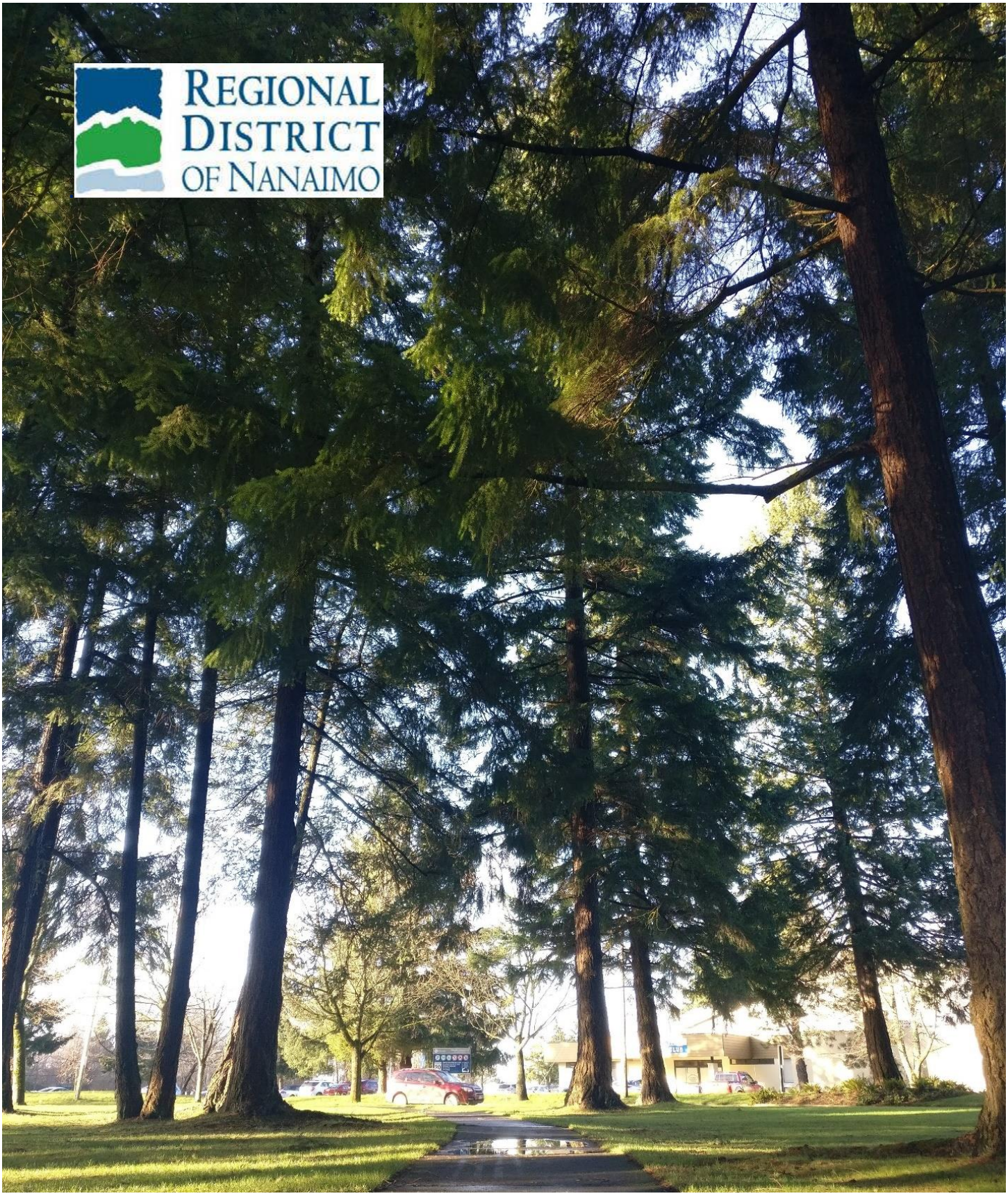

Regional Strategy for Rainwater Management

03/2022

Strategy Prepared by:
Emmons & Olivier Resources Canada, Inc. (EOR)
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Cover Image: Trail in Parksville Community Park – Parksville, BC Canada (Photo: EOR)

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March 1, 2022

Julie Pisani
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Dear Ms. Pisani:

Regarding: Final Regional Strategy for Rainwater Management Version 0

EOR is pleased to submit the final version of the Regional Strategy for Rainwater Management.

We would like to thank the Regional District of Nanaimo, partner municipalities and organizations for their assistance throughout development of the strategy and the valuable input we received from you. Specifically, we would like to thank yourself, Murray Walters, Shelley Norum, and Paul Thompson for input related to RDN initiatives, the development approvals process and the linkages with the LWMP and DWWP.

Sincerely,
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Issues and Revisions Registry

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Snuneymuxw First Nation
BC Ministry of Transportation & Infrastructure
Mosaic Forest Management
Mid Vancouver Island Habitat Enhancement Society
Nanaimo & Area Land Trust
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EXECUTIVE SUMMARY

The Regional District of Nanaimo's (RDN's) Regional Strategy for Rainwater Management (RSRM) forms the foundation of a sustainable approach to rainwater management within the RDN. Due to the number of overlapping jurisdictions present in the region, including private forestry, municipalities, provincial ministries and First Nations, rainwater management has been tackled in many different ways, using various standards, policies and approaches. Disparity in the region exists both in the existence and strength of standard requirements for rainwater management, as well as in the resources available to approve sustainable, resilient development. Many resources already exist to inform a regional watershed-based approach to rainwater management in the area and the RSRM works to bring them together, both to identify and fill remaining gaps and to develop a cohesive approach that accounts for local differences. Foundational to the RSRM are studies and assessments that provide a scientific basis to justify and support a water-balance based approach to rainwater management, upon which defensible performance targets and implementation tools grounded in the policy and jurisdictional framework of the region are formed.

Rainwater is the term used to encompass all precipitation, including snow melt, that falls on the surface of the land or water. Natural, unaltered watersheds soak up rainwater like a sponge, nourishing plants and replenishing streams, lakes, wetlands, and aquifers. Along with development of the land to facilitate housing, transportation, industry and commerce comes impervious surfaces, such as pavement and roofs, which prevent precipitation from naturally participating in the hydrologic cycle through processes of infiltration, evaporation and transpiration. Instead, in urban areas, the water runs quickly into storm drains, sewer systems, drainage ditches and watercourses, moving faster and in greater volumes than the natural hydrologic features of the land are capable of adapting to. This puts additional pressure on built infrastructure (commonly called grey infrastructure due to its composition of concrete, plastic and metal parts) that lacks the capacity to expand or adapt to new conditions. Exceeding the capacity of grey infrastructure results in flooding, erosion of natural watercourses, degradation of natural ecosystems and damage to public and private property, all of which will be compounded if future predictions about more intense rainfall events are realised.

Rainwater management is the approach used to control, treat and convey precipitation within the landscape, using both natural and built infrastructure. Sustainable, resilient rainwater management considers the full hydrologic cycle, and changes in climate, when identifying opportunities for safely capturing, storing, treating, conveying and discharging water on the landscape. Drought is as much a part of the hydrologic cycle as floodwaters are, and resilience requires building flexibility into the landscape to lessen the severity of the impacts of both extremes. Considering rainwater as a resource that can be used to solve problems, rather than a nuisance, is a key element of adopting a resilient strategy for rainwater management.

To ensure a resilient rainwater management approach, the RSRM includes the details for the **foundation setting studies and assessments** that will provide the scientific, educational and economic platform that the implementation of the RSRM will be built on. They include:

1. Watershed Studies
2. Watershed Monitoring
3. Regional Climate Change Assessment
4. Funding Assessment

Performance targets are the method of applying a consistent approach to resilient rainwater management across the region. In order to support consistency in the approach, targets must be clearly defined, defensible and based on science to avoid ambiguity during the development application process. Performance targets are directly linked to the watershed, groundwater and climate change science compiled by the foundation setting studies and assessments. The following four types of performance targets are recommended for the RSRM, with clearly defined terminology and backed by a preliminary Statement of Need and Reasonableness (SONAR) that will be updated as the foundation setting studies and assessments are completed:

1. **Release Rates Targets** limit peak flows discharged from the site to support the stability of receiving watercourses.
2. **Retention Volume Targets** capture on-site additional runoff volumes resulting from development in excess of runoff from the unaltered natural watershed condition.
3. **Recharge Volume Targets** match the volume of rainwater infiltrated on site to the volume that would have infiltrated within area of the unaltered natural watershed condition.
4. **Water Quality Targets** limit the levels of pollutants entering the receiving waters to protect public health and maintain healthy aquatic ecosystems and riparian habitat.

Implementation tools provide the technical and regulatory mechanisms to support implementation of the RSRM and performance targets. Implementation tools include regulation and policy, design standards and specifications, guidance documents and strategic planning tools. Examples of policies and tools used by other jurisdictions are provided as a basis upon which the RDN, and local municipalities if desired, can integrate the science-based approach to rainwater management into their existing regulatory structure. Policies, bylaws, development permit areas (DPAs), official community plans (OCPs) and land covenants are examined as potential methods of implementing the RSRM. Strategic planning tools include regionally coordinated programs to address recharge and regional rainwater management facilities, asset management planning and continued education and outreach, along with community partnerships, to ensure that rainwater management is continually developing and supported in the region.

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DEFINITIONS

Aquifer is groundwater collected within a body of permeable rock.

Better site design incorporates non-structural and natural approaches to new and redevelopment projects to reduce effects on watersheds by conserving natural areas, reducing impervious cover and better integrating stormwater treatment.

Evaporation is the process of turning liquid water into vapour.

Groundwater-Dependent Natural Resources (GDNR) are rare natural communities where soils are saturated from the upwelling of groundwater, creating spring rivulets and wet areas.

Groundwater is the water contained in the soil or in pores or spaces in rock.

Groundwater recharge occurs when water moves downward from surface water through soil and rocks to aquifer.

Hydrologic cycle is the circular process through which water passes from atmospheric vapour, through precipitation onto the land or water, and ultimately back into the atmosphere through evaporation and transpiration by vegetation.

Infiltration occurs when water sitting on the surface of the soil moves downward to fill the spaces within the soil or rock.

Infiltration system is a device or practice such as a basin, trench, underground system, rain garden or swale designed specifically to encourage infiltration, but does not include natural infiltration in pervious surfaces such as lawns, redirecting of rooftop downspouts onto lawns or minimal infiltration from practices such as swales or roadside channels designed primarily for conveyance and pollutant removal.

Low impact development (LID) commonly includes, but is not limited to, better site design when developing around natural hydrologic features, groundwater recharge, rainwater/stormwater harvesting & reuse, raingardens, bioretention facilities, infiltration galleries, tree trenches, bioswales, etc.

Pre-development natural watershed condition is the condition of the site preceding the creation of impervious surfaces or preceding changes in hydrology or infiltration by an alteration of site vegetation or contour.

Pre-treatment BMPs can include, but are not limited to, sediment pool/forebay, vegetated waterway, street sweeping, self-contained hydraulic and separation structures, or any other device designed to reduce inflowing solids by at least 50% and other pollutants to a level that can be treated satisfactorily in an infiltration practice.

Rainwater is the term used to encompass all precipitation, including snow melt.

Rainwater management is the approach and technologies used to collect, convey and discharge runoff from the landscape to the natural environment. The term stormwater management, used by many other jurisdictions, is consider synonymous with rainwater management. For the purpose of this report, the term rainwater management will be used, and is intended to include the concepts and approaches referenced to by either or both terms.

Surface water features include streams, creeks, rivers, lakes, wetlands, gullies, ephemeral streams, ponds, etc.

Transpiration is the means by which plants uptake water through their roots and release it into the atmosphere as a product of growth.

ACRONYM LIST

BMP	Best Management Practice
CCME	Canadian Council of Ministers of the Environment
CLOCA	Central Lake Ontario Conservation Authority
COFFEE Model	Coastal Fall Flood Ensemble Estimation
CTC	**C**VC, **T**RCA, **C**LOCA
CVC	Credit Valley Conservation
CVRD,	Comox Valley Regional District
DPA	Development Permit Area
DRASTIC	Depth, Recharge, Aquifer media, Soil media, Topography, Impact, Conductivity
EAP	Ecological Accounting Process
EOR	Emmons & Olivier Resources Canada Inc.
FCM	Federation of Canadian Municipalities
FLNR	Forests Lands Natural Resources
GARP	Groundwater At Risk of containing Pathogens
GDNR	Groundwater Dependent Natural Resources
GI	Green Infrastructure
GIS	Geographic Information System
GMF	Green Municipal Fund
IDF	Intensity Duration Frequency
ISMP	Integrated Stormwater Management Plan
LID	Low Impact Development
MAFF	Ministry of Agriculture, Food and Fisheries
MAMP	Municipal Asset Management Fund
MFLNRO	Ministry of Forests, Lands and Natural Resources Operations
MNAI	Municipal Natural Asset Initiative
MOESS	Manual of Engineering Standards and Specifications
MOTI	Ministry of Transportation and Infrastructure
MOU	Memorandum of Understanding
OCP	Official Community Plan
RDN	Regional District of Nanaimo
RSRM	Regional Strategy for Rainwater Management
RWM	Rainwater Management
RWMP	Rainwater Management Plan
SLR	Sea Level Rise
SONAR	Statement of Need and Reasonableness
STEP	Sustainable Technologies Evaluation Program
TAC	Technical Advisory Council
TRCA	Toronto Region Conservation Authority
VMP	Vulnerability Mapping Project
WHPA	Well Head Protection Area
WQ	Water Quality

1. INTRODUCTION

The Regional District of Nanaimo (RDN) has retained EOR to develop the Regional Strategy for Rainwater Management (RSRM), providing direction and an implementation plan for sustainable, resilient rainwater management in the region. Due to the number of overlapping jurisdictions present in the region, including private forestry, municipalities, provincial ministries and First Nations, rainwater management has been tackled in many different ways, using various standards, policies and approaches (see Gap Analysis in Appendix A). While many resources already exist to inform a watershed-based approach to rainwater management in the area, they have not yet been brought together to form a cohesive approach that accounts for local differences. Disparity in the region exists both in the existence and strength of standard requirements for rainwater management, as well as in the resources available and authority for approving sustainable, resilient development. Through workshops, working group meetings and public engagement, the expectations, roles & responsibilities, opportunities and barriers to rainwater management were assessed in order to develop the specific tools and recommendations needed to support resilient rainwater management in the RDN (see Workshop Summaries in Appendix C). A jurisdictional review looked at a range of other communities and the approaches they have taken to rainwater management that could be applied in the RDN (see Jurisdictional Review in Appendix A) and has informed many of the recommendations and samples of policy provided herein.

This RSRM forms the foundation of the rainwater management approach to be taken by the RDN and regional partners, providing recommendations for activities focusing on science-based tools and water-balance targets that may be adopted regionally. The feedback received, and review of existing and potential approaches, has set the direction of the RSRM outlined in this document.

1.1. Location

The Regional District of Nanaimo (RDN) is located on the eastern side of Vancouver Island, British Columbia (Figure 1). The RDN is situated within the traditional territories of several First Nations, including Snuneymuxw First Nation (Figure 2), Snaw-Naw-As First Nation (map not provided) and Qualicum First Nation (map not provided). It includes seven electoral districts (A to H), four municipalities including the City of Nanaimo, District of Lantzville, City of Parksville and Town of Qualicum Beach, crown land, agricultural land reserve and privately owned managed forests (Figure 3). The RDN frames its land base in terms of seven (7) Water Regions, for the purposes of water-centric organization and planning (Figure 4). The Water Regions are not defined based on single watersheds, but are based on a combination of watersheds, aquifers, and political boundaries.

1.2. Objectives

The following three (3) objectives were set by the RDN to guide development of the RSRM:

1. To outline a strategy for collaborative rainwater management in the region, at the watershed scale, for the protection of private property and the environment.
2. To coordinate actions across jurisdictions to maintain healthy watersheds in the context of climate change, land use pressures and evolving best practices for rainwater management.
3. To provide a basis to update policies, standards and bylaws, inform education and outreach, and support grant funding applications for infrastructure upgrades.

