

Municipal data and analyses of costs and benefits of implementing the proposed Wastewater System Effluent Regulation

September 7, 2010

Summary

The Government of Canada issued draft wastewater systems effluent regulations in March 2010. A Regulatory Impact Analysis Statement (RIAS) was issued in conjunction with the draft regulations. The RIAS included federal estimates of capital and operating costs necessary to meet the regulations, broken down by province, as well as estimates of property value and willingness-to-pay (WTP) benefits that would accrue to each province.

The RIAS cost estimates are much lower than detailed cost estimates provided by selected municipalities. Both the capital and operating costs that municipalities will face will be significantly higher than the Government of Canada estimates. FCM has compiled several municipal cost estimates for the implementation of the proposed regulation, and compared them with RIAS estimates.

The property value benefits analysis technique applied by the Government of Canada is based on assuming that the benefits associated with a significant treatment upgrade to constrained water bodies (such as the Halifax Harbour) are transferrable to all other regions of Canada. This technique is inappropriate, because many of the municipalities will be implementing less significant upgrades (e.g., primary to secondary treatment, rather than no treatment to primary treatment.) The water quality improvements experienced by the Halifax Harbour from such a significant upgrade are also often not the same as those that other regions would experience, due to different receiving environments. FCM has critiqued the benefits analysis technique applied in the RIAS.

Appendices with specific cost information on each municipality are included. Some municipalities have also performed ambient water quality impact analyses and benefit impact analyses. These analyses do not agree with the benefits estimated by the RIAS.

Implementation Cost Estimates

FCM has collected estimates of the costs of complying with the draft regulations from several municipalities and regions and compared them with RIAS estimates. These estimates are considered to be reliable given the extensive experience municipalities have with the costs of building and operating wastewater treatment facilities.

Data is presented for systems in Halifax, Greater Moncton, Regina, Metro Vancouver, Waterloo, Ottawa, London, and the Cape Breton region. The collected values do not represent an exhaustive cost assessment but a snapshot of expected capital, operating, monitoring and other costs that will impact municipalities of varying size if the proposed regulations are implemented.

Table 1 presents cost estimates for treatment plant compliance, and compares them with RIAS estimates for the relevant province. The costs of individual municipalities are approximately equal to or significantly exceed the RIAS estimate for the relevant province. (See Appendices A and C for detail on the calculations.) These estimates account for the risk assessment of each community and the consequent expectation for the year that the upgrades would need to be operational (e.g., by 2020 for high risk areas, or 2030 for medium risk areas). Annual operating costs were included directly when available, and otherwise estimated to be 3% of initial capital costs, in both cases reflecting real costs experienced by municipalities in the past. Lifetime operating costs in today's dollars (that is, present value terms) typically account for 20 to 40 percent of the total costs (capital plus operating) incurred in meeting the draft regulation.

Table 1. Estimated Costs of Treatment improvements for Selected Municipalities (in 2009 \$)

Treatment Area	Regulatory Compliance Treatment Upgrade Costs, compared to RIAS estimate			
	PV Capital costs (\$ M)	PV of operating costs (\$ M)	Total PV costs (\$ M)	RIAS total PV costs (\$ M)
Halifax Region	\$ 51 M	\$ 29 M	\$ 80 M	\$ 342 M (Nova Scotia)
Cape Breton Region	\$ 312 M	\$ 111 M	\$ 423 M	
Greater Moncton	\$ 77 M	\$ 28 M	\$ 105 M	\$ 107 M (New Brunswick)
Regina	\$ 65 M	\$ 23 M	\$ 88 M	\$ 36 M (Saskatchewan)
Metro Vancouver Region	\$ 368 M	\$ 134 M	\$ 502 M	\$ 338 M (British Columbia)

The capital and operational costs for compliance by the above-listed municipalities exceed the RIAS provincial estimates for the provinces of Nova Scotia, Saskatchewan, and British Columbia, and many municipalities that would experience costs aren't included in this sampling. If the costs to other New Brunswick communities were accounted for, they would certainly also exceed the RIAS estimate for New Brunswick. RIAS cost estimates are significantly understated.

