Denitrification in a Rotoehu Stream, 2nd installation

Additional results from 2008/2009 samplings

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1. Introduction

Landcare Research reported an investigation of the performance of a denitrification bed in a Rotoehu stream in May 2008 (Contract Report: LC0708/143). Environment Bay of Plenty agreed to continue sampling in late 2008/early 2009 to investigate further the nitrogen removal performance of the bed.

2. Updated Results

Samples were taken in August 2008, December 2008, and April 2009.

The field notes below, taken by Landcare Research at the time of sampling, illustrate that operating conditions varied over the duration of the experiment due to variation in the flows caused by natural disturbance and plug removal.

Site notes:

21 Aug 08: All fine, some weeding required; sediment removed; samples taken.

7 Dec 08: Weed growing over the chips, cleared, fern stem had blocked up pipe inlet at the culvert, some water pouring into bed at culvert probably equal to flow from exit holes in lysimeter – probably double flow in total; it is likely efficiency will be down. Samples taken.

15 April 2009: Flow from culvert good, no leakage.

Discovered the six original outlets at base of lysimeter had had their flow pipe connectors removed so major flows going on into the bed. (John McIntosh proved to be the culprit!). Total flows not measured but estimated to be now at least 5 times that of just top holes.

Temperature taken using handheld mercury thermometer – between 13C and 13.5C, pH taken back at lab on sample removed – 7.9 at approx. 20C. Samples taken.

Fig. 1 For reference – headworks March 2007 before top holes were bored.

Table 1 Nitrogen analyses (total N, nitrate- and nitrite-N (NOx-N), ammonium-N and organic N) of inlet and outlet flow at the Rotoehu stream installation

Rotoehu Stream Installation Average of duplicates, units mg/litre

Date	Total N Inlet mg L^{-1}	Total N Outlet mg L^{-1}	NOx-N Inlet mg L^{-1}	NOx-N Outlet mg L^{-1}	Organic N Inlet mg L^{-1}	Organic N Outlet mg L^{-1}	Ammonium N Inlet mg L^{-1}	Ammonium N Outlet mg L^{-1}	Est. Flow Inlet L min^{-1}	Est. Flow Outlet L min^{-1}
28/03/2007	2.38	0.95	2.52	0.78	0.00	0.15	0.01	0.01	29	47
10/05/2007	2.33	1.90	2.34	0.00	0.00	1.90	0.00	0.01	30	21
21/08/2007	2.29	0.82	2.33	0.00	0.00	0.79	0.01	0.02	27	19
19/09/2007	2.46	1.52	2.10	0.42	0.34	0.73	0.02	0.38	25	16
10/10/2007	2.29	1.32	2.31	0.79	0.00	0.35	0.04	0.14	27	18
14/11/2007	2.33	1.36	2.17	1.29	0.16	0.07	0.00	0.00	28	20
20/04/2008	2.44	1.06	2.29	0.89	0.16	0.16	0.01	0.02	20	19
21/08/2008	2.27	1.54	2.13	1.37	0.13	0.17	0.01	0.00	~20-30	~20-30
7/12/2008	1.97	1.68	1.97	1.74	0.00	0.02	0.02	0.01	~40-60	~40-60
15/04/2009	2.22	1.96	2.04	1.80	0.15	0.14	0.04	0.03	~100-150	~100-150

