OKANAGAN BASIN WATER BOARD

Needs Analysis for OBWB Funding of Stormwater Improvements

Mark Watt

7/11/2013

This report was a collaborative effort, with the assistance of Jacquie Belzile and Alan Newcomb and the generous input of Okanagan municipal staff. OBWB gratefully acknowledges the financial support of the Province of British Columbia through the Ministry of Community, Sport, and Cultural Development.

Needs Analysis for OBWB Funding of Stormwater Improvements

Executive Summary

Stormwater infrastructure is critical for protecting human and environmental health, municipal infrastructure and private property in the Okanagan Basin. This study was commissioned by the Okanagan Basin Water Board to assess current stormwater infrastructure funding needs and capacity in the region, and to gauge demand for a stormwater infrastructure grant program. The study involved a survey of utility managers and delegated staff in eight municipalities – Kelowna, West Kelowna, Vernon, Penticton, Armstrong, Osoyoos, Summerland and Lake Country – and determining the existence of Master Drainage and Liquid Waste Management Plans.

Research results describe the state of stormwater infrastructure in the Okanagan, the challenges municipalities face with regards to stormwater and related infrastructure, the current funding regime, and the widening gap between municipal stormwater needs and capacity to address them. The total value of existing stormwater assets in the Valley is estimated to be between $650 and $750 million. Existing deficiencies in stormwater infrastructure capacity are estimated at between $30 and $40 million, and expected to rise with growth in the near future to $60 million. Emerging stormwater challenges include:

- Water quality issues, such as non-point source pollution and increasing regulatory requirements for drinking water
- Insufficient storm infrastructure capacity to service existing lands uses
- Increasing damage to streams, infrastructure, and private property due to climate change and the increasing severity and frequency of storms.

Currently, the majority of funding for stormwater infrastructure comes from general revenue or municipal taxation. Utility managers described a lack of capital funding as the greatest obstacle to improving stormwater capacity in the Basin. Stormwater infrastructure is reportedly a low priority in municipal budgets, and is often allocated only after a storm has caused damage.

To address these challenges an integrated approach to stormwater management in the Basin is needed. A funding program that assists municipalities in achieving their stormwater infrastructure objectives would be welcomed by all of those surveyed. The following municipal priorities are possible uses for funding:

- Infrastructure to protect water quality
- Major storm infrastructure
- Master Drainage or Liquid Waste Management Plans
- Stormwater monitoring
- Education on stormwater management and quality.

Table of Contents

Introduction

Project Background

The Okanagan Basin Water Board (OBWB or Board) Directors commissioned this study to investigate the feasibility of expanding the Board's Sewerage Facilities Grants Program to include funding for municipal stormwater infrastructure.

Project Purpose

The project's purpose was to gather information on the state of municipal stormwater infrastructure, current municipal stormwater funding capacity and needs, and demand for a stormwater infrastructure funding program in the Okanagan Basin.

Expanding on this mandate, the study also provides background on stormwater management trends, challenges with stormwater in the region, and recommendations for what a stormwater funding program might look like.

Methodology

A survey of eight Okanagan municipalities (Kelowna, West Kelowna, Vernon, Penticton, Armstrong, Osoyoos, Summerland and Lake Country) was conducted by Mark Watt in January and February 2013, to assess local stormwater infrastructure needs and capacity. The survey questionnaire is included with summary responses in Appendix A. Survey interviews were conducted by phone or in person at the respondent's workplace.

Backgrounder on Stormwater Management

Defining Stormwater

Stormwater is the rainwater or snow melt runoff generated throughout a watershed after rain events or storms. The stormwater that does not get infiltrated into the watershed drains to its lowest point over land or via creeks, ditches and piped systems. As it moves through the watershed, this stormwater can absorb and transport many substances including minerals, fertilizers, pathogens, sediment and other contaminants.

Stormwater Management

Stormwater management is essentially the management of rainwater and runoff. As an interdisciplinary field, stormwater management can be looked at from a variety of perspectives. Engineers and technicians think of stormwater in terms of built structures and how to manage its flow, for example storm drainage ponds, catch basins and interceptors. Planners consider how the urban landscape affects stormwater, such as the impacts of impervious areas and the curbs and gutters of growing town centres. Water quality professionals view stormwater as a vehicle for transporting sediments and contaminants, and consider ways to mitigate these negative effects.

A key action of the Okanagan Sustainable Water Strategy is to "improve stormwater management with an integrated approach" (OWSC 2008). The BC Water and Waste Association also advocates for an integrated approach, and their position statement on stormwater helps to illustrate the context for stormwater management by local governments:

> Stormwater is the rainfall and snow melt runoff from developed land. It can cause floods, and erosion, and can contaminate nearby waterways, thus impacting the environment and impose limitations on beneficial uses such as irrigation, recreation and shellfish harvesting. In many watersheds in BC, stormwater management is an inter-jurisdictional and an interdisciplinary responsibility. In order to protect water quality and the public, every community should adopt an integrated watershed based approach to stormwater management which emphasizes on-site reduction and retention as best practice and recognizes the need to maintain and enhance existing infrastructure. (BCWWA 2011)

In line with this integrated perspective, this study speaks to municipal approaches as well as the wider watershed context beyond municipal influence.

A Brief History of Stormwater Management in the Okanagan

Historically, stormwater infrastructure involved communities building conveyance systems to move runoff away from public and private property as quickly as possible to prevent damage. These engineered systems used curbs and gutters to rapidly channel water to catch basins for the most basic treatment, or moved water via ditch or culvert systems directly to creek discharges.

In recent decades, the idea of end-of-pipe control and treatment has been replaced by a better understanding of how land use influences stormwater, and a shift in management towards:

- upland best management practices and infiltration
- source control for pollutants, and
- stewardship of water resources.

This shift led to a resurgence of stormwater innovation in the late 1990s and early 2000s, with new stormwater system designs including 'green infrastructure' components such as: infiltration galleries, drainage swales, man-made wetlands to improve water quality, and alternative cross-sections for roads that include innovative drainage components and more vegetation.

