Rotorua District Council
Spray Irrigation Compliance Report

Prepared by Stephen Park and John Holst

Environment Bay of Plenty
Environmental Publication 2009/13
November 2009

5 Quay Street
P O Box 364
Whakatane
NEW ZEALAND

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Environment Bay of Plenty
REGIONAL COUNCIL

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Cover Photo:
Storage Ponds in Waipa Forest

Acknowledgements

Alison Lowe of Rotorua District Council for providing additional information on the operation of wastewater treatment plant and spray irrigation scheme.

Cover Photo: Storage Ponds in Waipa Forest.

Executive Summary

This report presents an assessment of Rotorua District Council's compliance with conditions of Consent 60739 for spray irrigation of treated sewage effluent in Whakarewarewa Forest. It covers the period from May 2006 up to August 2009.

The main aim of the consent is to reduce nutrient loading to Lake Rotorua. Consent conditions restrict additional nutrient loading into Waipa Stream and hence Lake Rotorua to 3 tonnes of total phosphorus and 30 tonnes of total nitrogen per year. The previous compliance report (July 2003 to May 2006) had shown non-compliance with nitrogen (N) levels in the Waipa Stream for all but the first few months of that period although it was an improvement from the peak levels seen in 2001. Over the latest compliance assessment period up to August 2009, nitrogen loads have exceeded the limit with the exception of May and June 2007. Over this period the average load of nitrogen in Waipa Stream in excess of the consent limit was 3.8 tonne (as a 12 month rolling sum value). From mid 2006 to 2007 nitrogen loads in Waipa Stream had been decreasing before the trend was reversed. In the same period phosphorus loads have increased but remain well within the compliance limit of 3 tonnes per annum.

Non-compliance with total nitrogen levels in the Waipa Stream reflects a combination of the loads being applied to the spray irrigation area and stream flow. A decrease in the nitrogen load from the treatment plant had been achieved right through 2006 resulting in compliance being achieved by May 2007. The increase in nitrogen load from the treatment plant since the beginning of 2007 in addition to higher rainfall and stream flow has caused the non-compliance of nitrogen load in Waipa Stream. Current nitrogen loading to the spray irrigation area is around 20% higher than was achieved through the treatment plant in 2006 and 12% higher than 2002. If the treatment plant performance for nitrogen achieved in these periods could be maintained then it is expected that compliance with the consent limit would also be achieved. Rotorua District Council continues to optimise and improve treatment processes and investigate to determine relationships between recent plant upgrades or changes in the irrigation schedule and loads in Waipa Stream.

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Part 1: Introduction

1.1 Background

The Rotorua District Council holds consent number 60739 authorising the discharge of treated city effluent to the Whakarewarewa Forest. This consent was granted by the Bay of Plenty Regional Council on 26 October 2001. Spray irrigation of treated effluent to Whakarewarewa Forest commenced in 1991 under the conditions of the previous consent.

The objectives of this consent and the treatment and disposal systems are to reduce the nutrient load on Lake Rotorua. Water quality in the lake had been declining since the 1960s because of excessive phytoplankton growths caused by increased inputs of phosphorus and nitrogen. Major contributions of the nutrient increases were from the Rotorua city sewage treatment plant. Nitrogen from the plant accounted for 21% of the total input in 1988 and 6.9% in 1999 (Burns 1999). As nitrogen loads have increased or been more accurately assessed within the catchment, the contribution is now estimated to be 4.4%.

The conditions of consent 60793 restricting the mass loading of nutrients, aims to contribute towards restoring lake condition to that which prevailed prior to the 1960s, before widespread public concern about phytoplankton growths developed. It is a scientific view that this lake condition is achievable and will reduce the frequency and magnitude of nuisance algal blooms, maintain reasonable water appearance and clarity for recreational purposes, minimise periods of de-oxygenation, and reduce the internal nutrient inputs (Rutherford *et al*. 1989). Due to internal nutrient storage in the lake sediments and lags in peak loads from groundwater etc, water quality improvements would only be expected to occur over a long period of time.

Previous compliance monitoring of this consent has been reported in May 1994, April 1996, February 1999, April 2001, August 2003 and October 2006. This report updates compliance assessment for the period from May 2006 to August 2009.

1.2 Summary of treatment and disposal details

Consent number 60739 authorises the discharge of a peak daily flow of 44,000 m^3 of treated sewage to the Whakarewarewa Forest, by spray irrigation. Effluent may only be applied for a maximum continuous period of 24 hours and may not exceed 5mm/hour.

Sewage from the City of Rotorua is reticulated to the Rotorua Waste Water Treatment Plant. The treatment plant consists of the following processes:

- initial screening and grit removal;
- primary sedimentation;
- activated sludge process and nutrient removal;
- final clarification;

- effluent holding ponds;
- Methanol dosing;
- sludge and scum processing facilities.

After initial screening and grit removal effluent is distributed into the primary sedimentation tanks.

Primary sedimentation is a fairly conventional process utilised in many municipal waste water treatment plants, to remove settleable solids. Flow from sedimentation then passes to the activated sludge process. The activated sludge process is traditionally used to reduce organic contamination by stimulating bacterial degradation. However, in the Rotorua District Council Waste Water Treatment Plant the activated sludge process has been specifically designed to also achieve nutrient removal from the effluent flow. The specific design used in this situation is termed the Bardenpho process, where alternating anaerobic and aerobic conditions are used to enhance bacterial action to remove nitrogen and phosphorus.

As with conventional activated sludge processes, the effluent flow from the Bardenpho process is passed through a clarifier, where biological solids are removed.

Some solids removed in primary sedimentation and final clarification are returned at various stages to the effluent flow to enhance treatment processes. Solids are removed and disposed of to remove organic and nutrient load. The sludge contains on average 12g/kg phosphorus and 15g/kg nitrogen.

The original design population of the wastewater treatment plant (Stage IV) was 45,000. In May 2005 “Stage V” was implemented upgrading the treatment plant to a design population of 70,000. The upgrade included:

- new return activated sludge (RAS) pumps with increased capacity to help in denitrification
- methanol dosing to increase amount of nitrogen removed
- extension of Bardenpho secondary treatment and upgrade of aeration system - replacement of ceramic diffusers

Final effluent from the treatment process is pumped to holding ponds in the Whakarewarewa Forest prior to discharge by spray irrigation to forestland. The irrigation area is divided into 16 spray blocks of which 14 are operated on a daily rotational basis, leaving two blocks to cater for forestry harvesting and planting operations. The possible irrigable area for 14 blocks is 265 ha but Rotorua District Council are currently irrigating 80% of each block, giving a nett irrigation area of 220 ha. The total spray block area including the two unused spray blocks, wetlands, buffer zones and roads is 433 ha. The current irrigation application rates and rotation are an improvement over those previously used.

The irrigation of effluent to land utilises two main processes of nutrient removal:

- Phosphorus is removed as the treated effluent passes through the soil profile. Phosphorus is adsorbed onto allophane clay present in the volcanic soils. Phosphorus removed in this way is strongly held and not readily available for leaching.

- Nitrogen is removed by denitrification in the riparian zones and wetlands, and by relatively minor uptake by site vegetation.

The irrigation system relies on the passage of effluent through both the soils and wetlands.

The spray disposal of effluent commenced in 1991. The disposal area is in the Whakarewarewa Forest. This is a commercial forest production area. A plan of the disposal area is presented as Figure 1. The scheme is located in the catchments of the Waipa and Kauaka Streams.

Part 2: Methodology

Staff have assessed compliance with the consent conditions in the following ways:

- Site inspections have been carried out to assess compliance with conditions relating to operational matters including response to public complaints;
- Returns of data and results of self-monitoring have been reviewed and compared to consent conditions to determine compliance.
- Comparison of Waipa Stream nutrient increases with pre-spray irrigation 1989/90 baseline data.

The location of spray irrigation blocks in Whakarewarewa Forest (approximate), Waipa Stream and Lake Rotorua is shown in Figure 1.

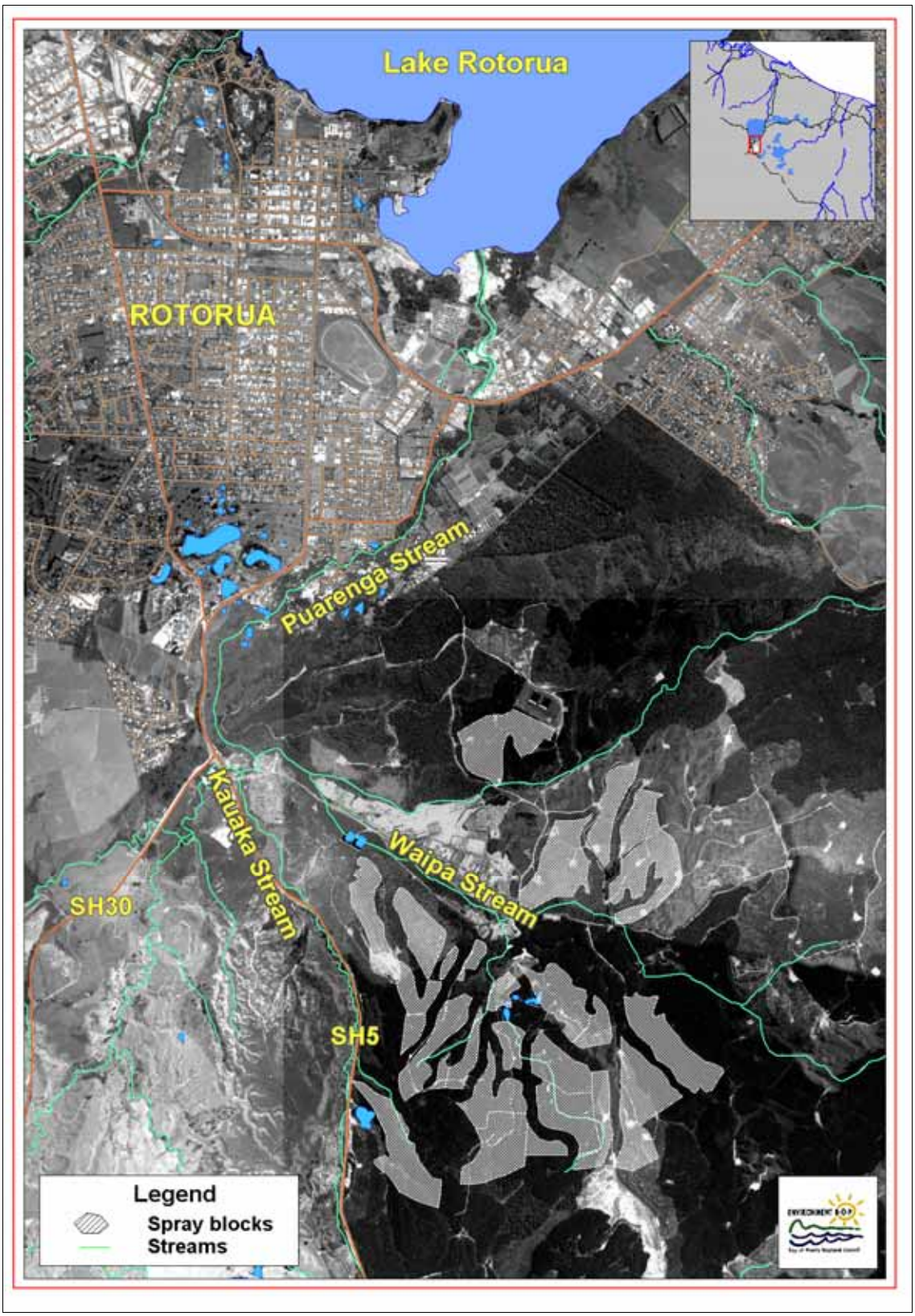

Figure 1 *Approximate location of Rotorua District Council's spray irrigation blocks in Whakarewarewa Forest for the application of treated effluent.*

Part 3: Compliance

3.1 Discharge permit number 60739

Resource consent number 60739 is a discharge permit authorising the discharge of treated sewage effluent from the Rotorua waste water treatment plant on to land within Whakarewarewa Forest. A copy of the consent is attached as Appendix 1.