It should be noted that the costs in Table 1 only reflect the additional costs associated with adding secondary treatment to a system with primary treatment. Many municipalities, such as Metro Vancouver, will need to build completely new treatment plants to meet the regulation. The full cost of doing so would be nearly twice as high. Furthermore, the costs in Table 1 are conservative, because they assume that energy prices will not rise rapidly. However, many forecasts indicate that energy prices will in fact rise rapidly over the 20 to 30 year period in question. Since energy costs are a significant proportion of operational costs, this means that operational costs will be higher than estimated in Table 1.

These cost assessments do not include the costs of separating combined sewers or the elimination of combined sewer overflows since, according to Environment Canada, this will not be required. Such costs could be significant. For example, for the City of Halifax, SSO management solutions are expected to result in \$560M in capital costs and \$14 million in annual operating costs (in 2009 \$). In addition, Halifax expects CSO screening costs to be \$10 million and annual associated operating costs to be \$0.2 million. They estimate the cost of CSO elimination to be approximately \$1.1 billion with annual operating costs of \$30 million. Other communities have provided similar estimates; the City of Ottawa estimates that CSO elimination would cost an additional \$2 billion dollars. There has been an enormous investment in collection systems and CSO management which have an asset value in billions of dollars. Elimination or premature reduction of CSOs will have economic costs and in some cases may generate environmental liabilities.

The cost estimates also assume that testing for Total Chlorine Residual will not be required. Environment Canada has indicated that although the standard for Total Chlorine Residual is included in the regulation there will be no testing or reporting requirements due to the technical limitations in measurement for chlorine residual in treated wastewater.

Some communities currently have no treatment, particularly in coastal areas, Cape Breton Regional Municipality is an example. They will be constructing ten new wastewater treatment facilities to manage flow collected from existing outfalls and will also be upgrading six existing facilities. They estimate the total inflated costs for the new treatment plants and the collection of existing outfalls to be approximately \$441 million with operating costs of approximately \$10 million. The inflated cost of the upgrades to existing facilities is \$42 million with new operating costs estimated at \$1 million per year. Since these facilities are considered high risk they will have to comply within 10 years leading to a total present value cost of \$ 423 million. If the elimination of combined sewer overflows was required \$0.5 billion would be added to the total cost; at the present time the existing collectors and treatment facilities are designed to three to four times dry weather flow.

Costs Incurred by Municipalities in Compliance

Many municipalities are already performing secondary treatment, but would nevertheless incur new capital costs and monitoring costs. Municipalities in compliance raised several cost concerns with respect to new capital costs, biosolids management, compliance, and environmental performance monitoring. For example, the City of Waterloo expects new capital expenditures of approximately \$700 million in order to comply with the regulation. Also attached in appendix are detailed cost estimates for the City of London with various discount rates.

Table 2. Estimated costs associated with monitoring

Municipality	PV Monitoring Costs (\$ M)
Ottawa	\$ 1.5M
London	\$ 0.5M
Total	\$ 0.82 B

The City of London estimates that additional monitoring necessary to comply with the regulation would cost an extra \$80,000 per year (see Appendix B for detail).

The regulation would cause many municipalities to face significant new replacement costs to remain in compliance, although they would not incur any near-term compliance costs. Approximately 2,700 growing communities have facilities that are in this situation.

Other Relevant Costs

Another significant cost relating to the regulation is biosolids management, which does not appear to be addressed by the RIAS. The CCME Strategy recognized that upgrading a wastewater facility to meet the proposed National Performance Standards would often create a concurrent need to increase the biosolids management capacity of the facility. The strategy therefore included a biosolids component in its estimate of the capital costs. Although the RIAS includes operating costs, it remains unclear how the RIAS estimates relate to the Strategy estimates and therefore it was felt that the presentation of some example values would be beneficial.

For jurisdictions that do not currently have treatment, costs associated with biosolids would be completely new and would be significant. Examples of these costs from existing operations are shown in Table 3. Depending on the province in which they operate, municipalities may be restricted in the options they have to manage this waste making it more difficult and expensive. Generally speaking options for biosolids management include land application, landfilling or incineration – the latter options being relatively expensive.

