Memo

City of Kelowna

Date: October 26, 2010

File: 1520-01

To: City Manager

From: General Manager, Community Services

Subject: Historic Storm Water Management and Current Practices

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Recommendation:

THAT Council receive for information the report from the General Manager, Community Services dated October 26, 2010.

Purpose: This report is in response to the following Council resolution dated August 23rd, 2010: "That Council directs staff to report back to Council with respect to historic storm water management and any challenges it may create."

Background:

The City of Kelowna has a unique storm drainage system that reflects local climatic conditions, soil conditions that exist in various areas, historic development activities and efforts by the City to implement best management practices. This report will provide a broad overview of those factors. Recognizing that the Council resolution was prompted as a result of the July 31st, 2010 Stewart Center fire and its impacts on Mill Creek and Okanagan Lake, this report will also provide information related to the major fire response and subsequent actions by our Drainage Utility group.

Due to a combination of factors such as low annual precipitation, suitable soil conditions in many areas, and large rural areas; the use of ditches, swales and soak away road shoulders was the standard of development in many areas of the city throughout the early years of development. With increased urbanization, building density and development in areas with poorer soil conditions, the use of piped networks was implemented. At this time there is some 412 kilometers of roadway served by ditches, swales and gravel road shoulders to provide drainage within the community and some 362 kilometers of piped network. The City's storm drainage system also has some 70 storm detention facilities, 9,000 storm drains, 1,750 drywells, and 31 oil/grit separators.

From a policy and bylaw perspective prior to 1991 the City's storm drainage design standards were approximately a 2 year storm event. Since that time development design standards require a 5 year storm event piped network and a 100 year storm event for major overland flows. This is consistent with other communities throughout Canada. In addition, new development properties must design to ensure flow releases from their development do not exceed the flow rates from that property prior to development. This is typically achieved by on-site storage or by soak away of excess waters.

In the late 1990s an Environmental Review of drainage resulted in changes to city standards and priorities to minimize the impacts of storm drainage on our creeks and Okanagan Lake. The Review found that storm drainage flows had significant impacts on aquatic life, particularly fish, due to the high volumes of water discharged in a short time period. Coming from this review the City put a very high emphasis on soaking away storm water wherever possible, installation of flow detention devices to slow down velocities, installation of water quality enhancement devices such as sediment traps and oil grit removers, and enhanced maintenance practices with increased cleaning frequencies. It should be noted that due to the massive volumes of water involved in storm drainage as well as water quality, the approach of running these waters through a treatment plant is not practiced throughout the world. There are some older cities that installed a single combined storm and sanitary pipe through which all waters flow to the treatment plant though typically with a significant rainfall this system directly discharges a combined flow untreated into their receiving streams. This practice has been discontinued due to its negative environmental impact.

Through the annual budget process the City spends approximately $1.6M in maintaining the drainage systems and on average approximately $1.5M annually in capital improvements. Over the years Council has approved improvements to many neighborhoods that were experiencing flooding during extreme rainfall events, upgrades to aging infrastructure, upgrades to major trunks and creeks to handle major events, and water quality enhancement devices. Maintenance programs including cleaning off all storm drains annually, cleaning pipes every 10 years, inspecting creek channels and clearing as necessary and water quality monitoring programs to assess creek health.

The Stewart Center fire occurred July 31st late on a Saturday evening during the August long weekend. The Fire Department, recognizing the building contents, called city storm drainage personnel out early during the fire. Due to the intensity of the fire, the Fire Department was using 9000 liters of water per minute and approximately 3,000,000 liters of water to extinguish the fire and protect surrounding buildings. Due to the volumes involved the blocking of storm drains and area lines was not possible without causing significant flooding. The storm line in the area also carries natural underground streams so there is flow in the pipe at all times. Flows began entering Mill Creek early in the morning and reached Okanagan Lake by Sunday afternoon. Early into the response the company storing and selling the fertilizers and pesticides called in outside environmental expertise who took over the response to the chemical spillage that had occurred. They brought in resources to conduct the water quality monitoring, collect and remove all possible contaminated liquids, cleanup the creek and storm drainage system, and cleanup the fire site.

