IN THE MATTER OF the Resource Management Act 1991

AND

IN THE MATTER OF Resource consent applications by various applicants from the Hakataramea Irrigation Water Quality Group

STATEMENT OF SUPPLEMENTAL EVIDENCE OF LYNN TORGERSON

SCOPE OF EVIDENCE

1 The supplemental evidence addresses questions that were raised by the Panel regarding my evidence about the water quality of the Hakataramea River.

2 In preparing my evidence, I have reviewed evidence prepared by Tom Heller, Ned Norton and Bridget Pringle, in addition to documents previously cited in my earlier evidence.

QUESTIONS RAISED BY THE PANEL

3 After the presentation of my evidence, Dr Ryder asked me several questions. He noted that I had stated that the water quality sampling took place on 6 May and 26 May, 2008 and queried whether there may have been intervening flows during this twenty-day period.

4 I have reviewed the water quality sampling notes, and found that the water quality sampling took place on 6 and 7 May, and there were no flooding events occurring during the sampling period. The report of the lab results was dated 26 May 2008.

5 In relation to the periphyton observations reported in my evidence, Dr Nicholas Ward carried out the water quality

sampling and made the observations on the presence and absence of algal/periphyton growth during his site visits.

6 Dr Ryder also asked whether I considered the NRRP standards, in particular WQL1.1 Water Quality Objectives for Rivers. Objective WQL1.1 aims to have the water quality of waterways that are not in a natural state maintained or improved. The Hakataramea River is not in a natural state as result of point source and non-point source discharges.

7 Table WQL5 establishes numerical outcomes for nutrient indicators in rivers that are not in a natural state. Looking at Table WQL5, the Hakataramea River is considered a hill country stream with more than 30% tertiary sediments. The table provides the limits for algal and periphyton cover. Existing water quality measurements show that periphyton and algal mats currently exceed these specified thresholds.

8 Objective WQL1.1 (2) (b) states that where the water quality does not meet the outcomes of Table WQL5, the water quality is to be improved so that the outcomes of Table WQL5 are achieved. In my evidence, I discussed the difficulty in determining the causes of the water quality problem in the Hakataramea River. Further I noted that there was likely to be several contributing sources and there has been no quantification of the extent that these sources could be affecting the water quality. While the ECan report suggests that overland flow and subsurface flow contribute solely to the nutrient loading in the river, the water quality measurements do not support this and indicates that there are other sources, which may include stock and wind-blown contributions.

9 Recognising that there are multiple sources of nutrient contributions to the river, I recommended a number of mitigation measures to reduce or eliminate these contributions. There is some literature available which provides an indication of the efficacy of some of the proposed measures, however, given the uncertainty as to the actual

nutrient sources and their extent in the Hakataramea River catchment, it is not reasonable to put a numerical value to these measures at this time.

10 While I can not quantify the improvements provided by these measures, the measures proposed aim to improve the system. Equally I can not say for sure that we will reach the outcomes, the measures employed will be an improvement upon the current situation. For example, as part of the proposed consent conditions, it is proposed to fence off the stream so that stock can not graze or walk in the river or tributaries. Currently, there is very little fencing and there is stock accessing the waterways.

11 To summarise, the proposed mitigation measures, and follow up monitoring to determine efficacy, are proposed in effort satisfy this objective, but also to improve upon the current situation.

12 Dr Ryder commented on figure 9 of my evidence suggesting that the flows on the y-axis would be better shown linearly, rather than logarithmically. Attached to my evidence, please find a Revised Figure 9, with the flows shown linearly.

13 Professor Skelton asked about my concern about the appropriateness of the nutrient modelling and he indicated that OVERSEER was easy to use. My concern about the modelling is not the ease in which it can be used, but rather whether the modelling is applied in the manner that it was intended and whether the inputs and the result can be verified. OVERSEER is a nutrient budget modelling tool and is used to track nutrients through overland runoff and sub-surface flow. Model inputs for OVERSEER include information on rainfall data and soil infiltration to determine runoff and sub-surface flow. It doesn't account for other nutrient contributions such as wind-blown losses or stock in the waterways. In this situation, the water quality data

suggests that there are other contributions other than overland flow and sub-surface runoff.

14 OVERSEER also makes predictions assuming that particular farm management practices are employed and it also assumes that a particular management practice is constant over time. Information provided by the farmers indicate that some of the farm management practices assumed in the modelling are not currently occurring and therefore the output may not actually reflect what is currently happening on the farm.

15 SPASMO is similar to OVERSEER in that it has been developed to model nutrients, however SPASMO was developed to track nutrient transported under horticultural practices rather than agricultural practice. The ECan study used SPASMO to model the nitrogen components, while OVERSEER was used to model the phosphorous components.

