

Executive Summary

This report presents an Integrated stormwater Management Plan (ISMP) for the Fishtrap Creek watershed in the City of Abbotsford.

The Fishtrap Creek watershed is approximately 85.1 km² in total, 31.8 km² of which is in Canada. It stretches approximately 21.2 km from headwater in southwest Abbotsford past Lynden, Washington to the Nooksack River in the United States. The watershed is largely agricultural, urban residential, and industrial and drains through three distinct physiographic features, namely the upland areas in southwest Abbotsford, the valley and floodplain in the lowland further downstream, and the low-lying farmlands in the United States. This ISMP study focuses on the watershed tributary to Fishtrap Creek at the Canada/US border.

ISMP Objectives

The purpose of an ISMP is to provide guidance and information on how to proceed with future land development and re-development while protecting and enhancing the overall health and natural resources of the watershed. To mitigate the impacts of developments and to enhance the health of the Fishtrap Creek watershed.

The key issues identified are localized flooding and poor drainage in lowland areas, and overgrown vegetation, beaver dams, and sediment depositions which decrease channel conveyance.

Background Review

A review of existing conditions and data included an initial summary of the watersheds' characteristics and a review of existing bylaws and criteria to manage stormwater and drainage, including municipal, provincial, and federal guidelines and regulations. Key drainage issues and environmental concerns were obtained from background documents and initial stakeholder input. These pertained to ongoing creek flooding, erosion, undersized drainage infrastructure, impacts of recent and future development and the need for protection of fisheries and other environmental values.

Stakeholder Consultation

The stakeholder consultation program included meetings with the municipality, on-line public questionnaires seeking input on the key issues and potential solutions conducted throughout the study. Both written and verbal feedback is received, documented, and integrated in this study.

Stakeholders included:

- City of Abbotsford (Engineering, Planning, Operations, and Parks, Recreation and Cultural);
- Abbotsford Committees - Development Advisory Committee (DAC), Agricultural, Dyking, Drainage, and Irrigation Advisory Committee (ADDIAC);
- Department of Fisheries and Oceans Canada (DFO);
- Ministry of Environment and Climate Change Strategy (MOEENV);
- Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO);
- Ministry of Transportation and Infrastructure (MOTI);
- Agricultural Land Commission (ALC);
- Abbotsford International Airport (YXX);
- BC WA Nooksack River Transboundary Technical Collaboration Group;

- Canadian Home Builders Association (CHBA);
- Abbotsford Ravine Park Salmonid Enhancement Society; and
- Residents of Abbotsford.

Key issues raised were water quality, wildlife presence/habitat, Creek erosion and sediment, invasive species, and flooding.

Land Use, Soils and Hydrology

The existing land uses of the watershed are predominately agriculture (53%), urban residential (11%) and industrial (15%) with suburban residential, commercial, and parks/open space making up the remainder. The urban development is in the northeast portion of the watershed, and rural and agricultural areas in the south and west portions. The total existing impervious area was calculated to be 33%. The future land use saw a minimal change in land use areas with 50% agriculture, 9% Urban residential, and 17% Industrial, however, the total impervious area went up to 48%.

Environmental Assessment

KWL completed a desktop review, field inventory, and assessment of environmental values in the study watersheds including aquatic species and habitats, riparian and watershed forest cover, terrestrial species and habitat, and water quality. Fishtrap Creek watershed contains approximately 17 fish species, including five salmon and trout species, eight native species, and four introduced species. The streams in the western rural/forested uplands provide good spawning and rearing habitat that decreases in the eastern urbanized uplands and the lowlands. Upland terrestrial habitat in the Fishtrap Creek watershed supports a variety of wildlife and plant species outside of riparian forested areas. Small forest patches, hedgerows, grasslands, and old fields, among other habitat types, form a habitat mosaic linking the sub-catchments within the watershed. Several confirmed (5) or potential (2) species at risk were identified and should be taken into consideration in land use planning.

