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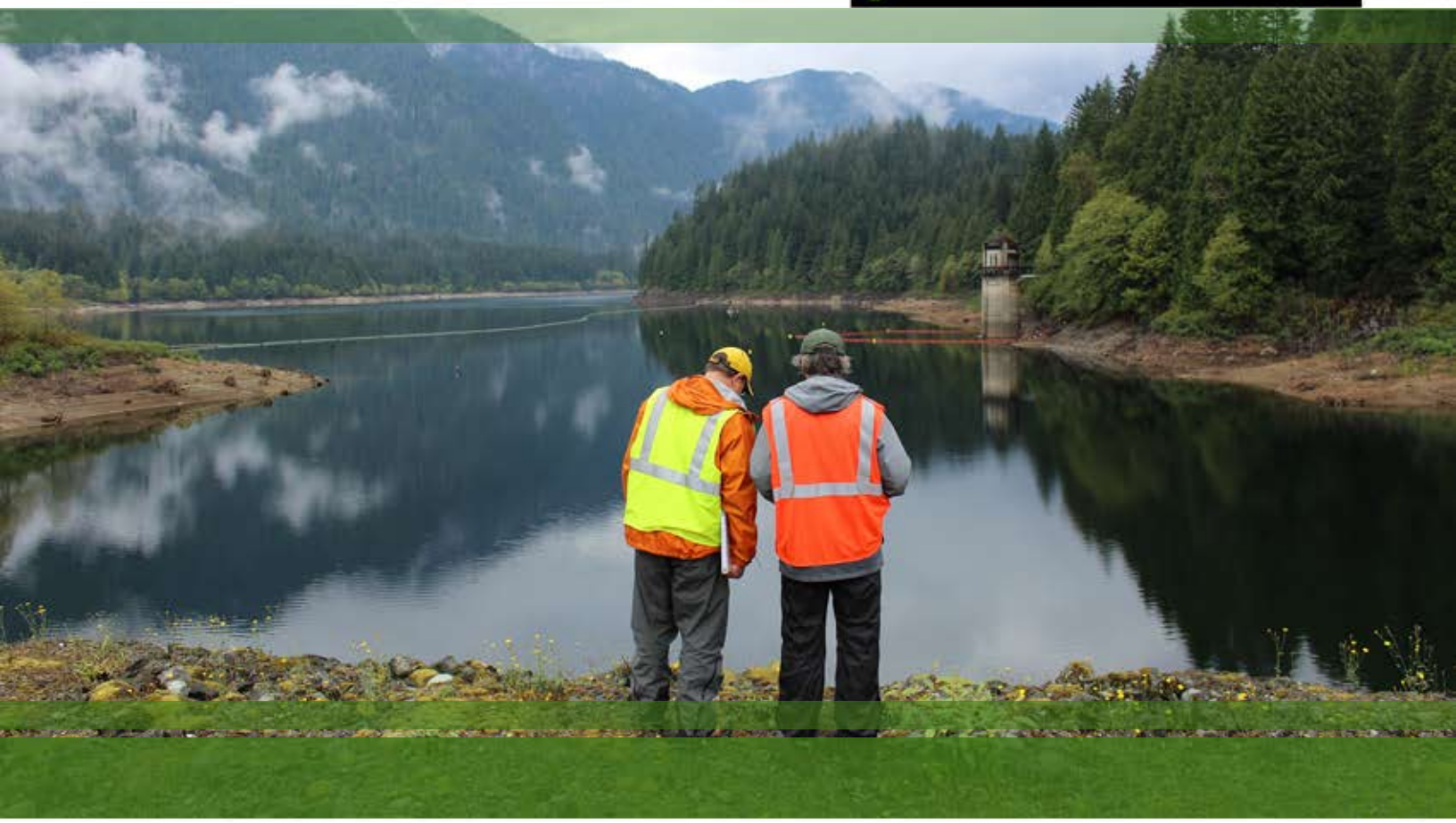

Reducing Water Extraction and Increasing Environmental Flows in the Coquitlam River

An ELC Clinic report prepared for:
Watershed Watch Salmon Society
Coquitlam River Watershed Roundtable

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WATERSHED WATCH SALMON SOCIETY

Coquitlam River Watershed Roundtable

Acknowledgements

We recognize and honour the Kwikwetlem First Nations peoples – the only inhabitants in the Lower Coquitlam River Watershed and surrounding areas since time immemorial.

This report does not specifically address the rights and title of the Kwikwetlem First Nation or other First Nations, and is written without prejudice to those rights.

The content of this report is provided as legal information and should not be relied on as legal advice.

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All errors and omissions are the responsibility of the Environmental Law Centre

Photos courtesy of Craig Orr, Watershed Watch Salmon Society

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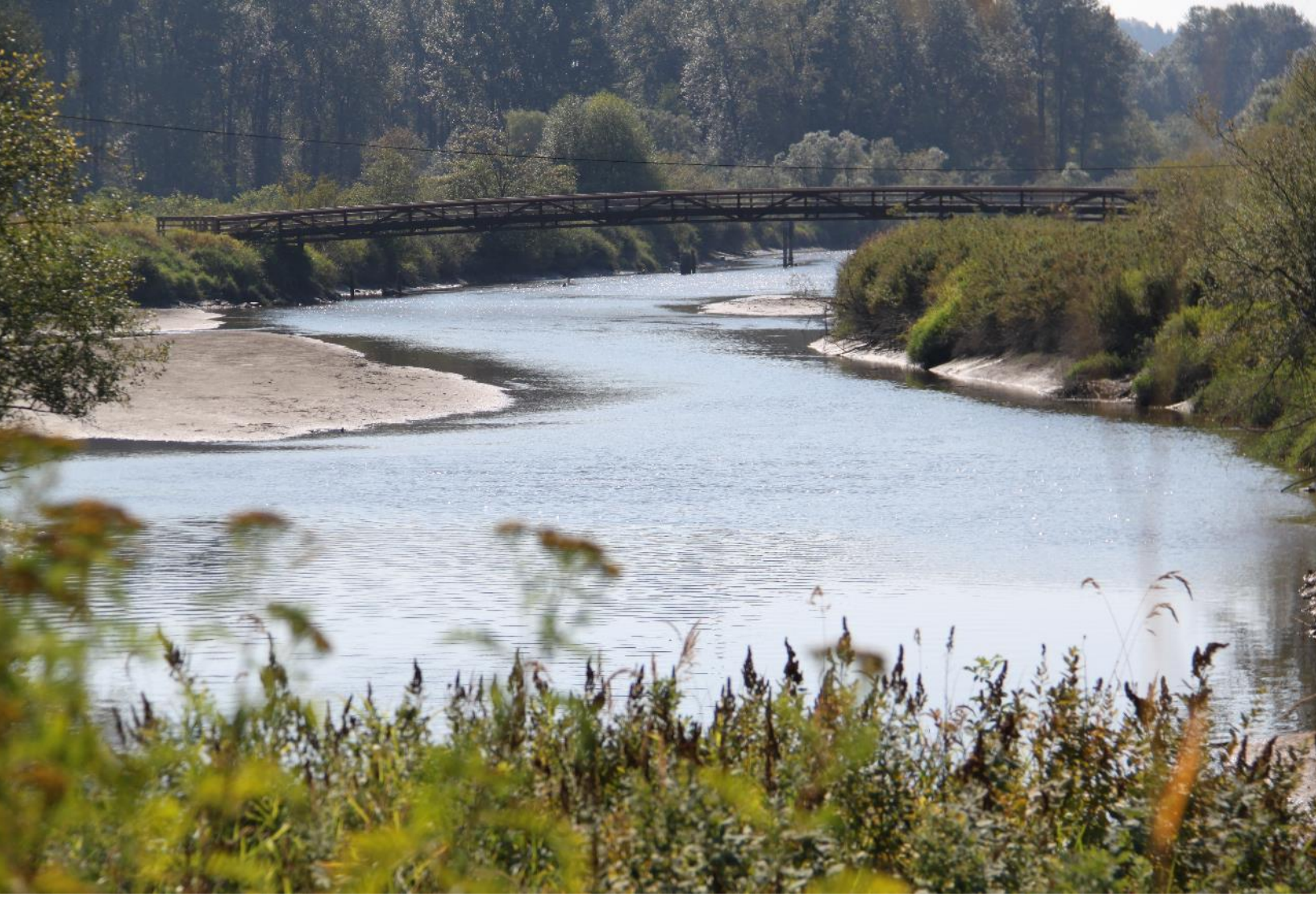


Coquitlam River

Part 1 - Executive Summary

The Coquitlam River Watershed is divided into two parts by BC Hydro's Coquitlam Dam; the Upper Coquitlam River Watershed, which contains the Coquitlam Lake Reservoir, and the Lower Coquitlam River Watershed, which contains the Lower Coquitlam River. Most of the water in the Lower Coquitlam River is sourced from flow released from the Coquitlam Dam and tributaries of the River.

The flow and quality of water in the Coquitlam River are threatened by numerous cumulative factors, including the presence and operation of the Coquitlam Dam, modifications to the water cycle due to urban development and diking, population growth, and the effects of climate change. Perhaps most importantly, BC Hydro's Coquitlam Dam and related management flows for hydroelectric purposes have had a negative impact on environmental flows and, thus, fish. Increasing population and urban growth in the Coquitlam River Watershed will increase the demand for drinking water and decrease modulated inflows into the Lower Coquitlam River as the landscape is converted to urban uses characterized by

impermeable surfaces. Drought conditions caused by climate change will likely exacerbate environmental flow issues.

Recognising the need for a comprehensive approach to watershed planning, in 2015 the Coquitlam River Watershed Roundtable developed the Lower Coquitlam River Watershed Plan that sets out a vision for how integrated planning and watershed management can promote a healthy watershed community. Although the Roundtable developed the Watershed Plan, implementation is complicated by the fact that governance of activities in the watershed rests with many entities, namely, the Kwikwetlem First Nation, Greater Vancouver Water District (GVWD), the City of Coquitlam, the City of Port Coquitlam, BC Hydro and the Province of BC.

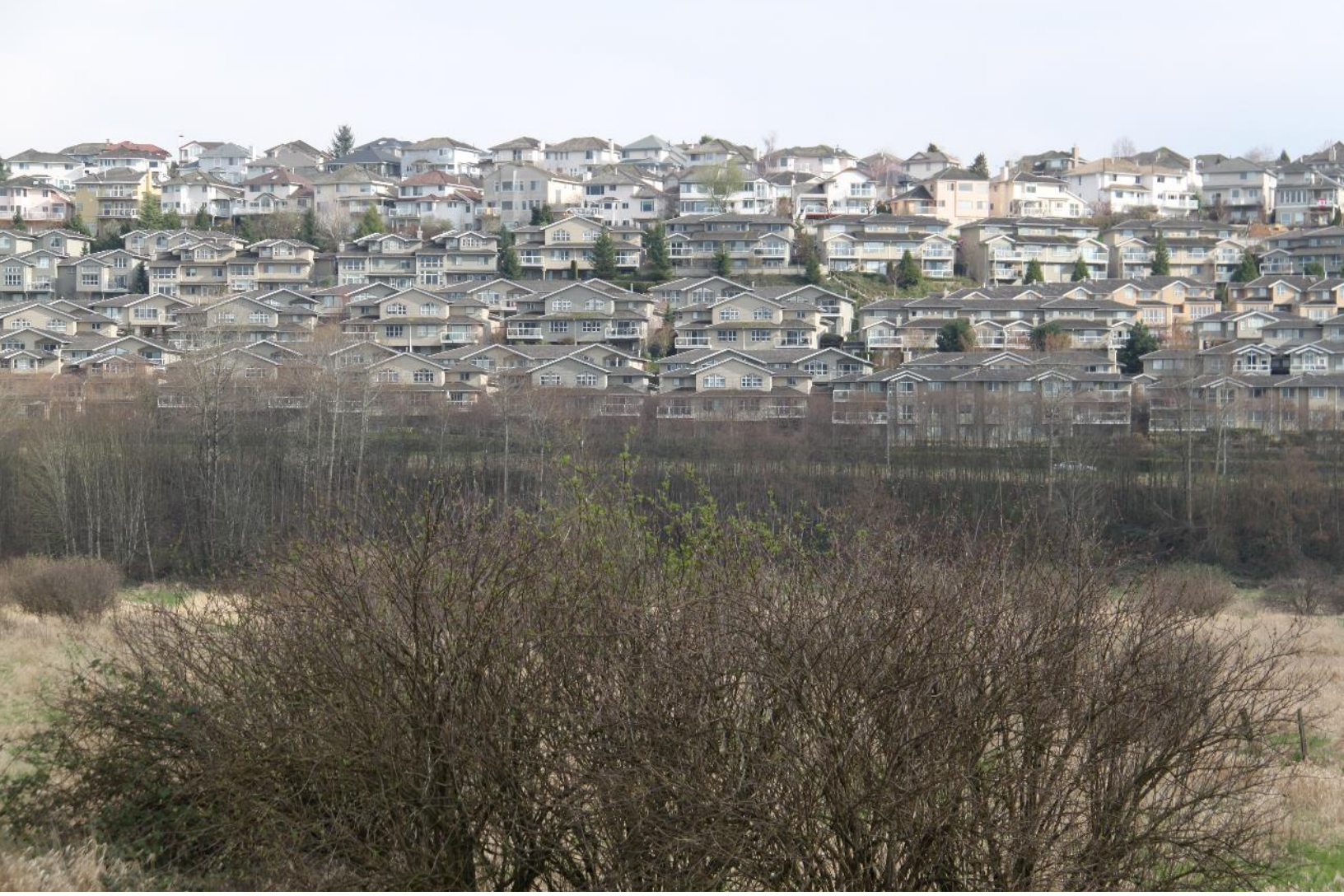
Fortunately, there are a number of actions that local, senior, and first nations governments can take that would help increase flows in the Lower Coquitlam River. Municipalities have the authority to adopt structural and operational water demand management approaches such as water metering and automatic summer water use restrictions. Water metering is considered a best practice for water conservation at the municipal level and is a prerequisite for any conservation-oriented water pricing. Automatic summer water use restrictions are demonstrably effective in reducing water use during peak use or drought. Municipalities have the authority to regulate impermeable surfaces, which negatively impact the water cycle within a watershed, and create incentives for green infrastructure. Also known as low-impact development, green infrastructure approaches include green roofs, rainwater harvesting systems, rain gardens, and stormwater utilities. Further, under the *Water Sustainability Act*, the Province of BC has the ability to direct the creation of water sustainability plans and set standards for environmental flow needs. In certain circumstances, the Province of BC also has the power to issue temporary and fish protection orders under the *Water Sustainability Act*.

Building on the success of water demand management approaches globally, the recommendations in this report provide direction for local governments within the Coquitlam River Watershed, including that the GVWD and the Cities of Coquitlam and Port Coquitlam:

- Phase-in mandatory water metering;
- Implement enhanced automatic summer water use restrictions by evaluating how they can, in addition to ensuring adequate drinking water supply, interact with other management parameters to improve watershed-specific flow conditions in the Coquitlam River; and
- Regulate impermeable surfaces and provide incentives for property owners to expand green infrastructure through a stormwater utility bylaw and rebates for green infrastructure.