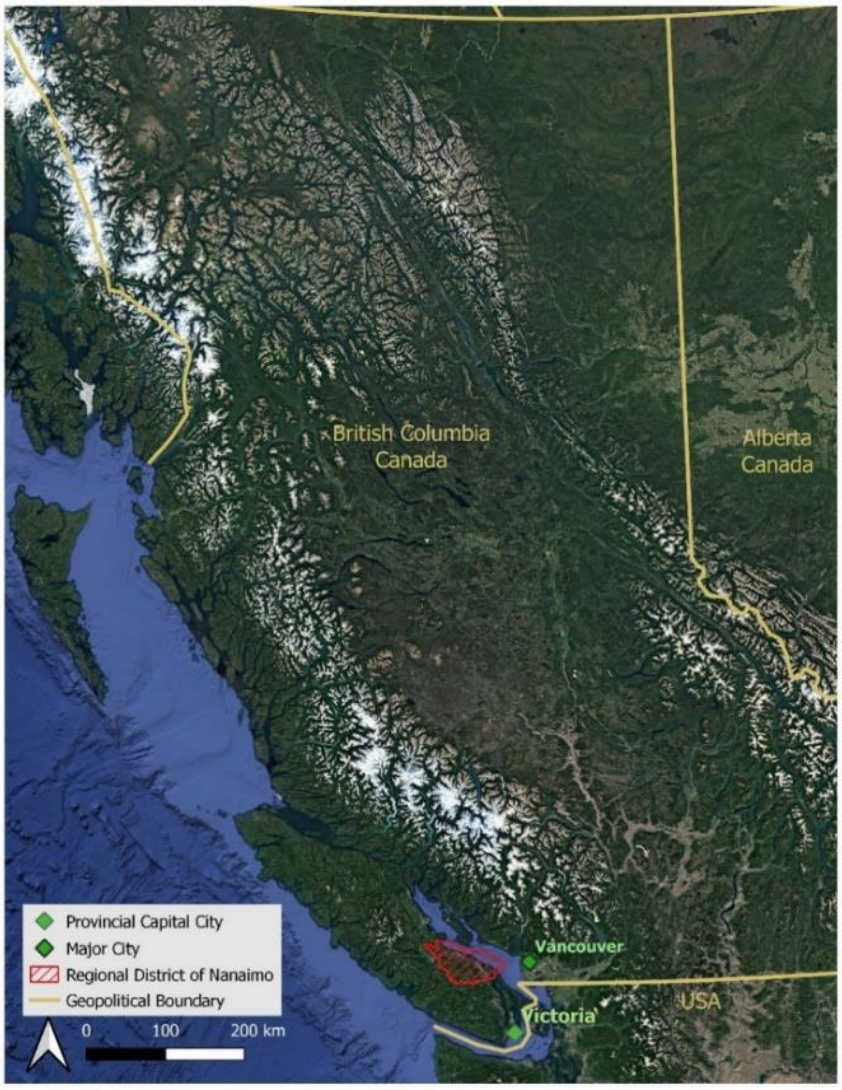


Figure 1. Location Map

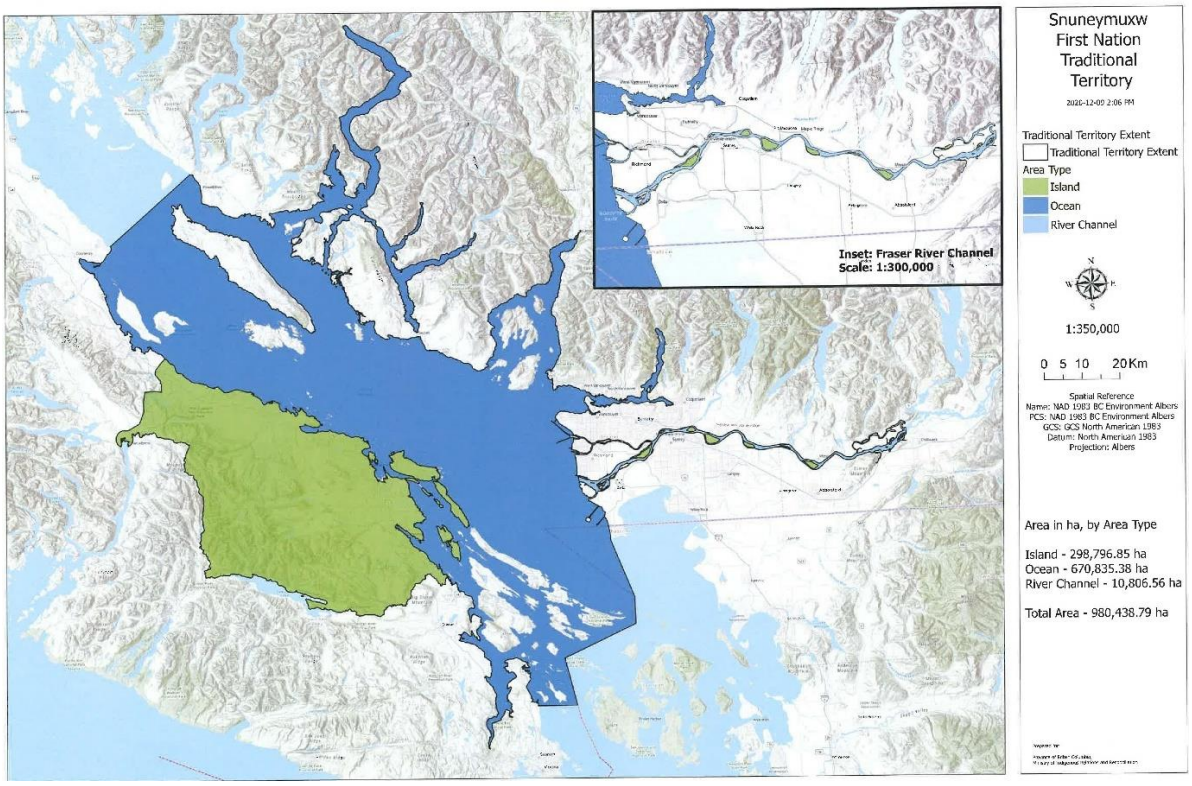


Figure 2. Snuneymuxw First Nation Traditional Territory

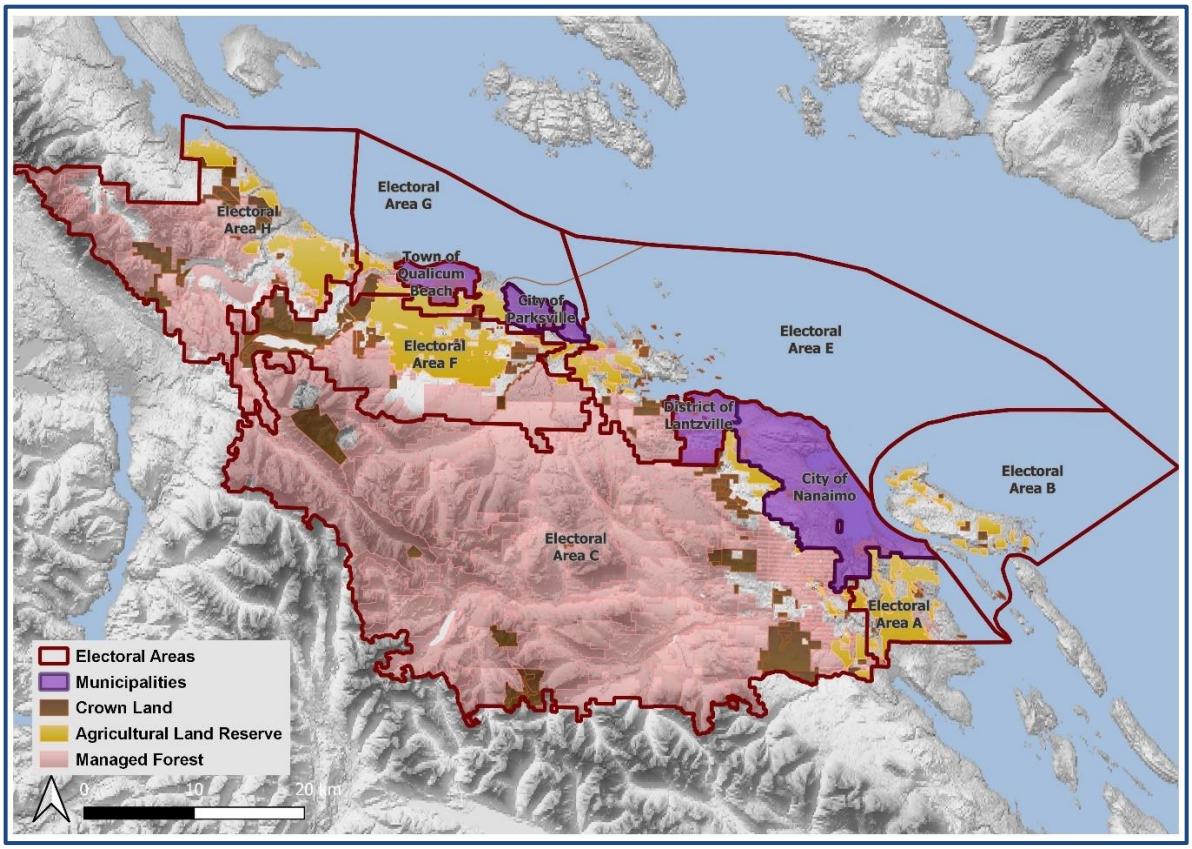


Figure 3. RDN Municipalities and Electoral Areas

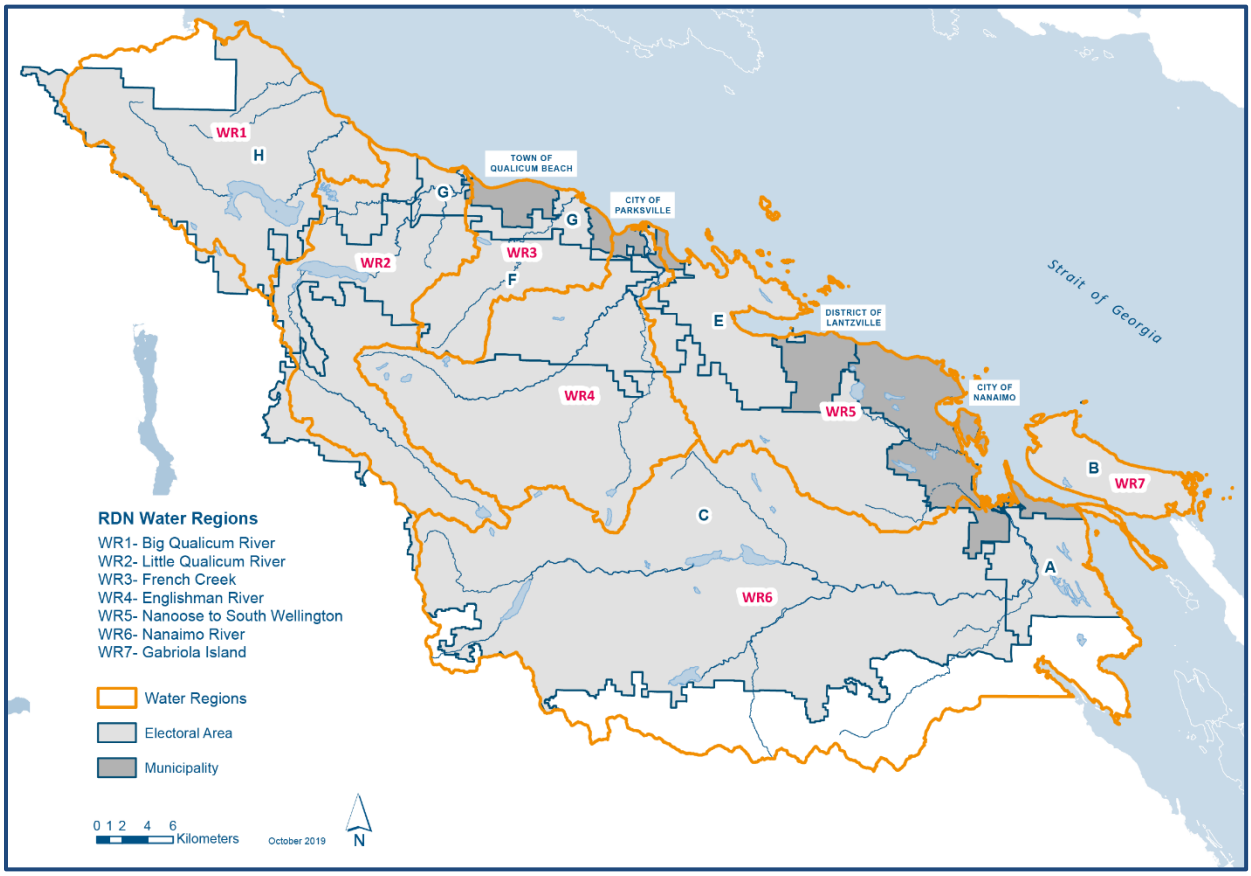
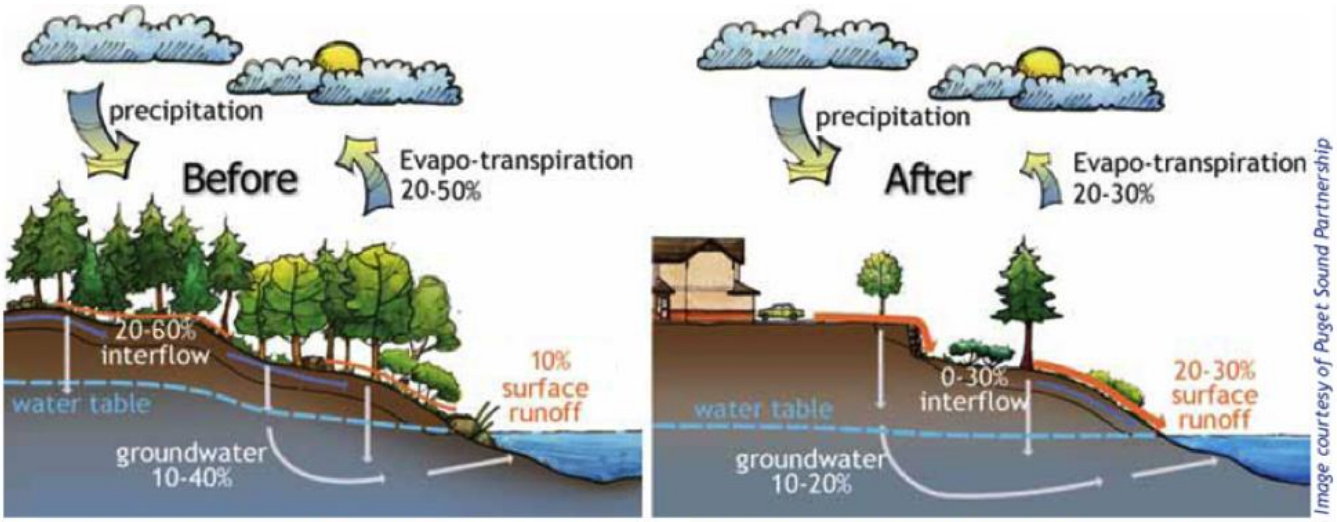


Figure 4: RDN Water Regions

2. STATEMENT OF NEED AND REASONABLENESS

This Statement of Need and Reasonableness ("SONAR") presents a summary of justification for the RDN's Regional Strategy for Rainwater Management. The SONAR provides the scientific background to support the RDN's implementation of the activities and tools included in the RSRM for the benefit of the land and water resources in the region and the undertaking of administrative burdens associated with the strategy. This SONAR is general in nature and based on industry best practices intended to support immediate action for rainwater management in the region. As the science-based studies and tools included in the RSRM are implemented, this SONAR should be replaced by SONARs for each target or category of targets, and include the scientific justification, design requirements, policies and programs needed to achieve the associated rainwater management goals. Prior to identification of science-based targets specific to each watershed, interim targets may be implemented according to industry best practices aimed at achieving natural watershed conditions.

Rainwater is the term used to encompass all precipitation, including snow melt, that falls on the surface of the land or water. Under *natural watershed condition*s, a portion of rainwater infiltrates into the soil, which in turn recharges groundwater, feeding groundwater-dependent natural resources. As the soil becomes saturated, excess water flows over the land as runoff and replenishes rivers, lakes, streams, wetlands and low-lying areas. The amount of water that infiltrates is directly related to the type of soil and vegetative cover present. For instance, unvegetated clay soils typically have a higher amount of runoff than sandy soils with dense vegetation. In a natural system most rainfall evaporates, infiltrates or is taken up by plants and transpired. Natural, unaltered watersheds soak up rainwater like a sponge, nourishing plants and replenishing streams, lakes, wetlands, and aquifers.



Before *development almost all rainfall is taken up by plants, evaporates or infiltrates through the ground.*
After *conventional development, surface runoff increases significantly while evaporation and infiltration into the ground decrease.*

Figure 5: Coastal BC Annual Water Balance (Adapted from Puget Sound Partnership & Water Balance Approach on Vancouver Island (2018))

Development of the land to accommodate housing, transportation, industry and commerce creates impervious surfaces such as pavement and roofs which prevent precipitation from naturally soaking into the ground. Instead, in urban areas, the water runs quickly into storm drains, sewer systems, drainage ditches and watercourses, moving faster and in greater volumes than the natural hydrologic features of the land are capable of absorbing (Figure 5). This puts pressure on both natural resources as well as built infrastructure without the capacity to expand or adapt to new conditions, resulting in flooding, erosion of natural watercourses, degradation of natural ecosystems and damage to public and private property.

