which were used as the tertiary component of the system throughout the current monitoring year. Intensive monitoring of the wetlands effluent quality was maintained during this period. However, the completion of the plant upgrade was not undertaken. Instead, options have been evaluated for the more favoured pipeline transfer of the treated wastewater out of the Mangawhero Stream catchment to the Hawera oxidation ponds system and then to the Tasman Sea through the ocean outfall. This has been progressed to the stage where timeframes for pipeline implementation and consent applications were established by the consent holder in response to the requirements of an enforcement order. After several pre-hearing meetings, the consent variation was the subject of a formal hearing which made its recommendation to the Minister of Conservation and was subsequently granted. An appeal of the decision to the Environment Court was withdrawn and construction of the new pipeline system and associated pumping and screening facilities (at the WWTP) were well advanced by June 2009.

The existing partially upgraded system, although identified as extensively overloaded, was well maintained and operated during the monitoring year. Mechanical aeration of the primary pond was successful in maintaining aerobic conditions throughout the period. Although localised odours were noted from time to time, there were no complaints received during the monitoring year.

Low to moderate dissolved oxygen levels were generally recorded in the primary oxidation pond during the monitoring period. This pond exhibited a moderate bacterial component of the microflora, and above average algal taxa richness, although some of the taxa present were indicative of high wastes loadings on the system.

Final effluent quality after wetlands treatment, remained well below the design standards originally proposed for the completely upgraded system (intended for surface water discharge).

Overall, environmental performance was poor as late summer physicochemical and biological monitoring surveys conducted under moderately low flow conditions continued to indicate significant impacts on the water quality of the Mangawhero Stream due to limited dilution of the wastewater treatment plant effluent and its failure to meet design standards. Aspects of biological water quality deterioration under low flow conditions were just as significant as recorded in previous monitoring periods, despite relatively recent improved stream morphology provided by willow removal work in the lower reaches of the stream. Physicochemical water quality effects, mainly increased $BOD_{5,}$ bacteria, and some nutrient levels, and poorer aesthetic quality, continued to be measured throughout the Mangawhero Stream and extended into the Waingongoro River downstream of their confluence. These trends can be expected to be alleviated when wastes are directed to the Hawera WWTP via the pipeline currently under construction.

Components of a suitable monitoring programme for 2009-2010 have been identified and included in recommendations.

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1. Introduction

1.1 Compliance monitoring programme reports and Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2008 to June 2009 by the Taranaki Regional Council describing the monitoring programme associated with the resource consent held by South Taranaki District Council for the Eltham wastewater treatment plant system.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of consents held by South Taranaki District Council that relate to the discharge of treated wastes into the Mangawhero Stream and to the emissions to air from the treatment plant. This is the twenty-second Annual Report to be prepared by the Taranaki Regional Council to cover these discharges and their effects.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by South Taranaki District Council in the Mangawhero catchment (a sub catchment of the Waingongoro catchment), the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Mangawhero and Waingongoro catchments.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretation, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2009-2010 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act (1991) and monitoring

The Resource Management Act primarily addresses environmental `effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

(a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

(d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic);
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, including impact monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the consent holder during the period under review, this report also assigns an overall rating. The categories used by the Council, and their interpretation, are as follows:

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or trivial (such as data supplied after a deadline) non-compliance with conditions.
- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the year were negligible or minor at most, items of concern were resolved positively, co-operatively, and quickly, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with.
- **improvement desirable** indicates that the Council may have been obliged to record a verified unauthorised incident involving significant environmental impacts against the company, and/or abatement notices may have been issued; there were adverse environmental effects arising from activities and intervention by Council staff was required, and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at end of the period under review.
- **poor** performance is used when there were grounds for prosecution or infringement notice.

1.2 Treatment plant system

1.2.1 Background

Eltham township sewage treatment has been provided historically by a two oxidation pond system. Various industrial wastes have also been accepted for treatment by this system. Mechanical aeration of the primary oxidation pond was introduced because of overloading of the two pond system as a consequence of the incorporation of these industrial wastes.

Investigations of individual industrial and total waste loadings being discharged into the treatment system were undertaken by NZ Dairy Research Institute in August 1992 with a follow-up survey performed in March/April 1993. Although some problems were experienced with these surveys, the wastewater loadings entering the ponds system were found to approach, and possibly exceed, the 1000 kg/day BOD_5 treatment capacity. These loadings probably accounted for the increase in mechanical aerator operating times recorded during this period.

Further investigations of wastes influent loadings to the treatment system, undertaken by the South Taranaki District Council in conjunction with its consultants during 1993-94, concluded that the Eltham sewage treatment plant was receiving a peak organic waste load equivalent to a population of 22 000 persons. The original design was based on a population of 5500 persons, prior to the installation of mechanical aeration. The consultant's report (Royds Garden, 1994a) also concluded that while 50% of the flow to the treatment system was contributed by Eltham's domestic sewage, more than 80% of the organic load was of industrial origin (which had large fluctuations in flow, pH, BOD_5 and suspended solids). This report also concluded that in order to obtain a new resource consent, significant upgrading of both the treatment and disposal of Eltham's industrial and domestic wastewater would be necessary. Although this upgrade would be required simply to cope with the existing sewage load, it would be essential to provide some reserve capacity for peak loads and probably further industrial expansion. It recommended planned establishment for a final plant capacity of approximately 30 000 population equivalent.

The consultant's companion report (Royds Garden, 1994b) provided options for treatment plant design and concluded that the best option for disposal was into the Mangawhero Stream despite the requirement for the highest standard of treatment.

Twin aerators had been installed in the primary pond in January 1988 with automatic control by rises/falls in the dissolved oxygen level of the primary pond (as measured by a probe situated at a depth of 700 mm toward the opposite perimeter of the pond). A computerised monitoring record of the aerator's operation and associated pond dissolved oxygen concentrations was maintained by the South Taranaki District Council and interrogated by South Taranaki District Council staff. However, calibration and problems associated with the dissolved oxygen probe performance have caused complications with the aerators' performance in recent years, to the extent that the probe became inoperative and was replaced during a system upgrade.

Although the addition of the twin aerators to the pond system increased treatment capacity from 235 kg to more than 1000 kg of BOD_5 (Biochemical Oxygen Demand) per day, the system was not capable of coping with the waste loadings. From time to time complaints were received by STDC and the Taranaki Regional Council concerning

objectionable odours emanating from the ponds system. These odours have generally occurred at times of calm weather (early morning and evening) and/or following aerator breakdown/maintenance, and these incidents were usually of short duration.

Despite the operation of the aerators, dissolved oxygen levels in the primary pond from time to time have fallen to levels lower than recommended for efficient pond operation. A combination of high pond loadings, low dissolved oxygen levels, and marked changes in weather conditions, contributed to a major deterioration in primary pond performance (with associated odour problems) over a relatively lengthy period in April/May 1993. The lack of dissolved oxygen at this time indicated that the pond had effectively become anaerobic and generated strong pungent odours. Depending on weather conditions, the smell was discernible throughout much of Eltham and caused considerable distress to residents near the ponds in Castle Street. STDC (in liaison with TRC staff) and industry took various measures to restore aerobic conditions and improve the ponds' performance, including chemical dosing, providing extra aeration (jet-boat and mechanical aerators), pumping effluent from the second pond back into the first pond, and reducing waste loadings. By mid-May the ponds had recovered to normal performance, with only occasional odours being reported since then. Restorative work, with associated monitoring, fortunately confined the problem to the primary pond, thereby maintaining normal ranges of quality in the effluent discharged into the receiving waters. However, despite the addition of further mechanical aeration which was maintained throughout the four most recent monitoring periods (up to five aeration units in operation), primary pond- monitored dissolved oxygen concentrations have often fallen below the minimum level (2 g/m^3) considered necessary for effective operation. Additional aeration also produced increased amounts of bacteria (ie biomass, suspended solids) which remained in suspension and were transferred through into the secondary pond where the pond's appearance altered markedly, often with an associated reduction in the dissolved oxygen concentration of this pond. Deterioration in effluent appearance and quality, with increased impacts on the receiving waters, was the ultimate consequence of additional aeration of the primary oxidation pond.

Previous monitoring reports have highlighted the following problems with the system from time to time:

(i) milky, turbid appearance of the primary pond;
(ii) abundance/domination of filamentous bacteria in the microflora of the pond(s);
(iii) intermittent odour problems associated with the primary pond;
(iv) absence of dissolved oxygen in the primary pond;
(v) marked detrimental impacts on the physicochemical water quality and biological communities of the Mangawhero Stream.

These matters were addressed by the consent holder's consultant as required by conditions attached to the previous short-term consent.

Poor stream water quality conditions have been identified from time to time in the past upstream of the oxidation ponds' discharge. Agricultural waste disposal practices on various farms were more intensively surveyed in this area of the catchment during the Taranaki Regional Council's annual 1994-95 round of dairy shed inspections and follow-up re-inspections performed where necessary to ensure compliance with consents and the Resource Management Act, 1991. Annual inspections have been

continued during subsequent monitoring periods, with only isolated short-term problems identified and rectified. No continuous major waste disposal problems were found, although the potential for contamination of receiving waters was identified should poor effluent disposal system management occur. These systems will continue to be monitored in future Regional Council dairy shed inspection rounds.

No usage of the Eltham wastewater treatment plant for disposal of industrial tanker wastes (eg, septic tank wastes etc) now occurs as there are purpose-built facilities in place to accept these wastes at the nearby Stratford oxidation ponds and more appropriately, the Hawera system. Monitoring of waste influent in the ponds is performed by South Taranaki District Council (by way of continuous recording of volume and pH), ensuring that stricter control of such usage now occurs.

1.2.2 Initial proposal for upgrade to the system

A working party was established by the South Taranaki District Council, and consultants were commissioned to identify the standard of wastewater treatment required together with options for treatment and disposal. The most suitable option for upgrading the existing facilities without causing significant adverse environmental effects on the Mangawhero Stream was selected by the working party and formed the basis of an application for renewal of the existing short-term consent. An air discharge consent application was also lodged for the proposed upgrade to the treatment system. These applications were processed in the latter part of 1994 without the need for a formal hearing, although a total of five submissions were received. The proposed upgraded system, when completed, was intended to produce a final effluent quality of:

BOD_5:	20 g/m^3
Suspended solids:	20 g/m^3
Faecal coliform bacteria:	<10 000 per 100 ml

and the components of the proposed upgrade included:

- a new pipeline to take wastewater from the Dairy Meats and Mainland Products Companies to the site;
- a new 0.43 ha covered anaerobic lagoon at the site to provide primary treatment of the Dairy Meats Company and Mainland Products Ltd wastewater. Biogas from the lagoon will be collected and either flared at the site or piped to Mainland Products Ltd for use in boilers. [This design of the anaerobic lagoon (EADER) was subsequently adjusted, by way of an approved 40% increase in volume, to provide greater capacity and increased retention time];
- a new activated sludge treatment plant or an equivalent process to provide further treatment of effluent from the anaerobic lagoon;
- a belt press for sludge removal (with an appropriate building) and off-site disposal (instead of sludge drying beds);
- the existing 3 ha oxidation pond, without a need for mechanical aeration, which would treat domestic sewage from Eltham and pre-treated wastewater from NZ Pastoral Foods;

- a new clarifier to remove sludge from the activated sludge plant effluent and suspended solids from the oxidation pond effluent. (A review of the location and size of the clarifier to the extent that it would treat only the activated sludge plant and anaerobic lagoon effluents was approved); and,
- a constructed wetland, converted from the existing secondary oxidation pond.

1.2.2.1 Progress with upgrade and subsequent alternative disposal method

A comprehensive history of progress is contained in the 2003-2004 annual report (TRC 2004-52). During the 2004-2005 monitoring period investigation and reviews relating to the pipeline diversion of wastes (out of the Mangawhero Stream) to the Hawera oxidation pond system were completed. An application was lodged for a variation of the appropriate ocean outfall coastal permit. This was delayed by requirements for several pre-hearing meetings as a result of submissions received to the application. A formal hearing was held in October 2006 and the recommendation to the Minister of Conservation (to vary the permit) was subsequently appealed by two submitters. These appeals were withdrawn in the latter part of the period.
The pipeline diversion, which had been delayed as a result of the appeals, has now commenced with pipeline and pump station construction following a review of costings undertaken by the Eltham dairying industries involved in the joint usage of the system.

A new wetlands outlet grate was installed in July 2006 to reduce the incidence of debris discharge with the wastewater. This outlet required increased maintenance but has been effective throughout the period to date.

No alterations to the layout of the wastewater plant occurred during the year under review. At the end of the 2008-2009 monitoring period the layout remained as illustrated in Figure 1, with wetlands vegetation remaining stable, while the wastewater levels were generally maintained at a suitable depth to provide for plant development. No use of the clarification component of the system was made during the period.

The primary pond was de-sludged during the 2006-2007 monitoring year with the de-watered sludge contained in geo-textile bags in an excavated, bunded area adjacent to the EADER (Figure 2). De-waterings and stormwater from this area continued to be returned to the primary pond through the clarifier during 2007-2008 and 2008-2009 and no odour problems were associated with this operation. However, STDC water treatment plant sludge was placed over the geotextile bags during 2008-2009 (Photos 1 & 2) without consultation, resulting in neighbours' concerns with respect to future sludge disposal at this site. The original intention had been to dispose of the Eltham WWTP pond sludge to the Patea landfill which, however, was subsequently closed.

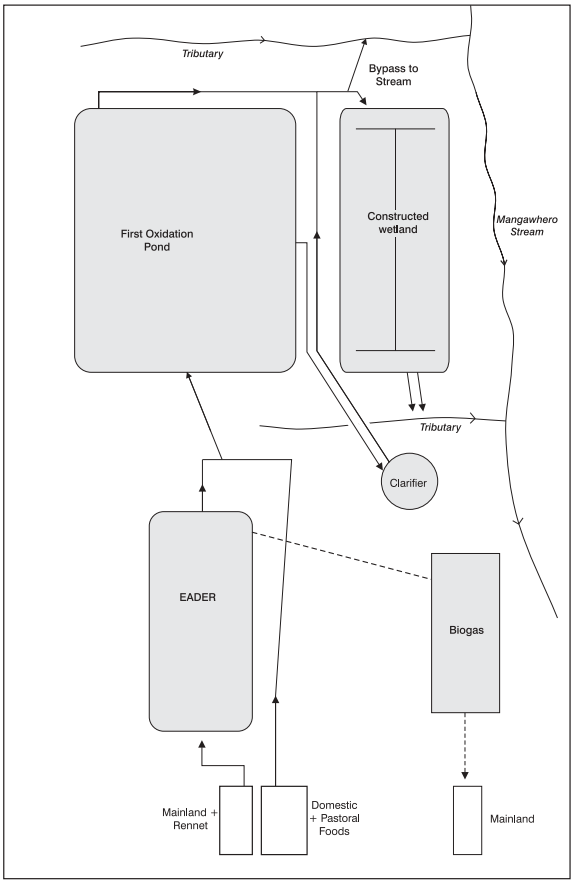

Figure 1 Schematic layout of Eltham wastewater treatment plant as at 30 June 2009

Figure 2 Aerial view of the Eltham WWTP showing the sludge geo-textile bags disposal area (lower LH corner) near the plant entrance

Photos 1 and 2 Water treatment plant sludge and geotextile WWTP sludge bags, May 2009

After meetings with interested parties STDC was advised that there were no specific issues preventing the consented burial of this sludge on site as chemical testing indicated that it was suitable for land disposal. Although STDC was planning to provide a sludge disposal facility at Whareroa (to take both water and wastewater treatment plant sludges), it was considered that rather than transport the Eltham sludge to that site, a one-off on-site disposal event was appropriate and could be consented. An application four such a consent is currently in preparation.

Photo 3 Step screen at new inlet to primary pond, June 2009

Photo 4 Future holding pond (current wetland) and outlet, June

Work commenced on the pipeline connection to the Hawera WWTP during the latter half of the monitoring period (see Appendix III). A step screen and new inlet to the primary pond (Photo 3) were constructed on the raw wastewater reticulation and a new stormwater pipe from this area was directed to the wetland (Photo 4). The wetland will be converted to a holding pond to provide high stormwater ingress containment in excess of the pumping capacity of the new pipeline connection. This system is anticipated to overflow on one to two occasions in five years necessitating a new consent for this discharge. Improved access to the outfall site was constructed for sampling purposes (Photo 5).

Photo 5 New access to outfall, June 2009


Photos 6 and 7 Pump base at rear of old clarifier, May 2009

Construction of the pump outlet from the primary pond component of the treatment system to the new pipeline was partially completed by June 2009 (Photos 6 and 7).

1.3 Receiving water riparian management

In recognition of the effectiveness of riparian vegetation as a management technique contributing to water quality improvement, and Special Condition 10 of consent 0160, Regional Council land management staff prepared a riparian management plan for the Mangawhero catchment (TRC, 1998b). This plan identified the 6.6 km reach of the Mangawhero Stream extending from about 2 km upstream of the wastewater treatment plant to the stream's confluence with the Waingongoro River, as the reach requiring a combination of riparian planting and fencing, and willow removal. Design and costs were assessed and progress with implementation of the plan was dependent on landowner agreements integrated with funding from various sources, including a consent holder contribution.

A comprehensive history of progress with willow removal and riparian planting and fencing has been provided in the 2003-2004 annual report (TRC 2004-52).

During the 2004-2005 period no new works were implemented due mainly to funding being exhausted. However, the Taranaki Regional Council employed a contractor to undertake the spraying of willow regrowth along the reach of the Mangawhero Stream from SH3 to the Mangawharawhara Stream confluence. It was considered vitally important that willows do not become re-established along the stream.

In addition to this, the true left bank immediately below the SH3 culvert was sprayed for bindweed and periwinkle. It was resprayed in the 2005-2006 period, with replanting of this area performed in the 2006 planting season along with some minor blanking (planting of the gaps) in this reach.

Several years of concern expressed by affected landowners in regard to ongoing problems with ponding and sediment build-up, resulted in a further 150 m of willow removal undertaken from the Mangawhero/Mangawharawhara confluence downstream towards the railway bridge during the 2005-2006 period. Material removed from the streambed and stream margin was stockpiled on the adjoining properties and dried out before burning and burying. This was implemented by the landowners.

The stream margin from above the Eltham WWTP, downstream to the confluence of the Mangawharawhara Stream has continued to be monitored in the 2007-2008 and 2008-2009 seasons for willow regrowth, assessment of previous plantings and the impact of willow removal. Particular attention continues to be paid to the area adjacent to the old Eltham landfill, downstream of the Castle Street bridge.

1.4 Resource consents

1.4.1 Water discharge permit

Section 15(1)(a) of the Resource Management Act stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

South Taranaki District Council holds water discharge permit 0160 which authorises the discharge of up to fifteen hundred cubic metres/day of treated wastewater from the municipal wastewater treatment plant system into the Mangawhero Stream. A copy of this consent is attached at Appendix I and is the principal subject of the monitoring programme. Consent conditions were changed in June 1996 and June 1997 and the consent was reviewed and conditions changed in December 1999. The consent expires on 1 June 2011 with review dates of June 2003 and June 2007. Special conditions attached to this consent require:

- progressive reporting on, and upgrading of the wastewater treatment system to achieve specific design effluent standards;
- limitations on effects in the receiving waters of the Mangawhero Stream;
- provisions of proper management and operation of the treatment system;
- provision of riparian management in the Mangawhero Stream catchment;
- consultation should additional trade wastes be considered for acceptance into the system and providing for review of permit conditions under such circumstances; and
- provision for review of conditions ensuring the adequacy of dealing with significant adverse effects on the environment.

1.4.2 Air discharge permit

Section 15(2)(a) of the Resource Management Act stipulates that no person may discharge any contaminant into the air from any place, in a manner that contravenes a rule in a regional plan, unless the discharge is expressly allowed for by a resource consent, or is an existing lawful activity.

South Taranaki District Council holds discharge permit 4618 authorising the discharge of miscellaneous emissions to the air from the Eltham wastewater treatment system. This consent was granted in November 1994, one condition was amended in June 1997, and the consent expires in June 2011, with review dates of June 1999 and June 2005. A copy of the consent is attached as Appendix I. Special conditions attached to this consent require:

- adoption of best practical options and exercise of the consent in accordance with submitted documentation to limit any adverse environmental effects;

- limitations on odours and airborne contaminants at or beyond the property boundary; and
- provision for review of conditions ensuring the adequacy of dealing with significant adverse effects on the environment.

1.5 Monitoring programme

1.5.1 Introduction

Section 35 of the Resource Management Act sets out an obligation for the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region.

The Taranaki Regional Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

An appropriate monitoring programme was established for the system in 1987 and upgraded annual programmes have continued since this date. The programme also required integration with other receiving water monitoring programmes for discharge consents in the vicinity of the municipal wastewater treatment plant system. The 2008-2009 monitoring programme consisted of four primary components.

1.5.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters. This particularly has been the case with the consideration of options for the future disposal of wastewater from the Eltham wastewater treatment system.