Literature shows that to maintain marginal levels of biodiversity and aquatic ecosystem health 50% of the watershed forest should be protected and that at least one large patch (>200 ha) of forest is present and that urban watershed maintain an RFI of 70-75%. The Fishtrap Creek watershed has 14% forest cover and an RFI of 50.5%. Both are lower than recommended values for a watershed and are predicted to decrease in the future.

Benthic invertebrates are a commonly used indicator of stream health and can be used to track changes in watershed health. Changes in both the species richness and composition of invertebrate communities indicate changes in watershed conditions. The Benthic Index of Biotic Integrity (B-IBI) was used to characterize the composition of the benthic invertebrate community. The mean B-IBI site score was 14, indicating very poor watershed health. Overall taxa diversity was low and dominated by a few highly tolerant taxa.

Results from the two sampling periods show water quality issues throughout the watershed including high water temperatures, low dissolved oxygen levels, high levels of fecal coliforms and E. coli, and high levels of nitrate and total nitrogen. Concerns were noted in East Fishtrap Creek downstream of the Fishtrap Creek Detention Ponds, Waechter Creek downstream of Simpson Road, and lower Fishtrap Creek downstream of Echo Road.

Based on the review of background information, field habitat assessment, and stakeholder engagement, several priority concerns, and recommendations for protecting fish and aquatic habitat within the watersheds were identified.

Drainage Assessment

A hydrologic and hydraulic PC-SWMM model was created for the Fishtrap watershed and drainage system including 8433 sub-catchments, 117 km of storm sewers, 177 culverts, 47 detention facilities, and the creek channels for Fishtrap and its tributaries. The model was calibrated and validated using flow monitoring data collected at the Fishtrap East FLO-DAR and Fishtrap Creek International Border gauges using real storm events from 2014 to 2015. AES design storms for the 10- and 100-year 2-, 6-, 12-, and 24-hour duration events were created using rainfall data from the Abbotsford Development Bylaw. Climate change was also incorporated into the design storms by applying a percentage increase factor as recommended by the Oct 2019 Draft Abbotsford Development Bylaw Update – Climate Change IDF Curves ¹ for the 2020-2100 median.

In the minor and major systems the pipes were determined undersized based on peak flows, duration of pipe surcharge, and water surcharge depth. The existing 10-year minor system was undersized in 4% of the total pipe length (4.45 km out of 111.25 km). In the major system (emergency routes & areas without overland flow paths), for the 100-year existing land use 2.89 km out of 6.15 km of the total pipe length was deficient. The culverts were determined undersized based on peak flows, pipe surcharge, and hydraulic grade line slopes. The culverts were assessed for the 200-year conveyance capacity which resulted in 18% of the culverts being identified as undersized under the existing conditions.

Under future conditions the minor system was undersized in 25% of the total pipe length (25.3k m), the major system was undersized in 3.23 km of pipe length, and 26% of the culverts were undersized.

42 existing detention ponds were assessed. 9 of these meet the 10-year discharge criteria of 5 L/s/ha, 22 exceed the 5 L/s/ha criteria due to an oversized orifice, and 11 exceed the 5 L/s/ha discharge criteria and have insufficient storage.

A 2D model was developed for the lowlands to determine the extent of flooding and any potential conveyance and flooding issues during the 10-year and 100-year design events. This assessment was able to identify 7 potential major flooding areas. The flooding at 3 of these areas were caused by undersized culverts. The flooding in the other 4 areas were caused by shallow channel slopes, low banks, and channel restrictions.

Erosion and Sedimentation

A field reconnaissance and drainage inventory of Fishtrap Creek and its major tributaries were undertaken in April and May 2019. The purpose was to identify erosion locations, significant sedimentation, creek obstructions, small undocumented footbridges, and undocumented drainage infrastructure.

Erosion sites were identified and assigned a hazard and consequence level based on a visual assessment of the measured height of scour or slippage and the proximity of man-made features (sheds, fences, buildings, retaining structures). 13 erosion sites were identified. These included 1 very high risk site, 1 high risk site, 6 moderate risk sites, 3 low risk sites, and 2 very low risk sites.