16 Both programmes are designed to look at blocks within a farm, and even the whole farm, but are not intended to look at the nutrient loading for an entire catchment. Given the hydrologic complexities and relationships within the Hakataramea River catchment, it seems that the results from such modelling should only be used as an indication, and should not be relied on for the actual assessment of effects.

17 As further indication of the limits of modelling, a comparison has been made between the modelling results provided in the ECan study and the actual measured results. Looking at Figure 2 attached, the modelled results from the ECan study are shown as Scenarios 1 to 4. Scenario 1 models the existing conditions. As can be seen in this figure, the modelled scenario and the measurements do not fit well, which may indicate some problems associated with the modelling assumptions.

18 In Mr Norton's evidence, he tries to explain why the modelled results would be different (and higher) than the measured results (paragraph 39). He concludes that the measurement of nutrient concentration shows what nutrient is leftover in solution after the periphyton have used what they can to produce biomass. Mr Norton's evidence suggests the Dissolved Inorganic Nitrogen (DIN) should increase when the periphyton is low.

19 Using a plot similar to Figure 2 presented in Mr Norton's evidence, I have taken the data and plotted the DIN as well. This can be seen on Figure 3 attached.

20 The pink squares show the percentage of periphyton cover on the dates of sampling (same as Mr Norton's figure). The blue line shows the concentration of DIN for those same sampling dates. The ECan report modelling finds the average DIN under the existing conditions is 0.59 mg/L. This average figure is shown as a green line across the plot.

21 Looking at the data points (and considering when there were any flood flows), the concentration of DIN and percentage of periphyton cover can be compared. During the period from 1999 to 2007, there were only two periods where the DIN was high and the periphyton cover was low.

22 Looking at that period, it appears that the DIN concentrations range near zero to 0.1 mg/L, with those two exceptions. As the modelling DIN figure of 0.59 mg/L is an average figure, one would expect that there would be a range of DIN both greater than and less than the average figure. However, the data shows that there is only one data point which exceeded the average. This doesn't seem to support the modelled figure even based on Mr Norton's explanation.

23 To summarise, while modelling tools such as OVERSEER are available and used widely, it is important that the actual model purpose, assumptions and limitations are considered when analysing the modelling results. In addition, verification

of the input data and results is also important when validating the use of results. In my opinion, the catchment-wide modelling used does not seem to be appropriate based on the discrepancies in the input information and does not provide a reasonable fit to the existing conditions data.

HAKATARAMEA MONITORING PLAN

24 There have been three studies on the impact to water quality of the Hakataramea River catchment from various irrigation proposals (Dungey Consulting 2005, Ryder Consulting 2005, and ECan 2007). The primary objective of these studies was to consider the impact of irrigation on the water quality as it relates to aquatic habitats and species. These studies are based on short term and limited data sets and strive to predict what will happen in the river as a result of the irrigation proposal. The data sets provides a "snapshot" of the various water quality variables at that time, but the studies do not attempt to establish a baseline survey of variables in which actual effects can be determined.

25 The Hakataramea Monitoring Plan also aims at obtaining a definitive and representative assessment of any effects caused by the use of water by the applicants. However, the aim is realised by collecting and assessing relevant data for a specified period of time **prior** to the commencement of the consents. This forms the baseline from which future monitoring results can be compared, and a determination of actual effects from the consented activity can be made. Recognising that the water quality is a catchment-wide concern, the Monitoring Plan considers the catchment contributions as a whole, rather than just the applicants' contributions.

26 As noted in earlier evidence, the water quality of the Hakataramea River is a function of a number of variables including geology, land use, hydrology and climate. Furthermore, water quality can have an effect on other things

such as aquatic organisms or downstream users of the water. In recognition of the complexity, a multi-disciplinary approach is necessary to establish an appropriate monitoring plan that will provide meaningful data. In preparing this proposed monitoring plan, experts in various disciplines were consulted to identify critical elements that must be included. These experts also provided advice on the locations of monitoring, components to be monitored and the time frame for monitoring. This proposed monitoring plan collates these elements identified by the experts into one document which has been prepared by the following contributors:

- Peter Callander, Hydrogeologist
- Leila Chrystall, Environmental Scientist
- Liz Coombes, Ecologist
- Hilary Lough, Environmental Engineer
- Lynn Torgerson, Environmental Engineer
- Dr Nicholas Ward, Environmental Engineer

27 The Hakataramea Catchment Monitoring Plan's purpose is to provide information which may be used to determine whether the exercise of the consents cause or are a contributing cause to changes in periphyton in the Hakataramea River, macro-invertebrates species in the surface water bodies, target native fish and salmonids, and the physical and chemical ground and surface water quality. As these can be affected by numerous variables, the baseline surveys consider those attributes which may have an impact.

