FINAL PLAN

CITY OF KAMLOOPS

INTEGRATED STORMWATER MANAGEMENT PLAN

Guiding Document

0368.0453.11 / April 2009

URBANSYSTEMS®

Suite 200 - 286 St. Paul Street
Kamloops BC V2C 6G4
Telephone: 250-374-8311
Fax: 250-374-5334

City of Kamloops
Integrated Stormwater Management Plan
Guiding Document

Final Plan

Client: City of Kamloops
105 Seymour Street
Kamloops, BC V2C 2C6

Prepared By: Urban Systems Ltd.
#200 – 286 St. Paul Street
Kamloops, BC V2C 6G4
Tel: (250) 374-8311
Fax: (250) 374-5334
Email: kamloops@urban-systems.com

Dylan Houlihan
Community Planner

Pablo Lopez, P. Eng.
Stormwater Engineer

Jeffrey M. Rice, P. Eng.
Senior Water Resources
Engineer / Senior Reviewer

Date Issued: 2009/04/06

Project No.: 0368.0453.11

TABLE OF CONTENTS

APPENDICES *(provided as an electronic file on the enclosed CD-ROM as the "Phase 2 Support Document")*

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONMYNS

BMP	Best Management Practice
ESC	Erosion and Sediment Control
GIS	Geographical Information System
GVRD	Greater Vancouver Regional District
IDF	Intensity-Duration-Frequency
ISMP	Integrated Stormwater Management Plan
LID	Low Impact Development
LWMP	Liquid Waste Management Plan
MDP	Master Drainage Plan
MWP	Master Watershed Plan
OCP	Official Community Plan

1.0 INTRODUCTION

1.1 Why is Stormwater Management important?

Stormwater management, for many years, has not been a "top-of-mind" issue in Kamloops. While there is some support for increased attention to stormwater management in the City's Official Community Plan (OCP) – KAMPLAN '04 - and various other plans, policies, and bylaws, there has not been a comprehensive study of stormwater management in Kamloops for quite some time. The topic has not received the attention it deserves due in large part perhaps to the fact that Kamloops is located in a semi-arid climatic zone and thus does not receive significant amounts of precipitation. Despite this, Kamloops does in fact experience high intensity rainfalls as well as snowmelt conditions which can make stormwater management more challenging and more complex. There are several other reasons why stormwater management should receive more attention; these include:

Storms are becoming more intense – Based on historical data collected from weather stations in Kamloops, storms are becoming even more intense. While the area is not necessarily receiving more annual precipitation, the same amount is falling in shorter periods of time. This creates challenges for the limited stormwater management tools that are in place in Kamloops.

Lands outside of Kamloops are losing absorptive capacity – The Mountain Pine Beetle epidemic has caused the death of many trees in the surrounding areas which used to absorb significant amounts of water. This water now must be absorbed directly into the soils or flow overland to creeks and other waterways. Compounding the issue is that, due to the loss of tree cover, soils have become sun-baked and compacted, causing them to lose their absorptive capacity. Thus more water is diverted to creeks, carrying other sediments, and eventually draining through Kamloops to the Thompson Rivers. This also increases the risk of flooding.

Stormwater is surface water resulting from rain events and/or snow melt. Other terms include runoff, drainage, and rain water.

Stormwater management is a way to avoid or mitigate the otherwise negative impacts of development on Kamloops' surface and ground waters.

An example of severe creek erosion

Improper stormwater management can lead to erosion – Kamloops has significant development in the hillsides. Much of this development has taken place on soils that are of dubious quality and thus there has been much effort to ensure slope subsidence does not occur. If the trend for more intense storms increases, it could challenge the systems that have been put in place to manage stormwater and prevent erosion in these areas.

Further, many streams in Kamloops start from the surrounding hillsides and flow downhill towards the Thompson Rivers and thus are more sensitive to improper stormwater management.

Managing stormwater is an important environmental issue – Proper stormwater management is required to protect environmental values; without it, there is risk to water quality and to aquatic habitats. The current system in Kamloops allows stormwater to enter into creeks and other water bodies without first being treated. As a result a wide variety of pollutants are washed into local surface waters. Since Kamloops may go for longer periods without rain, there will be more opportunity for contaminants to accumulate which will result in poorer stormwater runoff quality if proper interventions are not put in place.

The Thompson River is directly affected by the quality of water in local creeks.

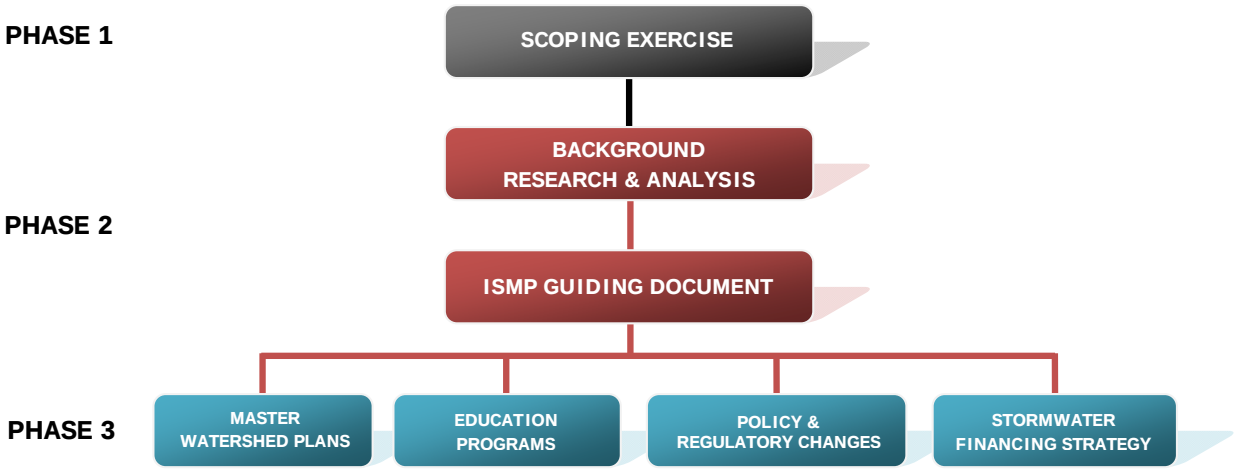
The most significant impacts of stormwater runoff occur due to conversion of natural open space, especially forests, to "hard" impervious surfaces, such as roads and buildings.

Residents of Kamloops desire better stormwater management – At the City's Sustainability Forum, held in November 2008, many respondents to a survey pertaining to water issues in Kamloops indicated that improved stormwater management was either an important issue or a very important issue. Similarly, many Fall 2008 Home Show attendees who visited the City's stormwater display also expressed concern for water quality and drainage issues (see Appendix F).

1.2 Background to Integrated Stormwater Management Plan (ISMP) Process

The Integrated Stormwater Management Plan process began in 2006 with an initial scoping report which led to the development of this guiding document. One outcome will be updated Master Drainage Plans, to be called Master Watershed Plans, which will be developed in the coming years for each of the City's watersheds. **Figure 1.1** illustrates the Integrated Stormwater Management Plan process.

Figure 1.1: Integrated Stormwater Management Plan Process



1.3 Audience

There are a number of potential audiences for the outcomes of integrated stormwater management planning, including:

Council **–** Council will be the ultimate implementers of this plan. It is important that they understand the purpose and importance of the planning process and that they provide support to Staff for the implementation of the Plan.

Staff **–** Many on City staff will have important roles in the implementation of this Plan. These include the City drainage engineer who acts as the point person for this process; other engineers in the Development and Engineering Servicing Department; current and long-range planners who must integrate stormwater management issues into various plans and bylaws; Environmental Services and Public Works staff who must address current issues and provide education to the general public; and reviewers and inspectors in the Building Department who will approve specific plans for on-site stormwater controls. It is important that the breadth of City staff acknowledge the importance of stormwater management and understand their role in implementing the plan.

Developers **–** The development community has a significant role to play in that they will be required to construct and, in many cases, pay for stormwater management tools. Effectively engaging the development community in the stormwater management process will alleviate any contentiousness associated with requiring a higher degree of attention to stormwater management in new development and redevelopment.

Other stakeholders – Other stakeholders such as the Ministry of Environment, various environmental groups, Kamloops Indian Band, and others all have a role to play in the development and implementation of this plan. These include addressing regulatory issues, leveraging potential partnerships and raising public awareness.

General public – The general public, through Council, must ultimately approve this plan. Further, it will be important that the general public become more knowledgeable about the importance of stormwater management as they will be required to fund implementation. Perhaps as importantly, there are many opportunities for the general public to become active as part of the solution to stormwater problems through the use of sustainable stormwater practices such as rain barrels, rain gardens, and "good housekeeping" (for example, by keeping deleterious materials like engine oil out of storm drains).

Ultimately, **Council** and **Staff** have been identified as the primary audiences for this **Guiding Document**. Thus, this plan is presented in a manner that allows a broad range of Council and staff, with different levels of knowledge, to become better aware of the importance of stormwater management in Kamloops and to learn some of the best practices that will work in the Kamloops environment. It will be the responsibility of Council and Staff to communicate this knowledge to the other audiences listed.