Channel flow obstructions were classified as beaver, woody debris or other (anthropogenic). Anthropogenic obstructions were refuse in the channel and structures. Most of the observed obstructions were comprised of natural channel obstructions such as fallen trees and accumulations of woody debris. These appear to be caused by bank erosion. 24 obstruction sites were identified. These included 4 beaver dams, 16 woody debris locations, and 4 refuse locations.

¹ Urban Systems (October 25, 2019). Abbotsford Development Bylaw Update – Climate Change IDF Curves – DRAFT

A desktop review and 2019 site reconnaissance was completed to identify areas of steep terrain and instability associated with creeks within the watershed. Overall, the geotechnical hazards noted within the project area included active stream bank erosion and some small-scale slumping and creep along Fishtrap Creek, East Fishtrap Creek and Enns Brook and their respective tributaries. No evidence of large scale, deep-seated instability was noted during the field reconnaissance, or from the data review completed.

Sedimentation continues to occur in several City-owned detention ponds and culverts and has proved challenging for operation and maintenance. The City conducted a pond survey and estimated sediment volumes for several City-owned ponds. Sedimentation is noted for the Fishtrap detention pond (45,700 m³ of sediment), the Gardner detention pond (1,700 m³ of sediment), Ponderosa detention pond (4,600 m³ of sediment), ditches adjacent to detention ponds, Gardner Park Pond, and at the head of the Fishtrap Pond south of Dehavilland Dr.

Mitigation of Impacts of Future Development

The OCP plans for proposed development and redevelopment within the Fishtrap watershed. Multi-unit residential development will significantly increase with densification of urban and suburban residential areas, and industrial will slightly increase with conversion from agricultural land uses. To protect the ecological health of the watershed, the impacts of the proposed development and redevelopment need to be mitigated. Impacts of urban and agricultural land development on watercourses include increased peak flows and total runoff volume, decreased infiltration, and impaired stream water quality.

The primary factors that affect the ecological values of urban streams are changes in hydrology, disturbances to the riparian corridor and to fish habitat, and deterioration in water quality. These factors can be condensed into two measurable watershed health indicators, used in the watershed health tracking system (WHTS) which are watershed imperviousness and riparian forest integrity. The overall goal of the ISMP is to maintain existing watershed health and achieve a no-net-loss for the watershed. A no-net-loss of watershed health would also imply that the benthic index of biological integrity (B-IBI) does not decrease. An effective way to illustrate the predicted consequences of various land use planning decisions is to plot the watershed health indicators. Watershed health tracking uses the relationship between the TIA, RFI and B-IBI scores to quantify predicted changes between existing and unmitigated future land use conditions. The predicted watershed health scores were evaluated for the Fishtrap Creek major sub-catchments. For existing land use, only the Peardonville Creek sub-catchment has a predicted B-IBI score over 20. All sub-catchments are highly or critically impaired and are not likely to support healthy populations of salmon or other once-native life-forms native cold water fish species. The less developed (lower TIA) Upper Fishtrap Creek, Waechter Creek, Peardonville Creek and Lower Fishtrap Creek sub-catchments have the predicted least impaired ecological health. The highly developed (high TIA and low RFI) Lower East and Middle East Fishtrap Creek sub-catchments have the expected poorest watershed health.

The primary goal of the Fishtrap watershed ISMP is to improve watershed health. Future development / redevelopment mitigation focusses on reducing sediment inputs and encroachments, mitigating hydrologic impacts, protecting and enhancing riparian areas, and enhancement projects.

Mitigation Alternatives

Alternatives were developed to address the existing issues (flooding, sedimentation, etc), mitigate the potential impacts of future development, and improve the watershed health. These alternatives were considered and evaluated, for review from the City and stakeholders.

Park Pond Sediment and Water Quality Improvements

There are five on-line detention ponds north of Highway 1 that were built to detain the 10-year post-development flow to reduce flooding in the agricultural lowlands. Their unintended consequences include altered flow regimes, high water temperature, low dissolved oxygen, organic particulate and dissolved nutrient loadings, invasive species and altered sediment transport (interrupted natural instream sediment leading to accelerated erosion downstream that is independent of the urban hydrology).