Key points coming from the fire and chemical spill include:

1) Pesticides and fertilizers fully mix with water and therefore cannot be removed by settlement devices or other storm water treatment devices such as stormceptors.
2) Volumes involved were extremely large. A vacuum truck would fill in less than one minute. There is no place in the Central Okanagan with capacity to store this volume of contaminated water. Uncertainty with which chemicals specifically were involved and to what concentrations also limited potential immediate actions.

3) The Fire Dept did take measures to limit water flow directly onto the products but again the intensity of the fire required high volumes to be used in dealing with the fire and protecting nearby properties.
4) This product could not be put into the sanitary sewer system. It would have killed our biological treatment process and resulted in hundreds of millions of liters of partially treated sanitary sewage entering Okanagan Lake.
5) Staff were able to redirect a significant portion of Mill Creek to the Mission Creek using the Mill Creek diversion structure. This significantly delayed the flow reaching Okanagan Lake.

From the Regional Emergency Operations Center perspective which involved staff, MOE, IHA, building owner and environmental responders, the spill was handled as promptly and effectively as possible under the circumstances. Univar Canada must be acknowledged for their prompt and comprehensive response by bringing in an environmental response firm. Without which outcomes may have been considerably worse.

Staff have been reviewing what has been learned from the incident and could be used in establishing a best practice for future incidents. Items that have been identified include:

1) Incidents of similar nature will occur again in the future in Kelowna and almost any city in the world.
2) Major fire responses can result in impacts to drainage systems and downstream receiving streams and lakes. These can include debris, heated water, various chemical constituents, and even chlorine from the water system, which depending on their volumes and concentrations, can have a negative impact on aquatic life. The Fire Dept demonstrated their sensitivity to these factors during this incident.
3) Staff have and are continuing to network with other municipalities throughout Canada to see if there are better practices elsewhere. While the networking will continue, to date no better practices have been found elsewhere that would have reduced the impact of the incident that occurred.
4) Utilities staff have worked closely with the Fire Department to identify potential high risk locations throughout the City so as to be more knowledgeable and better prepared for a future incident. Some 1,500 businesses have been identified to have materials that could create varying levels of risk should a similar fire occur.
5) It would be a great benefit to the City to have on an ongoing retainer, a qualified resourced environment response firm that could assist the City in a future incident. They can provide expertise beyond the City's abilities and also have access to outside resources to assist in the response.

The impact to Mill Creek and Okanagan Lake of such a spill is a very undesirable with its impact on fish and other aquatic life as well as impacting public use of beaches. Staff will continue to look for strategies and best practices to minimize the impacts should this happen again.

Internal Circulation: Utility Services Manager, Utilities Network Supervisor, Drainage Network Technician, Fire Chief, Communications Director, Risk Manager

Considerations not applicable to this report:

Legal/Statutory Authority:
Legal/Statutory Procedural Requirements:
Existing Policy:
Financial/Budgetary Considerations:
Personnel Implications:
External Agency/Public Comments:
Community & Media Relations Comments:
Alternate Recommendation:

Submitted by:

John Vos
General Manager - Community Services

cc: Internal Circulation

City of Kelowna

STORM WATER MANAGEMENT

Historic Overview, Current Practices, and Major Fire Response

City of Kelowna

UNDERLYING LOCAL CONDITIONS

- Low annual precipitation, good climate
- Large rural style development in early years
- Favorable soil conditions in many areas
- Use of gravel shoulders and ditches in early years
- Piped networks as increased density, urbanization, and soil conditions warranted