Further, for the Province of British Columbia to:

- Engage with the Watershed Roundtable to create a Water Sustainability Plan for the Lower Coquitlam River Watershed;
- Define environmental flow needs for the Coquitlam River using methods promoted in the Okanagan Environmental Flow Needs Project;
- Rely on the defined environmental flow needs in making decisions about water licence applications and to inform management response options when flows are threatened;
- Create, in partnership with the Kwikwetlem First Nation, an environmental flow needs regulation specific to the Lower Coquitlam River Watershed; and
- Make critical environmental flow protection and fish population protection orders under the *Water Sustainability Act* for the Coquitlam River and its tributaries when water levels have fallen below a critical environmental flow threshold or to a point which threatens fish survival.



Mary Hill, Port Coquitlam

Part 2 – Context

The Coquitlam River Watershed Roundtable ("the Roundtable") has taken important steps towards ensuring that the Coquitlam River is able to sustain itself, the natural environment, including fish, and the human population of the Watershed. However, since there are many entities and activities that have an impact on water use in the Coquitlam Watershed, implementation of the Coquitlam River Watershed Plan is challenging. The purpose of this report is to provide recommendations for improving environmental flows in the Coquitlam River and its tributaries by both decreasing water extraction and increasing modulated inflows through groundwater and other natural processes. These recommendations are made in the context of working towards the objectives outlined in the Coquitlam River Watershed Plan.

2.1 COQUITLAM RIVER WATERSHED

The Coquitlam River Watershed is a partially urbanized watershed that drains 261 km^2 of the North Shore Mountains in the Lower Mainland of BC.[1] A dam separates the watershed into the Upper Coquitlam River Watershed and the Lower Coquitlam River Watershed. The Upper Coquitlam River Watershed, above the Coquitlam Dam, is a protected area[2] and boasts a vast headwater wilderness including the Coquitlam Lake Reservoir. This watershed and reservoir serve as an important source of drinking water and hydroelectric power serving one third of the Metro Vancouver region.

The Lower Coquitlam River Watershed, below the Coquitlam Dam, is comprised of many smaller sub-watersheds (also called catchment areas) and includes at least thirty watercourses.[3] The Lower Coquitlam River runs through Coquitlam and Port Coquitlam and the traditional territory and reserve lands of the Kwikwetlem First Nation.[4] An estimated 100,000 residents live in the Lower Coquitlam River Watershed.[5] Urban and agricultural development, a dam and dikes have drastically altered the Lower Coquitlam River Watershed.[6]

2.2 WATERSHED HYDROLOGY

The drainage area of the Coquitlam Lake Reservoir in the upper watershed is 193 square km.[7] Average annual inflow into Coquitlam Lake Reservoir is about 23 cubic metres per second.[8] The Coquitlam dam creates the Coquitlam Lake Reservoir, the active storage of which (defined as the volume between the water licence upper and lower elevation limits) is 170 million cubic

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[1] Michael McPhee, ed, "Lower Coquitlam River Watershed Atlas," (2003) at p. 2, online: https://www.coquitlamriverwatershed.ca/download/coquitlam-river-watershed-atlas/?wpdmdl=386 [Lower Coquitlam River Watershed Atlas].

[2] Coquitlam Conservation Reserve was created between 1904 and 1910 to, in part, to protect the water supply of the City of New Westminster. See Ronald A. Shearer & John T. Sproul, "The Genesis of the Coquitlam Lake Conservation Reserve: A Footnote on Early Conservation Policy in the Lower Fraser Basin" (1996) Working Paper, Westwater Research Centre & Sustainable Development Research Institute – University of British Columbia at p. 4.

[3] *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 3.

[4] "Coquitlam River Watershed Roundtable 2020," online: https://www.coquitlamriverwatershed.ca/download/spring-2020-backgrounder/?wpdmdl=1961.

[5] *Ibid*.

[6] Tanis Douglas, "Lower Coquitlam River Fish Habitat and Flooding Assessment" Prepared for Watershed Watch Salmon Society and Kwikwetlem First Nation at p. ii, online: https://www.watershed-watch.org/wordpress/wp-content/uploads/2011/02/Final-CoquitlamLowerRiverAssessment.pdf [*Lower Coquitlam River Fish Habitat and Flooding Assessment*].

[7] BC Hydro, "Coquitlam-Buntzen Water Use Plan" (7 April 2005) at p. 5, online: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_coquitlam_water_use_plan_pdf.pdf [*Coquitlam-Buntzen Water Use Plan*].

[8] *Ibid*.

metres.[9] Water is diverted from Coquitlam Lake Reservoir to (1) Metro Vancouver via the Greater Vancouver Water District's pipeline, (2) the Department of Fisheries and Oceans via the facilities at Grant's Tomb, or (3) Buntzen Lake Reservoir via a diversion tunnel.[10] Water is also released from the reservoir into the Coquitlam River via water release valves in the Coquitlam Dam.[11]

The majority of water coming into the Lower Coquitlam River Watershed is from flow released from the Coquitlam Lake Reservoir and source tributaries.[12] From three outlet gates the maxiumum discharge from the Coquitlam Lake Reservoir into the Lower Coquitlam River is approximately 45 cubic metres per second.[13] The Coquitlam River receives inflow from tributaries and streams on both sides of the River – the major streams include Or Creek, Hoy Creek, Scott Creek, Maple Creek, Mundy Creek, Reeve Creek and Pinnacle Creek.[14] The hydrology of the Lower Coquitlam River Watershed is also influenced by precipitation, runoff from surface flows, stormwater discharges, and subsurface flows.[15]

2.3 IMPACT OF THE COQUITLAM DAM ON WATERSHED HYDROLOGY

Construction of the Coquitlam Dam in the early 1900s and urbanization of the watershed have had dramatic effects on watershed hydrology.[16] With urban development, hard and impervious surfaces such as roads, sidewalks, driveways, parking lots and buildings have been added to the watershed landscape; this causes surface runoff to increase because rain water cannot penetrate through the impervious surfaces into the ground to make their way to the River.[17] As a result, less water is available to source streams and the Coquitlam River during dry periods and there is more flow volume during storms – in other words, there is lower base flow seeping

[9] Although the *Coquitlam-Buntzen Water Use Plan*, *Ibid*, indicates a total storage volume of 22 million cubic metres, Cam Hiebert, Natural Resources Specialist, BC Hydro confirmed these figures and further clarified that water license permits an upper elevation of 154.86m and lower elevation of 132.00m, however operations within this range are further restricted by other limits such as a Flood Buffer, GVWD/Metro Vancouver operations. Personal communication, July 28 2020.

[10] *Ibid*.

[11] *Ibid*.

[12] *Ibid*.

[13] There are three Low Level outlet gates. Two are sluice gates (LLOG1 and LLOG2) with a maximum discharge of approximately 17 m3/s each. The third outlet is a knife gate and has a maximum discharge of approximately 11 m3/s. Combined, the max discharge from the LLOGs is ~45 m3/s. Cam Hiebert, Natural Resources Specialist, BC Hydro. Personal communication, July 28 2020. Note that the *Coquitlam-Buntzen Water Use Plan, Ibid,* indicates a maximum release from the Coquitlam Lake Reservoir of 1.7 cubic metres per second.

[14] *Ibid*.

[15] *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 7; *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 13.

[16] *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 7.

[17] *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 25.

through the ground and more frequent flooding.[18] Increased flood risk, in turn, has led to flood-proofing projects such as diking and channelization of the Coquitlam River and source tributaries.[19]

Population growth will pose challenges for maintaining adequate drinking water supply:

> The region is expected to grow by 35,000 people per year for the next few decades. Population growth will place demands not only on water supply but also on water infrastructure if not carefully planned.[20]

Climate change also threatens drinking water supplies sourced from the Coquitlam River:

> While climate change predictions do not show a large shift in the amount of precipitation for the region, they do indicate that snow packs at lower elevations will decrease, springs will be earlier, and summers will be longer. These predicted changes in climate may place more stress on the drinking water supply system. In addition, predicted increases in storm activity during the rainy season may result in increased slope failures and river channel instability leading to increased turbidity in source reservoirs and increased treatment costs.[21]

2.4 ORGANIZATIONS AND GOVERNMENTS RESPONSIBLE FOR ACTIVITIES IN THE WATERSHED

The Coquitlam River Watershed Roundtable is a multi-party advisory body dedicated to promoting the long-term sustainability of the Coquitlam River Watershed. Launched in 2011, the Roundtable is led by a Core Committee of 18 government and non-government members who meet every two months to advance the Roundtable's priorities. In 2015, the Coquitlam River Watershed Roundtable developed the Lower Coquitlam River Watershed Plan ("the Watershed Plan") that sets out a vision for how integrated planning and watershed management can promote a healthy watershed and community.[22] In developing the Watershed Plan, the Roundtable used the unique management methodology titled *Open Standards for the Practices of Conservation*, which values ecological as well as human well-

[18] *Ibid*.
[19] *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 15.
[20] *Ibid*.
[21] Metro Vancouver, "Drinking Water Management Plan" (June 2011) at p. 4, online: http://www.metrovancouver.org/services/water/WaterPublications/DWMP-2011.pdf [*Metro Vancouver Drinking Water Management Plan*].
[22] Marni Turek, "Lower Coquitlam River Watershed Plan, Final Draft Version: 1.0" online: https://www.coquitlamriverwatershed.ca/download/lower-coquitlam-river-watershed-plan-final-draft-version1-0/?wpdmdl=512 [*The Watershed Plan*].

being components in the creation of action plans for healthy watersheds and communities.[23] For the purposes of this report, a key feature of the Watershed Plan is that the Roundtable's identification of 'water extraction' as a medium-rated pressure (i.e. threat) to the watershed.[24] Increasing water extraction means that there are lower flows in the Coquitlam River, called environmental flows, which affect ecological health. The Watershed Plan identifies power generation and the need for potable water as contributing factors to this pressure.[25] Specifically, a lack of water metering and incentives to conserve are viewed as exacerbating water extraction.[26]

Although the Roundtable developed the Watershed Plan, implementation is complicated by the fact that governance of activities in the watershed rests with many entities, including the Kwikwetlem First Nation, Metro Vancouver Regional District (Metro Vancouver), the City of Coquitlam, the City of Port Coquitlam, BC Hydro, and the Province of BC.

2.4.1 Kwikwetlem First Nation

The Kwikwetlem First Nation has called the lands within the Coquitlam River Watershed home since time immemorial.[27] The Kwikwetlem First Nation continues to assert their inherent jurisdiction in the Watershed, and has taken steps in court to have their aboriginal rights and title to their traditional territory recognised.[28] Human and engineered impacts to the Coquitlam River Watershed has had an impact on the ability of the Kwikwetlem First Nation to exercise their Aboriginal rights.[29] In response, the Nation has sought to enhance its role in the management of the Coquitlam River Watershed by "working with Metro Vancouver and BC Hydro to develop a new relationship when it comes to decision-making and management in the Coquitlam River Watershed."[30]

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[23] The Open Standards for the Practice of Conservation, "About Open Standards," online: http://cmp-openstandards.org/about-os/.

[24] *The Watershed Plan, supra* note 22 at p. 12;

[25] Joelle Karras, "Lower Coquitlam River Watershed Plan: Tools for Healthy Watersheds and Health Humans" (June 2016) at p. 47, online: http://www.elc.uvic.ca/wordpress/wp-content/uploads/2016/08/LowerCoquitlamRiverWatershedPlan-Final_2016-01-05-1.pdf.

[26] *Ibid*.

[27] Leanna Leib-Milburn, "Towards First Nations Watershed Co-Management in Metro Vancouver: A Case of Kwikwetlem First Nation and the Coquitlam River Watershed" (April 2016) A project submitted in partial fulfillment of the requirements for the degree of Master of Acts (Planning) in the Facility of Graduate Studies, School of Community and Regional Planning, The University of British Columbia.

[28] Karey Brooks, "Kwikwetlem First Nation Title and Charter Claim" (February 10, 2016) online: http://jfklaw.ca/kwikwetlem-first-nation-title-and-charter-claim/.

[29] *Towards First Nations Watershed Co-Management in Metro Vancouver: A Case of Kwikwetlem First Nation and the Coquitlam River Watershed, supra* note 27 at 7.

[30] *Towards First Nations Watershed Co-Management in Metro Vancouver: A Case of Kwikwetlem First Nation and the Coquitlam River Watershed, supra* note 27 at 5.

2.4.2 Metro Vancouver

The Greater Vancouver Water District (GVWD) is the legal entity of Metro Vancouver responsible for drinking water.[31] The GVWD is a wholesaler of treated drinking water to its member jurisdictions – including the Cities of Coquitlam and Port Coquitlam. The Coquitlam Lake Reservoir supplies one third of the Metro Vancouver's drinking water, and that proportion can increase to approximately half of the region's supply during summer peak demand.[32]

The GVWD manages three water supply areas (Seymour, Capilano and Coquitlam) that provide the 2.5 million residents of the Metro Vancouver region with a clean, reliable and affordable supply of drinking water.[33] The GVWD provides drinking water through source water protection, water treatment, maintenance of the distribution system and monitoring of water quality.[34] The GVWD safeguards the land around the Coquitlam Lake Reservoir, secured under a 999-year lease from the Province, from unauthorized human access, urban development and human-caused disturbance to protect water quality.[35] The GVWD operates monitoring sites throughout the Coquitlam Watershed to gather data on snowpack, wildfire indicators, River hydrometrics, precipitation, climatology, limnology and water storage.[36] The GWVD also owns and operates the Coquitlam Water Treatment Plant, which treats approximately 380 million litres of drinking water per day.[37] The GVWD provides recent and current river levels and flows of the Seymour and Capilano Rivers but not the Coquitlam River as the Coquitlam Dam and downstream flows are managed by BC Hydro.[38]

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[31] Metro Vancouver is a political body and corporate entity operating under BC provincial legislation as a 'regional district' and 'greater boards' that delivers regional services, planning and political leadership on behalf of 24 local authorities. *Metro Vancouver Drinking Water Management Plan, supra* note 21 at p. 2. There are four local government boards: (1) Metro Vancouver Regional District, (2) Greater Vancouver Sewerage and Drainage District, (3) Greater Vancouver Water District, and (4) Metro Vancouver Housing Corporation. Metro Vancouver, "Boards," online: http://www.metrovancouver.org/boards/Pages/default.aspx.

[32] Metro Vancouver, "Watersheds and Reservoirs," online: http://www.metrovancouver.org/services/water/sources-supply/watersheds-reservoirs/Pages/default.aspx [*Metro Vancouver Watersheds & Reservoirs*].

[33] *Metro Vancouver Watersheds & Reservoirs, supra* note 322.

[34] In May 2002, the GVWD Board adopted a Watershed Management Plan that applies to Crown and private lands held by the GRVD within the Capilano, Seymour and Coquitlam watersheds. "Five-Year Implementation Plan for Capilano, Seymour and Coquitlam Watersheds" (November 2002), at p. 3, online: http://www.metrovancouver.org/services/water/WaterPublications/WSMP-5YearImplementation.pdf.