Actions to address this problem include:

1. Investigate and eliminate high nutrient sources;
2. Dredge sediments and vegetation and modify on-line ponds;
3. Dredge sediments and vegetation and convert the ponds to a creek channel with adjacent marsh benches; and
4. Separate the watercourses and ponds entirely.

Two potential pond improvement concepts for Alternative 3 were developed for discussion purposes with the City.

Water Quality Improvements

The environmental background and sampling identified several water quality issues in the watercourses. Several alternatives are proposed to identify pollutants and treat the water quality of outflows into the creeks, including:

1. Investigate and eliminate high nutrient sources;
2. Aggressively enforce fill and sediment control bylaws;
3. Require on-site source controls for pollutant generating surfaces such as parking lots and roads;
4. Construct community water quality treatment facilities;
5. Adopt best O&M practices for prevention;
6. Install fencing within rural areas to limit creek encroachment;
7. Restore native riparian vegetation; and
8. Combination of above options.

Environmental Restoration and Enhancement Opportunities

A series of environmental restoration and enhancement opportunities were identified which, if implemented, could restore, and enhance the ecological health of the watershed over time. These opportunities could be used to make gains in watershed health or as compensation works to offset impacts from future development or redevelopment.

The potential environmental restoration and enhancement opportunities were grouped under seven broad categories:

1. Fish passage improvements;
2. In-stream habitat restoration;
3. Riparian restoration, fencing and planting;
4. Wildlife corridors;
5. Water treatment opportunities; and
6. Low summer baseflow investigations.

Upland drainage system improvements

The conveyance deficiencies identified can be addressed with the following options to protect property and infrastructure:

1. Upgrade undersized structures;
2. Allow more surcharging and overland flows in some areas where it is safe to do so;
3. Improve detention deficiencies;
4. Accept a reduced level of service; and
5. Combination of above options.

Existing Detention Facilities

Potential alternatives for addressing the 11 deficient detention facilities that are overflowing are:

1. Modify detention criteria;
2. Increase the detention volume;
3. Apply stricter criteria elsewhere; and
4. Reconfigure facilities in series.

Lowland Flooding

Seven flooding areas in the lowlands were identified as requiring improvements and four of those were locations where there were restrictions in the channel conveyance capacity before spilling out into neighbouring areas. The other three flooding areas (Areas 1, 2, and 3) appear to be due to culvert capacity constraints.

The conveyance along areas 4, 5, 6, and 7 can be increased by lowering the channels/culverts to a more favorable slope, widening the channels, and raising neighboring land to prevent flooding.

Potential channel improvements may include:

1. Restoration of channel and riparian areas to appropriate morphology, form, and function;
2. Work with streamside landowners to identify appropriate land uses within flood affected areas and mitigate impacts of inevitable overbank events;
3. Aggressively enforce fill and sediment control bylaw;
4. Undertake investigations into sources of nutrients throughout the watershed; and
5. Consider enhanced beaver control where animal presence is impairing watercourse function or restoration activities or causing unacceptable flooding.

Erosion Mitigation

Erosion sites were identified during the field work and previous studies. There was one very high-risk site on the west tributary to Enns Brook, and one high risk site on middle Fishtrap Creek mainstem upstream of Marshall Road. These sites should be rehabilitated because they are causing damage to adjacent infrastructure. There were 10 moderate to low risk erosion sites and 18 woody debris jams (which are related to erosion) also identified.

The following are options for addressing the instream erosion:

1. Rehabilitate and stabilize high risk sites;
2. Continue to maximize infiltration;
3. Re-slope and revegetate banks;
4. Reconnect / re-establish floodplain areas;
5. Apply spot treatment of discrete erosion sites;
6. Stabilize proactively; and
7. Monitor erosion sites.

Mitigate the Impacts of Development

Maintaining flows in the watercourses at their current values, or moving toward returning flows to pre-development (forested) conditions, could be accomplished by one or more of the following:

1. Minimize imperviousness;
2. Maximize on-site and community full infiltration in permeable soils;
3. Implement on-site volume reduction source controls; and
4. Continue detention requirements.

