



Draft for discussion purposes

Report No. HR/TLG/2015-2016/4.9

Municipal and industrial water values in the Waikato River catchment

Memo to TLG on Point Sources

This memo was requested by the Technical Leaders Group for
the Healthy Rivers Wai Ora Project

The Technical Leaders Group approves the release of this memo to Project Partners and the Collaborative Stakeholder Group for the Healthy Rivers Wai Ora Project.

Signed by:

Date: 9 October 2015

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Memo

File No: 41 52 92
Date: 19 June 2015
To: Healthy Rivers/Wai Ora Technical Leaders Group
From: Blair Keenan
Subject: **Memo to TLG on Point Sources**

Purpose

This memo reports on additional information obtained from the operators of municipal and industrial point source sites, in relation to the report *Municipal and industrial water values in the Waikato River catchment* (Robak, 2013). It is accompanied by a spreadsheet which includes several versions of the point source data set¹.

Background

In 2013, on behalf of a joint venture between central government, the Waikato Regional Council, the Waikato River Authority, and Dairy NZ, the Ministry for the Environment commissioned Opus International Consultants Limited (Opus) to collate information about the major point sources of discharges to the Waikato-Waipā river catchment. These major point sources contribute approximately 7% of nitrogen loads and 18% of phosphorus loads (Vant 2014)².

The purpose of the study was to gain an understanding of the investment and ongoing costs of waste water treatment in the catchment. Opus provided a final report, *Municipal & industrial water values in the Waikato River catchment*, in December 2013, after it was reviewed by Peter Whitehouse of Water NZ (see attachment 1).

Summary of Opus findings

The Opus study (Robak, 2013) found that the total replacement cost of infrastructure in place is estimated to be \$306 million (\$200 million for municipal sites, \$106 million for industrial sites). Annual operating costs associated with this infrastructure are estimated to be \$21 million (\$12 million for municipal, \$9 million for industrial sites). An estimated \$247 million is expected to be spent on capital and operating expenses for these point sources over the next 10 years. The estimated amount of contaminants removed from wastewater being discharged is shown in table 1.

Opus assumed that the disposal of waste to land would prevent 100 per cent of contaminants from entering waterways. The Opus report estimates that, if all the sites included in the study were to invest in land disposal, this would require expenditure of \$836 million would be required over the next 10 years.

Table 1

¹ Refer DM# 3415466.

² So, for example, if all these were required to reduce N discharges by 10 percent, it would only reduce total loads by less than 1%. For phosphorus, a 10% reduction in p discharged from all sites would only reduce total loads by 1.8%.

| Contaminant | Proportion removed by treatment |
|---------------------------------|---------------------------------|
| Biochemical Oxygen Demand (BOD) | 93% |
| Suspended solids | 93% |
| Total nitrogen | 71% |
| Ammonia nitrogen | 75% |
| Total phosphorus | 83% |
| Faecal coliforms | 99.9% |
| E.Coli | 99.9% |

Opus report implied cost curves

In the Opus report, estimates are provided for each site for the replacement, operating and maintenance costs and the commensurate levels of discharge of various contaminants. These costs can be represented as annual costs³, and related to discharges to approximate abatement cost curves for each site. Table 2 provides a summary, aggregated for municipal, industrial and total point source sites.⁴