Table 3. Estimated costs relating to biosolids management

Municipality	Biosolids Generated (tonnes)	Unit PV Biosolids Costs (\$/t)	Total PV Biosolids Costs (\$M)
Ottawa	50,000	\$ 90/tonne	\$ 4.5M
London	70,000	\$ 39/tonne	\$ 2.73M
Total	\$ 0.82 B	\$ 0.82 B	\$ 0.82 B

To provide an example of the escalating costs associated with different methods of treatment, in Ottawa, where most biosolids are land applied, the unit cost is \$90/tonne, whereas landfilling cost are approximately \$120/tonne. The cost estimates for incineration and other methods that are not currently used by the city ranged between \$90/tonne and \$120/tonne.

Property Value Benefits Analysis

The property value benefits analysis technique applied by the Government of Canada assumes that the percentage-based benefits achieved through a significant treatment upgrade (from no treatment to primary treatment) to constrained water bodies (such as the Halifax Harbour) are transferrable to all other regions of Canada. It assumes that property values will rise from 5 to 10 percent after implementation, with smaller continuing gains in the future (due to the higher base value of the properties). This technique is inappropriate for a number of reasons. Many of the municipalities will be implementing less significant upgrades (e.g., primary to secondary treatment, rather than no treatment to primary treatment.) The water quality improvements experienced by the Halifax Harbour from such a significant upgrade are also often not the same as those that other regions would experience, due to different receiving environments. For example, an upgrade from primary to secondary treatment at the Iona Island treatment plant in Metro Vancouver will affect wastewater discharges approximately 7 kilometers offshore. Water quality modeling results indicate that no discernable differences in water quality parameters are expected at the shoreline of nearby communities. Therefore, no rise in property values near this facility is expected. Similar results exist for Metro Vancouver's other treatment plant that would require upgrading. (See Appendix A for detail on these analyses.)

The RIAS estimates that property value benefits will be worth \$14 billion across Canada, of which \$5.6 billion are in British Columbia. However, Metro Vancouver results indicate that no property value increases are expected. For British Columbia, and perhaps for other provinces, the RIAS technique and results are flawed and lead to the incorrect conclusion that benefits outweigh costs.

Conclusion

Municipalities fully support the Government of Canada's objective to reduce the pollution of Canadian water by improving wastewater treatment. This document seeks to highlight that the cost of implementing the proposed Wastewater System Effluent Regulation is much greater than what was presented to the public when the draft regulations were published in March 2010.

As highlighted in Table 1, the RIAS cost estimates are much lower than detailed cost estimates provided by selected municipalities to FCM for both the capital and operating costs. Depending on the final outcome of the regulations with respect to combined sewer overflows (CSOs), the cost could be orders of magnitude higher than what was proposed in the RIAS estimate.

Furthermore, the property value benefits analysis technique applied by the Government, which assumes that the benefits associated with a significant treatment upgrade to constrained water bodies (such as the Halifax Harbour) are transferrable to all other regions of Canada, is inappropriate. As discussed in detail in Appendix A, this is because many municipalities will be implementing less significant upgrades (e.g., primary to secondary treatment) rather than no treatment to primary treatment. The water quality improvements experienced by the Halifax Harbour from such a significant upgrade are also often not the same as those that other regions would experience, due to different receiving environments. For example, property value increases in Metro Vancouver are not expected, as no discernable change in shoreline water quality conditions is expected. Therefore, for British Columbia and perhaps for other provinces, the RIAS property value benefits estimates are flawed, and lead to the incorrect conclusion that benefits outweigh costs.

Although a cost benefit analysis using more accurate cost and benefit data may not result in the demonstration of greater economic benefits through implementation of the proposed regulations, municipalities still see great value in improving the quality of wastewater effluent. However, the need for a financing strategy is significant and municipal governments look forward to working with the federal government in the development of that strategy.

Appendix A. Metro Vancouver data and analyses

Costing Analysis

Metro Vancouver has estimated the present value of capital and operating costs associated with complying with the regulation. The estimates are presented in Table A1 below. The North Shore plant is assumed to be classified as high risk, therefore operational by 2020. The Iona Island plant is assumed to be classified as medium risk, therefore operational by 2030. An eight percent discount rate and 2 percent inflation rate for future capital and operating costs were assumed, to allow comparability with the RIAS, although Metro Vancouver typically uses a lower (6%) discount rate, which would cause costs to appear even higher. The estimated total costs to Metro Vancouver, in present value terms, are approximately fifty percent higher than the RIAS estimate for the entire province of British Columbia. These costs do not account for the full replacement costs of each of the facilities – those full costs would approximately double the costs listed in Table A1.

