BEFORE THE CANTERBURY REGIONAL COUNCIL

UNDER THE	Resource Management Act 1991
AND	
IN THE MATTER	of application CRC190445 by the Christchurch City Council for a comprehensive resource consent to discharge stormwater from within the Christchurch City area and in Banks Peninsula settlements on or into land, into water and into coastal environments

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STATEMENT OF EVIDENCE OF

SIMON RICHARD HARRIS FOR CHRISTCHURCH CITY COUNCIL

Dated 15 October 2018

CHRISTCHURCH CITY COUNCIL
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INTRODUCTION

1. My full name is Simon Richard Harris. I have been requested by the Christchurch City Council (**CCC** or **Council**) to give economic evidence in relation to the application for a comprehensive stormwater network discharge consent (**Application**).

2. I hold the qualifications of B.Agr.Sc (Hons) from Lincoln University. I am a member of the NZ Association of Agricultural and Resource Economics Society since 1991.

3. I am a Director of LWP Ltd. I have worked in the role for the past 4 years.

4. Previously I had been employed as Principal (Resource Economics) by Harris Consulting for 20 years, and as an associate with Brown Copeland and Co. Ltd for four years. During this time I worked as a consulting economist and undertook numerous consulting projects in resource economics and public policy. Prior to this I worked as a programme manager for the Foundation for Research, Science and Technology, and as a research assistant at Lincoln University Farm Management department and the Agribusiness and Economics Research Unit.

5. I have read and referred to the following documents when preparing my evidence:

   5.1 The draft evidence of Mr Tom Parsons;

   5.2 The draft evidence of Mr Brian Norton;

   5.3 The report “Assessment of Current and Future Stormwater Contaminant Load for Christchurch” prepared by Golder and Associates, September 2018’

   5.4 The evidence of Mr Eric van Nieuwkerk;

   5.5 The Avon SMP;

5.6 The Application lodged in July 2018, in particular the Golder (2018) Report, proposed conditions and the Environmental Monitoring Programme appended to the Application.

6. I confirm that I have read and agree to comply with the Code of Conduct for expert witnesses contained in the Environment Court Practice Note (dated December 2014). I confirm that the issues addressed in the statement of evidence are within my area of expertise. I have not knowingly omitted to consider facts or information that might alter or detract from the opinions expressed.

SUMMARY OF EVIDENCE

7. The purpose of this evidence is to provide evidence on the economic implications of different options for water quality treatment of stormwater in Christchurch City. This evidence does not assess the benefits of the stormwater network for reducing flooding in the city.

8. This evidence covers:

8.1 An outline of the approach to assessment of the economic implications;

8.2 Description of the four options for stormwater treatment considered in this analysis;

8.3 The costs of treatment;

8.4 The efficiency of treatment in terms of cost per % of contaminant removal;

8.5 Affordability of treatment options for ratepayers and section purchasers; and

8.6 The benefits of delaying a decision on treatment infrastructure that is additional to that proposed in the Application.

9. The Best Practice Infrastructure (**BPI**) scenario, being the one in the Application, includes the most cost effective treatment options. Requiring additional treatment

beyond this would add significantly to absolute costs and will have lower returns in terms of contaminants removed per dollar spent.

10. Source control appears from my assessment to be the least cost approach to reducing the copper and zinc loads to waterways and in the case of copper would reduce loads well below that able to be achieved from treatment. While source control is not currently within the control of the Council there is potential for it to become available over the term of the consent.

11. Average rates increase per household are modelled to be 1.79% higher after 30 years as a result of the BPI treatment, which could rise to 6.29% higher if the MT+ option was required. This is likely to be affordable for the average household or business, but may be significant for low income households and those paying a high proportion of their household income for housing.

12. The Environmental Monitoring Programme (EMP) in the consent conditions will provide better information through the duration of the consent on the appropriate level of treatment, and the availability of source controls will become more apparent over time. There are likely to be significant potential savings in costs if the decision on whether additional treatment to that in the Application is required can be delayed until this information is available.