3.2 Monitoring

Conditions requiring monitoring as part of ongoing compliance checks are:

- Condition 3 – Quantity and rate of discharge
- Condition 6 – Operation in accordance with Land Treatment Management Plan
- Condition 7 – Buffer zones
- Condition 8 – Monitoring stations
- Condition 9 – Effluent quality monitoring
- Condition 10 – Waipa Stream quality monitoring
- Condition 11 – Nutrient limits for surface water quality
- Condition 12 – Excess flows
- Condition 14 – Provision of reports
- Condition 15 – Warning signs

Compliance with each of the above conditions of consent 60739 is addressed in the following section of this report.

3.2.1 Condition 11 – nutrient limits for surface water quality

This condition requires the consent holder to operate the treatment scheme to ensure that sewage-derived nutrient that ends up in the Waipa Stream and hence Lake Rotorua is limited to 3 tonnes of total phosphorus and 30 tonnes of total nitrogen per annum for any 12 month period. Figure 2 below shows the increase in stream loading that is likely to have occurred as a result of the spray irrigation of treated effluent.

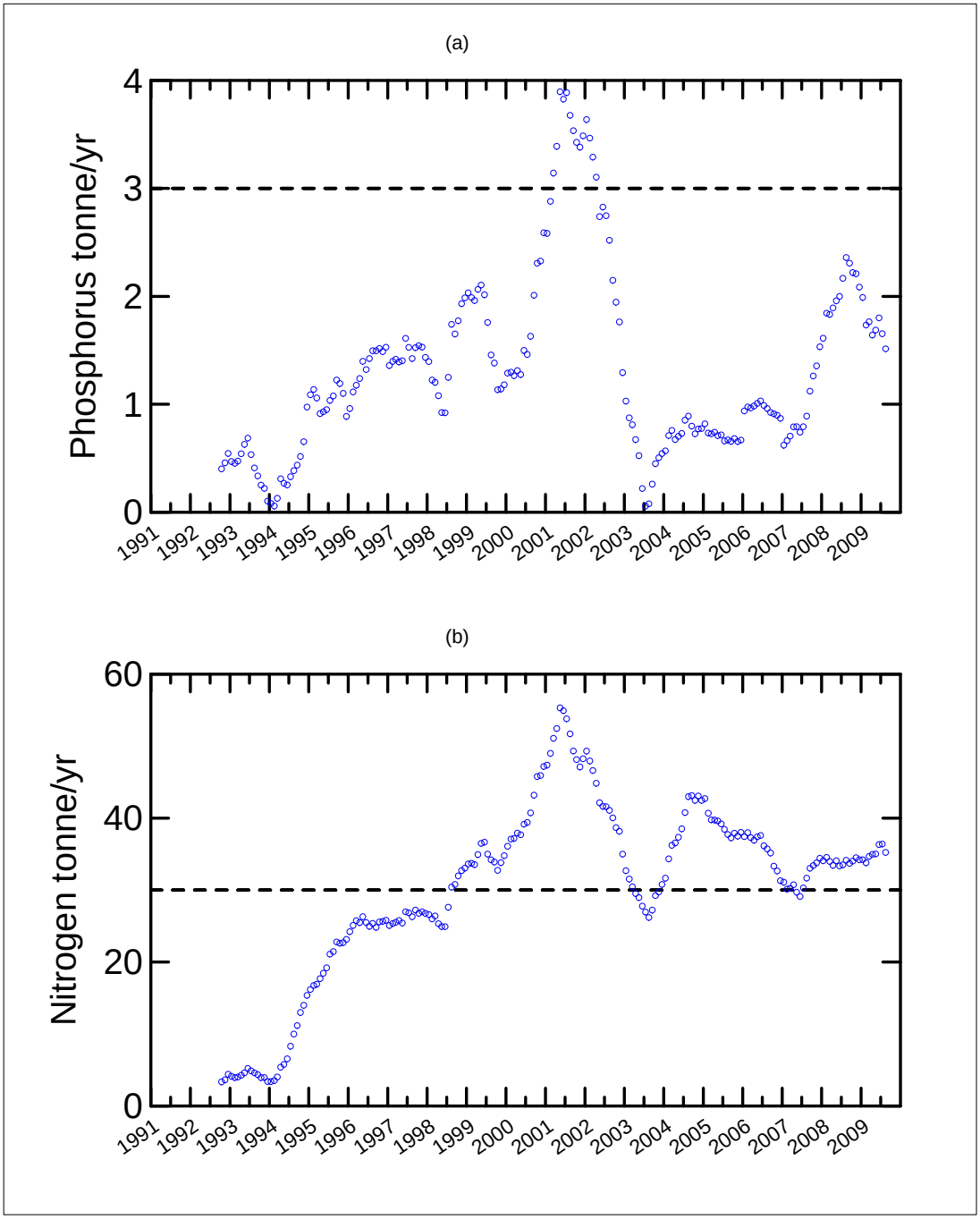

Figure 2 *Additional increase in mass load (12 month rolling sum) of total phosphorus and total nitrogen in Waipa Stream with the 1989/90 base load removed.*

Mass TP loadings to Waipa Stream have increased since spraying began and peaked in early to mid 2001 before rapidly dropping to low levels around June 2003. Since then loads have once again increased and peaked at just over 2 tonne by June 2008 before declining to around 1.5 tonne by August 2009. During the reporting period (June 2006–August 2009) total phosphorus loads have increased but compliance with the 3 tonnes per annum limit for phosphorus has been achieved.

A similar trend has been observed for additional mass loading of nitrogen which increased dramatically from 1993 and peaked in 2001 at 55 tonnes. This loading was well above the limit of 30 tonnes per annum for any 12 month period. Since then total nitrogen loads have shown an overall downward but fluctuating trend with two brief periods of compliance in Apr 03 – Nov 03 and May/Jun 07. For the current period being assessed for compliance (June 2006 – August 2009) the limit for total nitrogen loading has only been met for two months in May/Jun 2007.

The baseline nutrient load for Waipa Stream upon which this assessment is made was recorded by Environment Bay of Plenty in 1989/90 as 1,427 kg-TP and 5,188 kg-TN. A separate study by RDC (March 1991-March 1992) determined the annual load as 1,976 and 8,216 kg-TP and TN respectively, but overlaps with the commencement of spray irrigation. The Waipa Stream “upstream” data is not used as per the advisory note in the consent to calculate the additional nutrient load as the flow is markedly different and not recorded.

3.2.2 Condition 3 – quantity and rate

Condition 3.1 states that:

“The peak daily quantity of treated effluent discharged shall not exceed 44,000 cubic metres”.

Figure 3 shows the daily flow from 1995 onwards. Daily flows have been well within the limits set by condition 3.1.

Condition 3.2 limits the rate of application in any sub area of the forest spray irrigation zone. Application rates of effluent onto the spray irrigation blocks are controlled to achieve compliance with condition 3.2.

3.2.3 Condition 6 – effluent disposal system

Condition 6.1 requires a management plan for operation and maintenance of the spray irrigation system. A Plan was submitted and met with our approval..

Condition 6.2 specifies that effluent shall not be applied to any area where ponded surface water is present and when water is flowing off the surface of that area, such that it could directly enter any drain or natural watercourse by overland flow.

Condition 6.3 specifies that operation of the disposal system will not cause erosion.

3.2.4 Condition 7 – buffer zones

This condition requires the maintenance of buffer zones around the spray irrigation zones. Environment Bay of Plenty staff have approved a management plan for these buffer zones. These buffer zones have been inspected and have been maintained according to the required standards. Rotorua District Council currently have 30m buffer zones whereas the consent only requires 15m. They are considering making use of the additional 15m to increase their available irrigation area as pipelines are reinstated following harvesting.

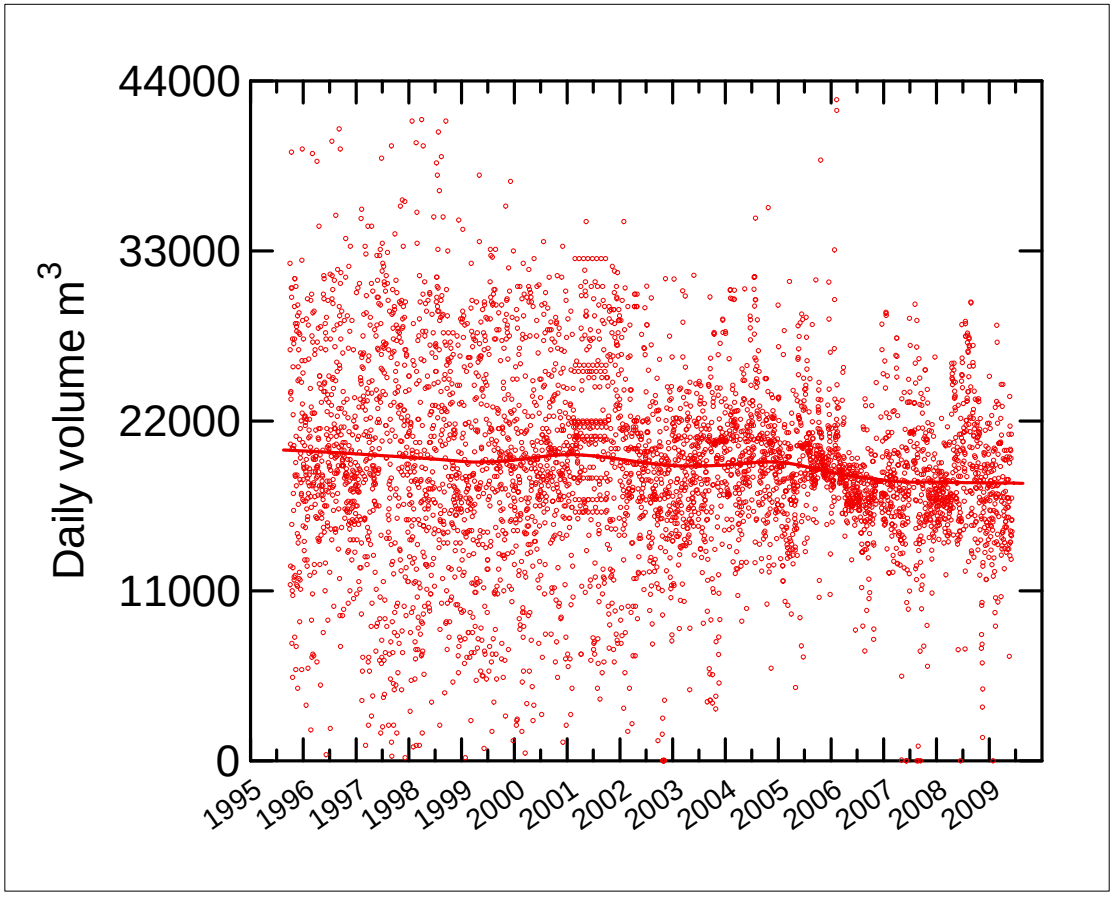

Figure 3 *Daily flow rate of Rotorua District Council's treated effluent (consent limit is 44,000m^3/day).*

3.2.5 Condition 8 – monitoring stations

Condition 8 requires the maintenance of set sampling points to access both the treated effluent prior to discharge and up/downstream sites on the Waipa Stream. These have been maintained.