2.1. Terminology

Many jurisdictions have found the term "pre-development" to be ambiguous. Sometimes it is understood as equivalent to the "existing condition," while in other situations it is assumed to reflect agricultural or managed forest conditions where contours and land cover have been altered without the addition of impervious surfaces. The goal of resilient rainwater management is to mimic natural hydrologic conditions prior to the alteration of land, vegetation or the natural water balance as much as possible to cause the least impact to downstream resources. Requiring applicants to meet "pre-development" conditions may imply they are only required to match the hydrologic function of the site immediately preceding the development application under review, also known as the existing condition. Peak rate, volume control and water quality standards set for the hydrologic function of a "natural watershed condition" - defined as preceding the creation of impervious surfaces or changes in hydrology or infiltration by an alteration of site vegetation or contour - will result in a higher level of protection that more closely mimics the natural processes that dominated the landscape prior to development of the land.

In order to ensure mutual understanding is achieved between site designers and approvals staff, ambiguous terms should be replaced in policy and procedures as soon as possible in order to close loopholes and achieve a resilient landscape into the future. Interim targets using strengthened terminology such as 'natural watershed condition' may be set prior to completion of watershed studies, following best practices in the industry, and to support immediate action towards achieving the goals of the RSRM. When standards are desired that relate to the condition and hydrologic function of the land immediately prior to development, the term 'existing conditions' is recommended.

2.2. Rainwater Management

Managing rainwater involves ensuring that the movement and collection of rainwater will not have adverse affects on private and public property, natural water bodies and watercourses, and natural ecosystems and habitats. Rainwater management is the approach used to control, treat and convey precipitation within the landscape, using both natural and built infrastructure. It typically involves controlling the flow rates, volumes and quality of rainwater released from a site into a stormwater system or natural receiving waters.

A combination of source controls, conveyance or routing practices, traditional (grey) rainwater management infrastructure and end-of-pipe solutions is appropriate in developing a resilient regional approach to rainwater management. Traditionally, source controls have not been implemented, relying instead on engineered, or grey infrastructure including pipes, ponds, outfalls, pump stations, to quickly move rainwater away from private and public property. Conveyance practices include pipes and ditches that move water from one location to another while protecting lives, property and natural features. End-of-Pipe controls typically focus on limiting peak flow discharge rates to downstream infrastructure and may be combined with water quality enhancement. While there are benefits to controlling runoff in this manner related to

protecting downstream infrastructure during high intensity events, these facilities are unable to match the natural functional hydrology of the site. Source controls, or low impact development (LID) and Green Infrastructure (GI) solutions seek to manage rainwater throughout site development by working with the functional hydrology of the site (see Figure 6). Requiring source controls through application of performance targets at the lot-scale allows for more equitable distribution of rainwater management based on imperviousness or area disturbed. Combining source controls with site design approaches, such as Better Site Design, that preserve natural hydrologic features such as drainage ways, groundwater-dependent natural resources, recharge areas and natural assets allow developments to more closely mimic the predevelopment natural watershed condition.

The full hydrologic cycle and changes in climate, are critical considerations when identifying opportunities for safely capturing, storing, treating, conveying and discharging water on the landscape. Drought is as much a part of the hydrologic cycle as floodwaters are, and resilience requires building flexibility into the landscape to lessen the severity of the impacts of both extremes. Considering the impacts of rainwater management approaches at the watershed scale and in terms of watershed-level cumulative effects, whether on residents, habitat, water quality, flows, volumes, or other indicators, is critical to achieving natural watershed conditions.

Altering natural hydrologic function through re-contouring, clearing vegetation, soil compaction and increasing imperviousness during development of a site results in increased volumes of runoff leaving the site at a faster rate. Increased runoff **peak flows** occurring during storm events may degrade the stability and function of rivers and streams, causing erosion, increased pollutant loads, and flooding. Cumulative increases in peak flows from several upstream developments can eventually exceed the capacity of built stormwater conveyance systems (pipes and ditches) causing flooding away from watercourses, the result of storm sewer backups or full pipes that cannot accept additional flows (surcharging). Increased volumes of surface runoff may increase the duration of elevated flows as stormwater ponds release the captured volumes over time, degrading the stability and function of rivers and streams, causing erosion and changing the shape of natural channels to accommodate the new flow regime. Changes in the intensity and duration of rainfall events are expected as climate change progresses and resilient rainwater management needs to expect and design for these events.

There exists a direct correlation between the volume of runoff and the length of time that a receiving waterbody remains inundated when water levels are elevated after a precipitation event. **Volume control** practices tend to encourage infiltration and transpiration, reducing the amount of surface runoff. Increased runoff volume also signifies a decrease in the amount of water infiltrating into the soil for interflow and groundwater recharge. Groundwater baseflow sustains the rivers and creeks in the RDN and groundwater supports the function and value of groundwater-dependent natural resources. As residents depend on groundwater as a source of water for household use, it is important to ensure that an adequate **recharge volume** is allowed to infiltrate and replenish aquifers and groundwater-dependent natural resources.

Terrain alteration, erosion during and following construction, and the replacement of natural, vegetated cover with impervious surface such as roadway, rooftop, parking area or sidewalk increases the transport of both sediments and man-made pollutants, such as oil and grease, antifreeze, deicing materials, metal and rubber particles from motor vehicles, fertilizers and herbicides, into downgradient surface waters. As well, both runoff from impervious surfaces and storm water outflow from rainwater management ponds can reach

higher temperatures and can increase the thermal load to a stream or lake thereby stressing cold-water fish populations such as trout. Provincial and federal standards address constituents of many of these known pollutants, providing maximum acceptable acute and chronic concentrations for recreation, protection of aquatic life and drinking water (CCME). Watershed specific **water quality** targets more stringent than the federal and provincial requirements may be required to restore watercourses and water bodies that are already impacted.

2.3. Natural Assets

Traditionally, rainwater management has focused on built infrastructure, including ponds and ditches. Since one of the goals of the RSRM is to maintain or mimic the natural hydrology of our watersheds, the strategy should also consider the role of natural assets in rainwater management. Recognizing the role natural assets (wetlands, forests, open space, etc.) play in managing rainwater, and accounting for these functions within the site design by conserving natural areas, reducing impervious cover and integrating rainwater treatment using non-structural and natural approaches (Better Site Design) elevates the perceived value of these resources and can rationalize the protection and investment in protecting these areas.

Natural assets include, but are not limited to, parks, open spaces, forests, wetlands, streams, riparian areas, and springs. The term Green Infrastructure (GI) applies to engineered facilities that rely on natural processes to manage rainwater such as bioretention and infiltration facilities and other low impact development (LID) features. Asset management is rising in the minds of municipal managers as the benefits related to justifying necessary improvements and repairs based on risk and social equity are becoming increasingly apparent. In the same way, the wisdom of managing natural assets as contributing to the overall function of various elements of the urban and rural environment is beginning to be recognized. From purely a rainwater management point of view, valuing natural resources according to the capital, operational and maintenance costs that would be required to build infrastructure to provide comparable ecosystem and hydrologic services is appropriate. Natural assets provide far more benefit to a community than just rainwater management and therefore a full cost accounting through a natural asset valuation process (e.g., Municipal Natural Asset Initiative (MNAI) or Ecological Accounting Process (EAP)) may be applied across several asset classes. Finally, due to their reliance on natural processes, natural assets provide resiliency in the face of climate change impacts (e.g., reducing urban heat island effect, buffering flood waters, carbon sequestration, generating oxygen, etc.) and benefits in this regard should not be underestimated in their valuation and management.

2.4. Climate Resiliency

As communities built to manage historic climate related events (flood, drought, wind, and heat) experience events that exceed the historic design criteria, they are often subject to public and private property damage, threat to public safety, exorbitant clean up and restoration costs, and disruptions in reliable delivery of many community services. Consideration of the impacts of changing climate variables in design is increasingly being considered the responsible and necessary approach for local governments. Increasingly the insurance industry is developing their own tools related to climate impacts in order to limit their liability for paying out for damages related to climate extremes. Additionally, legal liability exists under common law for communities that do not keep up with minimum Canadian municipal design standards to accommodate climate change impacts. Using currently available climate change projections at the regional scale will facilitate immediate planning efforts and should be updated as the science evolves to incorporate more

localized products. This planning level information will help local municipalities, the RDN, MOTI and other agencies with jurisdiction to assess their needs under a changing climate in a more consistent and cost-effective manner.

Figure 6: Green Infrastructure Rainwater Management Techniques

3. APPROACH

The intention of the RSRM is to provide a clear path to achieving a resilient rainwater management approach within the RDN. Resiliency includes managing rainwater during extreme climate conditions, supporting continued use and development in the area, recognizing the value of rainwater, promoting community-based stewardship and prioritizing opportunities for environmental sustainability. Figure 7 details the structure of the RSRM that is contained within the remainder of this document.

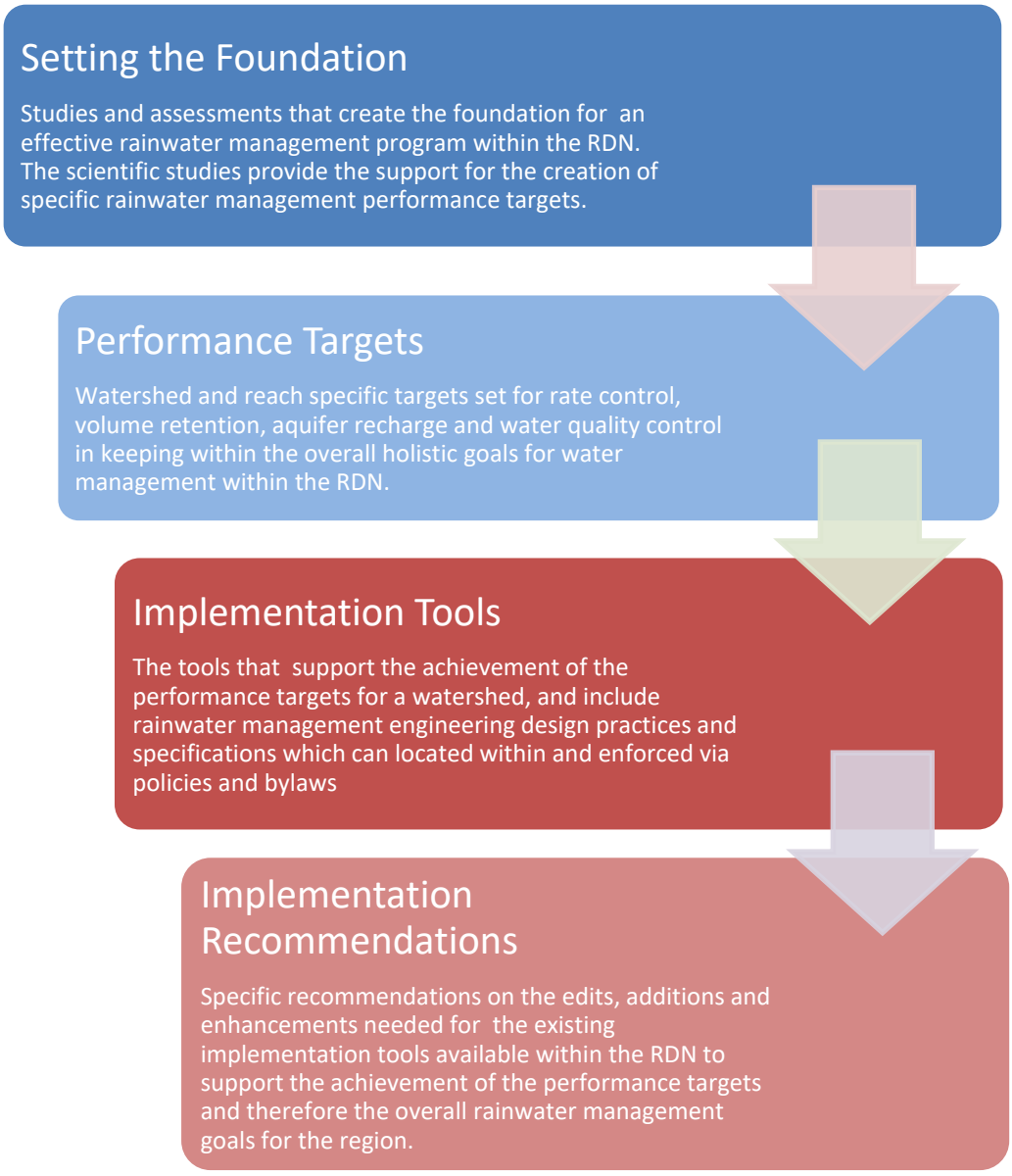


Figure 7: Structure of recommendations with the RSRM

Foundational studies and assessments are intended to build the scientific justification for performance targets, initiatives and programs that will be implemented through the RSRM. Implementation tools are the means by which the RDN, and any adopting municipalities, may begin to apply the scientific findings of the foundational studies and assessments consistently and defensibly across the region. These tools are accompanied by recommendations that will guide the RDN through the process of moving from scientific studies to regulatory enactment and include methodologies that will support consistent application of these critical targets across the region. This approach taken within the RSRM is intended to provide a clear pathway guiding the RDN and any adopting municipalities from the current baseline rainwater management approach toward a more resilient landscape, adapting to the changes expected in the future from climate change and development pressures.

Performance targets are key parameters that are either directly measurable or can be clearly inferred from other measurable metrics. They are typically used as both design parameters and the indicators of compliance with the standards. The typical rainwater management performance targets are discussed in more detail in Section 5 - Setting Performance Targets and as is intended for the RSRM, an adaptive management approach should be taken with the performance targets. Interim performance targets may be set prior to gaining a complete understanding of the state of the watershed and the science-based targets that support a return to a natural watershed condition or that incorporate climate resilience measures. Interim targets can require designs that meet or exceed hydrologic and hydraulic conditions of the site as it would have been in the natural watershed condition. For example, several development targets currently set in the RDN are related to the ambiguous 'pre-development' condition and could be updated simply by replacing the term 'pre-development' with 'natural watershed condition'.

Once there is scientific evidence to support more specific requirements for rainwater management that consider the cumulative watershed impact, as has been recently completed for French Creek, the interim performance targets can be replaced by science-based performance targets. Given that the location of a property under development will determine what the applicable rainwater management targets are, a map-based system may be an effective way to clearly communicate the various targets with the public, consulting engineers and approvals staff (Figure 8). Interim targets would remain in areas where watershed studies have not yet been completed and replaced as the science-based assessment of each reach within the watershed occurs. Using a map-based approach to communicate at any point in time what the most current performance targets are on a watershed basis, supports an adaptive management approach allowing for timely updates as watershed studies and monitoring are completed.

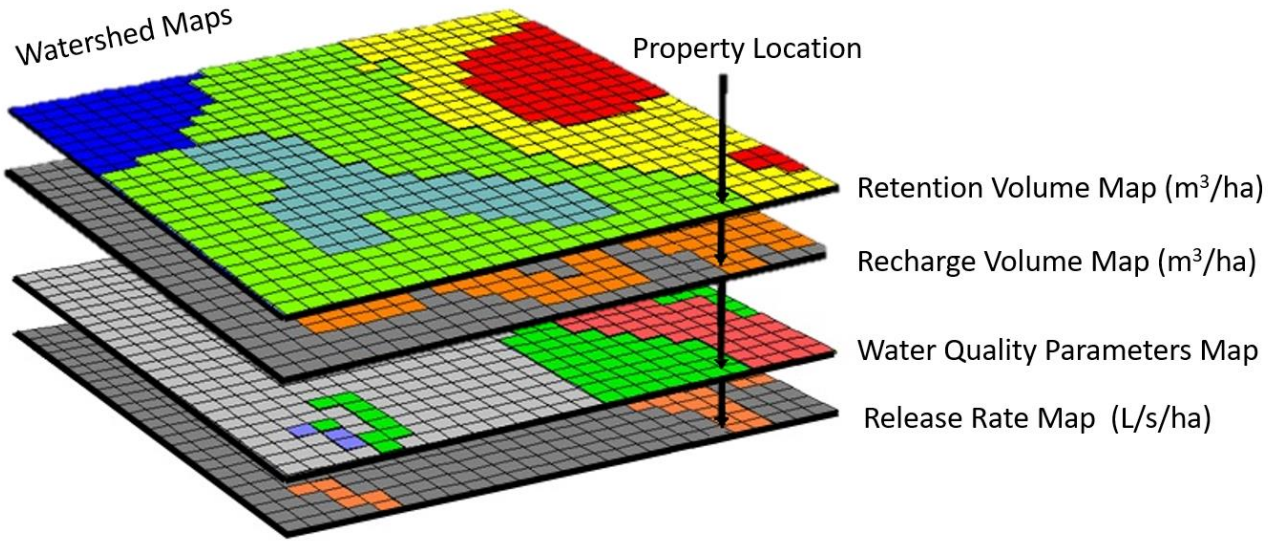


Figure 8: Mapping Layers example

Adaptive management is an appropriate approach to ensuring both that the targets are achieving the goals of restoring the natural watershed conditions, and that the emerging impacts of climate change are incorporated into the performance targets. Ongoing monitoring of stream health and stability, aquifer levels, habitat health and other metrics will reveal where performance targets need to be adjusted to ensure that the natural water balance is maintained and existing systems, both natural and anthropogenic, are protected from the cumulative impacts of development. Resilience in the face of climate change will likely require innovative rainwater management approaches, and aggressive performance targets, to mitigate the impacts of drought and flooding on water supply, natural assets and the infrastructure that maintains the quality of life of residents of the region. Watersheds and climate change impacts do not adhere to political boundaries and regional approaches to achieving a natural watershed condition and mitigating the impacts of climate change will need to be approached broadly throughout the region, through collaborative partnerships between all jurisdictions, communities, and land managers. The remainder of the RSRM provides additional detail about the foundational studies and assessments required for setting science-based performance targets and recommendations for implementing and funding the RSRM.