[35] Metro Vancouver, "Taking Care of the Watersheds," online: http://www.metrovancouver.org/services/water/sources-supply/watersheds/Pages/default.aspx.

[36] Metro Vancouver, "Testing & Reporting," online: http://www.metrovancouver.org/services/water/quality-facilities/testing-reporting/Pages/default.aspx.

[37] Metro Vancouver, "Drinking Water Facilities," online: http://www.metrovancouver.org/services/water/quality-facilities/facilities-processes/drinking-water-treatment-facilities/Pages/default.aspx.

[38] Metro Vancouver, "Seymour and Capilano River Levels," online: http://www.metrovancouver.org/services/water/conservation-reservoir-levels/seymour-capilano-river-levels/Pages/default.aspx.

The GVWD removes water from storage in the Coquitlam Lake Reservoir in compliance with its provincial water licence and an agreement with BC Hydro for drinking water supply. The BC Hydro/Metro Vancouver agreement identifies the maximum amount of water that may be directed from the Coquitlam Lake Reservoir to GVWD supply. While the GVWD's licensed diversions is 2.63 cubic metres per second per day, the 1987 BC Hydro/GVWD agreement permits domestic water release to be increased in excess of that permitted in the GVWD by water licenses, up to 13.7 cubic metres per second on any one day, or 7.9 cubic metres per second total annual average.[39] However, Metro Vancouver has expressed an intent to develop a new intake and water supply tunnel that would double the capacity of the current system.[40]

In 2005, the Board of the GVWD approved the Drinking Water Management Plan (DWMP) for Metro Vancouver and its member jurisdictions.[41] The 2011 version of the DWMP provides direction and priority for drinking water initiatives consistent with the Metro Vancouver Sustainability Framework.[42] Metro Vancouver's DWMP notes that opportunities should be identified to continue the trend of declining per-capita water use.[43]

2.4.3 Cities of Coquitlam and Port Coquitlam

Seventy-four percent (5,820 of 7,900 hectares) of the Lower Coquitlam River Watershed area lies inside the Cities of Coquitlam and Port Coquitlam. This area is zoned for six different land uses, as set out in the following table:[44]

Land Use Zone	**Percentage of total Lower Coquitlam River Watershed Area**
Outside of cities' boundaries	26%
Resource extraction	30%
Commercial	3%
High-density residential	4%
Low-density residential	19%
Park and institutional	14%
Agricultural	4%

[39] Cam Hiebert, Natural Resources Specialist, BC Hydro. Personal communication, July 28 2020. This is the maximum nomination amount. Note that the *Coquitlam-Buntzen Water Use Plan, supra* note 7 at p. 4 states a maximum flow of 7.88 cubic metres per second, which represents about 34 percent of the average annual reservoir inflow.

[40] Metro Vancouver (Jesse Montgomery, Matthew Dybwad, Bob Cheng) presentation to the Kwikwetlem First Nation and Metro Vancouver Water Services Technical Working Meeting February 26, 2018.

[41] *Metro Vancouver Drinking Water Management Plan, supra* note 21 at p. 4.

[42] Metro Vancouver, "Sustainability Framework" (2010), online: http://www.metrovancouver.org/about/aboutuspublications/MV-SustainabilityFramework.pdf.

[43] *Metro Vancouver Drinking Water Management Plan, supra* note 21 at p. 4.

[44] This table is adapted from a pie chart appearing in *Lower Coquitlam River Watershed Atlas, supra* note 1 at p. 27.

2.4.3.1 City of Coquitlam

The City of Coquitlam is a municipality within the Metro Vancouver Regional District and its drinking water is sourced, in part, from the Coquitlam Watershed. The population of the City of Coquitlam is currently 139,285,[45] and it is one of the fastest-growing cities in all of Canada. According to the 2016 Census, Coquitlam's average population growth from 2012-2016 was 1.96 % per year, making it the tenth fastest-growing Canadian city with a population of at least 100,000, and the third fastest-growing in BC.[46] The City has identified a population target of 224,000 by 2041[47] and projected that dwelling units would increase from 48,000 to 94,100 between 2011 and 2041.[48]

The City of Coquitlam has a land base of 122.3 km^2.[49] As of 2013, the City's land base was comprised of 50 % "Conservation and Recreation lands," 2 %"Agricultural lands" and 40 % "General Urban lands"[50] It is important to note that at least half of the land base of the City is green infrastructure that assists the City to manage hydrology without hard infrastructure.

The City of Coquitlam is a local authority which, like other jurisdictions in the Regional District, owns and operates the local water distribution system to supply water to residents and businesses.[51] The City is involved in urban and land use planning in the watershed through its citywide Official Community Plan,[52] which guides future land use and servicing decisions.[53] The City has put in place development cost charges, levied on new development to pay for the

[45] City of Coquitlam, "Demographics – Census & National Household Survey Data" online: https://www.coquitlam.ca/planning-and-development/resources/community-profiles-demographics/census.aspx.
[46] City of Coquitlam, "2018-2022 Financial Plan" at p. 3 online: https://www.coquitlam.ca/docs/default-source/city-hall-files/city-of-coquitlam-financial-plan-2018-2022.pdf [*City of Coquitlam 2018-2022 Financial Plan*].
[47] *City of Coquitlam 2018-2022 Financial Plan, supra* note 46 at p. 4.
[48] Letter from Lee-Ann Garnett, Senior Regional Planner - Planning, Policy and Environment Department – Metro Vancouver to Regional Planning and Agriculture Committee, "Consideration of the City of Coquitlam's Regional Context Statement," (September 20, 2013), online: http://www.metrovancouver.org/services/regional-planning/RegionalContextStatements/Coquitlam_acceptance_report_to_GVRD_Board_October_11_2013.pdf [*Consideration of the City of Coquitlam's Regional Context Statement*].
[49] Focus on Geography Series, 2011 Census, "Census Subdivision of Coquitlam, CY – British Columbia, online: https://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=5915034.
[50] *Consideration of the City of Coquitlam's Regional Context Statement, supra* note 488 at p. 2&3.
[51] *Metro Vancouver Drinking Water Management Plan, supra* note 21 at p. 4.
[52] City of Coquitlam, "Citywide Official Community Plan" (March 2002) online: http://www.coquitlam.ca/cityhall/plans/community-plans.aspx.
[53] City of Coquitlam, "Citywide Official Community Plan – Part 1: Introduction and Regional Context Statement," (March 2002) pg. 1, http://www.coquitlam.ca/docs/default-source/citywide-ocp/Part_1_-_Ch_1_-_Introduction_and_Regional_Context_Statement.pdf?sfvrsn=0.

costs of expanding and upgrading the community's transportation, water, sewer, drainage, and park infrastructure.[54]

The City of Coquitlam manages its local sub-watersheds through Integrated Watershed Management Plans in order to "preserve watershed health, while also meeting community needs and facilitating growth and development."[55] The City of Coquitlam, in partnership with the City of Port Coquitlam, has developed an Integrated Watershed Management Plan for the Hyde Creek Watershed.[56] The City of Coquitlam also developed Integrated Watershed Management Plans for the Partington Creek,[57] Como Creek,[58] Nelson Creek,[59] Austin & Rochester,[60] Mundy Creek,[61] and Scott / Hoy Creek Watersheds.[62] In addition, the City developed an Integrated Stormwater Management Strategy for the Stoney Creek Watershed,[63] and is in the process of developing an Integrated Stormwater Management Plan for Chines Watershed, in partnership with Metro Vancouver and Port Moody.[64]

[54] City of Coquitlam, "Development Cost Charges 2018 Update," online: https://www.coquitlam.ca/docs/default-source/community-planning-documents/2018-dcc-update-information-handout.pdf.
[55] City of Coquitlam "Integrated Watershed Management Plans" online: https://coquitlam.maps.arcgis.com/apps/MapJournal/index.html?appid=1cbbf769b5a54a02adea81b278cbf179.
[56] City of Coquitlam & City of Port Coquitlam, "Hyde Creek Integrated Watershed Management Plan," (April 2004) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Hyde_Creek_IWMP_Final_Report_Feb_2004.pdf?sfvrsn=0.
[57] City of Coquitlam, "Partington Creek Integrated Watershed Management Plan" (July 2011) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Partington_IWMP__March_2011.pdf?sfvrsn=0.
[58] City of Coquitlam, "Como Creek IWMP Update" (May 2014) Final Report, KWL Project No. 465.076-300, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Como_IWMP_Final_Report.pdf?sfvrsn=0.
[59] City of Coquitlam, "Nelson Creek Integrated Watershed Management Plan," (June 2012) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Nelson_IWMP_Final_Report.pdf?sfvrsn=0.
[60] City of Coquitlam, "Austin / Rochester Integrated Watershed Management Plan," (May 2015) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/austin-rochester-iwmp---final-report.pdf?sfvrsn=2.
[61] City of Coquitlam, "Mundy Creek Integrated Watershed Management Plan," (November 2015) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/mundy-creek-integrated-watershed-management-plan.pdf?sfvrsn=2.
[62] City of Coquitlam, "Scott Creek Integrated Watershed Management Plan," (January 2012) Final Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Scott_Creek_IWMP_-_Final_Report_Jan_2012.pdf?sfvrsn=0.
[63] Stoney Creek Stormwater Steering Committee, "Integrated Stormwater Management Strategy for Stoney Creek Watershed," (February 1999) Final Draft for Publication, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/Stoney_Creek_IWMP.pdf?sfvrsn=0.
[64] City of Coquitlam, Metro Vancouver, Port Moody & Associated Engineering, "Chines Integrated Stormwater Management Plan," (November 2015) Final Draft Report, online: https://www.coquitlam.ca/docs/default-source/city-services-documents/draft-chines-integrated-stormwater-management-plan.pdf?sfvrsn=2.

2.4.3.2 The City of Port Coquitlam

The City of Port Coquitlam is a municipality within Metro Vancouver and its drinking water is sourced, in part, from the Coquitlam Watershed. The population of the City of Port Coquitlam is currently 58,612.[65] Between 1991 and 1996, Port Coquitlam was the fastest growing community in the Lower Mainland with a population increase of almost 27 %.[66] This growth rate has slowed but remained above the regional average at about 7 % between 2006 and 2011.[67] As of 2013, the City of Port Coquitlam was projected to grow to approximately 68,000 by 2021 and 76,000 by 2031.[68] The number of housing units is increasing with the City permitting the construction of over 5,600 new housing units between 1991 and 2001, and 2900 were added between 2001 and 2011.[69]

The City of Port Coquitlam has a land base of just over 28 km^2.[70] Approximately 25% of the City of Port Coquitlam is reserved for "Conservation & Recreation" or "Agricultural" use.[71] As of 2013, 5% of the land base was designated for commercial or mixed use development,[72] 14.3% as industrial areas,[73] and more than 33% is designated and zoned as low-density residential.[74]

The City of Port Coquitlam is involved in urban and land use planning in the watershed through its Official Community Plan.[75] City council adopted the City of Port Coquitlam's Greenways Plan in 1999 and it continues to guide decisions related to preserving natural areas in Port Coquitlam.[76] Further, city council endorsed the City's Environmental Strategic Plan in 2011 and it sets environmental goals, objectives and strategic directions, describes actions to achieve these goals and identifies an environmental mission.[77]

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[65] Statistics Canada, "Census Profile, 2016 Census, at Port Coquitlam, CY, British Columbia," online: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5915039&Geo2=CD&Code2=5915&Data=Count&SearchText=port%20coquitlam&SearchType=Begins&SearchPR=01&B1=All&TABID=1.

[66] City of Port Coquitlam, "Official Community Plan" Bylaw No 3838, at p. 9, online: https://www.portcoquitlam.ca/wp-content/uploads/2017/01/3838-Official-Community-Plan.pdf [*City of Port Coquitlam Official Community Plan*].

[67] *Ibid*.

[68] *Ibid*.

[69] *Ibid*.

[70] *City of Port Coquitlam Official Community Plan, supra* note 666 at p. 10.

[71] Estimate based on *City of Port Coquitlam Official Community Plan, supra* note 666 at p. 15, "Map 2 – Regional Land Use Designations, Municipal Town Centre and Urban Containment Boundary."

[72] *City of Port Coquitlam Official Community Plan, supra* note 666 at p. 11.

[73] *Ibid.*

[74] *Ibid*.

[75] *City of Port Coquitlam Official Community Plan, supra* note 666.

[76] *City of Port Coquitlam Official Community Plan, supra* note 666 at p. 3.

[77] *City of Port Coquitlam, Official Community Plan, supra* note 666 at p. 4.

The City of Port Coquitlam manages its local sub-watersheds through Integrated Watershed Management Plans in order to: (1) maintain or improve the ecological functions of watercourses through restoration and enhancement of fish and wildlife habitat; (2) maintain or enhance biodiversity; (3) improve water quality; (4) minimize erosion and soil stability; and (5) ensure adequate flood control and protection of people and property.[78] It has developed an Integrated Watershed Management Plan for the Hyde Creek Watershed, in partnership with the City of Coquitlam.[79] A similar management plan is under review for Maple Creek Watershed.[80]

2.4.4 BC Hydro

BC Hydro is a Crown corporation, wholly owned by the Province of BC, and is one of the largest electricity utilities in Canada.[81] BC Hydro generates electricity through the operation of the Coquitlam-Buntzen Power Development, in respect of which it holds three water licences[82] issued under the former *Water Act*.[83] The "works" authorized are the Coquitlam Dam, with low level outlets and two fish-water release valves,[84] and an intake on Coquitlam Lake.[85] BC Hydro has an agreement with the GVWD, approved by the Comptroller of Water Rights, for supplying drinking water from the Coquitlam Lake Reservoir.[86]

BC Hydro owns and operates the Coquitlam Dam and associated generating stations. Coquitlam Lake Reservoir, upstream of the dam, is connected to the Buntzen Lake Reservoir via a diversion tunnel, which diverts a maximum of 40 cubic metres per second from the Coquitlam Lake Reservoir into the Buntzen Lake Reservoir.[87] From the Buntzen Lake Reservoir water flows via two release facilities, one at the Buntzen Dam, and another on the west shore, towards two

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[78] *Ibid*.

[79] *Hyde Creek Integrated Watershed Management Plan, supra* note 566.

[80] Port Coquitlam, "Watershed Planning" online: https://www.portcoquitlam.ca/city-services/environmental-services/watershed-planning/.

[81] World Wildlife Fund Canada. "Water for Power, Water for Nature: The Story of BC Hydro's Water Use Planning Program" (October 2014), online: http://awsassets.wwf.ca/downloads/wup_report_r04.pdf.

[82] Province of British Columbia, Final Water Licences 119709, 119710 and 119711.

[83] *Water Act,* RSBC 1996, c. 483 and continued under the *Water Sustainability Act*, SBC 2014 c 15; Province of British Columbia, *Water Act* Order Section 88, File Nos.: 0241200, 0241202 and 0084341, online: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/117500-119999/119709/Coquitlam%20Order.doc [*Water Act Order Section 88 Coquitlam –Buntzen Power Development*].

[84] Province of British Columbia Work No. PD442777.

[85] *Water Act Order Section 88 Coquitlam –Buntzen Power Development, supra* note 833; Province of British Columbia Work No. PD42776.

