20 November 2012

Forbes Ecology
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Geange Consulting
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Attn: Kerry Geange

Dear Kerry,

Compilation of Supporting Information Regarding Martinborough WWTP Assessment of In-stream Effects

This is a compilation of advice provided to Geange Consulting over the period 8th of June to 27th of November regarding the effects of the discharge of treated wastewater to the Ruamahunga River. The intention of this document is to compile previously prepared technical assessment work into one document in a format suitable for inclusion as an Appendix to the resource consent application.

Background:

My involvement in this project started with preparation of a response to the GWRC assessment of completeness of the resource consent application (i.e.: Aquanet Consulting Ltd letter dated 6th May 2012). That GWRC initiated review focused on two technical documents, and my response targeted matters raised in relation to one of those documents, the "Assessment of Ecological Effects on the Ruamahanga River, South Wairarapa", dated April 2012 and prepared by EAM Environmental Consultants (EAM)". My response is dated 8th June 2012, and the content of which forms the first part of this compilation below.

On the 28th June 2012 I provided Geange Consulting a summary of the effects section of the EAM Assessment of Ecological Effects on the Ruamahunga River. More recently (26th October) I provided a second review covering wider-sourced data to describe evidence for, and the nature of, known effects on the Ruamahunga River from the treated wastewater discharge.

On the 18th of November I provided a targeted appraisal of monitoring data and mass balance predictions relating to ammonia and total nitrogen concentrations and a comparison of those concentrations against relevant ANZECC trigger values and GWRC proposed water quality limits.

On the 27th of November I provided a series of mass balance calculation results to predict what effect various additional treatment scenarios would likely have on receiving environment quality.

All of the work outlined above follows in chronological order below.

Item One: ***Response to GWRC assessment of consent application for completeness of information (Aquanet Consulting Letter dated 6 May 2012).***

Dear Kerry,

Please find the requested assessment of the Aquanet Consulting Ltd letter titled: *Martinborough wastewater discharge to the Ruamahanga River, Assessment of consent application for completeness of information (6 May 2012).*

We understand that the Aquanet letter is a peer review of the *Assessment of Ecological Effects on the Ruamahanga River, South Wairarapa, from the Martinborough Wastewater Treatment Plant (April 2012),* made on behalf of the Greater Wellington Regional Council for completeness in terms of Section 88 of the RMA.

We have been asked to provide a comparative analysis of both documents, and either:

a. Advise an appropriate response to each matter raised by Aquanet based on the information contained in the application and AEE submitted; or,

b. Where insufficient information is available, we have been asked to provide a sufficient technical response and advise what additional analysis or information is required in order to do so.

Aquanet Consulting Ltd raised 14 points. These points have been addressed and responded to below:

1. <u>*Section 1.3.2 ammonia guidelines*</u>*: If the intention is to refer to ammonia as a toxicant, then the toxicants trigger value as per table 3.4.1 of the ANZECC should be used. The 0.021 mg/L trigger value used in the AEE is also from the ANZECC Guidelines but is not related to toxic effects; rather it is based on relative distribution of data at monitoring sites across the country. This point needs to be carried through to other sections of the report.*

Response: Table 3.4.1 of the ANZECC Guidelines specifies trigger values for toxicants. For Ammonia as a toxicant a trigger value of 0.9g/m^3 for protection of 95% of species in freshwater is specified[1]. See response below in relation to completeness review point 3.

2. ***Section 2.8, tables 5 and 8**: Are all the current consent's wastewater quality standards met? I note that the summer total ammonia-N geomean and 90th percentile do not meet table 5 "summer" standard, but I have not compared all the values. If I understand well, the Applicant's proposal is to maintain the effluent standards as per the current consent conditions. How will the applicant address the apparent ammonia-N exceedances (or any other exceedances)?*

Response: The query relates to the level of compliance of current consent's wastewater quality standards. From the information contained in the AEE it can be determined that:

- The treated wastewater quality meets the resource consent standards for oil, grease, and pH.
- The geometric mean of the six remaining parameters do not meet the requirements of Condition 7.

A summary of non-compliance is presented below. Tick marks indicate compliance of treated wastewater quality with the respective parameter. Crosses represent non-compliance. In the case of non-compliance, a summary of the scale of non-compliance against the July 2009 consent standards follows the table below.

Parameter	2.5 years from commencement of consent [Jan 2005].	Compliance of geometric mean	Compliance of 90th percentile < 50% of samples	7 years from commencement of consent [*July 2009*].	Compliance of geometric mean	Compliance of 90th percentile < 50% of samples
E coli (cfu/100mL)	2,000	✗	-	200	✗	-
BOD (g/m^3)	40	✗	-	15	✗	-

[1] 0.9g/m^3 at pH 8 and 20°C. However this value is dependent on pH and temperature. As most pH and temperature conditions will be less than pH 8 and 20°C the trigger value will be higher and therefore this value is conservative.