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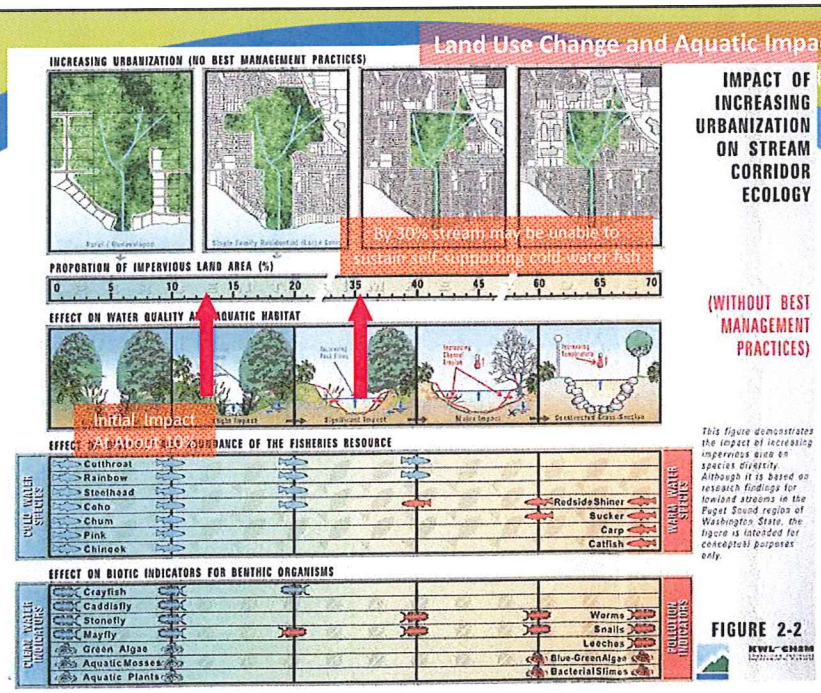
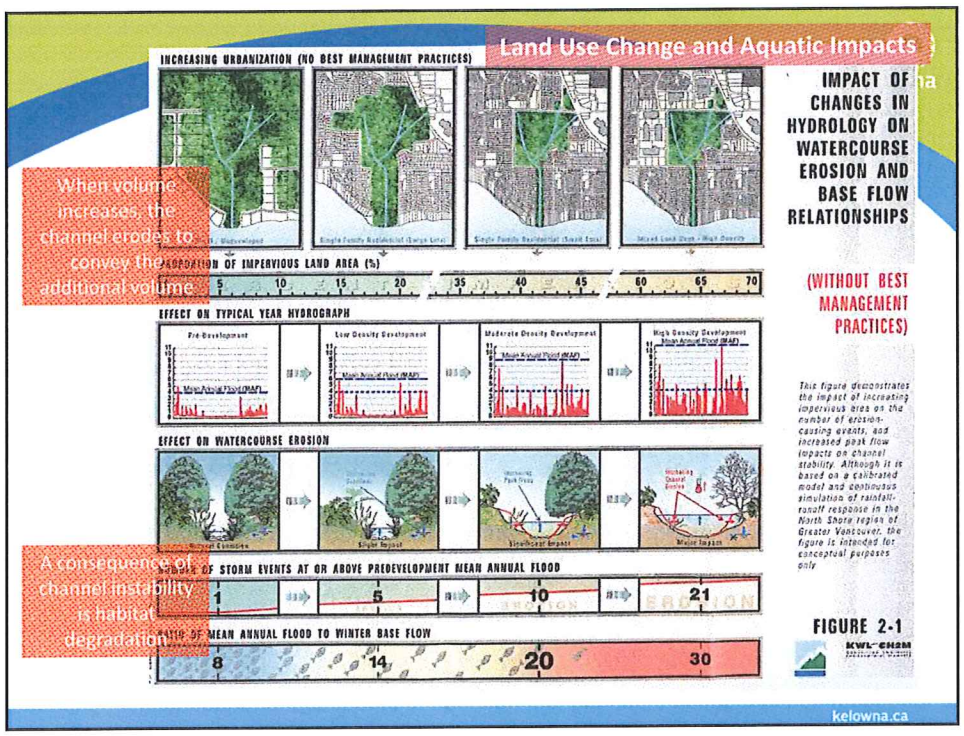
SERVICING STANDARDS

- Set through Subdivision Bylaw and Council Policies
- Early standards – 1 in 2 Year Storm Event
- 1992 Drainage standard review – 1 in 5 Yr Storm for piped networks, 100 Yr for overland flows
- 1998 Environmental Review of Drainage