[86] *Metro Vancouver Watersheds and Reservoirs, supra* note 32; BC Hydro, "Coquitlam-Buntzen Project Water Use Plan" Revised for Acceptance by the Comptroller of Water Rights," (7 April 2005) online: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_coquitlam_water_use_plan_pdf.pdf.

[87] *Coquitlam-Buntzen Water Use Plan, supra* note 7 at p. 3.

powerhouses situated on the shore of Indian Arm.[88] Power generation for the Coquitlam-Buntzen Project occurs at the two Buntzen generating stations and produces about 20 gigawatt hours of electricity each year, which is enough to provide electricity for 18,000 homes.[89] This is approximately 7.1 % of regional hydro generating capacity for the Lower Mainland/Coastal/Fraser Region, but only about 0.4 % of BC Hydro's power generating capacity.[90]

BC Hydro operates the Coquitlam Dam and controls flows in the Coquitlam River, which has an impact on fish populations. [91] Prior to 2008, fish-flow release valves in the Coquitlam Dam were the primary conduit through which water was released to support base environmental flows for fish in the Lower Coquitlam River.[92] In 2005, the Deputy Comptroller of Water Rights for BC issued an Order under the *Water Act,*[93] which prescribed operating conditions for the Coquitlam-Buntzen Hydroelectric System and required BC Hydro to alter the water-release facilities of the Coquitlam Dam in a manner that made it suitable to release the specified flows.[94] Thus, in 2008, the Coquitlam Dam was modified to include a "low level outlet gate" with a "1.22-metre-diameter flow control knife gate" that has since been used as the primary conduit to release flows in the Lower Coquitlam River for fish.[95]

BC Hydro's *Coquitlam-Buntzen Water Use Plan* (WUP), dated April 7, 2005[96] directs BC Hydro's operation of the Coquitlam Reservoir and Coquitlam Dam. The WUP recommends a review within 15 years its implementation but notes that a review may be triggered sooner if fish passage over the dam is provided or if the River is identified as being able to handle flushing flows higher than 200 cubic metres per second,[97] (which is an unrealistic flow as that volume would cause localized flooding in low lying areas along the lower Coquitlam River and the Plant Manager issues flood alerts to downstream stakeholders at any flow above 140 cubic metres

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[88] *Ibid*.

[89] *Ibid*.

[90] *Coquitlam-Buntzen Water Use Plan, supra* note 7 at p. 7.

[91] Craig Orr, "Coquitlam River Update by Craig Orr," (January 2018) Watershed Watch Salmon Society, https://www.watershed-watch.org/2018/01/coquitlam-river-update-by-craig-orr/.

[92] *Coquitlam-Buntzen Water Use Plan, supra* note 7 at p. 5.

[93] *Water Act, supra* note 833 at s. 88; *Water Act Order Section 88 Coquitlam –Buntzen Power Development*, *supra* note 833.

[94] *Water Act Order Section 88 Coquitlam –Buntzen Power Development, supra* note 833 at Schedule B: Modification of Works – Coquitlam Dam Release Facilities. The prescribed flows were set out in *Water Act Order Section 88 Coquitlam –Buntzen Power Development, supra* note 833 at Schedule C: Operating Parameters – Operating Conditions for the Coquitlam-Buntzen Hydroelectric to be implemented January 1, 2007.

[95] Fish & Wildlife Compensation Program, "Coquitlam Smolt Outmigration – Phase 2 Report: Sockeye Passage Design for Coquitlam Reservoir Forebay FWCP Project No. COA-F18-F-2362," (Redmond, Washington: R2 Resource Consultants, Inc, 2018) at p. 12&16, online: http://a100.gov.bc.ca/appsdata/acat/documents/r54480/COA_F18_F_2362_1533828142647_3824441823.pdf.

[96] *Coquitlam-Buntzen Water Use Plan, supra* note 7.

[97] *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 56.

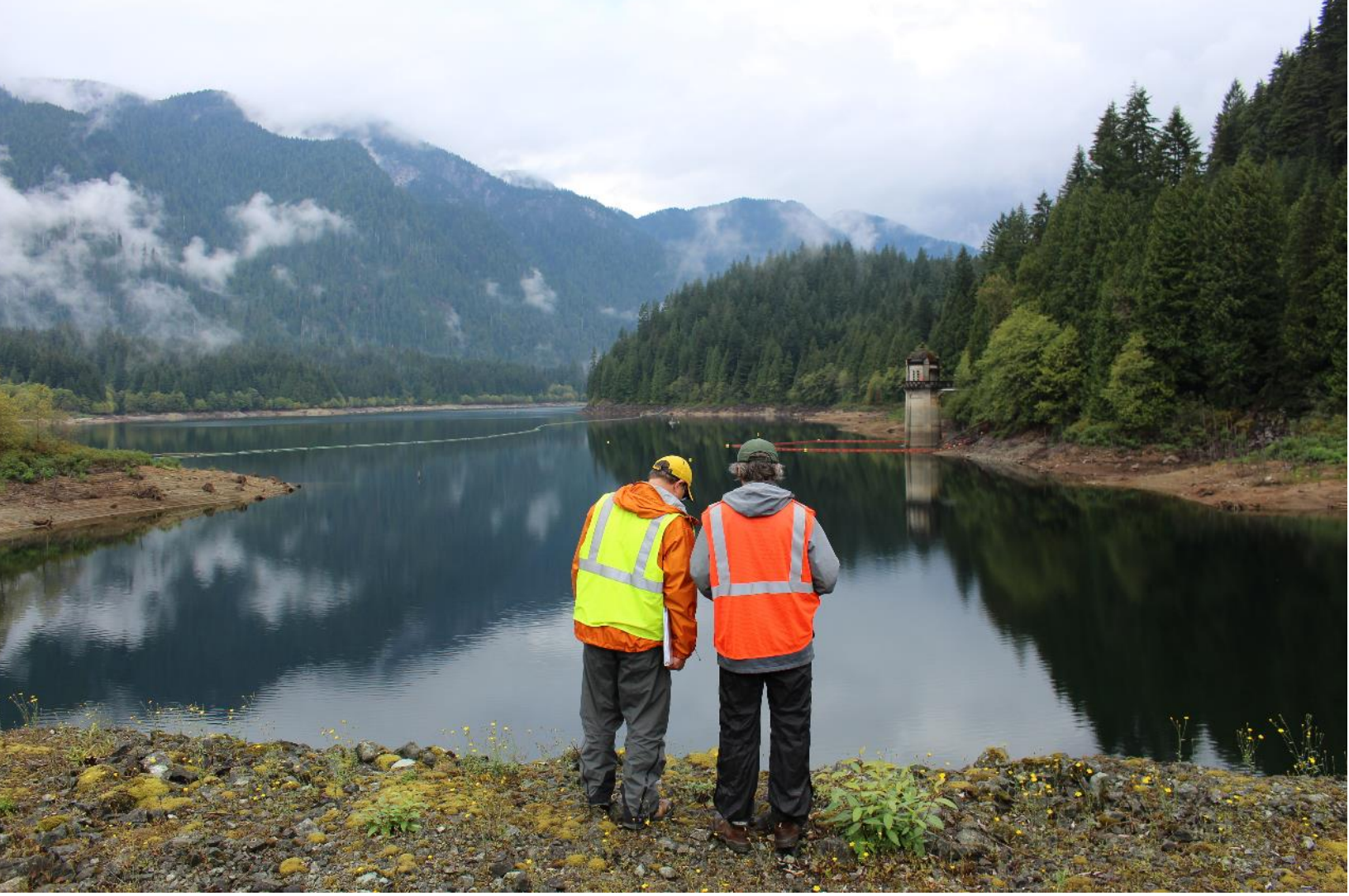
per second).[98] A scheduled suite of technical research studies delivered under the WUP process have now been concluded, and BC Hydro has indicated its intention to commence a water use plan order review.[99]

2.4.5 Province of British Columbia

The Province of BC asserts ownership over water and regulates the use of water in the province.[100] It issues water licences to water users such as Metro Vancouver and BC Hydro, and regulates the volume and method of use.[101] Under the new *Water Sustainability Act* (*WSA*) the Province of BC can order that water users reduce the amount of water they are diverting in low flow conditions (see Part 4 below), and can require organizations undertaking works in and about a stream to abide by specific permit conditions to protect species and ecosystems.[102]

In summary, as demonstrated throughout Part 2, governance activities in the watershed rests with many entities, including the Kwikwetlem First Nation, Metro Vancouver, the City of Coquitlam, the City of Port Coquitlam, BC Hydro, and the Province of BC. This creates challenges for ensuring that overall water management approaches achieve the goals of the Lower Coquitlam River Watershed Plan. Reducing the diversion of water from the River and ensuring adequate inflows along the full length of the River are key to water management. Fortunately, there are a number of actions that local and senior governments can take that would help increase flows in the Lower Coquitlam River.

[98] Cam Hiebert, Natural Resources Specialist, BC Hydro. Personal communication, July 28 2020.
[99] Coquitlam Water Use Plan Monitoring Committee Meeting Minutes, November 27 2019.
[100] *Water Sustainability Act*, SBC 2014, c. 15 at ss 5 & 6 [*WSA*].
[101] *WSA, supra* note 100 at ss. 7 and 9.
[102] *WSA, supra* note 100 at s. 11; *Water Sustainability Regulation,* BCReg 37/2019 at Part 3.



Coquitlam Reservoir

Part 3 - Municipal Water Demand Management and Green Infrastructure Enhancement

Water management has traditionally been supply-driven, which is no longer sustainable as regional populations (and use) increase, and hydrology in the region changes. Municipalities and water utilities are turning to water demand management to meet water supply needs.[103] Water demand management (WDM) refers to "any socially beneficial measure which reduces or reschedules average of peak water withdrawals or consumptive use from surface or groundwater, while maintaining or mitigating the extent to which return flows are

[103] Saroj Sharma & Kalanithy Vairavamoorthy, "Urban Water Demand Management: Prospects and Challenges for the Developing Countries" (2008) 23 Water and Environment Journal 210-218.

degraded."[104] It relies upon various techniques, which can be divided into three categories: economic, structural and operational, and socio-political.[105] Structural techniques "are those which alter existing structures to achieve better control over water demand."[106] Water metering is a particularly important structural technique for municipalities, because it provides the means to implement pricing controls.[107] Operational techniques are "actions by water users to modify existing water use procedures to control demand patterns more effectively"; they include water use restrictions.[108]

Since jurisdictions within Metro Vancouver source a portion of their drinking water from the Coquitlam River Watershed, decreasing the amount of water extracted from the Watershed by implementing WDM measures – such as water metering and water use restrictions - can augment environmental flows. Further, municipalities within Metro Vancouver can maintain and increase the amount of water flowing into the River in a controlled manner via rainwater infiltration into the landscape by regulating impermeable surfaces. To achieve municipal WDM and enhance infiltration through green infrastructure, municipalities within the Watershed, including the Cities of Coquitlam and Port Coquitlam, can (a) phase-in mandatory water metering, (b) enhance automatic summer water use restrictions and (c) regulate impermeable surfaces.

3.1 MANDATE WATER METERING FOR ALL CUSTOMERS

Water meters are devices that measure the amount of water being used by a consumer. Scholars and practitioners across Canada have advocated for water metering as a best practice and a top municipal priority.[109] Metro Vancouver and its member municipalities have indicated

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[104] Donald M. Tate, "Water Demand Management in Canada: A Review and Assessment" (1989) 14 Canadian Water Resources Journal 4 71-82 at p. 72:
In formal terms, water demand management consists of any socially beneficial measure which reduces or reschedules average peak water withdrawals or consumptive use from surface or groundwater, while maintaining or mitigating the extent to which return flows are degraded. This definition is based on a report on demand management by [D. B. Brooks and R. Peters, *Water: The Potential for Demand Management in Canada* (Ottawa-Hull: Science Council of Canada, 1988)], augmented to include a criterion for assessing the benefits to society of particular measures. The term "socially beneficial" in the definition means that the benefits to society of adopting particular measures should outweigh the costs of adoption [D. D. Baumann et al. "The Problem of Defining Water Conservation," The Cornett Papers, University of Victoria, Victoria, BC 125-134]. The aim is not to save water as such, but rather to increase net social welfare through water demand management.

[105] *Water Demand Management in Canada: A Review and Assessment, supra* note 1044 at p. 74.

[106] *Ibid*.

[107] *Ibid*.

[108] *Ibid*.

[109] Jordi Honey-Roses, David Gill, & Claudio Pareja, "BC Municipal Water Survey 2016" (March 2016) Water Planning Lab, School of Community and Regional Planning, University of British Columbia, online: http://waterplanninglab.sites.olt.ubc.ca/files/2016/03/BC-Municipal-Water-Survey-2016.pdf citing Federation of Canadian Municipalities & National Research Council, "Establishing a Metering Plan to Account for Water Use and Loss" (2003) Issue No. 1. online:

they are working towards universal water metering as a best practice,[110] which should be expedited in the Coquitlam River Watershed.

3.1.1 Benefits of Water Metering

Water meters help to manage consumer demand and incentivize water use-efficiency. The installation of water meters allows local governments to: (1) Establish a price based on the real cost of delivering volumes consumed; (2) Identify leaks; (3) Evaluate the impact of water conservation programs; and (4) Better prepare for and respond to drought.[111] It has been estimated that a universal metering program can result in approximately 10% to 40% sustained reduction in residential water usage, provided that metered water rates are established appropriately.[112]

Before the installation of water meters, the Sunshine Coast Regional District (SCRD) reported losing approximately 350 million litres of water per year due to leaks.[113] However, meter installations have allowed the SCRD to use information from the meter to identify and fix over 1000 leaks, saving about one million litres per day from being wasted.[114] Further, SCRD staff have estimated that repairing the leaks has reduced water consumption by 137.4 cubic metres per day in the North Pender Harbour System and 121.5 per day in the South Pender Harbour System.[115]

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https://data.fcm.ca/documents/reports/Infraguide/Establishing_a_Metering_Plan_to_Account_for_Water_Use_and_Loss_EN.pdf; American Water Works Association, "Statement of Policy on Water Supply Matters: Metering & Accountability" (2010) online: https://www.awwa.org/About-Us/policy-statements/policy-statement/articleid/206/metering-and-accountability; S. Renzetti, *Wave of the Future: The Case for Smarter Water Policy* (Toronto, Canada: C. D. Howe Institute, 2009); O. M. Brandes, S. Renzetti & K. Stinchcombe, "Worth Every Penny: A Primer on Conservation Oriented Water Pricing" (2010) Polis Project on Ecological Governance, University of Victoria [*Worth Every Penny: A Primer on Conservation Oriented Water Pricing*].

[110] Metro Vancouver, "Residential Water Metering in Metro Vancouver: Best Practices Guide for Local Governments" (*Water Metering Best Practices Guide*) (August 2019) online: http://www.metrovancouver.org/services/water/WaterPublications/ResidentialWaterMeteringinMV-BestPracticesGuide.pdf.

[111] *BC Municipal Water Survey 2016, supra* note 1099 at p. 7.