1.5.3 Site inspections

The Eltham wastewater treatment plant was visited seven times during the monitoring period. The main points of interest were plant operation, configuration and performance, air emissions and the discharges of treatment wastewater. These inspections provided for the operation, internal monitoring, and supervision of the plant to be reviewed by the Council and on-site odour surveys to be undertaken. One additional inspection to the normal monitoring programme was associated with an overflow within the system in the course of installation of the step-screen (a component of the upgrade prior to connection of the pipeline to the Hawera WWTP).

1.5.4 Wastewater and receiving water quality sampling

The Taranaki Regional Council performed sampling of wastewater quality and receiving water physicochemical quality for plant performance and impact assessments purposes. Frequency of sampling and the analytical parameters measured varied according to the purpose of monitoring.

1.5.5 Biological surveys

Two macroinvertebrate biological receiving water surveys were undertaken at sites in the Mangawhero Stream and Waingongoro River under late spring (December 2008) and autumn flow conditions, the latter during low flow conditions in March 2009.

2. Results

2.1 Inspections of treatment system operation

Six routine inspections were performed during the 2008-2009 period. This frequency was in recognition of the environmental performance history of the system. These were performed as scheduled during the monitoring period. Odour surveys were also undertaken at various locations around the wastewater treatment system on each scheduled inspection occasion and on one additional early morning occasion during the autumn period. Physical features of the system were recorded, and surface dissolved oxygen concentration was measured (by Winkler technique) at the perimeter of the oxidation pond adjacent to the outlet. Dissolved oxygen monitoring was not required within the constructed wetland. Microfloral samples were also collected from the oxidation pond at the time of each inspection for semi-quantitative assessments.

2.1.1 Odour surveys

Six odour surveys were carried out over the monitoring period in conjunction with site inspections and one additional programmed survey was performed in the late summer – autumn period, in early morning. Odour strength was rated according to the following scale:

0	=	no noticeable odours
1	=	slight occasional wafts
2	=	recognisable and noticeable
3	=	frequently noticeable
4a	=	unpleasant odours, frequently strong
4b	=	unpleasant odours, continuous and noticeable
5	=	putrid

2.1.1.1 Regular surveys

Eight sites around the wastewater treatment plant were monitored at the time of each mid-morning survey. As odour strength varies naturally according to wind direction and velocity, these variables were also recorded on each survey occasion.

Slight odours were recorded on all occasions in the immediate vicinity of the influent split to the primary pond. Generally these odours were slight as the improved sealing of the EADER outlet (performed early in 2003) had subsequently reduced the strength of the odours.

Slight odours were also noted on all occasions at the site at the inlet to the EADER and scale 1 on one occasion at all other sites (except the northwest corner of the primary pond). This indicated that noticeable odours from the influent split after the EADER, which is approximately 150 metres from the entrance, dissipated relatively rapidly and were generally localised. No hydrogen sulphide was detectable on any occasion near the perimeter of the WWTP. On all but one occasion, no odours were detectable at the main entrance gate to the WWTP nor on Castle St. No odours were recorded on Lady's Mile roadside (northern boundary of the WWTP) on any occasions. There were no odours associated with the de-sludging geotextile bags disposal area (see TRC, 2007)

nor with the additional water treatment plant sludge dumped at this site on any inspection occasion.

2.1.1.2 Additional survey

One additional early morning odour survey was performed in autumn (May 2009) under overcast, relatively calm conditions. All usual operations were occurring at the WWTP and the primary oxidation pond surface was flat. There were no unpleasant odours at any point in the WWTP system. Noticeable odours were recorded adjacent to the oxidation pond outlet and slight odours adjacent to the northwest corner of the pond. There were slight to occasional wafts of odours in Lady's Mile just beyond the oxidation pond perimeter.

2.1.1.3 Comments

Generally, the odour that local residents experience depends upon three factors. Firstly, the nature of wastewater treated; secondly, the design, maintenance and operation of the treatment system; and thirdly, ambient weather conditions. Air quality in the vicinity of the WWTP is unlikely to change unless either the composition, strength, or volume of the raw wastewater changes or the treatment and disposal system is upgraded. The aerators on the pond, through their mode of operation, cause release of odour to the atmosphere. The treatment system also includes a large covered anaerobic digester (EADER) as a primary component, which has never functioned as designed.

The strength of odour beyond the boundaries of the treatment plant site appears to be governed largely by weather conditions. Odour is strongest under calm conditions, when aerial emissions from the EADER and pond accumulate. This effect is accentuated when it is overcast, as vertical mixing with ambient air is reduced, and under warm temperatures, when odour-generating bacteria in the pond are most active. Effects are exacerbated by reduction in aeration capacity (mechanical) in the pond and deterioration in the floral population of this pond.

It has been concluded that odours of this nature from Eltham wastewater treatment plant will occur from time to time and will vary in their effect depending upon ambient weather conditions. Therefore, they may only be documented by way of continuing monitoring and recording of incidents, until such time as alternative waste disposal methods are implemented and thereafter in conjunction with the monitoring of the system after connection to the Hawera WWTP pipeline. It is essential that sufficient aeration is provided and capacity is maintained at all times, particularly coincident with seasonal changes in pond floral communities.

2.1.2 Dissolved oxygen levels in the primary pond

The results of dissolved oxygen monitoring in the primary pond recorded during regular inspections are included in Table 1.

Table 1 Dissolved oxygen measurements from the surface of the Eltham primary oxidation pond at the perimeter adjacent to the aerators' DO probe

Date	Time (NZST)	Temperature (°C)	Dissolved Oxygen	
			Concentration (g/m^3)	Saturation (%)
6 August 2008	0915	10.8	3.8	35
15 October 2008	0815	17.0	2.6	28
17 December 2008	0830	18.8	1.7	19
5 March 2009	0825	20.7	1.2	14
1 May 2009	0900	15.4	1.7	17
24 June 2009	0915	7.9	4.2	36

[Note: ( ) = additional inspection surveys]

The dissolved oxygen concentrations in oxidation pond systems vary both seasonally and during the day as a result of a combination of factors. The photosynthetic activity of the pond's biological flora together with the influent waste loadings on the system are major influencing factors. Another influence in the Eltham system is the intensity of mechanical aeration provided in the primary pond. Minimum dissolved oxygen concentrations are generally recorded in the early hours of daylight, and therefore pond performance has been evaluated by standardising sampling times toward mid-morning for all regular inspection visits during the monitoring period.

Results in Table 1 indicated a relatively narrow range of variations in dissolved oxygen concentrations (between 14 and 36% saturation) in the surface layer of the primary pond near the outlet for the period when the aerators were operating at full capacity. These levels were typical of the moderate levels generally recorded in this heavily loaded oxidation pond. Mechanical aeration of the pond (by seven to nine aerators) maintained positive dissolved oxygen concentrations on each survey occasion with the lowest concentrations measured during the summer-autumn period.

The South Taranaki District Council maintained manual on-site dissolved oxygen monitoring throughout the period for internal monitoring and operational purposes.

2.1.3 Primary pond conditions

Occasional very slight odours were recorded in the immediate vicinity of the primary oxidation pond on all of the regular inspection occasions downwind of the pond.

Extensive aeration of the primary pond (nine mechanical aerators in operation on all but one occasion when two aerators were being serviced) was continued. The pond was generally turbid in appearance but the colour varied from mid brown, through light brown to dark green. There was no evidence of sludge layers close to the surface of the primary pond on any inspection occasion.

Wave action on the pond surface was generally minimal (no more than rippling) as most of the inspections were coincident with light to moderate wind conditions although the aerators generated localised surface movement. Observations made in conjunction with dissolved oxygen sampling of the primary pond adjacent to the DO probe (ie, opposite the inlet position), showed that an anticlockwise current existed

around the pond as a result of the action of the aerators. This steady current was present on all inspection occasions due to the large number of aerators which were operational on the primary pond.

The pond's surrounds were tidy at all times (grazed by sheep or mown), the wavebands were tidy (sprayed) and the pond surface was free from accumulated debris. Ducks (mainly mallard) were very common on the pond throughout the year, often in large numbers (more in winter), with paradise ducks, gulls and black swan occasionally present. Pukeko and blue heron were noted at the margins on one occasion. These species are common members of the avifauna associated with treatment ponds systems (Don, 2004).

No clarification of part of the primary pond effluent was recorded during the period, and therefore no clarified effluent was discharged into the wetland. The clarifier was modified during the period for incorporation into the diversion reticulation into the Hawera WWTP pipeline.

No overflow discharges of primary pond treated wastes to the small tributary stream adjacent to the eastern boundary, were recorded at the time of any inspection visit. This followed repairs to the bypass gate in the 2001-2002 period.

2.1.4 Wetland conditions

No more than very slight downwind odours were associated with the wetland at the time of any inspection visit. The wastes in the wetland varied from light to mid brown, through dark green to pale grey green in appearance throughout the period. By winter wetlands wastewater appearance was pale green. On most inspection occasions there was no obvious surface disturbance during mainly light wind conditions. The surrounds were maintained in tidy condition by sheep grazing and mowing. No additional spreading of wetland vegetation was noted during the 2008-2009 period. Moderate numbers of pukekos were observed in the wetland on all occasions with ducks and a few peacocks on two occasions during the period. All primary pond effluent entered the wetland, with wastewater levels maintained at a relatively constant level following the installation of a staff gauge near the outlet in May, 2000. These levels varied from 120 to 150 mm in depth (adjacent to the outlet channel), but were more often in the 130 to 140 mm range. Maintenance of the new grate at the outlet continued to be necessary to ensure that these levels did not become excessive. Debris clearance of this grate was regularly performed during the period.

The final wetlands effluent varied in appearance from pale brown through light green to lime green. The estimated discharge rate ranged from 8 L/sec to 15 L/sec (more often about 10 L/sec), via the two outfall pipes. The consent holder maintained and improved access to these outfalls for sampling purposes (Photo 5). On most occasions there was a noticeable visual impact on the receiving waters of the Mangawhero Stream immediately downstream of the discharge (with an occasional report of 'sewage fungus' on the stream bed) with the exception of a stream fresh occasion when the receiving waters were discoloured naturally.

2.2 Register of incidents

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The register ('unauthorised incident register') includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Incidents may be alleged to be associated with a particular site. If there is an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2008-2009 year there was one incident recorded by the Council associated with the Eltham wastewater treatment plant. This incident, in early May 2009, related to a self-reported overflow of raw wastewater via a diversion manhole around the newly installed (but not operative) step-screen and into the wetland through a stormwater pipe (see Photo 3). This wastewater had been pumped to the primary pond but the pump ran out of fuel and the resultant overflow during the night entered the wetland, combining with the treated wastewater discharge via the normal outfall for about eight hours. A manhole riser was installed and the stormwater pipe blocked and relocated, with the step-screen manually operated to ensure no further overflow. The stream was inspected at various sites along its length to the Waingongoro River confluence and no evidence of raw wastewater effects were found. Signage was displayed at the Castle Street bridge by the consent holder.

Steps have been taken to ensure that no further discharges of this nature will enter natural waters and the future changes to operational procedures at the WWTP would ensure that any wastewater by-passing the step-screen would enter the primary pond and/or be retained in the converted wetland.

2.3 Results of wastewater treatment plant monitoring

2.3.1 Primary oxidation pond effluent quality

No assessments of the wastewater quality prior to discharge to the wetlands were required or undertaken during the monitoring year. Primary pond effluent data recorded since the incorporation of the EADER in the treatment system (to August 2001), are summarised in Table 2 and considered to represent typical wastewater quality discharged into the wetlands section of the treatment plant.

Table 2 Range of selected results of Eltham wastewater treatment plant's primary pond effluent analyses for the period April 1997 to August 2001 (ie subsequent to EADER installation)

Parameter	Unit	No of samples	Range	Median
BOD_5	g/m^3	64	33-250	87
pH		15	7.4-8.6	7.7
Conductivity @ 20°C	mS/m	26	82-145	113
Ammonia-N	g/m^3N	4	20.7-40.5	31.5
Suspended solids	g/m^3	66	38-400	120
Faecal coliform bacteria	nos/100 ml	24	3600-120000	34500

2.3.2 Wetlands effluent quality

The wetland was constructed (with associated planting of vegetation) in late 1998. All primary pond treated and any clarifier treated wastes were then re-directed to the wetland which discharged via twin outfalls (one from each half of the wetland) to a small unnamed tributary of the Mangawhero Stream (Figure 1). Survival of the plantings was poor during the first six months of 1999 to the extent that few plants remained in the wetland by 30 June 1999. Re-planting of half of the wetland was undertaken in early 2000 and final revegetation was performed from October 2000 to February 2001 during which time no wastes entered the wetland. Clarification of some of the primary pond wastes was performed from time-to-time during the 2001-2002 and 2002-2003 periods, but not during the period from mid 2003 to date. During summer 2007 some de-waterings from the primary pond sludge removal operation passed through the clarifier to the wetlands.

Aspects of the wetlands effluent quality were monitored on all inspection visits and results are presented in Table 3.

Table 3 Eltham WWTP wetlands effluent analytical results during the period July 2008 to June 2009

Parameter	Time	Total BOD_5	pH	Conductivity @ 20 °C	Suspended solids	Faecal coliform bacteria	Nutrients		
Date							Ammonia N	NO_2+NO_3-N	Dissolved reactive P
	(NZST)	(g/m^3)		(mS/m)	(g/m^3)	(nos 100/ml)	(g/m^3N)	(g/m^3N)	(g/m^3P)
06 Aug 08	0930	73	7.3	45.6	93	7700	4.58	2.80	6.58
15 Oct 08	0830	95	7.6	94.4	160	20000	27.0	0.23	3.79
17 Dec 08	0850	56	7.9	121	130	18000	27.0	0.02	12.1
5 Mar 09	0905	61	7.8	114	130	20000	21.8	0.16	8.38
1 May 09	0930	100	8.2	122	190	45000	-	-	-
24 Jun 09	0930	140	7.6	111	120	8300	13.0	1.59	6.06
Range		56-140	7.3-8.2	45.6-122	93-190	7700-45000	4.6-27.0	0.02-2.80	3.8-12.1
Median		98	7.7	113	130	19000	21.8	0.23	6.58

The effluent monitored through the period varied relatively widely in quality. Ranges and medians generally indicated improved wastewater effluent quality compared to that recorded over the previous period, but with minimal improvement compared with secondary pond effluent quality before incorporation of the wetlands into the system. In particular, the suspended solids and BOD_5 components of the wastewater appeared to have deteriorated in quality which may have been partly due to the carry through of sediment from the wetlands.

The data recorded for the wetland treated wastes during 2008-2009 (Table 3) may be compared with historical wetland effluent data from surveys performed prior to the current monitoring period and since the construction of the wetland in late 1998. These data are presented in Table 4.

Table 4 Range of selected results of Eltham wastewater treatment plant's wetland effluent analyses for the period January 1999 to June 2008

Parameter	Unit	No of samples	Range	Median
BOD_5	g/m^3	61	27-180	71
BOD_5 filtered	g/m^3	8	9-24	13
pH		57	6.1-8.6	7.7
Conductivity @ 20°C	mS/m	57	74-177	119
Dissolved reactive phosphorus	g/m^3P	54	0.76-57.8	10.0
Ammonia-N	g/m^3N	54	0.78-41.8	20.9
Nitrate + nitrite-N	g/m^3N	53	<0.02-8.26	0.06
Total phosphorus	g/m^3P	11	11.3-19.8	14.0
Suspended solids	g/m^3	62	23-280	98
Faecal coliform bacteria	nos/100 ml	60	1000-130000	16500
Chromium (soluble)	g/m^3	10	<0.030	<0.030
Zinc (soluble)	g/m^3	9	<0.005-0.096	0.022

A brief comparison of the wetlands effluent quality during 2008-09 with the historical data indicates marked deterioration in median BOD_5 and suspended solids levels. Relatively high suspended solids levels were recorded throughout the period. Bacterial quality was poorer than the historical median numbers on all but two occasions.

Considerable further improvement would remain to be achieved if the final effluent quality was to meet design criteria (30 g/m^3 BOD_5 and 50 g/m^3 suspended solids) for the originally proposed WWTP upgrade. Since wetland establishment, BOD_5 and suspended solids concentrations have ranged from 27 to 180 g/m^3 (median: 72 g/m^3) and 23 to 280 g/m^3 (median: 100 g/m^3) respectively, well in excess of these design criteria. [It should be noted that achievement of the design effluent quality will not be necessary when the disposal of the wastewater via the pipeline diversion to the Hawera oxidation pond system is completed].

The frequency of the sampling component of future monitoring programmes will continue to be addressed in association with appropriate conditions attached to any new consents.

2.3.3 Microflora of the Eltham wastewater treatment system

During the routine inspections, samples of the primary oxidation pond were collected for semi-quantitative microflora assessments. In the past, samples have been collected

from the wetlands (since 1999) following conversion of the secondary pond. However only occasional (four) wetland samples have been collected since August 2001 (see Appendix IV). Table 5 summarises the microflora present in the primary oxidation pond over the monitoring period together with previous years' results. Six samples were collected from the primary pond during the 2008-2009 monitoring year.

Samples of effluent were collected from the outlet of the oxidation pond and analysed under a binocular microscope to identify phytoplankton present in the sample including algal and non-algal groups. The presence and estimated abundance (present (P), abundant (A) or very abundant (VA)) of these were recorded and the dominant taxa were highlighted (in bold). Taxa richness (number of taxa) and the Microfloral Community Index (MfCI) were calculated. The MfCI was designed by Taranaki Regional Council biologists as a measure of sewage pond performance using the phytoplankton and some heterotrophic groups. This MfCI uses 'sensitivity' scores of 1 to 10 assigned to each taxon, depending on their occurrence in poorly-performing (overloaded) or well-performing ponds. Generally, the higher the MfCI value the better the performance of the pond.

2.3.3.1 Primary oxidation pond

During the 2008-2009 monitoring period, the number of taxa varied between 9 and 13 with a median of 11 taxa (Table 5, Figure 3). These results were higher than the long term average on all but one occasion.

Including the monitoring year under review, *Euglena* has dominated the community on 25 of the 114 occasions and has been abundant or very abundant on 41 occasions. Bacteria in the primary pond have been recorded as abundant or very abundant on 80 of 114 occasions since 1991, and have dominated the microflora on 42 occasions. The green algae *Ankistrodesmus* and *Chlorella* have also occurred frequently in the pond and were often noted as abundant or very abundant. The long term dominance and abundance of bacteria, *Ankistrodesmus* and *Euglena* is indicative of a pond system that has been overloaded with organic wastes. During the 2008-2009 period, *Euglena* was present on three occasions but not abundant. *Chlorella* was present on four occasions but although abundant once, it was also not dominant. *Ankistrodesmus* was present on four of the six occasions and was dominant on one of these. *Actinastrum* was present on all occasions and dominant once. The diatom, *Cyclotella* was present on all occasions and dominant on one occasion. Again, the frequency of occurrence of these taxa and bacteria in the pond were indicative of the heavy organic loading on this pond system throughout the monitoring period.