Land Use Change and Aquatic Impacts




Land Use Change and Aquatic Impacts
When volume increases, the channel erodes to convey the additional volume
A consequence of channel instability is habitat degradation
INCREASING URBANIZATION (NO BEST MANAGEMENT PRACTICES)
IMPACT OF CHANGES IN HYDROLOGY ON WATERCOURSE EROSION AND BASE FLOW RELATIONSHIPS
(WITHOUT BEST MANAGEMENT PRACTICES)
PROPORTION OF IMPERVIOUS LAND AREA (%)
5 10 15 20 35 40 45 60 65 70
EFFECT ON TYPICAL YEAR HYDROGRAPH
Pre-Development
Low Density Development
Moderate Density Development
High Density Development
EFFECT ON WATERCOURSE EROSION
Slight Impact
Significant Impact
Major Impact
NUMBER OF STORM EVENTS AT OR ABOVE PREDEVELOPMENT MEAN ANNUAL FLOOD
1
5
10
21
RATIO OF MEAN ANNUAL FLOOD TO WINTER BASE FLOW
8
14
20
30
This figure demonstrates the impact of increasing impervious area on the number of erosion-causing events, and increased peak flow impacts on channel stability. Although it is based on a calibrated model and continuous simulation of rainfall-runoff response in the North Shore region of Greater Vancouver, the figure is intended for conceptual purposes only
FIGURE 2-1
KWL-CHRM
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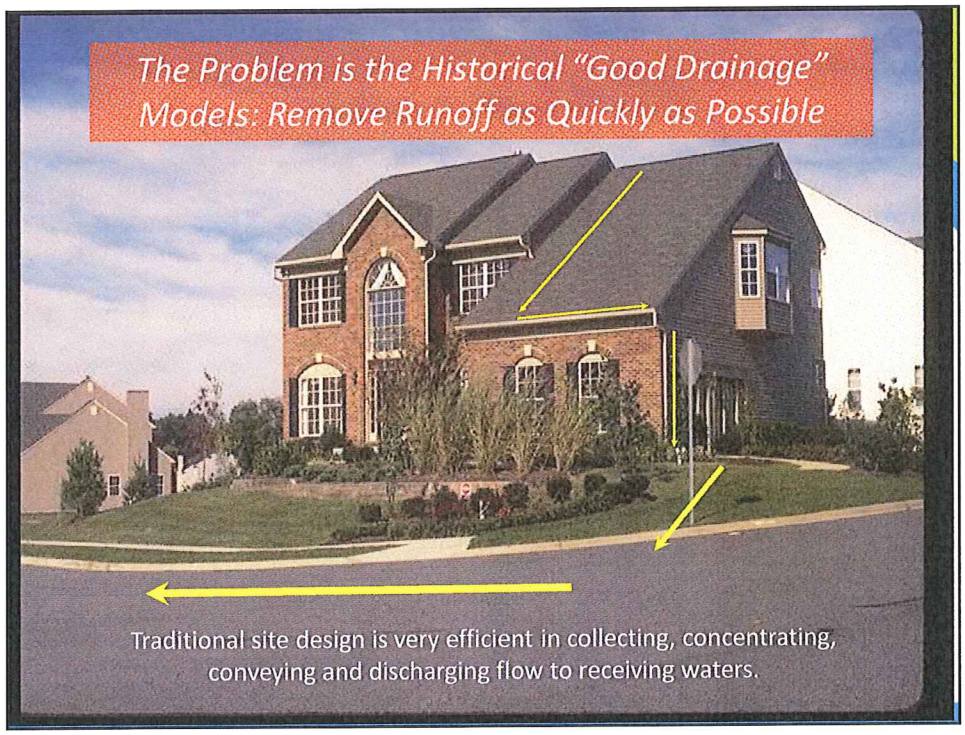

The Problem is the Historical "Good Drainage" Models: Remove Runoff as Quickly as Possible
Traditional site design is very efficient in collecting, concentrating, conveying and discharging flow to receiving waters.

ENVIRONMENTAL REVIEW FINDINGS

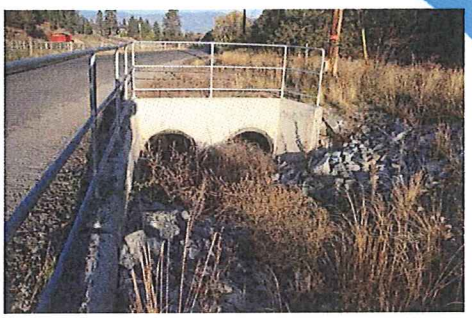
- Major investments in structural Best Management Practices (BMP) can moderate impacts but will not reverse the pattern.
- By the time pollutant loading is a measurably significant factor, the hydrological changes resulting from land use densification would have already flushed out the habitat.