[112] Brandes, Oliver, *et al. Thinking Beyond Pipes and Pumps: Top 10 Ways Communities Can Save Water and Money* (Polis Project on Ecological Governance, October 2006).

[113] Lisa McKnight-Yeates, "Meter-based leak detection saving a million saving a million litres a day: SCRD" (September 28, 2017) *Coast Reporter*, online: https://www.coastreporter.net/news/local-news/meter-based-leak-detection-saving-a-million-litres-a-day-scrd-1.23050311.

[114] *Ibid.*

[115] Sean Eckford, "Metering Finds Lots of Leaks" (April 29, 2017) Coast Reporter, online: https://www.coastreporter.net/news/local-news/metering-finds-lots-of-leaks-1.17295212.

Metered water connections are necessary for conservation-oriented water pricing,[116] which is an important and viable WDM strategy for consumers.[117] Monetary signals like prices can manage demand of water by reflecting its true value in cost, and, thus, change consumption behaviour.[118] Volumetric pricing structures - where consumption over a base volume is charged at a higher rate - are most efficient at incentivising water conservation because saving water saves money.[119]

The benefits of water metering for residential use are exemplified by the case of the inland California cities of Bakersfield, Chico, and Visalia. In 2009, California Water Service Company (CWSC) began a process of installing water meters on unmetered single-family residences and switching from flat rates to volumetric billing rates. In Bakersfield, Chico, and Visalia, unmetered residences used more water than comparable metered residences by an average of 15%, 22%, and 31%.[120] After six months of metering, average monthly water consumption decreased within the newly metered residences by 21% in Bakersfield, 13% in Chico, and 17% in Visalia.[121] These results show the immediate impact that water meter installation can have on residential water conservation efforts.

Further, BC municipalities that have adopted and implemented a universal water metering policy report that it has been effective in reducing water consumption. The BC Municipal Water Survey asked municipal water managers who work in metered communities throughout BC to provide their views on the impact, success and difficulties involved with a municipal universal water meter policy. The results indicated that most respondents found that the universal metering policy had been effective in reducing water consumption.[122] For more examples of water metering programs and conservation pricing, see the Metro Vancouver Residential Water Metering Best Practices Guide.[123]

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[116] *Worth Every Penny: A Primer on Conservation Oriented Water Pricing, supra* note 1099:
Conservation-oriented water pricing is a rate structure adopted by a water service provider where the costs of providing services are recovered, individual consumers are metered and pay for the volume of water they use, and the price signal is sufficient to affect individual decisions and encourage conservation and efficiency.

[117] *Ibid.*

[118] C. De Gispert, "The Economic Analysis of Industrial Water Demand: A Review," *Environment and Planning C: Government and Policy,* vol. 22, 2004, DOI:10.1068/c20sl; Ronald Griffin, *Water Resource Economics: The Analysis of Scarcity, Policies, and Projects*, (MIT Press, 2006).

[119] Program on Water Governance, "Fact Sheet: Water Pricing" online: http://watergovernance.sites.olt.ubc.ca/files/2010/04/FS_Water_Pricing.pdf.

[120] Stephanie Tanverakul and Lee Juneseok "Impacts of Metering on Residential Water Use in California," (Feb. 2015) 107 American Water Works Association. E69-E75, online: doi:10.5942/jawwa.2015.107.0005.

[121] *Ibid.*

[122] *BC Municipal Water Survey 2016, supra* note 1099 at p. 12.

[123] *Water Metering Best Practices Guide*, *supra* note 110.

3.1.2 Costs of Water Metering

Municipalities may be hesitant to install water meters due to the up-front cost. The cost of purchasing and installing water meters is quoted as between $200 and $1000.[124] Specific to the Metro Vancouver Region, in 2016 Mayor Darrell Mussatto estimated it would cost between $400 to $1000 per home to install water meters in the City of North Vancouver, and about $50 per year for reading and billing.[125] However, the costs of installing water meters can payoff in the long run. For instance, in Toronto, the cost of installing metres was $168 million, with annual savings of $33 million for the utility, which meant a capital payback period of seven years.[126]

The recent Metro Vancouver Regional Assessment of water metering evaluated the economic, social and environmental aspects of water metering, the results of which showed that, using a triple bottom line framework the "greatest overall financial and non-financial benefits are achieved by implementing water metering on all residential dwellings over an accelerated timeline" of ten years.[127]

3.1.3 Metering for Water Conservation in Metro Vancouver, Coquitlam and Port Coquitlam

Populations in Metro Vancouver, including in the Cities of Coquitlam and Port Coquitlam have grown rapidly. As populations have grown, so has water consumption. In Metro Vancouver, the overall water use is approximately a billion litres a day; more than 25 % higher than it was 30 years ago.[128] Lack of metering and low water prices have artificially increased demand, allowed wasteful use, and provided little incentive for efficiency improvements.

Currently, the City of Port Coquitlam requires water meters on all premises other than residential premises.[129] However, a water meter may be installed on residential premises where the Director of Engineering and Operations (or a delegate) deems it advisable.[130] Where

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[124] Jonathan Arnold, "The Benefits of Water Meter: We Can't Manage What We Won't Measure," (2017) Canada's Ecofiscal Commission, online: https://ecofiscal.ca/2017/10/25/benefits-water-meters-cant-manage-dont-measure/.
[125] "Metro Vancouver Studying Possibility of Water Meters" *CBC News* (19 April 2016) online: https://www.cbc.ca/news/canada/british-columbia/metro-vancouver-water-meters-1.3542195.
[126] *Ibid.*
[127] *Water Metering Best Practices Guide*, *supra* note 110.
[128] Jane Seyd, "Metro Vancouver keeps an eye on water use," *North Shore News* (27 June 2015) online: https://www.nsnews.com/news/metro-vancouver-keeps-an-eye-on-water-use-1.1982014.
[129] City of Port Coquitlam, "Waterworks Regulation Bylaw, No. 3935," at s. 4(1), online: https://www.portcoquitlam.ca/wp-content/uploads/2017/01/3935-Waterworks-Regulation-Bylaw.pdf [*City of Port Coquitlam Waterworks Regulation Bylaw No. 3935*].
[130] *Ibid,* at s. 4(2).

there is no water meter, the City of Coquitlam charges a flat annual fee for water use.[131] However, rates provided for in the City bylaw are charged where a water meter is installed in residential premises.[132]

Similarly, the City of Coquitlam requires water meters at service connections on property intended for "any use other than for a *residential dwelling unit(s)* (which shall include all institutional, commercial, industrial, agricultural use)".[133] However, the City of Coquitlam does not currently require water meters on all residential properties.[134] Rather, the General Manager of Engineering and Public Works of the City (or a delegate) may require that the owner of property install a water meter.[135] The City of Coquitlam charges an annual flat rate to all residential dwelling units that receive water, directly or indirectly, from the water system.[136]

Recognizing the problems with over consumption of water and the benefits of water metering, the Metro Vancouver Drinking Water Management Plan indicates that municipalities will "reassess the merits of developing residential water metering programs and municipal rebate programs for water efficient fixtures and appliances."[137] The Drinking Water Management Plan also states that a planned and on-going action aimed at ensuring the efficient supply of water is to "[i]nstall water meters on all new municipal system connections to Metro Vancouver's water mains."[138]

It is important to note that municipalities have the jurisdiction to impose differential or gradations of fees for water service as a WDM policy to stimulate water conservation. Municipalities may provide any service that the council considers necessary or desirable and may, by bylaw, regulate, prohibit and impose requirements in relation to that municipal service.[139] A council may also, by bylaw, impose a fee payable in respect of all or part of a

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[131] City of Port Coquitlam, "Utility Levies" online: https://www.portcoquitlam.ca/city-services/utility-levies/.

[132] *Ibid*.

[133] City of Coquitlam, "Water Distribution Bylaw, No. 4428, 2015," online: http://publicdocs.coquitlam.ca/cyberdocs/getdoc.asp?doc=3182066 [*City of Coquitlam Water Distribution Bylaw No. 4428 2015*]; City of Coquitlam, "Water Meter Specifications," (July 2015) online: https://www.coquitlam.ca/docs/default-source/city-services-documents/2015-coquitlam-water-meter-specifications.pdf?sfvrsn=2.

[134] *Ibid*.

[135] *City of Coquitlam Water Distribution Bylaw No. 4428, 2015, supra* note 13333 at s. 4.3.

[136] City of Coquitlam, "Taxes & Utilities," online: https://www.coquitlam.ca/city-services/taxes-utilities/utility-taxes/utility-taxes.aspx. Note: 48% of the Water Fee is paid to Metro Vancouver to cover the costs of running the regional supply system, including water treatment plants that deliver the clean, safe water to the city. 52% of the Water Fee covers City costs for the operation and management of the water system that provides water for fire protection as well as household, business and recreational use.

[137] *Metro Vancouver Drinking Water Management Plan, supra* note 21 at strategy 2.1.7.

[138] *Metro Vancouver Drinking Water Management Plan, supra* note 21 at strategy 3.2.3.

[139] *Community Charter*, SBC 2003 c 26 at s. 8(2).

service of the municipality and may establish terms and conditions for payment of a fee, including discounts, interest and penalties.[140]

To reduce the demand for water from the Coquitlam River Watershed for the regional water supply system, municipalities within Metro Vancouver, in particular the Cities of Coquitlam and Port Coquitlam, must phase-in mandatory water metering as a municipal WDM strategy. As demonstrated through multiple case studies, water metering enables conservation-oriented pricing, assists with leak detection, and encourages consumer conservation. These water conservation benefits outweigh the up-front costs of water metering. As Metro Vancouver has indicated that its municipalities will continue to work towards universal water metering, this measure should be fast-tracked.

3.2 ENHANCE AUTOMATIC SUMMER WATER RESTRICTIONS

A water restriction is a ban or other regulation to restrict the use of water either at times of peak use or for designated activities that are considered low priority. Summertime water restrictions are intended to conserve water when water use otherwise increases significantly due to outdoor uses. Automatic summer restrictions have proven effective in reducing summertime water use in the Capital Regional District of BC, Los Angeles, California, Colorado's northern Front Range, and in Austin, Texas. Metro Vancouver and its member municipalities, including the Cities of Coquitlam and Port Coquitlam, are now implementing automatic summer water restrictions by bylaw between May 1 – September 30.

3.2.1 Benefits of Automatic Summer Water Restrictions

During the summer months, water use increases drastically. For example, in 2017 the District of Squamish's water consumption increased by 70 % over the summer months.[141] The well-cited standard is that 50 % of municipal water use in the summer is for watering outdoor vegetation. Automatic limits on non-essential water use, such as for lawn watering and car washing, are intended to conserve water for essential uses such as drinking water and limit water extracted from source watercourses to maintain environmental flows.

A scientific study, reported in *The Effectiveness of Water Conservation Measures on Summer Resident Water Use in Los Angeles, California*, found that stringent mandatory outdoor watering restrictions, combined with pricing measures, were more effective than voluntary

[140] *Ibid,* at s. 194.

[141] District of Squamish, "May 1 water restrictions in place as water use increases 70 per cent in the summer months," (30 April 2018), online: https://squamish.ca/yourgovernment/news/may-1-water-restrictions-in-place-as-water-use-increases-70-per-cent-in-the-summer-months/.

outdoor watering restrictions at decreasing single-family water use in Los Angeles, California.[142] Between 2000 and 2010, the City of Los Angeles experienced some of the worst drought conditions of the past six decades.[143] In response, agencies in Southern California adopted various summertime water conservation programs ranging from voluntary conservation measures to more stringent, and mandatory conservation plans which included water rate increases.[144] Voluntary water restrictions, asking customers to reduce their water use by 10% were implemented in June 2007 through 2008.[145] The City enacted mandatory water restrictions in August 2008 that (1) prohibited water-waste practices such as irrigation during rainfall, (2) prohibited irrigation between 9am and 4pm, and (3) limited landscape watering time to 15 minutes per cycle, up to two cycles per day.[146] In June 2009, the City increased mandatory water restrictions were to include (1) two-day landscaping irrigation per week limit, (2) additional restrictions on the time and frequency of landscape irrigation for the use of sprinklers, and (3) additional prohibited water-waste usage such as car washing.[147] The study found the mandatory restrictions were most effective,[148] with the highest water use savings (19% to 23%) in the spring and summer of 2010, when the most stringent mandatory restrictions were in place.[149]

Drought conditions in 2002 prompted cities along Colorado's northern Front Range – Aurora, Boulder, Fort Collins, Lafayette, Louisville, Thornton, and Westminster – to enact restrictions on outdoor water use, particularly focused on limiting lawn watering.[150] One study tracked the different approaches used by eight water providers to determine the level of water savings achieved from 2000/2001 to 2002.[151] The study it compared daily water use during drought restrictions to an estimate of what use would have been, given the temperature and precipitation conditions (i.e. "expected use"), in the absence of restrictions.[152] The study found

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[142] C. Mini, T. S. Hogue & S. Pincetl, "The Effectiveness of Water Conservation Measures on Summer Residential Water Use in Los Angeles, California" (2014) 94 Resources, Conservation and Recycling 136-145 [*The Effectiveness of Water Conservation Measures on Summer Residential Water Use in Los Angeles, California*].

[143] *Ibid,* at p. 137 citing T. B. McKee, N. J. Doesken & J. Kleist "Standardized Precipitation Index" (1993) Colorado State University and S. Liu, T. S. Hogue, E.D. Stein, J. Barco, "Technical Report 683: Contemporary and Historical Hydrologic Analysis of the Ballona Creek Watershed" (Costa Mesa, California: Southern California Water Research Project, 2011).

[144] *Ibid,* at p. 137 citing California Department of Water Resources, "California Drought an Update" (State of California, 2009) at p. 1-112.

[145] *Ibid,* at p. 138 citing LADWP, "Mayor Villaraigosa Calls for Voluntary Water Conservation" (2007).

[146] *Ibid,* at p. 138.

[147] *Ibid*.

[148] *The Effectiveness of Water Conservation Measures on Summer Residential Water Use in Los Angeles, California, supra* note 14242 at p. 141.

[149] *Ibid* at p. 144.

[150] Douglas S. Kenney, Roberta A Klein & Martyn P. Clark, "Use and Effectiveness of Municipal Water Restrictions During Drought in Colorado" (2004) Journal of the American Water Resources Association 77-87 at p. 77 [*Use and Effectiveness of Municipal Water Restrictions during Drought in Colorado*].

[151] *Ibid,* at p. 80.

[152] *Ibid,* at p. 79.

that mandatory restrictions are more effective than voluntary restrictions; specifically water conservation volumes (measured in expected per capita use) ranged from 18% to 56% during periods of mandatory restrictions, compared to just 4% to 12% during periods of voluntary restrictions.[153] The study also found that "the level of water savings increases as the frequency of permitted watering days declines and as time limits (per zone) are tightened."[154]

The experience of Austin, Texas also provides lessons on automatic summer restrictions for water conservation in the face of population growth. Austin, Texas experienced rapid population growth from 1980 to 1985; the population grew 26.4% and, concurrently, the number of water utility connections rose by 20.2%.[155] In the face of drought conditions, in 1984/1985 the City of Austin adopted a water conservation ordinance with four conservation stages, triggered at various levels of daily water usage; see table below for an explanation of the stages.[156]

[153] *Ibid,* at p. 83-84.