Table 5 Planktonic microflora found in Eltham primary sewage treatment pond since April 1991

Algal Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
	8.4.91	25.3.92	31.8.92	26.11.92	20.1.93	25.2.93	19.4.93	30.4.93	27.5.93	15.9.93	5.11.93	7.12.93	17.12.93	10.3.94	7.4.94	27.4.94	10.8.94	16.11.94	20.12.94	18.1.95	2.3.95	23.5.95	7.8.95	12.10.95	13.12.95	15.2.96	24.4.96	27.6.96	31.7.96	25.9.96	20.11.96	21.1.97	13.3.97	17.4.97	30.4.97	12.6.97	17.7.97	18.9.97
GREEN ALGAE																																						
Unidentified																														P				P				
Unidentified Nannoplankton												VA											VA							VA					P		
Ankistrodesmus		**A**	P	P	P	P	A	A	P	A	VA	VA	P	VA	A	VA	A	A	VA	P	P	A	P	A	**VA**	A	VA	VA	A		P	A	A	A	**A**	P	P	**VA**
Closterium																																				P		
Chlorogonium																																						
Chlamydomonas																																		P				
Chlorella				A			P	P	**VA**	P	A		P	P	P	P	**VA**	**VA**	A	P	P	P		**VA**	A	P	**VA**	VA	**VA**	P	**VA**	**VA**	P	P	P	P	P	P
Oocystis							P																									P			P			
Chodatella			P													P						P							P							P	
Diacanthos														P				P	P															P				
Selenastrum																													P									
Palmella																																						
Polyedriopsis																																						
Colonial																																						
Unidentified																	P																				P	
Coelastrum											P								P	P	P			P								P	P	P	P		P	
Dictyosphearium			P	P	P	P	P		P	P	P	P		P	P	P	P	P	P	P	P	P	P		P	P					P	P	P	P			P
Golenkinia		A	**VA**			P	P		P	P	P			P	P	P	P	P	P	**VA**	A	A		P	VA	P			P					P	P			P
Micractinium		P			P					P		P	P	P			P				P					P						P						
Scenedesmus		A	P	P	P	P		P	P	P	P	P	P	P	P	P	P	P	P	A	P	A	P	P	P	P	P	P	P		P	P	P	P	P	P	P	P
Actinastrum		P	P	P		P											P	P	P	P	P	P	P	P	P	P	P	P	P			P	P	P	P			P
Pediastrum																																						
Eudorina																																						
Tetraspora																																						
Pandorina																																						
(Unbranched Filaments)																																						
Klebsormidium																																						
Unidentified																																						
CYANOBACTERIA																																						
Unidentified																																						
Chrococcus																																						
Oscillatoria		P			P		P																										P					
Microcystis																															P							
Pseudoanabaena																																						
DIATOMS																																						
Unidentified																																						
Aulacoseira/Melosira																																						
Navicular																																						
Nitzschia																					P									P								
Synedra																																						
Epithemia						P																																
Gomphonema																																	P					
Cyclotella																																						
GOLDEN BROWN ALGAE																																						
Synura																																						
DINOFLAGELLATES																																						
Peridinium group																																						
EUGLENOIDS																																						
Trachelmonas																																						
Euglena	VA	A	A	P	**A**	**A**	P	***	P	P	P	P	A	P	P	P	P	A	P	P	A	P	P	P	P	A	VA	P	P	P	A	A	P	**VA**	A	A	P	P	
Phacus			P															P																	P			
CRYPTOPHYTES																																						
Cryptomonas																																						
NON-ALGAL GROUPS																																						
Non-pigmented bacteria	**VA**	A	VA	**VA**	A	P	**VA**	**VA**	A	**VA**	**VA**	**VA**	**VA**	**VA**	**VA**	**VA**	VA	VA	**VA**	P	**VA**	**VA**	**VA**	A	VA	**VA**	VA	**VA**	VA	**VA**	VA	A	VA	**VA**	A	**VA**	**VA**	A
Fungi																																						
Protozoa	P	P	A	A	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	A	P	P	A	A	A	VA	VA	P	P	A	P	P	P	P	P		A
Nematodes																																						
Rotifers		P	P	P		P			P	P	P	P	P		P			P	P	P	P		P	P		P						P	P					P
NUMBER OF TAXA	3	10	11	9	8	10	9	5	9	10	10	9	8	10	9	9	11	12	12	11	13	10	9	10	9	11	7	7	10	7	8	11	13	13	10	8	8	9
MfCI	40	56	62	55	63	67	60	48	53	56	58	58	51	60	53	58	56	62	62	58	63	58	55	53	53	56	49	49	62	57	58	62	77	63	56	60	55	55

Key: P= Present U= Uncertain ID A=Abundant VA= Very Abundant **=Dead cells only

Table 5 (cont) Planktonic microflora found in the primary Eltham sewage treatment ponds since April, 1991

Algal Taxa	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
	20.11.97	29.1.98	25.3.98	14.5.98	15.7.98	17.9.98	19.11.98	27.1.99	17.3.99	20.5.99	21.7.99	24.11.99	29.2.00	26.4.00	21.6.00	2.8.00	5.10.00	6.12.00	21.2.01	26.4.01	14.6.01	15.8.01	18.10.01	13.12.01	28.2.02	17.4.02	20.6.02	2.8.02	24.10.02	5.12.02	12.02.03	30.04.03	18.06.03	14.08.03	19.11.03	22.01.04	21.04.04	19.05.04
GREEN ALGAE																																						
Unidentified																																						P
Unidentified Nannoplankton	A								P																													
Ankistrodesmus	**A**	**VA**	VA	**VA**	A	A	P	P	A	P	P	**VA**	P	P			P	P		A	P	P	P	P	P		P	P		P	P	P	P		P	P		P
Closterium																			P			P			P	P	P	P	P	A								
Chlorogonium																																						
Chlamydomonas																P										P	P											
Chlorella	P	VA	VA	A	A	**VA**	P	P	P													**A**	**A**	P		P	P		A	**VA**		P						P
Oocystis					P														P										U			U						
Chodatella											P																											
Diacanthos																																						
Selenastrum					P	P					P	P																										
Palmella																											?											
Polyedriopsis																																						
Colonial																																						
Unidentified					P																																P	P
Coelastrum				P	P			P																P							P	P			P			P
Dictyosphearium		P		P		P		P	P		P										P										P			P			P
Golenkinia	P	A	P	P	P	P		**VA**		P	P			P									P	P		P					P						
Micractinium	P		P		P	P						A					P	P	P	P		P		P	P												
Scenedesmus	P	P	P	P	P	P		P	P	P	P	P		P			P		P	P	P	P	P	P	P		P			P	P						P
Actinastrum	P	P	P	A				P				P	P				P													P								P
Pediastrum									P																													
Eudorina																						P																
Tetraspora																							P		P		P											
Pandorina																			P				P		P													
(Unbranched Filaments)																																						
Klebsormidium																																						
Unidentified																																						
CYANOBACTERIA																																						
Unidentified																																						
Chrococcus																																						
Oscillatoria									P																			P										
Microcystis																									P													
Pseudoanabaena																								P														
DIATOMS																																						
Unidentified																																						
Aulacoseira/Melosira																																						
Navicular																																						
Nitzschia																							P															
Synedra																																						
Epithemia																																						
Gomphonema																																						
Cyclotella					P	P	P	P			P	P	P												P						P								
GOLDEN BROWN ALGAE																																						
Synura																																						
DINOFLAGELLATES																																						
Peridinium group																																						
EUGLENOIDS																																						
Trachelmonas																											P											
Euglena	P	A	**A**	P	P	P	P	P	**A**	**A**	**A**	P	P	**VA**	**A**	P	P	P	**P**	**A**	P	P	P	A	**VA**	**VA**	**VA**	A	A	A	**VA**	P	**A**	P	**A**	**VA**	**VA**	**A**
Phacus																							P		P			P	P		A		P					
CRYPTOPHYTES																																						
Cryptomonas																									P		P											
NON-ALGAL GROUPS																																						
Non-pigmented bacteria	VA	A	A	A	**VA**	VA	**A**	VA	P	VA	VA	VA	**VA**	A	P	**VA**	**A**	**A**	P	P	**VA**	A	A	**VA**	A	VA	A	**A**	**A**	A	**A**	P	**A**	A	P	P	P
Fungi																																						
Protozoa	P	P	P	P	P	P		A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P
Nematodes																																						
Rotifers	P		P			P	P	P				P	P	P						P				P							P	P		P	P			
NUMBER OF TAXA	11	9	10	10	13	12	6	12	10	6	10	10	7	7	3	4	7	5	8	7	6	9	11	11	12	8	11	7	7	8	9	10	5	4	7	4	4	11
MfCI	52	53	51	58	66	65	48	60	64	43	68	64	50	43	40	50	51	48	78	50	53	71	73	70	82	60	82	66	66	55	63	60	52	40	60	40	45	60

Key: P= Present U= Uncertain ID A=Abundant VA= Very Abundant **=Dead cells only

Table 5 (cont) Planktonic microflora found in the primary Eltham sewage treatment ponds since April, 1991

Algal Taxa	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114
	24.6.04	21.7.04	16.9.04	24.11.04	20.1.05	2.3.05	17.3.05	24.3.05	1.4.05	8.4.05	18.5.05	20.7.05	15.9.05	17.11.05	24.1.06	15.3.06	11.5.06	25.5.06	26.7.06	20.9.06	15.11.06	17.1.07	15.2.07	01.03.07	23.05.07	4.07.07	1.8.07	5.09.07	23.11.07	16.01.08	14.04.08	18.06.08	6.8.08	15.10.08	17.12.08	5.3.09	1.5.09	24.6.09
GREEN ALGAE																																						
Unidentified	P	P	P	**A**		P	P		**A**	P	P	P		P																								
Unidentified Nannoplankton		P							P							P		P	P		P		P	P	P	P	P		P					P		P		
Ankistrodesmus	P	P	P	P	P	P	P	P		P	P	**A**	P	**A**		P	P	P	**A**	P	P	P	P					P					P	**A**		P		P
Closterium							P										P				P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P
Chlorogonium																			P		P								P	P		P						
Chlamydomonas		P	P	P						P		P	P				P	P				P											P					
Chlorella	P		P				P	P		**A**	P	P	**A**	P	P	P					A	P			P	P	P	P	P	P	P		P		A	P		P
Oocystis	P		P								P			P						P	A	P	P	P	P	**P**		**P**	**P**	**P**	**P**	P						
Chodatella																																						
Diacanthos																															P							
Selenastrum																																						
Palmella																																						
Polyedriopsis																																			P			
Colonial																																						
Unidentified						P	P																P	P														
Coelastrum		P	P		P				P	P		P	P	P	P	P	P		P		A	P	P					P	P			P				P	
Dictyosphearium		P		P	P					P	P	P	P	P					P	P	A	**P**						P							P	P	
Golenkinia																							P					P		P	P			P			
Micractinium	**A**				P						P		P							P	P							P	P	P	P	P		P			
Scenedesmus	P	P	P	P	P			P	P	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P	**P**	P	P		P	P	**A**	P	P	A	P
Actinastrum	P	A	P									P	P	P	**VA**	P		P	P	**P**	P	P	P	P			P	P	P	P		P	P	**VA**	P	P	P
Pediastrum																P			P	P	P	P							P	P	P	P			P	P	P	P
Eudorina																																						
Tetraspora																															U							
Pandorina																																						
(Unbranched Filaments)																						p			P													
Klebsormidium																															P							
Unidentified																										P							P	P	P			
CYANOBACTERIA																																						
Unidentified																		P					P							P								
Chrococcus																												P	U									
Oscillatoria																																						
Microcystis														P									P															
Pseudoanabaena																																						
DIATOMS																																						
Unidentified																		P						P	P		P											
Aulacoseira/Melosira																	P										U										
Navicular																																P						
Nitzschia																						P				P								P				
Synedra																	P																					
Epithemia																																						
Gomphonema																																						
Cyclotella																P	P	P	P	P	A	P	**A**	**P**	**P**		P	P	P	P	**P**		P	P	P	P	**VA**	P
GOLDEN BROWN ALGAE																																						
Synura																	P																					
DINOFLAGELLATES																																						
Peridinium group												P																		P								
EUGLENOIDS																																						
Trachelmonas																		**A**	P																			
Euglena	P	P	**A**	P	**VA**	**VA**	**P**	P	P			U	P	P	P	**A**	P	P			A	P	P	P			P				P		P		P	P	
Phacus		P				P																																
CRYPTOPHYTES																																						
Cryptomonas																																						
NON-ALGAL GROUPS																																						
Non-pigmented bacteria	P	**A**	P	**A**	P	P	**A**	**VA**	**VA**	P	**A**	P	A	P	P	P	P	P	P	P	P	P	P		P	P	P	P	P	P	P	A	**A**	A	A		**A**	VA	**A**
Fungi																						P																
Protozoa	P	P	P	P	P	P			P	P	P	P	P	P	P	P	P	P	P	P	P	P		P	P	P	P	P	P	P	P	P			P		P	P
Nematodes																																						
Rotifers	P				P	P			P		P	P	P	P	P			P			P		P		P								P	P	P	P	P	
NUMBER OF TAXA	11	12	11	8	9	8	7	5	8	9	9	13	12	13	8	11	12	13	12	10	17	17	15	9	11	9	9	15	14	13	15	10	10	13	11	12	10	9
MfCI	56	65	60	58	63	54	54	44	57	64	63	73	64	63	57	62	95	68	73	68	70	72	66	71	69	67	64	77	73	82	76	80	58	65	84	65	69	64

Key: P= Present U= Uncertain ID A=Abundant VA= Very Abundant **=Dead cells only

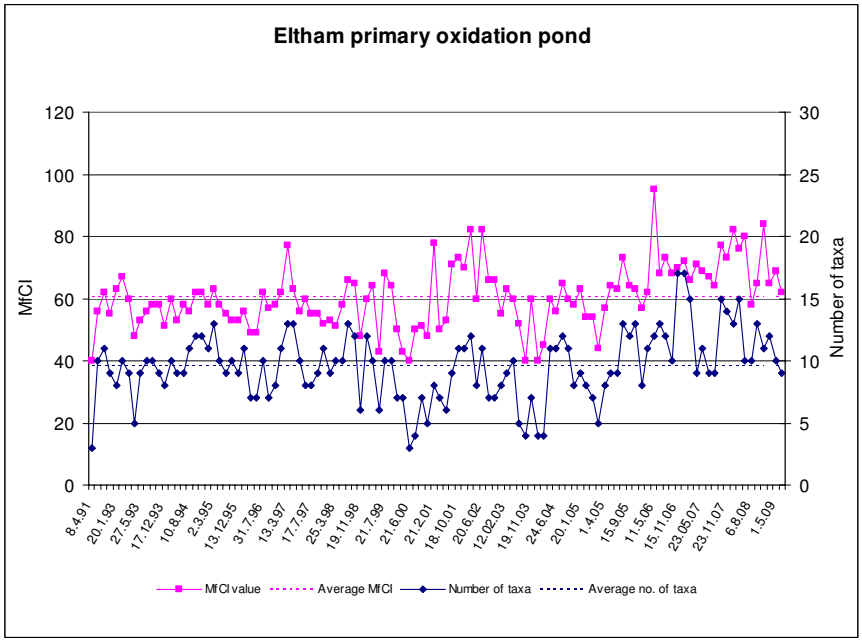

Figure 3 Numbers of taxa and MfCI values for the primary Eltham oxidation pond since monitoring began in 1991

The Eltham primary pond has the lowest pond MfCI average (61) of the treatment systems monitored in Taranaki. However, during the current monitoring period the MfCI ranged from 58 to 84 (Table 5). This was within the range of values obtained in the previous two monitoring periods (which ranged from 57 to 85). The presence of diatoms (particular *Cyclotella*) and the green alga, *Chlorella* (Table 5), and the increase in numbers of taxa and MfCI scores indicated a small improvement in general pond performance and was coincident with aerobic conditions (positive dissolved oxygen levels) on all sampling occasions.

2.4 Results of receiving environment monitoring

Two components of the monitoring programme which were operative during the period were specifically designed to assess the impacts of the wastewater treatment plant system effluent discharge upon the physicochemical quality and biological communities of the receiving waters of the Mangawhero Stream and Waingongoro River.

2.4.1 Physicochemical receiving water survey

A late summer assessment of the impact of the wastewater treatment plant system effluent discharge on the receiving waters of the Mangawhero Stream and Waingongoro River was performed on 5 March 2009 when flow in the Waingongoro River (at the Eltham Road hydrological site) was 816 L/sec representing a moderately low recession flow, some two weeks after the last significant river fresh. (Note: minimum monthly mean river flow for March is 386 L/s and mean monthly March flow is 1540 L/s at this site). The wetlands were fully in use with the wastes discharging at the normal site to a small tributary of the Mangawhero Stream, between stream sites 1 and 3. The site located further downstream in the Waingongoro River (site 8), provided an indication of wastes assimilation below the two major Eltham point source discharges.

The location of the sites (Figures 3 and 4) was as follows:

No	Site	Location	Map reference	Site code
1	Mangawhero Stream	upstream of oxidation ponds discharge	Q20: 227 952	MWH 000380
WT	Wetlands effluent	at outfall	Q20: 225 952	OXP 006002
3	Mangawhero Stream	approx. 400 m downstream of oxidation ponds' discharge (upstream of rubbish tip)	Q20: 224 951	MWH 000410
3a	Mangawhero Stream	150 m downstream of rubbish tip	Q20: 221 950	MWH 000425
4	Mangawhero Stream	at farm bridge (u/s SH3 and downstream of rubbish tip)	Q20: 218 948	MWH 000470
5	Mangawhero Stream	approx. 200 m downstream of the railbridge	Q20: 210 946	MWH 000490
6	Waingongoro River	approx. 150 m upstream of the Mangawhero Stream confluence	Q20: 208 947	WGG 000620
7	Waingongoro River	approx. 250 m downstream of the Mangawhero Stream confluence	Q20: 206 945	WGG 000640
8	Waingongoro River	approx. 2 km downstream of the Mangawhero Stream confluence (Stuart Rd)	Q20: 199 937	WGG 000665

Some of these sites (sites 3 to 5) also served as monitoring sites for the evaluation of any impacts of the old Eltham rubbish tip situated adjacent to the Mangawhero Stream (Figure 3). Flow gaugings were performed at two sites in the Mangawhero catchment during the survey. Stream flow was in the upper half of the range of flows (median: 40 L/sec) recorded at the time of previous summer/autumn low flow surveys. The Mangawhero Stream was slightly cloudy, brown in appearance upstream of the oxidation ponds discharge and noticeably discoloured (turbid brown) downstream of the discharge with the turbidity remaining noticeable throughout the length of the stream to the confluence with the Mangawharawhara Stream, and then slightly cloudy to the confluence with the Waingongoro River. The main river which was clear and uncoloured upstream, visually increased in turbidity (ie cloudy) below the confluence with the Mangawhero Stream and at the Stuart Road site a further 1.75km downstream.

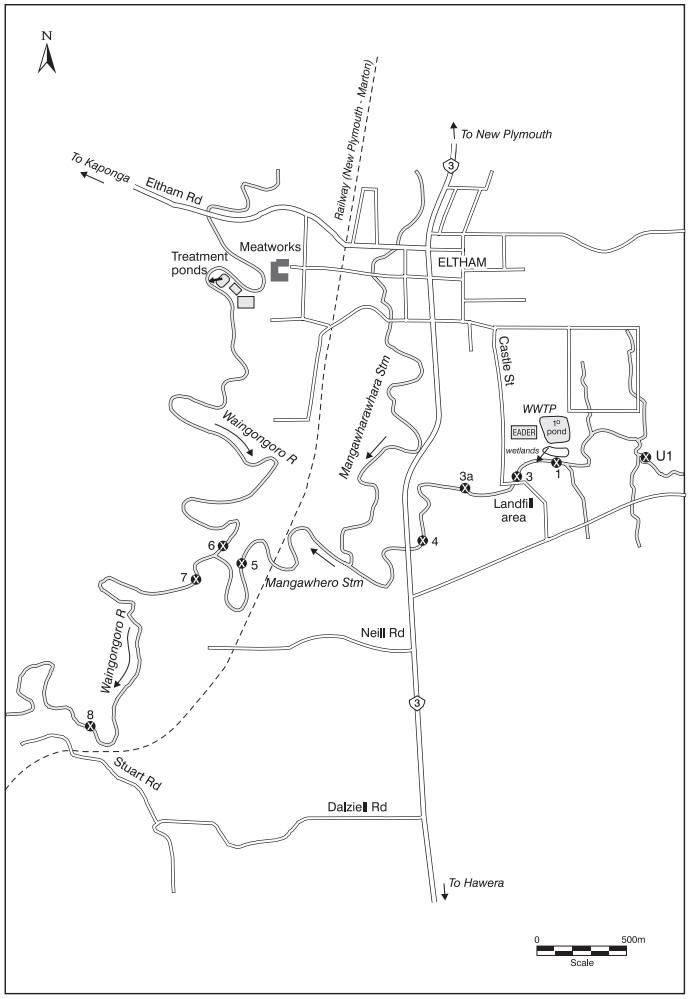

Figure 4 Location of sampling sites in relation to the Eltham wastewater treatment system

Figure 5 Aerial location map

The results of the current survey are summarised in Table 6. All analyses were performed in the Regional Council IANZ registered laboratory using standard methods.

Table 6 Results of the physicochemical sampling survey of 5 March 2009 in the Mangawhero Stream and Waingongoro River

Site		1	WT	3	4	5	6	7	8
Stream/River		Mangawhero S		Mangawhero S			Waingongoro R		
Location		Upstream	Discharge	Downstream			U/s	Downstream	
Parameter	Unit								
Time	NZST	0855	0905	0945	1015	1050	1125	1110	1200
Flow	L/s	78	≈15	-	-	319	816	1135	-
Temperature	°C	14.9	19.2	16.1	16.0	16.3	16.8	16.8	16.9
Dissolved oxygen	g/m³	7.9	6.8	7.2	4.7	7.2	9.7	9.4	9.6
DO Saturation	%	80	75	75	49	75	102	99	101
BOD_5	g/m³	2.5	61	15	17	5.4	0.6	2.0	1.7
BOD_5 (filtered, carbonaceous)	g/m³	-	12	-	-	-	-	-	-
pH		7.2	7.8	7.4	7.3	7.3	7.8	7.7	7.8
Conductivity @ 20°C	mS/m	28.4	114	39.7	39.1	23.5	11.1	14.0	14.4
Chloride	g/m³	29.4	196	54.2	54.3	29.6	12.5	16.0	16.9
Chromium (soluble)	g/m³	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc (soluble)	g/m³	0.009	0.037	0.026	0.018	0.009	<0.005	<0.005	<0.005
Dissolved reactive phosphorus	g/m³P	0.048	8.38	1.37	1.12	0.403	0.035	0.116	0.154
Ammonia-N	g/m³N	0.118	21.8	3.61	3.18	0.102	0.015	0.018	0.096
Nitrate + nitrite-N	g/m³N	1.81	0.16	1.53	1.90	2.62	0.84	1.25	1.28
Suspended solids	g/m³	4	130	29	24	7	<2	2	3
Black disc	m	0.62	-	0.19	0.26	0.41	1.99	1.22	0.90
Turbidity	NTU	6.6	94	22	22	8.3	1.4	2.8	2.6
Faecal coliform bacteria	nos/100ml	3500	20000	7800	4600	640	660	820	900
Appearance		cloudy, brown	turbid, yellow-brown	turbid, khaki	turbid, brown	slightly turbid, green	clear, no colour	cloudy, light grey	cloudy, greyish

The Mangawhero Stream flow (78 L/s upstream of the WWTP discharge) represented a moderately low flow which was above the median of the range of flows surveyed at comparable times by previous surveys. The moderate water quality upstream of the WWTP's discharge was typical of a swamp drainage developed catchment and indicative of limited impacts possibly due to cattle access, treated dairyshed wastes discharges, and general run-off from farmland (e.g. slightly elevated nutrient, BOD_5 and turbidity levels and a high faecal coliform bacterial number). Dissolved oxygen saturation level (80%) was higher than often typical of such a small swamp drainage and farming catchment stream.