Suspended solids (g/m^3)	60	✗	-	20	✗	-
Oil and grease (mg/L)	10	✓	✓	10	✓	✓
Total nitrogen (mg/L)	20	✗	-	15	✗	-
Ammonia nitrogen (mg/L)	5 summer 10 winter	✗	-	5 summer 10 winter	✗	-
Total phosphorus (mg/L)	10	✗	-	3	✗	-
pH	6.5-8.5	✓	✓	6.5-8.5	✓	✓

A more detailed summary of non-compliance of wastewater quality against resource consent standards (Condition 7 standards effective as of July 2009) is outlined below:

- E coli:
    - Summer-time geometric mean is 23 times greater than respective resource consent standard.
    - Winter-time geometric mean is 44.5 times greater than respective resource consent standard.
- BOD:
    - Summer-time geometric mean is 2 times greater than respective resource consent standard.
    - Winter-time geometric mean is 2.07 times greater than respective resource consent standard.
- Suspended solids:
    - Summer-time geometric mean is 2.2 times greater than respective resource consent standard.
    - Winter-time geometric mean is 1.85 times greater than respective resource consent standard.

- Total nitrogen:
    - Summer-time geometric mean is 1.6 times greater than respective resource consent standard.
    - Winter-time geometric mean is 1.7 times greater than respective resource consent standard.
- Ammonia nitrogen:
    - Summer-time geometric mean is 2.36 times greater than respective resource consent standard.
    - Winter-time geometric mean is 1.62 times greater than respective resource consent standard.
- Total phosphorous:
    - Summer-time geometric mean is 2.13 times greater than respective resource consent standard.
    - Winter-time geometric mean is 2.23 times greater than respective resource consent standard.

3. *Section 2.4:* *What are the mass loads referred to (Average, median, typical?)? Would it not be more correct to calculate the daily load for each day where effluent volume and quality data are available, and then provide descriptive statistics, such as average, median, min/max, etc…? If the intention is to provide a rough idea of average mass loads, then I suggest it should be calculated based on average (not median) concentrations.*

Response: Data has been calculated as suggested, see below. These calculations are based on seven days when treated wastewater quality and discharge quantity are known.

	SS (kg/day)	BOD (kg/day)	NH3-N (kg/day)	Total P (kg/day)	DRP (kg/day)	Total N (kg/day)
	46	28	9.8	2.8	2.2	14.8
	34	31	11.2	3.0	1.5	15.5
	10	12	8.9	2.0	1.8	11.1
	12	10	9.4	2.0	1.7	10.9
	13	3	10.5	2.0	1.8	12.2
	40	15	8.7	2.6	1.9	15.4
	38	7	5.5	2.3	1.8	10.8
min	*10*	*3*	*5.5*	*2.0*	*1.5*	*10.8*
mean	*28*	*15*	*9.1*	*2.4*	*1.8*	*12.9*
median	*34*	*12*	*9.4*	*2.3*	*1.8*	*12.2*
max	*46*	*31*	*11.2*	*3.0*	*2.2*	*15.5*
n	*7*	*7*	*7*	*7*	*7*	*7*

4. *<u>Sections 3.5.1 to 3.55 (Nutrients and periphyton):</u> I have already made this comment in relation to the Greytown AEE. These sections are a sentence-by sentence paraphrasing of part of a recent report I wrote for GWRC (and the figures are copied and pasted from the same report). This is rather unusual – it is more common practice to write a succinct summary and refer to the report – or reproduce sections of the actual report in an appendix if really relevant.*

Response: Agreed and noted.

5. *<u>Section 3.5.6:</u> The section starts with a mention that ammonia can be toxic to aquatic organisms. However, the guideline used is not effects-based which leads to the question: what do these results mean in terms of potential toxic effects?*

Response: The ANZECC uses the term 'toxicant' to describe chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment.

As noted earlier, Table 3.4.1 of the ANZECC Guidelines specifies trigger values for toxicants. For ammonia as a toxicant a trigger value of 0.9g/m^3 for protection of 95% of species in freshwater is specified (at pH 8 and 20°C).

