MEMORANDUM

TO:	Rotorua Project Steering Committee Technical Advisory Group
FROM:	Jonathan Abell, Chris McBride and David Hamilton
DATE:	05 June 2015

RE: Scope of Lake Rotorua Wastewater Discharge Environmental Effects Study

1. PURPOSE

This memo outlines the scope of the Lake Rotorua Wastewater Discharge Environmental Effects Study following the provision of additional information and discussions at the Rotorua Project Steering Committee Technical Advisory Group meeting on 27 May 2015.

Specifically, we clarify the following:

1. updates to the lists of scenarios that we propose to simulate using the lake models;
2. how we will consider potential effects to the Puarenga Stream.

2. MODEL SCENARIOS

2.1. 1–D model scenarios

We are using a one–dimensional (1–D) lake water quality model to simulate the effects of the proposed options on lake trophic status over multiple years. The model simulates differences in water quality at different depths. The baseline period for the analysis is 2007–2014 and therefore we have configured the water quality model to represent in-stream and in-lake effects from alum dosing of the Puarenga and Utuhina Stream inflows. The model has been updated to reflect information provided at the meeting about the temperature of treated wastewater. Table 1 presents the scenarios that we propose to analyse with the 1–D model.

We await details of projected nitrogen and phosphorus concentrations in treated wastewater that correspond to the proposed 'Rotorua Wastewater Strategy' option (full membrane bioreactor, as per Mott McDonald 2015[1]); hence, we have not included this option in the list of proposed scenarios.

[1] Mott MacDonald. 2015. Wastewater strategy. Draft report for Rotorua Lakes Council. May 2015. 29 p.

Table 1 Proposed scenarios to simulate with the 1–D model

#	Code	Scenario	Details
1	1D_0	Baseline with no effluent discharge simulated.	Eight year period (2007-2014). Alum dosing effects represented.
2	1D_1_Stream	Treatment option 1, discharge to Puarenga Stream	
3	1D_2i_Stream	Treatment option 2i, discharge to Puarenga Stream	
4	1D_2ii_Stream	Treatment option 2ii, discharge to Puarenga Stream	
5	1D_2iii_Stream	Treatment option 2iii, discharge to Puarenga Stream	
6	1D_3i_Stream	Treatment option 3i, discharge to Puarenga Stream	
7	1D_3ii_Stream	Treatment option 3ii, discharge to Puarenga Stream	
8	1D_2iii_Stream - DO	Treatment option 2iii, discharge to stream, no dissolved oxygen in effluent	Option 2iii has the 'best' P treatment (TP = 0.10 mg/L) and 'moderate' N treatment (TN = 4.37 mg/L)
9	1D_3i_Stream - DO	Treatment option 3i, discharge to stream, no dissolved oxygen in effluent	Option 3i has the 'best' N treatment (TN = 2.63 mg/L) and 'moderate' P treatment (TP = 0.20 mg/L)
10	1D_2iii_Bed	Treatment option 2iii, discharge to lake bed	
11	1D_3i_Bed	Treatment option 3i, discharge to lake bed	
12	1D_0 - LTS	Baseline, Land Treatment System loads removed from the Puarenga Stream	
13	1D_2iii_Stream - LTS	Treatment option 2iii, discharge to stream, Land Treatment System loads removed from the Puarenga Stream	
14	1D_3i_Stream - LTS	Treatment option 3i, discharge to stream, Land Treatment System loads removed from the Puarenga Stream	
15	1D_0 - Alum	Baseline, alum effects (in-lake and in-stream) not simulated	
16	1D_2iii_Stream - Alum	Treatment option 2iii, discharge to stream, alum effects (in-lake and in-stream) not simulated	
17	1D_3i_Stream - Alum	Treatment option 3i, discharge to stream, alum effects (in-lake and in-stream) not simulated	
18	1D_0 - LTS - Alum	Baseline, Land Treatment System loads removed from the Puarenga Stream, alum effects (in-lake and in-stream) not simulated	
19	1D_2iii_Stream - LTS - Alum	Treatment option 2iii, discharge to stream, Land Treatment System loads removed from the Puarenga Stream, alum effects (in-lake and in-stream) not simulated	
20	1D_3i_Stream - LTS - Alum	Treatment option 3i, discharge to stream, Land Treatment System loads removed from the Puarenga Stream, alum effects (in-lake and in-stream) not simulated	
21	1D_0_1.5_t_P	Baseline with no effluent discharge simulated and P loads in the Puarenga stream reduced by 0.2 t	To reflect an improvement in P treatment that reduces P loads from the LTS from 1.7 t/y to 1.5 t/y