Stormwater Program Review

Over the years, the City has developed stormwater management policies on a City-wide scale through bylaws and a watershed scale through ISMPs. The recommended Fishtrap Creek watershed criteria and bylaws include:

1. Develop restricted and special requirement areas to protect human/property safety and the environment;
2. Water quality treatment to treat stormwater prior to discharge to watercourses;
3. Reduce runoff volume to preserve baseflows and minimize downstream erosion and habitat degradation; and
4. Reduce runoff peaks to minimize downstream erosion and habitat degradation.

The City's development bylaw should also be updated with the following:

1. develop green road standards for stormwater treatment and volume reduction; and
2. develop examples and standards for Stormwater Source Controls to aid with implementation.

Existing Bylaw Revision and Enforcement – includes enhancing the Tree Protection Bylaw to require compensation for <20 cm diameter trees, enforcing the Streamside Protection Bylaw with no-net-loss variances except for creek crossings, and enforcing the Erosion and Sediment Control Bylaw.

Fishtrap Creek Integrated Stormwater Management Plan

The overall ISMP for the Fishtrap Creek watershed, developed together with the City and stakeholders, consists of components for:

- Drainage system upgrades;
- Lowland flooding reduction;
- Erosion and sedimentation management;
- Requirements to mitigate the impacts of future development;
- Environmental restoration and enhancement projects; and
- Municipal stormwater management program (bylaws, standards, monitoring, etc.) recommendations.

Table 9-1 summarizes the recommended ISMP projects, including cost estimates, implementation priority, and responsibility for implementation. The implementation includes Immediate Works, 5-year Plan, 25-year Plan, At Time of Development, and Long-Term Plan Initiatives.