ENVIRONMENTAL REVIEW - ACTIONS

- Require soak away wherever possible
- Onsite detention and flow release at pre development rates
- Installation of detention facilities to slow release to streams
- Installation of treatment devices at key locations

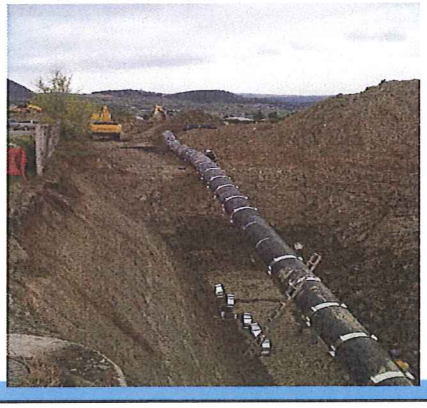
CURRENT DRAINAGE INVENTORY

- 412 km of roads with ditches or gravel shoulders

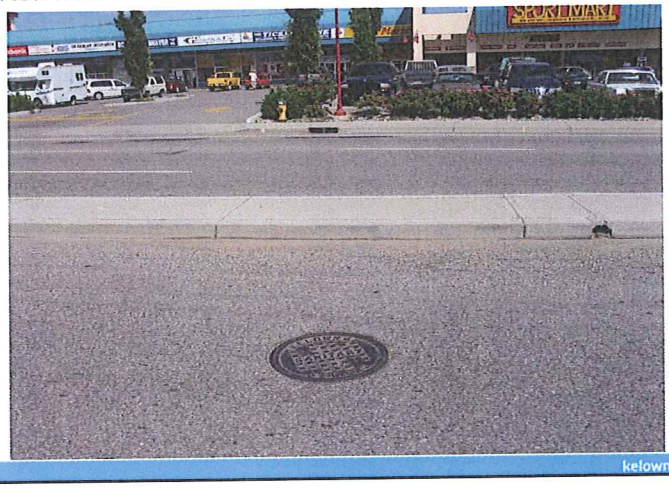
CURRENT DRAINAGE INVENTORY

- 362 KM OF PIPES
- 123 OUTFALLS INTO LAKE AND CREEKS
- 69 KM OF PERFORATED PIPE



CURRENT INVENTORY

- 9095 Storm Drains
- 4849 Manholes



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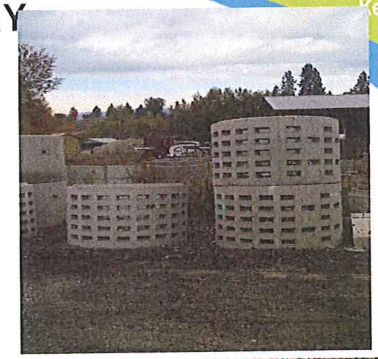
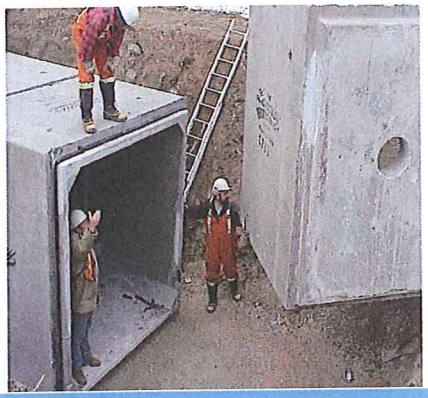
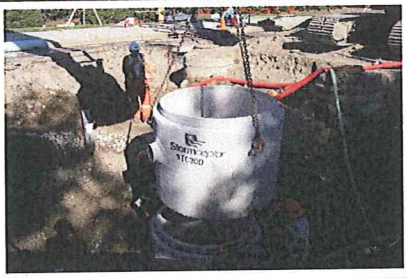
CURRENT INVENTORY