28 There are three parts to the baseline studies: land, surface water and groundwater. The land baseline study includes climate monitoring, land use inventory and physical catchment characteristics. The surface water baseline study includes the physico-chemical sampling, flow measurements and biological surveys. The groundwater baseline study considers the nutrients in the groundwater which could be

providing flow to part of the river. These components establish the initial conditions at regular intervals over a period of at least one year.

29 After the completion of one year of sampling, the results of the land, surface water, and groundwater baseline studies shall be assessed to determine the appropriateness of the monitoring timing intervals. The components of the baseline monitoring should also be evaluated to ensure that they are meaningful and appropriate. At this juncture, the on-going monitoring time intervals and components should be re-evaluated and modified as appropriate.

30 The Hakataramea River Catchment Monitoring Plan also identifies the on-going monitoring components relevant to the baseline studies. As would be expected, the on-going monitoring components are similar to those in the baseline studies and thus are to be used to compare with the baseline results.

31 To summarise, the Hakataramea River Catchment Monitoring Plan identifies the variables which may impact the water quality of the Hakataramea River, its tributaries and the groundwater in the catchment. A series of baseline studies is to be undertaken prior to the exercise of the irrigation consents to establish the existing conditions within the catchment. Once the consents are exercised, on-going monitoring is to be carried out. Comparison of the on-going monitoring results with that of the baseline results is to be made to determine whether any changes in periphyton cover, macro-invertebrates species, target native fish and salmonids, and the groundwater and surface water quality are from the exercise of the consents.