Table 9-1: Fishtrap Creek ISMP Plan & Implementation Strategy

Proposed ISMP			Priority	All Costs	City Capital Program	City Yearly Maintenance Monitoring	City Studies/ Policies	Misc	Responsibility	Priority of Works Totals			
										Immediate	5-Year	25 Year	LT
Flood Management									Subtotal	\$0	\$39,550,000	\$15,050,000	\$390,000
1	Lowland Flood Management Plan			\$1,950,000	\$1,950,000	\$0	\$0	\$0					
	Manage beaver dams and sediment that is typically trapped by them. Enlarge channel and berm bank to convey 10-year flow. Continue vegetation management in lowland creek sections.	5-Year Plan	\$480,000	\$480,000				City Engineering & Enviro. Services ³	\$480,000				
		5-Year Plan	\$1,470,000	\$1,470,000					\$1,470,000				
		Ongoing											
2	Upland Culvert and Storm Sewer Upgrades			\$53,040,000	\$53,040,000	\$0	\$0	\$72,400,000					
	Construct 5-Year Plan priority conveyance projects (36 culverts and 50 selected storm sewers). Construct 25-Year Plan conveyance projects (69 selected storm sewers).	5-Year Plan	\$37,600,000	\$37,600,000				City Engineering	\$37,600,000				
		6-10-Year Plan	\$1,050,000	\$1,050,000					\$1,050,000				
		11-25 Year Plan	\$14,000,000	\$14,000,000					\$14,000,000				
	Construct End-of-Life conveyance projects (10 selected storm sewers). Construct development conveyance projects (19 culverts & 359 selected storm sewers).	End-of-Life	\$390,000	\$390,000				Developer	\$390,000				
		At time of development							\$72,400,000				
Erosion Management									Subtotal	\$390,000	\$800,000	\$220,000	\$0
3	Rehabilitate Existing Erosion Sites and Mitigate Erosive Flows			\$750,000	\$700,000	\$0	\$50,000	\$0					
	Bank stabilization for two high priority sites. Stabilize with bioengineering the 10 moderate/low risk erosion sites. Perform erosion inventory (every 5 to 10 years).	Immediate	\$200,000	\$200,000				City Engineering & Environmental Services	\$200,000				
		5-Year Plan	\$500,000	\$500,000					\$500,000				
		Ongoing	\$50,000			\$50,000			\$50,000				
4	Existing Detention Facility Modifications for Erosion Management ¹			\$660,000	\$660,000	\$0	\$0	\$0					
	Complete Priority 1 detention facility modifications. Complete Priority 2 detention facility modifications. Complete Priority 3 & 4 detention facility modifications.	Immediate	\$140,000	\$140,000				City Engineering	\$140,000				
		5-Year Plan	\$300,000	\$300,000					\$300,000				
		25-Year Plan	\$220,000	\$220,000					\$220,000				
Sediment Management									Subtotal	\$5,500,000	\$0	\$0	\$0
5	Sediment Removals			\$5,500,000	\$5,500,000	\$0	\$0	\$0					
	Remove accumulated sediment and detritus from ponds. Undertake design to reconfigure Fishtrap Ponds. Continue sediment removals at existing sediment traps.	Immediate	\$5,400,000	\$5,400,000				City Engineering & Environmental Services, PRC	\$5,400,000				
		Immediate	\$100,000	\$100,000					\$100,000				
		Ongoing			ongoing								
Mitigation of the Impacts of Future Development (Requirements for All Development)													
6	Protect Riparian, Ravine, and Wildlife Areas to Protect Stream Health, Ravine/Slope Stability and Wildlife Habitats												
	Require appropriate riparian and geotechnical setbacks. No variances on riparian setbacks . Required use of Species at Risk setbacks. Establish or enlarge protected areas to provide several large core habitat areas for wildlife. Establish designated Wildlife Corridors for connectivity between large core habitat areas.	At time of development							Developer City Enviro. & Dev. Services Approval City Engineering MOTI				
7	Construct Hydrologic Volume Reduction Measures to Maintain Baseflows and Minimize Downstream Erosion and Habitat Degradation												
	Maximize low impact development techniques. Construct Stormwater Source Controls (bio-retention rain gardens or swales, pervious pavers, absorbent soil layers, green roofs, rainwater harvesting & reuse, etc.). Size to capture 72% of the 2-year, 24-hour event (53mm). No source controls in geotechnical setbacks. Regional facilities for baseflow augmentation (sustain baseflows).	At time of development											
8	Construct Stormwater Quality Treatment Measures to Treat Runoff Prior to Discharge to Watercourses												
	Size to treat 90% of average annual runoff (approx. 72% of the 2-year, 24-hour event (53 mm). Construct Stormwater Source Controls (rain gardens, vegetated swales, vegetated pervious pavers) to filter contaminants from roads and parking lots. Alternatively consider regional water quality facilities such as wetlands and wet ponds. Construct oil/grit separators as spill control devices for gas stations, high risk spill industry, large parking lots. Provide Erosion and Sediment Control measures during construction.	At time of development											
9	Construct Hydrologic Rate Control Measures to Minimize Downstream Erosion, Habitat Degradation and Flooding												
	Size to detain 10-year storms to 5 L/s/ha, or detain 100-year storms to 5 L/s/ha if a safe major flow path can't be identified. Construct detention/infiltration.	At time of development											