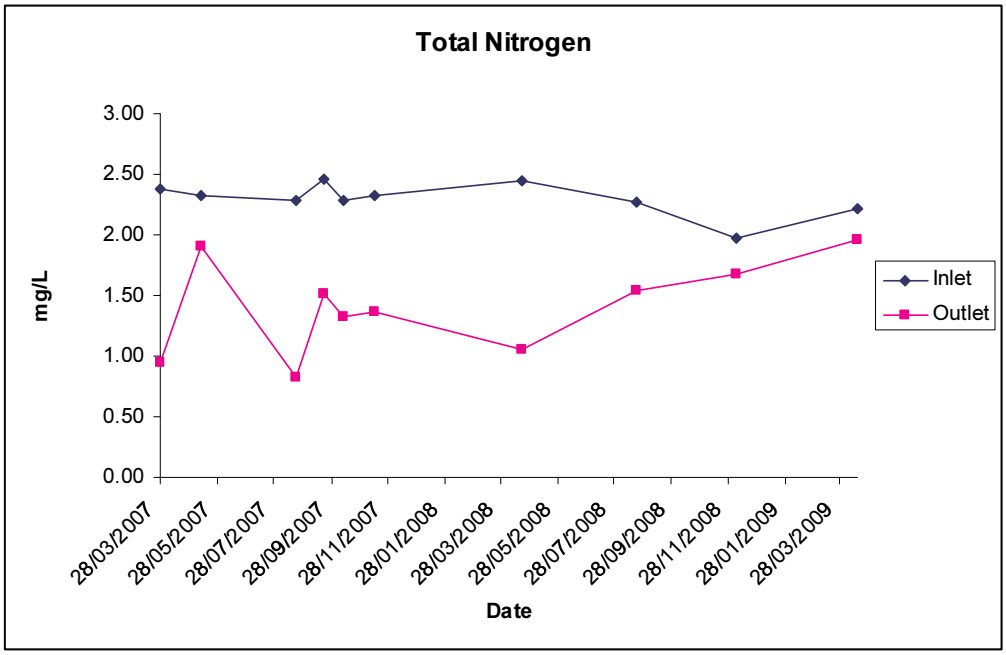

Fig. 2 Total Nitrogen levels entering and leaving the denitrification bed

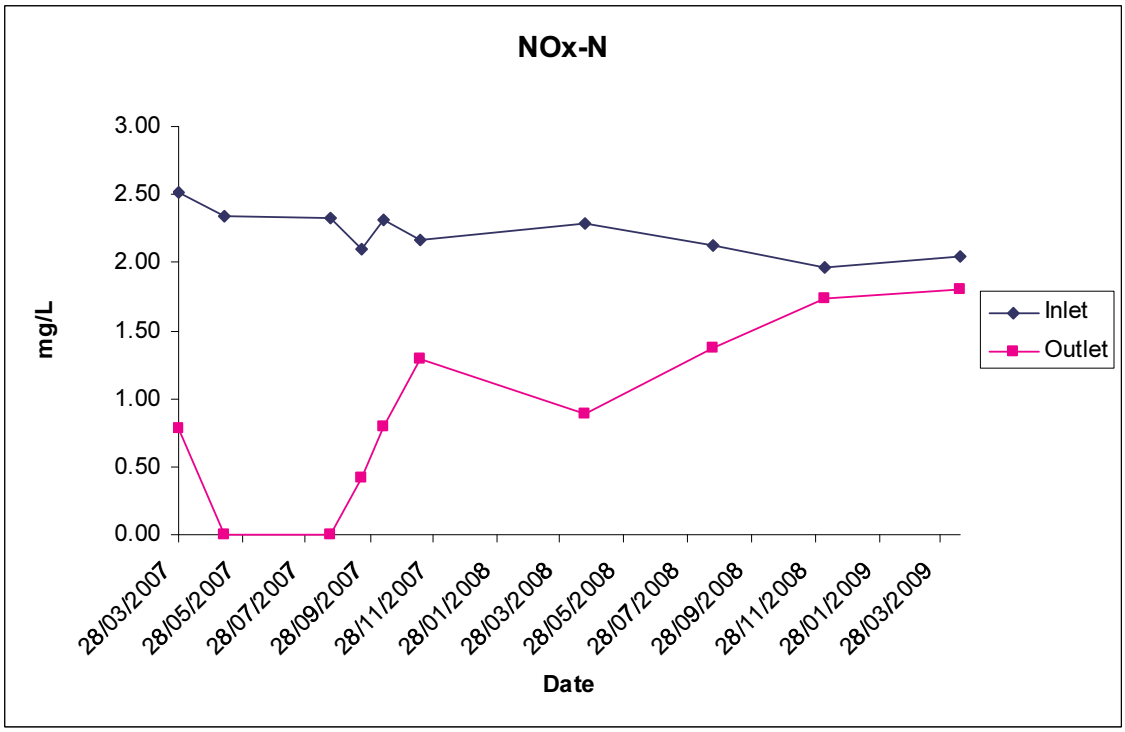

Fig. 3 Nitrate and nitrite (NOx-N) levels entering and leaving the denitrification bed