APPROACH AND ASSUMPTIONS

13. Economic analysis in the public policy sphere generally aims to maximise the net benefit (benefits minus costs) of any investment or policy option being investigated. In the case of this Application, the benefits are water quantity related (which is not the subject of my economic analysis) and water quality related, including benefits for biodiversity, recreation and amenity values, and the costs are associated with the installation and maintenance of stormwater treatment systems. However because it is unknown how the levels of contaminants in the waterways relates to the stormwater discharges, nor how the stormwater discharge contaminant loads can be related to specific levels of benefit, it is not possible to determine the direct relationship between benefits and costs of the Application.

14. This evidence therefore uses a combination of analytical approaches that are used to assist decision makers in determining the appropriate course of action. None of these

are definitive on their own, but each provides useful information on the costs and impacts of the infrastructure investment options. These analyses are:

a) the overall cost of different treatment and source control options;

b) the cost efficiency of contaminant removal;

c) the affordability of the different options; and

d) the benefits of delaying a decision on whether water quality treatment infrastructure additional to that in the Application is needed.

15. My analysis considers four scenarios which are a subset of the options assessed in the Golder (2018) report. These scenarios are:

I. BPI– represents the infrastructure planned for in the Application;

II. BPI plus source control (**BPISC**) – the Application infrastructure plus control of zinc and copper sources. The zinc source control comprises painting of unpainted and poorly painted galvanised iron roofs. The copper sources are controlled by requiring use of copper free brake pads on light vehicles;

III. Full Treatment (**FT**) – widespread coverage across the built environment within the city of any single water quality scenario component. Simplistically this represents wide coverage of treatment via a single device (rain garden *or* proprietary filtration device *or* large community facility). This is roughly equivalent to Mitigation Scenario F from the Avon SMP;

IV. Maximised plus raingardens (**MT+**) – represents wide coverage of devices in series across the built environment within the city to form a treatment train (rain garden *and* proprietary filtration device / other large community facility).

16. The analysis of infrastructure costs and timing uses data as specified in the evidence of Mr Tom Parsons and Mr Brian Norton. The modelling of contaminant removal is taken as specified in the evidence of Mr Eric Van Nieuwkerk. The financial unit at Council assisted with the development of the ratings analysis.

17. The costs and timing of roof painting is based on the data in in Mr Van Nieuwkerk's model on areas of poorly painted and unpainted roofing. I have estimated the costs of painting at $19.70/m^2, which is based on estimate from Rawlinsons construction cost estimator (2012)[1] that has been updated to 2018 using the Producers Price Indices for Non Residential construction.[2,3] I have assumed the roofs require painting every 10 years and the costs are averaged out over that period (i.e. 1/10th of the cost per year). Roof painting is estimated to cost $6.7 million per annum in 2042. It is likely that the costs of this painting would be incurred by the building owners, and the costs are not included in the rating analysis discussed below.

18. I have based the costs of copper free brake pads on:

a) Data from the Ministry of Transport (MOT, 2018)[4] regarding the per capita number of light vehicles in Canterbury adjusted to the population of Christchurch, which gives 309,929 light vehicles within Christchurch City and a growth trend of 1.9% per annum;

b) MOT, 2018 statistics on the composition of the light vehicle fleet (17% new);

c) The frequency of replacement of brake pads (CASQA 20165) for vehicles less than 4 years old (21%) and more than 4 years old (29%);

d) The additional cost of brake pad replacement with copper free brake pads is based on information from ECan (2018)[6] of $10 – $15/vehicle, which was adopted at $12.5/vehicle; and

e) In the base case I assumed that after 12 years there will be no additional cost from using copper free brake pads. This time frame is based on information in the CASQA report on the implementation pathway for phasing out of copper in brake pads in California and Washington states. The cost of maintaining

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1 Rawlinson & Co., 2012. NZ Construction Cost Handbook. Rawlhouse Publishing, Auckland.

2 On the basis that the poorly painted and unpainted galvanised iron roofs are most likely to be on commercial and industrial buildings.

3 StatisticsNZ Business Price Indicators, June 2018, https://www.stats.govt.nz/information-releases/business-price-indexes-june-2018-quarter. Accessed 12 September 2018.