Proposed ISMP			Priority	All Costs	City Capital Program	City Yearly Maintenance Monitoring	City Studies/ Policies	Misc	Responsibility	Priority of Works Totals				
										Immediate	5-Year	25 Year	LT	
Environmental Enhancement Projects										Subtotal	\$0	\$670,000	\$411,000	\$0
10	Riparian Restoration and Planting													
	On Municipal Lands: Remove high priority invasive plant species & plant native shrubs/trees. Remove debris from riparian area. Remove medium and low priority invasive plant species, plant native shrubs and trees.		5-Year Plan 25-Year Plan					\$67K \$35K + \$50/m²	City Enviro. Services					
	On Private Lands outside the ALR: Work with landowners to plant native shrubs and trees along riparian corridors where gaps in the riparian area exist.		25-Year Plan				\$25K	City Enviro. Services						
	On Private Lands within the ALR: Work with landowners to remove high priority invasive plant species and plant native shrubs and trees along riparian corridors where gaps exist. Work with landowners to remove medium priority invasive plant species and plant native shrubs and trees.		5-Year Plan 25-Year Plan				\$580.5K \$500K	City Enviro. Services						
11	Wildlife Corridor s													
	On Municipal and Private Lands: Work with property owner of 2767 Townline Road (PID: 001-679-074) to create a 400 m long forested corridor to link Gardner Park & Fishtrap Creek detention ponds.		Ongoing					\$25,000 + \$50/m²	City Enviro. Services					
12	Fish Passage			\$223,000	\$0	\$0	\$223,000							
	On Municipal Lands: Investigate feasibility of replacing culverts to allow for fish passage. Investigate whether structure/culvert is a fish barrier.		5-Year Plan 25-Year Plan	\$64,000 \$159,000			\$64,000 \$159,000		City Enviro. Services	\$64,000	\$159,000			
13	In-stream Habitat Restoration			\$290,000	\$0	\$252,000	\$38,000							
	On Municipal Lands: Study effective strategies to remove invasive in-stream plant species. Remove debris & create instream habitat complexity.		5-Year Plan 25-Year Plan	\$38,000 \$252,000		\$252,000	\$38,000		City Enviro. Services	\$38,000	\$252,000			
	On Private Lands outside the ALR: Work with developer/landowner to remove existing retaining wall & replace with bank regrading and riparian planting.		25-Year Plan					\$88,000	City Enviro. Services					
	On Private Lands within the ALR: Work with landowner to restore section of creek.		5-Year Plan				\$88,000	City Enviro. Services						
14	Water Treatment Opportunities			\$463,000	\$0	\$0	\$463,000							
	On Municipal Lands: Investigate the sources of water quality issues. Identify opportunities to improve water quality.		5-Year Plan	\$463,000			\$463,000		City Enviro. Services	\$463,000				
15	Low Summer Baseflow Investigations			\$105,000	\$0	\$0	\$105,000							
	On Municipal Lands: Investigate cause of low summer baseflows.		5-Year Plan	\$105,000			\$105,000		City Enviro. Services	\$105,000				
Municipal Stormwater Management Program										Subtotal	\$40,000	\$130,000	\$50,000	\$0
16	Bylaws and Standards (Apply Municipality Wide)			\$30,000	\$0	\$0	\$30,000							
	Update the City's Development Bylaw (2011) with the following: Develop green road standards for stormwater treatment and volume reduction (see CICIP road cross sections for an example). Enforce City's Erosion & Sediment Control and Streamside Protection Bylaws . No variances. Enhance and enforce City's Tree Protection Bylaw in all areas of the watershed. Update GIS and Watercourse Classification mapping based on field survey findings.		Immediate Immediate Immediate Immediate	\$30,000			\$30,000		City Engineering City Development Services	\$30,000				
17	Further Studies in Fishtrap Creek Watershed			\$160,000	\$0	\$0	\$160,000							
	Develop a Beaver Management Plan.		Immediate	\$10,000			\$10,000		City Engineering & Enviro. Services	\$10,000	\$100,000 \$50,000			
	Conduct additional creek surveys to complete the inventory in all tributaries.		5-Year Plan	\$100,000			\$100,000							
	Conduct public engagement on invasive fish and plant species in the watershed.		25-Year Plan	\$50,000			\$50,000							
18	Watershed Monitoring													
	Conduct watershed performance monitoring & adaptive management approach (every 5-years min)		Every 5-years minimum	\$30,000			\$30,000		City Engineering & Enviro. Services	\$30,000				
Note: Refer to Figures 8-1 to 8-8 1. Assume \$20k per facility. 2. Include 20% engineering costs, 8% mob/demob, 40% contingency. 3. Enviro. Services = Environmental Coordinators in Dev, Planning Division.			Totals	\$63,201,000	\$61,850,000	\$252,000	\$1,099,000	\$72,576,000	\$63,201,000	\$5,930,000	\$41,150,000	\$15,731,000	\$390,000	
											\$63,201,000			
			Priority	All Costs	City Capital Program	City Yearly Maintenance Monitoring	City Studies/ Policies.	Black	Responsibility	Immediate	5-Year	25 Year	LT	