1.4 Objectives

The objectives of this **Guiding Document** are:

1) Provide education to Council and staff about the importance of stormwater management planning in Kamloops;

2) Outline opportunities for the City to better manage stormwater, both in existing and future development, taking into account the local environment and current thinking among stormwater practitioners in North America;

3) Provide guidance on implementation of the Plan including guidance for the Phase 3 Master Watershed Plans; and

4) Identify ways that stormwater management can be better integrated into ongoing planning efforts, particularly the ongoing sustainability planning exercise.

1.5 Scope of Work

The work for Phase 2 of the Integrated Stormwater Management Plan entailed the following:

1. Develop technical working papers – Topics covered in the Working Papers included financing, engineering issues, policies and regulations, and a range of background issues such as climate, hydrology, environmental conditions, land use and stormwater infrastructure. The working papers are briefly described in Section 2 of this Plan while the full papers are included in the **Phase 2 Support Document**.

2. Establish and meet with working groups – Three groups were convened, a City staff team, a stakeholders group and a technical group. Minutes and other materials from these meetings can be found in the **Phase 2 Support Document**.

3. Inform the public and solicit their input at the fall Kamloops Home Show - The Integrated Stormwater Management Plan process was featured prominently at the Spring 2009 Home Show at the City of Kamloops booth, and attendees were invited to provide their feedback on stormwater management issues. The **Phase 2 Support Document** provides details.

4. Prepare this guiding document – This **Guiding Document** summarizes work completed to date and, more importantly, provides recommendations and an implementation plan for strengthening the City's stormwater management responsibilities and authorities.

1.6 Plan Outline

The remainder of this Guiding Document focuses on four critical topics for consideration by Council and Staff:

- What are the current stormwater issues facing the City? (Section 2)
- What guiding principles can be adopted to address these issues? (Section 3)
- What actions can the City take to implement a more comprehensive and integrated approach to stormwater management? (Section 4)
- Is there an orderly plan to undertake these actions? (Section 5)

A proposed Scope of Work for the Master Watershed Plans is provided in Table 4.1.

2.0 CURRENT STORMWATER MANAGEMENT ISSUES IN KAMLOOPS

A major component of the ISMP Phase 2 was to gather and collate current and historical background data and studies relating to stormwater management within the City. From this collated background data, several Working Papers were prepared. Each Working Paper focused on one or more technical subjects important to the planning process and provides the City and stakeholders with important information necessary to understand conditions, issues, challenges and opportunities for stormwater management within the City. The following sections summarize key aspects of the working papers that support this Guiding Document and future phases of the Kamloops ISMP.

2.1 Summary of Working Papers

Five Working Papers were prepared during Phase 2, focusing on the following general topics:

- Policies and Regulations
- Financing Options
- Engineering Issues
- Technical Background Data
- Hydrologic/Hydraulic Modeling Software

Each of these is discussed in the paragraphs that follow. Detailed information related to these topics can be found in the **Phase 2 Support Document**, under separate cover.

Land use planning is a critical part of stormwater management because it directly affects the extent of impervious are in the City.

2.1.1 Policies and Regulations

Many municipalities, including the City of Kamloops, implement regulations that directly affect stormwater management (e.g., Official Community Plans and Zoning Bylaws). However, few municipalities *explicitly* consider how land use and development practices relate to stormwater management when developing their bylaws and regulations. The purpose of this Working Paper was to collect and review City Plans, bylaws and policies and to identify policy gaps, as well as provisions that support, integrated stormwater management.

Four policy documents most influential to stormwater management were reviewed in detail in the working paper and a fifth one (the LWMP) is added here.

KAMPLAN (2004) – Official Community Plan – KAMPLAN '04 indirectly supports stormwater management by encouraging environmental sustainability, establishing Development Permit Areas to protect Environmentally Sensitive Areas, and supporting infill development. KAMPLAN '04 objectives that pertain directly to stormwater management include: ensure post-development flows meet pre-development levels; protect life and property; use existing natural drainage courses as primary drainage systems; and work with

senior governments to implement surface runoff/water quality management practices.

Urbanization of Peterson Creek – Peterson Creek can be seen between the two homes, where the vegetation is present.

Opportunities/Constraints – KAMPLAN '04 fails to include measurable targets for preserving open space or limiting impervious area, two particularly cogent means for limiting negative impacts to watersheds from urban development. This plan also does not identify an urban containment boundary to limit sprawl. A review and substantial update of KAMPLAN '04 is underway and should be complete by 2010, thus it is a good time to raise and address these issues.

Neighbourhood Plans – The City has completed several neighbourhood plans for various areas of the City. The neighbourhood specific policies in these plans relate to land use, environmental protection and servicing. Many of these plans include more detailed stormwater management policies, than those contained in KAMPLAN '04 or the City's other regulatory bylaws, which could be used as examples to be applied on a larger City wide basis.

Opportunities/Constraints - Like many of the KAMPLAN '04 policies related to stormwater management, neighbourhood plan policies are not often designed to be regulatory. To implement many of the neighbourhood plan objectives, the City would have to amend its regulatory bylaws.

Zoning Bylaw – The Zoning Bylaw includes provisions to establish maximum lot coverage and impose usable open space requirements both of which limit impervious area.

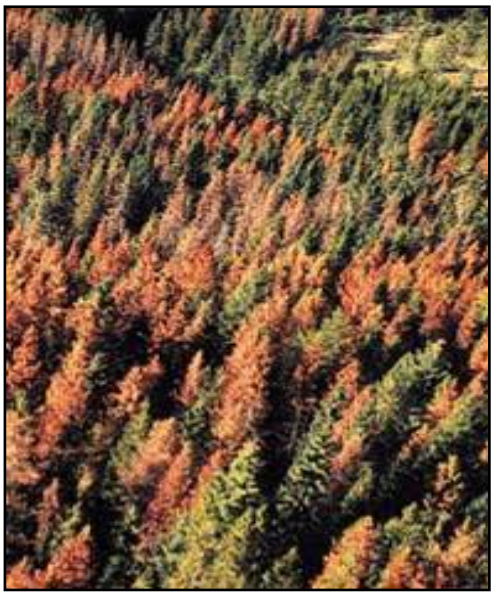
Opportunities/Constraints – The Bylaw could be improved by imposing more specific requirements to limit impervious area and protect open space. For example, the City could impose parking standards to limit the amount of impervious area from parking and / or also specify density averaging options to promote cluster development for the protection of the natural environment.

Subdivision Control Bylaw – This Bylaw establishes service levels and servicing standards for new development. The Subdivision Control Bylaw has perhaps the most potential to directly and significantly influence stormwater management by requiring the use of specific control methods or imposing specific control performance targets.

Opportunities/Constraints – Currently the Subdivision Control Bylaw does not include on-site stormwater source controls as acceptable Best Management Practices (BMPs). The Bylaw could be amended to require developers to install on-site stormwater source control BMP's such as porous pavements, constructed

vegetated swales, infiltration trenches and absorbent landscaping. Site adaptive planning policies that reduce impervious areas can also be added to the bylaw. (See Section 2.1.5 for discussion of BMPs.)

Tree Protection Bylaw – Tree protection is a highly effective component of stormwater management. The current Bylaw includes some counter productive tree removal exemptions that hinder the ISMP objectives.



Effects of Pine Beetle infestation.

Opportunities/Constraints - The Bylaw does not apply to trees on properties less than 2 ha, trees less than 5m in height or 10cm in diameter, or trees on property undergoing development in accordance with a subdivision plan. The City could significantly improve tree protection by reducing these exemptions.

Kamloops Liquid Waste Management Plan (LWMP) – provides direction for the safe and environmentally sustainable treatment, disposal and reuse of the City of Kamloops' sewage. The LWMP provides a strategy for managing current and future sewage demands. With a large part of the plan focusing on water quality issues such as the required levels of treatment, methods of treatment and other mitigation options.

Opportunities/Constraints – The Kamloops LWMP requires that a comprehensive Stormwater Management Plan be prepared to manage the disposal of stormwater into the Thompson Rivers. The LWMP does not, however, provide specific levels of stormwater treatment or management methods. As a result, there is a great deal of latitude available to implement stormwater strategies such as this Integrated Stormwater Management Plan.

Successful stormwater management requires effective implementation tools such as regulatory bylaws.

Currently, there are a number of regulatory gaps that make it difficult to fully implement the stormwater-related policies outlined in KAMPLAN '04 and in neighbourhood plans. Consequently, to achieve effective, integrated stormwater management, the City's broad policies must be augmented with effective implementation tools (i.e., regulatory bylaws that require compliance). To do this, existing policies and bylaws will have to be amended and new ones will have to be incorporated. Section 4 provides descriptions of

recommended revised and new policies and bylaws.

2.1.2 Financing Options

As with many initiatives, implementation of the ISMP will require funding. This Working Paper provided a broad overview of financing options available for stormwater management funding. Specifically, the Working Paper identified and evaluated financing options, reviewed the City's current stormwater management funding approach and discussed the applicability of a stormwater user fee to finance City activities.