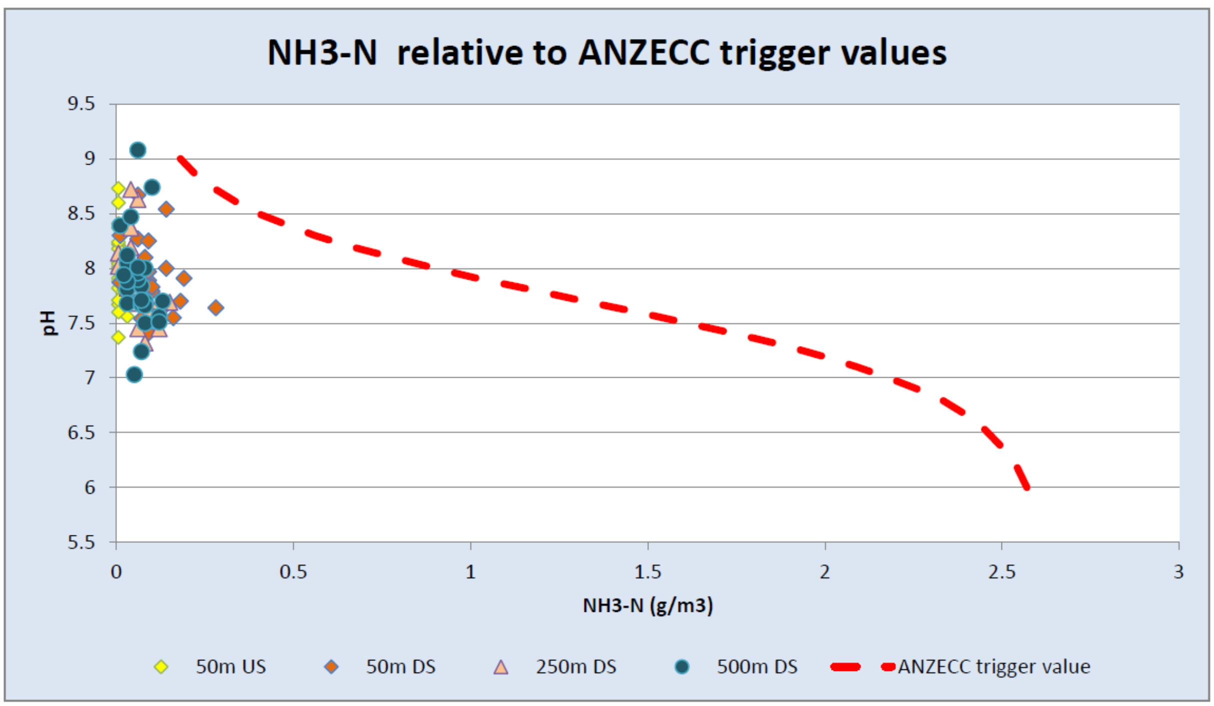
Table 26 of the EAM AEE (April 2012) provides ammonia summary statistics upstream, at the discharge, 50m DS, 250m DS, 500m DS, at Gladstone Bridge and at Pukio.

Ammonia toxicity is dependent on pH and water temperature. However, if a toxic trigger value concentration of 0.9g/m^3 is applied (conservatively assuming pH 8 and 20°C) ammonia is at less than toxic concentrations at all river monitoring locations. At the closest monitoring point to the treated wastewater outfall (50m DS of the discharge) median ammonia concentrations (0.09g/m^3) are 10 times less than the toxic trigger value. Also, at that monitoring location the maximum recorded ammonia concentration is 3.21 times less than the toxic trigger value.

Concentrations prior to the discharge of treated wastewater range from 1.45 times (minimum) to 46.7 times (maximum) the toxic trigger value concentration. However, ANZECC trigger values are applicable after reasonable mixing (rather than to unmixed treated wastewater).

On this basis the data suggests that mixing of treated wastewater reduces potentially toxic ammonia concentrations to less than toxic levels well within 50m downstream of the discharge point.

The plot below shows at 50m US, 50 DS, 250m DS and 500m DS downstream the majority of results substantially less than toxic concentrations.



6. *Section 3.5.10: I suggest it would be informative to also run these calculations based on the Table 3 limits, in particular for DRP, DIN and total ammonia-N.*

Response: Assimilative capacity using data presented in the EAM AEE Tables 18, 19, 20 and 21 against GWRC proposed water quality limits for the lower Ruamahanga River are presented below:

Parameter	GWRC proposed recommended limit	Flows < ½ median flow	Flows < median flow
Assimilative capacity in the Ruamahanga River at McLays			
DRP (mg/L)	0.014 (@<3* median)	0.002 ***(+0.012)***	0.002 ***(+0.012)***
DIN (mg/L)	0.180 (@ <3* median)	0.030 ***(+0.150)***	0.030 ***(+0.150)***
NH_4-N (mg/L)	0.900 (@ pH8 and 20°C) (@ all flows)	0.005 ***(+0.895)***	0.005 ***(+0.895)***
Clarity (m^{-1})	3 (@ < median)	5.07 ***(+2.07)***	4.26 ***(+1.26)***
E.coli (cfu/100mL)	550/100mL (@ <3*median)	4 ***(+546)***	1.5 ***(+548.5)***
Assimilative capacity in the Ruamahanga River at Te Ore Ore			
DRP (mg/L)	0.014 (@<3* median)	0.008 ***(+0.006)***	0.003 ***(+0.011)***
DIN (mg/L)	0.180 (@ <3* median)	0.385 ***(-0.205)***	0.385 ***(-0.205)***
NH_4-N (mg/L)	0.900 (@ pH8 and 20°C) (@ all flows)	0.005 ***(+0.895)***	0.005 ***(+0.895)***
Clarity (m^{-1})	3 (@ < median)	2.63 ***(-0.37)***	1.79 ***(-1.21)***
E.coli (cfu/100mL)	550/100mL (@ <3*median)	60 ***(+440)***	120 ***(+430)***
Assimilative capacity in the Ruamahanga River at Gladstone			
DRP (mg/L)	0.014 (@<3* median)	0.031 ***(-0.017)***	0.035 ***(-0.021)***
DIN (mg/L)	0.180 (@ <3* median)	0.429 ***(-0.249)***	0.320 ***(-0.140)***
NH_4-N (mg/L)	0.900 (@ pH8 and 20°C)	0.012 ***(+0.888)***	0.020 ***(+0.880)***

Parameter	GWRC proposed recommended limit	Flows < ½ median flow	Flows < median flow
	(@ all flows)		
Clarity (m^{-1})	3 (@ < median)	2.78 ***(-0.22)***	1.92 ***(-1.08)***
E.coli (cfu/100mL)	550/100mL (@ <3*median)	4 ***(+546)***	25 ***(+525)***
Assimilative capacity in the Ruamahanga River at Pukio			
DRP (mg/L)	0.014 (@<3* median)	0.007 ***(+0.007)***	0.015 ***(-0.001)***
DIN (mg/L)	0.180 (@ <3* median)	0.139 ***(+0.041)***	0.330 ***(-0.15)***
NH_4-N (mg/L)	0.900 (@ pH8 and 20°C) (@ all flows)	0.005 ***(+0.895)***	0.005 ***(+0.895)***
Clarity (m^{-1})	3 (@ < median)	2.1 ***(-0.9)***	1.0 ***(-2.0)***
E.coli (cfu/100mL)	550/100mL (@ <3*median)	45 ***(+505)***	61 ***(+489)***

In summary:

At McLays in the upper river catchment there is a surplus in assimilative capacity relative to the proposed GW recommended limit under both flow scenarios.

Downstream at Te Ore Ore the assimilative capacity/recommended limits for DIN and clarity are exceeded under both flow scenarios.

Further downstream at Gladstone the assimilative capacity/ recommended limits for DRP, DIN and clarity occurs under both flow scenarios.

At the lowest of the four monitoring sites and downstream of the Martinborough WWTP discharge point DRP and DIN exceed assimilative capacity under < median flow but comply under < ½ median flow conditions. Clarity is also reduced below the recommended limit.

7. *Section 3.5.11.2: The results essentially show a tripling of DRP and DIN loads between Gladstone and Pukio, although the concentrations of both are similar or lower at Pukio than they are at Gladstone. This is surprising given that mean flow at Pukio is only 1.6 times higher than at Gladstone. Are you please able to check/confirm the load calculations?*

Response: We have been unable to confirm with the author of the AEE the reason for this discrepancy between load and flow. However we do not view this as a critical point in considering the effects of the treated wastewater discharge on the environment.

8. *Section 4.2: The exact locations of the monitoring sites are unclear. Were the samples taken from the river's true left bank, or some distance in the channel, or along cross-river transects? Was a dye study undertaken to confirm that the samples were taken within the effluent plume? Were the samples taken monthly?*

Response: SWDC have confirmed the following aspects in relation to monitoring site locations:

- Samples are collected using an extendable 'grabber arm'.
- Where deep water is present adjacent to the river bank, samples are collected from the riverbank. Where shallow water adjoins the riverbank, the sampler wades across the river's width 10-15 metres to gather a sample from flowing water.
- Sample bottles are filled at roughly mid-depth of the water column.
- No studies (e.g dye study) of mixing of the treated wastewater discharge with the Ruamahanga River have been undertaken.

9. *Section 4.2: Could the water quality sampling data presented in the different table (e.g. table 26, table 27) be provided in an electronic format? Could the effluent discharge volume data on each water quality sampling day be also provided, please?*

Response: Both of these datasets accompany this response.

10. *Section 4.2 – Mass balance calculations: The effects of point-source discharge generally increase at low river flows, due to lesser available in-river dilution. The calculations should be undertaken at under low flow conditions (MALF and minimum flow) to provide an estimate of the discharge's potential effects on water quality at low river flows.*

Response: Mass balance calculations based on MALF and minimum flows in the Ruamahanga River are presented for water quality parameters below. Calculations are based on the following variables:

- Mean annual 7 day low flow @ Waihenga Bridge = 10.636 m^3/sec;
- Minimum flow @ Waihenga Bridge = 8.5 m^3/sec;
- Wet weather treated wastewater flow rate = 0.006 m^3/sec;
- Dry weather treated wastewater flow rate = 0.0074 m^3/sec.