3.2.6 Condition 9 – effluent monitoring

This condition sets out the constituents of the treated effluent that are to be analysed, how they should sampled and how the results should be calculated. Compliance with this requirement has been good. Results of this monitoring data help provide an overall understanding of what is happening with this treatment/irrigation scheme and are provided in Appendix 2.

3.2.7 Condition 10 – Waipa Stream monitoring

This condition stipulates the sampling points, frequency and constituents to be monitored in Waipa Stream. Compliance with this condition has been good overall. The monitoring results from Waipa Stream for a number of the constituents measured are presented in Appendix 3.

3.2.8 Condition 12 – excess flows

Condition 12 requires notification of any excess flow or spillage and details of its nature and cause. As a result of the February 2006 incident, Environment Bay of Plenty staff have addressed this requirement with the consent holder, resulting in improved lines of communication which will be included in the updated Management Plan.

3.2.9 Condition 13 – monitoring structures

Condition 13 relates to monitoring and maintenance of structures within streams that are used to supply monitoring information. These structures have been maintained in compliance with the consent conditions.

3.2.10 Condition 14 – reports

Condition 14 sets out the time frame requirements for reporting of results. Most of the self-monitoring results are required to be sent to Environment Bay of Plenty within 21 days of the end of each calendar month. Compliance with this minor condition is now very good. Rotorua District Council staff are co-operative and promptly respond to any additional requests regarding the compliance data.

3.2.11 Condition 15 – warning signs

Warning signs are to be maintained around the perimeter of the spray irrigation areas to warn public of the health risks involved. Inspections have shown that warning signs have been maintained around the spray irrigation blocks as required in the consent conditions.

Part 4: Discussion and Conclusions

4.1 Compliance results discussed in this report are based upon the period from April 2006 up until August 2009. Consent (60739) conditions restrict any additional nutrient loading to the Waipa Stream to 30 tonnes nitrogen and 3 tonnes phosphorus. This matches the maximum levels of sewage derived nutrient loading to Lake Rotorua that Rutherford *et. al*. (1989) calculated would pose a low risk to the objective of improving lake water quality back to an acceptable level. During the period being assessed total nitrogen loads to the Waipa Stream have consistently exceeded consent limits for nitrogen and for the later period (during 2009) it has been around 5 tonnes above the limit. Although this is an overall improvement since the peak in 2001 but it is well above the consent limit and places lake restoration objectives at risk.

4.2 Since nitrogen loading to Waipa Stream reached a peak in 2001 there has been a general decline with large fluctuations. Part of the decline and reduction of fluctuations has been due to improved management in the spray application in terms of maintenance, application rates and timing, and targeting of blocks where there is better denitrification in the receiving wetlands. The other major factor in the general decrease in nitrogen load has been improved treatment of the sewage in line with treatment plant modifications. For example upgrades at the treatment plant in May 2005 (expansion and implementation of methanol dosing) achieved a high level of nitrogen renovation with an average nitrogen concentration of 5 g/m^3 in effluent from the plant in 2006.

4.3 However there have been fluctuations in the nitrogen concentrations from the treatment plant and the low levels achieved in 2006 don't appear to be sustainable in the long term. Over the period June 08 – May 09 the average was 10 g/m^3 and currently it is back down to 8 g/m^3. The latest drop is due to recent changes and may represent a new sustainable equilibrium. Factors that have contributed to fluctuations in nitrogen from the treatment plant include;

- Changes (i.e. extension, c-dosing, change to ethanol dosing, sudden doubling of ethanol dosing following a period of no-C) to what is a biological system produce a large initial effect (i.e. high nitrogen removal) which cannot be sustained as microbial communities adjust to a stable equilibrium.
- Flow-balancing to remove peak volumes is now automated and creates a slightly more stable system in the Bardenpho process.
- Leachate from dewatering is now returned to the DAFs rather than the Bardenpho which has reduced the fluctuations in the nutrient load within the Bardenpho and improved stability.
- High rainfall reduces performance so flow-balancing has been undertaken to take the peak volume to a side-tank and reintroduce when flows are low.

4.4 Future improvements that may cause fluctuations but also reduce the nitrogen concentration in the effluent include trialling landfill leachate treatment to remove the high nitrogen load at source before it reaches the treatment plant. Also the first stage planning for a MBR sidestream (filtering system) that will work in parallel with the Bardenpho to take up to 1/3 of the flow has been initiated. This will also result in a more constant flow through the Bardenpho and less flow through the 2 clarifiers (better performance). It is 18-24 months away before being implemented with a budget cost in excess of $8 million in assets and additional operating.

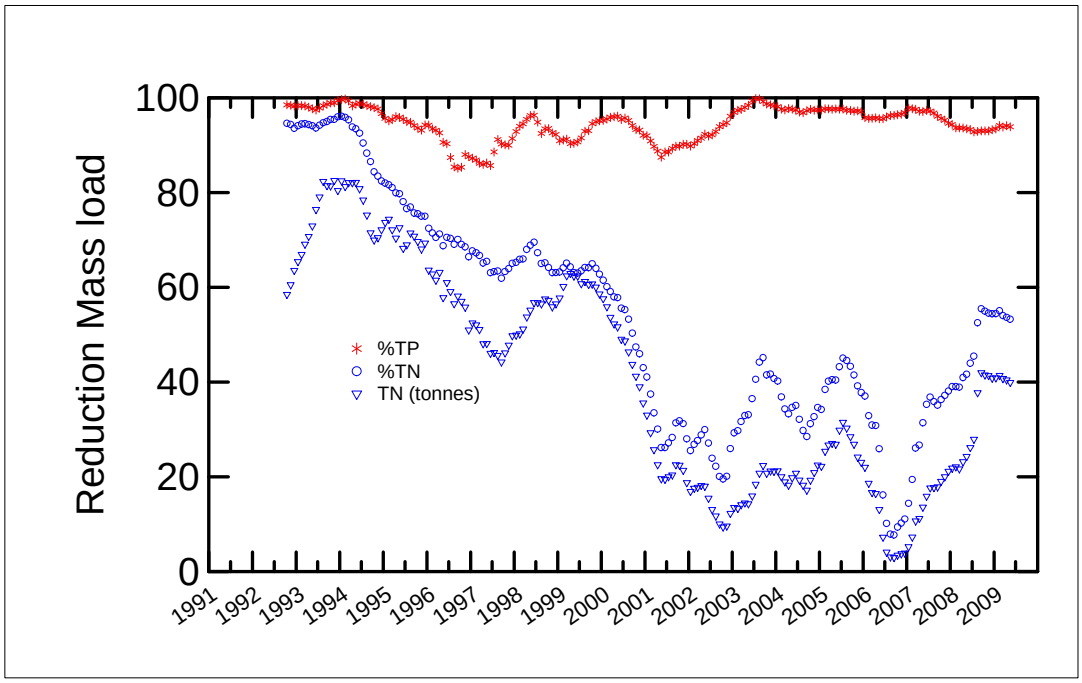

Figure 4 *Reduction in mass load of nutrient applied to the spray irrigation area in Whakarewarewa Forest as measured in Waipa Stream using comparison of 12 month rolling sums.*

4.5 Nutrient removal by spray irrigation over the period Jun 06 – May 09 has averaged 35% for TN and 95% for TP (shown in Figure 4) compared to an estimated design performance of 78% and 74%. These figures are based on an average effluent loading of 59 tonnes TN and 28 tonnes TP per year for the same period (Figure 16). Research by Scion (Rotorua District Council 1999) has suggested that nitrogen removal capacity of soils in the irrigation blocks is 77 kg/ha/yr. This would result in around 17 tonnes of nitrogen being removed by the land treatment system each year (based on 220 ha) which is close to that shown over recent years. The same research has also suggested that nitrogen is being stored in the soil and hence accumulating with time. Soil storage of nitrogen is recognised as not being sustainable in the long term.

4.6 Water quality for Lake Rotorua is assessed on an annual basis by comparison of trophic level index (TLI) with a target TLI set in the Proposed Regional Water and Land Plan. The TLI is composed of four components: water clarity; chlorophyll-a concentration; total nitrogen (TN); and total phosphorus (TP). Over the years 1990 to 2009 TN has increased (4.23 mg m^3/yr), TP has decreased (-0.76 mg m^3/yr), chlorophyll-a increased (0.86 mg m^3/yr) and clarity declined (-0.01 m/yr). The summary TLI has shown little overall change over the period 1991-2009.

4.7 Compliance with consent 60739 for the spray irrigation of treated effluent in Whakarewarewa Forest over the period June 2006 to August 2009 can be summarised as follows;

- Mass loading of total nitrogen in Waipa Stream has exceeded the consent limit of 30 tonnes/year for most of the period June 2006 to August 2009 having been in compliance only in May and June 2007.

- Mass loading of total phosphorus in Waipa Stream has increased over the last two years but remains well below the compliance limit of 3 tonnes/year.

- Compliance with the quantity and rate of effluent application has been good.
- Buffer zones have been maintained and meet the required standards.
- Reporting of monitoring results complies with consent conditions and Rotorua District Council staff provides information whenever requested.
- Monitoring of Waipa Stream has been conducted as required.
- Warning signs to inform the public of the spray irrigation sites have been maintained.
- Since the peak nitrogen loading from the spray irrigation scheme to Waipa Stream in 2001, there has been a general long term decline in line with modifications to the treatment plant. Periods of very low nutrient loading from the treatment plant are initially produced following changes (i.e. extensions, methanol dosing) which cannot be sustained in the long term and cause large fluctuations.
- There is a lag between nutrient loads from the treatment plant and the load observed in Waipa Stream. Over the last year nitrogen concentrations averaged 10 g/m^3 which would likely result in further non-compliance with the nitrogen loading in the short term. However current nitrogen load from the treatment plant (8 g/m^3) is thought to be sustainable and will produce a lower load from the spray irrigation scheme and may achieve compliance.
- Further improvements to reduce nitrogen are currently being trialled and planned.

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Appendices

Appendix 1 – Consent conditions

Bay of Plenty Regional Council

Resource Consent

Pursuant to section 105 of the Resource Management Act 1991, the **Bay of Plenty Regional Council**, by a decision dated 13 September 2001, **hereby grants** to:

ROTORUA DISTRICT COUNCIL

Private Bag RO 3029
ROTORUA

A resource consent:

(a) pursuant to section 15(1)(b) of the Resource Management Act 1991 to **discharge treated effluent from the Rotorua District Council wastewater treatment plant on to land in the Whakarewarewa State Forest**;

(b) pursuant to section 13(1)(a) of the Resource Management Act 1991 to **place, use and maintain a series of structures in or on the bed of the Waipa Stream and associated tributaries**; **and**

(c) pursuant to section 15(1)(c) of the Resource Management Act 1991 to **discharge treated effluent from the Rotorua District Council wastewater treatment plant into air in the Whakarewarewa State Forest**;

subject to the following conditions:

1 Purpose

1.1 For the purpose of discharging secondary treated effluent via irrigation sprinklers to land within the Whakarewarewa State Forest, and

1.2 For the purpose of placement, use and maintaining of a series of v-notch weirs, a concrete structure and a concrete flume in or on the bed of the Waipa Stream and associated tributaries for water monitoring, and

1.3 For the purpose of discharging odours and aerosols from secondary treated effluent via irrigation sprinklers to air within the Whakarewarewa State Forest

2 Location

2.1 Whakarewarewa State Forest within the areas delineated in the easement between the Crown and Rotorua District Council as registered February 2000 being those parts of the servient tenement marked ‘AW’, ‘AY’, ‘Q’, “AX’, and ‘BA’ on DPS 54801 and ‘A’ on DPS 84008, as shown on BOPRC Plan Number RC60739/1 submitted with the application for the consent.