4. SETTING THE FOUNDATION FOR RAINWATER MANAGEMENT

The foundational studies and assessments outlined within this section focus on gathering the science that is needed to set justified and defensible rainwater performance targets within the RDN, and on developing consistent funding and support to drive implementation of the RSRM. Due to the long history of environmental stewardship work already occurring within the RDN, these elements are, for the most part, established works or programs and this strategy looks to bring them together within a rainwater management framework and close any gaps that might exist.

Ultimately, establishing a solid foundation of knowledge will inform the creation of rainwater management performance targets that are specific to a watershed, natural area or aquifer, and be designed to ensure the protection of public and private property and the environment. The strategy recommends gathering most of the foundational science from watershed studies, either completed, in process or planned and through the consolidation of existing knowledge from within the province, region, municipalities and the wider rainwater management field. To ensure that this scientific knowledge has a chance to be applied, a source of reliable and ongoing funding for rainwater management must be found.

Closing the gaps that exist in the science supporting specific performance targets will take time and resources, however the need to start moving toward a resilient landscape is felt urgently in the region. Interim performance targets should be set using the justification in the Statement of Need and Reasonableness (SONAR) and based on industry best practices for rainwater management. Interim rainwater management performance targets for the RDN can be adopted from municipal and provincial standards or can be set based on seeking to mimic natural watershed conditions. Targets set for the natural watershed condition can be applied to regional management initiatives as well as site specific solutions.

This section outlines those required elements within these foundational studies and assessments that are required to establish an effective rainwater management program and include the following actions which are discussed in more detail in Table 1, below.

Table 1: Foundation Setting Actions

#	Foundation Setting Actions
1	**Watershed Studies to set Performance Targets** Conduct new, or review existing, **watershed studies** for the purpose of setting rainwater management performance targets specific to each Water Region and reach.
2	**Watershed Monitoring** Continue, and expand as needed, **monitoring of watershed parameters** to support watershed studies and enable evaluation of program and policy efficacy in mitigating impacts of development and climate change, informing adaptive management approaches to watershed health.
3	**Regional Climate Change Assessment** Conduct, or select, a region wide **climate change assessment specific to rainwater management** for the purpose of providing a unified knowledge base of the potential impacts of climate change. This assessment will be used to inform how the rainwater

	management performance targets and initiatives should be adapted to account for these potential impacts.
4	**Rainwater Management Funding Assessment** Complete an **assessment of funding needs** and potential avenues for funding to ensure a sustainable rainwater management program is created and goals are met.

Though this section is termed 'Setting the foundation for rainwater management', it is not expected or suggested that the actions outlined above must be completed in full before proceeding with further recommendations from within the RSRM. The elements provided within these studies and assessments provide a foundation on which to build a solid rainwater management program, but that foundation must be revisited in an adaptive way, as more studies are completed, and the impacts of targets are observed through monitoring.

The adaptive management approach illustrated in Figure 9 demonstrates how constant monitoring, feedback and adjustments of the performance targets are needed to move towards achieving the goals for rainwater management within the RDN. This process would also include updates to the SONAR for rainwater management and, eventually, replacement with target specific SONARs based on the watershed studies and monitoring results. Any updates to the performance targets will be accompanied by updates to the associated Policies, Regulations and Bylaws, and would remain undergirded by the foundational studies and assessments.

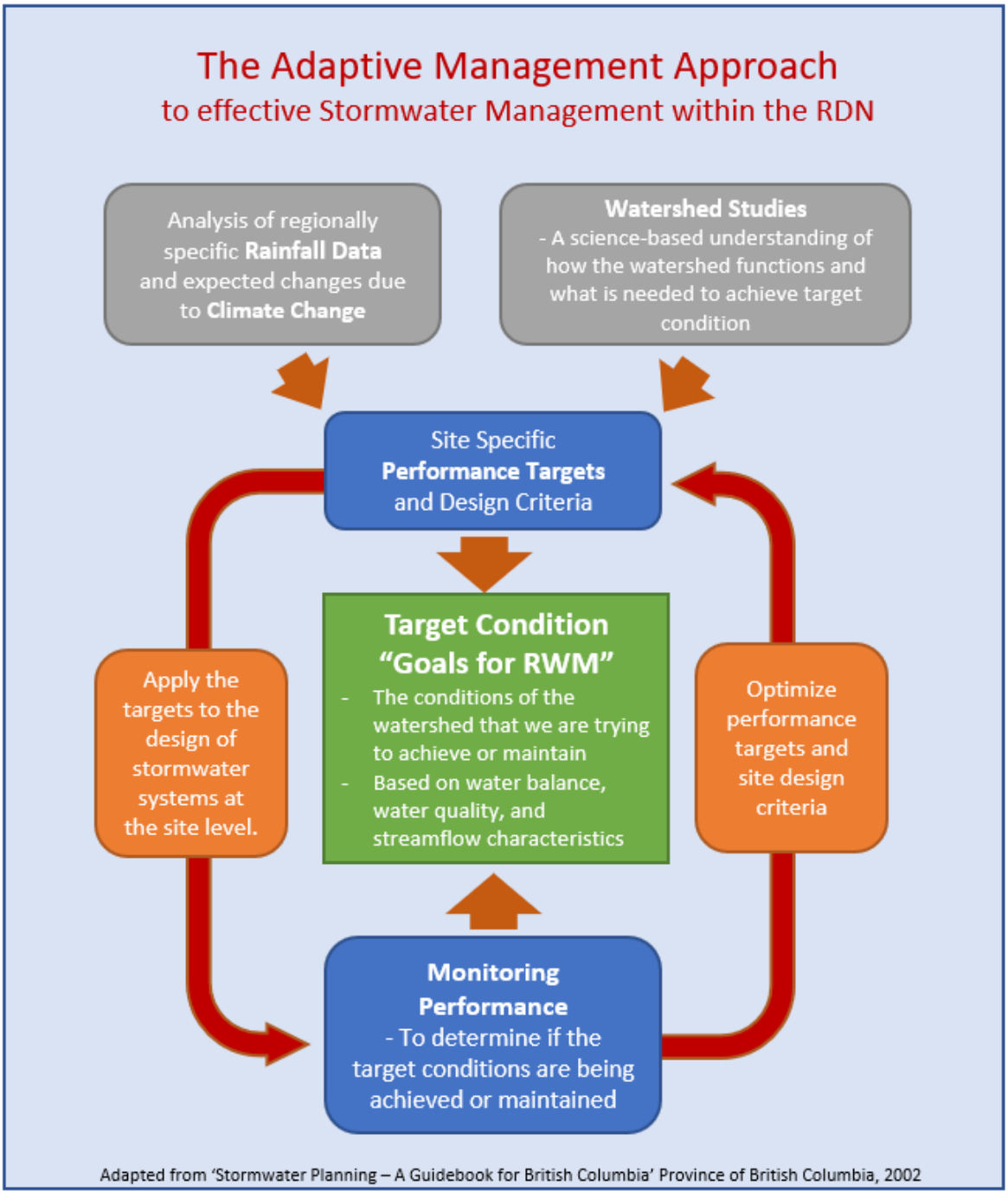


Figure 9: The Adaptive Management Approach

4.1. Watershed Studies to set Performance Targets

Foundation Setting Action 1: Conduct new, or review existing, watershed studies for the purpose of setting rainwater management performance targets specific to each water region and reach.

Understanding the current state of a watershed from a rainwater management lens can help identify the actions needed to ensure that development can occur while still maintaining the natural hydrologic function and ecological processes of that watershed. The natural watershed condition is identified as the 'Target Condition' in Figure 9, above and includes the maintenance or restoration of the natural hydrologic function of the watershed as was present prior to alteration of contours or vegetation. The functions of the watershed (from a rainwater management perspective) include the collection of rainfall, storage, and release of water during different seasons, and the conveyance of runoff to streams, rivers, and the ocean, while supporting healthy and diverse ecosystems. Watershed studies assess the current condition as well as the expected impacts of development growth on the hydrology of the contributing area and watercourses. They identify reach-specific performance targets necessary to mitigate impacts of development and restore hydrologic function to the natural watershed condition. The impacts of the changing climate are also considered in development of reach-specific targets intended to address the combined impacts of development and climate change impacts.

More information and tips for setting performance targets for the RDN is provided in Section 5 but the most common and widely accepted include the following:

Release Rate targets

- How fast can water be released from development into adjacent watercourses and infrastructure during a precipitation event of specified frequency. This target limits peak flows and maintains capacity to convey water safely to the receiving water.

Retention Volume targets

- Volume of water running off the land during a precipitation event of specified frequency that must be captured and managed on site, based on the amount of site imperviousness. This target ensures that development manages the additional runoff generated by increasing the site imperviousness.

Recharge Volume Targets

- Portion of the Retention Volume Target that must be infiltrated. This target maintains the groundwater component of the water balance. Ideally this target will be paired with a limit on the allowable impervious coverage (%) to ensure that natural infiltration processes are protected. The recharge volume target will necessarily vary with site-specific soil and aquifer conditions, and, in some areas, infiltration may not be possible due to slope stability or unsuitable soils. See the recommendation to establish a Recharge Management Program for details on possible approaches to this variability.

Water Quality targets

- The level of treatment required prior to release of water from a development. This target protects and restores healthy aquatic habitats and prevents sedimentation of rainwater infrastructure.

Many studies have already been conducted on the watersheds within the RDN, focusing on some or all of the items necessary for setting robust performance targets (see Table 2). Prioritization of the remaining partially-studied or unstudied watersheds should be conducted to determine the next watershed to be completed. Where performance targets are available from completed studies, they may be immediately applied, while interim targets are recommended for partially or unstudied watersheds (more information on interim targets is provided in Section 5.5). Performance targets will be implemented and enforced through RDN bylaws and policies as outlined in Section 6.2, below.

Table 2: Elements to Include in Performance Target Setting Watershed Studies

Watershed Study Elements	Description	Link to Performance Target
Hydrologic Analysis	This will include the current baseflow, inflows, hydrographs, and flow modelling for all reaches of the watershed.	Inform Release Rate, Retention Volume and Recharge Volume targets
Water Quality Evaluation	This will provide information on current sediment and pollutant loads and temperature	Create Water Quality performance targets
Current State Evaluation	This will identify areas in need of mitigation like slope instability, bank erosion, etc.	Inform area specific targets that may differ from reach targets
Surface Water & Groundwater Budgets	Water Budgets estimate the hydrological balance of surface flow, interflow and groundwater recharge for each watershed and aquifer to maintain drinking water supply, stream flows and groundwater dependent natural resources.	Inform Release Rate, Retention Volume targets and Recharge Volume targets (including allowable imperviousness)
Climate Change Impacts	The projected changes to the above elements due to climate change and based on the accepted Climate Change Assessment discussed below.	Incorporated into all performance targets.

Existing Initiatives:

- Water Quality Assessment and Objectives for the Englishman River Community Watershed (2010)
- Surface Water Quality Trend Analysis (2018;2021)
- French Creek Watershed Performance Targets Study (In Progress)
- Provincial resources for infiltration best practices
- Water Budget Project: RDN Phase One (2013); Refined Water Budget (Phase 3) for Nanoose (Electoral Area E) (2020)
- Groundwater Recharge Model for Gabriola Island (2016)
- Provincial groundwater monitoring & licensing
- Volunteer Observation Well monitoring; Aquifer Vulnerability Mapping

- Aquifer Recharge Mapping

Suggested Actions:

1. Begin discussions with local municipalities to discuss the process or issues related to adoption and implementation of performance targets identified through watershed studies.
2. Conduct a prioritization exercise, in collaboration with municipalities, to determine next steps in completing new and partially completed watershed studies.
3. Complete French Creek Watershed Performance Targets Study Phase 2 (implementation) and set Performance Targets based on Phase 1 study (NHC 2021).
4. Initiate the next Watershed Performance Targets Study based on Water Region.
5. Continue until all Water Regions have complete watershed studies.

Timelines:

Watershed studies are currently in progress, so the timelines associated with these actions are immediate and ongoing. Watershed studies will be conducted concurrently with other recommendations provided within this report.

Roles & Responsibilities:

- RDN to lead projects and consolidate existing information,
- Consultants to work on studies and modeling,
- Municipalities and MoTI to provide input.

Resources to support creation of Watershed Studies:

- Partnership for Water Sustainability in BC, Water Balance Tool
- City of Coquitlam, Integrated Watershed Management requirements
- Central Lake Ontario Conversation Authority (CLOCA), Conceptual Water Budget Report

4.2. Watershed Monitoring

Foundation Setting Action 2: Continue, and expand as needed, **monitoring of watershed parameters** to support watershed studies and enable evaluation of program and policy efficacy in mitigating impacts of development and climate change, informing adaptive management approaches to watershed health.

Long-term monitoring of a variety of parameters in the watershed is necessary to gain an understanding of the impacts of land use practices and management decisions, establish performance targets and to measure performance towards rainwater management goals. The following parameters (not exclusive) inform effective watershed and rainwater management:

- precipitation,
- surface water levels and flows,
- groundwater levels,
- water quality,
- stream and riparian health, and
- ecological indicators.

The RDN, the Province and stewardship groups have been, and will continue to, monitor the region's watershed health metrics. Surface water quality and ecological health indicators are part of existing community monitoring programs in the region. Residents in the RDN and neighbouring municipalities are dependent on aquifers for their drinking water and therefore continued groundwater monitoring is essential to ensure that the quality is being maintained and adequate volumes are recharged to support drinking water demands and groundwater-dependent natural resources. Groundwater monitoring is also critical to identify locations where high groundwater levels preclude capacity to absorb water through surface infiltration, requiring the use of alternate methods of rainwater management.

Current Initiatives include:

- RDN Community Watershed Monitoring Network
- RDN Surface Water Quality Trend Analysis
- RDN Volunteer Observation Well monitoring
- Drinking water well monitoring
- Provincial groundwater monitoring & licensing
- Water Survey of Canada, DFO, MFLNRO hydrometric monitoring
- Environment Canada Climate Stations
- Other local climate stations (i.e., municipal public works, school-based weather station network)

Suggested Actions:

1. Evaluate the current monitoring programs to identify data gaps related to rainwater management performance targets.
2. Prioritize the establishment of new monitoring initiatives to close identified data gaps.
3. Create partnerships to support this work (province, municipalities, stewardship groups, institutions) and providing training as needed.
4. Analyze the information to determine trends and identify additional performance targets needed to support watershed health.

Timeline:

Watershed health monitoring is ongoing and should be used in all watershed studies. Groundwater monitoring to track fluctuations in levels should be implemented immediately for aquifers that are not already tracked. Any additional monitoring data needed to support new watershed studies and to set and evaluate the efficacy of performance targets should be implemented immediately. All monitoring should be incorporated into the adaptive management process.

Roles & Responsibilities:

- Province to maintain ongoing monitoring networks, databases and protocols
- RDN to coordinate monitoring efforts at the local level
- Stewardship groups to assist with monitoring
- Municipalities to provide data sharing
- Consultants to conduct analysis of monitoring data

Resources to support Watershed Monitoring:

- RDN Community Watershed Monitoring Network
- Mid Vancouver Island Habitat Enhancement Society (MVIHES)
- The Pacific Streamkeepers Federation
- BC Water Tool

4.3. Regional Climate Change Assessment

Foundation Setting Action 3: Conduct, or select, a region wide **climate change assessment specific to rainwater management** for the purpose of providing a unified knowledge base of the potential impacts of climate change. This assessment will be used to inform how the rainwater management performance targets and initiatives should be adapted to account for these potential impacts.