An approximate dilution ratio in the receiving waters of 6 parts stream flow to 1 part effluent (allowing for the dilution provided by a small tributary inflow receiving the discharge from the primary pond diversion) was assessed by reference to selected analytical results and flow measurements. The main stream flow continued to be significantly impacted by the turbid, coloured effluent discharge. This was most pronounced in the marked increase in turbidity (very significantly reduced black disc transparency (by 69%)), suspended solids, nutrients (which, in terms of ammonia nitrogen and dissolved reactive phosphorus concentrations, were most affected), faecal coliform bacteria and BOD_5 levels recorded at sites 3 and 4 in particular, where visual impact of the discharge was very pronounced. This deterioration in the aesthetic

appearance of the Mangawhero Stream was also noticeable as far downstream as below the confluence with the Mangawharawhara Stream at the site near the Waingongoro River confluence (site 5), where the cloudy appearance was probably also associated with the presence of fine suspended matter generated by the extensive mechanical aeration of the primary oxidation pond. Elevated stream BOD_5 levels (which reached 17 g/m^3 at site 4 and remained as high as 5 g/m^3 at site 5) were indicative of the presence of poorly diluted and partially assimilated wastes in the receiving waters. This resulted in decreased dissolved oxygen concentrations in the stream, with a minimum DO saturation of 49% (at site 4) representing a poor DO concentration in the Mangawhero Stream (4.7 g/m^3), although not as low as recorded by some previous summer surveys. This was due in part to the relatively high dissolved oxygen saturation level in the wetlands wastewater and the moderate dilution provided by the stream. It was also due to the improved stream flow velocities provided by earlier removal of willow growth below SH3 which previously had caused extensive upstream ponding. Improvement in DO concentration (7.2 g/m^3) was recorded at site 5 below the Mangawharawhara Stream confluence where further dilution of the Mangawhero Stream (between sites 4 and 5), and in-stream waste assimilation, were illustrated by improvement in certain aspects of water quality, particularly bacteriological number, clarity and some nutrient levels . However, water quality remained impaired at site 5 in terms of elevated BOD_5 and nutrients levels at this site (approximately 800 m upstream of the Waingongoro River confluence). Stream habitat (swift, stony and bouldery bed with moderate instream macrophyte growth) altered considerably from the slower flowing, weed and muddy clay substrate common at sites 1, 3 and 4, although the turbidity remained elevated at site 5.

The water quality of the Waingongoro River was relatively good upstream of the Mangawhero Stream confluence in the absence of any meatworks treated effluent discharge to the river (apart from an elevated bacteriological level). Low BOD_5 and relatively low nutrient levels were indicative of the absence of the Riverlands (Eltham) Ltd's meatworks' wastes from the river due to diversion to pasture irrigation at the time of this survey. As a result of the relatively poor dilution of the wastewater treatment plant's discharge in the Mangawhero Stream on this survey occasion, some impacts on Mangawhero Stream water quality were measured immediately downstream in the Waingongoro River (eg, increased BOD_5 and nutrient levels and some increase in bacteria number, markedly decreased clarity (39% reduction in black disc) but minimal reduction in dissolved oxygen saturation level). The flow of the Mangawhero Stream was measured at 319 L/s (upstream of the confluence), and a recorded flow of 816 L/s in the Waingongoro River indicated an approximate dilution of the Mangawhero Stream of about two and a half times by the main river.

Minimal difference in Waingongoro River water quality was measured at site 8, approximately 2 km downstream of the Mangawhero Stream confluence, where there were no obvious indications of additional waste assimilation, bacterial die-off, re-aeration, nitrification or nutrient uptake by river bed periphyton which usually account for various improvements in water quality such as lower BOD_5, nutrients, and bacteriological levels and improved dissolved oxygen saturation. Minimal change in clarity was recorded as the river's appearance was affected at both sites by the turbid waters of the Mangawhero Stream, a trend recorded by most recent summer low flow surveys.

2.4.2 Physicochemical impacts on the Waingongoro River

In addition to the autumn low flow survey of the receiving waters, Taranaki Regional Council has been monitoring water quality conditions in the Waingongoro River (sites WGG000620 and WGG000640) and Mangawhero Stream (site MWH000498) in conjunction with the monthly state of the environment monitoring programme over the period from January 2001 to June 2009. This water quality monitoring has focused on nutrient species. A summary of the data is presented in Table 7. (This dataset also includes all summer low flow monitoring surveys since February 2001 including the most recent autumn survey of 5 March 2009).

Table 7 Summary of selected water quality results from two sites in the Waingongoro River (N = 111 samples) above and below the Mangawhero Stream confluence and one site in the lower Mangawhero Stream (N = 102 samples) for the period January 2001 to June 2009

Site		Waingongoro River				Mangawhero Stream (MWH000498)	
		u/s confluence (WGG000620)		d/s confluence (WGG000640)			
Parameter	Units	Range	Median	Range	Median	Range	Median
Temperature	°C	4.5-22.2	13.5	4.6-22.2	13.5	4.8-22.1	13.5
Conductivity @ 20°C	mS/m	5.1-20.2	12.1	6.6-21.6	14.6	12.3-50.0	21.2
pH		7.2-8.4	7.6	7.1-8.2	7.6	6.8-8.4	7.4
Dissolved reactive phosphorus	g/m^{3}P	0.014-0.880	0.049	0.030-0.947	0.116	0.024-1.57	0.184
Total phosphorus	g/m^{3}P	0.024-0.984	0.086	0.052-1.02	0.167	0.082-1.7	0.32
Ammoniacal nitrogen	g/m^{3}N	0.010-3.87	0.140	0.014-2.80	0.202	0.023-3.03	0.243
Nitrite nitrogen	g/m^{3}N	0.007-2.48	0.024	0.010-1.75	0.044	0.016-0.51	0.062
Nitrate nitrogen	g/m^{3}N	0.22-2.42	1.36	0.53-2.42	1.52	0.62-3.73	2.05
Total Kjeldahl nitrogen	g/m^{3}N	0.01-4.43	0.45	0.03-3.36	0.65	0.32-4.32	1.08
Total nitrogen	g/m^{3}N	0.41-8.93	2.02	0.88-7.04	2.36	2.07-7.16	3.16
Turbidity	NTU	0.6-41	1.7	1.2-38	2.8	1.5-50	6.4

Median parameter values indicate an approximate two and a half times dilution of the Mangawhero Stream flow by the flow of the Waingongoro River during the sampling surveys which included nine summers during which shorter periods and/or reduced loadings of Riverlands Eltham Ltd's meatworks treated wastes were discharged to the river.

All the principal nutrient species showed increases in the main river below the Mangawhero Stream confluence due to the relatively high nutrient loadings carried by that stream as a consequence of the Eltham WWTP discharge. These increases were usually more pronounced in the absence of the meatwork's wastes discharges (due to summer diversion to pasture irrigation) when upstream river concentrations were typically at lower background levels. Median nutrient concentrations indicate downstream increases in individual nutrient species in the main river varying between 12% and 136% with total nitrogen and total phosphorus increasing by 17% and 94% respectively.

2.4.3 Invertebrate and microflora biomonitoring surveys

The Taranaki Regional Council performed a reduced (four sites) late spring biomonitoring survey and a full (eight sites) late summer-early autumn survey in association with the discharge from the Eltham wastewater treatment system and adjacent to the old rubbish tip site. Both surveys coincided with the normal discharge of

wetlands treated wastes into a small tributary between sites 1 and 2 in the main stream. Results of these surveys are summarised in Table 8 together with appropriate historical data (from the freshwater biology database). The full reports are included as Appendix II.

Table 8 Summary of the results of 2008-2009 biomonitoring surveys and past biomonitoring data (1985-2007)

Site		Macroinvertebrate Fauna						
		Taxa Numbers			MCI value			No of surveys
No	Code	Dec 08	Mar 09	1985-2008	Dec 08	Mar 09	1985-2007	1985-2008
Mangawhero Stream								
1	MWH000380	12	13	10-25 [17]	72	72	58-79 [73]	37
3	MWH000410	-	14	6-22 [15]	-	63	47-72 [61]	23
4	MWH000470	-	8	9-18 [15]	-	48	51-74 [61]	21
5	MWH000490	15	16	13-25 [19]	72	63	64-86 [77]	32
Waingongoro River								
6	WGG000620	-	23	16-35 [27]	-	98	77-105 [92]	23
7	WGG000640	-	20	17-35 [26]	-	100	78-99 [90]	22
8	WGG000665	21	21	14-30 [20]	98	101	77-105 [92]	28

[Note: [ ] = median]

The spring survey, performed under moderate recession flows, concluded that macroinvertebrate community richnesses were lower than past median taxa numbers with the MCI scores slightly below past medians at upstream and downstream sites in the Mangawhero Stream. No change in MCI score was found between sites in a downstream direction. Lower abundances or absences of certain 'moderately sensitive' taxa (previously more abundant) which might be expected to be present at the 'better' physical habitat of site 5, 3 km downstream of the oxidation ponds' discharge, were indicative of the continued poorer physicochemical water quality conditions at the time of this survey. The MCI and $SQMCI_s$ scores recorded in the Waingongoro River downstream of the Mangawhero Stream confluence were indicative of deterioration in water quality below the confluence similar to trends frequently found by previous surveys and often under lower flow conditions.

The late summer survey was performed under low flow conditions in both the Mangawhero Stream and the Waingongoro River and was coincidental with the normal discharge of the wastewater treatment plant's treated wastes into the Mangawhero Stream after tertiary treatment by the wetland. This survey was the ninth summer survey since the willow removal work had been undertaken in the stream through the reach below the SH3 culvert resulting in some physical stream habitat improvements to the mid-reaches of the stream below the wastes discharge. Macroinvertebrate richness and MCI values found in the Mangawhero Stream were not indicative of any of the previously recorded historical willow removal improvements in physical stream habitat conditions but were influenced markedly by poor physicochemical water quality conditions during low flow conditions and minimal dilution of the wastewater discharge. Aspects of community composition (particularly very low $SQMCI_s$ values and decreased MCI scores) emphasised these impacts of poor physicochemical water quality conditions downstream of the Eltham wastewater treatment system discharge. Impacts of the wastewater treatment plant's discharge were apparent a short distance below the WWTP discharge and increased markedly toward the mid reaches of the

Mangawhero Stream at the boundary of the consented mixing zone (the SH3 site), where physicochemical water quality is often poorest as a result of more severe dissolved oxygen depletion as the wastewater assimilative capacity of the receiving waters is under greater pressure, especially under lengthy periods of low flow conditions (see Section 2.4.1). At the furthest downstream site, limited recovery in community composition was recorded to a lesser degree than might be expected given the improvement in physical habitat and dilution provided by the Mangawharawhara Stream tributary. Due to the delay experienced in the improvements to effluent quality which were to be provided by the completion to the upgrade of the wastewater treatment plant, these impacts were significant despite instream channel improvements provided by willow removal work undertaken in the reach of the stream between SH3 and the Mangawharawhara Stream confluence. However, in order for the necessary improvements to occur in physicochemical water quality and the associated recovery in macroinvertebrate faunal communities of the Mangawhero Stream, the lack of adequate wastewater dilution requires diversion of the discharge to an alternative receiving environment via the pipeline to the Hawera WWTP currently under construction.

The discharge from the Eltham Wastewater Treatment Plant appeared to have had some effects on the microfloral streambed communities in the Mangawhero Steam downstream of the discharge in mid reaches where some protozoa were attached to the harder components of the substrate under conditions of low receiving water dilution rates. Growths of heterotrophic organisms were not found further downstream or in the Waingongoro River.

No significant effects of the discharge on biological communities were recorded in the Waingongoro River immediately downstream of the Mangawhero Stream confluence, under low, late summer-early autumn flow conditions. Few significant differences in individual taxon abundances occurred in this reach of the main river and although $SQMCI_s$ scores showed some downstream reduction, minor differences in MCI scores were not statistically significant (Stark, 1998) in a downstream direction through this reach.

Both surveys emphasised that significant improvements in physicochemical water quality and the macroinvertebrate faunal communities of the Mangawhero Stream would not be anticipated until the removal of the wastewater discharge out of the Mangawhero Stream catchment to an alternative receiving environment, a matter which is currently being actioned by the consent holder.

3. Discussion

3.1 Discussion of plant performance

Delays to completion of the treatment system upgrade, necessitated non-notified changes to the existing consent (in the 1996-1997 period) extending the times for compliance by a further year for each state of the upgrade. A review of the consent in late 1999 subsequently tightened conditions for progress with, and reporting of, modifications to upgrade proposals necessitated by failures of the partially completed upgrade and reassessment of processes necessary to comply with design effluent criteria.

Although the secondary oxidation pond conversion to a wetland (stage II of the original upgrade) was completed in late 1998, poor vegetation growth was evident by the end of the 1998-1999 monitoring period. Replanting of half of the wetland was undertaken in early 2000 and the consent holder commissioned a consultant to address issues relating to the development of the wetlands. Completion of the wetland replanting was undertaken during spring 2000 requiring the temporary diversion of primary pond treated wastes into a small tributary at the rear of the wastewater treatment plant for a period of three months to allow also for re-establishment of the vegetation. This refurbishment resulted in gradual improvement in wetland vegetation in more recent years, although minimal if any, further improvement has been noted over the 2005 to 2009 monitoring years. The primary oxidation pond was de-sludged successfully during the 2006-2007 summer period with the de-watered sludge contained in geo-textile bags in a specially bunded disposal area adjacent to the EADER where it has remained until final on-site disposal is consented.

Continued failure of the EADER to perform to design criteria, despite considerable refurbishment and system monitoring, flowed through to poorer primary pond effluent quality than proposed by the original consultant's design standards. A new consultant, following liaison with the consent holder, local industrial users of the system, and the Council, trialled two revised options for plant upgrade to meet the design criteria required by the reviewed consent. The preferred option required the incorporation of an enlarged activated sludge treatment component treating mainly the industrial load prior to clarification and wetland polishing of the wastes. This component was to be tendered for completion over the summer of 2001-2002 for consent compliance by 31 March 2002. However, further developments have resulted in the adoption of a more preferable option for the cessation of the discharge to the Mangawhero Stream and transfer, by pipeline, of the wastes for ocean outfall discharge via the Hawera oxidation ponds wastewater treatment system. A commitment to this option was made and timetable for implementation prepared by the consent holder who was required to adhere to timeframes for progressing the pipeline implementation together with the consents necessary for this disposal option. Following several pre-hearing meetings, the necessary consent variation was granted by the Minister of Conservation after an appeal to the Environmental Court was withdrawn. The construction of the pipeline and associated pumping station was well advanced by the end of the 2008-2009 monitoring period.

The Eltham waste water treatment system was well maintained but performed to the usual below acceptable standards as a result of the continuing significant influent overloading and deficiencies in design during the twelve month monitoring period. Low to moderate dissolved oxygen concentrations were recorded in the primary pond

through the period. Odours were occasionally noticeable but generally slight, with no odour complaints received during the period.

The refurbished wetland system was operative throughout the period, with the quality of the final effluent discharged from the wetland varying during the period. This effluent quality showed some deterioration in comparison with historical data and was poorer than medians of various parameters' ranges recorded from recent (post upgrade) surveys. Increased frequency of effluent monitoring has continued to provide information in relation to seasonal variability in treatment system performance. However, final effluent quality has remained significantly below design standards anticipated from the upgraded WWTP due to overloading of the system and the plant design deficiencies referenced earlier.

Microflora sampled from the primary pond, indicated typical bacterial abundances through the monitoring period coincidental with the large industrial component of the waste loadings on the treatment system. Above average algal richnesses were found during most of the monitoring year and were indicative of aerobic pond conditions although from time-to-time the presence of certain taxa reflected the heavy wastes loadings on this pond.

3.2 Environmental effects of exercise of water permits

Significant impacts on the receiving water quality of the Mangawhero Stream continued to be recorded during the late summer-autumn survey when poor dilution of the wetland's effluent in the stream coincided with moderately low receiving water flow conditions. Moderate upstream water quality conditions were measured, consistent with the upper reaches of an essentially swamp-fed, intensively farmed drainage system. The water quality impacts of the wastewater treatment plant discharge, particularly the deterioration in aesthetic appearance and dissolved oxygen concentration and increase in BOD_5 concentration, nutrients' concentrations and bacterial numbers, were pronounced throughout the reaches of the stream as far downstream as the confluence with the Waingongoro River, despite some improvements in physical streamflow conditions since willow removal below SH3. Limited improvement in water quality was recorded below the Mangawharawhara Stream confluence despite increased dilution and further instream waste assimilation. Some impacts continued to be detected in the Waingongoro River downstream of the confluence with the Mangawhero Stream in terms of certain parameters, particularly increases in some nutrient species, bacteria numbers and BOD_5 levels and a marked decrease in clarity.

Significant impacts of the discharge on the macroinvertebrate fauna and the flora of the Mangawhero Stream also continued to be recorded below the discharge during summer low flow conditions, particularly in the mid reaches where the major deterioration in physicochemical water quality was recorded, with some recovery below the Mangawharawhara Stream confluence, where the stream continued to be noticeably turbid as a result of the discharge. No significant impacts were recorded on the fauna of the Waingongoro River below the Mangawhero Stream confluence under higher flow conditions than recorded during the previous summer survey.

Considerable progress was made by the Regional Council, in the latter part of the 1999-2000 period, with riparian planting initiatives in the Mangawhero Stream and progress continued through the 2000 to 2003 period. A financial contribution from the consent

holder has assisted with stream margin planting and, particularly willow removal, providing improvements to water levels and stream velocity, and reduction in flooding. Burning and burial of the removed willow was completed and the focus turned toward riparian planting of the stream margins. Monitoring has been the main focus of the 2004 to 2009 period with the focus on willow re-growth. Further willow removal was undertaken in the lower reaches of the stream in the 2005-06 period and subsequently this was buried or burned by landowners. Some willow pruning would be beneficial on the private land, previously used as the original landfill, in the reach below the Castle Street bridge. Riparian planting, combined with the intended removal of the wastewater discharge from the Mangawhero Stream, should result in marked improved physicochemical and biological water quality of the receiving waters.

3.3 Evaluation of performance

A tabular summary of the South Taranaki District Council's compliance record for the year under review is set out in Tables 9 and 10.

Table 9 Summary of performance for Consent 0160 - discharge of sewage treatment plant wastes to surface water

Condition requirement	Means of monitoring during period under review	Compliance achieved
1. Upgrade development plan requirement	Plan lodged but now redundant	N/A
2. Upgrade to be completed by date	Alternative disposal methods being pursued	N/A
3. Review provision in relation to 1	No longer applicable	N/A
4. Receiving water limits of effects	No longer applicable (see 2 above)	N/A
5. Reporting of upgrade progress	Delayed while alternative disposal methods investigated	N/A
6. Aerobic conditions to be maintained in oxidation ponds	Inspections and sampling programme; consent holder monitoring	Yes
7. Trade wastes provisions	Liaison between consent holder and Council	N/A (none this period)
8. Provision of trained operator	Liaison with consent holder	Yes
9. Provision of management plan	Plan lodged; liaison with consent holder aspects now redundant (see 1 and 2 above)	N/A
10. Riparian management mitigation	Liaison with consent holder. Council Land Management staff involvement	Yes
11. Provision of report re wetlands recommissioning	Provided by consent holder (ex consultant) but no longer relevant	N/A
12. Requirement for wetlands recommissioning	Complied with previously	N/A
13. Optional review provisions	No longer relevant in view of alternative disposal commitments	N/A

Table 10 Summary of performance for Consent 4618 - Discharge emissions to air from the Eltham WWTP

Condition requirement	Means of monitoring during period under review	Compliance achieved
1. Adopt best practicable option during exercise	Inspections	Yes
2. Limiting effects of waste sludge processing	Not developed as a component of the existing waste treatment system	N/A
3. Control of gas combustion system	Not a component of the existing waste treatment system	N/A
4. Requirement for staged system upgrade	Upgrade redundant as superseded by alternative disposal methods	N/A
5. Preparation and implementation of management plan	Consent holder prepared plan. Liaison with consent holder	Yes
6. Cover of anaerobic lagoon	Inspections	Yes
7. Limitation of effects of odours	Inspections and response to incidents	Yes
8. Sludge retention in clarifier	No use of clarifier as upgrade now redundant	N/A
9. Aerobic conditions required in oxidation ponds	Inspections and DO analyses	Yes
10. Limit to hydrogen sulphide levels at boundary	Inspections	Yes
11. Optional review of consent	No review sought by Council as alternative disposal methods to be progressed	N/A

The South Taranaki District Council demonstrated good compliance with operational aspects of the resource consent's conditions with no additional wastes loadings on the system during to period. However, the ineffectiveness of components of the original upgrade of the waste treatment plant resulted in the continuation of the very poor environmental performance particularly in terms of effects on the physicochemical water quality and biological communities of the Mangawhero Stream and to a lesser extent, the Waingongoro River. This was recognised at the time of the review of the consent which had tight timeframes and regular reporting requirements for the appropriate upgrade of wastewater treatment plant to provide a standard of effluent quality suitable for discharge into the Mangawhero Stream and ultimately the Waingongoro River (one of the principal fisheries on the Taranaki ringplain). However the completion of this upgrade, required by consent conditions, is to be superseded by the more favourable option of transfer of wastewater by pipeline to the Hawera oxidation ponds system, an option which has been adopted by the consent holder and is subject to appropriate timeframes. The consenting process has been completed since the withdrawal of an appeal lodged with the Environmental Court and the consent holder is now progressing toward completion of this preferred disposal option.