2.2 The monitoring structures are located within the bed of the Waipa Stream and associated tributaries as shown on BOPRC Plan Number RC60739/1.

3 Quantity and Rate

3.1 The peak daily quantity of treated effluent discharged shall not exceed 44,000 cubic metres.

3.2 Effluent may be applied to each irrigation sub area as delineated on plan BOPRC Plan Number RC60739/1 for a maximum continuous period of 24 hours and the rate of application shall not exceed 5mm/hour with a maximum of 120mm/day on any specific sub area.

4 Map Reference

4.1 At or about an area bounded by map references NZMS 260 U16 9470-3200, U16 9900-3200, U16 9900-2800, and U16 9470-2800.

5 Legal Description

5.1 Rotomahana Parekarangi Part 4A, Part 651, Part 652B, Block V, Tarawera SD (Rotorua District).

6 Effluent Disposal

6.1 The wastewater treatment and disposal system shall be operated and maintained at all times generally in accordance with the Land Treatment Management Plan dated March 2000, and any subsequent amendments acceptable to the Bay of Plenty Regional Council as confirmed in writing by the Chief Executive of the Regional Council or delegate.

6.2 Effluent shall not be applied to any area where ponded surface water is present and when water is flowing off the surface of that area, such that it could directly enter any drain or natural watercourse by overland flow.

6.3 The consent holder shall operate the effluent disposal system in a manner that does not cause erosion where practicable.

7 Buffer Zones

7.1 The consent holder shall not spray in the designated buffer zones as shown on drawing BOPRC Plan No RC60739/1 submitted with the application.

7.2 The consent holder shall maintain a buffer zone of undisturbed natural vegetation not less than 15 metres wide, separating the irrigated areas from wetlands.

7.3 The consent holder shall ensure there is no objectionable odour or aerosols beyond the boundary of the spray irrigation area as defined in condition 2.1 of this consent.

8 Monitoring Stations

8.1 The consent holder shall maintain an easily accessible sampling point immediately prior to discharge where a representative sample of the effluent can be obtained.

8.2 The consent holder shall maintain two water sampling stations on the Waipa Stream at Rotorua District Council monitoring sites 5 and 10 as shown in BOPRC Plan Number RC 60739/1 submitted with the application, for the purpose of assessing the environmental effects of the discharge from the land treatment area on the stream.

8.3 Analyses shall be carried out as set out in the latest edition of "Standard Methods for the Examination of Water and Wastewater" — APHA — AWWA — WPCF or such other similar method as may be acceptable to the Bay of Plenty Regional Council as confirmed in writing by the Chief Executive of the Regional Council or delegate.

9 Monitoring of Constituent Loads to the Land Treatment System

9.1 The consent holder shall measure and record the volume of effluent discharged each day and the corresponding sub areas irrigated.

9.2 The consent holder shall collect a weekly 7 day composite of the effluent discharged to the Land Treatment System and analyse for the following constituents:

- Chloride;
- Total Kjeldahl Nitrogen;
- Ammoniacal-Nitrogen;
- Total Oxidised Nitrogen;
- Total Phosphorus and
- Dissolved Reactive Phosphorus.

9.3 From these results the nutrient loads applied to the Land Treatment System shall be calculated on a calendar monthly basis.

9.4 The consent holder shall collect a representative sample of effluent on at least 4 days per month, representing different days of the week and analyse for *Escherichia coli* bacteria per 100 millilitres.

9.5 Effluent analyses as required under condition 9.2 for the determination of loads to the land treatment system as required under condition 10 for the determination of nutrient inputs to the Waipa Stream shall be carried out as set out in the latest edition of "Standard Methods for the Examination of Water and Wastewater' - APHA - AWWA - WPCF or such other similar method as may be acceptable to the Bay of Plenty Regional Council as confirmed in writing by the Chief Executive of the Regional Council or delegate.

10 Monitoring of Nutrient and Bacterial Concentrations in the Waipa Stream

10.1 The consent holder shall collect water quality samples from the Waipa Stream at the two points identified in condition 8.2 and at a frequency as specified in conditions 10.2 and 10.3.

10.2 At the downstream site (Site 5) the consent holder shall operate a continuous flow proportional water sampler, with appropriate sample preservation, and collect the samples no less than weekly.

10.3 At the upstream site (Site 10) the Consent holder shall collect a grab sample of water on no less than one occasion per month.

10.4 Samples collected at both sites identified in conditions 10.2 and 10.3 shall be analysed for the following constituents:

- Total phosphorus,
- Dissolved reactive phosphorus,
- Nitrate-nitrogen,
- Ammoniacal- nitrogen,
- Total Kjeldahl nitrogen,
- Chloride.

10.5 The consent holder shall collect grab samples at both sites no less than one occasion per month and analyse the samples for *Escherichia coli* bacteria per 100 ml.

11 Nutrient Limits- Surface Water Quality

The wastewater treatment plant and spray irrigation disposal system shall be operated to ensure that the total sewage-derived nitrogen and phosphorus in the Waipa Stream at site 5 does not exceed 30 tonnes and 3 tonnes respectively during any 12-month period beginning on the 1st day of any 4, but not greater than the 5 week period to coincide, as close as possible, with the end of the calendar month.

12 Flows in Excess of the Treatment Capacity

In the event of flows delivered to the treatment plant in wet weather exceeding the hydraulic capacity of the treatment plant and its associated transfer pumps, pipelines and holding lagoons or in the event of power outage or mechanical failure such that spillage of partly treated wastewater occurs the consent holder shall report to the Bay of Plenty Regional Council within 7 days on the following matters:

(a) The cause of the spillage, including return period of rainfall, if that be the cause,
(b) The approximate duration and quantity of the spillage,
(c) Nature of the spillage and estimate of nutrient and bacterial strength,
(d) Assessment of measures, which could be taken to prevent or mitigate the effects of such events in future.

13 Monitoring Structures in the Stream

13.1 The consent holder shall maintain the following structures required for the purpose of monitoring.

GAUGING STATION ID No.	STRUCTURE DESCRIPTION	LOCATION	APPROX. MAP REFERENCE NZMS 260 U16
4	V notch weir	Tributary to the Waipa Stream	950 313
5	Concrete structure	Lower Waipa Mill Road	947 312
6	V notch weir	Waipa Mill Road	954 309
8	V notch weir	Stream by Poplar Ave	967 302
10	Concrete flume	Stream by Hill Road	975 302
11	V notch weir	Up stream by Nice Road	985 306

13.2 Any scour of the river channel or banks resulting from any maintenance works under this consent, shall be effectively stabilised to the satisfaction of the Chief Executive of the Regional Council or delegate.

13.3 All works associated with the maintenance of the structures shall be carried out in a manner that minimises discoloration of the tributaries to the Waipa Stream and the Waipa Stream, as far as practicable.

13.4 The works shall be carried out in a manner that minimises adverse effects on fish passage as far as practicable.

14 Reports

14.1 Results of the monitoring stated in conditions 9.1, 9.2, 9.3 and 9.4 shall be sent to the Regional Council within 21 days after the end of March and September.

14.2 The results of analyses carried out as required by conditions 10.4 and 10.5 together with the mean daily flow of the Waipa Stream at site 5 shall be sent to the Regional Council within 21 days after the end of each calendar month.

14.3 A monitoring report shall be sent to the Regional Council based on the results of the analyses reported for condition 11, detailing the total sewage-derived nitrogen and phosphorus loads within the Waipa Stream for any continuous 12-month period within 21 days after the end of any 4, but no greater than the 5 week period to coincide as close as possible with the end of the calendar month.

14.4 Warning Signs

The consent holder shall erect and maintain signs to the satisfaction of the Chief Executive of the Regional Council or delegate on the perimeter of the spray areas, at the main access points and any paths where the public readily gain access, to warn the public that spray irrigation of treated sewage effluent is taking place and the public health risks involved.

15 Consent Review

The Regional Council may, within six months of the fifth, tenth and fifteenth year anniversary of the commencement of this consent, serve notice on the consent holder under sections 128(1)(a)(iii) of the Resource Management Act 1991 of its intention to review condition 11.1 of this consent. The purpose of the review is to assess impact, compliance and monitoring reports, on the general quality of the Waipa and Puarenga Streams, Lake Rotorua and down stream waters, and if necessary alter nutrient loads.

The consent holder may, within six months of the fifth, tenth and fifteenth year anniversary of the commencement of this consent, apply to the Regional Council under section 127(1)(a) of the Resource Management Act 1991 to change discharge limits pursuant to conditions 3.1 and 11.1 and monitoring as set out in conditions 8, 9, and 10 of this consent. The purpose of the change is to adjust discharge limits based on the general water quality of the Waipa and Puarenga Streams, Lake Rotorua and down stream waters.

16 Term of Consent

This consent shall expire on 31 July 2021.

17 Resource Management Charges

The consent holder shall pay the Bay of Plenty Regional Council such administrative charges as are fixed from time to time by the Regional Council in accordance with section 36 of the Resource Management Act 1991.

17.1 **The consent** hereby authorised is granted under the Resource Management Act 1991 and does not constitute an authority under any other Act, Regulation or Bylaw.

Advice Notes:

1 *The calculation of sewage derived nitrogen and phosphorus in the Waipa Stream should take into account the background load in the stream as determined at the upstream sampling site number 10.*

2 *Reports pursuant to condition 14 shall be addressed to the Principal Compliance Officer of Environment B·O·P.*

3 *The consent holder is advised that non-compliance with consent conditions may result in enforcement action against the consent holder and/or their contractors.*

4 *The consent holder is responsible for ensuring that all contractors carrying out works under this consent are made aware of the relevant consent conditions, plans and associated documents.*

5 *Calculation of the starting day of any 12-month period referred to in conditions 11 and 14.3, is to ensure that reporting periods commence as close as possible to the first day of the month, having regard to the consent holder's weekly monitoring regime.*