Over the past decade planning for new development has also evolved, with increasing opportunities to integrate storm-related green infrastructure. Developers have proven they can provide stormwater design alternatives, ones that often provide higher value than traditional storm infrastructure. For example, many stormwater detention ponds in new developments are community assets, used as parkland and wildlife habitat.

More information on stormwater innovation has also become available. The engineering community has provided planning tools for assessing alternative design scenarios (Stephens personal communication 2010) and the Province has released a guidebook for stormwater planning (MOE 2010). These have added momentum to the shift towards integrated stormwater planning and infrastructure design.

Research Findings

The survey findings provide insights into the:

- state of current stormwater infrastructure in the Okanagan
- stormwater management challenges facing municipalities
- current funding regime
- widening gap between municipal stormwater needs and the funding capacity to address them.

The State of Stormwater Infrastructure

The following table gives an overview of the current state of stormwater infrastructure in the eight municipalities surveyed, based on their existing plans. This estimate is likely conservative.

Table 1. State of Stormwater Infrastructure in Okanagan Municipalities

Municipality	Drainage Issues	Storm Water Quality Works	Drainage Master Plan	Monitor Water Quality	Bylaw(s)	Asset Value (millions)	Current Funding Deficiency (millions)
Kelowna	✓	✓	2010	**Yes**	Storm and Subdivision	$416 M	$8.1 M
Vernon	✓	✓	2012	No	Subdivision	$121 M	$13 M
West Kelowna	✓		2011	No	Subdivision	$1 M	$3 M
Penticton	✓	✓	2007	No	Irrigation, Sewer & Water; Subdivision	$8.4 M	$9.7 M
Armstrong	✓		None	No	Subdivision	-	-
Osoyoos	✓		None	No	Subdivision	-	-
Summerland	✓		2009	No	Subdivision	-	$12.3
Lake Country	✓	✓	2013-14	No	Subdivision	$1 - 2 M	-
Total	All	4 of 8	5 of 8	Only 1	All SD, 1 SW	>$700 M	>$45 M

Note: A dash (-) indicates that no data was reported at the time of the interview.

Stormwater Assets and Valuation

Stormwater infrastructure accounts for approximately 5% to 10% of total municipal infrastructure assets. The total value of stormwater infrastructure in the Valley is estimated to be between $650 million and $750 million[1].

The value of stormwater infrastructure assets in the Okanagan is estimated to be between $650 and $750 million.

[1] This does not include stormwater infrastructure in unincorporated areas. The total stormwater infrastructure value and deficit would higher if they were included. Subdivision drainage and major road infrastructure in unincorporated areas fall under Provincial jurisdiction.

As recognized by the 2012 Canadian Infrastructure Report Card, the ability of municipalities to accurately value their infrastructure assets in a survey such as this one may be limited by "finite financial resources" and inadequate staff and time to perform a "more thorough, real-time evaluation of the state and performance of their physical infrastructure" (CCA, CPWA, CSCE, FCM 2012). Therefore these numbers should be viewed as estimates based on the best knowledge of those interviewed and available reports.

Condition and Type of Infrastructure

Of those municipalities that have done an assessment of their stormwater infrastructure, the majority rate their stormwater assets as lower or in similar condition to their other infrastructure in terms of age and performance.

Drainage managers indicate that there is not enough infrastructure in place to accommodate land uses and that existing infrastructure is either undersized or needs replacement. Each municipality reported having some degree of stormwater infrastructure deficiency, depending on their built up infrastructure or level of urbanization. Mostly these are volume or capacity deficiencies and are outlined as immediate needs in municipal Master Drainage or Liquid Waste Management Plans.

Interview responses also reveal a lack of water quality infrastructure components in existing systems, with only half of respondents stating they have stormwater quality works (see Table 1). Many larger municipalities in the Okanagan and other parts of BC have infrastructure design criteria that include water quality components to ensure system effectiveness. For instance, these systems often employ sediment and oil-water separators at critical locations. Very few of the smaller municipalities in the Okanagan have separators or detention facilities.

Traditionally, urbanized stormwater systems drain to catch basins, which outlet to ditches or streams via culvert infrastructure. The smaller municipalities typically have at least one urban centre with some curb, gutter and catch basin infrastructure in commercial areas and new subdivisions. In these systems new infrastructure is only installed as part of development requirements or if there is a major storm that causes property damage. In contrast, larger systems are more sophisticated and may include thousands of catch basins and are part of Master Drainage or Liquid Waste Management Plans. At all scales, the majority of stormwater deficiencies tend to be in older residential areas. Older subdivisions often have restricted ditch systems due to historical encroachment or inadequate maintenance except after a storm event. New developments are not limited in the same way in terms of capacity and water quality improvement as they are designed to meet current criteria in stormwater or subdivision bylaws.

In the late 1990s some municipalities successfully obtained external funds to pilot innovative stormwater solutions. As a result, many kilometers of streams were restored, water quality improvement devices were installed, and monitoring programs for recording stream health improvement and water quality data were expanded (COK personal communication 2013). Developers also began integrating new green infrastructure components (i.e. swales, detention ponds, etc.) into their stormwater designs. Within some municipalities these changes met with challenges from residents regarding natural-looking aesthetics, and their new monitoring and maintenance responsibilities. In recent years, reduced municipal infrastructure budgets have limited opportunities for successful implementation of innovative designs unless a clear business case has been documented.

Maintenance and Monitoring

Storm infrastructure requires routine maintenance and monitoring to maintain effectiveness. Most Okanagan communities have annual stormwater infrastructure maintenance programs, though the range and type of maintenance work varies. For instance, in smaller systems maintenance may occur annually or bi-annually, addressing catch basins and ditches. At a minimum, this may involve cleaning or mowing a ditch when it becomes obstructed.