3.4 Recommendations from the 2007-2008 Annual Report

The previous Annual Report (TRC 2008-47) contained the following recommendations in relation to consents monitoring of the operation of the wastewater treatment plant system:

1. THAT monitoring be continued for the 2008-2009 period in accordance with an appropriate programme formulated in conjunction with the requirements of the consents.

2. THAT regular liaison continues between the consent holder and the Regional Council with respect to monitoring records of primary pond dissolved oxygen levels in relation to aerator performance, and monitoring wetland performance in general.

3. THAT the consent holder immediately advises the Taranaki Regional Council of any operational problems with the primary pond aerators, and the steps taken to ensure that aerobic conditions are maintained within the ponds' system.

4. THAT the consent holder regularly liaises with the Taranaki Regional Council with respect to progress with the option for an alternative disposal method, and in respect of any appropriate consents required in relation to this alternative.

5. THAT the Taranaki Regional Council maintains a suitable inspection programme and recording system, and reports upon wastes disposal management in the Mangawhero Stream catchment, particularly in respect of agricultural wastes disposal upstream of the oxidation ponds' system discharge.

All recommendations were complied with, and the consent holder maintained liaison and reporting to the Regional Council in relation to alternative options for diversion of the wastewater out of the Mangawhero Stream and commenced construction of the pipeline and pumping system to the Hawera WWTP. The requisite consent application was lodged for occasional overflow of treated wastes from the upgraded system to the Mangawhero Stream. No operational problems required notification during the period and monitoring of the wetlands was continued. The Regional Council continued inspections of waste disposal practices in the upstream catchment of the Mangawhero Stream (by way of the regular annual round of dairy shed inspections), as required by Recommendation 5, with follow-up inspections where necessary and internal reporting within the existing consents' database.

The monitoring programme was performed as scheduled by the Regional Council which also undertook the additional monitoring of the wetland component of the treatment system and additional odour surveys of the WWTP, particularly during the autumn-early winter period.

3.5 Alterations to the monitoring programme for 2009-2010

In designing and implementing the monitoring programmes for water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of municipal treatment processes within Taranaki discharging to the environment.

In recognition of the high proportion of industrial waste loading on the ponds system, the requirement for efficient aeration within the primary pond, and prior to diversion of the waste discharge to an alternative receiving environment, the previous monitoring programme provided for:

(a) a minimum of six (2-monthly) inspections of the ponds system with associated primary pond and wetland algal and primary pond dissolved oxygen sampling and selected effluent quality analysis, and appropriate odour surveys;

(b) additional odour surveys under early morning/evening conditions;

(c) a summer low flow receiving water physicochemical survey with the appropriate effluent analyses; and

(d) a summer biomonitoring survey of the receiving waters of the Mangawhero Stream and extending into the Waingongoro River; plus a spring biomonitoring survey of two critical Mangawhero Stream sites and one site in the Waingongoro River.

This programme also continues to recognise that although there has been general improvement in operational performance of the system since the installation of additional primary pond aeration, the potential exists for operational problems due to the excessive wastes loadings on the treatment system, until the discharge is diverted to an alternative receiving environment. Therefore close attention must continue to be given to system performance monitoring by the consent holder including appropriate monitoring of wetland re-establishment and the maintenance of regular liaison with the Taranaki Regional Council.

No further additions, or alterations, to the monitoring programme for the 2009-2010 period are required as the situation will remain unchanged until the alternative wastes disposal method is completed and operational.

3.6 Exercise of optional review of consent

Resource consent **4618** provided for an optional review of the consent in June 2005. Condition 11 allows the Council to review the consent, if there are grounds that require a review.

Although adverse effects were recorded under conditions of mechanical aeration failure, proposals being progressed toward an alternative wastewater disposal

methodology warranted a general revisit of existing consents in terms of their appropriateness following adoption of an alternative disposal option. It was therefore considered that a review of this air discharge permit was not warranted at the time. This remains the situation.

4. Recommendations

As a result of the 2008-2009 monitoring programme for consents 0160 and 4618 the following recommendations are made:

1. THAT monitoring be continued for the 2009-2010 period in accordance with an appropriate programme formulated in conjunction with the requirements of the consents.

2. THAT regular liaison continues between the consent holder and the Regional Council with respect to monitoring records of primary pond dissolved oxygen levels in relation to aerator effectiveness, and monitoring wetland performance in general.

3. THAT the consent holder immediately advises the Taranaki Regional Council of any operational problems with the primary pond aerators, and the steps taken to ensure that aerobic conditions are maintained within the ponds' system.

4. THAT the consent holder regularly liaises with the Taranaki Regional Council with respect to progress with the construction and implementation of the alternative disposal method and in respect of the appropriate consent for the on-site disposal of sludge.

5. THAT the Taranaki Regional Council maintains a suitable inspection programme and recording system and reports upon wastes disposal management in the Mangawhero Stream catchment, particularly in respect of agricultural wastes disposal upstream of the WWTP system discharge.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

biomonitoring	assessing the health of the environment using aquatic organisms
BOD	biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate
BODF	biochemical oxygen demand of a filtered sample
bund	a wall around a tank to contain its contents in the case of a leak
CBOD	carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate
cfu	colony forming units (nos/100 ml). A measure of the concentration of bacteria
CONDY	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m
Cr*	chromium
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
E.coli	*Escherichia coli*, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
fresh	elevated flow in a stream, such as after heavy rainfall
g/m^3	grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
l/s	litres per second
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
MfCI	microflora community index; a numerical indication of the state of treatment pond biological life which takes into account the sensitivity of floral taxa to wastewater quality
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	ammonium, normally expressed in terms of the mass of nitrogen (N)
NO_3	nitrate, normally expressed in terms of the mass of nitrogen (N)
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.

pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
physicochemical	measurement of both physical properties(e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and subsequent amendments
SS	suspended solids,
taxon	a group of animals
Temp	temperature, measured in °C (degrees Celsius)
Turb	turbidity, expressed in NTU
UIR	Unauthorised Incident Register entry- an event recorded by the Council on the basis that it had potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
Zn*	zinc

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter ‘D’, denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

For further information on analytical methods, contact the Council’s laboratory

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Appendix I

Resource consents held by South Taranaki District Council

TRK944618

TARANAKI REGIONAL COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder: SOUTH TARANAKI DISTRICT COUNCIL
PRIVATE BAG 902 HAWERA

Change to Conditions Date: 23 June 1997 ★

CONDITIONS OF CONSENT

Consent Granted: TO DISCHARGE UP TO 800 CUBIC METRES/DAY OF CARBON DIOXIDE [FROM FLARING OF BIOGAS] AND MISCELLANEOUS EMISSIONS TO THE AIR FROM THE ELTHAM WASTEWATER TREATMENT SYSTEM AT OR ABOUT GR: Q20:225-951

Expiry Date: 1 June 2011 [Granted: 10 November 1994]

Review Date[s]: June 1999 and June 2005

Site Location: ELTHAM WASTEWATER TREATMENT PLANT, CASTLE STREET, ELTHAM

Legal Description: LOT 9 DP2321 SUB LOT 3 DP1564 SEC 43 BLK X NGAERE SD

For General, Standard and Special Conditions pertaining to this consent please see reverse side of this document.

TRK944618

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

special conditions 1 to 3 [unchanged]

1. THAT at all times the consent holder shall adopt the best practicable option to prevent or minimise any actual or potential effect on the environment arising from emissions from the flare, sludge drying processes or any other emissions to air from the site.

2. THAT prior to undertaking any processing of waste sludge at the site the consent holder shall provide the Taranaki Regional Council with an analysis of the sludge composition. Waste sludge processing shall not be undertaken at the site unless the consent holder has demonstrated to the written satisfaction of the General Manager, Taranaki Regional Council, that such processing can be undertaken without causing a significant adverse off-site environmental effect [including, but not limited to, impacts of odour on neighbouring residents].

3. THAT the biogas flare shall be operated so as to, as far as practicable, ensure complete combustion and minimise smoke emissions.

special condition 4 [amended]

4. THAT the wastewater treatment system shall be progressively upgraded, substantially in accordance with the information provided in support of the consent application. Treatment shall be to the standard described for Phase I by 1 June 1996, to the standard described for Phase II by 1 June 1999, and to the standard described for Phase III by 1 June 1999. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review pursuant to section 128 of the Resource Management Act 1991 within six months of these dates if the standard of treatment indicated in the supporting information is not achieved by those dates.

special conditions 5 to 11 [unchanged]

5. THAT the consent holder shall prepare, implement and maintain a management plan which shall include operating procedures which avoid, remedy or mitigate against adverse effects arising from the wastewater treatment plant operation, or plant failure, and in particular procedures which avoid, reduce, or mitigate against adverse effects arising from the discharge to air. The management plan shall be provided to the satisfaction of the General Manager, Taranaki Regional Council, within three months of the granting of this consent.

TARANAKI
REGIONAL
COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
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6. THAT the anaerobic lagoon shall be covered with a non-porous cover which is sealed so that there are no uncontrolled discharges to air.

7. THAT there shall be no offensive or objectionable odours in the opinion of an enforcement officer of the Taranaki Regional Council beyond the site boundary arising from emissions from the anaerobic lagoon, the activated sludge basin, any waste sludge treatment facility, the clarifier or the wetland. In determining whether an odour is offensive or objectionable, the enforcement officer shall have regard to any impacts on nearby residents which the officer is aware of.

8. THAT sludge retention time in the clarifier shall be minimised consistent with effective sludge blanket management.

9. THAT the aerated lagoon shall be maintained in an aerobic condition at all times.

10. THAT the ambient concentration of hydrogen sulphide at or beyond the boundary arising from the exercise of this consent shall be less than 2 micrograms per cubic metre averaged over any 30-minute period.

11. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 1999 and/or June 2005 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the discharge on the receiving environment.

Signed at Stratford on 23 June 1997

For and on behalf of
TARANAKI REGIONAL COUNCIL

DIRECTOR--RESOURCE MANAGEMENT

Consent 0160-3

TARANAKI
REGIONAL
COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

Discharge Permit

Pursuant to the Resource Management Act 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA
Review Completed Date:	15 December 1999 [Granted: 10 November 1994]

Conditions of Consent

Consent Granted:	To discharge up to 1800 cubic metres/day [25 litres/second] of treated wastewater from the Eltham municipal oxidation ponds sewage treatment system into the Mangawhero Stream a tributary of the Mangawharawhara Stream in the Waingongoro catchment at or about GR: Q20:225-951
Expiry Date:	1 June 2011
Review Date(s):	June 1999, June 2002, June 2005, June 2007
Site Location:	Eltham Wastewater Treatment Plant, Castle Street, Eltham
Legal Description:	Lot 9 DP 2321 Sub Lot 3 DP 1564 Sec 43 Blk X Ngaere SD
Catchment:	Waingongoro
Tributary:	Mangawharawhara Mangawhero

For General, Standard and Special conditions pertaining to this consent please see reverse side of this document

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council, the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

(i) the administration, monitoring and supervision of this consent; and
(ii) charges authorised by regulations.

Special conditions

1. The wastewater treatment system shall be upgraded, substantially in accordance with a development plan to be prepared by the consent holder and lodged with the Taranaki Regional Council by 30 June 2000. The development plan shall demonstrate how the Eltham Waste Water Treatment Plant will meet effluent standards of 30 gm^{-3} total carbonaceous BOD_5 and 50 $gm^{-3}$of suspended solids.

2. The wastewater treatment system shall be upgraded to the standards described in the development plan, supplied under special condition 1, by 31 March 2002.

3. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review, pursuant to section 128 of the Resource Management Act 1991, within two months of the receipt of the development plan provided under condition 1, for the purpose of assessing whether the development plan's proposal will met the effluent standards contained in special condition 1.

4. THAT following the commission of the facilities described in the development plan, the discharge shall not give rise to any of the following effects in the receiving waters of the Mangawhero Stream downstream of State Highway 3 at grid reference Q20:217-947:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
b) any conspicuous change in the colour or visual clarity;
c) any emission of objectionable odour;
d) the rendering of fresh water unsuitable for consumption by farm animals;
e) any significant adverse effects on aquatic life, habitats, or ecology.

5. THAT the consent holder shall record progress toward the completion of the upgrade of the wastewater treatment system and report to the Taranaki Regional Council by 1 December 2000, 1 June 2001 and 1 December 2001.

6. THAT the oxidation pond shall remain in an aerobic condition at all times.

7. THAT the consent holder shall advise the Taranaki Regional Council in writing prior to accepting into the wastewater treatment system any further trade wastes which may over-load the system or contain toxic or hazardous wastes. Within 30 days of advice from the consent holder, the Taranaki Regional Council may review any or all of the conditions of this consent to address the effects of such trade wastes.

8. THAT the consent holder shall provide a suitably trained operator to ensure proper and efficient operation and maintenance of the wastewater treatment system to the satisfaction of the General Manager, Taranaki Regional Council.

9. THAT:

   a) the consent holder shall prepare a management plan, within three months of the provision of the development plan (special condition 1), which shall address management of the Eltham Wastewater Treatment Plant and shall demonstrate the means by which conditions set in this consent shall be met, particularly monitoring of the plant and the minimisation of nutrients in the discharge;
   b) the management plan shall be subject to review when the development plan under special condition 1 is provided, and thereafter upon two months notice by either the consent holder or the Taranaki Regional Council;
   c) in the case of any contradiction between the management plan and the conditions of this resource consent, the conditions of this resource consent shall prevail; and
   d) the consent holder shall adhere to and comply with the procedures, requirements, obligations and all other matters specified in the management plan, unless it can be demonstrated to the satisfaction of the General Manager, Taranaki Regional Council, that any changes in those procedures, requirements, and obligations will result in the same or any lesser adverse environmental effect than already allowed.

10. THAT the consent holder shall mitigate the effects of the discharge of wastewater through riparian management in the Mangawhero Stream Catchment, to the satisfaction of the General Manager, Taranaki Regional Council.

11. THAT the consent holder shall provide by 30 June 2000, a suitably qualified consultant's report in relation to the appropriate re-commissioning of the wetlands. The report shall address:

   a) the timing of the re-planting of the wetland;
   b) the effluent loadings which may be applied to the wetlands following the re-commissioning, taking into account matters addressed by special conditions 1, 2 and 4; and
   c) matters related to management of the effluent diversion to the stream, during appropriate receiving water flow conditions, while re-commissioning of the wetlands is performed.

12. The re-commissioning of the wetlands system, to meet the standards proposed in the information submitted with the original application, shall be completed by 31 December 2002.

13. THAT pursuant to section 128 of the Resource Management Act 1991, the Taranaki Regional Council may review any or all of the conditions of this consent, by giving notice of review during the months of June 2002 and/or June 2007, for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Signed at Stratford on 15 December 1999

For and on behalf of
Taranaki Regional Council

General Manager

Appendix II

Biomonitoring surveys performed in December 2008 and March 2009

To Environmental Monitoring Manager,
From Scientific Officer, C R Fowles
File 03-02-005-12/01
Document No 552836
Report No CF475
Date 6 January 2009

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham Wastewater Treatment Plant's discharge and Rubbish Tip Leachate discharge, December 2008

1. Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates and algae from two established sampling sites (sites 1 and 5) in the Mangawhero Stream on 5 December 2008 and one site (site 8) in the Waingongoro River (illustrated in Figure 1) on 8 December 2008.

This survey was the fourteenth spring biomonitoring programme, an expansion of the normal programme due to the partial upgrade of the Eltham sewage treatment scheme including development of a wetland component of the upgrade. It was also coincident with riparian planting of the Mangawhero Stream banks and stream willow clearance work over the past several years.

These sites were:

Site No	Site code	Map reference	Location
1	MWH000380	Q20: 227 952	Mangawhero Stream: upstream of oxidation ponds' discharge
5	MWH000490	Q20: 210 946	Mangawhero Stream: approximately 200 m downstream of rail bridge and downstream of the Mangawharawhara Stream confluence
8	WGG000665	Q20: 199 937	Waingongoro River: approximately 2 km downstream of Mangawhero Stream confluence

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	=	less than 5 individuals;
C (common)	=	5-19 individuals;
A (abundant)	=	20-99 individuals;
VA (very abundant)	=	100-499 individuals;
XA (extremely abundant)	=	500 or more individuals.

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

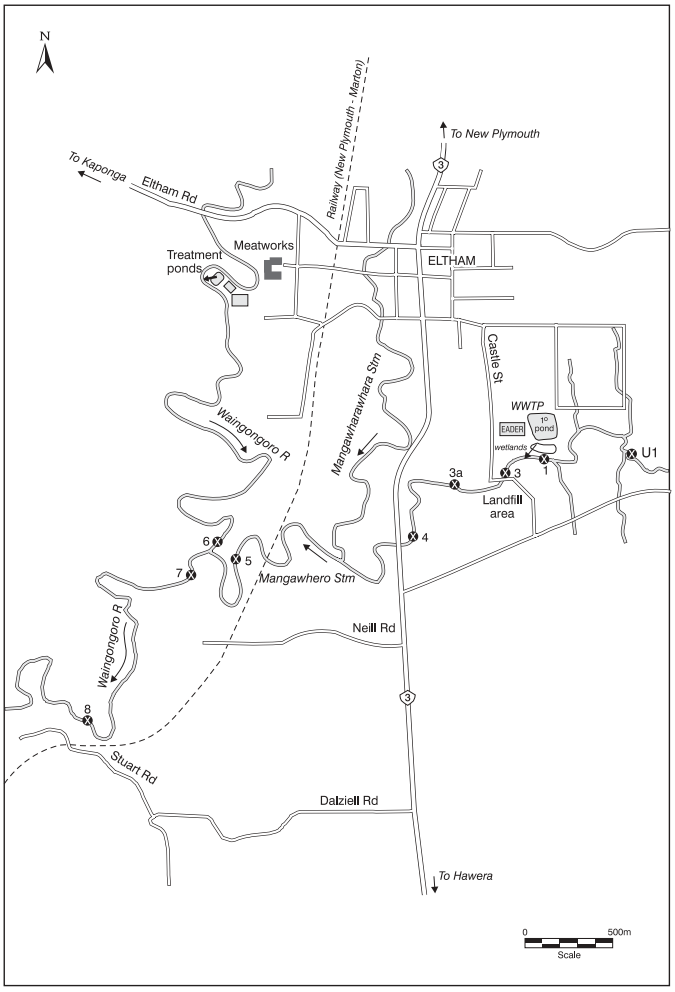

Figure 1 Biomonitoring site locations in the Mangawhero Stream (sites U1 and 1-5) and Waingongoro River (sites 6, 7 and 8) in relation to Eltham oxidation ponds and landfill

Figure 2 Aerial location map

A semi-quantitative MCI value, SQMCIs (Stark, 1999) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these scores, and dividing by the sum of the loading factors. The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

Sub-samples of algal and detrital material were also taken from the macroinvertebrate samples at all sites and were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of masses of the organisms is an indicator of organic enrichment within a stream.

2. Results and discussion

This spring survey was performed under steady recession, moderate flow conditions, 10 days after a significant fresh in the Mangawhero Stream and 15 days after a fresh in excess of 3 times and in excess of 7 times the median flow in the Waingongoro River. The moderate flow in the Mangawhero Stream was cloudy, but uncoloured in appearance upstream of the discharge (site 1) and at the downstream, swifter flowing site 5. Filamentous algae were patchy on the clay substrate (site 1) with some marginal aquatic weed. Periphyton mats were patchy on the stony, harder substrate site where green filamentous algae were widespread throughout the stream (site 5) and weed was present throughout the channel. Stream water temperatures ranged from 17.4°C to 17.6°C during this early afternoon survey.