2.2. 3–D scenarios

We are using a three–dimensional (3–D) hydrodynamic model to examine how mixing processes may affect the transport and dilution of treated wastewater within the lake. We are comparing the effects of discharge to Sulphur Bay (via the Puarenga Stream) with discharge to the lake bed, at a site located 2 km directly to the north of the Puarenga Stream mouth (depth ≈ 27 m). We will compare summer (2013/2014) and winter (2014) periods. Simulations involve a short 'spin-up' period and then run for 30 to 60 days. For all scenarios, we will also examine how consistent winds from either the north–east or south–west affect the results. These are the dominant wind directions in Rotorua and previous work led by Max Gibbs (NIWA) indicates that these wind conditions establish alternate circulation patterns that have the potential to exert major and differing effects on how treated wastewater moves throughout the lake. Finally, we will run a scenario to examine whether there are likely to be differences in transport depending on whether the point of discharge is at the mouth of the Puarenga Stream (representing sites 1–3), or at a site ~ 300 m to the east (representing sites 4–5). Table 2 presents the scenarios that we propose to analyse with the 3–D model.

Table 2 Proposed scenarios to simulate with the 3–D model

#	Code	Scenario
1	3D_W_Stream	Winter, effluent discharge to the Puarenga Stream
2	3D_W_Stream_SW	Winter, effluent discharge to the Puarenga Stream, SW wind forcing
3	3D_W_Stream_NE	Winter, effluent discharge to the Puarenga Stream, NE wind forcing
4	3D_W_Bed	Winter, effluent discharge to the lake bed
5	3D_W_Bed_SW	Winter, effluent discharge to the lake bed, SW wind forcing
6	3D_W_Bed_NE	Winter, effluent discharge to the lake bed, NE wind forcing
7	3D_S_Stream	Summer, effluent discharge to the Puarenga Stream
8	3D_S_Stream_SW	Summer, effluent discharge to the Puarenga Stream, SW wind forcing
9	3D_S_Stream_NE	Summer, effluent discharge to the Puarenga Stream, NE wind forcing
10	3D_S_Bed	Summer, effluent discharge to the lake bed
11	3D_S_Bed_SW	Summer, effluent discharge to the lake bed, SW wind forcing
12	3D_S_Bed_NE	Summer, effluent discharge to the lake bed, NE wind forcing
13	3D_S_Stream+Shore	Summer, discharge to both stream and shore to compare tracer paths

3. IN–STREAM EFFECTS

We will provide discussion of the potential ecological effects of the proposed options on the lower reach of the Puarenga Stream. This will be primarily based on the results of mass balance calculations to examine in–stream dilution and assess issues including short-term nitrate toxicity. Currently, our understanding of treated wastewater composition is based on mean concentrations presented in Table 9.1 in Mott MacDonald (2014[2]), and we await estimates of temporal variability of wastewater nitrogen and phosphorus concentrations under the proposed treatment options.

4. CLOSURE

We welcome any comments. Otherwise, we will proceed with the assessment as described. We intend to prepare a draft report for presentation at the Rotorua Project Steering Committee Technical Advisory Group meeting scheduled for 16 June 2015. We intend to prepare a final report for presentation to the Rotorua Project Steering Committee at a workshop on 17 July 2015.

[2] Mott Macdonald. 2014. Detailed Feasibility Study for Alternatives to Land Disposal. Draft Report prepared for Rotorua District Council. November 2014. 101 pages.