Utility managers reported that little or no stormwater monitoring is occurring in Okanagan municipalities.

Monitoring infrastructure is important because it provides data that is critical to stormwater management and infrastructure planning. Stormwater flows are modelled to predict or measure their magnitude and classed according to their probability of occurring, ranging from minor storms (a five year storm) to a major storm (up to a 100 year storm). Local data is needed to calibrate these hydrologic models in order to design appropriate infrastructure for storm response. The same is true for water quality data. Without critical measurement of storm events the loading of contaminants or sediments on streams and lakes is uncertain.

Utility managers reported that little or no stormwater monitoring is occurring, with the exception of Kelowna, which monitors both water quality and flow. A few other municipalities have monitoring infrastructure to track rainfall.

Local Regulatory Context

Urbanized areas in the Okanagan Basin represent only 1% to 2% of the entire watershed, yet have a significant impact on stormwater management as runoff is not absorbed by these impervious areas and is shed faster from them. 'First flush' flows from infrastructure during storm events combine with flows from the wider watershed which can erode creeks and ditches, collecting silt and contaminants along the way and then depositing them in streams and lakes.

In the last 10 to 20 years communities have been encouraged or required to minimize stormwater flow effects and to treat or separate sediments or contaminants (such as oils) from rainwater. Municipal bylaws have been developed that require minor and major flow diversions and treatment. These form part of the best management requirements for municipal infrastructure development (ie. Master Municipal Contract Documents and Specifications or MMCDS), or are governed by municipal policy in Official Community Plans, Master Drainage Plans, Subdivision By-laws or other stormwater policy and design manuals.

Of the municipalities surveyed, only Kelowna has a storm drainage bylaw (their *Sanitary-Storm Bylaw* (1993)). All other jurisdictions surveyed have provisions in their subdivision bylaws that address stormwater. All respondents stated that there is little or no enforcement associated with violations of these bylaws, with the exception of requirements at time of development.

Planning for stormwater is also at various stages, as shown in Table 1. Managers stated that having their Master Drainage Plans or Liquid Waste Management Plans current was important.

The Problem: Emerging Challenges in Okanagan Stormwater Management

Maintaining the reliability and capability of municipal stormwater infrastructure is a growing problem for Okanagan municipalities. As shown in Table 1, all eight municipalities have drainage issues and funding deficiencies related to stormwater. Survey respondents also described several emerging concerns over water quality, stream and aquatic life protection, and climate change.

Water Quality

Water quality is an ongoing concern among municipalities, particularly in cases where they may need to bring in drinking water filtration if source water quality is inadequate. Or, in cases where reduced water quality may impact beach water quality and other recreational uses, negatively affecting tourism.

Non-point Source Pollution (NPSP)

In the Okanagan valley, stormwater drains into Okanagan Lake and is considered to be a contributing source of pollution to the lake system. Stormwater carries a wide variety of pollutants such as sand, silt, dissolved metals, pesticides, nutrients and fecal matter (EBA 2011). Such *non-point source pollution* (NPSP) – the pollution transported by rainwater runoff throughout the system – is a significant part of the problem.

Non-point source pollution has surpassed point-source pollution as the primary source of nutrients to the Basin's waters.

Currently, non-point sources are the primary inputs of nutrients to the waters of the Basin (Insight Consulting 2010). For example, prior to 1990, wastewater treatment plants (a point source of pollution) contributed over 90% of the Lake's phosphorous load (CLPA Consulting Ltd. 2009). In 2009 the Okanagan Basin Water Management Plan Update estimated that 80% of the phosphorous load to Okanagan Lake is from non-point source pollution (CLPA 2009). The update also suggested that Okanagan Lake has reached its assimilative capacity for phosphorous and is now dependent on effective management of stormwater and septic systems to prevent further loading (CLPA 2009).

Managing non-point source pollution from stormwater generated across a watershed is difficult and requires an understanding of:

- how land use impacts water quality
- pollution prevention
- water quality monitoring and education, and
- stormwater infrastructure that improves water quality (Watt 1997)
- pollutant loading on a valley-wide or watershed basis

To date the optimal mix of structural and non-structural solutions for NPSP in the Okanagan have not been determined.

Protection of Drinking Water Sources

The primary concern for municipalities is how stormwater affects the quality of their drinking water sources. Since 2010 Interior Health (IH) has re-emphasised expectation of drinking water filtration in the Conditions and Operating permits for purveyors who supply domestic water. This presents a significant challenge to municipalities as the cost to install filtration for Kelowna Joint Water Purveyors and Greater Vernon alone is estimated to be over $400 million. According to Kelowna's Drinking Water Source Protection Study, IH can allow a water utility to defer installation of water filtration infrastructure if the utility meets several conditions, including:

- consistently meeting water quality standards
- implementing a plan to protect water sources, and
- having a contingency plan to construct filtration infrastructure if required. (EBA 2011)

In addition, drinking water source protection is now a requirement as part of a purveyor's drinking water permit. The main sources of contamination in Okanagan creeks that could lead to reduced water quality at domestic intakes include:

- protozoan parasites, e.g. *Cryptosporidium* and *Giardia*
- pathogenic bacteria
- stormwater
- agricultural runoff
- industrial runoff
- sediment loadings triggered by human activities such as mining, salvage forestry, all-terrain vehicle (ATV) and off-road motorsports, and natural events such as wildfires. (EBA 2011)

Okanagan lakes are a main source for many water purveyors, with 32% of Okanagan drinking water coming from Okanagan or Kalamalka-Wood Lakes, and Mission Creek (Okanagan Water Supply & Demand Study, 2010). This surface water quality is normally excellent; however stormwater can have significant negative impacts on source water quality. Stormwater presents two main threats: 1) short-lived, high contamination concentration events, and 2) exceptional contamination events, such as accidental chemical spills, that may be transported by stormwater infrastructure.