DATED at Whakatane this 26th day of October 2001

For and on behalf of
The Bay of Plenty Regional Council

J A Jones
Chief Executive

Appendix 2 – Effluent monitoring results

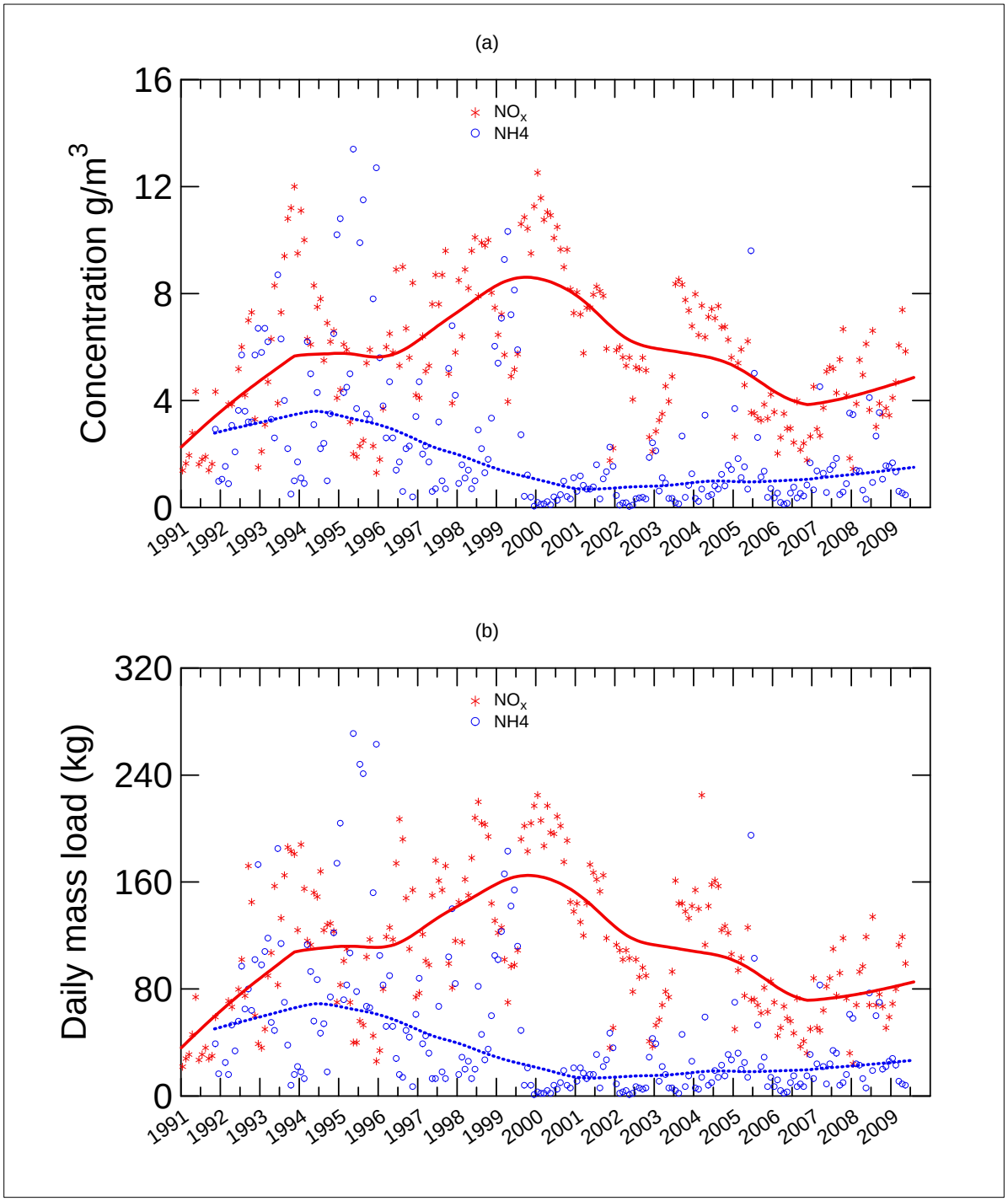

Figure 5 *Concentration and daily mass load (monthly mean) of NO_x and NH_4 recorded in the effluent (Lowess trend line).*

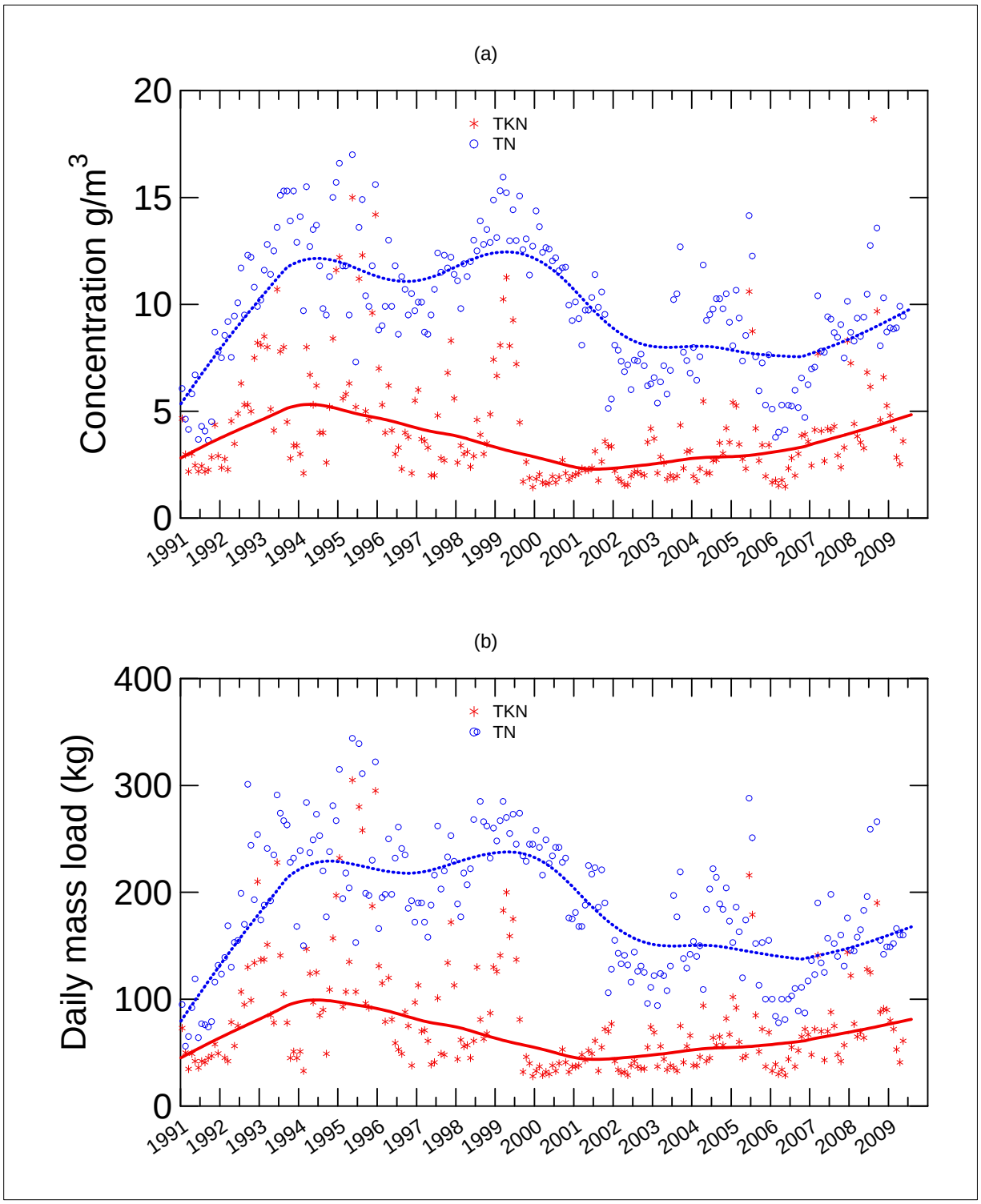

Figure 6 *Concentration and daily mass load (monthly mean) of TKN and TN recorded in the effluent (Lowess trend line).*

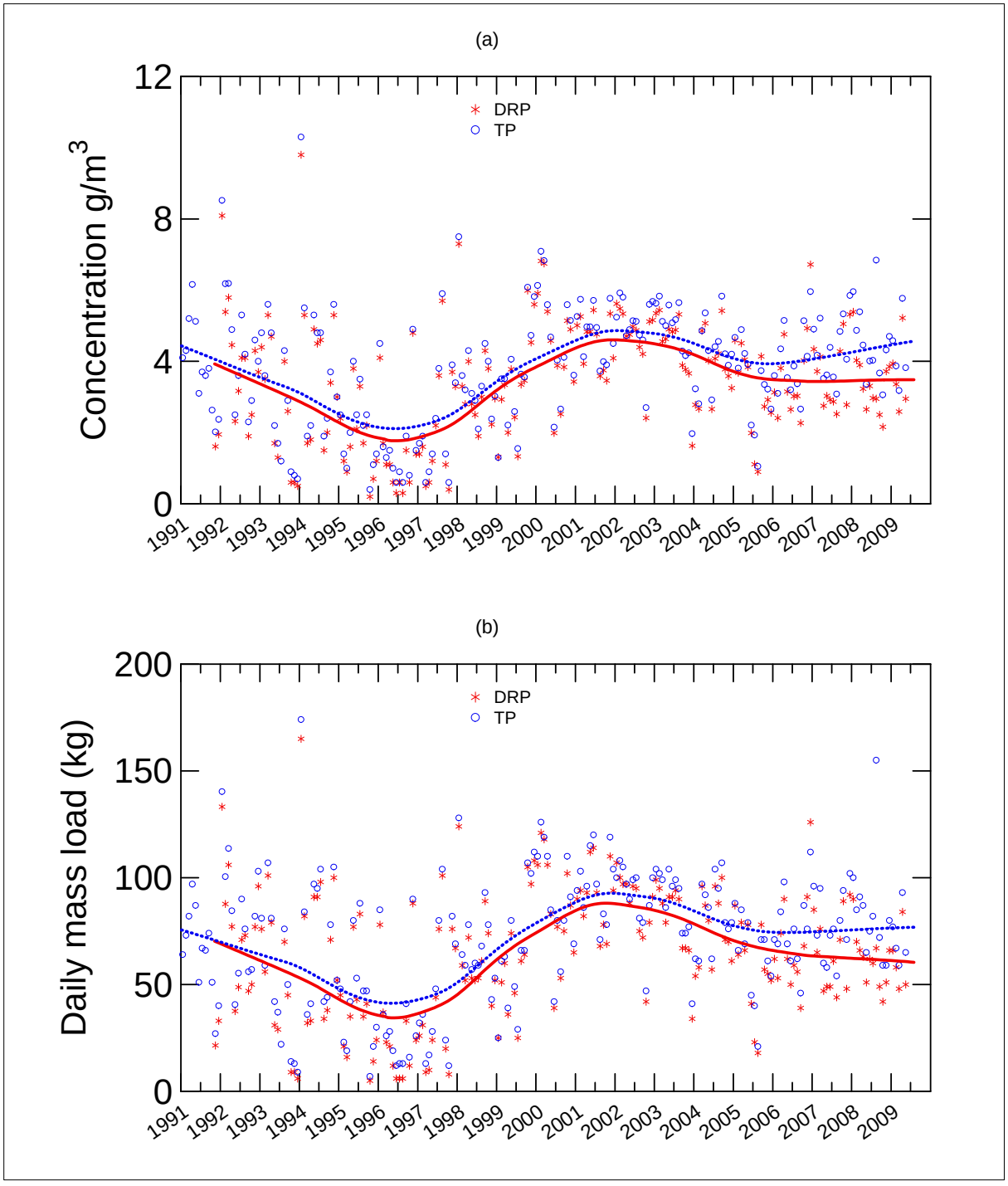

Figure 7 *Concentration and daily mass load (monthly mean) of DRP and TP recorded in the effluent (Lowess trend line).*