Table A1. Estimated Costs of Treatment Improvements in the Metro Vancouver region

Treatment Area	Costs of secondary upgrade (primary to secondary) (in 2009 \$)			
	Capital costs (\$ B)	PV of capital costs (\$ B)	PV of operating costs (\$ B)	Total PV costs (\$ B)
North Shore / Lions Gate Plant	\$ 240 M	\$ 155 M	\$ 58 M	\$ 214 M
Richmond / Iona Island Plant	\$ 577 M	\$ 212 M	\$ 76 M	\$ 288 M
Total	\$ 817 M	\$ 368 M	\$ 134 M	\$ 502 M

Receiving Environment Water Quality Analysis

August 2010 Predicted Water Quality in the Receiving Environment for Discharged Primary Treated Wastewater Based on Effluent and Observed Background Chemistry, and Modelled Dilutions in Burrard Inlet and Strait of Georgia

PURPOSE

Wastewater treatment plant (WWTP) effluent quality, for Iona Island and Lions Gate WWTPs, together with effluent dispersion model results and available background water quality was used to predict concentrations in the receiving environment. The overall context is to assess the potential for significant/noticeable changes to water quality along the shoreline as a result of planned upgrades in water treatment from primary to secondary treatment.

BACKGROUND

Typically, at least for traditional constituents of interest (e.g., suspended solids), primary treatment results in reduction of these constituents on the order of 60% compared with a reduction of about 90% for secondary treatment from the influent to the effluent. This results in concentrations in secondary effluent that would be expected to be about one-quarter of those in primary effluent for the same constituents. This may be significant in terms of loading to the environment and the potential for cumulative environmental effects. However, when the current conditions are compared with background conditions and/or water quality criteria, these improvements may not be appreciable along the shoreline. The review below considers this in evaluating the shoreline conditions.

DATA REVIEW

Maximum effluent concentrations for a variety of wastewater constituents were used to predict concentrations in the receiving environment based on modeled dilution (Table 1) and background conditions for Lions Gate and Iona WWTPs. Constituents assessed as part of this review included total metals, suspended solids, and nonylphenols. For constituents of emerging concern (e.g., nonylphenols) for which treatment is not specifically designed, the degree of reduction is highly variable, generally lower, and in some cases may not result in reduction at all. Fecal coliforms were not assessed as their reduction is not so much dependent on treatment type, but rather disinfection.

Nonylphenols (NPs) were assessed even though secondary treatment works are not specifically designed to reduce such trace organics of emerging concern. In addition, many of these types of constituents may not have water quality criteria values to be compared with. However, there is an interim water quality criteria value for NPs in the marine environment (i.e., federal water quality guideline), and the worst case predicted concentrations in the receiving environment are below the guideline near shore.

Approach

Effluent chemistry, background water chemistry and modeled dilution results together were used to predict the concentration of various constituents of wastewater in the receiving environment for the currently discharged primary treated wastewater for Lions Gate and Iona WWTPs. These results were compared with both water quality criteria values (first, provincial water quality objectives; second, provincial water quality guidelines; or third, federal water quality guidelines if there wasn't a value for the former) and background chemistry to indicate overall water quality along the shoreline.

Wastewater effluent quality from both Lions Gate and Iona WWTPs was reviewed and median and maximum concentrations for various constituents were determined using data from annual WWTP process monitoring (for 2004 to 2008/09) and/or special studies (various years) depending on the constituent.

Background water chemistry data was gathered from water column or initial dilution zone type studies. For Lions Gate, a location in outer Burrard Inlet was used as background and was sampled on flood tides when it would not be expected to be influenced by the discharge from the WWTP, and otherwise be representative of existing Burrard Inlet water quality. For Iona, a location several kilometers south was selected, as there is a net northerly flow in this area, and which through various studies this site has been determined to not be influenced by the Iona discharge, and otherwise be representative of the Strait of Georgia in the vicinity of the Iona discharge.