Lynn Torgerson
24 September 2008

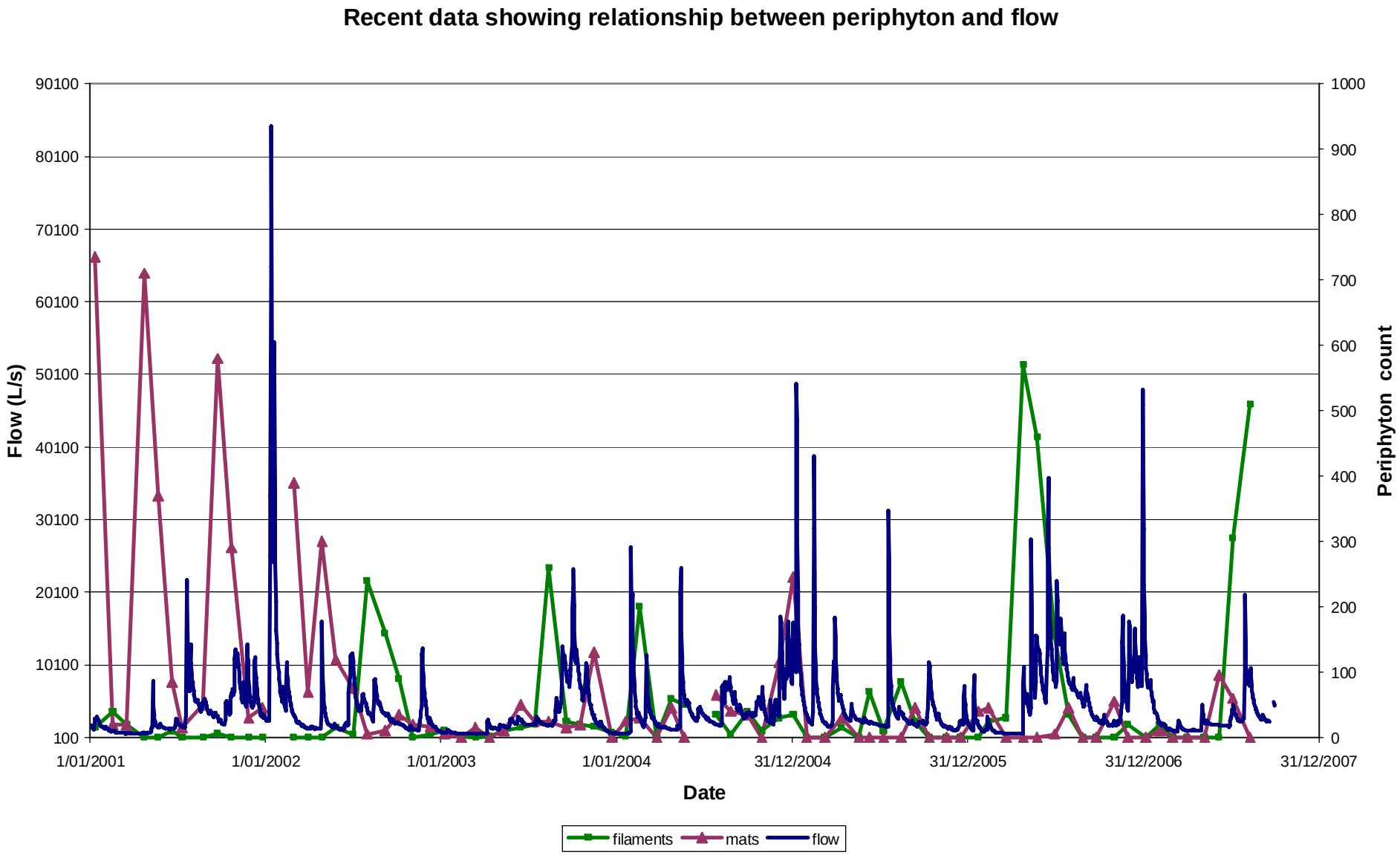

Figure 9 revised : Recent Data showing relationship between Periphyton and Flow in the Hakataramea River above MH Bridge (Data supplied by NIWA)