4 MOT, 2018. The New Zealand 2016 Vehicle Fleet: Data Spreadsheet

5 CASQA, 2016. Estimated Urban Runoff Copper Reductions Resulting from Brake Pad Copper Restrictions. California Stormwater Quality Association, April 13 2016. Accessed from https://www.casqa.org/news-library/public-resources, June 2018.

6 ECan 2018. The hidden pollutant in our brake pads. Environment Canterbury web page. www.ecan.govt.nz/get-involved/news-and -events/2018/the-hidden-pollutant-in-our-brake-pads/. Accessed July 2018.

duplicate manufacturing and supply chains for brake pads for all vehicle models is likely to be greater than the cost of simply moving all brake pad formulations to a copper free formulation over the same period, particularly given the rapid development of copper free formulations. Already there has been a voluntary movement to copper free brake pads through the USA, with the US Environmental Protection Agency, Environmental Council of the States, and motor vehicle industry associations signing a memorandum of understanding (**MOU**) that will see the copper content of brakes in the USA reduced to 0.5% by 2025.[7] I consider that by the same logic it is likely that copper brake pads will be phased out internationally as well. I sensitivity tested this assumption by maintaining additional costs of copper free brake pads for the full analysis period.

19. I combined the costs and outcomes for each scenario into an analytical framework that allows the capital and operating costs to be compared across different timescales. The results are presented as total capital spend (**capex**), the annual operating costs (**opex**) at 35 years when all infrastructure is installed, and a Net Present Value (**NPV**) of the future capex and opex cashflows on treatment over the whole 35 year period.

20. I have assumed that opex is sufficient to maintain the infrastructure in a good operating state for the period of analysis, and no renewal of infrastructure is allowed for over the period of the analysis. Opex is included for treatment infrastructure, which is likely to be incurred by the Council, and for galvanised iron roof painting and copper free brake pads, which is likely to be incurred by private households and businesses. From a societal point of view the incidence of the costs does not affect the overall outcome, so these are treated in the same way in the analysis.

21. A discount rate of 6% was used for the NPV analysis, which is the NZ Treasury recommendation for infrastructure projects,[8] but higher than Council's cost of capital (4% currently rising to 5% in 10 years). The sensitivity of results refers to how much the results change as a result of differing input assumptions. I tested the sensitivity of the NPV costs to discount rates using 4% and 8% discount rates. All figures for this part of the analysis are in nominal (2018) dollars.

7 http://www.copperfreebrakes.org/assets/mou-press-release-final-01-21-15-3.pdf. Accessed September 2018.
8 https://treasury.govt.nz/information-and-services/state-sector-leadership/guidance/financial-reporting-policies-and-guidance/discount-rates. Accessed 21 September 2018.

22. The expenditure on treatment costs is usefully understood in the context of cost effectiveness of contaminant removal, and the affordability of that expenditure. The cost effectiveness was calculated using the results of the analysis undertaken by Mr Van Nieuwkerk described in his evidence. The calculation estimates cost per additional percentage removal of contaminant for each scenario when all the infrastructure is fully installed, with the BPI scenario reported as relative to existing treatment infrastructure, the BPISC and FT scenarios reported as their marginal cost effectiveness relative to Best Practice Infrastructure, and the MT+ scenario relative to the FT scenario. This approach allows the costs and gains of each incremental treatment to be assessed.

23. The analysis of the impacts on rates utilised the Council's rating model. This model charges all infrastructure capex as a loan, repaid at 3% per year at an interest cost of 4% rising to 5% by 2027. Opex for infrastructure are charged directly to rates. I included the cashflows of expenditure into the rating model used by Council to estimate the rate requirements for their Long Term Plan (**LTP**), which already includes the BPI costs. The Council's rating model includes the impact of inflation and of growth within the city. Inflation affects the magnitude of costs incurred, but also affects the ability of householders to pay for the infrastructure. The addition of households through growth adds to the rating base to pay for infrastructure. In order to simplify the results and present them in a format that is understandable, my analysis:

a) Estimates the difference in total rates comparing current stormwater quality infrastructure with each of the scenarios at different time periods; and

b) Applies the additional percentage difference in total rates to the current rates cost for an average rating unit (residential and commercial) to provide an indicative estimate of the additional cost that is associated with each scenario.[9]

24. In addition to the rating impacts the addition of water quality treatment infrastructure to new developments adds costs for the developer. It is assumed in this analysis that the costs of this infrastructure are passed on to the purchasers of sections directly, although it should be noted that the ability to pass on these costs will depend on the

9 A sensitivity test using simple average (rate revenue required divided by projected household and business rating units) gives resulting absolute value changes that are of a similar order to the results presented here.

state of the market at the time of sale, and the different relative development costs between locations.