Plume dispersion model reports were reviewed to estimate average and minimum dilutions at the surface both along the shoreline at various locations (Table 1). Average and minimum dilutions are shown for Lions Gate, while only minimum dilutions shown for Iona (as average dilutions are the same or better).

Concentrations were then predicted for a given dilution (location) using the following formula:

$$\frac{C_{\text{eff}}}{(DF+1)} + \frac{C_{\text{bg}}}{(1+1/DF)} = C_{\text{env}}$$

Where:

C_{eff} = effluent concentration (maximum concentration was used)

C_{bg} = background concentration (average concentration was used)

C_{env} = predicted concentration in the environment

DF = dilution factor (minimum was used) for a given location / condition

In addition, to predicting receiving environment concentrations using primary effluent quality, secondary effluent quality was predicted based on the assumption that reductions would result in concentrations about one-quarter those in primary effluent. Subsequently, concentrations in the receiving environment were also predicted based on the “predicted secondary effluent” quality, and were then also compared with background conditions for both Lions Gate and Iona (Tables 2 and 3).

Near Shore Water Quality: Lions Gate WWTP

A range of dilutions were used based on different seasonal conditions at the water surface for several areas in outer Burrard Inlet to predict concentrations in the receiving water. A range of minimum dilutions from 580:1 to better than 10,000:1 are predicted for areas from Ambelside on the north shore to Dundarave and Pt. Atkinson and Jericho to Spanish Bank on the south shore. At the lowest predicted

dilution of 580:1 (which is predicted to occur near Ambelside during winter unstratified conditions) most constituents discharged in the effluent would be diluted to background concentrations, and for those that would not be (e.g., copper), they would be below the corresponding water quality criteria value. Boron is an exception to this (for both Lions Gate and Iona); however, concentrations in the primary effluent are considerably lower than in the receiving environment and are also well below the water quality criteria value (i.e., it is the background conditions that are elevated for boron). Further, using predicted secondary effluent quality for the same scenarios, there is little difference between the predicted receiving environment concentrations for the same constituents with the addition of secondary treatment (Table 2). That is, concentrations attain 100-120% of background for both primary and secondary effluents, at minimum dilutions along the shoreline, (note: $\pm 20\%$ is typically considered within the uncertainty of analytical methodology).

Near Shore Water Quality: Iona WWTP

A range of dilutions were used based on different seasonal conditions at the water surface for several areas in the Strait of Georgia and outer Burrard Inlet. A range of minimum dilutions from 16,000:1 to better than 100,000:1 are predicted for areas from Pts. Atkinson and Grey to Spanish and Sturgeon Banks (Table 1). At the lowest predicted dilution of 16,000:1 all constituents discharged in the effluent would be diluted to background concentrations, and would also be below the corresponding water quality criteria value (except boron as noted above). Further, using predicted secondary effluent quality for the same scenarios, there is little difference between the predicted receiving environment concentrations for the same constituents with the addition of secondary treatment (Table 3). That is, concentrations attain 100-120% of background for both primary and secondary effluents, at minimum dilutions along the shoreline, (note: $\pm 20\%$ is typically considered within the uncertainty of analytical methodology).

ASSESSMENT

Under the current conditions for primary treated effluent discharged into the receiving environment, neither Lions Gate nor Iona WWTPs appear to negatively affect receiving environment water quality at the shoreline, as background conditions and/or water quality criteria values are already met under these existing conditions (i.e., with primary treatment). Therefore, although there is up to four times difference between primary and secondary effluent concentrations it is not likely to result in a noticeable difference in the near shore environment.