Climate change is altering temperature and precipitation patterns which directly impact current and future approaches to rainwater management. Current typical conditions across the region consist of wet winters and dry summers, and are expected to be exacerbated with more extremes in both seasons, resulting in even wetter winters and even drier summers (Dillon Consulting 2020). Evapotranspiration is expected to increase due to warmer conditions year-round. Another aspect of climate change that is important to account for is expected sea level rise (SLR) and the resulting impacts on floodplains and increased pluvial (overland) flood hazards resulting from an inability to discharge to the ocean in areas near the coast. As the majority of development within the RDN and municipalities exists along the coastlines, an inability of municipal systems and watercourses to drain fully when elevated sea levels block outfalls could pose significant challenges. Finally, the opportunity to recharge aquifers may also be affected as intense precipitation increasingly runs off saturated surfaces in recharge areas rather than infiltrating. This may stress water supplies in ways that even a return to historically natural hydrologic function within the region may not be sufficient to completely alleviate.

Pluvial flooding, or overland flooding occurs when an urban drainage system is overwhelmed resulting in flooding of streets and structures outside of the floodplain. Pluvial flooding often disproportionately affects areas with lower socio-economic advantages and, when identified through flood hazard mapping, can help in applying an equity lens to decision making regarding capital spending. Pluvial flooding analyses can be combined with infrastructure modeling to identify areas that have not historically experienced overland flooding but that may experience it under extreme rainfall and sea level rise conditions, allowing for emergency response planning and consideration of preventative action or projects. Flood hazard mapping may also facilitate identification of 'upstream' areas that are contributing to pluvial flooding due to the cumulative impacts within the rainwater management infrastructure, and where preventative actions or projects may have more impact than attempting to manage the water at the source of ponding.

Drought forms the other extreme related to rainwater management under a changing climate. As extreme rainfall events replace historic patterns of precipitation, the ability of the natural watershed condition to recharge aquifers may be reduced through generation of hydrophyilic soils during dry periods, while saturated soils during intense rainfalls or following multi-day rain events behave similarly to impervious surfaces when much of the water is lost to runoff. These conditions may result

in an overall reduction in the water available for recharging aquifers, though not necessarily a reduction in annual precipitation, requiring innovative solutions to enhance recharge and capture more volume during intense rainfalls for use during dry periods.

Understanding how climate change will affect the region is essential to creating a long-term rainwater strategy that can proactively manage those changes, rather than reacting to them as they occur. Within the RDN, the Energy and Sustainability Department and Long-Range Planning Department work on initiatives that focus on adapting to climate change and many considerations for climate change have already been integrated into long range plans and current studies, including the recent Water Budget study for Electoral Area E and Sea Level Rise and Floodplain Hazard Mapping. Table 3 outlines the elements intended to provide up-to-date understanding of the emerging science around climate change and how they link to the rainwater management performance targets.

Table 3: Elements to include in a Climate Change (CC) Assessment for Rainwater Management

CC Assessment Elements	Description	Link to Performance Targets
Regionally accepted CC precipitation models	Develop or adopt a regional climate adjusted IDF and continuous precipitation standard for use in planning and design. Precedent to follow: 'Climate Projections for the Cowichan Valley Regional District' (2017)'.	Inform Release Rate, Retention Volume and Recharge Volume Targets
Pluvial Flood Hazard Maps	Develop Flood Hazard maps for pluvial flooding. Update Floodplain mapping if CC assessment indicates changes from current maps are expected. Using GIS analysis, the RDN LiDAR surface data can be combined with historic and projected (climate changed) rainfall depths, existing floodplain assessments and sea level rise (SLR) estimates to identify low lying areas that may be subject to pluvial flooding when overland flow routes are blocked, or infrastructure has reached capacity. These estimates are especially important when looking at resiliency-based retrofits in older communities that lack modern rainwater management infrastructure.	Inform Release Rates and Retention Volume Targets. Inform potential locations for regional facilities to mitigate CC impacts.
Groundwater Elevation Analysis	Establish long-term groundwater monitoring network (potentially in partnership with the province) to develop an understanding of natural seasonal fluctuations, impacts of licensed and unlicensed withdrawals, and potential climate change impacts on aquifer levels. Collaborate with the province to develop approaches to addressing climate related changes and trends in aquifer levels across the RDN.	Inform aquifer specific Recharge Volume Targets (including allowable imperviousness).

Existing Initiatives:

- Climate Action Technical Advisory Committee Action 1 – Water Supply Resilience Work
- Flood Risk Assessment Report, RDN/Qualicum Beach (Sept 2019)
- River Floodplain Mapping and Risk Assessment Project: Englishman River; Little Qualicum River & Nanaimo River
- Parksville Community Park Stormwater Management Master Plan (2021) – IDF Curves up to 10-day duration event
- French Creek Watershed Targets Study (in progress)
- City of Nanaimo Climate Changed IDF Curves
- Provincial COFFEE model (flood forecasting)
- BC Groundwater Well Licensing required by spring 2022
- Volunteer Observation Well monitoring
- Drinking water well monitoring
- Pacific Climate Impacts Consortium, Plan2Adapt Tool
- Climate BC model tool
- BC Agricultural Demand Model report
- BC Landscape Water Calculator
- Lidar Snow Mapping by VIU

Suggested Actions:

1. Review climate change approaches to rainwater management adopted by local municipalities. Adopt or develop regional climate change approach(es) for rainwater management planning.
2. Conduct or continue pluvial flooding assessment and develop Flood Hazard Mapping to support prioritization of retrofit projects.
3. Maintain long-term groundwater monitoring network on all drinking water aquifers in partnership with the province.

Timeline:

Immediately as some elements within the strategy (setting performance targets, creating bylaws and setting DPAs for vulnerable areas) rely on the completion of this climate change assessment.

Roles & Responsibilities:

- RDN to lead CC model consolidation/ regional acceptance, Flood Hazard mapping & Groundwater monitoring analysis.
- Municipalities to provide documentation of climate change studies and approved climate change approaches to rainwater management
- Province to support with data, methodologies and research for groundwater analysis
- Consultants to conduct modeling and technical studies as required

Resources to support recommendations:

- Climate BC – a MS windows application that provides climate data

- CVRD, 'Climate Projections for the Cowichan Valley Regional District" report
- Retooling for Climate Change BC
- Ministry of Water, Land and Air Protection BC, Flood Hazard Area Land use management guidelines,
- CTC Source Protection Region (Ontario), Vulnerability Analysis Methodology (see section 6)
- Vancouver Island University, Intrinsic Vulnerability mapping Methods of Vancouver Island 2010

4.4. Funding Assessment

Foundation Setting Action 4: Complete an assessment of funding needs and potential avenues for funding to ensure a sustainable rainwater management program is created and goals are met.

A lack of resources is often cited by municipalities as a barrier to maintaining existing rainwater infrastructure at the level expected by citizens, and to implementing evolving technologies and approaches for rainwater management. Historically, rainwater management is funded by the property taxes collected by the municipality or regional district. While rainwater management may be a priority for the organization, funding for rainwater projects must be weighed against all other projects also funded by the tax base including, but not limited to, social services, building operations, transit and inter-jurisdictional governance and is therefore subject to some level of political will. Often water and sanitary sewer services have dedicated utilities to ensure that new development and ongoing operations and maintenance are guaranteed to meet the community expectation of service. Rainwater management is also an essential service, and, in many Canadian municipalities, aging infrastructure is creating a significant deficit in terms of funding required to maintain the level of service expected by the public. There are limited methods available to regional districts and municipalities to obtain a reliable source of funding to ensure the ongoing operation of rainwater management systems in Canada, as outlined in Table 4.

Implementing rainwater management is essential for the RDN and member municipalities to protect its watershed natural assets and drinking water sources and there could be significant consequences in the long-term if rainwater management is not prioritized. In the RDN, the Liquid Waste Management Plan is able to provide some funding for rainwater management activities and managing existing assets. An assessment of the funding required to maintain existing infrastructure and assets, and to implement the watershed-based management of rainwater to mitigate for the impacts of future development and climate change, is necessary to determine whether the dedicated funding through the LWMP is sufficient. Many cities have realized the importance of implementing a rainwater utility (also known as a stormwater or drainage utility) that collects separate (though not typically additional) funds from citizens relying on publicly provided rainwater infrastructure. This dedicated funding provides municipalities or regions the confidence to plan current and future expenditures for rainwater management infrastructure and techniques with known budgets and without concerns about shifting political priorities Additional funding or resources may also be available through grants for studies, pilot projects or partnerships with academic institutions, though this funding is not typically consistent. Table 4 outlines key recommendation and opportunities for developing sustainable funding for rainwater management.

Table 4: Elements to include in a Funding Assessment for Rainwater Management.

Funding Assessment Elements	Description
Assess the Needs	Clarify the potential needs for funding to meet the goals for rainwater management within the RDN. Funds could be used for the following: • Salary of dedicated rainwater management employee to action the strategy • Budget for consultants /technical experts to conduct the studies and write guidance documents • Budget to maintain, rehabilitate and replace existing rainwater management infrastructure • Budget for installation of rainwater management facilities • Budget for land acquisition for protection of recharge zones • Budget for pilot projects • Budget for education and outreach initiatives and incentives • Budget for stewardship groups to conduct rehabilitation works
Funding Options:	
Rainwater Utility	Assess the feasibility of creating a rainwater utility for the RDN (and Municipalities) to support rainwater infrastructure and planning. Typically rainwater utilities provide funding for both capital and operational expenses associated with engineered rainwater infrastructure, as well as the staff and resources to support the goals of sustainable rainwater management. As an incentive, a reduction in the utility fees could be offered for homeowners or developments that manage their rainwater onsite.
Development Cost Charge (DCC)	Assess the feasibility of incorporating a rainwater management Development Cost Charge for new developments to manage the rainwater infrastructure or facilities required. Currently 7 DCC Bylaws exist within the RDN related to water and sewer infrastructure but do not include rainwater management infrastructure. As an incentive, a reduction in the DCC could be offered for those developments that manage all rainwater within their site or exceed the requirements of the performance targets, pending approval by the District Engineer.
Grants / Technical Resources	Assess the available technical resources and grant funding to support rainwater infrastructure and planning. See the list of potential resources below this table.
Regional Taxes	Assess the feasibility of claiming a dedicated portion of regional taxes for rainwater management. This may be set up through the LWMP.
Cash-in-lieu Option / Off-setting Program	Assess the feasibility of creating a cash-in-lieu option when specific performance targets cannot be completely met on a site or development for any reason including, but not limited to soil type,

Funding Assessment Elements	Description
	aquifer vulnerability, slope stability or development footprint. Cash-in-lieu options may also be structured as Offsetting or Banking programs depending on the preferences of those managing the program and local precedent. In this RSRM these three terms are used interchangeably to represent all options that may be used to achieve the same goals. At times, site conditions may limit the ability of a development to fully meet the performance targets on site. Under this approach, it is the responsibility of the developer to comply with the targets to the maximum extent possible and provide technical justification for short-falls before being granted cash-in-lieu options to address the outstanding portion of targets off-site. An offsetting program would require use of the funds collected through this program to develop projects (including restoration, enhancement or acquisition) that meet the targets elsewhere within the reach or aquifer. This off-setting program should be regionally managed and could include partnerships with local organizations tasked with implementing off-site measures to compensate for sites that are unable to fully comply with the performance targets. Participation in this type of program could be extended to the local municipalities through a memorandum of understanding (MOU) for a consistent, regional approach to maintaining watershed and aquifer health, and building resiliency to climate change impacts.

Existing Initiatives:

- RDN Community Parks Development Cost Charge
- RDN and Town of Qualicum Beach Federation of Canadian Municipalities Municipal Asset Management Program Grants
- Municipal Natural Assets Initiative, City of Nanaimo

Suggested Actions:

1. Identify any gaps between available funds and rainwater management level of services expectations.
2. Create internal RDN working group with members from related divisions (planning, engineering, bylaw enforcement, finance/accounting, operations, etc.) to assess funding options.
3. Pursue available grants for eligible projects and initiatives.

Timeline:

Immediately and concurrent with other recommendations within this report, as securing and then maintaining funding can be considered an ongoing action.

Roles & Responsibilities:

- RDN to lead regional efforts

- Municipalities to collaborate on regional opportunities

Resources to support Funding recommendations:

- Government of British Columbia, Ministry of Community Services, Development Cost Charges Best Practices Guide (gov.bc.ca)
- City of Victoria, Stormwater Utility FAQs

Funding and Grant Opportunities:

a. Investing in Canada Infrastructure Program (BC)
    i. Partnership with the government of Canada and local governments to invest in green infrastructure (environmental quality) and rural community infrastructure (<25000 pop.). (https://www2.gov.bc.ca/gov/content/governments/local-governments/grants-transfers/grants)

b. Infrastructure Planning Grant Program (BC)
    ii. Open to municipalities and regional districts to support comprehensive planning projects such as asset management plans, integrated stormwater infrastructure plans, water master plans, liquid waste management plans. (https://www2.gov.bc.ca/gov/content/governments/local-governments/grants-transfers/grants/infrastructure-planning-grant-program)

c. Federation of Canadian Municipalities (FCM)
    iii. Municipal Asset Management Program (MAMP) – provides funds to municipalities and municipal partners to advance asset management planning. (https://fcm.ca/en/funding/mamp/asset-management-grants-municipalities)
    iv. Green Municipal Fund (GMF) – provides funds to municipalities and municipal partners for environmental projects. Funding covers plans, studies, pilot projects and capital projects in the fields of sustainability, water, waste, energy, climate change, housing, and brownfield development. (https://fcm.ca/en/funding/gmf/pilot-projects-stormwater-quality-community-project)

d. Municipal Natural Assets Initiative
    v. MNAI organizes cohorts with other communities to begin the process of incorporating natural assets into existing asset management processes by identifying holistic benefits and estimating value. (https://mnai.ca/media/2018/07/MNAI_Nanaimo-Final.pdf)

e. Disaster Mitigation and Adaptation Fund (Federal)
    vi. The DMAF funds structural and natural infrastructure projects to increase resilience of communities that are impacted by natural disasters triggered by climate change. (https://www.infrastructure.gc.ca/dmaf-faac/index-eng.html)

5. SETTING PERFORMANCE TARGETS

Setting the performance targets falls under the Foundation Setting Action 1:

Foundation Setting Action 1: Conduct new, or review existing, watershed studies for the purpose of setting rainwater management performance targets specific to each water region and reach.

Setting performance targets for rainwater management in the region ensures that the regional goals of maintaining healthy waters in the context of climate change, land use pressures and evolving best practices for rainwater management can be met through many small-scale actions such as LID, protection of natural assets and other rainwater management best practices. Performance based targets aim to set defensible, science-based standards that must be met on all applicable projects. These targets can be applied on a regional or watershed scale depending on the target and may be related to land use, zoning or location within the watershed or aquifer area. For example, a groundwater recharge volume target could be set for new subdivisions within an Aquifer Recharge Area classified as having low vulnerability to surface contamination, within the French Creek watershed. The performance targets for the RDN will be based on watershed studies and water budget modeling to support the current and long-term stability of natural watercourses, maintenance of aquifer levels, ecosystem and habitat protection, infrastructure and natural asset protection and safeguarding of public and private property. The issues and supporting strategy around rainwater management are clear and there is action that can be taken immediately to improve the mitigation measures employed in the RDN. Interim targets should be set based on industry best practices, as described in the SONAR, and remain in place for all areas that do not have a completed watershed study.

Current requirements and recommendations related to rainwater management within the RDN are not all performance based and have varying degrees of enforcement strength. They are found within various Development Permit Areas, Official Community Plans, guidance manuals, MoTI guidance and are often limited to certain components of rainwater management such as water quality or site stormwater discharge (see detailed Gaps Analysis in Appendix B). To enable the RDN to require and enforce these standards, wording within the standards must reduce ambiguity by replacing phrases such as 'recommended', 'highly encouraged' or 'where feasible' that leave room for negotiation, with specific qualitative and quantitative requirements backed by watershed monitoring and modeling results.

Setting firm targets means that exemptions will only be applied when appropriate alternatives are able to meet the requirements within the watershed or aquifer area and the inability to meet the targets is justified technically rather than stemming solely from an economic choice. Strengthening rainwater management in the RDN means applying a consistent and equitable approach based on the scientific studies establishing the needs of the watershed and people living within it. Ensuring equity also means that enforcement of the performance targets is applied evenly across development sites based on scientifically determined requirements specific to the location within a watershed or aquifer. This means evaluating at how these targets will be applied and how they can be adjusted based on the zoning type (Commercial, Industrial, Residential, etc.) and land use (multi-family

residential, single family residential, etc.) to ensure that what is being asked is feasible and promotes responsible development within all zoning types.