In summary, under mean annual 7 day low flow and minimum flow conditions, using the variables listed above, all water quality parameters except ammonia and DRP comply with relevant ANZECC and GWRC maximum limits.

Under these low flow conditions, and with the assumed available dilution ammonia would at times not comply with ANZECC default trigger value.

Dissolved Reactive Phosphorus contributed by the treated wastewater discharge increase the concentration after full mixing by between 19% and 29%.

	Ammoniacal-N											Compliance after full mixing		
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	ANZECC trigger value (toxicant trigger value)	GWRC proposed limit	ANZECC (default)	ANZECC (toxicant)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3	g/m3			
	Mean annual 7 day low flow @ Waihenga Bridge													
dry weather ww flow rate	10.636	0.006	1773	0.005	25.9	**0.0196**	0.0146	292	0.021	0.9	0.9	✓	✓	✓
wet weather ww flow rate	10.636	0.0074	1437	0.005	25.9	**0.0230**	0.0180	360	0.021	0.9	0.9	×	✓	✓
	Minimum flow @ Waihenga Bridge													
dry weather ww flow rate	8.5	0.006	1417	0.005	25.9	**0.0233**	0.0183	366	0.021	0.9	0.9	×	✓	✓
wet weather ww flow rate	8.5	0.0074	1149	0.005	25.9	**0.0275**	0.0225	451	0.021	0.9	0.9	×	✓	✓

* background median value from sampling (*n=27*)
** 'summer' median contaminant concentration

	E.coli										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	MfE 'acceptable' for contact recreation	GWRC proposed limit	MfE acceptable for contact recreation	GWRC
	m3/sec	m3/sec		cfu/100ml	cfu/100ml	cfu/100ml	cfu/100ml	%	cfu/100ml	cfu/100ml		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	46	500	**46.28**	0.2821	1	<260cfu/100ml	<260cfu/100ml	✓	✓
wet weather ww flow rate	10.636	0.0074	1437	46	500	**46.35**	0.3479	1	<260cfu/100ml	<260cfu/100ml	✓	✓
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	46	500	**46.35**	0.3529	1	<260cfu/100ml	<260cfu/100ml	✓	✓
wet weather ww flow rate	8.5	0.0074	1149	46	500	**46.44**	0.4353	1	<260cfu/100ml	<260cfu/100ml	✓	✓

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

	DRP										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	0.018	6.03	**0.0214**	0.0034	19	0.01	0.014	×	×
wet weather ww flow rate	10.636	0.0074	1437	0.018	6.03	**0.0222**	0.0042	23	0.01	0.014	×	×
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	0.018	6.03	**0.0223**	0.0043	24	0.01	0.014	×	×
wet weather ww flow rate	8.5	0.0074	1149	0.018	6.03	**0.0232**	0.0052	29	0.01	0.014	×	×

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

	Total P										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	0.025	7.2	**0.0291**	0.0041	16	0.033	-	✓	-
wet weather ww flow rate	10.636	0.0074	1437	0.025	7.2	**0.0300**	0.0050	20	0.033	-	✓	-
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	0.025	7.2	**0.0301**	0.0051	20	0.033	-	✓	-
wet weather ww flow rate	8.5	0.0074	1149	0.025	7.2	**0.0313**	0.0063	25	0.033	-	✓	-

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

	Total N										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	0.49	32.3	**0.5082**	0.0182	4	0.614	-	✓	-
wet weather ww flow rate	10.636	0.0074	1437	0.49	32.3	**0.5125**	0.0225	5	0.614	-	✓	-
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	0.49	32.3	**0.5128**	0.0228	5	0.614	-	✓	-
wet weather ww flow rate	8.5	0.0074	1149	0.49	32.3	**0.5181**	0.0281	6	0.614	-	✓	-

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

	Suspended solids										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	2.5	32	**2.52**	0.0181	1	-	-	-	-
wet weather ww flow rate	10.636	0.0074	1437	2.5	32	**2.52**	0.0223	1	-	-	-	-
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	2.5	32	**2.52**	0.0226	1	-	-	-	-
wet weather ww flow rate	8.5	0.0074	1149	2.5	32	**2.53**	0.0279	1	-	-	-	-