Flow in the Waingongoro River at Eltham Road was 1.23 m^3/sec at the time of the survey, below the average monthly mean flow (1.97 m^3/sec) for December, and above the minimum monthly mean flow (0.77 m^3/sec). River flow was clear and uncoloured at the sampling site with patchy mats and filamentous algal growth, but no moss present on the substrate. Water temperature was 16.4°C at the time of this mid morning survey.

2.1 Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various established stream sites are summarised in Table 1 and illustrated in Figure 3.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and March 2008

Site	Site code	No. of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	MWH000380	37	10-25	17	58-79	73
5	MWH000490	32	13-25	19	64-86	77
8	WGG000665	28	14-30	20	77-105	92

The macroinvertebrate fauna recorded by the current survey at each of the three sites are presented in Table 2.

Table 1 Macroinvertebrate fauna of the Mangawhero Stream (sites 1 and 5) and Waingongoro River (site 8)* in relation to the Eltham WWTP discharge, sampled on 5 December and *8 December 2008

Taxa list	Site Number	MCI score	1	5	8
	Site Code		MWH000380	MWH000490	WGG000665
	Sample Number		FWB080351	FWB080352	FWB000368
COELENTERATA		3	-	C	-
NEMATODA		3	-	-	R
ANNELIDA	Oligochaeta	1	A	XA	A
	Lumbricidae	5	-	R	-
MOLLUSCA	*Potamopyrgus*	4	-	A	R
CRUSTACEA	Ostracoda	1	-	VA	-
	Paracalliope	5	R	XA	R
EPHEMEROPTERA	*Coloburiscus*	7	-	-	C
	Deleatidium	8	-	-	A
	Austroclima	7	A	R	C
PLECOPTERA	*Zelandoperla*	8	-	-	R
COLEOPTERA	Hydraenidae	8	-	-	A
	Elmidae	6	R	R	A
MEGALOPTERA	*Archichauliodes*	7	-	-	R
TRICHOPTERA	*Aoteapsyche*	4	-	C	VA
	Hydrobiosis	5	A	C	A
	Costachorema	7	-	-	C
	Oxyethira	2	C	C	R
	Pycnocentrodes	5	-	-	R
DIPTERA	*Aphrophila*	5	R	-	C
	Maoridiamesa	3	-	A	VA
	Orthocladiinae	2	A	C	VA
	Tanytarsini	3	-	R	A
	Chironomus	1	R	-	-
	Polypedilum	3	R	-	-
	Austrosimulium	3	-	C	A
	Empididae	3	R	-	-
	No of taxa		12	15	21
	MCI		72	72	98
	SQMCIs		3.5	2.9	3.6
	EPT (taxa)		2	3	8
	%EPT (taxa)		17	20	38

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

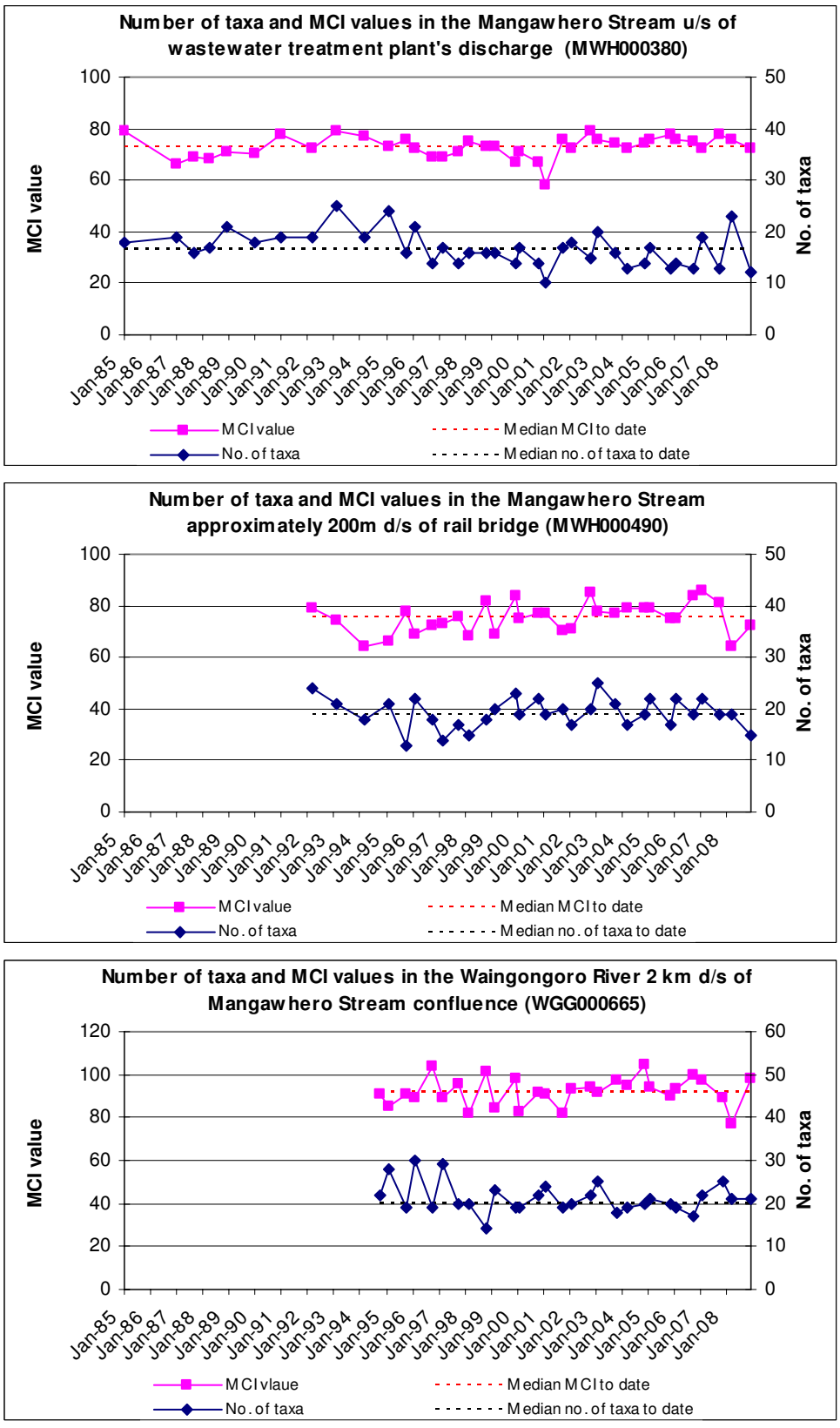

Figure 3 Taxa richness and MCI scores recorded to date

2.1.1 Mangawhero Stream: site 1 (upstream of the wetland's discharge) and site 5 (downstream of Mangawharawhara Stream confluence; approx 3 km below the WWTP discharge)

These two sites have very different habitats and, together with the deterioration in water quality downstream of the Eltham Wastewater Treatment Plant's discharge, these factors are reflected in the macroinvertebrate communities found at the two sites (Table 2).

The upstream site (site 1) habitat was comprised almost entirely of a clay substrate with some sand and fine gravel, and with patchy filamentous algae and marginal vegetation. This site was dominated by two 'moderately sensitive' taxa (mayfly (*Austroclima*), and free-living caddisfly (*Hydrobiosis)*); and two 'tolerant' taxa (oligochaete worms and orthoclad midges). Each of these taxa had also been dominant at the time of previous spring surveys with the number of characteristic taxa lower in this survey than typical of past surveys.

Although sections of the stream at this upstream site were swift flowing, slower current speeds were common amongst areas of filamentous algae and weed attached to the substrate of the stream. The dominant taxa and the remainder of the fauna found at this site are commonly found in this type of habitat, although the abundances of the mayfly, *Austroclima* and the presence of other 'sensitive' taxa continued to indicate reasonably well oxygenated flow conditions as a component of this habitat. Taxa richness (12) was five taxa lower than the median number recorded from previous surveys (Table 1). This was the fourteenth spring survey performed in the Mangawhero Stream and the survey recorded a MCI value of 72 units which was an insignificant one unit lower than the median of all past survey results and typical of a small swamp seepage stream subject to moderate nutrient enrichment from developed farmland drainage. The score reflected the absence of 'highly sensitive' taxa and relatively high percentage of 'tolerant' taxa (50% of richness) in the community at this site. This score was six units lower than the median value (78 units) found by 144 surveys of 'control' sites in similar streams in the region (TRC 1999 (updated, 2007)) at equivalent altitudes to this site.

Patchy algal mats, widespread filamentous green algae and macrophyte beds were recorded at the swifter flowing, harder substrate of site 5 at the time of this spring survey. The macroinvertebrate fauna community showed a small downstream increase in taxa richness (15 taxa), which was four taxa less than the median number previously recorded at this site (Table 1). The dominant taxa included four 'tolerant' taxa (extremely abundant oligochaete worms; snail (*Potamopyrgus*), ostracod seed shrimps, and midges (*Maoridiamesa*)); and one 'moderately sensitive' taxon (extremely abundant amphipod (*Paracalliope*)). All of the dominant taxa were associated with the weed and the algae. Variation in stream habitat probably accounted for most of the changes in abundances of taxa between the two sites, including the significant increases in abundances of worms, snails, ostracods, amphipods and midges. There was also a marked decrease in the abundance of the 'sensitive' mayfly, *Austroclima*; these factors combining to lower the $SQMCI_s$ score by 0.6 unit in a downstream direction.

The MCI value (72) at this site represented no change from the score recorded at the upstream ('control') site, despite some improvement in physical stream habitat conditions, as a result of the presence and assimilation of WWTP wastes through the reach 3 km downstream of the WWTP. This score was five units lower than the median value of scores from all past surveys (Table 1). A decrease (of 17%) in the proportion of

'sensitive' taxa at this site, despite the physical substrate improvement at this site in the lower stream, was indicative of poor water quality conditions, as the MCI value for such a habitat in the absence of the discharge might be expected to be higher than the median recorded by surveys to date. For instance, the current survey's MCI score was a significant (Stark, 1998) 16 units lower than the median score recorded from 44 previous surveys at 'control' sites in similar streams (rising below the National Park) at altitudes between 155 and 199 m asl (TRC 1999 (updated, 2007)). Macroinvertebrate communities at this site would be expected to show evidence of improvement following the intended removal of the Eltham wastewater treatment plant discharge from the Mangawhero Stream.

2.1.2 Waingongoro River site (downstream of the Mangawhero Stream confluence (site 8))

Twenty-eight surveys have been undertaken previously at this site, approximately 2 km downstream of the Mangawhero Stream confluence (which is the receiving water for the Eltham municipal wastewater treatment system discharge).

The number of taxa found in the present survey (21) was very similar to the median found at this site to date and slightly below that typical of macroinvertebrate community richness found in the mid-reaches of Taranaki ringplain rivers. The community was characterised by one 'highly sensitive' taxon (mayfly (*Deleatidium*)); two 'moderately sensitive' taxa (free-living caddisfly (*Hydrobiosis*) and elmid beetles); and six 'tolerant' taxa (oligochaete worms, sandfly (*Austrosimulium*), (midges (orthoclads, tanytarsids and *Maoridiamesa*) and net-building caddisfly (*Aoteapsyche*)) (Table 2). The abundance of the 'highly sensitive' taxon (mayfly (*Deleatidium*)) at this river site was indicative of recent good physicochemical water quality. However, the number of characteristic 'sensitive' taxa was lower than usually found, although the overall richness was similar to that found in the reach of the river upstream of the Mangawhero Stream confluence (CF476).

The MCI score (98) indicated minimal deterioration in the macroinvertebrate community in comparison with the community present in the reach in the vicinity of the Riverlands meatworks upstream of the Mangawhero Stream where the MCI scores ranged from 99 to 111 units at the time of the same day monitoring of the meatworks' discharge (CF476). A small increase in the abundances of certain 'tolerant' taxa lowered the $SQMCI_s$ score by 1.7 units below the confluence. The current MCI score (at site 8) of 98 units was six units higher than the median score recorded by past surveys at this site (Table 1), but it was seven units below the median score (105) recorded by 263 surveys of 'control' sites at a similar altitude in ringplain National Park-sourced streams and rivers (TRC 1999 (updated, 2007)).

This decrease in MCI value below the Mangawhero Stream confluence followed the usual trend of downstream decreases recorded by several earlier surveys (since 1994) and was similar to the trends recorded at the time of five of the previous six spring surveys.

2.2 Microscopic streambed heterotrophic assessment

The microscopic heterotrophic assessments of substrate growths performed for all sites indicated an absence of any mats, plumes or dense growths of heterotrophic organisms at each of the three sites.

3. Conclusions

This survey was the fourteenth spring survey performed subsequent to the installation of increased aeration of the primary oxidation pond and the eighth since replanting of the second oxidation pond conversion to a wetland by STDC. The survey coincided with moderate recession flows and patchy to widespread periphyton populations and macrophyte beds on the bed and/or margins at both Mangawhero Stream sites and patchy periphyton at the site in the Waingongoro River downstream of the Mangawhero Stream confluence.

Macroinvertebrate community richnesses were lower than past median taxa numbers with the MCI scores slightly below past medians at upstream and downstream sites in the Mangawhero Stream. No change was found in MCI score between the two sites in a downstream direction. Lower abundances or absences of certain 'moderately sensitive' taxa (previously more abundant) which might be expected to be present at the 'better' physical habitat of site 5, 3 km downstream of the wastewater treatment plant's discharge, were indicative of the continued poorer physicochemical water quality conditions at the time of this survey. The MCI and $SQMCI_s$ scores recorded in the Waingongoro River downstream of the Mangawhero Stream confluence were indicative of deterioration in water quality below the confluence similar to trends frequently found by previous surveys and often under lower flow conditions. Future improvement in physicochemical water quality and the associated macroinvertebrate faunal communities in the Mangawhero Stream would not be anticipated until the proposed diversion of the discharge to an alternative receiving environment.

4. Summary

The Council's standard 'kick-sampling' technique was used at two established sites to collect streambed macroinvertebrates from the Mangawhero Stream and at one established site in the Waingongoro River. Samples were sorted and identified to provide number of taxa (richness) and MCI and $SQMCI_s$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_s$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either the MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring macroinvertebrate survey indicated that the discharge of treated wastewater from the Eltham WWTP was having some effects on the macroinvertebrate communities of the Mangawhero Stream. Changes in the macroinvertebrate communities were recorded between the upstream 'control' site, and the site nearly 3km downstream of the WWT Plant discharge near the confluence with the Waingongoro River where deteriorations in aspects of physicochemical water quality were due to overloading of the assimilative capacity of the receiving waters. As a result of higher spring flows, and therefore greater wastes dilution, no deterioration in MCI score was recorded, nor was there coincidental microscopic evidence of 'heterotrophic

growths' (which have often been associated with summer, warmer low flow conditions).

The macroinvertebrate communities of the Mangawhero Stream contained relatively high proportions of 'tolerant' taxa at both sites, with numerical dominance by 'tolerant' taxa greater at the downstream site when the community was characterised more by 'tolerant' taxa. Taxonomic richness (number of taxa) was moderate at the time of this spring survey coincident with patchy to widespread filamentous algal cover and weed growth at both sites.

MCI and $SQMCI_s$ scores indicated that the Mangawhero Stream communities were of 'poor' health, and at the impacted downstream site, below the typical condition recorded in similar Taranaki streams.

The macroinvertebrate community found in the Waingongoro River below the Mangawhero Stream confluence showed a small downstream decline in $SQMCI_s$ value and relatively insignificant decrease in MCI score compared with the surveyed reach of the river above the confluence; atypical of the trend often found by past surveys, but consistent with the greater dilution provided by the higher spring flows preceding this survey.

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To Monitoring Manager-Environmental Management, K Brodie
From Scientific Officer, Chris R Fowles
Consent Nos 0160, 3387
Report No CF483
File No 03-02-005-12/01
Doc No 598774
Date 28 April 2009

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to South Taranaki District Council's Eltham wastewater treatment plant's discharge and rubbish tip leachate discharge, March 2009

Method

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from four established sampling sites in the Mangawhero Stream on 4 March 2009. The two sites in the Waingongoro River (illustrated in Figure 1) and an additional site, established in the river (site 8) approximately 2 km further downstream for monitoring use in conjunction with the Riverlands Eltham Ltd discharges, and the state of the environment monitoring programme, were sampled on 3 March 2009.

Treated wastewater from the wetlands was being discharged to the Mangawhero Stream via the usual outfall to the tributary below the Wastewater Treatment Plant. The normal WWTP operation (utilising tertiary wetlands wastes polishing) had been occurring throughout the summer period.

The sites sampled were:

Site No	Site code	Map reference	Location
1	MWH000380	Q20: 227 952	Mangawhero Stream: upstream of wastewater treatment plant's discharge
3	MWH000410	Q20: 224 951	Mangawhero Stream: upstream of rubbish tip, and approximately 400 m downstream of wastewater treatment plant's discharge
4	MWH000470	Q20: 218 947	Mangawhero Stream: SH3 bridge
5	MWH000490	Q20: 210 946	Mangawhero Stream: approximately 200 m downstream of rail bridge
6	WGG000620	Q20: 208 947	Waingongoro River: approximately 150 m upstream of Mangawhero Stream confluence
7	WGG000640	Q20: 206 945	Waingongoro River: approximately 200 m downstream of Mangawhero Stream confluence
8	WGG000665	Q20: 199 937	Waingongoro River: approximately 2 km downstream of Mangawhero Stream confluence (off Stuart Road)

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

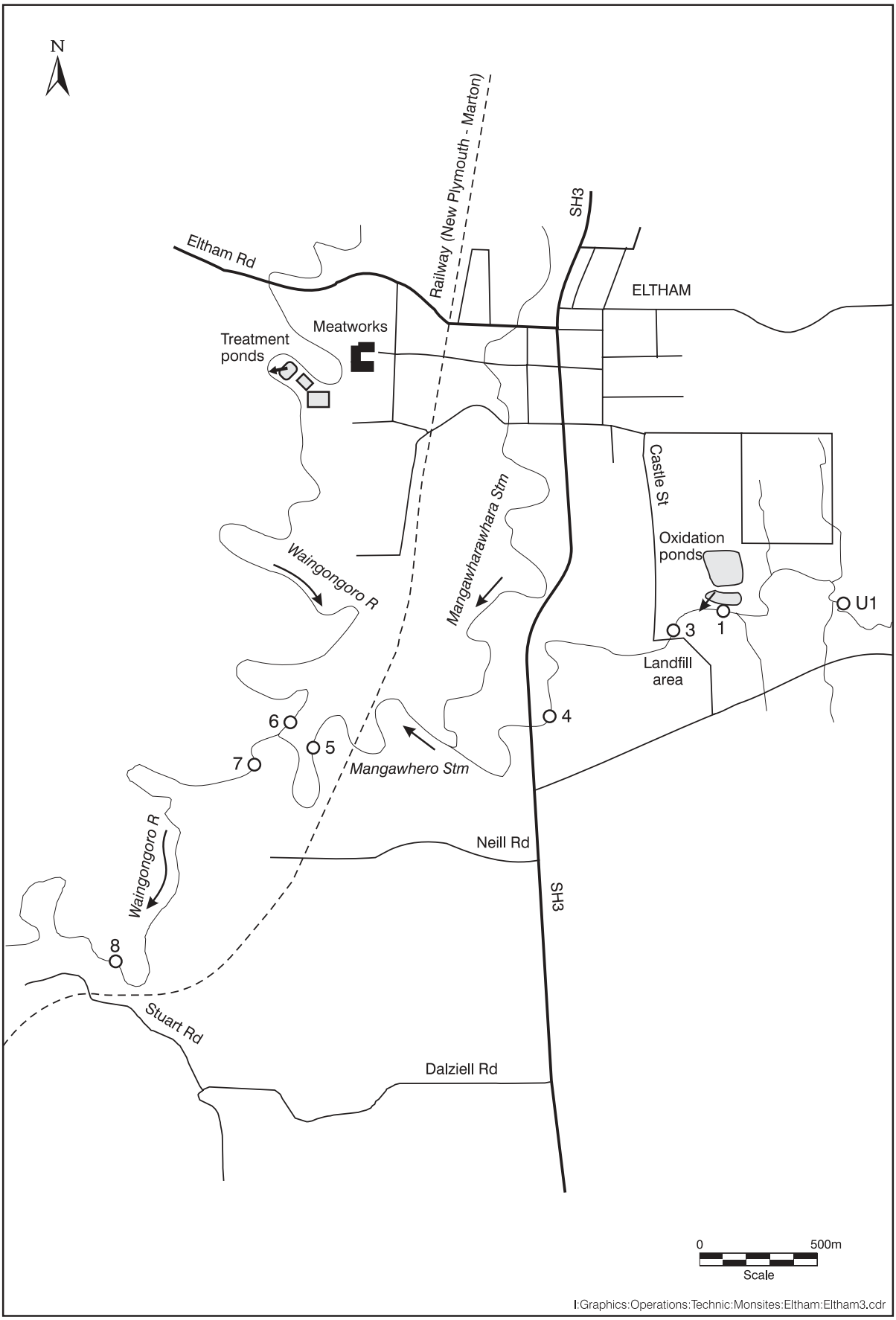

Figure 1 Biomonitoring (sites 1-8) site locations in the Mangawhero Stream and Waingongoro River in relation to Eltham wastewater treatment plant and landfill

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= 20-99 individuals;
VA (very abundant)	= 100-499 individuals;
XA (extremely abundant)	= 500 or more individuals.