25. The opex for infrastructure in new developments is added to the rates across the city. Therefore new households contribute rates to pay opex on all infrastructure and also the capital on the retrofit infrastructure.

26. There is a benefit to delaying investment when:

    i. the future is uncertain; and

    ii. the (investment) decision is irreversible, whether fully or in part; and

    iii. the actor holding the (investment) option has the ability to delay.

27. An indicative assessment of the benefits of a delay are outlined in the Discussion section below.

RESULTS

Costs of treatment

28. The costs of the four treatment scenarios are shown in **Table 1** below, which shows the total capex, the opex for year 35 when all infrastructure is installed, and the NPV of each scenario. The capital costs of the BPI and BPISC are identical because no additional treatment infrastructure is included in the scenario with source control, and only the opex is altered to reflect the additional costs of painting roofs and sourcing copper free brake pads. The opex costs of BPISC in year 35 when all infrastructure is installed and all roofs painted is 322% greater than BPI.

29. The costs of FT are 78% greater than BPI for capex, and 169% greater for opex. The greater opex reflects the additional costs of servicing stormfilters, which are a major feature of the additional treatment in this option.

30. The MT+ scenario has 139% more capital expenditure than BPI, and the opex are 330% greater, which reflects the large number of facilities that must be serviced in this scenario.

31. The NPV of the costs, which incorporates the capex, opex and the timing of their expenditures, increases significantly beyond the BPI. The BPISC is 25% greater cost than BPI, FT is 115% greater, and MT+ is 151% greater.

32. The sensitivity of the NPV outcomes to different discount rates is shown in Table 2 below. They show that the BPI NPV results vary between $210 million and $310 million with a lower (4%) and higher (8%) discount rate. For the FT option the NPV results vary between $460m and $660m. An alternate assumption that the separate supply chains and price differential for copper free brake pads remained throughout the 35 year analysis period resulted in an additional $8 million in NPV costs. This difference is unlikely to affect any of the conclusions of this analysis.

Table 1: Costs of water quality treatment scenarios (2018 dollars)

Scenario	Total capital cost ($m)	Opex year 35 ($m)	NPV ($m, 6%)
BPI	$470	$2.3	$250
BPISC	$470	$9.9	$310
FT	$830	$8.6	$540
MT+	$1,120	$10.1	$630

Table 2: Sensitivity of NPV outcomes to discount rate ($m NPV)

Scenario	NPV(4%) $m,	NPV(6%) $m,	NPV(8%) $m,
BPI	$310	$250	$210
BPISC	$400	$310	$260
FT	$660	$540	$460
MT+	$790	$630	$520

Cost efficiency of contaminant removal

33. The removal of contaminants under each scenario below from Mr Van Nieuwkerk's evidence is shown in **Table 3**. The table shows that the most TSS and Zinc is removed under MT+, while the most Copper is removed in the BPISC option.

34. I assessed the cost efficiency of removal by comparing the cost of treatment with the proportion of contaminant removed by that treatment option at year 35. This is calculated using the total capex to year 35, and adds the capitalised value of the year 35 opex (using 6% discount rate). This analysis gives an indicator of the marginal cost per percentage reduction in contaminant at maximum treatment (i.e. once all infrastructure installed, roofs painted etc)– *i.e.* how much extra contaminant the measures remove versus how much additional cost the measure adds.

35. These results are shown in **Figure 1** below. They show that for TSS the BPI removes contaminants at the lowest cost, but that source treatment is substantially lower cost per percentage removed for both Zinc and Copper removal than any of the other treatment options.