Financing Options - Under the Community Charter and Local Government Act, municipalities can make use of the following cost-recovery tools for stormwater management:

- General revenues – General property taxes levied based on assessed value;
- Local service taxes – Taxes levied in a specific area(s) of the City for specific services provided to that area;
- Works and services – Infrastructure improvements constructed by developers as part of the subdivision or building permit process;
- Stormwater fees – Fees similar to water or sewer utility user fees that are levied to provide dedicated funding for stormwater management initiatives;
- Development cost charges – Fees levied on new development to assist with financing engineering infrastructure, parkland acquisitions, and parkland improvements needed to support growth;
- Grants – Provincial and Federal Grants.

The City currently finances stormwater management costs through general revenues, development cost charges, and works and services agreements. It does not, however, have a dedicated source of funding for stormwater management nor does the City use grants or local service taxes for stormwater initiatives. On-going operation and maintenance costs for stormwater must compete with other City initiatives funded through general revenues.

Rating the Financing Alternatives – To choose among potential funding sources, a set of criteria was established to evaluate each option. Ideally, preferred or chosen funding sources should:

- Minimize exposure to financial risk (to the City and its taxpayers) – The City assumes financial risk when long-term borrowing (by the City) is employed as a means to finance capital projects that are required prior to having collected the necessary funds to pay for these projects.
- Promote fairness (the "user pay" principle) – Those who use the service should also pay for the service. Costs should be allocated to reflect demands or impacts on systems.
- Provide certainty and sufficiency – Financial tools should provide sufficient revenues to fund required initiatives in a given timeframe.

- Minimize administrative cost – Funding strategies should be cost effective to administer.
- Reflect established practices – It may be more challenging to gain support for funding approaches that are new to the City.

An evaluation matrix was prepared to compare how each financing option performs against the criteria (see Table 2.1). As shown, stormwater fees are expected to be the City's best option for funding stormwater management initiatives.

Table 2.1: Evaluation of Potential Financing Options

	GENERAL REVENUE	LOCAL SERVICE TAXES	WORKS AND SERVICES	DEVELOPMENT COST CHARGES	STORMWATER FEES	GRANTS
Minimize Financial Risk	●	●	●	◐ - ●	●	○
Promote Fairness ("user pay")	○	◐	◐	◐	●	○
Provide Certainty and Sufficiency	○	○	○	○	●	○
Minimize Administrative Cost	●	◐	●	●	◐	○
Reflect Established Practices	●	○	●	●	◐	●

● Ability to satisfy the evaluation criterion is **above average**.

◐ Ability to satisfy the evaluation criterion is **average**.

○ Ability to satisfy the evaluation criterion is **below average**.

Stormwater Fees – A stormwater fee is simply a fee levied by local governments for the provision of stormwater management services. Just as water and sanitary user charges provide the City with dedicated, stable sources of revenue for water and sanitary services, a stormwater fee would provide the City with a dedicated, stable source of revenue for stormwater management services. Furthermore, like water and sanitary user charges, stormwater fees can be designed to reflect the user pay principle – that is, the greater the demand on the stormwater management system (i.e., the greater proportion of a parcel that is covered by impervious surfaces), the greater the user fee should be for that parcel.

Stormwater fees are becoming the tool of choice for generating stormwater management revenue.

Revenues collected through stormwater fees can be used to pay for any component of the City's stormwater management service, including:

- Planning and engineering analyses,
- Capital improvements (both growth and non-growth related),
- Capital reinvestment (i.e., long-term infrastructure replacement),
- Operations and maintenance,
- Administration and financial services related to providing the services,
- Public safety and hazard mitigation (e.g., disaster preparedness), and
- Public education.

Stormwater fees have gained widespread acceptance among North American communities (especially in the U.S.) and are being used as an alternative to general revenues because they are considered to be the most equitable way of securing stable funding for stormwater management services. At this time, the City of White Rock is the only BC municipality to have implemented a true stormwater fee (i.e., a fee that is designed to reflect use of the stormwater system). Other BC municipalities (e.g., Surrey, Abbotsford, Langley Township, and Campbell River) levy fees specifically for stormwater, but these fees do not necessarily reflect the extent of use of the stormwater system. In any case, regardless of the fee system design, these municipalities have secured a dedicated and stable source of funding for their stormwater management initiatives.

2.1.3 Technical Background Data

This working paper focused on gathering general background data for use in updating individual Master Watershed Plans during Phase 3 of the ISMP. The data included the following topics:

- Topography,
- Climate,
- Hydrology,
- Soils and Hydrogeology,
- Environment,
- Land use,
- Stormwater infrastructure, and
- Stormwater quality.

The purpose of the working paper was to understand the overall context of stormwater management in the City and identify what additional data will be required for updating individual Master Watershed Plans in Phase 3. The following paragraphs summarize the working paper's discussion of the listed topics.

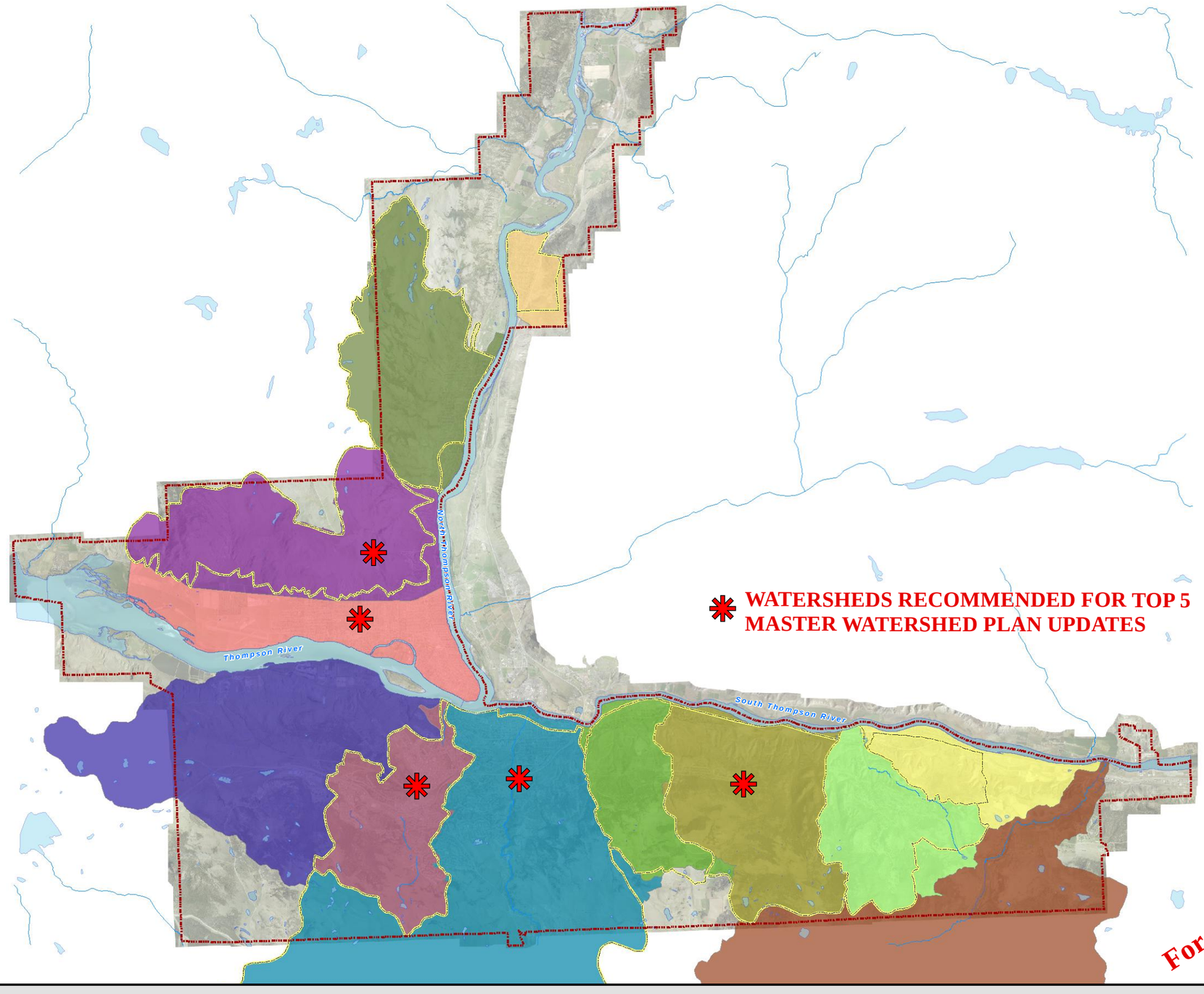
Topography

The City of Kamloops' topography consists of diverse and challenging formations due to its location amongst the Thompson Rivers' valleys. The City collects and maintains very good topographic data which was used to define the various watershed boundaries within City limits. These watersheds can be seen on Figure 2.1 (Integrated Stormwater Management Plan – Master Watershed Plan Catchment Boundaries). The Master Watershed Plan Updates will reflect these watersheds.