Table 2

| MUNICIPAL | | | | | | | | | |
|----------------------|-------------------------|-----------------------------------|-----------------------|-------------------------|---------|--------|--------|----------|--|
| | Replacement Cost \$m | Annualised Replacement cost | Operating cost \$m | Total annual cost | SS | TN | TP | Ecoli | |
| No treatment | 0 | - | 0 | - | 9,339 | 1,334 | 265 | 8.49E+17 | |
| Primary | 99.2 | 8.53 | 5.157 | 13.69 | 4,654 | 1,065 | 213 | 8.39E+17 | |
| Secondary | 123.2 | 10.59 | 8.963 | 19.55 | 2,171 | 372 | 149 | 1.36E+15 | |
| Tertiary | 199.4 | 17.14 | 10.69 | 27.83 | 937 | 342 | 113 | 8.58E+14 | |
| Land disposal | 372.4 | 32.02 | 39.536 | 71.55 | - | - | - | 0 | |
| % currently excluded | | | | | | 72% | 44% | 100% | |
| INDUSTRIAL | | | | | | | | | |
| | Replacement Cost \$m | Annualised Replacement cost | Operating cost \$m | Total annual cost | SS | TN | TP | Ecoli | |
| No treatment | 0 | - | 0 | - | 23421 | 2165 | 778 | 3.22E+18 | |
| Primary | 65.6 | 5.64 | 4.64 | 10.28 | 11709 | 1733 | 626 | 3.22E+18 | |
| Secondary | 86.3 | 7.42 | 7.85 | 15.27 | 4502 | 454 | 224.5 | 5.98E+15 | |
| Tertiary | 138 | 11.86 | 9.29 | 21.15 | 984 | 924 | 316.57 | 2.17E+15 | |
| Land disposal | 321.3 | 27.62 | 24.07 | 51.69 | 0 | 0 | 0 | 0 | |
| % currently excluded | | | | | | 57% | 59% | 100% | |
| POINT SOURCES | | | | | | | | | |
| | Replacement Cost \$m | Annualised Replacement cost | Operating cost \$m | Total annual cost | SS | TN | TP | Ecoli | |
| No treatment | 0 | - | 0 | - | 32760 | 3499 | 1043 | 4.07E+18 | |
| Primary | 164.8 | 14.17 | 9.797 | 23.97 | 16362.8 | 2797.6 | 839.4 | 4.06E+18 | |
| Secondary | 209.5 | 18.01 | 16.813 | 34.82 | 6673.2 | 826.1 | 373.5 | 7.34E+15 | |
| Tertiary | 337.4 | 29.01 | 19.98 | 48.99 | 1920.9 | 1266 | 429.87 | 3.03E+15 | |
| Land disposal | 693.7 | 59.64 | 63.606 | 123.24 | 0 | 0 | 0 | 0 | |
| % currently excluded | | | | | | 64% | 59% | 100% | |

It is noted that the estimates for total nitrogen (TN) and total phosphorus (TP) shown in table 2 increase in the step from secondary to tertiary treatment for industrial point sources. This is likely a result of the variety of sources that Opus used to develop these estimates. The

³ In the table 2, annualised replacement costs are calculated on the basis of a 20-year loan at a 6 percent interest rate. These assumptions are indicative, and can be varied if required.

⁴ A spreadsheet with data by site is available (DM#3415466).

sources used, and uncertainties relating to the industrial sites in particular, are well documented in the Opus report.

It should be noted that while the information available for municipal wastewater sites was reasonably comprehensive, the information on municipal stormwater and industrial wastewater was less so, and the analysis relies on expert estimates and information from technical literature. Because of the uncertainties regarding the current information, care needs to be taken in interpreting results. The Opus report recommends that, if treatment levels at point sources are proposed to be increased in future, further detailed analysis should be undertaken to ensure cost effective solutions to wider water quality issues are found. Additional data from Waikato Regional Council monitoring has been subsequently used to more accurately reflect actual discharges⁵.

Feedback from operators

The Opus report was circulated to the operators of the point source sites, and feedback was invited as an additional check on the quality of the data used.⁶ Relatively little additional information was received from most operators. South Waikato District Council and Hamilton City Council provided additional data, which has been incorporated into the accompanying spreadsheet.

Kinleith Pulp and Paper Mill

Carter Holt Harvey, operator of the Kinleith Pulp and Paper Mill raised particular concerns around the data in the Opus report in respect of its site. Feedback from Carter Holt Harvey noted⁷, amongst other things that:

- The Opus report underestimates replacement costs for existing (secondary) plant by a factor of 2 or 3 for replacement costs, and a factor of 2 for operating and maintenance costs;
- Estimates for 'tertiary' treatment are also likely to be underestimated by a considerable margin. It is noted that this is not necessarily a simple matter of adding additional treatment plant, but may involve significant investment in the mill itself (there is already expenditure on production facilities to reduce loads to waste water treatment plants, and this has not been captured by the Opus report).
- If historical discharges are considered, 'untreated' discharges are substantially higher than the Opus estimate. The implication is that the amount of contaminant removed from existing discharges is higher than the Opus estimate.
- The feasibility of land disposal for this site is questionable. It is not clear that there is land available for the disposal of 87,000m³/day, nor what the other effects of the removal of that volume of water from the river may have.
- A near-zero level of discharges (which is the level broadly assumed to be achieved by land-based treatment) would require a once-in-30-year upgrade to the mill, which is probably in the order of \$1 billion. This is not all water treatment and would provide economic benefits too. The effect on the viability of the business is not clear, however.
- The pulp and paper mill does not produce discharges of faecal coliforms or E coli, so the values in the Opus report for bacterial contaminants are questioned in respect of the Kinleith site.

Table 3.1: Original data for Kinleith

⁵ Source: DM#2986905.