Under good weather conditions, a base load of very low concentration contaminants enters the lakes via creeks. These are diluted first by creek water, then by lake water, so that the contamination that reaches intakes is low and usually meets health criteria. Storms speed up this process and can create high contamination concentrations for short periods – a potential drinking water threat. These events are often associated with times of high creek flow when contaminant loadings – which depend on flow rate and contaminant concentration – are high.

An optimal stormwater system with both natural and manmade infrastructure is less likely to have source water quality issues (IH personal communication 2011).

Land Use and the Damaging Impacts of Storm Events

Another challenge for municipalities is the damaging impacts of storms on streams, infrastructure and private property.

Land Use

Land use largely determines how stormwater moves and the level of water contamination it causes. The amount of sediments and other "washed off" contaminants carried to water bodies is relative to the land use that the stormwater passes through or over (Schuler 1997). Land uses such as agriculture, industry, transportation, forestry and urbanization can all impact water quality. The observed sediment loads in local creeks in 1997 and more recently in 2012 point to serious upper watershed problems predicated by a mix of land use and natural processes (COK personal communication 1997; Dobson personal communication 2013).

Existing shortcomings in the drainage system mean there is not enough infrastructure in place to handle stormwater for current land uses, yet land use distribution makes it difficult to locate new infrastructure to address these deficiencies. Larger municipalities have problems obtaining land for new infrastructure, especially in areas that are being revitalized or having their stormwater systems updated in developed areas (COK personal communication 2013). In some places there are land uses that cannot be compromised, such as the Agricultural Land Reserve (ALR) or creek setbacks protected under provincial regulations.

Land use changes and encroachment have reduced the ability of streams and soils to accommodate and naturally treat stormwater in many urban areas. For example, historical urban areas and town centers are highly impervious, creating more rapid run off with fewer opportunities to slow it, spread it, or infiltrate it. Land use changes combined with inadequate stormwater infrastructure result in downstream sediment transport and other stream impacts.

Stream Impacts

Stormwater and stormwater management have significant impacts on streams, affecting their hydrology, morphology, water quality and ecology, as summarized in Table 2. Kelowna's Environmental Review of Drainage found stormwater impacts to streams to be proportional to the amount of impervious area (Kerr, Wood, and Liedel Ltd 1998). Some urban areas are over 25% impervious, constraining efforts to modify or mitigate stormwater flow and improve water quality (Gow and Watt 1997). As stormwater is erosive, it washes away aquatic habitat degrading local ecosystems.

Streams, creeks and ditches are important stormwater infrastructure and need as much attention and restoration as the traditional piped network. Providing additional stormwater flow capacity will be difficult and expensive unless there is some restoration of natural downstream capacity by widening and deepening streams.

Stormwater impacts to creeks and receiving water bodies can be monitored and, in some cases, degradation can be reversed with long term planning, non-point source pollution control, thoughtful land use policies, and targeted investments in infrastructure.

Infrastructure and Private Property Impacts

Impervious surfaces do not allow water to infiltrate, forcing stormwater to journey over land and increasing the potential for flooding or water damage to nearby properties. Engineered options for detention or retention may not work under saturated conditions if surrounding areas have limited infiltration capacity and mimic impervious conditions. Stormwater design options to overcome these limitations include additional and emergency bypass overland conveyance of surface waters or costly enlargement of piped systems, detention facilities, and vaults.

As the severity and frequency of storms has increased, water damage has become the leading cause of damage to Canadian homes, resulting in approximately $1.3 billion a year in insured losses (Insurance Board of Canada 2012)

Table 2. Summary of Stormwater and Stormwater Management Impacts Associated with Urban Streams (adapted from Schueler 1995)

Changes in stream hydrology	Changes in stream morphology
• Increased magnitude or frequency of floods • Increased frequency of erosive bankfull and sub-bankfull floods • Reduced groundwater recharge • Higher flow velocity during storm events	• Channel widening and deepening • Streambank erosion • Channel scour • Shifting bars of coarse sediment • Embedding of stream substrate: hard structures that cause sediment and gravel to accumulate • Loss of pool/riffle structure • Stream enclosure or increased direction of water to constructed channels (e.g. concrete channels, culverts, etc.)
Changes in stream water quality	**Changes in stream ecology**
• Sediment pulse during construction • Nutrient loads promote stream and lake algal growth • Bacterial contamination during dry and wet weather • Higher loads of organic matter • Higher concentrations of metals, hydrocarbons, and priority pollutants • Stream warming • Trash and debris jams	• Shift from external and sediment production to internal production • Reduced diversity of aquatic insects, indicating a decrease in stream health • Reduced diversity of fish • Creation of barriers to fish migration • Degradation of wetlands, riparian zones, and springs • Decline in amphibian populations

Climate Change

With the climate changing, larger storm events are occurring more frequently, increasing stress on both the piped networks and the natural environment.

Whether climate change brings stronger storms or prolonged dry periods[2], it will further compromise an Okanagan utility manager's ability to deal with the next storm. Some experts anticipate that high-flow events will become more frequent and severe, increasing stormwater pollution (WEF 2013). In the Okanagan summer's inverse conditions result in extended dry periods between rainfalls. These conditions increase the pressure on water treatment facilities during first flush events since they increase concentration of contaminants[3].

Climate change impacts to stormwater can be significant to a micro-climate or an entire watershed (Watt 1997). For instance, climatic changes in upland headwater streams can have a major effect on the downstream urban portion of the watershed. Small violent storms can dump significant rainfall in the upper watershed, consequently overflowing downstream capacity in the lower watershed or urban area, eroding away riparian and in-stream habitat, and contributing to water quality degradation.

Those interviewed recognized that ongoing planning is necessary to align growth and future works with the changing climate and frequency of storms. A liability issue may develop for municipalities that assess a stormwater risk and plan infrastructure developments to address it, then fail to fund or build them. With the onset of more frequent storms even those plans that are realized may fail. Indeed stormwater infrastructure is the only infrastructure that is built to fail, as storm intensity will inevitably outstrip its capacity at some point in its lifetime. Stormwater infrastructure can be undersized and at best has the capacity to manage a 2, 5 or 10 year storm event and direct very large storm flows overland where possible. Limiting impervious surfaces and mimicking natural conditions are often better than end-of-pipe solutions (Watt & Gow 1997).