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, $SQMCI_S$ (Stark, 1999) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these scores, and dividing by the sum of the loading factors. The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

Sub-samples of algal and detrital material were also taken from the macroinvertebrate samples and were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of these organisms is an indicator of organic enrichment within a stream.

Results and discussion

This late summer-early autumn survey was performed under low flow conditions in the Mangawhero Stream some 22 days after a significant fresh in this stream. The stream was cloudy and uncoloured in appearance upstream of the wastewater treatment plant's discharge, and dirty, brown at the downstream sites (3 and 4) due to the turbid brown wastes discharge (estimated at 25 litres/sec), whereas the appearance was cloudy and greyish at the swifter low flowing, harder substrate of site 5 below the Mangawharawhara Stream confluence where there were thick beds of aquatic vegetation in the stream channel. Stream water temperatures ranged from 14.2˚C to 15.3˚C during this mid morning survey. Thin periphyton mats were present at sites 3 and 5. Filamentous green algal growth was patchy at sites 1 and 5, and non-existent at sites 3 and 4, with aquatic weed throughout the channel at site 5 and at the edges of all other sites. No moss was present on the streambed at any of the sites. Some patches of 'sewage fungus' were noticeable on the hard substrate at sites 3 and 4. Improvement in flow velocities continued to be recorded at sites 3 and 4 in the reach below the wastes discharge where shallower, faster (steady) flows had resulted from willow clearance works (below SH3) performed nine years previously. These instream habitat improvements also included more exposed sections of harder substrate compared with previous deeper, more sedimented conditions in this reach.

A low recession flow (0.91 m^3/sec) was recorded in the Waingongoro River at Eltham Road at the time of the survey which occurred 11 days after a fresh in excess of three and seven times median flow. The river was clear and uncoloured upstream of the Mangawhero Stream confluence but cloudy downstream of the confluence and at Stuart Road (site 8). The river flow was lower than the average mean monthly flow (1.54 m^3/sec) for March but in excess of the minimum mean monthly flow (386 L/sec). River temperatures ranged from 16.7°C to 17.3°C at sites 6, 7 and 8. Thin periphyton mats and patchy filamentous algae were recorded at all three sites at the time of this late morning survey.

Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various river and stream sites are summarised in Table 1 and illustrated in Figures 2 and 3.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and December 2008

Site	No. of Surveys	Taxa Numbers		MCI Values	
		Range	Median	Range	Median
1	38	10-25	17	58-79	73
3	23	6-22	15	47-72	60
4	21	9-18	15	51-74	60
5	33	13-25	19	64-86	77
6	23	16-35	27	77-105	91
7	22	17-35	26	78-99	90
8	29	14-30	20	77-105	92

The macroinvertebrate fauna recorded at the four Mangawhero Stream sites (1, 3, 4 and 5) and three Waingongoro River sites (6, 7 and 8) are presented in Tables 2 and 3 respectively.

Mangawhero Stream: Site 1 (upstream of wastewater treatment plant's wetlands discharge and upstream of the old rubbish tip)

The flow at this site was low, cloudy, uncoloured and swift. The habitat was comprised of patchy filamentous algae on a mainly hard clay substrate with aquatic vegetation at the channel margins. The riparian vegetation planting was well established since being undertaken along the stream banks subsequent to the drain clearance work about ten years previously.

A poor taxa richness (13 taxa) was recorded, four taxa fewer than the median richness recorded by 38 previous surveys at this site (Table 1). No 'highly sensitive' taxa were found at this site, with the fauna characterised by one 'tolerant' taxon (orthoclad midges); plus two 'moderately sensitive' taxa (amphipods (*Paracalliope*) and mayfly (*Austroclima*)). Many of these taxa and the remainder of the fauna found at this site (Table 2) are generalists and often common inhabitants of weedy, sedimented beds, in slower flowing Taranaki streams which may be characterised by moderate physicochemical water quality, particularly when swamp-fed. All of these dominant taxa were characteristic of this site at the time of the previous summer survey (CF445) although there was a decrease of six 'tolerant' and one 'sensitive' taxa at the time of the latest survey. The MCI score (72) was one unit below the median of previous surveys' results at this site (Table 1 and Figure 2). This score was 2 units lower than the median score (78) from 147 surveys of small non-ringplain Taranaki streams at 'control' sites within the altitude range from 200 to 249 m asl (TRC 1999 (updated 2008)) and was typical of small, weedy, swamp-fed Taranaki streams draining developed farmland catchment and subject to moderate organic enrichment. This score also reflected the total absence of 'highly sensitive' taxa, typical components of the fauna of higher quality ring plain streams; and the high proportion of 'tolerant' taxa (54% of total taxa) in the community.

Table 2 Macroinvertebrate fauna of the Mangawhero Stream in relation to Eltham WWTP discharge sampled on 4 March 2009

Taxa list	Site Number	MCI score	1	3	4	5
	Site Code		MWH000380	MWH000410	MWH000470	MWH000490
	Sample Number		FWB090129	FWB09130	FWB09131	FWB09132
COELENTERATA		3	-	A	R	-
PLATYHELMINTHES	*Cura*	3	-	A	-	-
NEMATODA		3	-	-	R	C
ANNELIDA	Oligochaeta	1	C	XA	XA	XA
	Lumbricidae	5	-	-	-	R
MOLLUSCA	*Potamopyrgus*	4	-	C	-	VA
CRUSTACEA	Ostracoda	1	C	VA	XA	XA
	Paracalliope	5	A	-	-	XA
EPHEMEROPTERA	*Austroclima*	7	A	C	-	-
PLECOPTERA	*Zelandobius*	5	R	-	-	-
COLEOPTERA	Elmidae	6	R	-	-	C
TRICHOPTERA	*Aoteapsyche*	4	R	R	-	C
	Hydrobiosis	5	C	C	-	R
	Oxyethira	2	C	R	-	A
	Paroxyethira	2	-	-	-	R
	Triplectides	5	-	-	R	-
DIPTERA	*Aphrophila*	5	C	R	-	-
	Orthocladiinae	2	A	A	C	A
	Chironomus	1	R	C	VA	R
	Polypedilum	3	C	R	-	R
	Austrosimulium	3	-	R	R	A
	Muscidae	3	-	-	-	C
		No of taxa	13	14	8	16
		MCI	72	63	48	63
		SQMCIs	4.1	1.3	1.0	2.5
		EPT (taxa)	4	3	1	2
		%EPT (taxa)	31	21	12	12

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

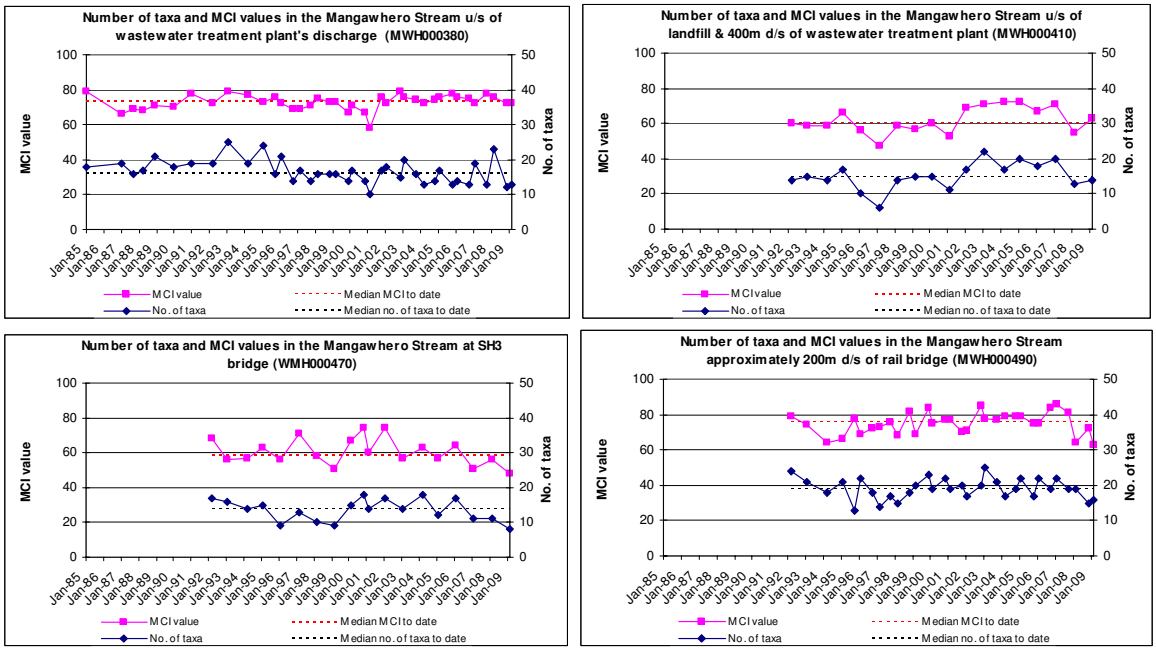

Figure 2 Taxa richness and MCI values for the four Mangawhero Stream sites to date

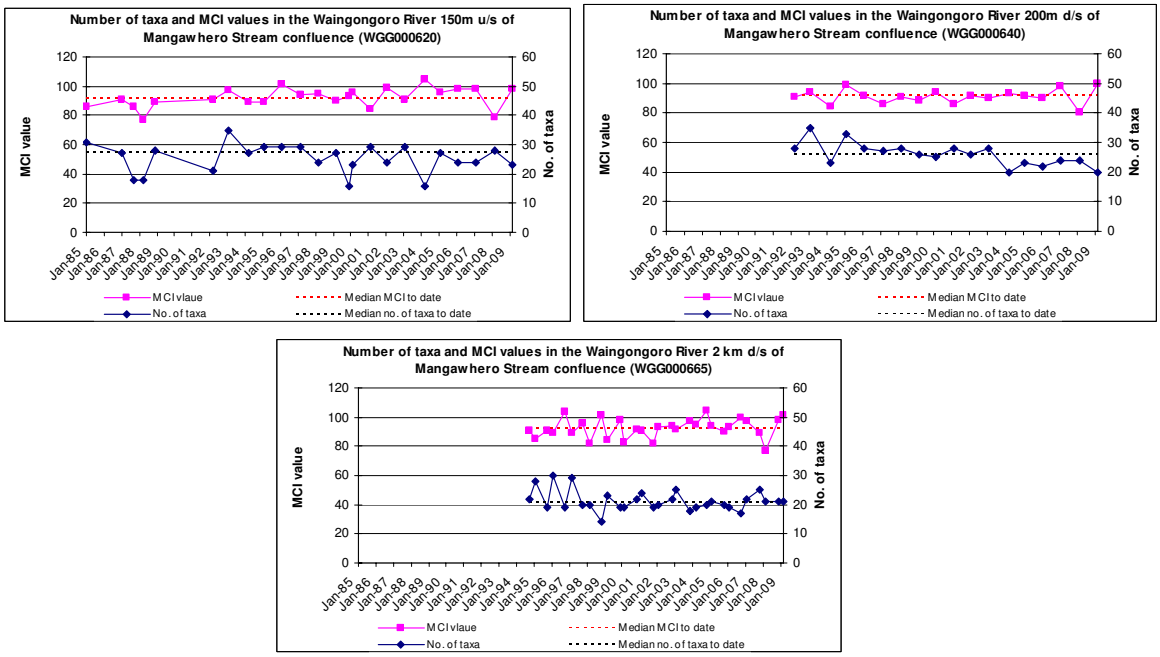

Figure 3 Taxa richness and MCI values for the three Waingongoro River sites to date

Mangawhero Stream: Site 3 (road bridge upstream of rubbish tip and 400m downstream of wastewater treatment plant's discharge)

The continued turbid brown appearance of the flow was due to inadequate dilution of the WWTP discharge, although some improvement in physical habitat at this site has been noted over recent years since channel improvement works were performed downstream. There was a swift flow over a very shallow, sedimented, mainly sandy and silty bed with some harder substrate in the form of wood, some cobbles and boulders. Weed was present at the edges of the stream. A similar richness (14 taxa) compared to that at the upstream 'control' site was recorded with a decrease in MCI score (63) of 9 units consistent with poorer physical habitat and the aesthetically very poor physicochemical water quality at this site due in part to the low amount of dilution of the wastewater discharge provided by the low stream flow preceding this survey. There were marked changes in community composition between sites 1 and 3 with 10 of the 17 taxa found at these sites (ie over this reach), present at both sites. Nearly all 'moderately sensitive' taxa found at the upstream 'control' site were absent or significantly lower in abundance at site 3. Taxa number (14) and MCI value (63) were similar to respective medians previously recorded at this site (Table 1 and Figure 2) again reflecting the impacts of organic enrichment from the wastewater treatment plant's discharge. These impacts were also indicated by the composition of the dominant taxa (Table 2) which included no 'sensitive' taxa but only (five) lower scoring, 'tolerant' taxa common to poorer quality waters and habitats; in particular the 'tolerant' oligochaete worms (extremely abundant), ostracods, coelenterates, flatworm (*Cura*), and orthoclad midges). This was a similar taxa dominance to that recorded by the previous summer survey. Some of the very 'tolerant' taxa were extremely abundant, which was reflected in the extremely low $SQMCI_S$ value (1.3 units) recorded. The marked reduction in abundances of all 'moderately sensitive' taxa reflected the very poor physicochemical conditions at this site, approximately 400 metres downstream of site 1. This was a direct result of poor wastes dilution provided by the low flow experienced prior to the survey during the late summer-autumn period. The condition of the biological community at this site indicated no improvement in overall habitat conditions in comparison with the communities surveyed under low receiving water conditions during summer surveys prior to downstream channel improvements (Figure 2), some nine years earlier.

Mangawhero Stream: Site 4 (SH3, downstream of rubbish tip and wastewater treatment plant's discharge)

Willow removal works from the reach of the stream immediately downstream of the SH3 culvert (9 years earlier) had also improved some aspects of habitat quality (ie lowered water levels, increased flow velocities, and a reduction in silty conditions) at this site. The very poor taxa richness (8 taxa) present at this site was lower in comparison with those at the nearest two upstream sites, including the upstream 'control' site 1 and was one taxon fewer than the minimum recorded by all previous surveys at this site (Table 1 and Figure 2). The fauna was characterised by no 'moderately sensitive' taxa but by three 'tolerant' taxa (extremely abundant oligochaete worms and ostracod seed shrimps; and very abundant bloodworm midge (*Chironomus*)), consistent with further deterioration in physicochemical water quality conditions as partial wastes assimilation impacted in a downstream direction. In comparison with the upstream 'control' site (1), community composition was significantly different with only four of the total 16 taxa found at the two sites, present at both. Several significant downstream decreases in abundances of individual 'moderately sensitive' taxa were also recorded at this site eg, the absence of mayflies, stoneflies, certain caddisflies, beetles and craneflies from the site 3 community. The MCI score (48 units) recorded at this site was a significant (Stark, 1989) 24 units lower than score at the upstream 'control' site, reflecting the poor physicochemical water quality and was 12 units below the median recorded by twenty-one previous surveys (Table 1 and Figure 2) and represented

further deterioration in communities between sites 3 and 4. The $SQMCI_s$ value (1.0 unit) was extremely low due to the numerical dominance of the fauna by very 'tolerant' taxa which, despite certain longer-term improvements in the site's physical habitat, reflected the poor physicochemical water quality conditions preceding this survey under low, late summer-autumn flows in the Mangawhero Stream. The results also indicated that, under these conditions, any impacts of rubbish tip leachate seepage on the stream would be difficult to assess in the reach between sites 3 and 4.

Mangawhero Stream: Site 5 (downstream of Mangawharawhara Stream and upstream of Waingongoro River confluences)

The habitat at this site differed significantly from that at the upstream sites, with slightly deeper, swifter, open flow over a sandy, cobble and boulder substrate, with the weed (*Potamogeton crispus*) very common throughout the stream channel following the summer low flow conditions. Thin periphyton mats and patchy filamentous algal growths were present. Some areas of silty, softer sediment were noted in addition to the cobble and boulder substrate. Flow at this site was cloudy and grey in appearance but with marked visual improvement compared with conditions recorded at the two impacted sites further upstream, partly as a result of the filtering effect of the thick weed beds upstream and increased dilution by the ringplain Mangawhawhara Stream tributary.

Moderate taxa richness (16 taxa) was recorded with improvement in richness particularly in comparison with taxa numbers at the nearest upstream site. This taxa number was three taxa fewer than the median number (19 taxa) found from previous surveys (Table 1), although rarities contributed 31% of this taxa richness. This richness was similar to that recorded by many of the previous summer surveys (Figure 2). A much higher MCI value of 63 units was recorded compared to that upstream at site 4, but this value was one unit lower than the minimum of MCI scores previously surveyed at this downstream site indicative of the poor dilution and wastes assimilation through the reach of the stream below the WWTP wastes discharge. This MCI score (63) remained 9 units lower than the score recorded at the 'control' site 1 upstream of the wastewater treatment plant's discharge despite improved physical habitat conditions and the significant increase in dilution flow provided by the Mangawharawhara Stream inflow.

The dominant taxa (Table 2) included six 'tolerant' taxa (extremely abundant ostracod seed shrimps and oligochaete worms; snail (*Potamopyrgus*), algal-piercing caddisfly (*Oxyethira*), sandfly (*Austrosimulium*), and orthoclad midges); and one 'moderately' sensitive taxon, (extremely abundant amphipod (*Paracalliope*)). This was fewer 'sensitive' taxa than dominant at the time of the previous summer survey, which had been preceded by a very lengthy period of low summer flows. However, the continued numerical dominance of the community by certain low-scoring 'tolerant' taxa (such as the ostracods and worms) resulted in the low $SQMCI_s$ value (2.5 units) in the lower range of those recorded by most recent surveys at this site, but an improvement of 1.5 units on the score recorded upstream at site 4 due to the extreme abundance of 'sensitive' amphipods which are common inhabitants of aquatic vegetation habitats. As noted in previous summers' surveys, certain 'sensitive' taxa, which generally were recorded at this lower stream site in earlier surveys prior to increased loadings on the WWTP, continued to be less abundant numerically or completely absent from the macroinvertebrate fauna at the time of this survey. These taxa included the mayfly (*Austroclima*), dobsonfly (*Archichauliodes*), free-living caddisflies and stoneflies in particular. Conversely, certain 'tolerant' taxa were numerically far more abundant.

Waingongoro River: Sites 6, 7 and 8 (upstream and downstream of the Mangawhero Stream confluence)

All three sites' habitats were characterised by relatively shallow, swift, riffle flows over substrates composed of some silt, sand and gravel, but primarily of cobbles and boulders. Algal mats were thin through the reach surveyed with patchy filamentous green algal growths but no moss at all three sites.

Table 3 Macroinvertebrate fauna of the Waingongoro River in relation to Eltham WWTP discharge sampled on 3 March 2009

Taxa list	Site Number	MCI score	6	7	8
	Site Code		WGG000620	WGG000640	WGG000665
	Sample Number		FWB09124	FWB09125	FWB09126
PLATYHELMINTHES	*Cura*	3	R	-	-
ANNELIDA	Oligochaeta	1	C	R	C
MOLLUSCA	*Potamopyrgus*	4	VA	C	C
CRUSTACEA	Ostracoda	1	R	C	R
EPHEMEROPTERA	*Nesameletus*	9	R	R	-
	Coloburiscus	7	C	R	C
	Deleatidium	8	XA	XA	A
	Austroclima	7	A	C	R
PLECOPTERA	*Megaleptoperla*	9	-	-	R
	Zelandoperla	8	R	R	R
	Zelandobius	5	-	R	-
COLEOPTERA	Hydraenidae	8	R	R	R
	Elmidae	6	VA	VA	VA
MEGALOPTERA	*Archichauliodes*	7	C	C	C
TRICHOPTERA	*Aoteapsyche*	4	XA	XA	VA
	Hydrobiosis	5	VA	A	A
	Costachorema	7	R	-	R
	Oxyethira	2	R	-	-
	Pycnocentrodes	5	C	-	R
DIPTERA	*Aphrophila*	5	R	R	R
	Eriopterini	5	R	-	-
	Maoridiamesa	3	A	C	A
	Orthocladiinae	2	R	A	VA
	Tanytarsini	3	C	C	C
	Austrosimulium	3	R	R	R
	Empididae	3	-	-	R
	Tanyderidae	4	-	R	-
	No of taxa		23	20	21
	MCI		98	100	101
	SQMCI$_S$		5.7	5.9	4.3
	EPT (taxa)		9	8	9
	%EPT (taxa)		39	40	43
'Tolerant' taxa	'Moderately sensitive' taxa			'Highly sensitive' taxa	

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

The macroinvertebrate communities recorded at sites 6 and 7 were of moderate richnesses with only a small decrease in richness in a downstream direction to site 8 (Table 3) ranging from 23 to 20 taxa. All sites' taxa numbers were lower than, or similar to, median numbers previously recorded (Table 1). MCI values (98 to 101) were near the maxima of ranges of past surveys' values and 7 to 10 units higher than median scores previously recorded (Table 1 and Figure 3) despite low flow conditions preceding the survey. This was emphasised by the presence of several 'highly sensitive' taxa in this reach of the river. There were very few significant differences in individual taxon abundances between sites, with decreased numbers of a 'sensitive' caddisfly and 'tolerant' snail and an increase in 'tolerant' midges immediately downstream of the Mangawhero Stream confluence and a decrease in number of a 'highly sensitive' mayfly further downstream at site 8. These few subtle changes in community composition were insufficient to significantly alter the $SQMCI_s$ values either side of the Mangawhero Stream confluence but the reduction in mayfly numbers resulted in a decrease of 1.6 SQMCI units further downstream at the Stuart Road site.