Climate

Climatic data is essential to understanding hydrologic processes at work in Kamloops' watersheds. Currently, Environment Canada collects raw temperature, precipitation, wind speed, humidity and air pressure data at the airport. The City also has been collecting climatic data at several stations through out the City. Data from these various stations can be used in the Master Watershed Plan updates to compare and contrast the varying climatic and hydrologic conditions that are present throughout the Kamloops areas.

Climate change will have a significant impact on stormwater generation in Kamloops.



Kamloops
Canada's Tournament Capital

Legend

- Municipal Boundary
- Original Drainage Basins

Revised Drainage Basins

- Barnhartvale
- Batchelor/Brocklehurst
- Campbell Creek
- Dallas
- East Valleyview
- Guerin Creek
- North Shore
- Peterson Creek
- Rayleigh
- Rose Hill
- West Kamloops
- Westsyde

THE ACCURACY & COMPLETENESS OF INFORMATION SHOWN ON THIS DRAWING IS NOT GUARANTEED. IT WILL BE THE RESPONSIBILITY OF THE USER OF THE INFORMATION SHOWN ON THIS DRAWING TO LOCATE & ESTABLISH THE PRECISE LOCATION OF ALL EXISTING INFORMATION WHETHER SHOWN OR NOT.

For Information
April 6, 2009

SOURCES:
- BASE INFORMATION: PROVIDED BY THE CITY OF KAMLOOPS

URBANSYSTEMS

Integrated Stormwater Management Plan - Master Watershed Plan Catchment Boundaries

0 1.5 3 6 Kilometers

N

Figure 2.1

U:\Projects_KAM\0368\0453.11\D-Drafting-Design-Analysis\GIS\Projects\Figure 2.1 - Revised Major Drainage Basins.mxd 2008-04-07 cr

As signs of climatic changes become more prevalent it will be imperative that climatic data continues to be collected and maintained over time to help monitor the effects of the changing climatic conditions (i.e., peak storm intensities, precipitation patterns, temperature changes, etc.) and the associated effects on the local hydrologic cycles.

Hydrology

Hydrologic (stream flow) data is essential to stormwater planning and adaptive management. Along with climatic data, stream flow data is critical to the understanding of the complex natural and urbanized hydrologic processes present throughout the City. At this time, there is no stream flow data available for any of the streams within or near City limits. Therefore, it is recommended that the City purchase and install at least two (2) permanent, continuously recording stream gauges on City streams.

Soils and Hydrogeology

A watershed's subsurface conditions are key to the water balance of the area, significantly affecting the amount of surface runoff is generated. Thus it is essential to have an understanding of local soils and subsurface conditions. Therefore, basic soils, surficial geology and groundwater data were collected during Phase 2, though analysis was not a part of the current scope of work. In overview, the soils around Kamloops are locally quite variable. For example, north shore areas generally consist of free draining coarse-grained materials, while many areas on the south shore are characterized by fine-grained soils that exhibit significant slope instability. During the update of Master Watershed Plans in Phase 3 of the ISMP, a fuller analysis of the soils and hydrogeologic conditions will be completed.

Steep slopes present a challenge for erosion control

Environmental

A preliminary review of available data was performed to gather environmental data relating to the ISMP. The City has a significant collection of environmental data that was used for this investigation. Kamloops contains diverse environmental conditions that must be accounted for during development. These include rivers, streams, riparian areas, floodplains, grasslands, forested slopes, rocky outcrops and talus slopes.

Protection of Kamloops' environmentally sensitive areas is an essential component of stormwater management.

These areas provide unique ecological functions or habitat, act as natural stormwater regulating features and are highly susceptible to negative development impacts. Therefore, protection of local environmentally sensitive areas is an essential component of the ISMP.

Despite the City's significant environmental inventory, there are a gaps in the data that will need confirmation through field work when the Master Watershed Plans are updated. Some of the environmental data gaps include confirmation of extent and quality of riparian areas; specific locations of rocky outcrops, talus slopes and springs; and confirmation of forest and grassland covers. Refer to Appendix C in the **Phase 2 Support Document** for more detail on available environmental data.

Land Use

The City of Kamloops and the BC Assessment Authority maintain high-quality land use data bases that can be used to help identify watershed characteristics of urbanized areas.

More specifically, impervious areas and associated hydrologic (runoff) characteristics can be determined from this land use data.

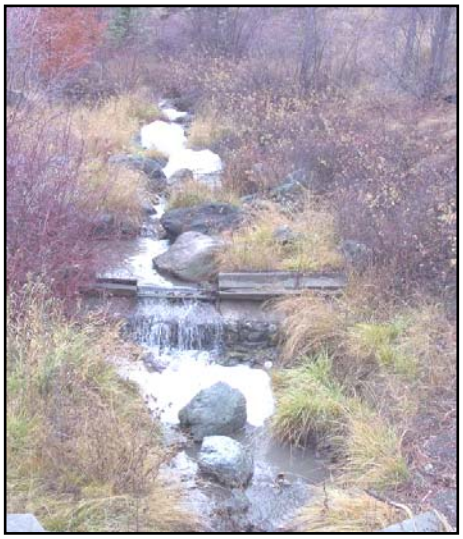
Stormwater Infrastructure

The City's GIS database contains extensive stormwater infrastructure data including: storm sewer locations, sizes, lengths, inverts and material types; catch basins; outlet structures; detention pond locations; rock (infiltration) pits; and open channels. This data will be used to prepare the hydrology models for each Master Watershed Plan. Any gaps in this data will be verified and updated during individual MWP updates.

Stormwater Quality

Urban development not only affects stormwater runoff peaks and volumes but also the quality of that runoff. Typical runoff pollutants include suspended sediments, nutrients (nitrogen and phosphorous), trace metals (copper, nickel and zinc), bacteria and hydrocarbons.

In the late 1990's, a short lived stormwater quality monitoring program was initiated by the City. The program was well-documented and planned, however the results proved not very helpful to fully understanding the extent and nature of stormwater pollution in the City.



A preliminary screening-level stormwater quality analysis was performed during Phase 2 of the ISMP. This analysis provided a general planning estimate of likely storm pollutant export from the different watersheds in Kamloops. More sophisticated modeling will have to be done during MWP updates to analyze the complex physical, chemical and biological factors associated with stormwater quality.

2.1.4 Hydrologic / Hydraulic Modeling Software

A review of available modeling software that would be suitable for the needs of future ISMP initiatives was completed and a recommendation was made for purchase of software by the City Engineering Department.

2.1.5 Engineering Issues

This working paper focused on engineering control aspects of the ISMP. Topics presented in this working paper included:

- Key technical issues to be addressed in the ISMP.
- Best management practices in the local environment.
- Master Drainage Plan updates, including system simulation (i.e., modeling).

These topics are summarized in the following sections.

Key technical issues – A number of issues were identified during both Phase 1 and Phase 2 (the current phase) of the ISMP. These issues include:

- Adequacy of collection and conveyance systems.
- Lack of adequate erosion and sediment control during construction.

Street flooding can be a nuisance and a source of pollution

- Applicability of low impact development (LID) stormwater control methods in Kamloops.
- Need to develop Design Standards for use of best management practices, including progressive LID measures.

- Importance of groundwater conditions to stormwater management.
- Lack of overland flow routes, putting property owners at risk to flooding.
- Importance of protecting natural drainage courses.
- Significance of runoff quality and its role in causing significant environmental impacts to local aquatic life and habitats.
- Long term viability of detention ponds as a stormwater control method.

Guerin Creek – noticeable trash & debris present

Best Management Practices – For centuries, stormwater management, if undertaken at all, consisted primarily of ditches and pipes to convey surface runoff away from properties and communities as quickly as possible. In the last 50 years, communities and regions around North America have increasingly applied other stormwater control methods, often called "best management practices" or BMPs, to mitigate the negative effects of urbanization on watersheds. During that time, in British Columbia, BMPs have been applied primarily to reduce downstream flooding, generally at the end of storm drain pipes (or storm sewers). More recently, stormwater practitioners have come to realize that effective stormwater management must address not only peak runoff rates (i.e., flooding), but also total runoff volumes and the water quality of the runoff.

BMP's are subdivided into four categories:

- ***Site adaptive planning***
- ***Source controls***
- ***Structural controls***
- ***Non-structural controls***

Best Management Practices are the "on the ground" methods for avoiding and mitigating the negative impacts of urban development on stormwater. **Table 2.2** provides an overview of BMPs. Through *site adaptive planning* the total amount of impervious surface area on development sites can be reduced, impervious area being a key factor in determining the impacts of urbanization on stormwater.

To supplement these impervious area reductions, *source controls*, fitted to each specific development site, can be used to replicate natural water cycle processes – infiltration, evaporation and transpiration – before runoff becomes excessive. In some cases, very large development sites, neighbourhoods or regions must use *structural controls*, generally located downstream of the affected area, to manage stormwater in a more centralized way.