[2] This increases the potential for hydrophobic conditions which compound runoff volumes and erosion.
[3] Data gathered during these events show elevated levels of contamination (COK 2009).

Municipal Stormwater Funding Now and in the Future

Current Funding Regimes

Funding for stormwater management in the Okanagan comes from municipal general revenue or taxation – the primary funding method used for stormwater infrastructure capital, operations and maintenance.

In cases where there are severe storm impacts, municipalities may be eligible for Provincial Emergency Program (PEP) funding to repair storm-related damage. PEP funds cannot be used to mitigate upstream infrastructure problems or land use. Generally, this funding opportunity is available when the liability and risk from larger watershed impacts is associated with land use under provincial jurisdiction. For example, creek works or dike upgrades like those completed for Mission, Mill, Penticton, Trepanier, Vernon and other creeks. Or in cases were the ditches, roads, and landslide repairs in crown lands or regional areas are a provincial responsibility (Ministry of Transportation and Ministry of Forests, Lands and Parks).

Outside of municipal boundaries, the Ministry of Transportation and Highways funds all stormwater related infrastructure in regional districts, either through highway expansion or through subdivision approvals in rural areas. Stormwater management in the upper watershed on crown land is controlled by crown interests and is the responsibility of the Province.

Stormwater Equity: Charging by impervious area

In an effort to increase equity among stormwater users, Halifax Water recently proposed a new stormwater rate system whereby customers pay an annual stormwater charge based on their site's impervious area.

Residential customers (up to 4 units) will pay $47.91 (increasing to $52.22 in 2014) based on an average impervious area of 224m^2, while all other customers will pay based on the actual impervious area of their sites. (Halifax Water 2013)

In other jurisdictions, large urban centers and a few municipalities have formed Stormwater Utilities[4] similar to a Water or Sewer Utility, whereby service is paid for in proportion to use of infrastructure. This user-pay or utility basis is not currently used in the Okanagan. One municipality is exploring formation of a stormwater utility to assure consistent funding for infrastructure replacement. Another municipality considered a stormwater utility, but was unable to gain the support necessary for implementation. Most respondents expressed little interest in creating a stormwater utility. However, all respondents wanted some form of consistent funding for stormwater infrastructure to be made available.

[4] In the context of this survey, *stormwater utility* refers to stormwater utilities owned and operated by municipalities.

Existing Municipal Funding Capacity

The greatest obstacle to improving stormwater capacity in the Basin is insufficient capital funding. Every utility manager interviewed agreed that funding for stormwater infrastructure is lacking and that funding availability is generally reactive, meaning it becomes available only after a storm event when action must be taken.

Many of the municipalities surveyed have been actively planning to improve stormwater infrastructure, and there are some good Master Drainage Plans and Liquid Waste Management Plans that provide capital estimates for new infrastructure. The problem lies in raising funds from municipal general revenues for these installations or upgrades.

Acquiring funds for stormwater infrastructure is difficult when competing with other municipal wants and needs, as it is considered a low budget priority among the municipalities surveyed. Managers report that annual infrastructure capital is difficult to obtain or non-existent due to other higher priority infrastructure needs (such as drinking water infrastructure, roads, policing or fire protection) taking precedence. Only one municipality – West Kelowna – is investing substantially in stormwater over the next few years, with capital upgrades and new systems where none previously existed. While some municipalities reported having annual capital funds to finance their existing plans, most obtain capital funds from operational budgets or financing when upgrades are needed after a storm event. In contrast to capital funding, maintenance or operational funding is easier to acquire for stormwater systems. Some local municipalities are assessing the true costs of their stormwater management and have put in place asset management systems detailing the operational costs of outdated systems and the potential costs for new infrastructure.

Need for Stormwater Funding

Municipalities are required by provincial regulation to report annually on their infrastructure value and asset depreciation to the Public Sector Accounting Board (PSAB). Okanagan municipalities are at various stages in this reporting process, though all have provided gross estimates, totalling over $650 million for stormwater infrastructure. Condition assessments on a large portion of this infrastructure have yet to be completed, so estimates have been based primarily on age, type of material, inspections, observations and anecdotal information.

The Annual Allowable Lifecycle Cost (AALC) is a measure used to approximate the replacement value and amount of annual investment required to keep assets functioning until replacement. AALC is calculated based on an asset's age and estimates of its remaining functional life. To date only a few Okanagan municipalities have completed AALC assessments. These estimates combined with deficiencies identified in this survey are valued at over $40 million.

The gap between existing demand for stormwater infrastructure funds and current funding capacity is represented by existing stormwater deficiencies, which respondents estimate to be 5% to 10% of the total value of their municipal infrastructure[5]. The gross estimate of existing stormwater deficiencies

[5] Total infrastructure including water infrastructure, transportation infrastructure and other built municipal assets.

identified by staff and in updated drainage plans is between $30 million to $40 million. This breaks down by municipality as follows: $13 million for Vernon, $8 million for Kelowna, $12.3 million for Summerland, and $9.7 million for Penticton. These estimates do not include the cost of new land required to locate infrastructure. Nor do they include infrastructure costs related to future growth in the Development Cost Charge (DCC) areas mandated in their Official Community Plans.

Managers of large municipalities anticipate a very significant future deficit for storm drainage as a result of growth – close to $60 million. Growth in already built up areas and future developments will require greater stormwater infrastructure investment than can be supported by current funding methods.

The widening gap between stormwater infrastructure needs and funding capacity means that with each passing year municipalities are losing the ability to fund priorities in drainage plans and correct deficiencies where property damage is imminent or water quality is compromised.