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

	BOD										Compliance after full mixing	
	River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
	m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
	Mean annual 7 day low flow @ Waihenga Bridge											
dry weather ww flow rate	10.636	0.006	1773	0.5	28	**0.5158**	0.0158	3	-	*2*	-	✓
wet weather ww flow rate	10.636	0.0074	1437	0.5	28	**0.5195**	0.0195	4	-	*2*	-	✓
	Minimum flow @ Waihenga Bridge											
dry weather ww flow rate	8.5	0.006	1417	0.5	28	**0.5198**	0.0198	4	-	*2*	-	✓
wet weather ww flow rate	8.5	0.0074	1149	0.5	28	**0.5244**	0.0244	5	-	*2*	-	✓

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

11. *Section 4.2 – Mass balance calculations: what upstream concentrations are these calculations based on? What is the discharge's contribution to the calculated downstream concentrations? (These comments/questions are valid for all water quality determinands);*

Response: Upstream concentrations used in the mass balance calculations are based on 11 to 14 samples taken within 100m upstream of the Martinborough treated wastewater discharge point. The median value of that data set has been used to represent background conditions.

12. *Section 4.2.3: Why were calculations not run for E. coli? This would be the best way to predict the likely effects of the discharge once/if the UV treatment system performs to the proposed standard (100 E. coli/100mL).*

Response: An *E.coli* mass balance calculation has now been completed, see response to point 11 above.

13. *Section 4.3: Could a copy (electronic if more convenient) of the macroinvertebrate sampling reports be provided, please (Coffey, 2006 to 2011)?*

Response: See PDF files enclosed.

14. *Section 5.4 appears incomplete.*

Response: no response possible.

-------END OF I TEM ONE-------

Item Two: ***Summary of EAM (2012) Assessment of Environmental Effects, Martinborough WWTP discharge***

Dear Kerry,

I am pleased to provide you with a summary of the findings of the Environmental Assessments and Monitoring Ltd (EAM) Assessment of Environmental Effects relating to the discharge of treated wastewater from the Martinborough Wastewater Treatment Plant. I have formatted the summary under similar headings to those that we used for the Featherston Assessment of Environmental Effects.

It is important to note that the following is a direct summary of the EAM analyses and conclusions. I have undertaken no additional analysis as part of this review. In several locations for completeness I have included in summary form excerpts from the Forbes Ecology response to the Aquanet Completeness Review (my Letter dated 8th June). For clarity, those findings are provided in blue text.

1. Assessment of effects to aquatic ecology

1.1 Macroinvertebrates

- MCI and QMCI scores at the reference site and the 500m downstream site fall within the 'fair' range while at the 200m downstream site scores generally fall with the 'poor' range.
- Some stress is evident in macroinvertebrate communities at both the reference and 500m downstream sites, while the community at the 200m downstream site is likely impaired, due to the treated wastewater discharge.
- No significant differences in MCI or QMCI scores between the reference site and the 500m downstream site (within years). This indicates broadly that the aquatic macroinvertebrate community is significantly adversely affected at the point 200m downstream of the discharge point, and not significantly affected 500m downstream from the discharge point.

1.2 Periphyton

- After complete mixing, under flows less than median flow in the Ruamahanga River periphyton biomass is likely to exceed the guideline limits of 50 mg/m^2, and 120 mg/m^2 guidelines after approximately 10 to 20 days, and 15 to 20 days respectively during stable flows.

1.3 Fish

- No analysis of effects to fish communities is provided.

2. Assessment of effects to water quality

2.1 Temperature, pH and dissolved oxygen

- It is unlikely that the discharge of treated effluent from the MWWTP will have anything but negligible effects with regards to % DO saturation levels in the Ruamahanga River after reasonable mixing has occurred.

2.2 Clarity

- It is predicted that at all flows there is unlikely to be significant changes in visual clarity (<0.5%) downstream of the discharge from the MWWTP.

- Based on predictions the in-stream target of <30% change for the protection of contact recreation and amenity values of the Ruamahanga River would be met.

2.4 Nutrients

Ammonia

- The discharge is contributing significant levels of NH4-N to the Ruamahanga River, causing levels of which adverse effects may be occurring up to 500m downstream of the site.
- Based on mass balance calculations, under mean annual 7 day low flow and minimum flow conditions ammonia would at times not comply with ANZECC default trigger value for protection of 95% of species.
- Ammonia concentrations reported by EAM at 50m, 200m and 500m downstream of the discharge point are all less than (i.e. complying with) the ANZECC acute ammonia toxicity threshold of 0.9mg/L.

Dissolved Inorganic Nitrogen

- Based on predictions from mass balance calculations, it is considered that DIN concentrations would comply with ANZECC 95% protection trigger values under river flow conditions of half median, median, 3 x median and >3 x median.
- However, of the above flow categories, only half median flow conditions are predicted to comply with the proposed GWRC DIN guideline.