Table 2.2: BEST MANAGEMENT PRACTICES (including Low Impact Development Methods)

Best Management Practice	Scale or Scope				Primary Stormwater Issue(s) Addressed				Overall Evaluation					
	Site	Neighbor-hood	Water-shed	Regional	Volume Control	WQ Control	Peak Control	Erosion Control	Effective-ness	Sustain-ability	Cost	Ownership	Accepted by Sr. Envl Agencies?	Experi-ence
Site Adaptive Planning														
Disconnect Impervious Areas	X	X			X				1	1	2	na	Y	1
Green Street		X			X		X		1	1	2	C/P	Y	2
Limit building footprint size	X				X		X		1	1	0	C/P	Y	1
Narrow Pavement Street		X			X				2	1	1	C/P	Y	2
Reduce parking requirements	X				X	X	X		1	1	0	C/P	Y	1
Source Controls														
Amended Soils/Absorbent Landscaping	X				X				1	1	1	P	Y	2
Disconnected Downspouts & Splashpads	X				X				1	1	1	P	Y	1
Green Roof	X				X				1	2	2	P	Y	2
Infiltration (Engineered System)	X	X			X	X			1	2	3	C/P	Y?	1
Infiltration Basin	X	X			X	X			1	1	2	C/P	Y	1
Infiltration Swale		X			X	X			1	1	1	C/P	Y	1
Infiltration Trench	X	X			X	X			1	1	2/3	C/P	Y	1
Planter Boxes	X								2	1	1	P	Y	1
Porous Pavement (asphalt)	X	X			X	X	X		1	1?	2	C/P	Y	2
Porous Pavement (concrete)	X	X			X	X	X		1	1?	2	C/P	Y	3
Porous Pavement (permeable pavers)	X	X			X	X	X		1	1?	2	C/P	Y	1
Rain Barrel	X				X				1	1	1	P	Y	1
Rain Garden (Bioretention)	X	(X)			X				1	1	1/2	P	Y	1
Rock / Soakaway Pit	X				X				1	1	2	P	Y	1
Structural Controls														
Biofiltration Swale (Bioswale)		X				X			1	1	1/2	C/P	Y	1
Constructed Wetlands		X	X	X	X	X			1	2	2/3	C	Y	1
Dry Detention Pond		X	(X)	X			X		2	2	2	C	N	1
Grass (Vegetated) Swale		X			X				1	1	1/2	C/P	Y	1
Subsurface Gravel Wetland	X	X				X	(X)		1	1	2	C/P	Y?	3
Oil / Grit Separator	X	X		X		X			2	2	2	P	N	1
Perforated Storm Sewer		X		X	X		X		2	2	2	C/P	Y	2
Sand Filters	X	X		X		X			1	2	2/3	C	Y	1
Underground Vault (for sediment)	X	X		X		X			2	2	2/3	C/P	N	1
Underground Vault (media filters)	X	X		(X)		X			1	2	3	C/P	N	1
Vegetated Filter Strips	X	X				X		X	1	1	1	C	Y	1
Wet Detention Pond		X	X	X		X	X		1	2	2/3	C/P	Y	1
Non-Structural Practices														
Early Revegetation of Cleared Sites	X							X	1	1	1	P	Y	1
Maintenance of Riparian Corridors			X	X		X	X	X	1	1	2	C/P	Y	1
Minimize Soil Compaction	X				X			X	1	1	1	P	Y	1
Preserve Natural Drainage Features	X	X	X		X				1	1	2	C/P	Y	1
Protect / Retain Wetlands		X	X		X	X	X		1	1	2	C/P	Y	1
Public Education Programs			X	X	X	X	X	X	2	1	2	C/P	Y	1
Catch Basin Cleaning Program	X	X	X	X		X			1	2	2	C	Y?	1
Retain / Plant Trees at Building Sites	X				X				1	1	1	P	Y	1
Street Cleaning Program			X	X		X			1	2	3	C	U	2

Ranking Values:

Effectiveness 1 to 3, w/re: to primary issues addressed (1=best)
Sustainability 1 to 3 w/re: long term usage & risk of failure (1=best)
Cost 0 to 3 (0=very low or none)
Ownership (Responsibility) C(ity); P(rivate)
Acceptance by Senior Env'l Agencies Y(es, likely); N(ot top choice); U(nknown)
Experience in North America 1 to 3, w/re: to common usage & availability of design standards (1=high)

Cost rankings partially based on information presented in "Stormwater Best Management Practices in an Ultra-Urban Setting," U.S. Federal Highway Administration, ca. 2005.

Finally, *non-structural practices* are used to ensure the long-term viability of both source and structural controls and to minimize the potential for urban activities to cause stormwater problems in the first place.

Site adaptive planning and source control BMPs together are sometimes denoted *low impact development* (LID) or sustainable urban drainage methods. Although the methods have been known for quite some time, LID in general has received increasing emphasis in the last few years, particularly in British Columbia where the methods are encouraged for use in the Province's "Stormwater Planning" guidelines manual published in 2002.

Kamloops' watersheds can benefit from the use of low impact development

Source controls, typically decentralized and applied to individual properties, are often installed and maintained by private property owners, although a municipality may also use LID within public rights of way or other public lands. On the other hand, structural controls are considered "end of pipe" solutions, often best applied in remedial situations or when a municipality desires to exercise more direct control of the BMPs. Determining which type of BMP is best suited for each site, development, neighborhood or region requires careful analysis and evaluation. Further, the overall mix of *publicly-owned and maintained* versus *privately-owned and maintained* best management practices is best established by watershed, taking into account land use, topography, climate, soils, hydrogeology and other watershed-based conditions. Of course, the City's general assessment of such issues as risk, staffing, resource availability, cost and potential to meet stormwater objectives will also be a major determinant of this mix.

Will LID work in Kamloops?

Some concerns have been raised about the cost-effectiveness and feasibility of LID in the context of the Kamloops area. The fact is, conventional drainage infrastructure (consisting primarily of ditches and storm drain pipes) does not and can not meet environmental objectives, and it merely passes problems downstream. Even with the addition of commonly used structural BMPs such as detention ponds (which are used in Kamloops), conventional drainage infrastructure can only meet some, but not all, environmental and flood-control objectives. It does poorly at runoff quality control and often is unable to control erosion, at times actually worsening stream erosion. If the City wishes to meet broad stormwater management / environmental objectives, the Kamloops ISMP should incorporate LID that focuses on site adaptive planning and source control measures. A successful LID program should be flexible, allowing consideration of site-specific conditions focusing on factors such as local climate, topography, soils and hydrogeologic conditions.

LID methods can provide stormwater management as well as aesthetic value to communities

Concern has also been expressed about using LID in the cold weather and dry climate conditions of Kamloops. To ease these concerns, it should be noted that there are several examples of North American communities (and regions) that currently use low impact development in similar or even harsher climates. The primary keys to successful low impact development are (1) to use LID in conjunction with the full palate of BMPs and (2) to adapt the LID designs to local, site conditions.

2.2 Master Watershed Plans

In the late 1980's and early 1990's, eight of the City's watersheds were studied and Master Drainage Plans (MDPs) were prepared for each. During Phase 2, several more watersheds were identified for which the City should prepare plans. (See **Figure 2.1**.)

In recognition of the wider scope of the ISMP, as compared to the earlier studies, the updated MDPs should really be called Master Watershed Plans (MWPs). During Phase 3 of the Kamloops ISMP, Master Watershed Plans will recommend specific stormwater improvements to existing and proposed future development areas within each watershed and provide a roadmap for implementing the various recommendations set forth in this Guiding Document. The MWPs will not be inexpensive (perhaps $75,000 each), thus the intent is to schedule the plans for the coming decade. A recommended Scope of Work for the MWPs can be found in Table 4.1.

Stormwater management planning has come to rely on sophisticated hydrologic and hydraulic modeling to simulate watershed conditions, assess infrastructure performance and assist with infrastructure design. During Phase 3 of the ISMP, modeling should focus on developing a systematic understanding of the hydrology of each watershed, using models that can adequately simulate the complex hydrologic conditions that are present, or are projected to be in the future, including the use of BMPs. The hydrologic modeling efforts should:

- Use continuous (extended period) simulations
- Have the ability to simulate soils conditions and their impact on runoff
- Make full use of the City's GIS database with respect to topography, ground cover, infrastructure, etc.
- Use the flow and weather data the City is now or will be collecting for model calibration and verification
- Link with less complex hydraulic models for design of facilities in the future.

Currently, complex modeling software capable of modeling these scenarios is available.

Once the initial watershed hydrologic models are prepared, they should be maintained over time to reflect changing land use and development conditions throughout the watersheds. This could be done during the regular cycle of MWP updates or at other intervals as needed. In addition, the hydraulic models which will be used for infrastructure design should be maintained as well, to reflect installation of improvements and other changes to the stormwater system.

3.0 GUIDING PRINCIPLES FOR STORMWATER MANAGEMENT

A series of guiding principles for stormwater management has been established for Kamloops. Moving forward, these provide Council and Staff a list of principles to reference as additional work relating directly and indirectly to stormwater management occurs in the future, particularly as the City progresses with Master Watershed Plans.

They also provide a basis for the recommendations made in Section 4 of this report. The guiding principles are intended to act as a catalyst for elevating the importance of and attention paid to stormwater management in Kamloops. By educating Council and Staff on these principles, it will enable the City, as an organization, to deal more efficiently and effectively with stormwater management issues.