[154] *Ibid,* at p. 85.

[155] Douglas T. Shaw and David R. Maidment, "Intervention Analysis of Water Use Restrictions, Austin, Texas," (1987) 23 Water Resources Bulletin 6 1037-1046 [*Intervention Analysis of Water Use Restrictions, Austin, Texas*].

[156] Information in table is sourced from *Intervention Analysis of Water Use Restrictions, Austin, Texas, ibid,* p. 1038.

	Stage 1	Stage 2	Stage 3	Stage 4
Trigger	Automatic May 1 to September 30.	Triggered by total daily water use in excess of 150 million gallons per day (MGD) for three consecutive days or use in excess of 157 MGD for one day.	Daily water use in excess of 157 MGD for three consecutive days or use in excess of 165 MGD for one day.	In the event of a major line break or other major system failure
Prohibition	Voluntary compliance with stage 2 restrictions requested.	Outdoor watering with individual sprinklers allowed once every five days on a designated day, during the hours of 12 midnight to 12 noon and 7pm to 12 midnight; car washing and filling of swimming pools allowed only on designated day during same hours as watering; restrictions on spray fountains, ornamental foundations, irrigation of golf courses, and use of water from fire hydrants.	1984: Same as Stage 2 except outdoor watering allowed only if a hand-held hose, bucket, drip irrigation system or permanently installed automatic sprinkler system was used. 1985: Outdoor watering with individual sprinklers or sprinkler systems allowed on designated days only from 6am to 10am and 7pm to 10pm and watering with a hand-held house, bucket or drop irrigation system was allowed on any day but only during the hours above.	Stricter limitations on outdoor water use.

One study found that for 1984, conservation measures reduced water use in Austin by 2.77 MGD during the first Stage 1 voluntary conservation period and by 13.45 MGD during the Stage 2 mandatory conservation period.[157] For 1985, the estimated reductions in water use from the entire mandatory restriction program (Stages 2 and 3 combined) was an average of 5.5 MGD.[158] Interestingly, the authors noted that in 1985 Stages 2 and 3 restrictions corresponded to an average decrease of 6.7 MGD and 4.4 MGD, respectively, and so the Stage 3 policy may have been less effective at inducing further compliance than the less restrictive Stage 2 policy for 1985.[159]

[157] *Intervention Analysis of Water Use Restrictions, Austin, Texas, supra* note 155 at 1043.
[158] *Ibid,* at 1044.
[159] *Ibid.*

The Capital Regional District (CRD) has had summer water restrictions since 1992.[160] As the regional government for 13 municipalities, including Victoria, and three electoral areas located on the southern tip of Vancouver Island, [161] the CRD *Water Conservation Bylaw* establishes three stages of progressively restrictive water use. Stage 1 is in effect May 1 through September 30, each and every year, unless more stringent water conservation measures are required.[162]

See the table below for more detailed explanation:[163]

	Stage 1	**Stage 2**	**Stage 3**
Trigger	Automatic May 1 to September 30	By resolution of the Regional Water Supply Commission.	By resolution of the Regional Water Supply Commission.
Prohibition		Wash sidewalks, driveways, parking lots, exterior building surfaces, use a motion-activated sprinkler to deter animals or wildlife; water a lawn at a cemetery; allow a spray park to emit water continually; fill an ornamental fountain; operate an ornamental fountain.	Water a lawn, turn or boulevard; fill a swimming pool, hot tub or garden pond; operate a spray park; fill with water or operate a n ornamental fountain; wash sidewalks, driveways, parking lots, exterior building surfaces; use a motion activated sprinkler to deter animals or wildlife;
Lawn watering for residential, commercial and institutional properties	Even-numbered addresses may water lawns Wednesday and Saturday from 4-10am and from 7-10pm. Odd-numbered addresses may water lawns Thursday and Sunday from 4-10 am and from 7-10pm.	Even-numbered addresses may water lawns Wednesday from 4-10am and from 7-10pm. Odd-numbered addresses may water lawns Thursday from 4-10 am and from 7-10pm.	
Landscape watering	Established trees, shrubs and garden beds may be	Established trees, shrubs and garden beds may be	Trees, shrubs, and vegetables may be

[160] "History of Watering Schedules in the Capital Regional District (CRD)," online: https://www.crd.bc.ca/docs/default-source/water-pdf/history_of_watering_restrictions.pdf?sfvrsn=550423ca_2.
[161] Capital Regional District, "What is CRD," online: https://www.crd.bc.ca/about/what-is-crd.
[162] CRD, "Watering Schedules," online: https://www.crd.bc.ca/education/water-conservation/at-home/watering-schedules.
[163] Capital Regional District, "Water Conservation Bylaw, No. 4099" at s. 5 and Schedule A, online: https://www.crd.bc.ca/docs/default-source/crd-document-library/bylaws/water/4099---capital-regional-district-water-conservation-bylaw-no-1-2016.pdf?sfvrsn=a0ed24ca_4.

	watered by a hand-held hose with a shut-off nozzle, a hand-held container or a micro-drip irrigation system on any day at any time or by a sprinkler during prescribed hours for Stage 1 lawn watering.	watered by a hand-held hose with a shut-off nozzle, a hand-held container or a micro-drip irrigation system on any day at any time or by a sprinkler during the hours of 4-10am.	watered by a hand-held hose with a shut-off nozzle, a hand-held container or a micro-drip irrigation system on any way between 4-10am and 7-10pm
Other outdoor uses	Residential swimming pools, wading pools or hot tubs may be filled at any time. Vehicles may be washed using a hand-held container, house (with shut-off nozzle) or at a car dealership/carwash.	Vehicles may be washed using a hand-held container, house (with shut-off nozzle) or at a car dealership/carwash.	
Use for public authorities	Water lawns and boulevards on Mondays and Fridays between 1-10am and 7-10pm. Water playing fields during the same time period.	Water lawns and boulevards on Mondays between 1-10am and 7-10pm. Water playing fields between 1-10 am and 7-10pm, no more than 3 days/week.	Water playing fields between 4-10am, no more than 3 days a week.

3.2.2 Automatic Summer Restrictions for Water Conservation in Metro Vancouver, Coquitlam and Port Coquitlam

Metro Vancouver has adopted mandatory exterior water restrictions. GVWD's 2017 Drinking Water Conservation Plan (DWCP) is a regional policy developed with local governments and other stakeholders to manage the use of potable water during periods of high demand – mostly during late spring to early fall – and during periods of water shortages and emergencies.[164] The DWCP applies to local government members of the GVWD and the use of drinking water from the GVWD's water system.[165] Subsequently, municipalities such as the City of Coquitlam and the City of Port Coquitlam enacted bylaws to implement the DWCP.[166]

[164] Metro Vancouver, "Drinking Water Conservation Plan" (2017), online: http://www.metrovancouver.org/services/water/WaterPublications/DrinkingWaterConservationPlan.pdf [*Metro Vancouver Drinking Water Conservation Plan*].
[165] City of Coquitlam, "Drinking Water Conservation Plan Bylaw No. 4838, 2018," online: http://publicdocs.coquitlam.ca/cyberdocs/getdoc.asp?doc=2896391.
[166] City of Port Coquitlam, "Drinking Water Conservation Plan Bylaw No. 4045, 2018," online: https://www.portcoquitlam.ca/wp-content/uploads/2017/01/4045-Drinking-Water-Conservation-Plan-1.pdf.

The DWCP establishes four stages of water restrictions, which residents and property owners in municipalities such as Coquitlam and Port Coquitlam must follow during the summer months to help sustain water supply and help maintain consistent water pressure:[167]

- Stage 1 is automatically in effect on May 1 until October 15;
- Stages 2 and 3 are activated or deactivated by the GWD Commissioner – these are likely to be activated during unusually hot and dry conditions to maximize conservation; and
- Stage 4 is activated and deactivated by the GVWD Commissioner during an emergency to immediately limit water use to essential needs only.[168]

The automatic restrictions in place from May 1 to October 15, described by Stage 1, restrict the days of the week and time of day residential and non-residential water users may water their lawns, trees, shrubs, flowers, and playing fields.[169] Stage 1 also prohibits the flushing of water mains.[170] Currently, prohibitions on non-essential water use such as for washing vehicles and boats or filling aesthetic water features do not come into effect until Stage 3 is activated by the GVWD Commissioner during unusually hot and dry conditions to maximise conservation.[171]

Based on successful water restrictions in place in the Capital Regional District, Los Angeles, California, Colorado's northern Front Range, and Austin Texas, Metro Vancouver's automatic summertime water use restrictions could be enhanced by evaluating how they can, in addition to ensuring adequate drinking water supply, interact with other management parameters to improve watershed-specific flow conditions in the Coquitlam River.

3.3 MUNICIPAL REGULATION OF IMPERMEABLE SURFACES

Impermeable surfaces within a watershed increase surface runoff following rainfall events and decrease the amount of water that permeates into the ground and recharges groundwater and surface water sources such as reservoirs and rivers. Focusing on a green infrastructure approach to development and retrofitting existing developed areas can reduce or eliminate the changes to water quantity caused by impermeable surfaces. Metro Vancouver and its member

[167] City of Coquitlam, "Go Slow on Your H2O: Watering Restrictions May 1 – October 15," online: https://www.coquitlam.ca/docs/default-source/city-services-documents/sprinkling-regulations-brochure.pdf?sfvrsn=2; City of Coquitlam, "Water Conservation," online: https://www.coquitlam.ca/city-services/water/water-conservation/water-conservation.aspx; City of Port Coquitlam, "Water Use Restrictions," online: https://www.portcoquitlam.ca/city-services/environmental-services/water-protection-conservation/lawn-watering/; Port Coquitlam, "Water Use Restrictions" online: https://www.portcoquitlam.ca/city-services/environmental-services/water-protection-conservation/lawn-watering/.

[168] *Metro Vancouver Drinking Water Conservation Plan, supra* note 1644 at p. 3-12.

[169] *Ibid,* at p. 4-5.

[170] *Ibid,* at p. 5.

[171] *Ibid,* at p. 3&10.

municipalities, including the Cities of Coquitlam and Port Coquitlam have the authority to establish the maximum percentage of land that can be covered by impermeable surfaces and regulate the design and installation of drainage infrastructure. Metro Vancouver and municipalities can enhance and provide incentives for taking a green infrastructure approach to hydrological function, and can use the City of Victoria's example of a stormwater utility bylaw and rebates for green infrastructure.

3.3.1 Problems with Impermeable Surfaces

In a natural environment most rainfall is absorbed by soil, which attenuates flow volumes in surface water sources and recharges groundwater. However, impermeable surfaces such as asphalt and concrete do not allow water to infiltrate into the underlying soil – rather, rain and snowfall run off of impermeable surfaces as storm water runoff. [172] Scholars note that changes to the impervious-pervious surface balance in a watershed due to urbanization cause significant impacts to both the quality[173] and quantity of storm water runoff, leading to degraded stream and watershed systems.[174]

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[172] S. V. Shithra, Dr. M. V. Harindranathan Nair, A. Amarnath & N. S. Anjana, "Impacts of Impervious Surfaces on the Environment" (2015) 4 International Journal of Engineering Science Invention 5 27-31 at 27 [*Impacts of Impervious Surfaces on the Environment*].

[173] Impervious surfaces and gray infrastructure also have an impact on water quality. Stream quality starts to degrade where more than 10% of the watershed is impervious. Melissa Keeley, Althea Koburger, David P. Dolowitz, Dale Medearis, Darla Nickel & William Shuster, "Perspectives on the Use of Green Infrastructure for Stormwater Management in Cleveland and Milwaukee" (2013) 51 Environmental Management 1093-1108. Impervious cover and runoff directly impact the transportation of pollutants including bacteria, pathogens, nutrients, pesticides, fertilizers, toxic contaminants, sediment, and petroleum products. *Impacts of Impervious Surfaces on the Environment, supra* note 17272 at p. 27-28 citing J. D. Hurd & D. L. Civco, "Temporal Characteristics of Impervious Surfaces for the State of Connecticut," (2004) ASPRS Annual Conference Proceedings. Impervious surfaces increase amount of storm water runoff, which picks up pollutants from the urban landscapes as it sweeps over roofs, streets, and parking lots and carry them into surrounding lakes and rivers. *Impacts of Impervious Surfaces on the Environment, supra* note 17272 at p. 28. Further, sewer overflows occur when the gray infrastructure system designed to direct wastewater into waterbodies are overwhelmed and results in the spillage of polluted effluent into nearby surface waters and water bodies. *Perspectives on the Use of Green Infrastructure for Stormwater Management in Cleveland and Milwaukee,* this note173 at 1094. In *Lower Coquitlam River Fish Habitat and Flooding Assessments*, consultants indicated that "the quality of stormwater feeding into the river and its off-channel areas has had little analysis." *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 42.

[174] *Impacts of Impervious Surfaces on the Environment, supra* note 17272 citing Morisawa, M., LaFlure, E., 'Hydraulic geometry, stream equilibrium and urbanization in adjustments of the fluvial systems'. In: Rhodes, DD; Williams, GP, eds, Proceedings of 10th Annual Geomorphology Symposium Series (Binghamton. New York: 1979); Arnold, D. G., Boison, P. J. and Patton, P. C. "Sawmill Brook: An example of rapid geomorphic change related to urbanization", (1982) J. Geol., 90 155–166; Bannerman, R.T., Ownes, D.W., Dobbs, R.B., Hornewer, N.J., "Sources of Pollutants in Wisconsin Stormwater," (1993) 28 Water Science and Technology 35 241–259; Girija, D., "Environmental Impact Assessment of Surface Water Drainage System in the Central Area of Cochin using GIS and Remote Sensing," (2005) M. Tech. Thesis, CUSAT.

Changes in water quantity generally become an issue when impervious areas exceed 10% of the watershed area.[175] Further, when impervious areas exceed 30% stream habitat tends to become unusable for salmonids.[176] Impervious surfaces in a watershed reduce base flows in surface water sources such as a river because lower infiltration of surface water reduces consistent groundwater recharge, which decreases the flow of groundwater into surface water sources, particularly at the most critical low-flow and high temperature times of year for aquatic organisms.[177] In other words, impermeable surfaces cause water to runoff into surface water sources quickly following rainfall events, rather than permeate into soil and slowly move through the soil as groundwater. With high impermeability, water levels in river will be generally low but spike very quickly for short time periods following a rainfall event.

The problems caused by impermeable surfaces are exacerbated by reliance on "gray infrastructure" for stormwater management. Experts explain that "conventional stormwater infrastructure has been designed to prevent flooding and convey rainfall and snowmelt as quickly as possible through drainage and water treatment systems such as pipes, tanks or underground storage facilities (known as "gray" infrastructure)."[178] Stormwater runoff is piped into the Coquitlam River from the surrounding neighbourhoods in the Cities of Coquitlam and Port Coquitlam.[179] However, "it is not known how much stormwater has altered the hydrograph of the Coquitlam River" and it is important to keep in mind that "the altered flow regime [caused by the dam] will have a much larger effect on the river than will stormwater run-off."[180]

3.3.2 Green Infrastructure as an Alternative to Impermeable Surfaces

Green infrastructure, also known as low impact development, can reduce or eliminate the changes to water quantity caused by impervious areas by creating features in developed areas that allow water to soak into the ground.[181] Green infrastructure represents a range of measures that use plant/soil systems, or engineered systems to harvest and reuse, store, infiltrate or evapotranspire stormwater to ensure consistent groundwater and river recharge,

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[175] *Lower Coquitlam River Fish Habitat and Flooding, supra* note 6 at p. 14.