Dissolved Reactive Phosphorous

- Mass balance predictions for DRP suggest that only under half median flows would DRP likely comply with ANZECC and GWRC guidelines. Under median, 3 x median and >3 x median flows DRP would likely not comply.
- Based on mass balance calculations, under mean annual 7 day low flow and minimum flow conditions DRP contributed by the treated wastewater discharge increases the concentration after full mixing by between 19% and 29%.

2.5 Indicator bacteria

E.coli

- With one exception, discharge monitoring has found that *E.coli* counts around the MWWTP have been below the MfE ‘alert’ range for contact recreation.
- The one occasion where *E. coli* levels entered the amber range was in March at the 50m downstream site.
- Comparison of the reference site to the three downstream discharge monitoring sites revealed no significant differences on *E.coli* concentration.

- Monitoring data suggests that *E. coli* levels reduce to within the range reported at the upstream reference site within 50m of the discharge.

3. Section 107 considerations

RMA S107 Effects	EAM analysis for Martinborough WWTP
(1) The production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials.	No analysis provided.
(2) Any conspicuous change in the colour or visual clarity.	No analysis of colour. Effects on visual clarity predicted by calculations to be insignificant.
(3) Any emission of objectionable odour.	No analysis provided.
(4) The rendering of freshwater unsuitable for consumption by farm animals.	No analysis provided.
(5) Any significant adverse effects on aquatic life.	Localised significant adverse effects have been recorded: • Aquatic macroinvertebrate communities significantly affected at the point 200m downstream of the treated wastewater discharge point. Those communities not significantly affected 500m downstream. • Ammonia concentrations regularly exceed the default ANZECC trigger value for ammonia, but do not exceed the ANZECC acute toxicity trigger value for ammonia. Wider-spread and cumulative effects: • After mixing nutrient concentrations have only intermittent compliance with ANZECC and proposed GWRC guideline values. • Cumulative effects on the lake receiving environments by nutrient discharges is unquantified.

4. Summary of effects

The treated wastewater discharge to the Ruamahanga River from the Martinborough WWTP has been found to cause localised significant adverse effects. These effects are evident from monitoring of aquatic macroinvertebrate communities and water quality, and are summarised as follows.

At a point 200m downstream of the treated wastewater discharge point, macroinvertebrate communities have been consistently found to be significantly impacted. Comparison with upstream (background) and further downstream communities attributes the treated wastewater discharge as the cause of the impact.

However, 500m downstream of the discharge point the aquatic macroinvertebrate community is comparable to that upstream of the discharge point. This suggests that while there are significant adverse effects on in-stream fauna, those effects are localised to within less than 500m downstream of the discharge point.

Ammonia concentrations recorded at monitoring points downstream of the outfall commonly exceed ANZECC default trigger values of protection of 95% of species. However, an exceedance of the ANZECC trigger value for acute toxic effects by ammonia has never been recorded during monitoring at the site.

The treated wastewater discharge contributes quantities of both nitrogen and phosphorous compounds to the Ruamahanga River. The cumulative effects of these nutrients on lake receiving environments has not been assessed.

-------END OF I TEM TWO-------

Item Three: ***Martinborough WWTP, appraisal of Total Nitrogen and Ammonia compliance.***

All concentration units are g/m^3.

Total nitrogen:

Monitoring results (*n* = 27) –

ANZECC default trigger value	50m upstream		50m downstream		250m downstream		500m downstream	
	median	95%ile	median	95%ile	median	95%ile	median	95%ile
0.614	0.490	**1.122**	**0.640**	**1.231**	0.560	**1.189**	0.550	**1.181**

Mass balance calculation results –

Total N										Compliance after full mixing	
River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	GWRC proposed limit	ANZECC trigger value (default trigger value)	GWRC
m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3		
Mean annual 7 day low flow @ Waihenga Bridge											
10.636	0.006	1773	0.49	32.3	**0.5082**	0.0182	4	*0.614*	-	✓	-
10.636	0.0074	1437	0.49	32.3	**0.5125**	0.0225	5	*0.614*	-	✓	-
Minimum flow @ Waihenga Bridge											
8.5	0.006	1417	0.49	32.3	**0.5128**	0.0228	5	*0.614*	-	✓	-
8.5	0.0074	1149	0.49	32.3	**0.5181**	0.0281	6	*0.614*	-	✓	-

* background median value from sampling *(n=27)*
** 'summer' median contaminant concentration