The guiding principles are:

Long-term thinking will guide decision making – Stormwater management issues cannot be addressed quickly in Kamloops. It took a long-time for the City's stormwater management practices to evolve to the point they are at now in Kamloops and it is recognized that it will take time for the philosophy and implementation of stormwater management to evolve to practices that are more sustainable. Thus a long-term approach is required to understand and address the breadth and depth of issues in Kamloops in order to be successful.

The City will provide leadership to the community – By having Council's continued support and a knowledgeable staff, the City will be able to provide leadership to the community. This will mean applying best practices to its own operations and capital projects, to the extent feasible. This will also mean providing education to developers, stakeholders, and the general public, as well as ensuring best management practices are followed in Kamloops.

Implementation will be context sensitive – It is critical that appropriate stormwater management solutions are sought. A "one-size fits all" philosophy will not work for Kamloops. It is important that guidance for stormwater management solutions be developed at the watershed level, where possible, and that detailed design of stormwater management solutions be applied at the site level.

This will recognize that there are critical differences between the various watersheds and that even within individual watersheds there is enough variation in site conditions that any interventions must be context sensitive. For example, the MWPs will need to address, in a context sensitive manner, the need to limit stormwater infiltration in Aberdeen. A similar approach is needed for silt bluff areas.

However, it is also recognized that there are low impact development techniques that can respond to a variety of unique situations, such as those mentioned, and that these will be employed in combination with a full spectrum of BMPs.

The goals and objectives of stormwater management will permeate the City's regulatory framework – The City recognizes that in order for stormwater management to be treated with the importance it requires, that goals and objectives regarding stormwater must permeate throughout the City's regulatory framework. As such, existing policies must be modified and new policies potentially developed to address stormwater management. In this way, the stormwater management process becomes an ongoing exercise rather than a static, one-time planning initiative. The complexity of stormwater management practices in Kamloops should evolve as capacity develops.

Preserving and enhancing important environmental values will be a top priority – The City will work with developers to ensure environmental impacts of run-off from new development are minimized. At the same time, the City will seek to address situations where current stormwater management practices are harmful to the environment. Measurable performance targets will be established and monitored to ensure compliance.

Stormwater management will take into account the capacity of the City – While it is important that stormwater management processes are fair, it is also important that they fit within the capacity of the City to undertake. Neither the planning and engineering, nor the financing of stormwater management, can be of such a complexity that Staff cannot effectively implement stormwater management.

Stormwater management will be integrated with other initiatives – It will be important that stormwater management be integrated with other planning, engineering and financing initiatives. Most pointedly, the ISMP must integrate with the guidance that will evolve from the development of the City's Environmental Plan, as well as the City's Sustainability Plan/Official Community Plan.

Stormwater management will have dedicated annual funding – Stormwater management will have dedicated annual funding allotments and should be based on a "user pay" principle. It is critical that stable funding that is appropriate to the scale of stormwater management implementation is developed. This will ingrain the idea that stormwater management is an important consideration for the City of Kamloops.

The City will require that the full spectrum of storm events be addressed appropriately – Identifying how different storm events will be addressed will help the City ensure that appropriate infrastructure is implemented and that stormwater management is addressed in an efficient manner that respects environmental values, and mimics nature to the fullest extent possible.

The City will facilitate innovation – The City will facilitate innovation by first recognizing that a "one-size fits all" solution will not work in Kamloops and by secondly establishing performance based targets in order to account for the need to be context sensitive in terms of stormwater management. The City will work with developers to utilize best management practices (including low impact development) to add value to development.

An example of innovative stormwater control with a rain garden

Preventative approaches should be explored – One of the major issues with stormwater runoff is the amount of pollution it disperses to waterways which in turn has adverse impacts on water quality and the watershed in general. To promote better runoff quality, the City will explore preventative measures to reduce accumulation of surface pollutants before they become an issue of stormwater quality. Or put differently, in the long run, it is always better to prevent pollution than have to clean it up!

4.0 RECOMMENDATIONS

This section summarizes recommendations for future implementation of the ISMP.

4.1 Council Acceptance of the Integrated Stormwater Management Plan Guiding Document

City Council should accept, in principle, the recommendations and implementation plan of the ISMP Guiding Document. The rationale for accepting the recommendations include:

- It provides staff the ability to begin implementing the ISMP and continue with related processes;
- It sends a message to the public that stormwater management is important in Kamloops; and
- It sends a message to developers that stormwater management will be an important consideration in new development.

4.2 Integration with the Official Community Plan and Environmental Plan

The City is currently developing a Sustainability Plan, which in turn will be integrated with the City's Official Community Plan (OCP). It is critical that the guidance provided in the ISMP be reflected in these plans. This will ensure that stormwater management will be addressed appropriately in the full hierarchy of City plans.

One specific item to consider is the establishment of an urban containment boundary. This boundary, which is not in KAMPLAN (2004) currently, should be added to KAMPLAN to prohibit urban development outside core development areas and to encourage densification through infill development. This will also serve to maintain open space and natural areas in the upper portions of watersheds.

The City has begun the process of updating KAMPLAN with much of 2009 and 2010 dedicated towards this task. This will be a critical opportunity to incorporate a more sustainable stormwater management perspective into City-wide initiatives.

4.3 Internal Stormwater Management Committee

The City should develop an internal stormwater management committee consisting of staff, and potentially a member of Council, that can provide overall direction for the implementation of the ISMP. This committee should at least include the following:

- Drainage engineer
- Community planner
- Subdivision approval officer
- Environmental services staff
- Utility manager
- Parks

This group reflects the integrated nature of this plan and will help to ensure that projects

achieve the synergy required to make them economically feasible and more sustainable over the long-term.

4.4 Stormwater Control Performance Targets

The City should adopt targets for stormwater control that focus on runoff rate and volume and on runoff quality. We recommend the use of a "dual target" system which will allow different classes of development or land use to meet stormwater management goals in an efficient manner. For commercial, industrial, institutional and multi-family residential development (including redevelopment), we recommend the use of a performance standard which must be met:

- For small storms (less than 12 mm in 24 hours): Capture and retain on site all rainwater for reuse, infiltration, evaporation and/or transpiration.
- For medium storms (between 12 mm and 24 mm in 24 hours): Capture and detain for slow release the next increment of stormwater exceeding that specified for small storms.
- For large storms (greater than 24 mm in 24 hours): Provide safe conveyance of all stormwater, in agreement with the applicable Master Watershed Plan.
- On an average basis, remove 80% of Total Suspended Solids (TSS) down to 50 micron particle size.
- On an average basis, limit discharge of Oil & Grease to less than 10 mg/L.

Additional requirements may be necessary for specific properties, such as gas stations, industrial parks, and other locations at "high risk" for wash off of potentially toxic pollutants. In these cases, the emphasis will be on encouraging the use of "good housekeeping" and trapping methods to prevent release or wash off of contaminants in the first place and on providing protocols for atypical or rare circumstances, for example spills.

Both stormwater performance and prescriptive standards are proposed to account for various land uses.

For single family residential development (including redevelopment), we recommend the use of a prescriptive standard, by which specific low impact BMPs must be installed or used on residential lots and local streets:

- Place 150-200 mm of amended topsoil prior to seeding or sodding on lots and boulevards
- Meet minimum tree retention and planting requirement (see Section 4.7.5)
- Direct roof leaders to ground (not a storm sewer) or to a perforated pipe placed in the yard
- Install bioswales and/or rain gardens for street runoff, with overflows to the storm sewer

Installation of LID stormwater controls such as these that provide contact between runoff and soils should be accepted as meeting the goals for small storm volume control and for

treatment control, as described under performance standards.

The Master Watershed Plans should use these targets as a basis for analyzing and evaluating alternative stormwater management options, and for recommending a cost-effective mix of public and private stormwater controls. Further, the MWPs should identify any areas within the watersheds where the use of specific BMPs may be inadvisable or may require design accommodations to avoid unacceptable impacts. An example is requiring the use of perforated underdrain systems for porous pavements and bioswales in order to minimize potential negative impacts of infiltration in specific areas.

4.5 Operational Best Management Practices

The City should develop internal policies to ensure that Public Works' operations are consistent with the new outlook on stormwater management. This includes developing internal policies for such matters as street sweeping, spill containment, and stormwater infrastructure (outfalls, bioswales, catch basins, rain gardens, etc.) maintenance.

An effective education program is essential to the success of the ISMP implementation.

4.6 Education Program

In order to communicate the importance of stormwater management planning, the City needs to develop a multi-pronged education program that is adaptable to a variety of audiences. A goal of the education programs is to ensure buy-in from various stakeholders. Further, education should be focused both on how to address existing stormwater management deficiencies as well as how to proactively prepare for future development.

For City Staff, there are two key audiences that need to be informed of stormwater management issues. First, Public Works staff need to be educated about the impacts they can have on stormwater management quality through various operations such as street sweeping, spill containment, and stormwater infrastructure maintenance. Second, planning and engineering staff must be able to integrate stormwater management with other components of planning and design.