The risk of failing or inadequate infrastructure is becoming increasingly evident after each storm. In the future, existing stormwater infrastructure will not be able to provide the necessary service to protect property, infrastructure or the environment. Municipalities are faced with slowly deteriorating infrastructure for all their utilities. However, deficiencies in stormwater infrastructure are seemingly higher than in other forms of infrastructure, possibly due to the apparently benign nature of stormwater in BC's dry interior. Until a storm actually causes damage, municipalities appear reluctant to invest in stormwater infrastructure – a reactive approach which does not allow for the integrated stormwater management needed to deal with underlying problems.

A Prescription for Change

Okanagan communities are working towards solutions to their stormwater problems. Many have programs that address both stormwater quality and volume[6]. As seen in earlier sections, the stormwater challenges facing municipalities are great, yet their ability to raise funds to meet these challenges is diminishing.

What is lacking?

Survey results show that Okanagan municipalities lack a consistent approach to funding stormwater infrastructure and are in a constant reactive state for stormwater infrastructure and private property repair. Funding of stormwater infrastructure condition assessment, replacement and upgrade often falls to the bottom of the list, even though the impacts of its failure can be severe. This may be because municipalities are often uncertain whether to classify 'green' types of infrastructure as a utility 'asset' to be managed, as opposed to a park, pond, stream, etc., there is less certainty over when a failure event may occur, as high flows are only experienced some of the time with large intervals between, and there is a perception that the risk of failure is less severe than that of water and wastewater assets.

Municipalities also lack adequate bylaws, enforcement and education about stormwater. On the environmental side, past development and existing land use have compromised the ability of natural systems in the region to deal with hydrological and water quality impacts resulting from storms.

What is needed?

Unless there is a shift in thinking there will always be a stormwater funding capacity issue. Making the cultural shift to viewing stormwater infrastructure as an important asset is critical to affecting change. Stormwater is not just a drainage or flood management issue, but is also a resource for fish (and other aquatic species), groundwater recharge, water supply and recreation.

A consistent approach to dealing with stormwater infrastructure deficiencies and maintaining assets is also required to keep pace with the changing hydrological regime. Such an approach requires adequate levels of funds for stormwater infrastructure that can be applied consistently over time.

Recommendations for Board Consideration

With its watershed perspective OBWB is uniquely positioned to assist municipalities in responding to emerging challenges in stormwater management in the Basin. The following recommendations illustrate ways the Board can help municipalities to effect positive change on stormwater issues:

- ***Establish a stormwater funding program –*** The program could focus on funding municipal priority projects for stormwater, with funding conditions that favor projects showing direct improvements to water quality, active efforts to minimize impacts to fish and fish habitat, or other environmental factors, and innovative 'green infrastructure' design.

---

[6] Projects that address stormwater volumes have indirect water quality benefits because they reduce erosion and sediment loads on creeks and water bodies.

Those municipalities with up to date Master Drainage Plans already have plans and cost estimates for required works. These plans include phase in strategies based on risk assessments, land use considerations, and engineered solutions designed to maximize system performance.

Based on interview responses, municipal funding priorities include:

1. *Infrastructure to protect water quality*

Protecting water quality was a top priority among municipalities interviewed. Water quality protection is important for health, environmental, and economic reasons. Water purveyors want to protect drinking water source quality to ensure public safety and defer the installation of costly filtration infrastructure. As mentioned earlier, the cost to install filtration infrastructure for large purveyors is over $400 million, whereas the cost of source water protection is possibly orders of magnitude less and is distributed beyond municipal boundaries.

Funded projects could address central themes for source water protection: installing water quality infrastructure components, planning at the local and watershed level, enforcement of regulations and bylaws, monitoring of water quality and education. For instance, developing and implementing a Drinking Water Source Protection Plan that addresses stormwater can be a major component in obtaining a filtration deferral.

2. *Major storm infrastructure*

Major storm infrastructure was another high priority for those interviewed. Most managers stated that dealing with private property and infrastructure damage from shorter duration, higher intensity storms have become a routine priority. Funding for infrastructure to help minimize the impacts of major storms is needed to protect stream health and to prevent costly damage to private property and infrastructure.

Another consideration is funding for preventative measures or climate change adaptations that can help municipalities prepare for increasingly intense rainfall. Funding could support actions such as:

- reducing impervious surfaces at time of re-development
- limiting impervious surface for new development
- maintaining existing vegetation and restoring barren areas
- limiting or restricting development in critical infiltration areas and beside streams
- restoring stream width where possible and establishing floodplain areas.

New infrastructure that receives rainwater should also be designed to minimize contaminants to creeks and the lake system.

3. Master Drainage Plans or Liquid Waste Management Plans

Planning is an essential part of stormwater management and funding could be used to support Master Drainage Plan or Liquid Waste Management Plan development or updating. This will help municipalities to better define their stormwater needs and methods for addressing them.

4. Monitoring

As shown in the Research Findings, there is a lack of storm and water quality monitoring at the municipal level. To effectively change urban stormwater management plans to address increased climate variability requires local assessments and monitoring of climatic conditions within the watershed. Funding is required to install storm and water quality monitoring equipment. Some degree of basin-wide data sharing or coordination may also be beneficial.

Many watersheds have micro-climates that reflect different water balances. Detailed modeling and historical records can provide baseline data for running climate change scenarios. Historical climate data (including rainfall records) is available from Environment Canada, and the Water Survey of Canada has stream flow data for major streams. Integrating this information with new information from monitoring of local conditions would allow for better planning and management of stormwater.

5. Education on stormwater management and quality

The need for education programming on stormwater was echoed by all of the municipalities surveyed. Urban stormwater education and watershed education were normal activities for water purveyors and communities in the 1990s and early 2000s. In the past communities relied on the Provincial government to provide funding for education. Since this pool of funding has dried up, a new watershed-based funding approach is needed. Previous programs, such as Clean Water NPSP (2002) and Living Greener (2001), were successful, but short-lived.