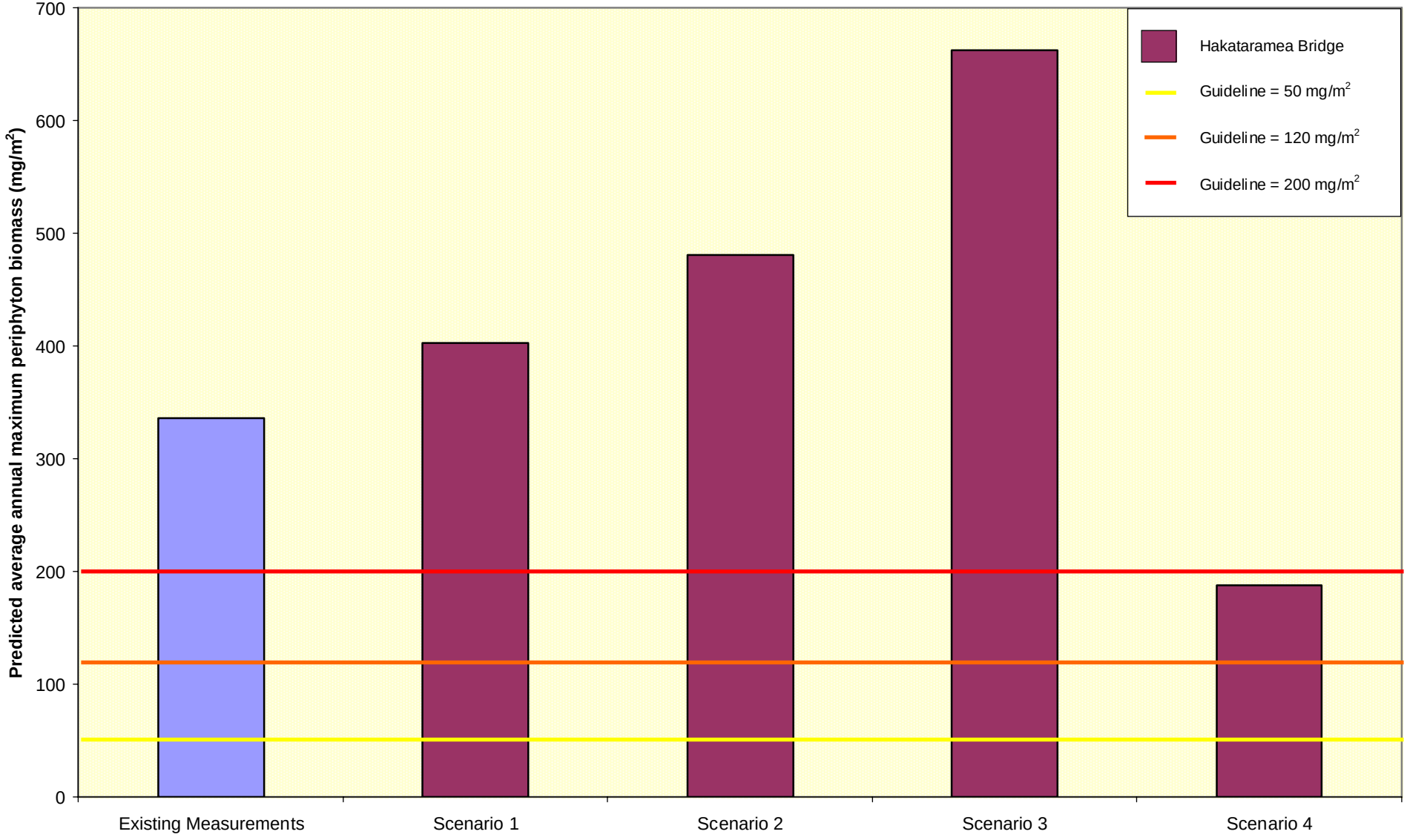

Figure 2: Comparison of Predicted Periphyton Biomass Between Scenarios

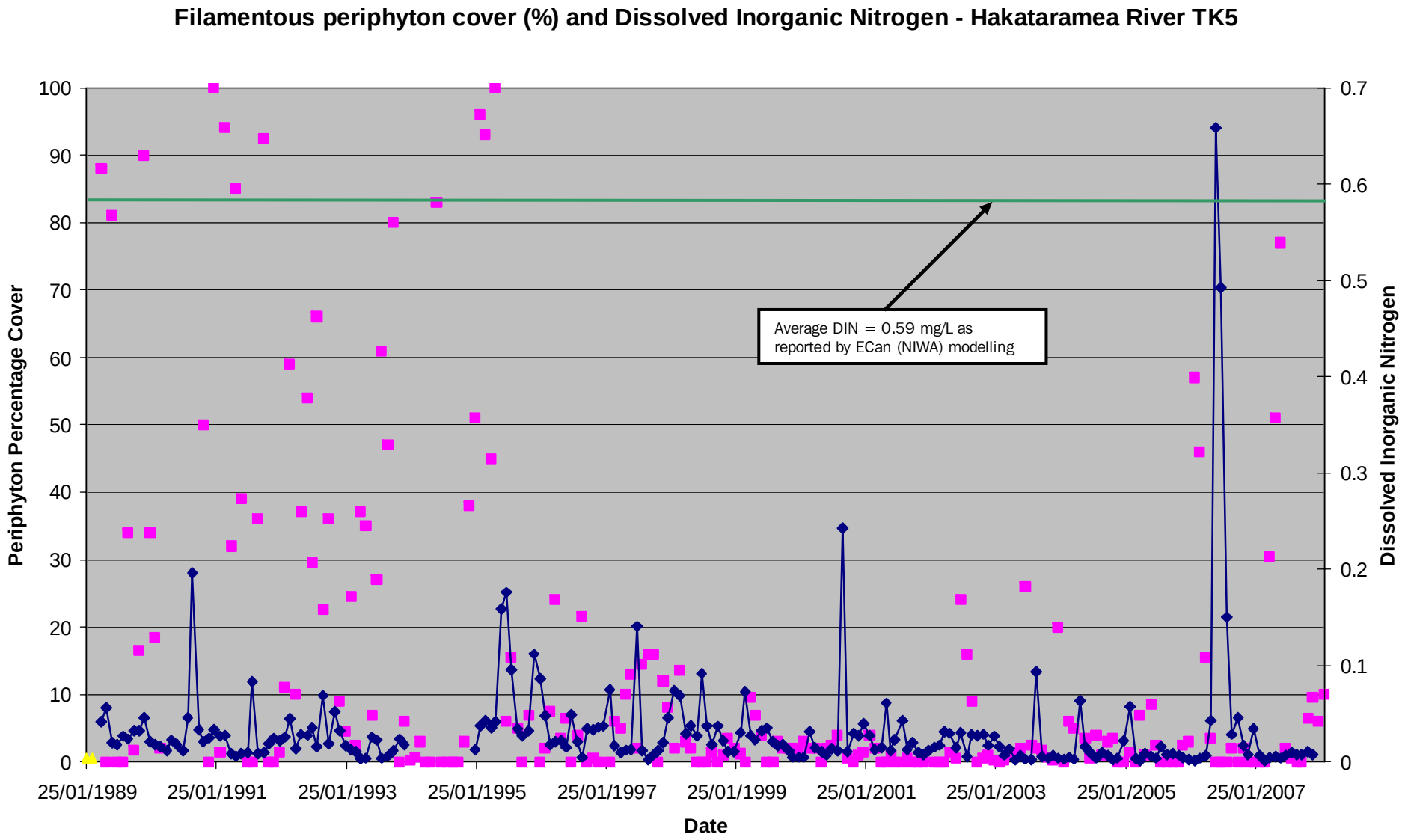

Figure 3: Dissolved Inorganic Nitrogen and Periphyton Cover in the Hakataramea River at TK 5 (Data provided by NIWA)