For developers, it is important to communicate why stormwater management is important, what they should do in their own developments, and the costs and benefits of undertaking this work. It is particularly important that developers have a better understanding of stormwater management as they will be, in many cases, called upon to implement and pay for applying mitigation techniques.

For the general public, there are a few needs for stormwater management education. These include:

- Helping them to understand how they can personally positively and negatively impact stormwater management;

- Helping them to understand how stormwater management relates to environmental protection; and
- Helping them to understand why it is important to pay stormwater management fees, if indeed that option is chosen as recommended in this **Guiding Document**.

Education for the general public can come through the City's ECOSmart program and Kamloops-specific materials (brochures, etc.) relating to stormwater should be distributed. Particular emphasis should be put on educating children as they can influence the decisions that their parents make. The use of more passive education should be encouraged as well. Passive education could include attractive and meaningful signage on catch basins, and development and description of demonstration projects such as rain gardens and bioswales, similar to the xeriscape demonstration garden at McArthur Island. The goals of the education program should be to continuously raise the profile of stormwater management and watershed protection and to distribute this knowledge to all age groups.

One specific initiative the City could undertake to broaden the community understanding of stormwater management would be to publish an annual report on stormwater management practices in Kamloops. This report could highlight physical interventions that the City and others have implemented that demonstrate best management practices; summarize and analyze key data that reflect on stormwater (i.e. flow rates, IDF curves); provide updates on Master Watershed Plans; and provide general education for initiatives residents could undertake to better manage stormwater on their own properties. This annual report would be an important communications piece, particularly in terms of promoting the need for a user pay stormwater charge and after a stormwater charge is implemented to provide accountability for the funding collected.

4.7 Policy Updates

Based on the research undertaken for the Policies and Regulations Working Paper, a number of policies and bylaws can be modified to better reflect stormwater management issues.

4.7.1 Erosion and Sediment Control Bylaw

An Erosion and Sediment and Control Bylaw would seek to limit the discharge of sediment from construction activities into the stormwater system. This bylaw would stipulate how erosion and sediment control plans for construction sites would be developed and acted upon. It would also provide guidelines for inspection and outline enforcement and penalties for non-compliance.

4.7.2 Watercourse Protection Bylaw

While the City currently has a Watercourses Regulation Bylaw, it is old and does not have regulations on prohibiting discharge of certain pollutants into watercourses. To help ensure water quality is not compromised a new watercourses protection bylaw should update the previous bylaw and include a more detailed list of substances that are prohibited from being

discharged as well as the type of controls and monitoring required.

4.7.3 Zoning Bylaw

The Zoning Bylaw should be modified to reduce impervious coverage and encourage alternative landscape design that is more sustainable for stormwater management. Impervious coverage could be reduced by setting a maximum for off-street parking stalls, and requiring the use of pervious materials for parking pads. Further, the City should consider maximum impervious area regulations for all zones. Within the landscaping requirements, the City could encourage the use of bioswales, wetlands, and rain gardens for stormwater management.

4.7.4 Subdivision Control Bylaw

The Subdivision Control Bylaw is currently under review. However, moving forward, a series of measures should be included that will better address stormwater management issues in Kamloops. Potential amendments include:

- Require all buildings to disconnect roof leaders, subject to suitable site conditions.
- Require the use of LID to manage stormwater on site, subject to suitable site conditions, specifically when stormwater infiltration may be used.
- Require the use of BMPs to supplement LID where needed.
- Develop alternate road standards to narrow pavement width.
- Allow the use of pervious pavement for parking areas, subject to suitable site conditions.
- Establish prescriptive and performance standards for stormwater runoff volume, rates, timing and quality (see Section 4.3, above).
- Allow flexibility in service levels (e.g., allow the use of open swales in urban areas).
- Encourage depressed boulevards for rain gardens or swales (currently, boulevards are typically required to drain to the curb).
- Require protection of existing trees as well as provision for new tree plantings as part of subdivision development.

4.7.5 Tree Protection Bylaw

The City should review exemptions to the Tree Protection Bylaw. Trees are an important part of stormwater management as they absorb stormwater and slow down its flow. Currently, the bylaw does not apply to trees that are less than 5 m in height or less than 10 cm in diameter and to trees located on property less

than 2 ha in size and zoned Residential, Commercial or Industrial. The City should consider reducing or rewording these exemptions to provide better tree protection.

4.8 Comprehensive Financing Strategy

The City should determine how it plans to finance stormwater management initiatives in the future. Currently, stormwater management is funded through general revenues, development cost charges, and works and services. To ensure long-term financial sustainability, the City should consider developing a comprehensive financing strategy for all elements of its stormwater management service. The financing strategy should include the continued use of development cost charges and works and services to help fund growth-related infrastructure needs. Most importantly, the financing strategy should also introduce the use of a stormwater fee to eliminate reliance on general revenues.

The use of a stormwater fee would:

- Provide a stable and dedicated source of funding for any component of the City's stormwater management service (e.g., engineering analysis, long term capital replacement, operations and maintenance, watershed planning, public education);
- Help ensure that stormwater management services are funded based on the user-pay principle;
- Raise the profile of stormwater management in the community; and
- Allow the City to be proactive about stormwater management.

The development of a stormwater fee, as with other fees, would require the City to address a number of policy questions related to the design and implementation of the fee. The three most important questions the City will have to address are:

- Which services will be funded through the stormwater fee?
- Which user pay approach (i.e., proportionate pay, beneficiary pay, ability to pay, or polluter pay) is most appropriate?
- How will the fee be designed to reflect the user pay approach?

These and other questions would have to be answered while keeping in mind the need to ensure the fee does not become overly complex for the City to administer.

4.9 Master Watershed Plans

A series of individual Master Watershed Plans will be required over the next 10 – 15 years. Upon consultation with various City staff members, MWP updates were prioritized in light of existing and projected population within the watershed; stream and environmental health conditions; flooding, erosion and water quality concerns; and public acceptance issues. With the understanding that each MWP will take approximately one year to complete, the following schedule is proposed for the first five MWPs:

- North Shore
- Peterson Creek
- Guerin Creek
- East Valleyview (Juniper)
- Batchelor Heights / Brocklehurst

The suggested schedule could be altered in the future to accommodate changing conditions such as new development growth patterns. If revisions are made, the scheduled updates should be done in concert with other regional community plans or development strategies to maximize the efficiencies of the multiple initiatives.

To help develop a framework for the future master watershed plan updates, a general scope of work was prepared and can be found in Table 4.1.

4.10 Design Manual for Best Management Practices

The City should develop a design manual outlining best management practices for stormwater management. The manual can provide a more localized approach to various stormwater management techniques and could address the issue of Kamloops' many micro-environments and how to adjust to these. For instance, best management practices for Aberdeen may be quite different than those for Brocklehurst. Further, the BMP's that are to be used in Kamloops should include those that have been successful in climates similar to Kamloops. A list of BMP's that could be used in Kamloops could include but not be limited to: rain gardens, bio-swales, pervious pavements for parking areas and other infiltration-based practices as referenced in the document "Stormwater Source Control Design Guidelines – 2005," published by the Greater Vancouver Regional District.

In addition, the Design Manual should include requirements for site development Stormwater Management Plans and Erosion and Sediment Control Plans. Requirements could include specific items such as: stormwater management approaches (e.g., allowing the use of source control / Low Impact Development measures), detention / retention requirements, design storm requirements, designated IDF (rainfall intensity) data, acceptable hydrology methods (models) for design and analysis, appropriate sediment control measures, etc.

Eventually, these should be incorporated into the Subdivision Control Bylaw where more detail can be specified in the corresponding Design Manual Bylaw schedule.

BMP industry standards are often changing. Therefore, to stay up-to-date, the City should review them every three to five years and revise the manual accordingly.

Table 4.1 –General Outline of Tasks for Master Watershed Plans (MWP) *

Item #	Task
1.	Establish and implement a public consultation process for the update, including convening technical and stakeholders working groups.
2.	Obtain, review and evaluate current and historical mapping, data, reports, etc.
3.	Collect hydrometric (stream flow) and climate data.
4.	Perform hydrometric monitoring for use in modeling effort.
5.	Develop a drainage system and stream inventory (site reconnaissance and survey as required).
6.	Perform hydrogeological and geotechnical assessments; develop a conceptual model of the groundwater regime for the watershed.
7.	Develop land use information, for both existing and potential future built-out (OCP) conditions, including determining impervious surface areas within sub-catchments.
8.	Prepare an inventory of aquatic species and habitat(s).
9.	Determine extent and quality of existing and potential riparian corridors.
10.	Prepare an inventory of terrestrial species and habitat(s).
11.	Establish baseline creek health, through combination of benthic community, water quality and sediment quality sampling.
12.	Prepare base mapping (GIS).
13.	Perform hydrologic analysis of watershed (existing and future conditions); includes development of an appropriate model as well as calibration and verification of the model and validation of model parameters.
14.	Perform hydraulic analysis of existing infrastructure (existing and future conditions), including flood and capacity assessments; includes development of an appropriate model as well as calibration and verification of the model and validation of model parameters.
15.	Assess current and future potential for channel erosion in creek(s).
16.	Assess current and future runoff pollutant loadings, including accounting for application of BMPs.
17.	Assess other natural hazard conditions that intersect with stormwater concerns (e.g., land slide areas).
18.	Identify opportunities for recreation and public access to creeks.
19.	Assess current and future ecological health of creek(s).
20.	Assess implications of climate change on modeling results and on application of BMPs or other mitigative measures.
21	Formulate alternatives to manage flooding, erosion and water quality.
22.	Formulate alternative land use options to minimize negative impacts to creek(s).
23.	Evaluate the alternative management options.
24.	Develop a Master Watershed Plan (MWP) for the watershed. The plan must identify a cost-effective mix of publicly and privately implemented stormwater controls for the watershed.
25.	Develop an implementation plan and timeline that will identify key items such as priority actions, capital improvements, cost estimates, and special financing mechanisms if applicable.
26.	Formulate an adaptive management plan for the watershed over time, including monitoring program(s).
27.	Make recommendations for consideration in other City comprehensive planning processes such as OCP, NCPs, Parks and Recreations plans, etc.
28.	Prepare appropriate documentation.