When provincial funding ran out the students and watershed coordinators were let go, removing the human face from programs as they shifted to other media. Eventually, local funding was reallocated and programs were closed down. These programs need updating and re-deployment. The very low budget priority given for stormwater infrastructure reinforces the need for more and better education.

New education programs are needed to ensure residents and elected officials understand how stormwater works and the implications of polluting Okanagan Lake or other water supplies. This requires integrating knowledge of planning, ecology, and engineering. Stormwater-related pollution has lasting effects on the economy and viability of communities in the Basin that need to be publicised.

- ***Raise awareness of stormwater and watershed issues through a valley-wide education program –*** Education programming at the watershed level is also needed to increase public understanding of stormwater, transfer knowledge, and build capacity across the Basin. Such a program could highlight how stormwater is integrated across the Basin and how improved stormwater management can help protect streams, drinking water and local industries (like tourism and agriculture). The education program could draw on new mapping techniques to illustrate land use change, aquatic resources, agricultural areas, and drainage zones.

Training engineers on green stormwater solutions could also be useful – or connecting them with existing information. Engineers have specific training with pipes, but can be hesitant to implement less conventional solutions, as they do not necessarily have expertise with this. There is a perception that maintenance requirements with green infrastructure can be high.

Financial incentives are a key tool for changing behaviour. In addition to basic educational programming, it would be beneficial to lay out financial risks and costs (current and future), environmental costs, and public health concerns.

- ***Develop a valley-wide strategy for managing non-point source pollution –*** As storm drainage systems expand and watershed activity increases due to community growth, stormwater loading of phosphorous and other contaminants from the entire watershed could be several times greater than currently understood, warranting the development of specific control strategies (CLPA 2009). This could include coordinated bylaws for rainfall capture, run off control, and flood risk management. A basin-wide strategy for managing contamination from stormwater could be created to raise awareness of this issue and help address non-point source pollution.
- ***Encourage municipalities to:***
    - ***Use innovative stormwater infrastructure*** – Innovative solutions for stormwater infrastructure can help to mitigate the effects of storms and improve water quality protection and should be integrated into municipal planning approaches. Pilot or full scale implementation of hydraulic and water quality infrastructure innovations are one way to demonstrate Okanagan based solutions.
    - ***Develop stormwater response plans*** – Stormwater response plans enable municipalities to better deal with the elevated contaminants in stormwater from first flush events and accidental spills. This recommendation aims to mitigate and reduce the risk of future events impacting drinking water sources, the aquatic environment, and water users.
    - ***Determine and implement a consistent approach to how they fund infrastructure*** – In addition to providing funding, the Board can encourage municipalities to develop consistent funding approaches.
    - ***Investigate and build a case for stormwater utility creation*** – One alternative for sustainable funding is the creation of stormwater utilities, a prospect that the Board could assist municipalities in exploring.

- ***Emphasize the importance of provincial responsibility –*** As noted in drinking water source protection studies, the majority of the Okanagan watershed lies outside of municipal boundaries and requires provincial oversight (EBA 2011). As an organization representing municipal interests in the watershed, OBWB can articulate this larger provincial responsibility in its interactions and outreach activities.

Ideas for Moving from Sanitary to Stormwater Funding

One way for the OBWB to provide funding for stormwater initiatives is by amending its wastewater treatment infrastructure funding program to include a stormwater infrastructure funding program.

The existing Sewerage Facilities Grant Program was established in 1975, by recommendation of the Okanagan Basin Study[7]. The study found sewage pollution from municipal treatment plant outfalls and leaking sewer systems was harming lake water quality. The purpose of the grant program was to subsidize upgrades of sewer treatment plants and community sewer collection systems to reduce nutrient inputs to streams and lakes.

Over time these upgrades have contributed to a dramatic decline in point-source pollution in the Basin, diminishing the need for sanitary funding. Non-point source pollution and stormwater management have emerged as new concerns, and present an avenue to redirect funds towards the same ends – pollution reduction and protection of the lake system.

Currently, the OBWB sanitary funding program obtains funding as outlined in its letters patent by utilizing a portion of the total annual OBWB tax assessment, which amounts to approximately $2 million per year. As the demand for sanitary funding declines, a stormwater funding program could be initiated to replace it or phased-in as debt gets retired. Or a stormwater program could be started separately with an additional assessment.

The provision of funding opportunities for stormwater at the local level will help raise awareness of the importance of stormwater at the political level, show OBWB leadership and encourage stewardship of the valley's water resources.

---

[7] "That a program of pollution control for tributary streams be established by instituting strict regulations on feedlot and septic tank developments, removing all direct discharges to streams of industrial and municipal wastes causing pollution and protecting streams with appropriate green strips in areas where logging or cultivation is practiced or where there are concentrations of cattle, horses, or livestock." And "That a waste management program aimed at reducing phosphorus loadings to control rooted aquatic plant and algae growth in the main valley lakes be undertaken immediately by the regional authority [i.e., the OBWB]."

Appendix A: Stormwater Survey & Summary of Municipal Responses

The following questions are for staff working in planning and/or engineering services for Okanagan local governments.

1. Do you think that Stormwater/Rainwater drainage management is an issue for your area?
   a. For clarification can you state why?
   All said yes.

2. Are you more concerned about drainage impacts to private property, public infrastructure (roads/pathways) or other factors, such as pollution (sediment and contaminants)?
   Responses were varied with some concerned about all however private property and infrastructure damage seemed more of a concern.

3. What would you classify as priority stormwater projects for your jurisdiction? Please rate 1 to 4 with #1 being highest.
   a. Water Quality (source protection for drinking water)
   b. Flood Flow Diversion
   c. Drainage Infrastructure for Minor storms
   d. Drainage Infrastructure for Major Storms.