Table 1 Modeled Dilution in Receiving Environment of (a) Lions Gate and (b) Iona WWTP discharges

(a) Lions Gate

Surface Dilutions (X:1) by Area	Average Dilutions		Minimum Dilutions	
	June Freshet	March Winter Unstratified	June Freshet	March Winter Unstratified
Ambelside	<10,000	<580	<5,000	<580
Dudarave	<10,000	<1,000	<10,000	<1,000
Pt Atkinson	<10,000	<10,000	<10,000	<10,000
Jericho/Kits	<10,000	<10,000	<10,000	<10,000
Spanish Bank	<10,000	<10,000	<10,000	<1,700

Estimated from:

Seaconsult Marine Research Ltd. And EVS Environment Consultants. 1999. Fate and Effects of Discharges from Lions Gate Wastewater Treatment Plant. Prepared for Greater Vancouver Regional District, Burnaby, BC by Seaconsult Marine Research Ltd., Vancouver, BC and EVS Environment Consultants, North Vancouver, BC. 128 pp. + Appendices and Dispersion Model on 4 CDs.

(b) Iona

Surface Dilutions (X:1) by Area ^a	Winter	Freshet	Summer
Vicinity of Pt Atkinson	<100,000	<100,000	<16,000
Vicinity of Pt Grey	<100,000	<100,000	<30,000
Spanish Bank	<100,000	<100,000	<100,000
Richmond / Sturgeon Bank	<100,000	<100,000	<100,000

a Average dilutions are the same or better and therefore not shown

Estimated from:

Hodgins, D.O and S.L.M. Hodgins. 1999. Iona Deep Sea Outfall 1999 Environmental Monitoring Program: Effluent Dispersion and Solids Deposition Modelling Study. Prepared for Greater Vancouver Sewerage and Drainage District, Burnaby, BC by Seaconsult Marine Research Ltd., Vancouver, BC. December 1999. 108 pp. + Appendices and Plume Dispersion and Solids Deposition Models on 2 CDs

Table 2 Predicted concentrations for minimum dilutions at various locations along the shoreline compared with background conditions for Lions Gate WWTP discharge: Primary and Secondary Effluents

Comparison of Predicted Concentrations for Primary and Secondary Effluent in the Receiving Environment Compared with Background																											
Constituent (mg/L unless otherwise)	Reference / Background ^a	Criteria ^b		Ambleside (large winter tides)						Dundarave						Spanish Bank						Pt Atkinson					
		30-d	Max	Concentration		Meets WQ CVs		% of Background		Concentration		Meets WQ CVs		% of Background		Concentration		Meets WQ CVs		% of Background		Concentration		Meets WQ CVs		% of Background	
				Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Indicators with WQO																											
Copper - T	0.001	0.002	0.003	0.001	0.001	Yes	Yes	138	109	0.001	0.001	Yes	Yes	122	105	0.001	0.001	Yes	Yes	113	103	0.001	0.001	Yes	Yes	102	101
Lead - T	0.000	0.002	0.14	0.000	0.000	Yes	Yes	101	100	0.000	0.000	Yes	Yes	101	100	0.000	0.000	Yes	Yes	100	100	0.000	0.000	Yes	Yes	100	100
Mercury - T ^f	0.00001	0.00002	--	<0.00001	<0.00001	Yes	Yes	102	100	<0.00001	<0.00001	Yes	Yes	101	100	<0.00001	<0.00001	Yes	Yes	101	100	<0.00001	<0.00001	Yes	Yes	100	100
Zinc - T	0.002	0.086	0.095	0.00	0.00	Yes	Yes	109	102	0.00	0.00	Yes	Yes	105	101	0.00	0.00	Yes	Yes	103	101	0.00	0.00	Yes	Yes	101	100
Indicators with WQG																											
Metals																											
Arsenic - T	<0.001	--	0.0125	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100
Barium - T	0.008	--	0.5	0.008	0.008	Yes	Yes	100	100	0.008	0.008	Yes	Yes	100	100	0.008	0.008	Yes	Yes	100	100	0.008	0.008	Yes	Yes	100	100
Boron - T ^c	3.95	--	1.2	3.94	3.94	No	No	100	100	3.95	3.95	No	No	100	100	3.95	3.95	No	No	100	100	3.95	3.95	No	No	100	100
Cadmium - T	<0.0001	--	0.00012	<0.0001	<0.0001	Yes	Yes	101	100	<0.0001	<0.0001	Yes	Yes	101	100	<0.0001	<0.0001	Yes	Yes	100	100	<0.0001	<0.0001	Yes	Yes	100	100
Nickel - T	0.000	0.0083	0.075	0.000	0.000	Yes	Yes	103	101	0.000	0.000	Yes	Yes	101	100	0.000	0.000	Yes	Yes	101	100	0.000	0.000	Yes	Yes	100	100
Selenium - T ^f	<0.00	0.002	--	<0.00	<0.00	Yes	Yes	103	101	<0.00	<0.00	Yes	Yes	102	100	<0.00	<0.00	Yes	Yes	101	100	<0.00	<0.00	Yes	Yes	100	100
Silver - T	0.001	0.0015	0.003	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100
Indicators with WQO^g																											
TSS ^h	19.4	--	29.4	20	19	Yes	Yes	101	100	20	19	Yes	Yes	101	100	19	19	Yes	Yes	100	100	19	19	Yes	Yes	100	100
Indicators with WQGⁱ																											
Nonylphenols ^h - TEQ	0.0449	--	0.7	0.05	0.05	Yes	Yes	118	104	0.05	0.05	Yes	Yes	111	103	0.05	0.05	Yes	Yes	106	102	0.05	0.05	Yes	Yes	101	100