⁶ A record of this correspondence can be found in DM#3266549.

⁷ Source: DM#3140490.

| Kinleith | Replacement Cost \$m | Annualised Replacement cost | Operating cost \$m | Total annual cost | SS | TN | TP | Ecoli |
|------------------------|----------------------|-----------------------------|--------------------|-------------------|--------------|------------|-----------|-----------------|
| No treatment | 0 | - | 0 | - | 12,310 | 416 | 128 | 4.80E+13 |
| Primary | 29.0 | 2.49 | 0.09 | 2.58 | 6,155 | 333 | 103 | 4.80E+13 |
| Secondary | 40 | 3.44 | 2.46 | 5.90 | 2,981 | 146 | 20 | 4.80E+13 |
| Tertiary | 64 | 5.50 | 2.88 | 8.38 | 602 | 123 | 74 | 8.90E+10 |
| Land disposal - total | 197.7 | 17.00 | 12.16 | 29.16 | - | 0 | 0 | 0 |
| Land disposal marginal | 157.7 | 13.56 | 9.7 | 23.26 | | | | |

Table 3.2: Revised data for Kinleith*

| Kinleith | Replacement Cost \$m | Annualised Replacement cost | Operating cost \$m | Total annual cost | SS | TN | TP | Ecoli |
|------------------|----------------------|-----------------------------|--------------------|-------------------|--------------|------------|-------------|-----------------|
| No treatment | 0 | - | 0 | - | 12,310 | 416 | 128 | 0.00E+00 |
| Primary | 29.0 | 2.49 | 0.09 | 2.58 | 6,155 | 333 | 103 | 0.00E+00 |
| Secondary | 100 | 8.60 | 4.92 | 13.52 | 2,981 | 164 | 19.3 | 0.00E+00 |
| Tertiary | 160 | 13.76 | 5.76 | 19.52 | 602 | 123 | 74 | 0.00E+00 |
| Mill upgrade | 1000 | 85.97 | 5.76 | 91.73 | - | 0 | 0 | 0 |

* Costs and E.coli discharges are based on the operator feedback in the bullet points above. Land disposal costs are based on the mill upgrade scenario mentioned above. Operating costs are unknown, but assumed to be the same as the 'tertiary' option. TN and TP discharges for secondary are based on Waikato Regional Council monitoring data. It is noted that TP discharges are higher in the tertiary treatment scenario than actual discharges. Based on table 21 of Robak (2013), TP removal at tertiary is typically 1% higher than for secondary, so a TP figure of approximately 19 could be substituted for tertiary TP in this table.

Waipa District, Waikato District and Hamilton City

The three territorial authorities involved in a joint study of water services provided additional information on planned future capital expenditure from Mott MacDonald (2015). These councils operate seven of the major point sources covered in the Opus report.

Table 4: New information on future wastewater treatment capital spending

| | Total capex 2016-45 (\$m) | Average capex per year (\$m) |
|--------------------|----------------------------------|-------------------------------------|
| Hamilton | 274.6 | 9.2 |
| Cambridge | 24.2 | 0.8 |
| Te Awamutu | 27.5 | 0.9 |
| Te Kauwhata | 7.2 | 0.2 |
| Meremere | 2.4 | 0.1 |
| Huntly | 1.7 | 0.1 |
| Ngaruawahia | 0.5 | 0.02 |

These figures are undiscounted sums of future planned expenditures.
Source: Mott MacDonald (2015), Appendix C.

The costs in the Opus report are estimates of the replacement, operating and maintenance costs of the capital already in place. In the accompanying spreadsheet, these are combined to provide an estimate of 'total annual costs' (see also tables 2 and 3 above). They do not account for additional future expenditure that may be required to account for population growth. Hence, abatement costs derived from the Opus report may underestimate future costs that would be incurred when meeting constraints on point source discharges. As a first approximation of the effects of future growth, the average capital expenditure per year for each of the sites in table 4 could be added to the respective replacement cost figure in the spreadsheet⁸.

⁸ This has been done in the accompanying spreadsheet in the 'With feedback' tab.

Remaining data questions

Ex ante expectations would normally suggest that, as treatment levels increase, costs increase and discharges fall. However, there remain a number of apparent inconsistencies in the data for individual sites. These include: Tokoroa (for TN); Hamilton (for TN); Pukekohe (for TN and TP); Meremere (for SS, TN, TP and E. Coli); Te Kuiti (for TN); Te Awamutu (for TP and E.Coli); Taupo (for TN and TP); Kinleith (for TP); Te Awamutu Dairy (for TN and TP); Roto-o-Rangi (for SS, TN and TP); Lichfield (for TN); Hautapu (for TN); and Tuakau (for E.Coli).