Municipality	Water quality	Flood flow	Minor Storm	Major Storm
Kelowna	2	4	3	1
Vernon	1	4	3	2
West Kelowna	4	3	2	1
Penticton	3	1	4	2
Osoyoos	2	3	4	1
Armstrong	2	4	1	3
Lake country	1	4	3	2
Summerland	2	4	1	3

4. What are your greatest obstacles to upgrading storm drainage infrastructure projects in your community? *Funding*

5. Does your community have an annual budget for storm drainage infrastructure improvement?
   All said yes.
   a. If your community has annual funding how do they prioritize the projects?
   The general theme was that stormwater infrastructure ranked lower than other infrastructure and is always first to be cut from budget when there are competing priorities.
   b. Does the annual budget also address maintenance?
   All said yes.

6. Do you have a by-law for storm drainage? *(7 of 8 have a by-law)*
   a. Does it have source protection or pollution prevention language? (*1 only)*
   b. Does it also have a municipal ticketing (MTI) by-law *(1 only*)
   c. Have there been any fines or warning violations in the last year*? (none)*

7. Do you have a storm drainage master plan or liquid waste management plan that includes storm drainage?
4 of 8 have these plans and they are current.

8. Has your jurisdiction considered creating a storm utility? Why or why not?
Only 1 is considering. There seems to be a lot of resistance.

9. Under PSAB municipalities are to assess their storm drainage infrastructure.
   a. What percentage of your entire infrastructure dollar value is storm drainage infrastructure? *1-10%*
   b. How did you rate your stormwater infrastructure condition compared to other infrastructure? *(poor, **similar**, better).*

10. Do you feel there is a need for stormwater protection education to increase public understanding for drainage improvements that improves water quality and decreases flood/storm damage? *All said yes.*

How should this education program be delivered? *Not Clear*

11. Does your community have a storm drainage monitoring program for flow and water quality?
Only 1 does

12. Do you have any further comments or questions for OBWB staff on storm drainage infrastructure?
No.

References

Arnold, C.L. and C.J. Gibbons, 1996. 'Impervious Surface Coverage: The Emergence of a Key Environmental Indicator'. *APA Journal*. Spring 1996: 243-258.

Associated Engineering. May 2011. *Filtration Deferral Planning Report* & *Recommended Risk Management Actions* : 4.1-4.2.

BC Ministry of Environment - Water Management Branch. 1997. *Non-point Source Pollution Action Plan*. Victoria: Ministry of Environment.

BC Ministry of Environment. 2010. *Beyond the Guidebook 2010: Implementing a New Culture for Watershed Protection and Restoration in British Columbia*. Available online at: http://www.waterbucket.ca/cfa/sites/wbccfa/documents/media

BC Water and Waste Association (BCWWA). 2011. *Position Statement: Management of Stormwater*. Available online at: http://bcwwa.org/resources/position-statements.html

Canadian Climate Change Impacts and Adaptation Research Network (C-CIARN). 2007. *Adapting to Climate Change: An Introduction for Canadian Municipalities, Report*. Available online at: http://www.c-ciarn.ca/primer/index_e.html

Canadian Construction Association, Canadian Public Works Association, Canadian Society for Civil Engineering, and Federation of Canadian Municipalities (CCA, CPWA, CSCE, FCM). 2012. *Canadian Infrastructure Report Card - Volume 1: 2012 Municipal Roads and Water Systems*. Available online at: http://www.canadainfrastructure.ca/downloads/Canadian_Infrastructure_Report_Card_EN.pdf

CLPA Consulting, Ltd. 2009. *Okanagan Basin Wastewater Management Plan Update.*

City of Kelowna (COK).1992-2007. *Annual Water Quality Reports*. City of Kelowna, BC.

City of Kelowna. 1993. *The City of Kelowna Sanitary Sewer/Storm Drainage By-law and You*. City of Kelowna, BC.

EBA. May, 2011. *Drinking Water Source Protection: Recommendations*. 27-30

Engler, John. 1997. 'A New Approach to Nonpoint Source Pollution'. In: *Water Environment & Technology*. 10

Environmental Protection Agency (EPA). 1997. *Nonpoint Source Pollution: The Nation's Largest Water Quality Problem.* Available online at: http://www.epa.giv/OWOW/NPS/facts/point1.htm

Gow and Watt. 1997. *Non-Point Source Pollution and the Kelowna Creek Watershed*

Halifax Water. 2013. *Residential Stormwater Billing FAQ.* Available online at: http://www.halifax.ca/hrwc/ResidentialStormwaterBillingFAQ.html

Insight Environmental Consulting. 2010. *From Rain to Resource*. Report Prepared for OBWB

Insurance Board of Canada. 2012. 'Insurance and Climate Change: Preparing for the Storm'. Presentation by Robert Tremblay.

Kerr, Wood, Leidal, Gore & Storrie Inc. 1998. *Framework for a Watershed Management Approach to Environmental Monitoring, Technical Working Paper No. 2*. City of Kelowna, BC.

Okanagan Water Stewardship Council. 2008. *Okanagan Sustainable Water Strategy; Action Plan 1.0*.

Reese, Andrew. 2013. 'Ten Reasons Managing Stormwater is Different than Wastewater. In *The Stormwater Report* 2 (11).

Schueler, T. 1995. *Site Planning For Urban Stream Protection*.

Schueler, T. 1997. 'The Economics of Watershed Protection'. In *Watershed Protection Techniques*. 2(4):469-481.

Terrene Institute. 1996. *A Watershed Approach to Urban Runoff*. Terrene Institute, Washington, DC.

Water Environment Federation. 2013. *The Large Storm*. Available online at: http://www.wef.org/AWK/pages_cs2.aspx?id=12884902443

Watt, M and Gow, T. 1997. *Non-point Source Pollution and the Kelowna Creek Watershed*. City of Kelowna, BC.

Watt, M. 1997. *Effects of Stormwater on Urban Streams.* City of Kelowna, BC.

Watt, M. 2005. *State of the Environment Report*. City of Kelowna, BC.