Minimal change in MCI score (Stark, 1998) was recorded between sites immediately adjacent to the Mangawhero Stream confluence or in the MCI score found at the Stuart Road site, 2 km further downstream. The minimal change in MCI score in this reach was inconsistent with the trend of a number of previous surveys which have showed decreases downstream of the Mangawhero Stream confluence attributable to some deterioration in physicochemical water quality at this site due to the wastewater loadings on this tributary.

In general, this 2.5 km reach of the river was characterised by one 'highly sensitive' taxon (mayfly (*Deleatidium*)); up to three 'moderately sensitive' taxa (mayfly (*Austroclima*), elmid beetles, and caddisfly (*Hydrobiosis*)); and up to four 'tolerant' taxa (snail (*Potamopyrgus*), net-building caddisfly (*Aoteapsyche*), and midges (orthoclads and *Maoridiamesa*)). These characteristic taxa were typical of those found in the communities in this reach of the river, but well below the number (particularly 'tolerant' taxa) found by the previous summer survey which followed an extremely low flow period. Comparatively, this summer survey found a slightly lower number of total taxa (26) in this reach, of which 17 were recorded at all three sites. The MCI scores recorded over this reach of the river however, were typical of scores found during summer flows in the mid-reaches of a river draining a developed catchment and receiving point source wastes discharges and agricultural run-off. The MCI scores (98 to 101 units) and taxa richnesses (20 to 23 taxa) were slightly lower than the median score (105) but similar to median richness (21 taxa) recorded by 272 previous surveys of 'control' sites located between 155 and 199 m a.s.l. in National Park-sourced ringplain streams and rivers (TRC, 1999 (updated 2008)).

Microscopic streambed heterotrophic assessment

Mangawhero Stream

No heterotrophic growths were visually apparent in the field at the time of the survey. However, closer inspection of the samples and microscopic analysis of samples from each site showed there were no mats, plumes or dense growths of heterotrophic organisms at site 1 in the Mangawhero Stream, but small amounts of pale growths of stalked ciliate protozoa were attached to the harder components of the substrate at site 4 and further downstream at site 5 (the boundary of the mixing zone at SH3).

Waingongoro River

Microscopic analysis of samples from the Waingongoro River showed no evidence of mats, plumes or dense growths of heterotrophic organisms, indicating no effects on the riverbed

microflora from the wastewater treatment plant's discharge to the Mangawhero Stream (some 4 km upstream of the confluence with the river).

Conclusions

This late summer-early autumn survey was performed during low flow conditions in the Mangawhero Stream and in the Waingongoro River coincidental with the discharge of the Wastewater Treatment Plant's treated wastes into the Mangawhero Stream after tertiary treatment by the wetland. This survey was the ninth summer survey since the willow removal work had been undertaken in the stream through the reach below the SH3 culvert result which had resulted in some physical stream habitat improvements to the mid-reaches of the stream below the wastes discharge.

Macroinvertebrate richness and MCI values found in the Mangawhero Stream were not indicative of any of the previously recorded historical willow removal improvement in physical stream habitat conditions but were influenced markedly by poor physicochemical water quality conditions during low flow conditions and minimal dilution of the wastewater discharge. Aspects of community composition (particularly very low $SQMCI_s$ values and decreased MCI scores) emphasised these impacts of poor physicochemical water quality conditions downstream of the Eltham wastewater treatment system discharge. Impacts of the wastewater treatment plant's discharge were apparent a short distance below the WWTP discharge and increased toward the mid reaches of the Mangawhero Stream at the boundary of the consented mixing zone (the SH3 site), where physicochemical water quality is often poorest as a result of more severe dissolved oxygen depletion as the wastewater assimilative capacity of the receiving waters is under greater pressure, especially under lengthy periods of low flow conditions. At the furthest downstream site, limited recovery in community composition was recorded to a lesser degree than might be expected given the improvement in physical habitat and dilution provided by the Mangawharawhara Stream tributary. Due to the delay experienced in the improvements to effluent quality which was to be provided by the completion to the upgrade of the wastewater treatment plant, these impacts continued to be significant despite instream channel improvements provided by willow removal work undertaken in the reach of the stream between SH3 and the Mangawharawhara Stream confluence. However, in order for the necessary improvements to occur in physicochemical water quality and the associated recovery in macroinvertebrate faunal communities of the Mangawhero Stream, the lack of adequate wastewater dilution requires diversion of the discharge to an alternative receiving environment, a solution which is progressing with the current construction of a wastewater pipeline diversion to the Hawera Wastewater Treatment Plant.

The discharge from the Eltham Wastewater Treatment Plant had some effects on the microfloral streambed communities in the Mangawhero Stream downstream of the discharge in mid reaches where some protozoa were attached to the harder components of the substrate under conditions of low receiving water dilution rates. Growths of heterotrophic organisms were not found further downstream or in the Waingongoro River.

No significant effects of the discharge on biological communities were recorded in the Waingongoro River immediately downstream of the Mangawhero Stream confluence, under low, late summer-early autumn flow conditions. Few significant differences in individual taxon abundances occurred in this reach of the main river and although $SQMCI_s$ scores showed some downstream reduction, minor differences in MCI scores were not statistically significant (Stark, 1998) in a downstream direction through this reach.

Summary

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Mangawhero Stream and at three established sites in the Waingongoro River. Samples were sorted and identified to provide number of taxa (richness) and MCI and $SQMCI_S$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring. Significant differences in either the MCI or $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This late summer-early autumn macroinvertebrate survey following period of low recession flow indicated that the discharge of treated wastewater from the Eltham WWTP was having significant effects on the macroinvertebrate communities of the Mangawhero Stream. Changes in the macroinvertebrate communities were recorded between the upstream 'control' site, and sites downstream of the WWT Plant discharge as far as the confluence with the Waingongoro River, and were more significant at the two sites in the mid reaches to the boundary of the consented mixing zone (SH3), where physicochemical water quality was poorest due to poor dilution of the wastewater discharge and overloading of the assimilative capacity of the receiving waters. The presence of traces of heterotrophic growths at two downstream Mangawhero Stream sites was consistent with these macroinvertebrate community effects.

The macroinvertebrate communities of the Mangawhero Stream contained high proportions of 'tolerant' taxa at all sites and the communities downstream of the discharge were dominated almost entirely by 'tolerant' taxa. Taxonomic richness (number of taxa) was moderate to poor at the time of this late summer-early autumn survey under low flow conditions.

MCI and $SQMCI_S$ scores indicated that the Mangawhero Stream communities ranged from poor to very poor 'health' at all of the downstream sites, well below the typical condition recorded in similar Taranaki streams.

No significant differences in macroinvertebrate communities were found in the Waingongoro River below the Mangawhero Stream confluence although there was some downstream decline in SQMCI scores but minimal change in taxa richness and MCI value through the surveyed reach of the river, indicative of minimal impacts from the Mangawhero Stream which receives the Eltham WWTP discharge. The 'health' of the main river throughout the reach was 'good' and typical of conditions recorded in the mid reaches of similar Taranaki ringplain rivers.

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Appendix III

WWTP Upgrade Progress

CH2M Beca

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16 December 2008

To the People of South Taranaki District

Invitation to visit the Hawera and Eltham Wastewater Treatment Plants and proposed sludge disposal site on Monday, 22 December at 10:00 am

Background

The South Taranaki District Council is working hard to improve the way it handles the treatment and disposal of wastewater (sewage) in the Hawera - Eltham area.

Local wastewater is particularly hard to deal with because of the many large food processing plants in the area. Each plant produces more wastewater than a small town.

The agreed plan is to pipe all of Eltham's wastewater to the existing Hawera wastewater treatment plant and upgrade this plant to handle the additional wastewater treatment demand for the whole area.

This solution, however, is complicated by two concerns:

1. The existing treatment systems in both towns have to handle extremely large amounts of rainwater on rare occasions. This is because stormwater and groundwater can now get into (infiltrate) the system.

2. All South Taranaki District wastewater treatment plants and water treatment plants need to have a secure place to dispose of their sludge when their ponds are cleaned. For wastewater treatment ponds this is about once every 20 years and for water treatment ponds it is about every one or two years)

The Details: Eltham Pipeline

The new system to pump all of Eltham's wastewater to Hawera (from Pond 1 on left) is designed to handle not only all of Eltham's wastewater but nearly all of the storm water that can now get into the town's aging sewerage system.

It is not practicable, however, to build a

CH2M Beca

pipeline to Hawera that can handle absolutely all of the stormwater and groundwater that finds its way into the existing system. As a consequence, during the very rare (once or twice in 5 years) storm it is proposed to allow an "emergency" overflow from Pond 2 into the nearby Mangawhero Stream. Currently, all of Eltham's treated wastewater discharges into this stream.

In such extreme circumstances, both Ponds 1 and 2 will be acting as a containment and treatment facility, so what is discharged in the "emergency" will already have had some treatment. The Mangawhero Stream will also be flowing at very high levels so overflow from the Pond 2 will be quickly diluted.

It is not an ideal solution, but it will occur only very rarely, and only until the existing stormwater and ground water infiltration problems in the Eltham town sewerage system can be solved. Once that happens, the new pipe to Hawera should be able to handle all 'emergency' circumstances.

The Details: Hawera Treatment Plant

The situation at the Hawera Wastewater Treatment Plant is very similar to the Eltham situation. The Hawera plant is being upgraded to handle all of the wastewater from Eltham, Normanby and Hawera. It will also be able to handle nearly all of the stormwater and groundwater that infiltrates into the system from Hawera during major rain storms.

However, despite the recent addition of an emergency holding pond, it is estimated that once every 5 years the system will become so overloaded by unwanted stormwater (after a series of storms) that some wastewater may overflow directly into the nearby unnamed stream before it is fully treated.

In the long term, the solution must be to stop the infiltration of storm water and groundwater into any part of the system so the wastewater treatment plant does not get overloaded with extra water. However, like Eltham, at this point in time it is simply impractical to design a system that is capable of handling both all of the wastewater and all of the stormwater, all of the time.

"Emergency Overflow" Consent Required

The wastewater treatment improvements proposed for Eltham and Hawera will substantially improve the existing system. Nearly all wastewater discharges will be removed from the Mangawhero Stream. In Hawera, the quality of the treated discharges out the existing outfall will be greatly improved. However, while the proposed improvements will radically reduce the number of unwanted discharges during storms they will not eliminate them entirely; at least not in the short term.

When stormwater and groundwater infiltration into the existing sewerage system in both towns is improved the new systems should be able to handle all high flows.

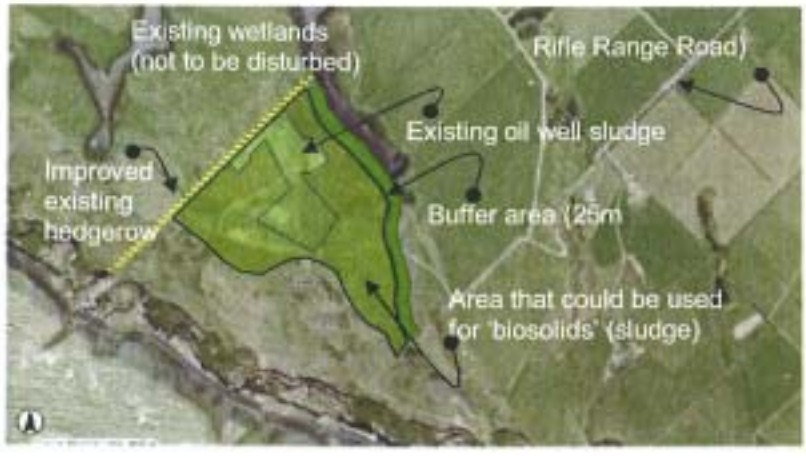
However, until these difficult and costly improvements can be put in place, consent is being sought from the Taranaki Regional Council to allow very rare (once or twice in 5 years) "emergency" discharges into nearby streams.

Sludge Handling from Wastewater and Water Treatment Plants in South Taranaki

A related problem that affects all wastewater and water treatment plants in South Taranaki District, is the disposal of sludge from existing wastewater and water treatment ponds. The bottom of these ponds need to be cleaned occasionally, and the dried sludge put somewhere.

A number of possible sites were looked at and ultimately one came out well ahead of the others. The site considered most suitable:

- Is at the end of Rifle Range Road near Hawera and remote from everyone
- Could benefit from the soil enrichment that dewatered sludge could provide as it is currently poor quality (very sandy)
- Is central to all wastewater and water treatment plants in South Taranaki
- Is already being used for the disposal of oil well drilling sludge
- Is owned by Fonterra who is a willing lessee (provided suitable conditions for site management and restoration are agreed).



Use of the site for sludge would require resource consent. As the site would ultimately need to be replanted and landscaped so it could become productive, such conditions would need to be included in any conditions of consent that might be granted.

What this means to you

As agreed at the initial consultation meeting in Hawera on 3 December, on Monday 22 December, staff from the South Taranaki District Council and its consultants, CH2M Beca will be visiting all three sites to consult with Iwi and the Taranaki Regional Council about what is being proposed.

You are invited. Please meet at the Eltham Wastewater Treatment Plant on Castle Street at 10:00am. This will be followed by site visits to the Hawera Treatment Plant and the proposed sludge disposal site on Rifle Range Road. If you will need transportation for the site visits please let us know. We will then have lunch at a place to be announced on the day to discuss the projects.

Additionally, for your information, Assessments of Environmental Effects have been prepared or are being prepared for all three applications for consent required under the Resource Management Act.

1. Consent for (rare) Emergency discharge to Mangawhero Stream for the Eltham Wastewater Treatment Plant during extreme wet weather
2. Consent for (rare) Emergency discharge to unnamed stream for the Hawera Wastewater Treatment Plant during extreme wet weather
3. Consent to dispose of sludge at the proposed site on Rifle Range Road

If you would like further details or would like to make comments (either verbally or in writing) on any or all of these applications, please contact either Vikky Kuyl at the South Taranaki District Council (phone: 0800 111 323), Bridget O'Dempsey at CH2M Beca (phone: 06 759 5752, email bridget.odempsey@beca.com) or Ted Wells at Beca (phone 06 759 5755 or email ted.wells@beca.com)

Yours faithfully,

Bridget O'Dempsey
Senior Environmental Engineer
on behalf of
CH2M Beca Ltd

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Email: bridget.odempsey@beca.com

Appendix IV

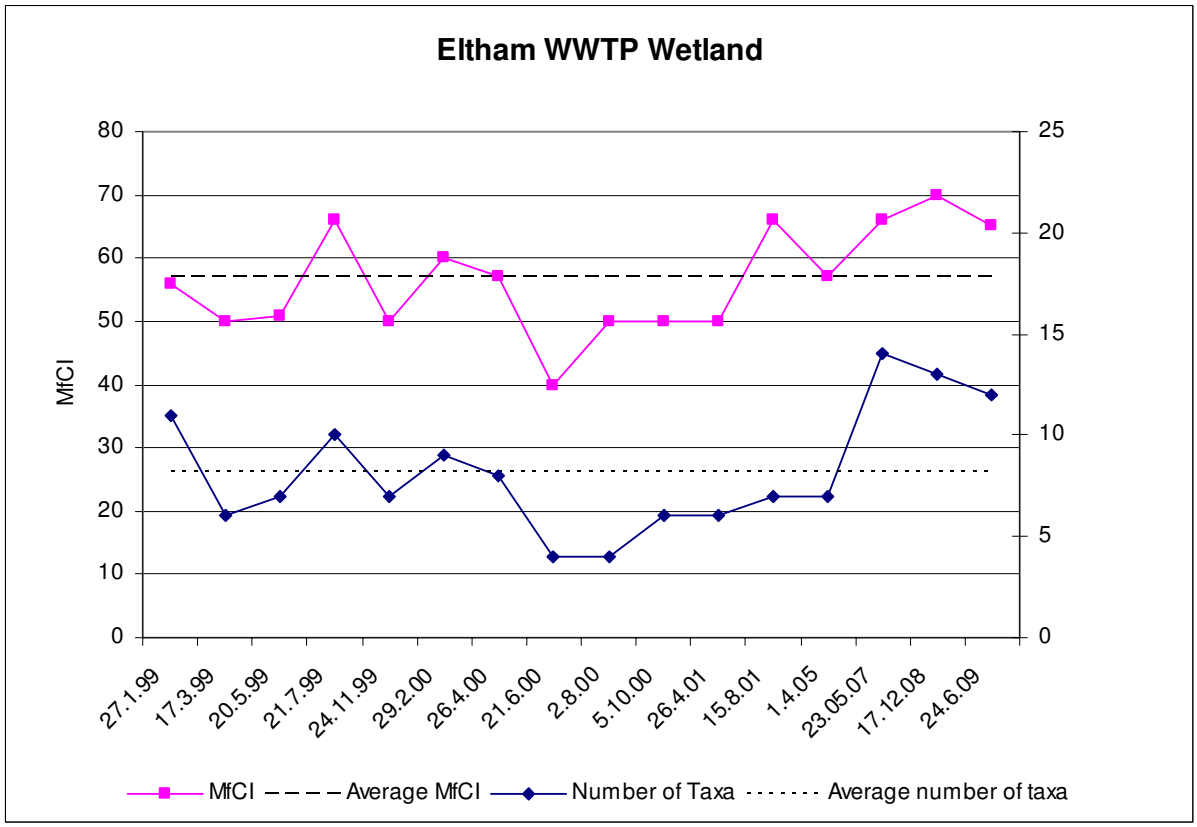
Microflora of the Eltham WWTP wetland

(1999 to date)

Table 1 Planktonic Microflora found in the Eltham Wastewater Treatment Plant Wetland since January 1999

Algal Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	27.1.99	17.3.99	20.5.99	21.7.99	24.11.99	29.2.00	26.4.00	21.6.00	2.8.00	5.10.00	26.4.01	15.8.01	1.4.05	23.05.07	17.12.08	24.6.09
GREEN ALGAE																
Nannoplankton													A	P		P
Ankistrodesmus	P	P	P	P	**VA**	P	P			P	**A**	P	P		P	P
Closterium														P	A	P
Chlorella	P			P								**A**		P	P	
Oocystis														**P**		
Chodatella																
Chlamydomonas				P			P		P							
Diacanthos																
Selenastrum				P												
Polyedriopsis															P	
Colonial - unidentified																
Botryococcus																
Coelastrum	P			P		P							P	P		
Dictyosphearium															P	
Pediastrum																P
Micractinium					A	P				P	P					
Golenkinia	**VA**	P	P	P										P		
Scenedesmus	P	P	P	P		P	P	P		P	P	P	P	P	A	P
Eudorina												P				
Pandorina																
Actinastrum	P				P	P									**VA**	P
(Unbranched Filaments)																
Unidentified														P	P	
Hyalotheca																
CYANOBACTERIA														P		
Oscillatoria		P	P													
Microcystis (Anacystis)																
DIATOMS																
Cyclotella	P			P		P								P	P	P
Unknown (small rods)																
Nitzschia							P							P		P
Navicula																
GOLDEN BROWN ALGAE																
Synura																
EUGLENOIDS																
Euglena	P	**A**	**A**	P	A	P	P	**A**	P	**P**	P	P	***	P	P	P
Phacus																
CRYPTOPHYTES																
Cryptomonas																
NON-ALGAL GROUPS																
Non-pigmented bacteria	VA	P	VA	**VA**	VA	**VA**	**VA**	A	**VA**	P	P	A	**VA**	**P**	P	**VA**
Fungi																
Protozoa	P		P		P		P		P	P	P	P	P	P	P	P
Rotifers	P				P	P	P	P					P		P	P
NUMBER OF TAXA	11	6	7	10	7	9	8	4	4	6	6	7	7	14	13	12
MfCI	56	50	51	66	50	60	57	40	50	50	50	66	57	66	70	65

Key : P = Present, A = Abundant, VA = Very Abundant, U= Uncertain


Eltham WWTP Wetland
MfCI
80
70
60
50
40
30
20
10
0
25
20
15
10
5
0
27.1.99
17.3.99
20.5.99
21.7.99
24.11.99
29.2.00
26.4.00
21.6.00
2.8.00
5.10.00
26.4.01
15.8.01
1.4.05
23.05.07
17.12.08
24.6.09
MfCI
Average MfCI
Number of Taxa
Average number of taxa