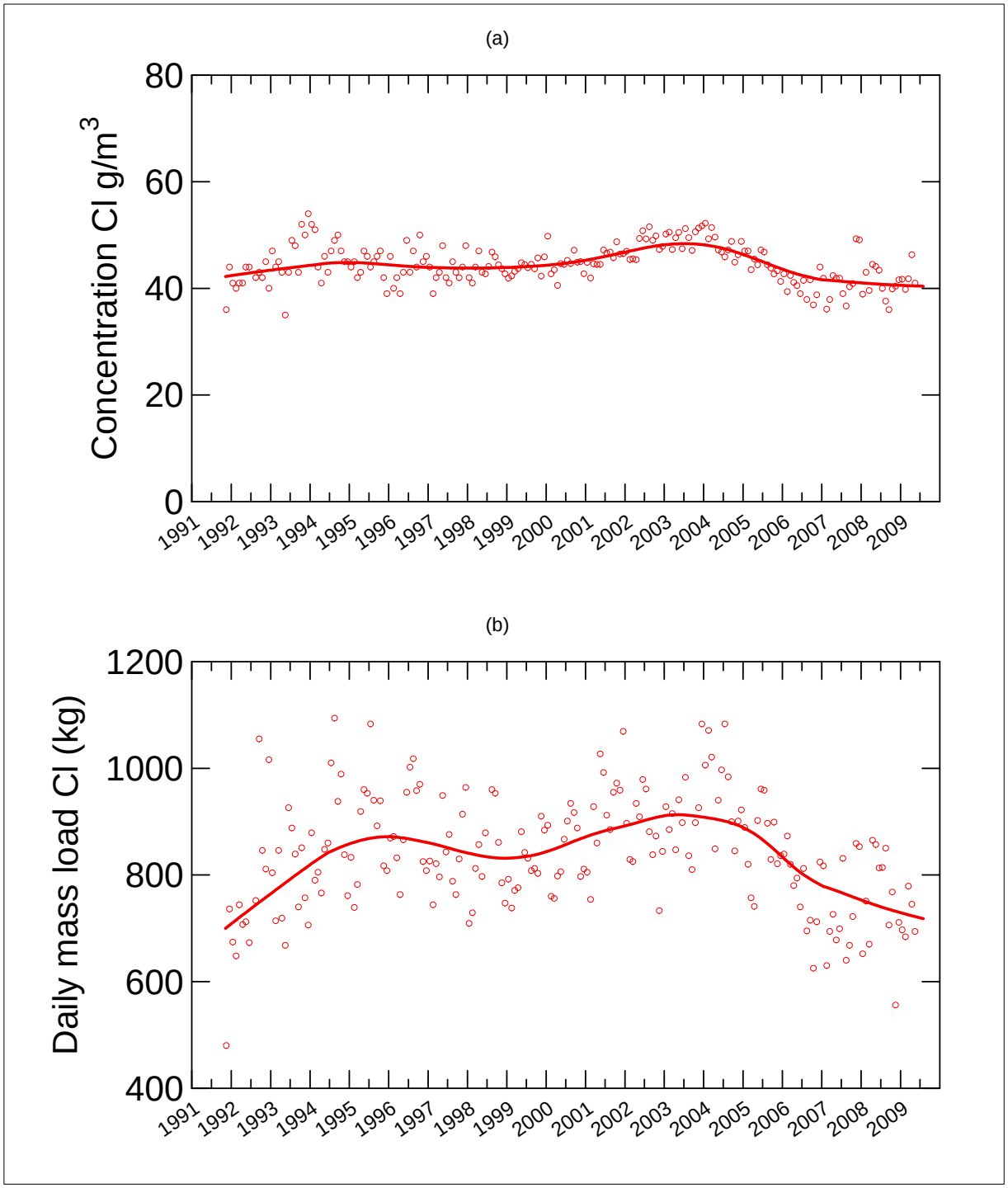

Figure 8 *Concentration and daily mass load (monthly mean) of Chloride recorded in the effluent (Lowess trend line).*

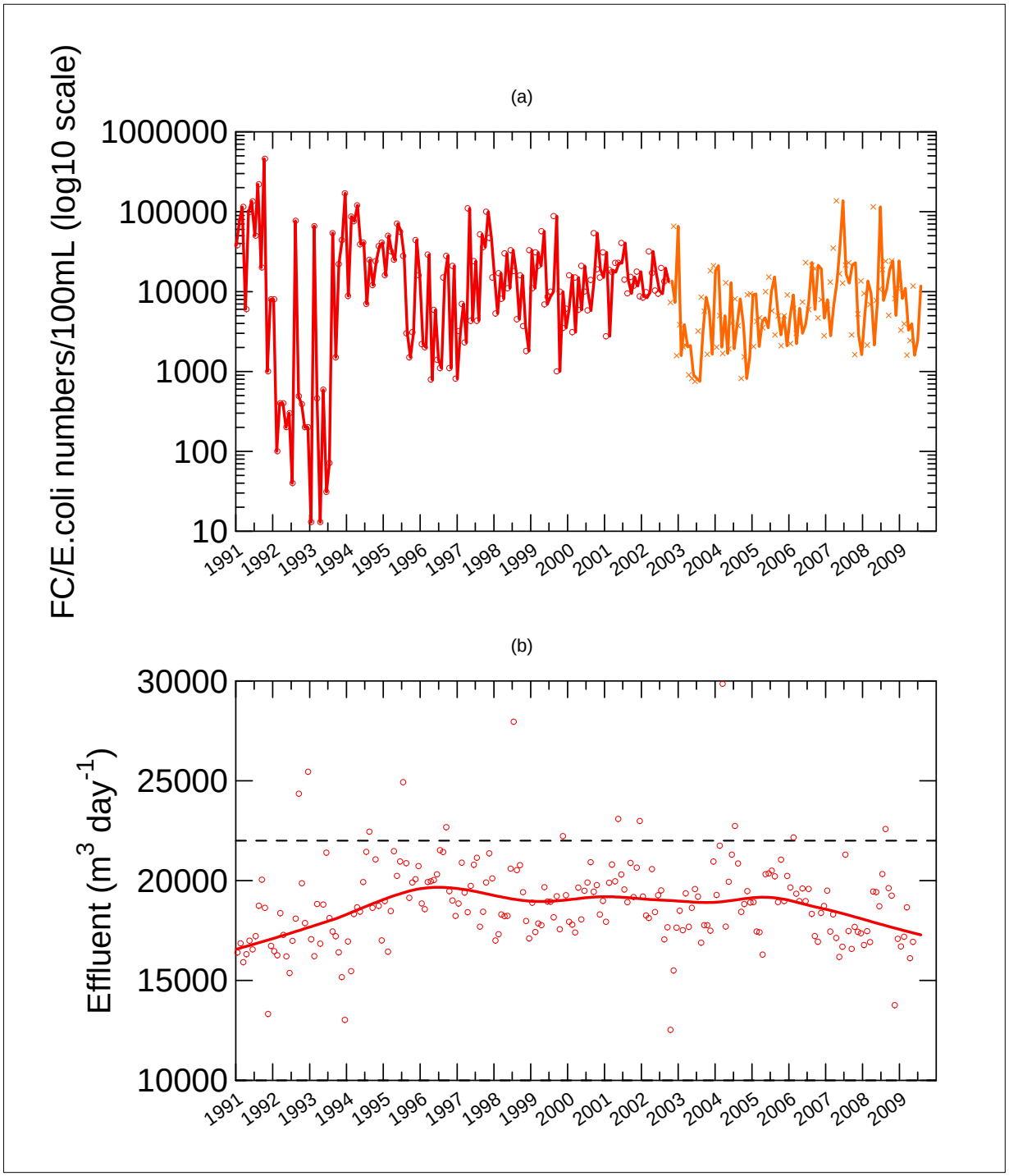

Figure 9 *Number of FC/E.coli bacteria in the effluent and daily volume of effluent (monthly mean and lowess trend line).*

Appendix 3 – Waipa Stream monitoring results

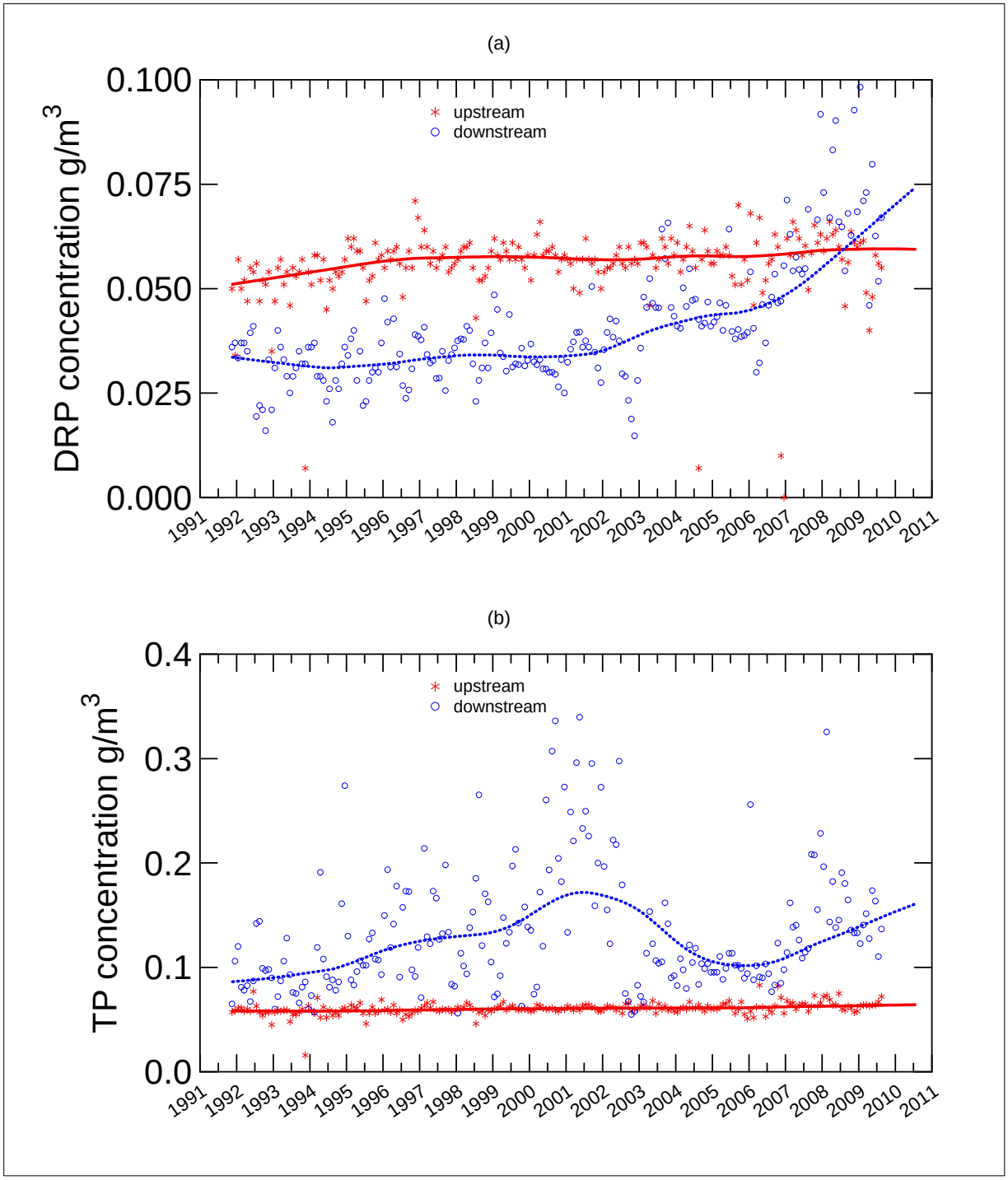

Figure 10 *Concentration of DRP and TP at upstream and downstream sites in Waipa Stream, Rotorua (Lowess trend line).*