36. MT+ is very cost inefficient at removing all contaminant with the highest cost per percentage of contaminant removed, while FT is significantly less cost efficient than BPI at removing all contaminants, and only slightly more cost efficient than MT+ at removing zinc and copper.

37. This analysis shows that the BPI scenario has likely used the most cost efficient measures for removing contaminants, and that as additional treatment infrastructure is added it is less and less cost efficient at removing contaminants.

Table 3: Load reduction from each treatment scenario

	Load reduction from No Treatment in year 35		
Scenario	**TSS**	**Zinc**	**Copper**
Best Practice Infrastructure	29%	21%	31%
Best practice plus source control	29%	40%	94%
Full treatment	46%	36%	49%
Maximised plus raingardens	49%	45%	57%

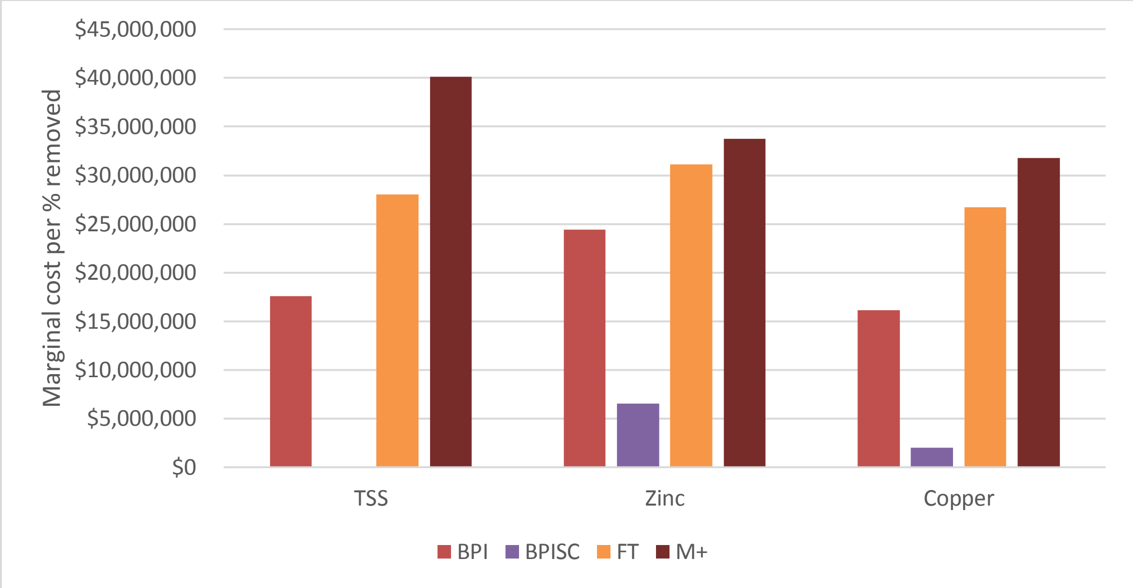

Figure 1: Cost of treatment compared with the proportion of contaminant removed, CCC Stormwater consent application (NPV(6%))

Impacts on Rates

38. The costs of the stormwater management are borne by ratepayers, developers, households and businesses. The ratepayers bear a significant proportion of the capex of the BPI, with a proportion borne by developers and section purchasers in new subdivisions. However all the opex in the BPI option is borne by ratepayers as the infrastructure is transferred to Council control. All the costs in the FT and MT+ scenarios are charged through rates because they are retrofits to existing subdivisions. The costs of source control in BPISC are borne directly by households and businesses through the costs of roof painting and copper free brake pads. These costs do not translate directly into costs for ratepayers because of timing and loan repayment implications, as well as growth in the number of ratepayers in the city.

39. The difference in rates for 2019, 2029, 2039 and 2042 resulting from the water quality infrastructure are shown in **Table 4**, and the indicative cost of this relative to current rates for the average property (CV) are shown in **Table 5** below. The results show that for the average household with the Best Practice Infrastructure, the rates would be 1.06% higher ($28/year) in 2028, rising to 1.79% more ($45/year) to 2042 at the end of the consent period. The FT scenario would add 4.96% ($131/year) to rates in 2028

for the average residential property, and 4.6% ($112/year) in 2042. MT+ would add 6.29% to rates ($167/year) in 2042 for the average residential property.