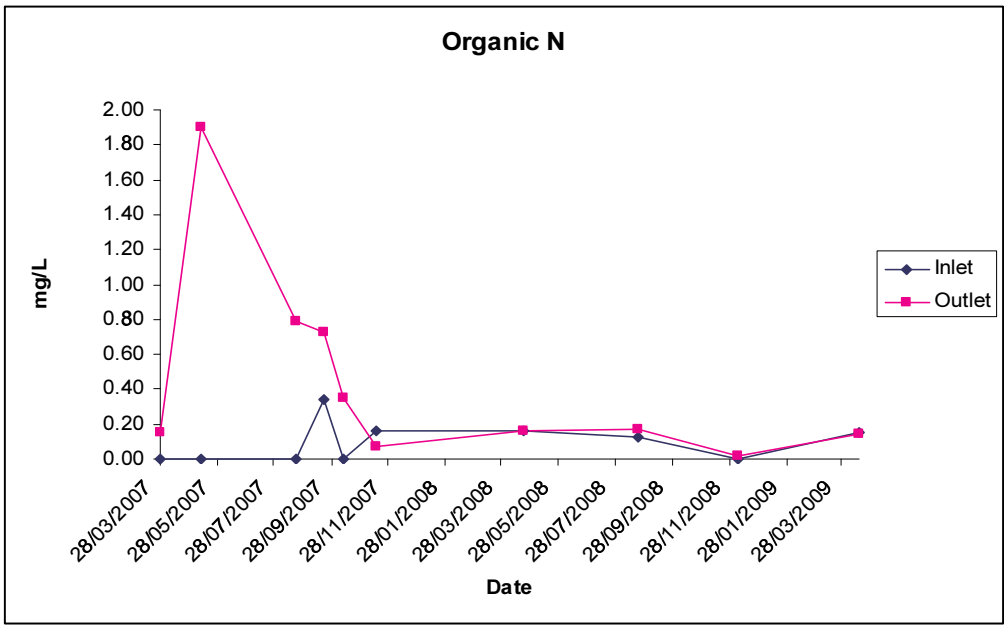

Fig. 4 Organic Nitrogen levels entering and leaving the denitrification bed

Discussion

Total nitrogen levels in the stream at entry to the bed appear to be dropping marginally over time and, as noted in the previous report, nitrogen is largely in NOx (nitrate and nitrite) form. The nitrate removal efficiency of the bed (as a function of percentage removal of N from the inflow to the outflow) has deteriorated over time, but it is important to note that flow rate through the bed has dramatically increased over the past two sampling dates. The bed continues to remove some nitrate from the inflow even at the highest rate of flow encountered. Unfortunately the assessments of flows are very much estimates as we did not have the gear on hand to measure over multiple points; however, using averages of the approximations yields:

	NOx-N Inlet mg L^{-1}	NOx-N Outlet mg L^{-1}	NOx-N Removal mg L^{-1}	Flow estimate L min^{-1}	NOx-N removed mg min^{-1}
21/08/2008	2.13	1.37	0.76	25	19
7/12/2008	1.97	1.74	0.23	50	11.5
15/04/2009	2.04	1.80	0.24	125	30

Table 2 NOx removal performance

Table 2 shows the amount of NOx removal on a mass per time period basis using estimates of flow rate at the time of sampling. Based on these calculations, removal of NOx on a mass is similar between sampling, suggesting the bed continues to operate but is now underdesigned for the volume of water passing through it.

3. Conclusions

The bed continues to remove nitrogen present in the stream flow at the previously quoted figure of approximately 2 g NOx m^{-3} (of bed) d^{-1}. The performance of the bed with regard to mass removal of nitrogen per day appears to be relatively immune to heightened flows through the bed.

It is recommended that the bed be re-sampled in two years time. This would be valuable to evaluate longer term performance.