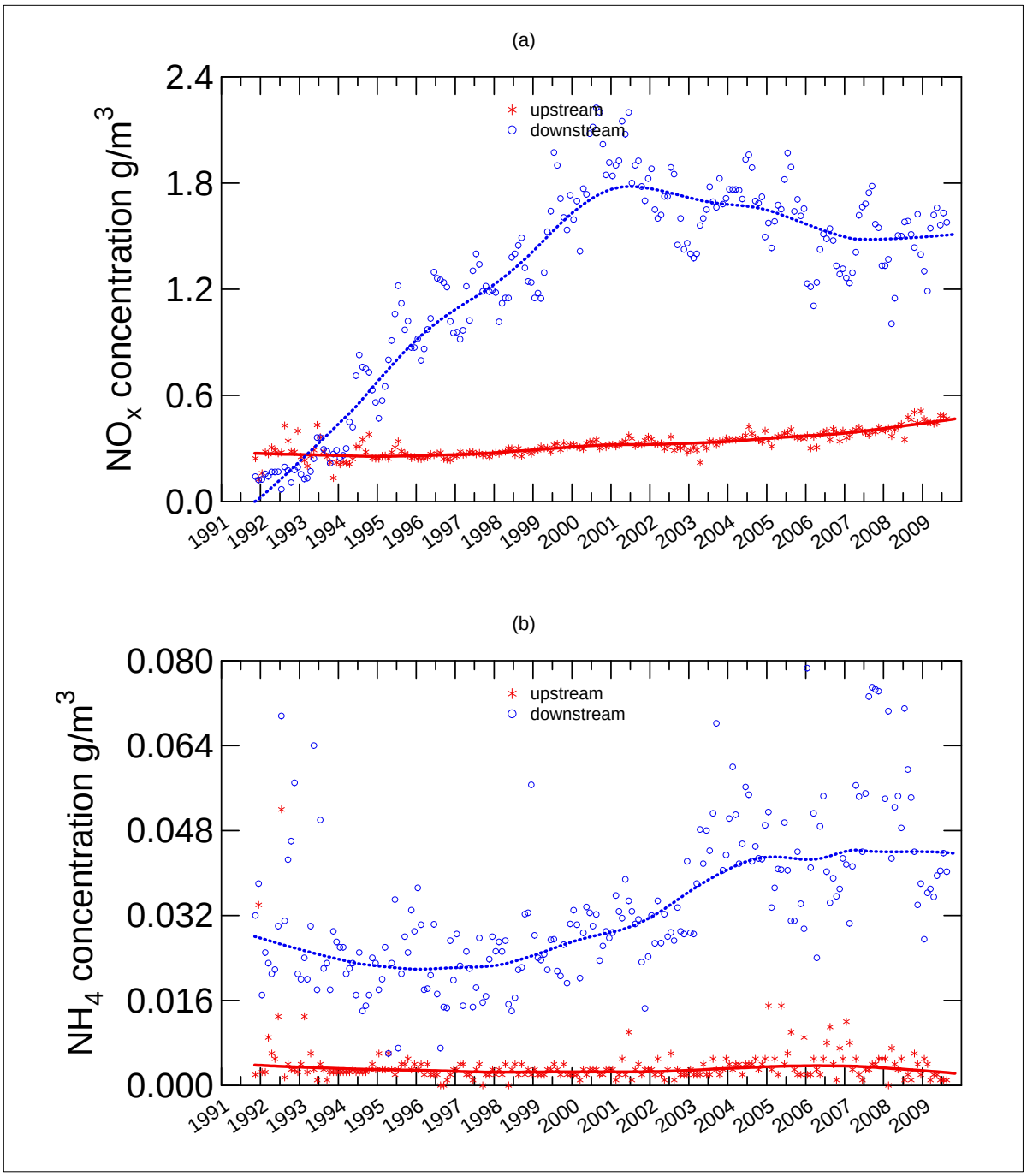

Figure 11 *Concentration of NO_x and NH_4 at upstream and downstream sites in Waipa Stream, Rotorua (Lowess trend line).*

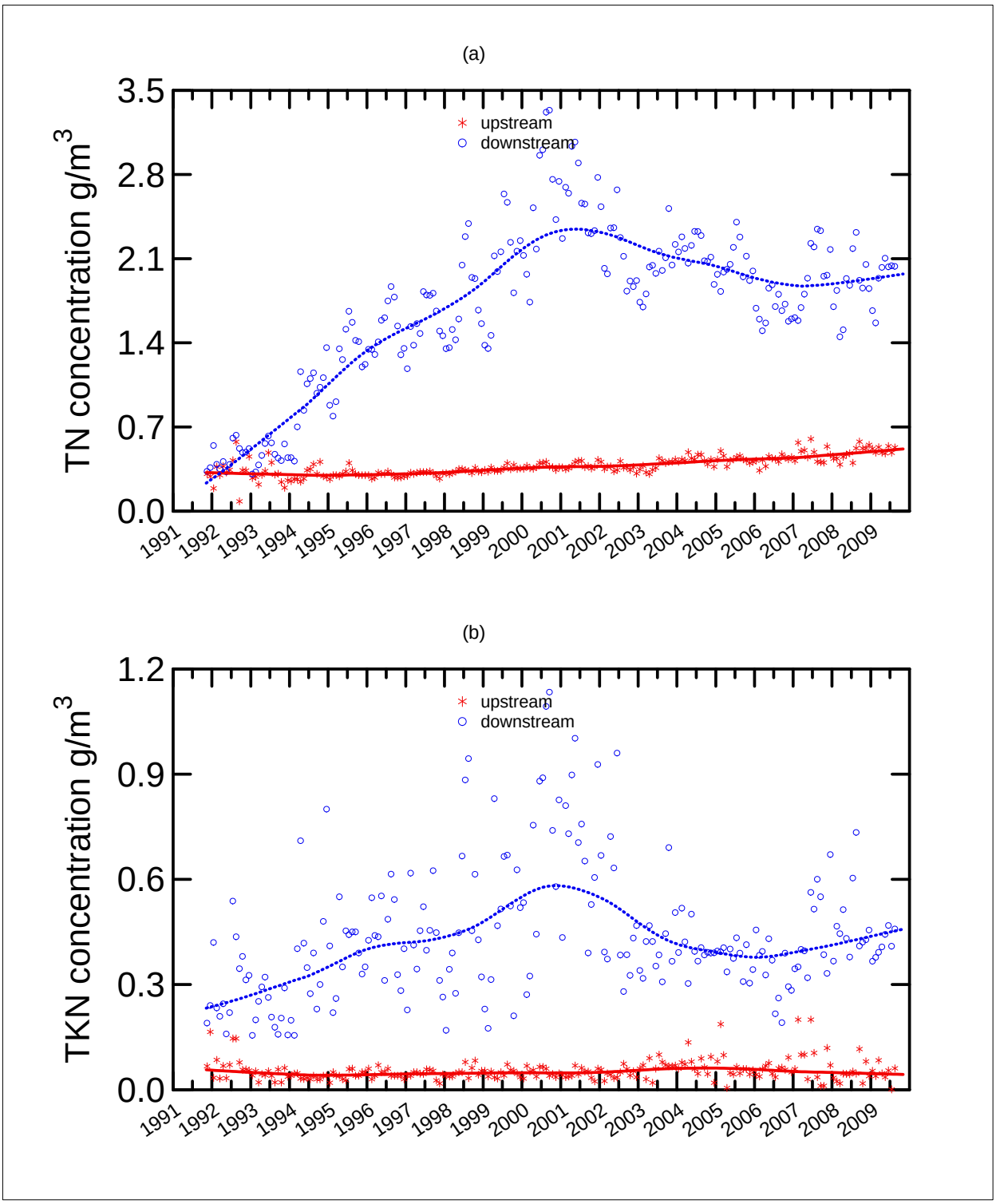

Figure 12 *Concentration of TN and TKN at upstream and downstream sites in Waipa Stream, Rotorua (Lowess trend line).*

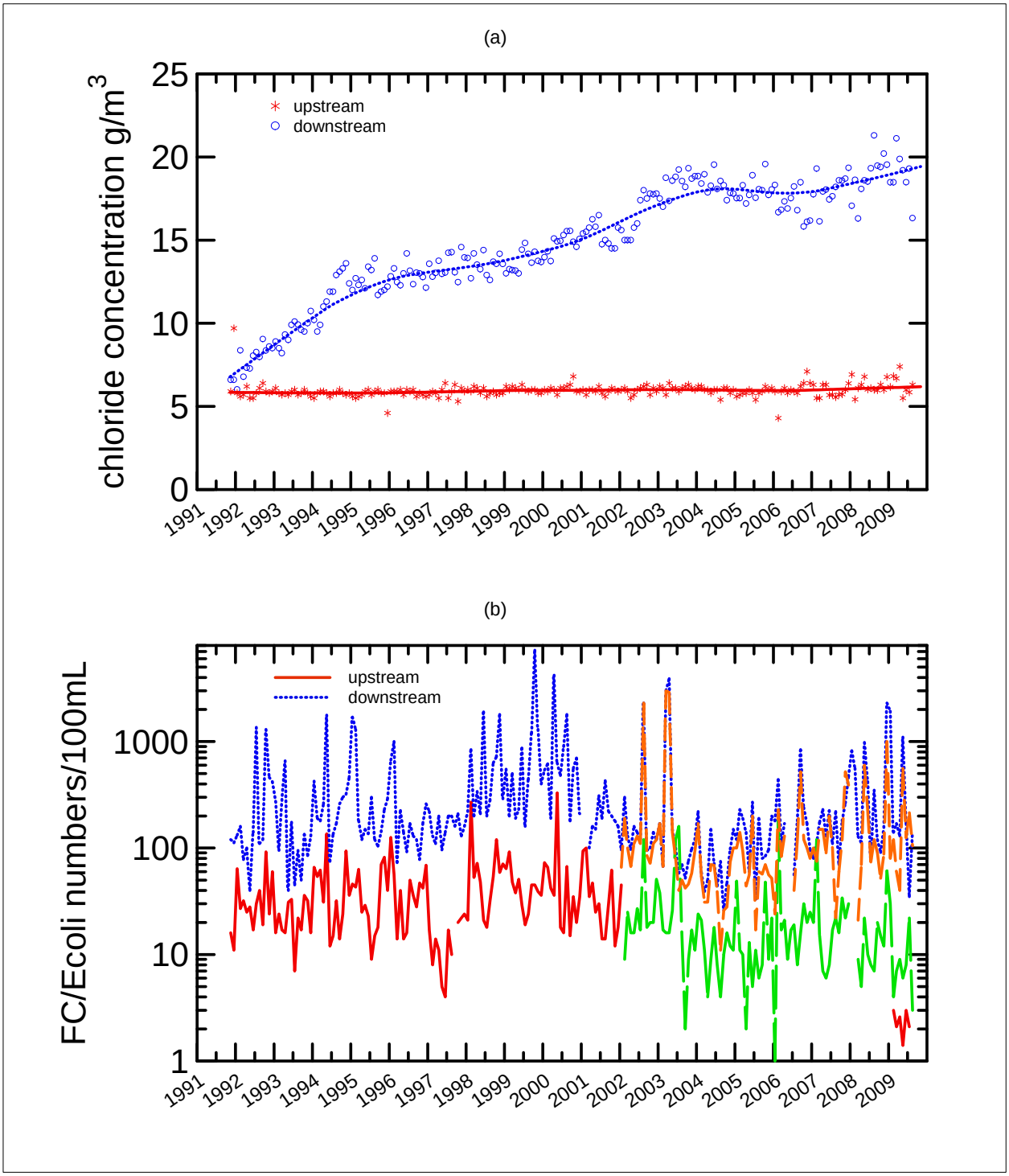

Figure 13 *Concentration of chloride (Lowess trend line) and faecal coliforms/E.coli measured at upstream and downstream sites in Waipa Stream, Rotorua.*