40. For the average business the costs of FT would be an additional $565/year rates in 2028, and $480/year to 2042, while MT+ would result in an additional $570 per year in 2028, and $718/year in 2042.

Table 4: Increase in rates associated with water quality infrastructure scenario

	Difference in total rates increase for water quality related infrastructure			
Scenario	**2019**	**2028**	**2038**	**2042**
BPI	0.03%	1.06%	1.69%	1.79%
BPISC	0.03%	1.06%	1.69%	1.79%
FT	0.26%	4.96%	4.74%	4.60%
MT+	0.26%	5.01%	6.07%	6.29%

Table 5: Additional rating cost in 2018 prices for water quality related infrastructure

Property type	Scenario	Increase in Annual Rates Cost in a given future year ($/average unit) for water quality related infrastructure			
		2019	**2028**	**2038**	**2042**
Average Household (based on CV)	**BPI**	$1	$28	$45	$45
	BPISC	$1	$28	$45	$45
	FT	$7	$131	$125	$112
	MT+	$7	$132	$160	$167
Average Commercial (based on CV)	**BPI**	$3	$121	$193	$192
	BPISC	$3	$121	$193	$192
	FT	$30	$565	$539	$480
	MT+	$30	$570	$691	$718

Impact on Section costs

41. New developments will include treatment to mitigate the effects of additional runoff. I have assumed that the capex associated with these treatments is included in development contributions or paid directly by the developer, and so do not appear in my rating impact calculation above. These costs have the potential to impact on the costs of sections in new developments, although the extent to which they are passed

on to section costs will depend on the specific market conditions at the time, and in some situations may impact on developer margins rather than section costs. The analysis here assumes that all the costs are passed on to section purchasers.

42. Statistics NZ[10] estimates an additional 25,200 households in Christchurch in 2038, and capital expenditure on stormwater infrastructure for growth developments is $117 million through to year 2038[11]. This would amount to an additional $2,400 per new household in water quality infrastructure related capex costs. It is unclear to me as to what extent this reflects that actual cost for each new development section because a proportion of the new households will be infill housing, or will be built on land that is already subdivided and is within the treatment areas allowed for under the rated development costings (i.e. not new subdivisions for which development contributions are liable). Therefore this estimate should be treated as a lower bound of the cost per section.

DISCUSSION

Results

43. My analysis above is based on information provided from various sources and is subject to the various caveats associated with that data. The analysis should therefore be seen as having reasonable error margins and some caution should be taken. Nevertheless the results show enough consistency that allows me to express an opinion on some key themes to be drawn.

44. The costs of moving to higher levels of treatment than those proposed in the Application would be substantial. These would amount to an additional $290 million in NPV of costs with FT, and an additional NPV of $380 million with MT+. As an indicative comparison the total capital cost of $830 million for FT compares with a total capital expenditure of $266 million for parks and open spaces of over the ten years of the LTP, or with Council contribution to major projects shown in Table 6. The NPV of costs associated with FT would be sufficient to pay for the Council's contribution to the largest item (multi-use arena) on its own.

[10] Statistics NZ, 2015. Subnational Family and Household Projections. https://www.stats.govt.nz/information-releases/subnational-family-and-household-projections-2013base2038. Accessed 10 September, 2018.
[11] From estimates of expenditure on growth projects, Brian Norton, pers.comm.

Table 6: Council contribution to major community facilities and anchor projects (Source LTP 2018 - 2028)

Major community facility/ Anchor project	Council contribution ($m)
Christchurch Art Gallery	$57.60
Turanga: new Central library	$92.70
Nga Puna Wai Sports Hub Stage 1	$53.70
Taiora: QEII Recreation and Sports Centre	$38.60
Christchurch Town Hall	$152.20
Performing arts	$31.10
South West Library, Customer Services and Leisure Centre	$35.70
Convention Centre	-
Car parking	$70.00
New multi-use arena	$253.00
Central city metro sports facility	$151.30
Avon river park	$6.40
Transport Interchange	$29.90
Transport Plan - phase 1	$27.00
The Square	$4.60
The Frame (public realm)	$6.80
Earthquake memorial	-
Total	**$1,010.60**

45. The cost efficiency of removal of contaminants decreases significantly as additional infrastructure is added. This is largely because the most cost effective treatments have been included within Best Practice Infrastructure scenario proposed in the Application, and the highest priority catchments have been targeted. The addition of further treatment therefore increases costs while having less impact per dollar spent.