- ^a background concentrations are medians of Lions Gate IDZ studies in 2001 and 2006 (and 2009 for NPs)
- ^b water quality criteria values are for 30 day average or maximum instantaneous concentrations; noted as WQ objective (WQO) or guideline (WQG) in the first column
- ^c boron in the effluent is less than the WQ criteria value; boron in the background environment exceeds WQ criteria value
- ^d shading indicates that maximum concentration at specified dilution is above 120% of background
- ^e percents are to three significant figures
- ^f there is no maximum WQ criteria value, so the corresponding 30-d average criteria value was used for illustrative purposes
- ^g provincial water quality objective for suspended solids is 10 mg/L above background concentration
- ^h indicator for nonylphenols is based on toxicity equivalence for various individual constituents; marine guideline is interim
- ⁱ background data are from Burrard Inlet (LG IDZ 2006 and 2009 studies) as no data yet available from 2010 Iona IDZ study

Table 3 Predicted concentrations for minimum dilutions at various locations along the shoreline compared with background conditions for Iona WWTP discharge: Primary and Secondary Effluents

Comparison of Predicted Concentrations for Primary and Secondary Effluent in the Receiving Environment Compared with Background ^{d,e}																					
Constituent (mg/L unless otherwise noted)		Reference / Background ^a		Criteria ^b		Pt Atkinson Area (summer)				West Vancouver and Pt Grey Areas (summer)				Remainder of Areas (summer)							
						16,000		30,000		100,000											
						Concentration		Meets WQ CVs		Concentration		Meets WQ CVs		Concentration		Meets WQ CVs					
Indicators with WQG																					
Metals																					
Arsenic - T	0.0014	--	0.0125	<0.0014	<0.0014	Yes	Yes	100	100	<0.0014	<0.0014	Yes	Yes	100	100	<0.0014	<0.0014	Yes	Yes	100	100
Barium - T	0.008	--	0.5	0.01	0.01	Yes	Yes	100	100	0.01	0.01	Yes	Yes	100	100	0.01	0.01	Yes	Yes	100	100
Boron - T ^c	4.52	--	1.2	4.5	4.5	No	No	100	100	4.5	4.5	No	No	100	100	4.5	4.5	No	No	100	100
Cadmium - T	0.000075	--	0.00012	<0.0001	<0.0001	Yes	Yes	100	100	<0.0001	<0.0001	Yes	Yes	100	100	<0.0001	<0.0001	Yes	Yes	100	100
Copper - T	0.000415	0.002	0.003	0.0004	0.0004	Yes	Yes	101	100	0.0004	0.0004	Yes	Yes	101	100	0.0004	0.0004	Yes	Yes	100	100
Lead - T	<0.00005	0.002	0.14	0.00005	0.00005	Yes	Yes	100	100	0.00005	0.00005	Yes	Yes	100	100	0.00005	0.00005	Yes	Yes	100	100
Mercury - T ^f	<0.000006	0.00002	--	<0.00001	<0.00001	Yes	Yes	100	100	<0.00001	<0.00001	Yes	Yes	100	100	<0.00001	<0.00001	Yes	Yes	100	100
Nickel - T	0.00047	0.0083	0.075	0.0005	0.0005	Yes	Yes	100	100	0.0005	0.0005	Yes	Yes	100	100	0.0005	0.0005	Yes	Yes	100	100
Selenium - T ^f	<0.0005	0.002	--	<0.00	<0.00	Yes	Yes	100	100	<0.00	<0.00	Yes	Yes	100	100	<0.00	<0.00	Yes	Yes	100	100
Silver - T	<0.00053	0.0015	0.003	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100	<0.001	<0.001	Yes	Yes	100	100
Zinc - T	<0.0006	--	0.01	0.0006	0.0006	Yes	Yes	101	100	0.0006	0.0006	Yes	Yes	100	100	0.0006	0.0006	Yes	Yes	100	100
Indicators with WQG																					
TSS ^g	5.5	10.5	10.5	5.5	5.5	Yes	Yes	100	100	5.5	5.5	Yes	Yes	100	100	5.5	5.5	Yes	Yes	100	100
Indicators with WQG																					
Nonylphenols ^{h,i} - TEQ µg/L	0.0449	--	0.7	0.05	0.05	Yes	Yes	110	102	0.05	0.05	Yes	Yes	105	101	0.05	0.05	Yes	Yes	102	100