As the RDN, municipalities and regional partners move forward with setting defensible, science-based targets, continued monitoring of the watersheds will reveal the efficacy of actions taken. Evaluation of long-term trends will reveal areas or parameters that may require alternative approaches or additional actions to build toward resiliency in rainwater management. Continually re-assessing and adjusting as new information is gathered is called Adaptive Management. As the impacts of climate change are better understood, a rainwater management strategy that applies a flexible response approach allows for adjusting both to emerging changes and expected impacts over time. Adaptive management is the appropriate approach to maintaining functional systems over time as new techniques, technology and data emerges (Figure 10).

Drainage requirements, such as those required by MoTI for rural roads, highways and subdivisions, are not necessarily fully synonymous with rainwater management as defined in this RSRM. Drainage requirements, and traditional rainwater management approaches, tend to focus on moving the water away as efficiently as possible without excessive negative impacts to the site or conveyance infrastructure. The rainwater management strategy recommended in the RSRM seeks to manage rainwater as close to the source as possible in an effort to maintain the hydrologic balance of the overall system. This rainwater management strategy incorporates drainage requirements by recommending setting specific release rate targets but bases those on maintaining the health and stability of receiving waters rather than focusing solely on the capacity of the engineered conveyance infrastructure. The recommended rainwater management strategy also considers the duration of flows through volume control and aquifer recharge requirements, since sustained elevated flows have channel forming impacts that can alter the downstream receiving watercourses over time. Developments will be required (via the Implementation Tools outlined below) to meet the performance targets by designing rainwater management facilities and approaches using the design standards and specifications that are outlined in Section 6.1.1.

The Statement of Need and Reasonableness (SONAR) provided in Section 2 provides the technical foundation for the rainwater management targets outlined below. As watershed studies and groundwater assessments are completed, a SONAR can be completed for each updated target based on the specific requirements to achieving resilient conditions. The following sections define the most typical types of rainwater management targets as identified in the SONAR in Section 2:

5.1. Release Rate Targets

Post-development release rates (L/s/ha) mimic the functional hydrology of the natural watershed condition, not exceeding the surface runoff rates for all design events.

Traditionally this rainwater management target is based on the capacity of the engineered conveyance infrastructure to safely convey the flows. It is important to consider the sustainability of rainwater management in the watershed by adopting peak flow rate targets that also address the health and stability of the receiving watercourses, limiting discharges to rates observed in a functional natural watershed condition. It is important to strengthen the language around the release

rate targets to ensure that ambiguity is removed, and to mitigate the impacts of the development on downstream infrastructure and natural environments.

Examples:

> The … maximum site release rate shall be 5 L/s/ha of total contributory catchment. (Lanztville, Subdivision and Development Works and Services Bylaw No. 175, 2020)
>
> Detain post-development flows to pre-development levels for the 6-month, 24-hour (50% of the 2-year, 24 -hour) event for areas draining to watercourses to minimize erosion. If downstream drainage system cannot accommodate the 5-year post-development flows, detain them to pre-development levels. (Nanaimo, Manual of Engineering Standards & Specification (MoESS), 2020) [*Note: ambiguity exists in the term 'pre-development'*]

5.2. Retention Volume Targets

Rainfall depth (mm/ha) or volume of runoff in excess of the natural watershed condition (m^3/ha) to be retained and managed on site

Retention volume capture targets require a certain volume of precipitation to be managed on site without discharge. Retained volumes are typically 'discharged' through infiltration, evapotranspiration in vegetated rainwater management practices, or reused for beneficial purposes (e.g., irrigation, toilet flushing, etc.) on site. Retained volume targets seek to mimic the functional hydrology of the site by limiting the peak flows and duration of elevated flows leaving the site. Reducing runoff volumes supports watercourse stability, prevents cumulative impacts on rainwater infrastructure capacity and maintains water balance at the point of precipitation.

In some cases, as in the Yellow Point Aquifer area, the sensitivity of the aquifer and constraints on the local drainage system have confined the rainwater quantity target to full site retention and reuse within a rainwater harvesting system.

Example:

> Retain, infiltrate, or reuse the 6-month, 24-hour (50% of the 2-year, 24-hour) post development runoff volume. For Nanaimo, this equates to approximately 31mm of rainfall depth. (Nanaimo, MoESS, 2020)

5.3. Recharge Volume Targets

Volume of retained rainwater (m^3/ha) to be infiltrated on the site to sustain aquifer recharge in support of hydrologic and ecological function matching the natural watershed condition

Recharge volume targets are similar to retention volume targets however they specify infiltration as the means of discharging the set volume of rainwater from the site. They may be set as a percentage of the retention volume, or a volume related to impervious area. Recharge volume targets seek to

maintain healthy aquifer levels and work toward achieving functional hydrology associated with the natural watershed condition within the built landscape. When comparing post-development recharge volumes to recharge in the natural watershed condition, it is also important to consider the imperviousness of the site and may be worth setting a related target to limit the allowable impervious area of the development. The recharge volume targets are also related to soil conditions since some locations have unstable soils or slopes, or soils that do not allow infiltration at rates that will allow recharge to happen in a timely manner. In these instances, alternate approaches to ensuring recharge is maintained on an aquifer basis have been discussed in Table 13.

Examples:

> To promote a reduction in storm flows and maintenance of stream base flows, groundwater recharge systems shall be investigated and used where shown to be appropriate and technically feasible and as recommended in the Watershed Studies, or as otherwise approved by the City (City of Coquitlam, Stormwater Management Policy and Design Manual, 2019)
>
> Maintain pre-development groundwater recharge rates and appropriate distribution, ensuring the protection of related hydrologic and ecologic functions. (Toronto Region Conservation Authority (TRCA), Stormwater Management Criteria, 2012) [*Note - ambiguity exists in the term 'pre-development'*]

5.4. Water Quality Targets

Post-development runoff water quality is suitable to support recreation, aquatic life and riparian health

Water quality targets are based on the acceptable water quality that can be released from site or assimilated in the receiving waterbody. Water quality targets often include a list of what cannot be released into the watershed (toxic materials, etc.) and are intended to protect or restore the health of the watershed, riparian and aquatic habitat and protect human health. General Provincial and Federal water quality targets exist for recreational use and protection of aquatic life.

Example:

> Remove 80% of Total Suspended Solids (TSS) over 50µm particle size. For impervious surfaces exposed to vehicle traffic provide water quality treatment for 90% of the average annual runoff (the 6-month, 24-hour storm or 50% of the 2-year, 24-hour storm). (Nanaimo, MOESS, 2019)

5.5. Interim Targets

It is recommended that a set of interim performance targets be established as a minimum requirement to ensure capacity within the existing rainwater management infrastructure, and scientifically established natural watershed conditions, until watershed studies are complete.

Interim performance targets can be current best practices within the RDN or may be adopted from the current standards of a local municipality and adapted for use across the RDN if required.

Current targets included in municipal standards could be used as interim targets until watershed studies have been completed. Ambiguity in the language included in current performance targets may be removed prior to completion of the watershed studies by clarifying the term 'pre-development' or replacing it with either 'existing condition' or 'natural watershed condition' depending on the intent. Strong interim targets focussed on mitigating the impacts of development, ensuring that existing engineered systems are protected, and seeking to mimic the natural watershed condition can be set using industry best practice.

It is recommended to include wording in any applicable bylaws or guidance documents that these strong interim targets must be followed unless an approved watershed study, ISMP, aquifer assessment or area specific study exists, at which point targets defined in these studies will supersede the interim targets for sites within the area. This ensures that specific targets are being enforced when they are ready while all sites under development still remain responsible for rainwater management, in an equitable manner.

Resources to support recommendations:

- See specific performance targets outlined within Rainwater Management Guidance Documents
    - City of Coquitlam, Stormwater Management Policy & Design Manual (2019)
    - City of Chilliwack, Policy and Design Criteria Manual for Surface Water Management (2002)
    - City of Nanaimo, Manual of Engineering Standards and Specification (MoESS) Section 7 – Stormwater Management (2020)
    - District of Metchosin Bylaw No. 467 For the protection and management of rainwater (2016)
- BC Inter-Governmental Partnership, Beyond the Guidebook: Establish Watershed-Specific Runoff Capture Performance Targets (2008)
- Ministry of Water, Land and Air Protection BC, Stormwater Planning: A guidebook for British Columbia (May 2002)
- West Coast Environmental Law, The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories

6. IMPLEMENTATION TOOLS & IMPLEMENTATION RECOMMENDATIONS

This section outlines the methods and guidance for implementing the performance targets, including the technical guidance and standards required for design, the policy tools to ensure that the targets can be enforced and the strategic planning tools that ensure that the strategy is a success over the long term (see Figure 10).

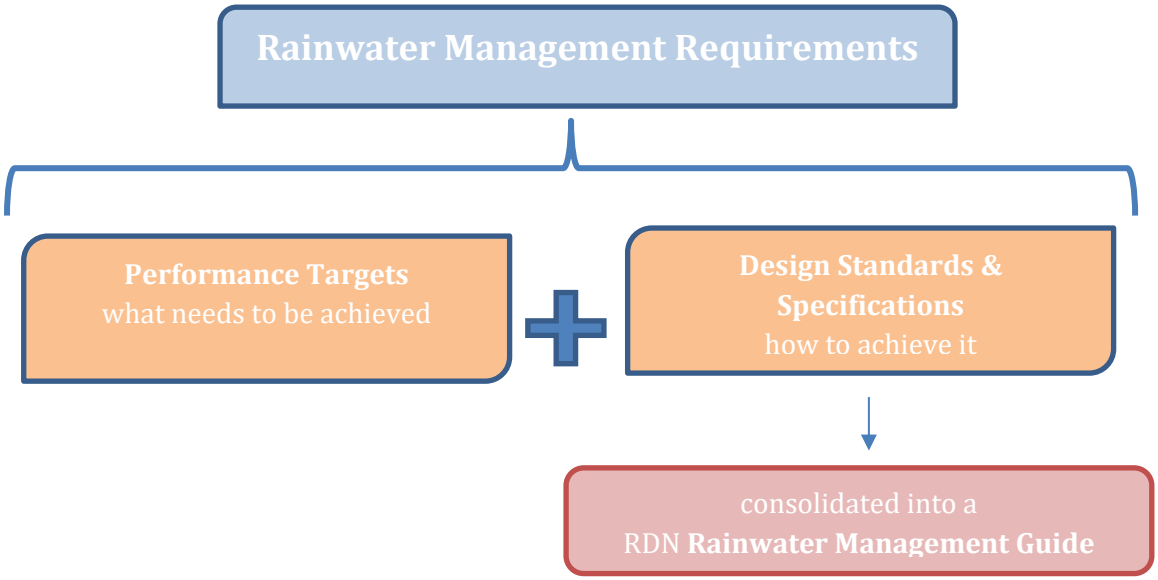


Figure 10: Relationship of Rainwater Management Requirement Components

6.1. Technical Tools

6.1.1. Design Standards & Specifications

Design standards and specifications are recommended within this section to provide the information and direction to design a system to achieve the set rainwater management performance targets. They include the calculations to use in estimating runoff volumes, the coefficients to use for different land types, and reference maps with infiltration rates and IDF curves to estimate rainfall volumes for a set storm. They can also include references to best management practices (BMPs) for infiltration practices and landscaping, as well as templates and checklists for consistent and clear review of rainwater management plan submissions. Within the field of rainwater management there is not a single set of design standards and specifications that works for all locations and jurisdictions, and it is up to each jurisdiction to specify what works best for their climate, land uses and development growth patterns.

Setting regional design standards and specifications will ensure that all rainwater management practices within the region are designed with the same quality and types of data, assumptions, and methodologies, ensuring a consistent approach to rainwater management and providing a level playing field for all developers within the region. Providing these clear guidelines and expectations around design also ensures that planners can be confident in the rainwater management designs

submitted by developers, resulting in a more efficient and streamlined review process. The process for developing a set of RDN design standards and specifications requires building on the work already completed by many other jurisdictions, including the municipalities within the RDN, and is outlined in Table 5.

The process of consolidating rainwater management design standards and specification can be a large task, and it not the intention of this strategy that this process be fully completed before moving forward with other recommendations. In the same way that an adaptive management approach is recommended for continuous refinement of performance targets, the standards and specifications can be adopted over time and then continuously refined and updated as studies, technologies and approaches emerge.

Table 5: Implementation Recommendations for Design Standards & Specifications

	Implementation Recommendations	Link to Performance Targets
T.1	Create/ Adopt standard **Climate Change precipitation projections** as outlined in Section 4.3 above.	Inform Release Rate, Retention Volume and Recharge Volume targets
T.2	Create/ Adopt acceptable **calculation & modeling methodologies** for the following: - Runoff Calculation methodology with defined coefficients and parameters - Time of Concentration - Modelling Parameters (and when modelling is required)	Related to Release Rate, Retention Volume targets
T.3	Create / Adopt standard **maps** for the following: - Soil infiltration rates - Hydrologic calculation/modeling parameters - Evapotranspiration rates - Aquifer recharge zones - Aquifer Vulnerability areas /Well-Head Protection Areas - Floodplain and flood hazards	Inform & relate to Release Rate, Retention Volume and Recharge Volume targets
T.4	Create / Adopt an acceptable methodology for calculating a **Site Scale Water Balance** for incorporation into a rainwater management plan submission. This may include referencing the maps, data sets and climate projects outlined above.	Related to Release Rate, Retention Volume and Recharge Volume targets

	Implementation Recommendations	Link to Performance Targets
T.5	Create / Adopt standard procedures for **soil infiltration testing**.	Related to Recharge Volume targets
T.6	Define/Adopt **Sediment and Erosion Control** design standards and specifications.	Related to Water Quality targets
T.7	Define / Adopt **Pre-treatment** requirements for any infiltrating systems installed	Related to Water Quality targets
T.8	Define/Adopt **Operations & Maintenance** requirements for rainwater management systems.	Related to adaptive management approach
T.9	Define/Adopt rainwater **Best Management Practices (BMPs), Low Impact Development (LID) or Green Infrastructure (GI)** standards and specification most applicable for use within the RDN. Reference exemplary design standards from other jurisdictions (e.g., CVC, City of Coquitlam), and incorporate local adjustments for naturally occurring conditions if required.	Related to Release Rate, Retention Volume, Recharge Volume and Water Quality targets
T.10	**Provide education around Agricultural BMPs** to improve discharged rainwater quantity, rates and quality. Collaborate with Ministry of Agriculture, Fisheries and Food to apply and enforce.	Related to Release Rate, Retention Volume, Recharge Volume and Water Quality targets
T.11	Create a template/ list of what needs to be included within a **Rainwater Management Plan Submission** for review and approval. Consider requesting an interim Rainwater Management Plan at the review stage and then a Final Rainwater Management Plan provided as a condition of receiving the final Development permit. Different templates/checklists may be required for different development types and lot sizes depending on the required performance targets (i.e., subdivisions vs industrial sites).	Informed by Release Rate, Retention Volume, Recharge Volume and Water Quality targets
T.12	Create a plan for **Tracking and Monitoring** of any rainwater management or LID systems installed. This will link with the requirements for ongoing Operations and Maintenance but also	Related to adaptive

	Implementation Recommendations	Link to Performance Targets
	help to provide a snapshot of what is going on in the region for purposes of LID promotion and potential long-term performance studies. Developing an Asset Management Plan is an excellent method of capturing the full lifecycle requirements for all rainwater management facilities and natural assets.	management approach

Resources to support recommendations:

- City of Coquitlam, Stormwater Management Policy & Design Manual (see Section 5 for description of a comprehensive Stormwater Management Plan submission)
- District of West Vancouver, Stormwater Management Plan Submission Guidelines (2016)
- City of Coquitlam, Rainwater Management – Source Controls
- City of Chilliwack, Policy and Design Criteria Manual for Surface water Management
- CVRD, Climate Projections for the Cowichan Valley Regional District
- Sustainable Technologies Evaluation Program (STEP), Sediment & Erosion Control Guidelines

6.1.2. Guidance Documents / Manuals

The creation of a guidance document that consolidates all regional standards, specifications and recommendations required for meeting the set performance targets will facilitate strong policies, and clarity for developers and approvers, resulting in successful implementation of resilient rainwater

management. Effective communication with developers through a consolidated regional guideline will reduce the review time needed by planners by clearly outlining parameters to be reviewed resulting in a more streamlined approvals process.

The recommended guidance document will contain all of the design standards and specifications as listed above and in Table 6 and will include reference to applicable engineering standards from the Ministry of Transportation and Infrastructure (BC MoTI 2019) as needed. This guidance manual could then be adopted as a bylaw, official policy or be referenced from within official policies as the document to follow to meet the performance target requirements. More information on enforcing this guidance document is provided in Section 6.2 Regulatory & Policy Tools below.