[176] Stream habitats become unusable for salmonids when impervious areas exceed 30% because sudden high flows cause erosion that scours fish habitat. *Ibid*.

[177] *Impacts of Impervious Surfaces on the Environment, supra* note 17272 at p. 27 citing R. Klein, "Urbanization and Stream Quality Impairment" (1979) 15 American Water Resources Association, Water Resources Bulletin 4; *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 14.

[178] *Perspectives on the Use of Green Infrastructure for Stormwater Management in Cleveland and Milwaukee, supra* note 1733.

[179] *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 16.

[180] *Lower Coquitlam River Fish Habitat and Flooding Assessment, supra* note 6 at p. 14.

[181] *Ibid*.

and reduce extreme fluctuations in river recharge.[182] At the community level, green infrastructure includes:

- Undeveloped areas, both natural and altered (greenfield), including sensitive ecosystems;
- Parks and greenways that link habitat and provide recreation opportunities;
- Ditches, rivers, creeks, streams and wetlands that retain and carry rain or stormwater, improve water quality, and provide habitat;
- Working lands such as agricultural, forested, and grasslands grazing areas, including seasonally flooded agricultural lands;
- Aquifers and watersheds that provide drinking water;
- Engineered wetlands and detention ponds that retain rain or stormwater and improve infiltration; and
- Trees, rooftop gardens, and community gardens that clean air and cool urbanized areas in the summer.[183]

Within particular built areas, green infrastructure includes:

- rainwater harvesting systems such as cisterns;
- rain gardens;
- planter boxes;
- bioswales, which are rain gardens placed between sidewalk and curb); permeable pavements; and
- French drains, which are trench filled with gravel or a perforated pipe that directs water from an area.[184]

It is important that Metro Vancouver and member municipalities, including the Cities of Coquitlam and Port Coquitlam create incentives for the use of green infrastructure approaches to ensure that the hydrological profile of the Lower Coquitlam River maintains consistent base flows recharged by groundwater, rather than experiencing inconsistent base flows extreme volume fluctuations due to high surface runoff following rainfall events.

[182] *Perspectives on the Use of Green Infrastructure for Stormwater Management in Cleveland and Milwaukee, supra* note 1733 at p. 1094.
[183] Deborah Curran et al, *Green Bylaws Toolkit for Conserving Sensitive Ecosystems and Green Infrastructure* (Victoria: University of Victoria Environmental Law Centre, April 2016) at p. 10, online: www.greenbylaws.ca.
[184] United States Environmental Protection Agency, "What is Green Infrastructure?" online: https://www.epa.gov/green-infrastructure/what-green-infrastructure.

3.3.3 Regulation of Impermeable Surfaces in Metro Vancouver, Coquitlam and Port Coquitlam

Current regulations for maximum imperviousness in municipalities in the Coquitlam River Watershed are insufficient to maintain hydrology for adequate environmental flows in the Coquitlam River. Local governments have regulated impermeable surfaces but these regulations permit significant impervious cover and do not differentiate between imperviousness and effective imperviousness. The effective imperviousness of a site can be lower than the surface area of the impermeable surface if rainwater management includes infiltrating stormwater into soil from impermeable surfaces such as roofs and driveways. The City of Port Coquitlam zoning bylaw limits impervious surface area[185] for residentially zoned land (between 65% and 70%) and industrially zoned land (80%).[186] The City of Coquitlam sets limits on impervious[187] surface area for commercial and business areas (85%), industrial areas (72%), residential areas (between 20 and 65%).[188] Effective imperviousness can be much lower than these figures to maintain hydrological function and flows into the Coquitlam River.

3.3.4 Regional and Municipal Incentives for Green Infrastructure Alternatives to Impermeable Surfaces

The *Community Charter* and the *Local Government Act* establish the core authority of local governments for impermeable surfaces and drainage. Under the *Local Government Act*, regional districts and municipalities may, by bylaw, establish the maximum percentage of the area of land that may be covered by impermeable material.[189] Under the *Community Charter*, municipalities have the authority to regulate the design and installation of drainage and dikes and impose requirements on persons undertaking the construction of works to maintain a proper flow of water in a stream, ditch, drain or sewer, or reclaim or protect part of the landmass of the municipality.[190]

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[185] City of Port Coquitlam, "Bylaw No. 3630: A Zoning Bylaw for the City of Port Coquitlam," at Section I Definitions, online: https://www.portcoquitlam.ca/wp-content/uploads/2018/07/3630-Zoning-Bylaw-2008.pdf:
Impervious surface area means any hard-surfaced, man-made area that does not readily absorb or retain rainwater, including but not limited to roofs, driveways, parking spaces, patios, sidewalks, sport courts, ornamental pools, swimming pools or any other hard surface. For clarity, green roofs and driveways, parking spaces and patios constructed of gravel, unit pavers, grasscrete or similar porous materials, do not constitute impervious surfaces.

[186] *Ibid,* at s. 2.4&4.4

[187] City of Coquitlam "Stormwater Management Policy and Design Manual" (2003), online: https://www.coquitlam.ca/docs/default-source/city-hall-files/Stormwater_Management_Policy_and_Design_Manual.pdf
Impervious - A term applied to a material through which water cannot pass, or through which water passes very slowly.

[188] *Ibid,* at B-32.

[189] *Local Government Act,* RSBC 2015 c 1 at s. 523(2).

[190] *Community Charter, supra* note 1399 at s. 69.

Municipalities in BC are beginning to regulate and create incentives for green infrastructure. For example, the City of Victoria enacted a storm water utility bylaw in 2015 which establishes a user-pay system.[191] The City of Victoria charges residents a stormwater utility fee that connects the impact a property has on the stormwater system directly to the owner's municipal utility bill.[192] One of the factors that is used to determine the property-specific stormwater utility charge is the total "impervious area," defined as "hard surfaces such as roofs, parking areas and driveways" on each property,[193] and calculated using building plans, aerial photography and GIS mapping technology.[194] A rate of $0.6919 per square meter of impervious area is charged to a property owner as their stormwater utility fee.[195] The new utility also offers financial incentives for sustainable rainwater management and converting impermeable surface to green infrastructure, which includes rain gardens, cisterns and permeable (absorbent) paved areas.[196] A resident using approved rainwater management methods can apply for 10-50% off their annual stormwater utility bill.[197] See the table below for details about the credits and rebates available to residents in low-density areas, [198] defined as "a property on which no more than four self-contained dwelling units are situated, and includes a vacant lot that is zoned for such use."[199]

[191] City of Victoria, "Sanitary Sewer and Stormwater Utilities Bylaw No. 14-071," online: https://www.victoria.ca/assets/Default/Sanitary%20Sewer%20and%20Stormwater%20Utilities%20Bylaw%2014-071%20(consolidated)%20May%202016.pdf.

[192] City of Victoria, "Stormwater Management" online: https://www.victoria.ca/EN/main/residents/water-sewer-stormwater/stormwater.html.

[193] City of Victoria, "Stormwater Utility" online: https://www.victoria.ca/EN/main/residents/water-sewer-stormwater/stormwater/stormwater-utility.html.

[194] *Ibid*.

[195] *Ibid*.

[196] City of Victoria, "Rainwater Rewards Program" online: https://www.victoria.ca/EN/main/residents/water-sewer-stormwater/stormwater/rainwater_rewards_program.html.

[197] *Ibid*.

[198] This table is sourced from City of Victoria, "Rainwater Rewards Credit and Rebate Amounts," online: https://www.victoria.ca/EN/main/residents/water-sewer-stormwater/stormwater/credit_rebate_amounts.html. For credits available to businesses, institutions, condos and apartments, see: City of Victoria, "Rainwater Rewards Credits" online: https://www.victoria.ca/assets/Departments/Engineering~Public~Works/Documents/SWURainwaterRewardsCredits.pdf.

[199] City of Victoria "Sanitary Sewer and Stormwater Utilities Bylaw, No. 14-071", online: https://www.victoria.ca/assets/City~Hall/Bylaws/Sanitary%20Sewer%20Stormwater%20Utilities%20Bylaw_14-071.pdf.

Low Density Residential Credits

Rainwater Management Method	Minimum Size	Min. Roof Area Treated (sq. m)	Ongoing Credit
Cistern	1200L	25	10%
Infiltration Chamber		25	10%
Rain Garden		25	10%
Bioswale		25	10%
Permeable Paving	10 sq. m	25	10%
Permeable Paving with rock reservoir		25	10%

Low Density Residential Rebates

Rainwater Management Method	Min. Size	$/L	$/sq. m	Min. Rebate	Max Rebate
Rain Barrel (2x175L size)	350L	$0.10		$35	$100
Cistern	1200L	$0.15		$180	$600
Rain Garden/Bioswale/Infiltration Chamber	25 sq. m		$15	$375	$1000
Permeable Pavement	10 sq. m		$20	$200	$750
Permeable Pavement with Rock Reservoir	25 sq. m		$30	$750	$1500

Metro Vancouver and its member municipalities, including the Cities of Coquitlam and Port Coquitlam have the authority to establish the maximum percentage of land that can be covered by impermeable surfaces and regulate the design and installation of drainage and dike infrastructure. Metro Vancouver and the municipalities can use the City of Victoria's example of a stormwater utility bylaw to create incentives for property owners to use green infrastructure approaches. In addition, for new development, the Cities can require by subdivision and drainage bylaws that green infrastructure be the primary method of rainwater management, which can include a simple performance-based measure that all new subdivisions must result in no net increase in post-development flows from pre-development volumes off of a site.

Municipalities can help reduce water extraction and increase environmental flows in the Lower Coquitlam River by undertaking WDM measures such as water metering and water restrictions, and enhance green infrastructure within their boundaries. Water metering manages consumer water demand, creates incentives for water-use efficiency, and is a necessary precondition to conservation-oriented water pricing. Summer water restrictions are demonstrably effective at conserving water during drought and peak usage periods. Further, focusing on a green infrastructure approach to development and retrofitting within municipalities can increase the amount of water that permeates into the ground, recharges groundwater, and contributes to environmental flows in the Lower Coquitlam River. As such, municipalities that govern within or

influence the Lower Coquitlam River should consider these measures, in accordance with the recommendations made in this report.

Gravel Pits

Part 4 – Provincial Strategies for Watershed Health

In addition to municipal WDM and green infrastructure approaches, the new *WSA* contains several mechanisms for provincial government action to protect waterways within a municipality. These include, in particular, water sustainability plans and the ability to set standards for environmental flow needs (EFN). Creating a water sustainability plan for the Lower Coquitlam River Watershed that establishes environmental flow need volumes and numerical limits for water withdrawals could assist in restricting water extraction and prevent or address conflicts between water users and EFN. The EFN of the Coquitlam River could be

determined using the methods developed through the Okanagan Environmental Flow Needs Project. The River-specific EFN can then be used in water licence applications decisions on the Coquitlam River and those streams or aquifers connected to the Coquitlam River. The EFN can also be used to inform management response options for when flow-related impacts are expected or occurring. Finally, the Province can enact an EFN regulation specific to the Lower Coquitlam River Watershed to deal with geographically specific problems and assist water decision makers in managing water use. Note that the *WSA* empowers the Minister to make orders to reduce or cease water diversions where flow levels have fallen below a critical environmental flow threshold or where they threaten fish survival. The provincial government can use these types of orders to protect the Coquitlam River in the future.

4.1 WATER SUSTAINABILITY PLANS

The discussion paper *Environmental Flow Needs in British Columbia* explains water sustainability planning as follows:

> The *Water Sustainability Act* renamed water management plans as water sustainability plans and provided new regulatory powers that can be exercised on the recommendation of a water sustainability plan, including regulations restricting the authority of approving officers, restricting the use of land or resources, reducing water rights, imposing requirements in respect of works and providing for dedicated agricultural water that can only be used for prescribed lands and purposes.[200]

The *WSA* enables the creation of water sustainability plans for areas where these plans can help prevent or address conflicts between water users, conflicts between water users and EFN, risks to aquatic ecosystem health or risk to water quality.[201] As such, water sustainability plans are expected to be a useful tool for dealing with cumulative impacts on water.[202] The *WSA* provisions related to plan regulations are particularly powerful. For the purposes of the water sustainability plan, the government can make regulations to restrict the use of Crown land,[203] relating to approvals for the purposes of the *Land Title Act*,[204] for the use of land and natural resources,[205] for water rights,[206] on agricultural water use,[207] and for activities affecting

[200] James S. Mattison, "Environmental Flow Needs in British Columbia" (February 1, 2016) Discussion Paper prepared for WWF-Canada and the POLIS Project on Ecological Governance Forum on Environmental Flow Needs in BC at p. 20.

[201] *WSA, supra* note 100 at s. 65.

[202] "Environmental Sector Expectation for BC's Groundwater Regulations," online: https://www.wcel.org/sites/default/files/old/files/150723_Groundwater_SOE_June.pdf

[203] *WSA*, supra note 100 at s. 76.

[204] *WSA supra* note 100 at s. 77.

[205] *WSA, supra* note 100 at s. 78.

[206] *WSA, supra* note 100 at s. 79&80.

[207] *WSA, supra* note 100 at s. 82.

groundwater such as well construction.[208] A water sustainability plan can establish environmental flow need volumes, and can identify the conditions under which the Minister must make flow order restricting water diversion. It is particularly important for the Lower Coquitlam River that the Minister initiate a water sustainability plan as a plan will assist in preventing or addressing conflicts between the needs of water users and EFN.