- 31 Oil Grit Separators
- 70 Storage/Treatment
- 1766 Drywells







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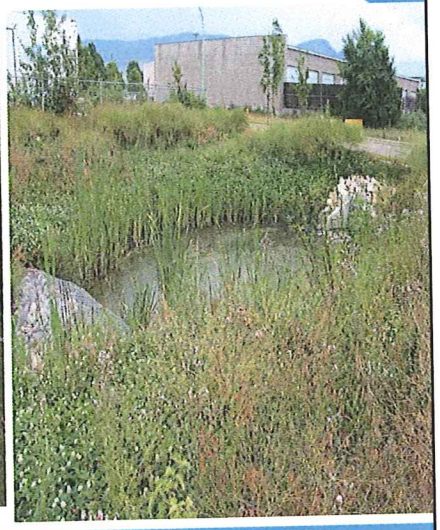
STORM DETENTION/TREATMENT FACILITIES



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BUDGET

- Network Annual Maintenance - $1,250,000
- Ditch/Shoulder Maintenance - $ 437,000
- Annual Capital - average $1.5M
- Staff - 8 operating, 2 technical/engineering
- Total value of network system - over $500M

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OPERATING BUDGET SERVICE LEVELS

- Clean 10% of pipes, manholes annually
- Clean 100% of storm drains and oil/grit separators
- Cleaning and grading of ditches, culverts and gravel shoulders as required
- Repairs to aging infrastructure
- Cleaning of blockages in creek channels
- Flooding response
- Inspection of key infrastructure
- Comprehensive water quality monitoring of creeks and storm outfalls

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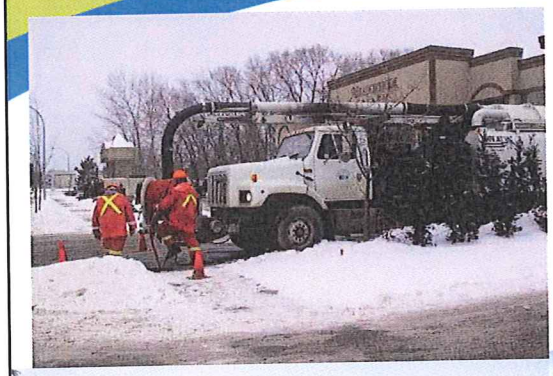

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STORM DRAINAGE - MAJOR FIRE IMPACTS

STORM DRAINAGE - MAJOR FIRE IMPACTS

- High volumes of water
- Potential environmental impacts
  - Heated water
  - Chlorinated water
  - Debris, soils, and soot
  - Materials used in building construction and furniture/equipment stored inside
  - Products stored in buildings (chemicals, petroleum products, organic products)

STORM DRAINAGE- MAJOR FIRE IMPACTS

- Drainage response issues
  - Flow and overall Volumes
  - Uncertainty of products in water
  - Availability of resources and expertise

MAJOR FIRE EXAMPLE - STEWART CENTER FIRE

- Saturday Evening, July 31, 2010
- 9,000 liters of water per minute, approx 3,000,000 liters total
- Pesticides and fertilizers as well as other fire debris into storm drains

MAJOR FIRE EXAMPLE - STEWART

- DRAINAGE RESPONSE ISSUES
  - High volumes - Unable to contain onsite or load into trucks
  - Would fill vacuum truck in less than 1 minute
  - Unknown chemical concentrations
  - No place with size to store these volumes
  - Storm line has underground streams flowing into it
  - Products fully mixed with fire water

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STORM FLUSHING/VACUUM TRUCK

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MAJOR FIRE RESPONSE - STEWART FIRE

- DRAINAGE RESPONSE
  - Thru EOC brought in MOE and specialist environmental response agency
  - Captured and stored about 2.5 M liters of contaminated water for treatment, hauled to Lower Mainland for treatment
  - Special environmental testing
  - Cleanup of storm drainage system and creek
  - Temporary diversion of most of Mill Creek flow via Diversion structure

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MILL CREEK DIVERSION

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DRAINAGE - MAJOR FIRE RESPONSE

City of Kelowna

- LESSONS LEARNED, ACTIONS UNDERWAY
  - Similar fire and drainage system, likely similar outcome, worldwide
  - Identify with Fire Dept higher risk businesses and locations (1500 identified) to better position future responses
  - Networking with other municipalities/agencies to seek out best practices (none better found to date)
  - Consider positioning corporation with special environmental response firm on retainer

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