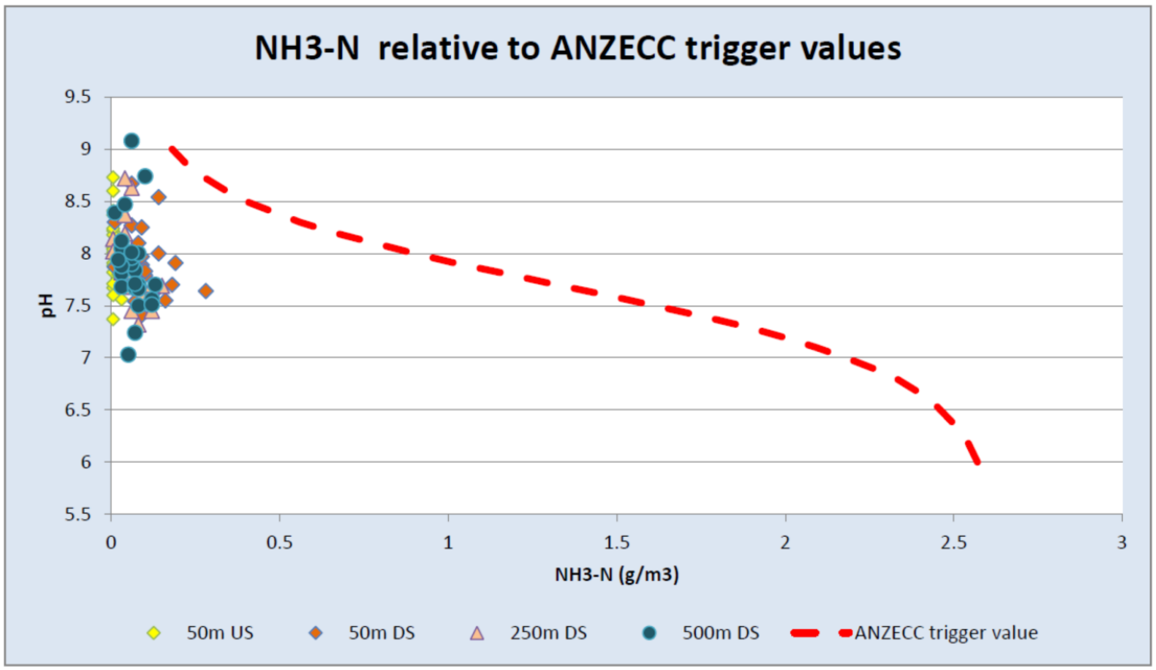
Summary: from monitoring it is clear that by 250m downstream of the outfall, median total nitrogen concentrations have returned to less than the ANZECC default trigger value. 95%ile results at all sites (including upstream) exceed the ANZECC default trigger value. Based on mass balance calculations, under mean annual 7 day flow and minimum flow rates (assuming effluent flow rates of 0.006 and 0.0074m^3/sec) compliance after full mixing is predicted. On this basis it can be concluded that compliance with the ANZECC default trigger value is variable.

Ammonia:

Monitoring results (n = 27) –

ANZECC default trigger value	ANZECC acute toxicity trigger value	GWRC proposed limit	50m upstream		50m downstream		250m downstream		500m downstream	
			median	95%ile	median	95%ile	median	95%ile	median	95%ile
0.021	0.900	0.900	0.020	**0.030**	**0.090**	**0.187**	**0.060**	**0.120**	**0.060**	**0.120**

Assessment against ANZECC toxicity trigger value -



Mass balance calculation results –

Ammoniacal-N											Compliance after full mixing		
River flow	Effluent flow rate	Dilution ratio	Background*	Effluent**	Fully mixed concentration	Addition to downstream concentration	% increase to downstream concentration	ANZECC trigger value (default trigger value)	ANZECC trigger value (toxicant trigger value)	GWRC proposed limit	ANZECC (default)	ANZECC (toxicant)	GWRC
m3/sec	m3/sec		g/m3	g/m3	g/m3	g/m3	%	g/m3	g/m3	g/m3			
Mean annual 7 day low flow @ Waihenga Bridge													
10.636	0.006	1773	0.005	25.9	**0.0196**	0.0146	292	*0.021*	*0.9*	0.9	✓	✓	✓
10.636	0.0074	1437	0.005	25.9	**0.0230**	0.0180	360	*0.021*	*0.9*	0.9	×	✓	✓
Minimum flow @ Waihenga Bridge													
8.5	0.006	1417	0.005	25.9	**0.0233**	0.0183	366	*0.021*	*0.9*	0.9	×	✓	✓
8.5	0.0074	1149	0.005	25.9	**0.0275**	0.0225	451	*0.021*	*0.9*	0.9	×	✓	✓

* background median value from sampling (*n=27*)
** 'summer' median contaminant concentration

Summary: monitoring shows that within 500m downstream of the outfall, compliance of ammonia (NH_3-N) with ANZECC default trigger level is rarely met. However, acutely toxic concentrations have not been recorded, and are not predicted to occur from mass balance calculations (compliance with ANZECC toxicant trigger value and GWRC proposed limit).

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Item Four: ***Mass balance calculation results under various enhanced treatment scenarios.***

Please do not hesitate to contact me with any queries whatsoever on 022 367 2326 or by email at forbesecology@gmail.com.

Yours sincerely

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