46. Source control is the most cost effective for removal of zinc and copper by a significant margin. It appears possible that with source control and BPI the levels of copper in waterways could be reduced to levels below that which could be achieved with FT, and the levels of zinc could be close to equal that from MT+. Source control methods are not currently within Council control, but there is potential for source control to be implemented over the period of the consent, and proposed consent conditions (Other Actions by the Consent Holder) will require the Council to promote both regulatory and non-regulatory measures that would assist with source control. The impact of this on the decision making process is discussed further below.

47. The infrastructure will result in an additional $45 (BPI) - $167 (MT+) per year in rates increase for the average household, and $192 - $718 per year in rates increase for the average business ratepayer. Rate costs are incurred by both owner-occupiers and by renters, since the costs of rates will be ultimately passed on in rents. Nationally there are 33% of households that spend more than 40% of their income on housing. While the additional costs of further treatment are not likely to result in financial hardship for average households, for low income households and households paying a high proportion of their income in rent, they are potentially significant.

48. Section prices are likely to be unaffected by the BPI scenario because stormwater mitigation is already required and so is already priced into new (greenfields) section prices. No additional treatment of new sections over and above the BPI scenario is envisaged in the FT or MT+ scenarios.

Potential for source controls

49. I understand from Mr Nieuwkerk's draft evidence that source controls have the potential to significantly reduce contaminants in waterways, and while they are not currently within Council control there is potential for them to be introduced. Control of copper in brake pads appears most likely, and there is a reasonable possibility that given regulations introduced in parts of the USA, copper free brake pads would become universally used even with no regulatory action in NZ. The zinc source control tested here has the potential for significant impacts in terms of reducing zinc contaminants entering waterways, and only covers a proportion of the zinc sources. It is possible that more extensive management of the use of zinc in building materials could further reduce the discharge of this contaminant to waterways. However the potential for voluntary or regulatory action to control copper and zinc contaminant sources is by no means certain.

50. In my opinion national level regulation would appear to be the most desirable course of action for control of zinc and copper since it would ensure consistent application across the country and would be most effective. Control of contaminant sources such as brake pads at a regional or district level would require suppliers to maintain separate supply chains, and because of the relative ease of obtaining brake pads from outside the region is likely to have lower efficacy than national regulation. Furthermore in respect of zinc I have been informed that the ability of Territorial local authorities

(TLA) to impose controls on the use of zinc or require painting of zinc coated materials may be limited. I understand that it is not clear that TLAs have the ability to impose controls to manage water quality, which is normally the role of regional councils. Legal interpretations of powers to act in this respect are outside of my expertise.

51. In respect of national regulation, the levels of zinc and copper are elevated[12] in Auckland, Wellington and Christchurch urban streams, and concentrations are positively correlated with the proportion of urban land cover in upstream catchments. Given that all urban areas are facing the same issues, and given the apparent greater efficacy and lower cost of source control, in my view it would appear reasonable for central government to consider implementing regulation (which is outside the control of this Application). I understand the Council has indicated in the consent conditions that they will be representing to national government the importance of introducing source controls[13]. That possibility of source control measures being implemented therefore represents a potential future course of action that should be taken into account when assessing the desirability of different levels of infrastructure. The analysis above has shown that the costs of source control are significantly lower than treatment for the same level of contaminant reduction.

Benefits of delaying a decision on additional treatment

52. There are benefits to a delay in making a decision on whether additional treatment beyond BPI should be required of the discharge consent. These benefits arise as a result of the time value of money, and the value associated with improved decision making with further information.

53. The time value of money states that a dollar spent in the future is worth less than a dollar spent now. This arises because a dollar available now can be invested at a given rate of return that will result in its value being greater in the future. By delaying expenditure there is a substantial reduction in the effective present day cost of the works.