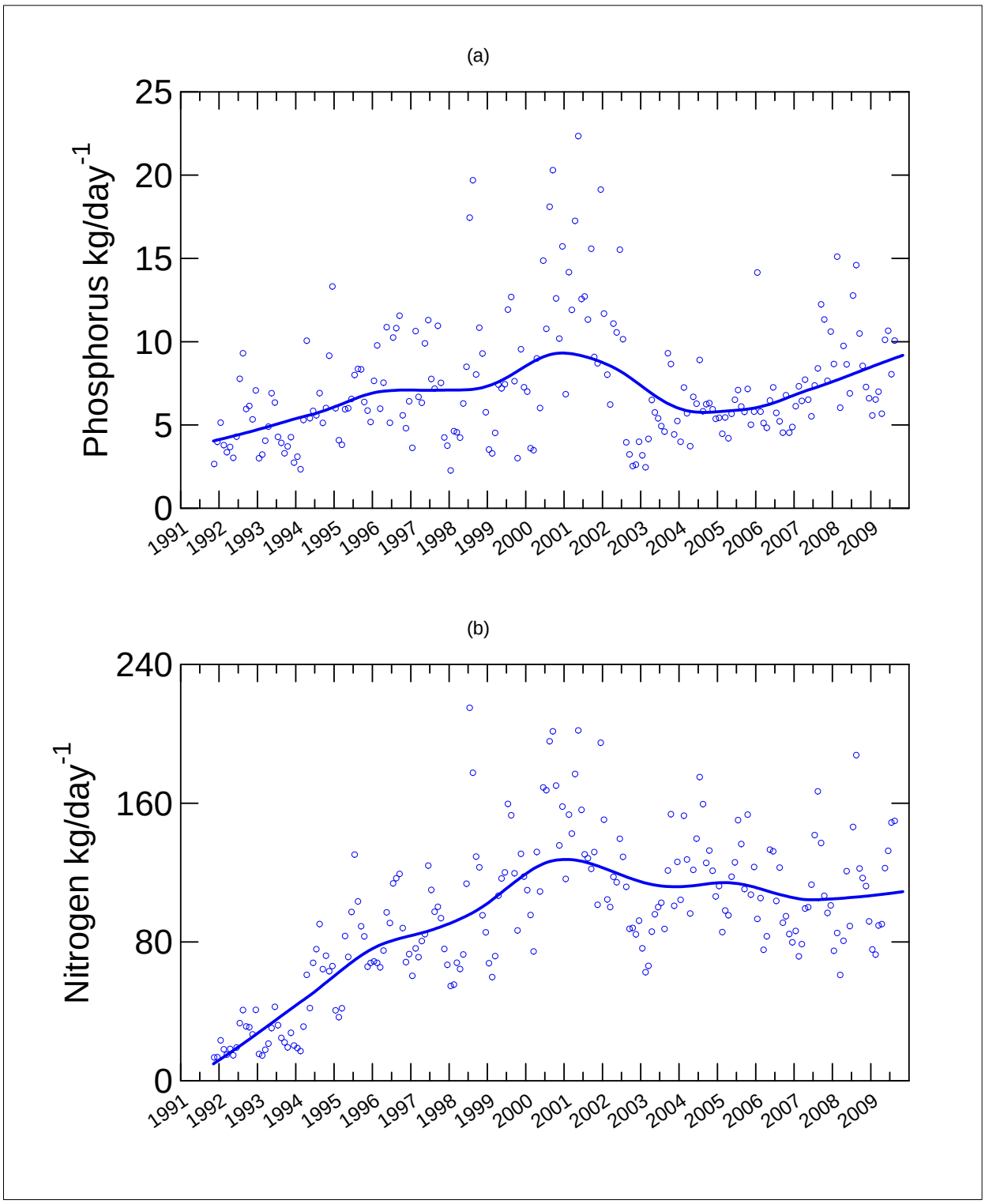

Figure 14 *Average mass load of TP and TN measured at the downstream site in Waipa Stream, Rotorua (Lowess trend line).*

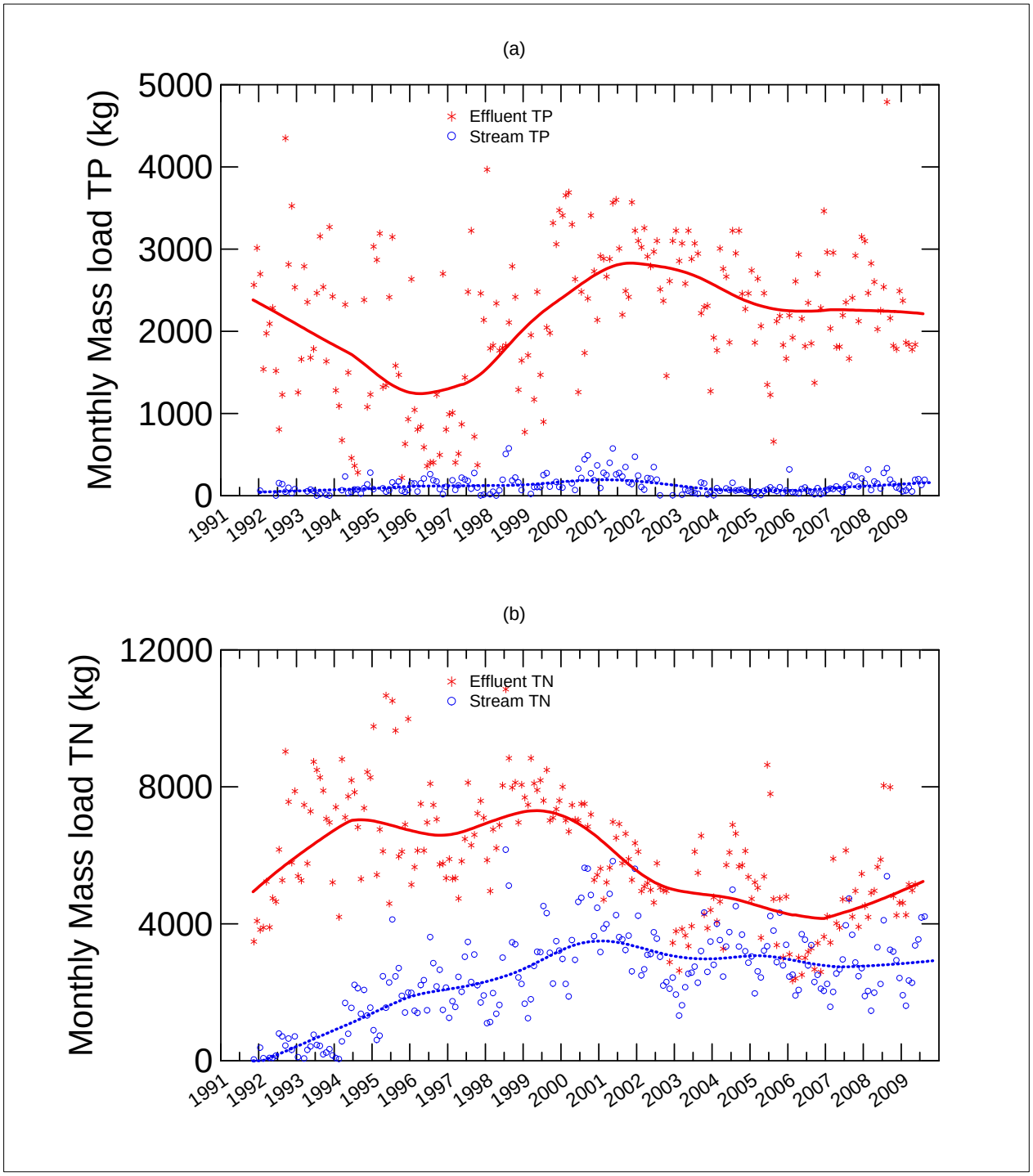

Figure 15 *Monthly mass load of TP and TN measured in the effluent discharged in the spray irrigation area and at the downstream site in Waipa Stream.*

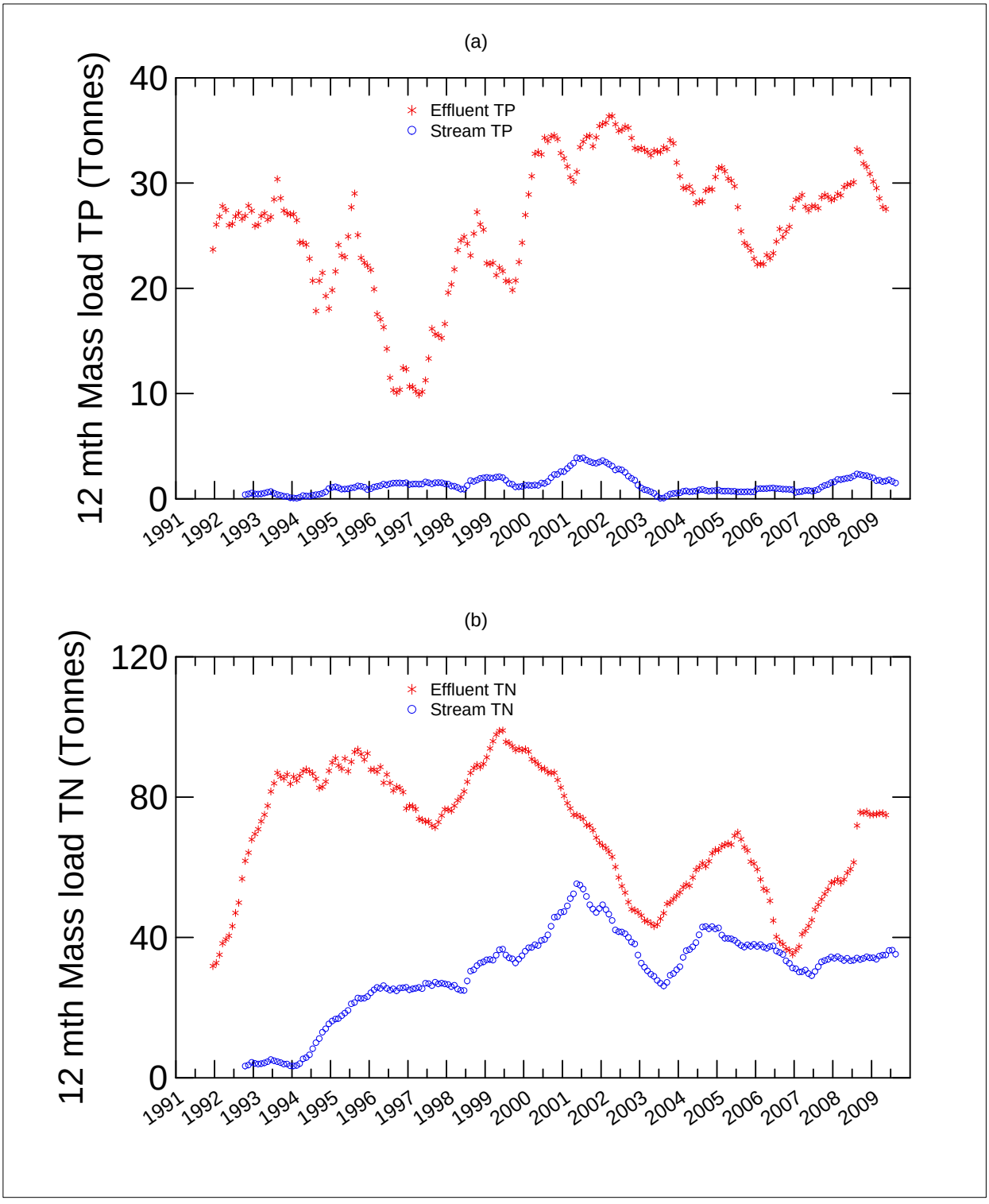

Figure 16 *Twelve month rolling sum of TP and TN mass load measured in the effluent discharged in the spray irrigation area and at the downstream site in Waipa Stream.*