* **NOTE:** This list of tasks should be considered an overall guide to the work to be completed. The final scope of work will vary with the watershed, as well as perhaps with available funding, and should be prepared just prior to undertaking the work (or issuing a Request for Proposal).

4.11 Stormwater Management Monitoring Program

The City should continue its current practice of maintaining a network of weather stations around the City. We recommend that the Parks and Engineering Departments coordinate downloading and analyzing the data from these stations. Statistical analysis should be completed on the data annually.

The City should establish a stream flow monitoring program. Initially, we recommend establishing two permanent hydrometric stations within a single watershed, preferably on Peterson Creek, with one each on upper and lower sections of the creek. In addition to continuous flow measurements (5 or 15 minute intervals), the station could also collect basic water quality data such as turbidity, temperature and conductivity. Ideally, these stations would be established prior to the commencement of individual watershed plans as the information can be used in calibration of hydrologic models (see Section 2).

The City may wish to develop a broader monitoring program, specifically with respect to water quality though perhaps also with respect to stream flow, that can be used to establish baseline conditions and assess changes over time. Given the number of other critical ISMP initiatives that the City will be pursuing, it seems prudent to await the completion of one or more updated MWPs before embarking on additional expensive monitoring.

4.12 Demonstration Projects

The City should identify some pilot projects that can be undertaken to show leadership for the use of sustainable stormwater practices. A few ideas include:

- Initiate a "1000 Rain Gardens" program to promote the use of rain gardens in the community. The City could establish a goal of working with residents, businesses, and their own Parks department to have 1,000 rain gardens established in the City by 2014 (five years). A rain garden is a concave garden that captures stormwater and provides detention as well as treatment.

Example of a rain garden used for stormwater volume and quality control

- Pilot test permeable pavements on roads. City staff has indicated its concerns with respect to the use of permeable pavement (specifically, permeable asphalt) on City streets. In general in North America, permeable pavement has been used primarily for parking lots, sidewalks and other non-vehicular traffic areas. Although some communities are starting to use it for streets.

Water percolates through porous asphalt to recharge ground water

The City could test permeable pavements in several Kamloops streets to determine if some areas could benefit from its use. Candidate streets include a cul-de-sac and several other low volume residential streets at various elevations around the City. Some of the performance parameters that could be tested include the level of maintenance required, the impact on snow removal, and the deterioration rate of the pavement.

Green streets can increase property values in a community

- Continue to test the Green Streets program. The City should continue the Green Streets program it has started and look for other areas of the community where this program could be implemented. This could be coupled with the testing of permeable pavement.

5.0 IMPLEMENTATION PLAN

With the guiding principles and recommendations set in this Guiding Document an implementation plan was prepared to assist with the development of subsequent ISMP initiatives (see Table 5.1). The following considerations were included in the implementation plan.

5.1 Priority

All of the recommendations are valuable to the implementation of the ISMP. The recommendations were prioritized based on discussions with City staff and on how they best suit the ISMP process. Therefore the recommendations were not prioritized relative to each other. Instead, a priority rating of low (L), medium (M) and high (H) were used.

5.2 Timeline

The recommendation timeframes presented in this plan are approximate and set relative to the completion of the ISMP Guiding Document (Phase 2).

5.3 Task Responsibility

The tasks associated with the recommendations will all require at least some supervision by City staff. However, some tasks may be better suited for outside consultants (coordinating with City staff), for City staff alone or a combination of the two. Action items identified to be done by both City staff and consultants will likely require that City staff play a larger role on the initiative(s).

As recommended in Section 4.3, the ISMP will benefit greatly from oversight by an Internal Stormwater Management Committee dedicated to successful implementation.

5.4 Staffing Resources

Estimates of staffing were made to assist in identifying the City's investment in the ISMP process as it moves forward. Resources are listed in hours.

5.5 Costs

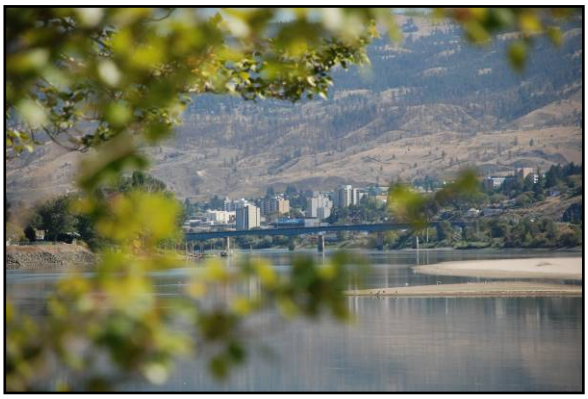
Preliminary cost estimates for each recommendation or task were made and are shown for budgeting purposes. These estimates should be updated under subsequent phases with the completion of more detailed terms of reference. Based on recommendations by City staff, the proposed cost estimates are based on the assumption that consultants will be performing the task(s).

Table 5.1: ISMP Implementation Plan

Task*	Priority (L = Low, M = Medium, H = High)	Timeline (Yrs - based on start date of 2009)	Task Done By: (CY = City, CT = Consultant)	City Staffing Resources Level of Effort (hrs)	Cost ($)
4.1 Council Acceptance in Principle of Integrated Stormwater Management Plan Guiding Document	H	0-1 Yr	CY/CT	80 hrs	5–10K
4.2 Integration with the Official Community Plan and Environmental Plan	H	0-2 Yrs	CY/CT	80 hrs	10–30K
4.3 Internal Stormwater Management Committee	H	0-10 Yrs (on-going)	CY	80 hrs/yr for each of 6 people	5-10k/yr
4.4 Stormwater Control Performance Targets	H	0-2 Yrs	CY/CT	-	-
4.5 Operational Best Management Practices	M	0-2 Yrs	CY	100 hrs	-
4.6 Education Program	H	0-2 Yrs	CY	300 hrs/yr	20 – 50K
4.7 Policy Updates	H	0-5 Yrs	CT	400 hrs	50 – 60K
4.7.1 Erosion and Sediment Control Bylaw	H	0-1 Yrs	CT	-	-
4.7.2 Watercourse Protection Bylaw	H	0-2 Yrs	CT	-	-
4.7.3 Zoning Bylaw	M	0-5 Yrs	CT	-	-
4.7.4 Subdivision Control Bylaw	H	0-2 Yrs	CT	-	-
4.7.5 Tree Protection Bylaw	L	0-5 Yrs	CT	-	-
4.8 Comprehensive Financing Strategy	M	0-5 Yrs	CY/CT	200 hrs	60-80K
4.9 Master Watershed Plans	H	0-12 Yrs	CT	120 hrs/ea	75K/ea
4.10 Design Manual for Best Management Practices	H	0-2 Yrs	CT	80 hrs	20-40K
4.11 Stormwater Management Monitoring Program	H	0-1 Yr	CT	200 hrs/yr	40-60K plus 10-15K/yr
4.12 Demonstration Projects	M	0-5 Yrs	CY/CT	200 hrs per project	40–60K per project

* Task Numbers reference Section 4 of this Guiding Document.

6.0 CONCLUSION



At first glance, the importance of stormwater management in semi-arid climates such as that found in Kamloops may not be clearly evident. However there are several reasons why managing stormwater in Kamloops is important. Without effective stormwater management, environmental values will continue to be at risk. As well, without a comprehensive plan, the City may not be prepared to manage erosion and flooding that can occur during rain events. Finally, without effective stormwater management, Kamloops may not be able to adequately address new risks associated with long-term climate change.

Conventional stormwater management can not adequately address these issues; however through the process of developing its **Integrated Stormwater Management Plan** (ISMP), Kamloops is stepping up and exploring more progressive and effective ways to address stormwater issues within its many watersheds. This **Guiding Document**, which is the primary output of Phase 2 of the ISMP, provides the framework for an overall stormwater management strategy for the City and for the development of individual **Master Watershed Plans** (MWP). A supplement to the Guiding Document, the **Phase 2 Support Document**, contains more detailed data and background assessments which can be used in the development of the MWPs.