There may be a number of reasons for these differences, including the different data sources used by Opus in its report. In some cases estimates by Opus, based on expert opinion, or published literature differ from monitoring data, or that from Assessment of Environmental Effects (AEE) reports. In some cases, for example, data from AEE reports may reflect consent conditions, rather than actual discharges (possibly because the site is operating below its consented capacity). Using the hypothetical data from the Opus report, all but a few of these differences disappear. It may also be that, in some cases, treatment may focus on particular types of contaminants and not others. Further expert knowledge would be required on a site-by-site basis to determine this.

There are a number of potential approaches to addressing such data inconsistencies. One approach would be to simply assume that the level of discharges at the higher level of treatment would be the same as for the previous level. Another would be to use the marginal expected removal rate. For example, if you expected to remove 90 per cent of a contaminant with secondary treatment, and 95 per cent with tertiary treatment, it could be assumed that the difference is a constant 5 per cent (or that it tertiary removes 5.6 per cent more than secondary treatment). These are 'quick fixes', and only appropriate if they are considered to represent a reasonable approximation of reality, or are unlikely to make a substantive difference to modelled outcomes. The types of amendments suggested in this exchange have not been made to any of the data at this time.

References

Mott MacDonald, 2015. *Business Case Analysis for Water Services*. Mott MacDonald Engineering Assessment and Evaluation report for Hamilton, Waipa and Waikato Council.

Robak, Anna, 2013. *Municipal and industrial water values in the Waikato River catchment*. Opus International Consultants Limited. Report for the Ministry for the Environment.

Vant, Bill, 2014. *Sources of nitrogen and phosphorus in the Waikato and Waipa rivers, 2003–12*. Waikato Regional Council TR 2014/56

Attachment 1: Email regarding review of Opus report⁹

From: Peter Whitehouse [<mailto:peter.whitehouse@waternz.org.nz>]

Sent: Tuesday, 19 November 2013 10:38 a.m.

To: Jean Le Roux

Cc: 'diana.hilgert@mpi.govt.nz'

Subject: RE: IQA - Waikato municipal and industrial water values

Jean – I have now reviewed the report and offer the following comments:

- Yes, the limitations are properly described
- Yes, the explanations are clear
- I did not find any of the text inflammatory in nature
- I haven't made any attempt to establish the accuracy of the financial information employed but do note I know Anna Robak, the study's author, and John Crawford, a reviewer of it. I have always found them professional and ethical to deal with so assume the methodology utilised was robust.
- My only suggestion of textual clarification would be in reference to Table 3 on p13. The financial figures require explanation in terms of what they are – i.e. are they millions? All the other figures are explained as tonnes/yr., etc.

Trust this brief comment assists.

Cheers

Peter

Peter Whitehouse | Manager, Advocacy & Learning



Greenock House | Level 12, 39 The Terrace

PO Box 1316 | Wellington 6140 | www.waternz.org.nz

DDI: +64 4 495 0895 | Tel: +64 4 472 8925 | Mob: +64 27 282 8680 | Fax: 64 4 472 8926

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From: Jean Le Roux [<mailto:Jean.LeRoux@mfe.govt.nz>]

Sent: Friday, 1 November 2013 9:07 a.m.

To: Peter Whitehouse

Cc: 'diana.hilgert@mpi.govt.nz'

Subject: IQA - Waikato municipal and industrial water values

Dear Peter,

Please find attached the final draft report on municipal and industrial water values for the Waikato river catchment.

My apologies for the delay but it took longer than expected to integrate all the changes to the report.

Could you please provide comments on:

- the *limitations* of the work undertaken – are these properly described, and their impact identified?
- the *explanations* – are these clear?

Please so also mark any proposed:

- *minor edits* – eg typos/language edits etc.
- *language changes* – please mark any statements that could be inflammatory to others on matters than are beyond the scope of the study.

⁹ From WRC DM#2911375

I would be very grateful if you could provide feedback by Friday 22nd November. Please note I am out of the country from the 7 to the 22 November so please direct any query to Diana Hilgert (Diana.hilgert@mpi.govt.nz) in the meantime.

Thank you very much for your contribution and I am really looking forward to hearing back from you,

Kind regards,

Jean

Jean Le Roux – Senior Economist

Ministry for the Environment – Manatu Mo Te Taiao

DDI: **04 439 7636** Website: www.mfe.govt.nz

23 Kate Sheppard Place, PO Box 10362, Wellington 6143