Table 6: Implementation Recommendations for Guidance Documents / Manuals

Implementation Recommendations	
T.13	**Create a 'RDN Rainwater Management Guide' document** outlining the following: - RDN's up-to-date rainwater management performance targets by watershed and reach (interim or final), - development applicability of targets, - design standards & specifications - best management practices (BMPs) for source, conveyance, and end-of-pipe rainwater controls for reference Neighbouring municipalities without fully developed rainwater management strategies may choose to update their requirements by referring back to the **RDN Rainwater Management Guide** unless local system requirements, watershed studies, aquifer assessments or other particular requirements supersede them. Sample wording that could be contained within Municipal Engineering Design manuals: "*Developments to follow design standards and meet performance targets as outlined within the RDN Rainwater Management Guide unless local watershed studies / ISMPs provide more direct instruction and higher standards*." Municipalities can also choose to reference particular standards or specifications within the **RDN Rainwater Management Guide** rather than the guide as a whole, as each component of the document would be developed collaboratively with the intent to be shared within the region. Ensure that related guides like the RDN Sustainability Guide, include reference to this document.

Resources to support recommendations:
Rainwater management guide examples:

- City of Coquitlam, Stormwater Management Policy & Design Manual (2019)
- City of Chilliwack, Policy and Design Criteria Manual for Surface Water Management (2002)

- City of Nanaimo, Manual of Engineering Standards and Specification (MoESS) Section 7 – Stormwater Management (2020)
- District of Metchosin Bylaw No. 467. Bylaw No. 467 For the Protection and Management of Rainwater (2016)

Documents to guide the creation of a rainwater management guide:

- West Coast Environmental Law, The Green Infrastructure Guide: Issues, implementation Strategies and Success Stories (2007)
- CVC /TRCA, LID Stormwater Management Planning and Design Guide (2010)
- BC Ministry of Water, Land and Air Protection, Stormwater Planning: A Guidebook for British Columbia (2002)
- Metro Vancouver, Stormwater Source Control Design Guidelines (2012)
- Partnership for Water Sustainability BC, Rainwater Management: An Introduction to the Guidebook for BC

6.2. Regulatory & Policy Tools

6.2.1. Policies

A policy is a defined set of actions adopted and endorsed by a governing body. Within the RDN, policies are endorsed by a board of directors that represent the electoral areas and the municipalities. Policies can cover a wide range of topics, though no current policy specific to rainwater management exists within the RDN.

From the Jurisdictional Review (see technical memo in Appendix A) requirements for rainwater management may be found within a single rainwater management policy or elements of rainwater management may be found within traditional and existing policies like drainage policies, engineering standards, sediment and erosion control policies, Climate Change adaptation policies, and landscaping policies. This is true for the RDN as well, as elements of rainwater management are found within a variety of policies as demonstrated in the Gaps Analysis (Appendix B).

Currently within the RDN, drainage design for roadways and sub-divisions within the electoral areas is governed by the design standards provided by the Ministry of Transportation and Infrastructure (BC MoTI 2019). This policy focuses on only one element of rainwater management, the water leaving a site. Language in the MoTI design standards does encourage rainwater source controls, but its focus is on ensuring the regional drainage system will not cause adverse effects on the environment and property. The MoTI design standards do not apply to all new developments within the region, only those that connect to a MoTI road or right of way.

Recommendations with regards to policies, listed in Table 7, are focused on closing the gaps in coverage of the rainwater management requirements, as well as ensuring they can be applied equitably across the region.

Table 7: Implementation Recommendations for Policies

Implementation Recommendations	
T.14	**Clarify roles and responsibilities with MoTI** regarding enforcement (i.e. development application review) of new performance targets. Ensure that any Retention Volume and Release Rate Targets meet or exceed any drainage requirements specified by the MoTI within the Supplement to TAC Geometric Design Guide – Hydraulics Chapter (BC MoTI 2019). Identify potential gaps in application of MoTI requirements to ensure new performance targets and design standards and specifications will be applied equitably within the Region.
T.15	**Create a Memorandum of Understanding (MOU) / Policy with neighbouring regional districts and municipalities** for applying rainwater management in areas where watersheds and aquifers overlap political boundaries.
T.16	**Create an information sharing agreement/ policy** with the province (MoTI, MAFF, MFLNRO, ALC, Islands Trust) and Mosaic Forest Management to facilitate information sharing in regards to relevant rainwater management data to ensure that water balance calculations can remain up to date and water quality impacts are mitigated. Monitoring is necessary for an adaptive management approach to rainwater management and collaboration between agencies collecting data will realize economic efficiencies and better data coverage. This information could include: - Runoff calculations from new subdivisions for purpose of estimating flows to nearby watercourses and potential groundwater recharge. - Agricultural withdrawals - Flows to adjacent watercourses from agricultural and managed forest lands - Seasonal aquifer fluctuation data and real-time aquifer levels - Provincial and site specific rainwater management design criteria for managing agricultural land and forests, to support regional modeling efforts

Resources to support recommendations:

- Okanagan Basin Water Board, Source Water Protection Toolkit BC
- Cowichan Watershed Board, Cowichan Basin Watershed Management Plan

6.2.2. Bylaws

Bylaws are rules created by a community or region that only apply to itself and within the RDN, Zoning Bylaws 500 and 1285 (Area F) are most applicable to rainwater management. These bylaws outline land use regulations, define specific Development Permit Area (DPA) requirements for the protection of natural areas and resources and to define the character or form of development within community centers. The RDN Zoning Bylaws are the main source of requirements concerning water and rainwater management and as such, the majority of recommendations in Table 8 relate to closing existing gaps in coverage of rainwater management requirements.

Table 8: Implementation Recommendations for Bylaws

Implementation Recommendations and Options	
T.17	**Consider creation of a Rainwater Management Bylaw** as one option for enacting strong rainwater management requirements. Strength of language, for example by replacing 'recommend' or 'consider' with words like 'require' or 'account for', is important to ensuring loopholes are minimized and the intent of the bylaw can be enforced. See precedent set by District of Metchosin, Bylaw No. 467 For the Protection and Management of Rainwater (2016)
T.18	**Incorporate elements of Better Site Design** for rainwater management into current requirements within Bylaws 500 (Schedule 3F) & 1285. Better site design (BSD) can be applied at the regional, development or site level, to protect natural drainage and ecological features by siting buildings and roads non-uniformly across the site. BSD seeks to preserve natural drainage features including, but not limited to, contours, gully's/drainageways, wetlands, streams, groundwater dependent natural resources, recharge areas, forests, tree stands and sensitive ecosystems.
T.19	Amend the Zoning Bylaws (500 & 1285) to **incorporate more rainwater management friendly landscaping requirements** within more zoning types and land uses, as the current landscaping regulations focus mainly on providing screening and buffering. Elements to incorporate could include: - Specify a minimum topsoil depth (e,g. 300 mm) - Specify that all downspouts are to be directed to pervious surfaces (as per BC Building Code) - Specify a maximum [percentage] of lot area may be covered by impervious surfaces, including building footprint. Impervious surfaces include decks, patios, driveways, sports facilities, shelters or anything that replaces natural vegetation and soils with highly compact or water-resistant coverings. - Specify minimum tree requirements (count and size) Consider expanding the elements of tree protection to apply more broadly within the RDN. Current DPAs restrict the removal of trees over 20 cm or greater at breast height for the creation of an accessory building (Marine Coast DPA, Hazard Lands DPA) and 10 cm and over for the creation of a trail (Freshwater & Fish Habitat DPA, Sensitive EcoSystems DPA). Applying tree protection more broadly would mean that traditional site layouts may need to be reconsidered, such as through application of Better Site Design, but would ensure that areas of mature trees are protected for habitat and pervious areas are provided for runoff capture and infiltration.
T.20	Consider creating **zoned areas for the designation of groundwater recharge** within the Zoning Bylaws (500 & 1285) based on water supply vulnerability assessments, and groundwater flow patterns. Define recharge areas at appropriate resolutions for site-scale application of rainwater management targets within Rainwater Management Plans required within

	DPAs and development applications. Consider including aquifer recharge zone boundaries on the RDN's Public Viewer, similar to the Aquifer Vulnerability layers. See precedents set by Comox Valley Regional District, Zoning Bylaw No. 520 which has 'Water Supply and Resource Area (WS-RA)' designation within the Rural/ Resource Zone to protect groundwater supplies and limit lot coverage to 35% and one single detached dwelling. If amending the Zoning Bylaws is not feasible, an alternative option would be to create a new DPA specific to groundwater recharge as outlined in section 6.2.3 below.

Resources to support recommendations:

- Stewardship Centre for BC, Green Bylaws Toolkit for Protecting and Enhancing the Natural Environment and Green Infrastructure 2021 (see Chapter 23: Rainwater Management Bylaws Provisions)
- District of Metchosin, Bylaw No. 467 For the Protection and Management of Rainwater (2016)
- Capital Region District, Bylaw No. 4168 Saanich Peninsula Stormwater Source Control (2017)
- Okanagan Valley Water Board, Groundwater Bylaws Toolkit
- Sustainable Technologies Evaluation Program (STEP) Ontario, Better Site Design Fact Sheet
- City of Coquitlam, Lot design requirements for Stormwater Management
- Comox Valley Regional District, Zoning Bylaw No. 520, 2019WS with dedicated zoning for groundwater recharge (see section 805)
- West Coast Law, Topsoil- Law and Policy Primer for Rainwater Management and Water Conservation (2010)
  Sunshine Coast Regional District, Zoning Bylaw 310 - RU5 Rural Watershed Protection zone

6.2.3. Development Permit Areas

Development Permit Areas (DPAs) identify locations that have special requirements for land development including the protection of natural areas from development (Eagle and Heron Nesting Trees), the protection of development from hazards (Hazard Lands), and for establishing the form and character of communities.

The DPAs are designated within the Official Community Plans (OCPs) which include their applicable areas and justification, then those guidelines and exemptions are included into zoning bylaws. There are DPAs common to the entire region (Freshwater & Fish Habitat DPA, Aquifers DPA) and those only relevant to a certain community (Bowser Village Centre DPA). Additionally, exemptions to the requirements exist within the DPA requirements.

Including rainwater management requirements within a current DPA requires an understanding of the current applicability and coverage of that DPA. Table 9 compares area coverage of the Aquifers DPA and Freshwater & Fish Habitat DPA, which both include elements of rainwater management, to illustrate the differences in applicability of these DPAs. Table 10 covers the Implementation Recommendations for DPAs. Electoral Area B does not have any DPAs identified within their OCPs as they are managed under the Islands Trust

Table 9: DPA Coverage Comparison

Electoral Area	Aquifer DPA coverage:	Freshwater and Fish Habitat DPA coverage:
A	Yellow Point Aquifer DPA and Aquifer DPA only covers coastal half and lands inside the Growth Containment Boundary and Industrial Lands.	Entire Electoral area
B	No DPAs identified in OCPs	
C	No known Aquifer DPA areas identified in OCP	Entire Electoral area
E	No known Aquifer DPA areas identified in OCP (Two neighborhood ISMPs exist which include aquifer considerations)	Entire Electoral area
F	No known Aquifer DPA areas identified in OCP	Entire Electoral area
G	Entire Electoral area	Entire Electoral area
H	Coastal half of the Electoral Area (representing mapped aquifers)	Entire Electoral area

Table 10: Implementation Recommendations for Development Permit Areas

Implementation Recommendations	
T.21	**Consider creating a Rainwater Management DPA or amending an existing DPA** Option 1: Create a Rainwater Management DPA to specify adherence to performance targets (interim or final as per watershed studies, aquifer assessments or area specific plans) and design standards & specification as per the RDN Rainwater Management Guide. Ensure all applicable development types and land areas are included. Option 2: Edit the Freshwater & Fish Habitat DPA to specify adherence to performance targets (interim or final as per watershed studies, aquifer assessments

	or area specific plans) and design standards & specification as per the RDN Rainwater Management Guide. This DPA already applies to all Electoral Areas within the RDN (see Table 9 above) and contains rainwater management criteria. Option 3: Edit the Aquifers DPA to specify adherence to performance targets (interim or final as per watershed studies, aquifer assessments or area specific plans) and design standards & specification as per the RDN Rainwater Management Guide. Expansion of the coverage of the Aquifers DPA would be required to fill the gaps highlighted in Table 9.
T.22	**Edit the Aquifers DPA** to include recharge and well-head vulnerability areas, as follows: • Expand or confirm areas of the aquifer identified as Vulnerable (to contamination) from the Vulnerability mapping assessment as covered by the Aquifers DPA. • Identify and delineate wellhead protection areas based on measured groundwater flows within aquifers accessed for municipal and community drinking water wells. Provide specific pre-treatment requirements or limitations on infiltration facilities specified within well-head protection areas and vulnerable recharge zones. • Identify aquifers vulnerable to withdrawals, either seasonally or broadly, from a water supply perspective. • Delineate groundwater recharge boundaries and associated requirements for recharge and water quality within those areas based on aquifer assessments (if zoned areas for groundwater recharge are not able to be designated within current Zoning Bylaws).
T.23	**Create a webpage for rainwater management related DPA information** to clarify requirements within the DPAs.

Resources to support recommendations:

- Comox Valley Regional District Planning Application Website (for clear communication of DPAs)
- Stewardship Centre for BC, Green Bylaws Toolkit for Protecting and Enhancing the Natural Environment and Green Infrastructure 2021 (see Chapter 23: Rainwater Management Bylaws Provisions, including DPA provisions)
- CTC Source Protection Region (Ontario), Vulnerability Analysis Methodology (see Section 6)
- Vancouver Island University, Intrinsic Vulnerability mapping Methods of Vancouver Island 2010

6.2.4. Official Community Plans

An Official Community Plan (OCP) is a long-term vision for a community, describing the objectives and policies that guide planning and land use management. If a community chooses to enact or update an OCP, all bylaws and policies within the community must be consistent with that plan.

Within the RDN there are 7 OCPs created by each of the Electoral Areas, with Area C having 2 OCPs due to its size and the island of Gabriola being covered by a separate OCP bylaw under the Islands Trust. The inclusion of rainwater management policies and objectives vary within the current OCPs with some having complete sections for rainwater management requirements and others having more general wording included within overall goals. The OCPs also include the applicable DPAs from within the Zoning Bylaw which include requirements specific to natural systems, potential hazards or development character within communities. The variance in inclusion and strength of requirements supports the need for a unified vision of rainwater management across the RDN. Table 11 outlines recommendations for consideration when updating OCPs.

Table 11: Implementation Recommendations for Official Community Plans

Implementation Recommendations	
T.24	**Create draft wording around meeting updated rainwater management requirements** for inclusion into OCPs when they are updated. Since updates to OCPs are infrequent, including this wording would provide support for, and direct, other policy tools which could be enacted on shorter time scales. Example Wording: "*All applicable developments are required to meet the rainwater management performance targets through adherence to the RDN Rainwater Management Guide design guidelines. The performance targets outlined within the RDN Rainwater Management Guide must be met, unless the development is located within an area with a completed Watershed Study providing area specific performance targets that would override those provided within the Guide.*"
T.25	Ensure that all OCPs **include language related to designing and planning for Climate Change**, referring to the RDN Rainwater Management Guide for methodology and selected Climate Change projections.

Resources to support recommendations:

- Okanagan Basin Water Board, Groundwater Bylaws Toolkit 2009 (see section 5.2 Sample Official Community Plan Policies)

6.2.5. Land Covenants

The recommendation in Table 12 relates to development permitting and the legal instruments within this process that exist to protect infrastructure and the environment, specifically restrictive land covenants. Section 219 of the Land Title Act (British Columbia) grants municipalities and regional districts the authority to register a covenant against the title of the land for the purpose of holding that owner (and successors) accountable for specified provisions. In the case of rainwater management, the Section 219 covenant is used within the RDN and other districts (Comox Valley Regional District 2014) to assign responsibility to land owners for the operations and maintenance of rainwater management systems located and installed on their lands as conditions of their development permits. Most often these covenants are applied to standard proprietary devices like Oil & Grit separators within larger developments, but their use could be expanded.

Table 12: Implementation Recommendations for Development Permitting

Implementation Recommendations	
T.26	**Expand the use of the Section 219 Covenants to register an approved final Rainwater Management Plan** on title with the property to legally ensure the ongoing operation and maintenance of the practice(s) as outlined within the plan. This covenant could be applied in all cases or just in cases where the municipality or region is dependent on the proper functioning of the rainwater management system for its services or ecological protection. The current Aquifer DPA does provide a clause for requirement of section 219 covenant registration.