^a background concentrations are medians of data from 1996 Iona Water Column Study (IRC and GVRD 1997) and/or interim 2010 Iona IDZ Week 1 data (Interim Data for August 2010, received August 23, 2010)

^b water quality criteria values are for 30 day average or maximum instantaneous concentrations; noted as WQ objective (WQO) or guideline (WQG) in the first column

^c boron in the effluent is less than the WQ criteria value; boron in the background environment exceeds WQ criteria value

^d shading indicates that maximum concentration at specified dilution is above 120% of background

^e percents are to three significant figures

^f there is no maximum WQ criteria value, so the corresponding 30-d average criteria value was used for illustrative purposes

^g provincial water quality guideline for suspended solids is 25 mg/L above background concentrations for max and 5 mg/L above background over 24-h period

^h indicator for nonylphenol is based on toxicity equivalence for various individual constituents; marine guideline is interim

ⁱ background data are from Burrard Inlet (LG IDZ 2006 and 2009 studies) as no data yet available from 2010 Iona IDZ study

Appendix B. City of London data and analyses

The City of London provided a detailed cost estimate for analytical testing requirements on an annual basis for compliance with the regulation. The figures are shown in Table B1.

Table B1. Analytical testing per year City of London

Parameter		Cost	# of samples	Total Cost
cBOD		\$8.50	416	\$3,536.00
TSS		\$6.00	416	\$2,496.00
TRC			480	\$0.00
E. Coli		\$10.00	416	\$4,160.00
TKN		\$10.25	416	\$4,264.00
NH3		\$8.20	416	\$3,411.20
NO3		\$10.00	416	\$4,160.00
NO2		\$10.00	416	\$4,160.00
TP		\$12.00	416	\$4,992.00
Acute Toxicity	Rainbow Trout	\$220.00	76	\$16,720.00
	Daphnia	\$165.00	76	\$12,540.00
Chronic Toxicity	Fat head minnows	\$1,200.00		
	Ceriodaphnia	\$1,350.00		
Substances of Potential concern		\$1,000.00	20	\$20,000.00
Total				\$80,439.20

Appendix C. Economic cost parameters for present value estimates

O&M annual costs as % of capital:	
	3%
Discount rate:	
	8%
Future inflation on capital expenditures:	
	2%
Future inflation on O&M expenditures:	
	2%

Data for individual cities and facilities	Moncton	Regina	Halifax	Cape Breton Region	Metro Vancouver (North Shore)	Metro Vancouver (Iona Island)
Actual secondary upgrade \$ capital costs if it were built now (2009 \$M)	\$ 120	\$100	\$ 140	\$ 483	\$ 240	\$ 577
Risk level (year in operation)	High (2020)	High (2020)	Medium (2030)	High (2020)	High (2020)	Medium (2030)
Estimated annual O&M costs (\$2009 M)	\$ 3.6	\$ 3.0	\$ 10.0	\$ 11.0	\$ 7.4	\$ 17.0