In a contemporary context, water sustainability plans are the mechanism to integrate historic and future land and water management, and provide "explicit implementation authority that can allow a WSP to amend or change existing water licences or affect the decision-making jurisdiction of public officers under other provincial law."[209] Water sustainability plans are also viewed as on tool under provincial law that can acknowledge Indigenous authority in operationalizing collaborative governance or government-to-government arrangements. For a detailed discussion of water sustainability plans, see *Water Sustainability Plans: Potential, Options and Essential Content.*[210]

4.1.1 Process for Creating Water Sustainability Plan

The Minister, on request or on their own initiative, may make an order designating an area for the purpose of the development of a water sustainability plan.[211] The Minister may also designate a local government or another person as the "person responsible" for preparing the proposed plan.[212] The Minister may establish the process by which a proposed water sustainability plan is to be developed.[213] The Minister may also limit the issues to be considered in a water sustainability plan development process or the recommendations that may be made in the plan for measures to address the issues considered in the plan.[214] The responsible person must establish the terms of reference for the water sustainability plan.[215]

Following drafting, the proposed plan may be submitted to the Minister for approval.[216] Where the plan contains a recommendation that a regulation or order under the *WSA* or another Act be made in relation to the plan, the Lieutenant Governor in Council (Premier and Ministers)

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[208] *WSA, supra* note 100 at s. 83.
[209] Deborah Curran and Oliver Brandes, "Water Sustainability Plans: Potential, Options and Essential Content" online: https://poliswaterproject.org/files/2019/10/POLIS-WSP2019-6e1-web.pdf at p. 3.
[210] *Ibid.*
[211] *WSA, supra* note 100 at s. 65(1).
[212] *WSA, supra* note 100 at s. 66(2)(a).
[213] *WSA, supra* note 100 at s. 66(1).
[214] *WSA, supra* note 100 at s. 67.
[215] *WSA, supra* note 100 at s. 66(2)(b)&(c).
[216] *WSA, supra* note 100 at s. 74(1).

may approve all or part of the plan.[217] Otherwise, the Minister may accept all or part of the proposed plan as a water sustainability plan.[218]

4.2 ENVIRONMENTAL FLOW NEEDS

The *WSA* provides new authority for when streams are at risk of falling or have fallen below the water levels necessary to sustain their ecosystem by requiring decision makers to consider EFN when making decisions about water licence applications.[219] Establishing the EFN for the Coquitlam River can be used by decision makers when evaluating water licence applications or to inform management responses when flows are threatened. Further, the Province can adopt a Coquitlam River-specific EFN regulation in partnership with Kwikwetlem First Nation to address problems specific to the watershed and guide management decisions. Note that in the future the Minister may make orders protecting the Coquitlam River in cases where the flow falls below a critical environmental flow threshold or at a level that threatens fish survival.

4.2.1 Defining Environmental Flow Needs

EFN in relation to a stream, as defined by the *WSA*, means "the volume and timing of water flow required for the proper functioning of the aquatic ecosystem of the stream".[220] By definition, EFN are focused on ecological needs and do not balance ecological needs with water demand. While balancing water demand with ecological needs is a valid consideration within a socio-economic context, it needs to be done in a separate step from the environmental flow need-setting step.[221]

Under the *WSA* a decision maker must consider the EFN of a stream when evaluating a water licence application on a stream or aquifer that the decision maker considers reasonably likely to be hydraulically connected to that stream.[222] Thus, the decision maker must determine the environmental flow need and then determine if there is adequate flow for additional extractive uses to be licensed.[223]

EFN are also important for other governments and authorities:

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[217] *WSA, supra* note 100 at s. 75(3).
[218] *WSA, supra* note 100 at s. 75(1).
[219] *WSA, supra* note 100 at s. 15.
[220] *WSA, supra* note 100 at s. 1.
[221] Associated Environmental Working Document Version 1, "Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams" (May 2016) at p. 5-5&5-6 [*Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams*].
[222] Oliver Brandes, *et al*. *Awash with Opportunity* (Polis Project on Ecological Governance, November 2015).
[223] *Environmental Flow Needs in British Columbia, supra* note 200 at p. 9.

> First Nations and others require an understanding of EFNs when developing fish population and fish habitat restoration plans. Regional Districts consider residential, agricultural, industrial and environmental flow needs in their long range development plans. BC Agriculture is working to ensure the security of existing licences during times of scarcity when the requirements to protect critical environmental flows could warrant the imposition of restrictions on water use.[224]

EFN can be used to inform management response options if flow related impacts are existing or expected.[225] See the table below for typical management responses to existing or anticipated flow impacts.[226]

Management Response Category	Example Management Response
Modify operations	Increase water use efficiency Implement flow ramping restrictions during sensitive periods Retain natural hydrograph characteristics during reservoir filling Develop drought response plans
Manage the supply	Deny a water licence application for additional use Suggest a modified application that uses less water during times of scarcity Create additional storage to meet human and/or EFN Develop Water Sustainability Plan that consider the need for restrictions, reductions of water rights and compensation as required.

4.2.2 Assessing Risk to Environmental Flow Needs

The provincial government has developed an Environmental Flow Needs Policy to guide the review of applications for water licences. The policy is not a method for determining environmental flows but rather a framework for assessing risk and identifying where cautionary measures could be taken or additional analysis may be needed.[227]

The *WSA* and Environmental Flow Needs Policy apply to decisions about both surface water and groundwater diversions from aquifers that are hydraulically connected to a stream.

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[224] *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at p. 1-1.

[225] *Ibid* at 5-1 citing Northwest Hydraulic Consultants, "Hydrology, Water Use and Conservation Flows for Kokanee Salmon and Rainbow Trout in the Okanagan Lake Basin, B.C." (2001) Prepared for B.C. Fisheries Management Branch, Victoria, BC.

[226] The table is adapted from *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at 5-2.

[227] Ministry of Forests, Lands and Natural Resource Operations & Ministry of Environment, "Environmental Flow Needs Policy" online: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/efn_policy_mar-2016_signed.pdf.

However, the Environmental Flow Needs Policy fails to provide adequate direction for assessing potential risk to EFN caused by groundwater extraction. Explicit direction is required because groundwater is often critical to environmental flows and can have a thermally or chemically distinct and non-substitutable contribution to EFN.[228] Moreover, groundwater pumping has a different hydrological impact (with a constant depletion) than surface water controls.[229] Lastly, groundwater impacts to environmental flows occur often on a different timescales (from months to centuries) than impact on surface water withdrawals.[230] Therefore, specific direction for environmental flows in water sustainability plans, and the next iteration of the Environmental Flow Needs Policy must:

- explicitly include the assessment of the flux of groundwater's contribution to EFN,
- recognize non-substitutable contributions of groundwater to EFN, and
- incorporate risk assessment of the potential long-term impact of groundwater pumping.

4.2.3 Method for Determining Environmental Flow Needs: Example from the Okanagan

The decision maker must determine the EFN in accordance with (a) a regulation passed by Cabinet prescribing methods of determining the EFN of a stream, or (b) a suitable method.[231] Cabinet has the power to enact a regulation prescribing methods of determining the EFN of a stream, however, to date, it has not done so.[232] The Environmental Flow Needs Project of the Okanagan is an example from which we can draw lessons to be implemented in the Lower Coquitlam River Watershed. Importantly, the Okanagan Nation Alliance had adopted the Syilx Nation Siwɬkʷ (water) Declaration in 2014 as a statement of their water law.[233] Locating water as their relation and as life, the Siwɬkʷ (water) Declaration recognizes water as the connector of relationships, health and resilience, placing the Syilx people in a position of having duties and responsibilities to ensure siwɬkʷ can maintain all of these relationships.

The Environmental Flow Needs Project is a collaborative project between the Okanagan Nation Alliance,[234] the Ministry of Forest, Land, and Natural Resource Operations (FLNRO) and the

[228] Tara Forstner et al., "Mapping Aquifer Stress, Groundwater Recharge, Groundwater Use, and the Contribution of Groundwater to Environmental Flows for Unconfined Aquifers across British Columbia," (August 2018) Water Science Series, 2018-04.
[229] *Ibid.*
[230] *Ibid.*
[231] *Environmental Flow Needs in British Columbia, supra* note 200 at p. 10.
[232] *WSA, supra* note 100 at s. 127.
[233] *Syilx Nation Siwɬkʷ Declaration* (2014 July 31) ONA AGA Spaxomin, BC, online: https://www.syilx.org/wp/wp-content/uploads/2016/11/Okanagan-Nation-Water-Declaration_Final_CEC_Adopted_July_31_2014.pdf.
[234] There are eight member communities that comprise the Okanagan Nation Alliance, from North to South: Upper Nicola Band, Okanagan Indian Band, Westbank First Nation, Penticton Indian Band, Osoyoos Indian Band, Lower

Okanagan Basin Water Board (OBWB).[235] The goal of the project is to develop EFN (target flows) and critical flows (minimum flows) for water management in Okanagan streams. Phase 1 of the project consisted of developing methods for environmental flow need setting. This included a literature review of EFN methodologies and historical information gathering on Okanagan streams. The working document *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams* is the final deliverable of Phase 1. It recommended a general approach to EFN-setting that combines two proposed methods for determining EFN:

- For lower risk (EFN-setting situations), the study recommends the use of a desktop method termed the Okanagan Tennant method; and
- For higher risk situations (such as for water allocation decision-making), the study recommends use of the Okanagan Tennant method followed by the field-based Okanagan Weighted Useable Width (WUW) method.[236]

The working document also provided guidance on how to apply the methods in an EFN-setting exercise, along with specific information relevant to EFN-setting for each of the 19 selected tributaries that are the subject of the project.[237]

The Okanagan Nation Alliance, with support from their member bands, conducted Phase 2 of the project. Between July and August 2016 the project team established Fish Habitat Transect sites (up to 10 per stream) in all 11 streams.[238] In addition, they installed a total of approximately 24 hydrometric stations, including 2 real-time stations, that will be maintained at least throughout the life of the project.

The Okanagan Nation Alliance anticipates that the defined EFN and critical flows to be used by FLNRO staff in water licensing and drought management decisions will be developed in a workshop or series of workshops following Phase 2 data collection.[239]

The authors of *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Stream* outlined lessons learned in establishing EFNs in a BC setting. First, EFN should be developed in consideration of the range of management response options that will

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Similkameen Indian Band, Upper Similkameen Indian Band, Colville Confederated Tribes. Okanagan Nation Alliance, "Member Communities" online: https://www.syilx.org/governance/member-communities/.

[235] Okanagan Nation Alliance, "Environmental Flow Needs (EFN)" online: https://www.syilx.org/projects/environmental-flow-needs-efn/ [*Okanagan Nation Alliance Environmental Flow Need*s].

[236] *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at p. 5-1.

[237] *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at p. 1-4.

[238] *Okanagan Nation Alliance Environmental Flow Needs, supra* note 2355.

[239] *Ibid*.

be considered.[240] Second, EFN should include flow targets and associated monitoring criteria specific to known limiting factors affecting the environmental value(s) of concern.[241] Third, land management activities that modify hydrologic processes and have an impact on the river can change the EFN required to maintain a productive capacity of an ecosystem.[242] Fourth, it is important to understand the degree to which current licenced water uses are affecting stream flows.[243] Finally, the most appropriate spatial unit for the basic EFN is the entire stream from the mouth all the way up the main stem and tributaries.[244]

4.2.4 Coquitlam River-Specific Regulation

Section 124(4)(d) of the *WSA* enables Cabinet or the Minister almost unfettered discretion to designate an area to which an EFN regulation would apply, as long as it adequately describes the area. Such a designated area could be a stream, an aquifer, a watershed, geological formation, or map, a plan or a legal description.[245] In addition, section 124(4)(c) empowers Cabinet or the Minister to make different regulations for different classes of water, watersheds, natural resources, and other ecological parameters,[246] which "basically empowers area-based regulations that could deal with geographically specific problems". The Okanagan is employed as an example:

> For example, the vineyards in the Okanagan have unusual water requirements in that the irrigation usually stops when the grapes are ripening to stress the vines and concentrate the sugars in the grapes. After harvest, the grapes are irrigated heavily to hydrate the vines before winter. This places a late reason irrigation demand (October into November) at a time of very low flows in the Okanagan River. A specific regulation could be created for this area to assist the water decision makers to manage this water use.[247]

Similarly, the unique characteristics of the Lower Coquitlam River Watershed, as important for anadromous fish and urbanization, warrant the creation of a specific regulation to assist water decision makers to manage water use in the region. Note that a Coquitlam River Regulation must be developed in full partnership with Kwikwetlem First Nation whose interest in environmental flows relate to their constitutionally affirmed aboriginal rights.

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[240] *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at 5-1.
[241] *Ibid,* at 5-2.
[242] *Ibid*.
[243] *Ibid*.
[244] *Ibid*.
[245] *Environmental Flow Needs in British Columbia, supra* note 200 at p. 16 citing *WSA, supra* note 100 at s. 124(4)(d).
[246] *Ibid,* at p. 16 citing *WSA, supra* note 100 at s. 124(4)(c).
[247] *Ibid,* at p. 16.

4.3 OTHER *WATER SUSTAINABILITY ACT* TOOLS

Two other tools under the *WSA* – temporary and fish protection orders - warrant mention. If the Minister considers that one or more streams in an area have fallen or are at risk or falling below their critical environmental flow thresholds,[248] the Minister may make a temporary order declaring a significant water shortage in the area designated in the order.[249] A critical environmental flow threshold is defined as the "volume of water flow below which significant or irreversible harm to the aquatic ecosystem of the stream is likely to occur."[250] Where this order has been made, critical environmental flow threshold for the stream has precedence over the rights of other licensees on the stream and others using water without a license. An engineer under the *WSA* may then order water users to stop using water according to their licence priority except for "essential household use" of no more than 250 L/day. [251]

In addition, where the Minister considers that the flow of water in a stream is or is likely to become so low that the survival of a population of fish in the stream may be or may become threatened, the Minister may make an order respecting the diversion, rate of diversion, time of diversion, or use, including storage and time of storage, of water from the specified stream, or a specified aquifer hydraulically connected to the stream, regardless of the precedence of rights on the stream.[252]

[248] Note: there is no procedure prescribed for determining a critical environmental flow threshold but the Minister may establish or ask an advisory board to provide advice in relation to methods for determining critical environmental flow thresholds. *WSA, supra* note 100 at s. 115(1)(b); *Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams, supra* note 22121 at 5-16.

[249] *Environmental Flow Needs in British Columbia, supra* note 200 at p. 15 citing *WSA, supra* note 100 at s. 86(1).

[250] *WSA, supra* note 100 at s. 2.

[251] *WSA, supra* note 100 at s. 22(10)&(11).

[252] *WSA, supra* note 100 at s. 88(1). Note that the Minister must consider the needs of agricultural users before making such an order. *WSA, supra* note 100 at s. 88(2).

Part 5 - Conclusion

To support the health of the Lower Coquitlam River Watershed, flows into the Coquitlam River and its tributaries must be increased and the amount of water diverted from the Coquitlam River must be decreased. The recommendations in this report focus on enhancing environmental flows by leaving more water in the Coquitlam River, ensuring adequate natural flows, and attenuating the impacts of urbanization. This report recommends that municipalities within Metro Vancouver, including Coquitlam and Port Coquitlam, must:

- Phase-in mandatory water metering;
- Implement enhanced automatic summer water use restrictions to be in effect May 1 to October 30 to limit landscape irrigation to two days a week, restrict the time and frequency of the use of sprinklers, and prohibit non-essential outdoor water uses such as car/boat washing and filling aesthetic water features; and
- Regulate impermeable surfaces and provide incentives for property owners to expand green infrastructure through a stormwater utility bylaw and rebates for green infrastructure.

Further, the Province of British Columbia must:

- Engage with the Watershed Roundtable to create a Water Sustainability Plan for the Lower Coquitlam River Watershed;
- Define environmental flow needs for the Coquitlam River using methods promoted in the Okanagan Environmental Flow Needs Project;
- Rely on the defined environmental flow needs in making decisions about water licence applications and to inform management response options when flows are threatened;
- Create, in partnership with the Kwikwetlem First Nation, an environmental flow needs regulation specific to the Lower Coquitlam River Watershed; and
- Use orders protecting the Coquitlam River and its tributaries where water levels have fallen below a critical environmental flow threshold or to a point which threatens fish survival.