54. The value associated with improved decision making arises from the uncertainty surrounding a number of areas in relation to the required level of stormwater discharge

12 MFE 2017. New Zealand Environmental Reporting Series: Our Freshwater 2017. Ministry for the Environment, Wellington.

13 In Other Actions by Consent Holder section of the consent conditions.

treatment, and the likelihood that this uncertainty will be reduced with the improved information that comes from the proposed monitoring programme. In the case of the stormwater infrastructure, uncertainty exists around:

a) The specific levels of contaminants that will meet water quality objectives;

b) The levels of contaminants being discharged from urban areas;

c) The efficacy of treatment required to meet desired standards;

d) The introduction of source controls.

55. The first three of these (levels of contaminants in waterways that will meet water quality objectives, the levels of contaminants lost from urban areas, and the efficacy of the treatment infrastructure) are likely to be resolved by monitoring over the period of the consent as set out in the conditions associated with the sections on Stormwater Management Plans and the Stormwater Quality Investigation Actions. The potential for source controls will similarly become more apparent over time, either by changes to the brake pad market (copper) or the regulatory environment for building materials (zinc) and brake pads (copper). With this information available better investment decisions could be made about the levels of treatment infrastructure required to meet water quality standards.

56. The benefits of the delay should be offset against a potential cost from the risks associated with delaying implementation of treatment. These costs would accrue as risks to ecological, recreational and amenity values of the waterways. These costs are not quantified in this analysis but should be included qualitatively.

57. I have undertaken an indicative analysis of the benefit of a delay in decision making. In this analysis the BPI proposed by the Council is assumed to be constant. In terms of determining whether additional treatment above BPI is required, the analysis assumes two[14] areas where decisions can be better made with information that becomes available in the future. These are:

14 In practice there are a number of intermediate (for example partial treatment) and combinatory scenarios (source controls plus partial treatment) that could also be considered, but for ease of explanation these are ignored.

i. Whether BPI meets requirements for water quality objectives, which is resolved by further monitoring;

ii. Whether source control can be used as an option to manage contaminant losses.

58. My analysis assumes that a delay of 25 years occurs before better information will be available and decisions made, which matches the consent period. It also reflects the likelihood of the time required for installation of sufficient treatment infrastructure, monitoring of results, and modelling of potential outcomes. The analysis assigns (with sensitivity testing) nominal probabilities to each of these factors of 20% for the BPI being sufficient treatment to meet water quality objectives, and 20% for source control being implemented and no further treatment being needed. The indicative savings from a delay in decision making are shown in Table 7 and amount to $250 million NPV. The savings range from $235m to $278m NPV, using different assumptions about the probability of the requirement for further treatment and the availability of source control options as shown in Table 8. The level of savings is more sensitive to changes in timing of the decision with a range of $214 - $269m as shown in Table 9.

Table 7: Savings resulting in delaying decision on further treatment

Scenario	**Probability**	**Expected value of additional treatment costs in 2018 ($m NPV(6%))**
BPI meets water quality requirements – no further measures needed	20%	$0
BPI does not meet water quality, but source control introduced and does meet standards.	16% *(80% probability of further measures being required, 20% probability of source control occurring)*	$2.1
FT required regardless	64% *(80% probability of further measures being required, 80% probability of no source control)*	$40
Total Expected Value (TEV)	**100%**	$42
Cost of FT installed from 2018		$291
Saving from delay (FT – TEV)		**$250**

Table 8: Sensitivity analysis of savings from delay, changes in probability

		Probability no further measures required beyond BPI ($m NPV (6%))				
		5%	**10%**	**20%**	**40%**	**60%**
Probability source control	**5%**	$235	$238	$244	$256	$268
	10%	$237	$240	$246	$257	$269
	20%	$242	$244	$250	$260	$270
	40%	$251	$253	$257	$266	$274
	60%	$260	$262	$265	$272	$278

Table 9: Sensitivity analysis of savings from delay, changes in timing

	Years to decision		
	15	**25**	**35**
Savings in infrastructure costs ($m, NPV(6%))	$214	$250	$269

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