Resources to support recommendations:

- Land Trust Alliance BC, Conservation Covenants: A Guide for Developers and Planning Departments
- Comox Valley Regional District, Stormwater Management Covenants and Subdivision Policy 3320-00
- District of North Vancouver, Storm Water Pump Covenant
- City of Coquitlam, Stormwater Management Policy and Design Manual (2019) (specifies requirement to provide two reports, 1st at Preliminary Planning phase and 2nd at Detailed Design phase)
- Stewardship Centre for BC, Green Bylaws Toolkit for Protecting and Enhancing the Natural Environment and Green Infrastructure 2021 (see Chapter 23: Rainwater Management Bylaws Provisions)

6.3. Strategic Planning Tools

6.3.1. Regional Coordination Programs

The long-term success of implementing a regional approach to rainwater management is dependent on ensuring that actions are taken on the RSRM and developing regional programs is one way to ensure the momentum continues over time. Regional programs could be coordinated by the RDN, or other partner organizations, and membership could be comprised of representatives from RDN, MoTI, municipalities, stewardship/environmental groups, First Nations, developers, consultants, forest managers, agricultural sector representatives, and educational institutions. Table 13 includes recommendations for three potential programs that would be most effective when implemented at a regional scale.

Table 13: Implementation Recommendations for Regional Coordination Programs

Implementation Recommendations	
T.27	**Create a Recharge Management Program** to adopt a regional approach to managing aquifers. This program would require all possible options for on-site groundwater recharge to be implemented on a development or re-development site

	(subject to aquifer vulnerability requirements) prior to exploration/allowance of off-site options. The onus would be on developers to prove that they are unable to meet the recharge requirements, such as at locations with limitations due to aquifer vulnerability, well-head protection zones, underlying soil conditions or zoning requirements. To ensure aquifer protection and mitigation of the impacts of development, cash-in-lieu would be required even when the site has been proven unable to meet the requirements, removing the financial incentive to 'do nothing' or penalizing specific lots due to site conditions. Goals of the program would be to ensure well-head protection for community drinking water sources while maintaining sustained groundwater recharge to support drinking water supplies and groundwater-dependent natural resources. Payments could be used to fund a Strategy Implementation officer, purchase land for recharge zones, fund rehabilitation efforts and/or construct regional rainwater recharge facilities in areas where targets are hard to meet. As an option, a Memorandum of Understanding, or other agreement, could be entered into with the RDN, local municipalities where there are fewer opportunities to make up recharge, and organizations (which may include RDN/NGOs/First Nations) charged with implementing recharge projects within the aquifer but outside the municipal boundary. Alternately to a cash-in-lieu program, which would operate similarly to the provincial Local Government Parkland Acquisition Fees, this program could be set up as a recharge banking program on the open market with terms set by the RDN. This may require provincial collaboration to enact a regulatory vehicle for implementation.
T.28	**Create a Rainwater Strategy Implementation Group** to oversee the implementation of the approved strategy and ensure that consistent and scientifically backed rainwater management stays integrated across departments and the region. This could be an extension of the scope of the current RDN Rainwater Working Group or a new one. The implementation group would require a dedicated Strategy Integration Officer to manage consolidating the emerging science, identifying next steps and working to gain consensus from a multi-stakeholder group.
T.29	**Regional Rainwater Facility Program** Research the feasibility of creating a regional facilities program to ensure groundwater recharge, peak flow reduction, end-of-pipe controls, and water quality systems are effective and efficiently implemented in areas where small, site-level rainwater management facilities required through the development approvals process will not meet the goals and targets defined within the watershed studies and aquifer assessments. These facilities could provide water storage to increase resilience to drought due to climate change, act as infiltration galleries or provide areas for floodwater during extreme flood events (City of Mississauga 2021). These facilities could be created in partnership with local municipalities to protect downstream infrastructure, homes and buildings.

	These facilities could also manage water in areas of dense redevelopment so that new developments are able to connect their infrastructure directly (for a fee) instead of managing it independently. Facilities could be funded through a Rainwater Utility, or an offsetting program such as those described in Section 4.4. Consider the precedent set for rainwater storage on Gabriola Island and other Gulf Islands.

Resources to support recommendations:

- TRCA, CTC Source Protection Plan Water Balance Requirements (see language around an off-setting program)
- Province of British Columbia Local Government Parkland Acquisition Fees
- Province of Alberta Wetland Policy
- Minnesota Board of Water and Soil Resources: Establishing a Wetland Bank

6.3.2. Community Partnerships

Fostering community partnerships around rainwater management will ensure that many of the monitoring and educational efforts currently accomplished in the region are sustained into the future. Community partnerships are also needed to provide feedback on the success of initiatives and to support the ambitious goals of the RSRM. Community partners will include stewardship and environmental groups, educational institutions, commerce/business partners, private landowners and local First Nations. Table 14 identifies key recommendations for partnerships within the community to achieve the goals of the RSRM.

Table 14: Implementation Recommendations for Community Partnerships

Implementation Recommendations	
T.30	**Continue to foster community partnerships** to help achieve the recommendations within this RSRM, specifically related to watershed monitoring and the work done by the RDN's Community Watershed Monitoring Network to contribute to the adaptive management approach. Consider the expansion of monitoring currently not covered by the Community Watershed Monitoring Network, including: - Base Flow Levels - Flow rate monitoring in ditches and undefined watercourses - Invertebrate/macroinvertebrate surveys - Rainfall data This expansion of monitoring and community partnership should be supported through training, funds, and recognition of the vital role that community groups can play for rainwater management within the RDN.
T.31	**Continue to leverage community partnerships around education** to build a broader understanding of the importance of resilient rainwater management and how it can impact many elements within the RDN such as, but not limited to, stream flows, aquifer recharge, drinking water supply, and water quality.

	Hold community workshops, speaker series, site tours and create reference materials to focus on effective rainwater management within the public realm (i.e., homeowners).
T.32	**Build a Low Impact Development pilot project** to highlight new technologies and demonstrate how a sustainable rainwater management system can be successfully installed. The pilot project could be built in partnership with a local business, the local municipality (public lands) or on an RDN site.

Resources to support recommendations:

- Trent Conservation Ontario, Source Protection Educational Resources

6.3.3. Development Approvals Process

The recommendations in Table 15 relate to the development approvals process and issuance of permits for new development and re-development. Development permits are issued for projects subject to meeting requirements (including the new performance targets) set out by the RDN within its by-laws and policies and developers are guided through this process by the RDN's planners.

Providing clarity in the development approvals process is challenging in a jurisdictional environment where multiple levels of government have authority in close proximity to one another. Within the RDN, ensuring the development review and approvals process is clear will ensure landowners, developers and consultants are aware of the requirements for development at any location in the RDN Electoral Areas. Clarity on applicable performance targets and design requirements will reduce ambiguity, making permit approvals a more cost-effective process. Seamlessly integrating the elements required for resilient rainwater management (plans, performance target calculations, etc.) into the approvals process for development permits (and other relevant permits) will ensure that the performance targets are being met. Feedback on the efficacy and impacts of the performance targets can be incorporated into the adaptive management process.

Table 15: Implementation Recommendations for the Development Review Process

Implementation Recommendations	
T.33	**Require the submission of a separate Rainwater Management Plan** on sites where Rainwater Management is required as per the OCP, DPAs or a specific Policy. Have the plan prepared by a qualified professional, detailing how the development will meet the performance targets, as a condition of receiving the Development Permit. Include an outline of the information to be included within a rainwater management plan submission within the recommended RDN Rainwater Management Guide. Consider requiring two submissions of the plan, the first with initial permit application for feedback and a final approved Rainwater Management Plan, which would be provided as a condition of receiving the final Development permit.
T.34	**Conduct a review of the development approvals process** for all permit types that require rainwater management within the RDN with purpose of clarifying current

	procedures, identifying and clarifying all roles and responsibilities with respect to rainwater management, and identifying potential gaps in rainwater management requirements. This review would involve engagement with the development community to identify any barriers faced that could be addressed through alterations to the current development approvals process as well as the creation of a clear set of instructions for developers and homeowners just starting the development approvals process. This information on the development approvals process could then be contained within a new document or information on rainwater management updated within an existing one and by organized by permit type if necessary.
T.35	**Create (or integrate within existing land zoning map) a map outlining rainwater management requirements**, on a site/lot basis, with the purpose of simplifying overlapping criteria and applicable policies (i.e., Aquifers and Sensitive Ecosystems DPAs). Map could be expanded to include municipal requirements aligned with RDN objectives. See Figure 8 for a conceptual representation related to communicating these spatially variable requirements.

Resources to support recommendations:

- Comox Valley Regional District, Development Handbook & Website (for clear communication of requirements, approvals process and DPA videos)
- BC Ministry of Municipal Affairs, Provincial Response to the Resolutions of the 2020 Union of British Columbia Municipalities, March 2021, (see pages 82-83)

6.3.4. Asset Management Planning

Asset Management Planning involves organizing data and information about assets in a way that supports transparent prioritization of projects based on organizational goals, community expectations, technical requirements and moving the existing level of service of the asset class (in this case rainwater) toward those goals, expectations and requirements. Within an asset management approach, project prioritization is typically based on a combination of technical and non-technical performance criteria, and risk analysis. Levels of service are determined for various levels of interaction with the asset class, from an overarching corporate mandate to the expectations of the community related to their experienced quality of life. By contrast the functional asset level of service relates to the condition, remaining life, and technical service level provided by individual assets. By defining these expectations and actual service provided, every action or project can be directly tied to maintaining or improving the level of service provided by that asset class and can be prioritized based on transparent and clearly defined goals.

In recent years, natural assets such as parks, trees, waterbodies, wetlands, springs, streams, rivers, riparian areas, forests and meadows have begun to be recognized for the benefits they provide to our communities. An understanding of the engineered infrastructure required to replace the functions these natural assets provide if they were removed is critical to determining their value. Natural asset management is recognized as a key component of a resilient rainwater management system since all natural assets require rainwater to continue providing benefits, and as such also contribute to

managing rainwater. Valuing natural assets can be challenging since not all benefits are tangible, however even a partial accounting will reveal far more rainwater management benefits than can be easily replaced with engineered systems. Robust accounting of ecological and rainwater management services should be applied and expanded to natural assets as the body of knowledge expands in this area (see Table 16).

Table 16: Implementation Recommendations for Asset Management Planning

Implementation Recommendations	
T.36	**Expand the RDN's Asset Management Plan to incorporate all rainwater management assets**, including natural assets and green infrastructure or LID facilities. Natural assets include open spaces, forests, wetlands, riparian areas, streams, rivers, lakes, urban trees, parks, green spaces and groundwater-dependent natural resources (features with surface emergence of groundwater at a spring or seepage area, sufficiently mineral rich to support a plant community or aquatic ecosystem). Valuing natural assets can be challenging. One approach would be to consider the cost of fully replacing the services with engineered infrastructure and assessing whether full replacement is even possible. Other approaches used in the region and on Vancouver Island have included the Ecological Accounting Process (EAP) for stream and riparian assets, and the Municipal Natural Asset Initiative (MNAI) methodology. A combination of approaches, or other newly developed methodologies may be most appropriate and should be evaluated.
T.37	**Identify co-benefits of Parkland Assets for Rainwater Management** Parkland is a natural asset that can provide many benefits and have many overlapping uses including a large contribution to the management of rainwater regionally. The case for acquiring new parkland can be strengthened by including the additional benefits of integrating rainwater management into the services provided by the park. In addition to protecting sensitive areas or habitats and providing public recreational amenities, parklands could include the following rainwater management elements: - Natural areas for recharge in aquifers with low recharge - Dedicated recharge facilities – underground or above - Overflow / Allowable flood zones for times of high water - Location of regional rainwater ponds that act as park features for birdwatching, and habitat

Resources to support recommendations:

- Asset Management BC – A Framework
- Primer on the Ecological Accounting Process (EAP) – A methodology for valuing the Water Balance Services provided by nature.
- Municipal Natural Assets Initiative
- Town of Gibson, Source to Sea Project for Natural Asset Management
- biodivCanada, Ecosystem Services Toolkit (See Tab 7 for valuation methods)

6.3.5. Education & Outreach

As various components of the RSRM will impact numerous departments, organizations and municipalities within the RDN, it is important that communication around the strategy and the scientifically based justifications for pursuing it are clear and well supported. A clearly understood and supported strategy will ensure its long-term success through continued integration across RDN departments, within the municipalities, between other organizations, as well as within the wider community. Any education around rainwater management must include a description of how the wider regional goals for climate resiliency and healthy ecosystems can be met through the application of performance targets applied at the development scale.

To support the implementation of the RSRM and recommended actions, education and outreach is needed both within the RDN as an organization, with partner organizations and municipalities as well as with the wider community. Table 17 details specific recommendations related to rainwater management related education within the region.

Table 17: Implementation Recommendations for Education & Outreach

Implementation Recommendations	
T.38	**Continue to develop a community understanding of the impacts of urbanization on the hydrologic cycle** and demonstrate the role of holistic rainwater management approaches, specifically Low Impact Development (LID), in mitigating negative impacts. Emphasize water as a resource necessary to support healthy ecosystems, riparian areas, and support communities with clean drinking water. Contrast traditional rainwater management and its impacts with taking a healthy watershed approach to rainwater management. Consider the creation of videos for the website and expansion of outreach programs currently being delivered by the RDN Team WaterSmart and other community partners.
T.39	**Create or expand on current school-based programs** specific to educating students about water issues and resilient rainwater management within the RDN. Continue providing school programming and water focused lesson modules for Districts 68 & 69 and consider the installation of a raingarden at a local school to facilitate further learning around rainwater management.
T.40	**Host workshops with the development community when new performance targets are implemented to provide clarity and justification** from scientific-basis, zoning and location applicability, available tools developed to clarify requirements, and emphasize importance of meeting those goals. Continue to educate the development community as performance targets are updated with emerging science, specifically around watershed health metrics trends and climate change science.

Resources to support recommendations:

- University of Boulder, Colorado, Teach Engineering Program – Stormwater Lesson
- Pacific Education Institute, Stormwater Curriculum
- List of Stewardship Groups working in the RDN – Pacific Streamkeepers
  - Departure Creek Streamkeepers
  - Qualicum Beach Streamkeepers
  - Mid Vancouver Island Habitat Enhancement Society
- List of Institutions with the RDN
  - Mt Arrowsmith Biosphere Research Institution at Vancouver Island University
  - Nanaimo & Area Land Trust

7. REFERENCES

BC MoTI. 2019. BC Supplement to TAC Geometric Design Guide 2019 3rd Edition - 1000 Hydraulics Chapter. British Columbia: BC Ministry of Transportation Infrastructure. [accessed 2021 Sep 14]. https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/highway-design-and-survey/tac/tac-2019-supplement/bctac2019-chapter-1000.pdf.

British Columbia. Land Title Act. [accessed 2021 Oct 29]. https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96250_15.

CCME. Water Quality Guidelines for the Protection of Aquatic Life. Can Counc Minist Environ. http://st-ts.ccme.ca/en/index.html?chems=all&chapters=1.

City of Coquitlam. 2019. City of Coquitlam - Stormwater Management Policy and Design Manual. [accessed 2021 Sep 7]. https://www.coquitlam.ca/DocumentCenter/View/343/Stormwater-Management-Policy-and-Design-Manual-PDF?bidId=.

City of Mississauga. 2021. Mississauga Valley Park Stormwater Management Facility - Virtual Open House. https://www.mississauga.ca/wp-content/uploads/2021/02/23164203/MV-Park-Presentation.pdf.

City of Nanaimo. 2020. Nanaimo Manual of Engineering Standards & Specifications.

Comox Valley Regional District. 2014. Stormwater Management Covenants and Subdivision - Board Approved Policy.

Dillon Consulting. 2020. City of Parksville - Rainfall Design & Climate Change Guidance. Oakville, ON: City of Parksville Report No.: 20–2568.

District of Lantzville. 2020. Lantzville Subdivision and Development Works and Services Bylaw No 175.

NHC. 2021. Watershed Performance Targets for Rainwater Management - French Creek Water Region Phase 1 - Hydrologic Modelling and Performance Targets. Nanaimo, BC: Regional District of Nanaimo Report No.: 3006259.

Toronto and Region Conservation Authority. 2012. Stormwater Management Criteria.

TRCA. 2016. Water Balance Assessments within the York Region WHPA-Q2. Toronto Region Conservation Authority CTC Source Protection Plan Water Balance Requirements. [accessed 2020 Aug 31]. https://trca.ca/app/uploads/2016/04/TRCA_WHPA-Q_Guidance_FINAL.pdf.

APPENDIX A. TECHNICAL MEMO: GAPS ANALYSIS & JURISDICTIONAL REVIEW

APPENDIX B. WORKSHOP SUMMARIES

APPENDIX C. PUBLIC ENGAGEMENT SUMMARY