TOWN OF CRESTON

STORMWATER MANAGEMENT MASTER PLAN

FINAL REPORT

FEBRUARY 20, 2026



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STORMWATER MANAGEMENT MASTER PLAN

FINAL REPORT

CLIENT: TOWN OF CRESTON

PROJECT NO:

DATE: FEBRUARY 20, 2026

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FIRST ISSUE				
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THIRD ISSUE				
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January 28, 2026	Draft Report			
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FINAL REPORT				
February 20, 2026	Final Report			
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EXECUTIVE SUMMARY

PURPOSE OF THE PLAN

The Stormwater Management Master Plan (SMMP) provides the Town of Creston with an updated assessment of its stormwater system under existing and future climate conditions. Using hydrologic and hydraulic modelling, climate-adjusted rainfall data, and field observations, the Plan identifies system performance issues, evaluates risk, and recommends targeted upgrades, operations improvements, and funding strategies to support long-term municipal planning.

SYSTEM PERFORMANCE OVERVIEW

Assessment of the existing drainage network shows a clear difference between the performance of the minor (underground) system and the major (overland) system:

- The minor system does not reliably meet the 5-year level of service. Older, small-diameter pipes, shallow grades, and inconsistent sizing mean many segments operate near or above capacity during relatively common storm events. This increases the risk of surcharging, backpressure at manholes, and overflow at low points.
- The major overland system performs relatively well during heavy rainfall, allowing most runoff from larger events to move predictably along roads, swales, and channels toward Dodd's and Glaser/King Creek.
- Localized issues persist in several roadway sags where ponding or diversion toward private property can occur. These locations can be addressed through targeted interventions.
- Climate change intensifies system strain. Under 2080s RCP 8.5 rainfall projections, surcharging and surface ponding become more frequent and severe, highlighting the need for proactive upgrades.

Overall, findings indicate that full replacement of the storm sewer system is neither necessary nor cost-effective. A phased approach focused on targeted local improvements and strengthening the major system offers the best value.

RECOMMENDED APPROACH

It is recommended that Creston implement a combination of strategic infrastructure upgrades, operational enhancements, policy tools, and funding mechanisms.

TARGETED INFRASTRUCTURE IMPROVEMENTS

- Address localized overland flooding issues at identified sag areas.
- Upgrade undersized culverts on Dodd's Creek and Glaser/King Creek to reduce overtopping and roadway washout risk.
- Implement downtown drainage enhancements:
    - Cook Street: bioswale to improve conveyance and infiltration.
    - Canyon Street: green-street retrofit with LID features to support revitalization goals.
- Deliver development-driven upgrades in growth areas (Devon St., Cavell–Devon, Glaser Dr., Glaser/King Creek re-channelization) consistent with the DCC program.

OPERATIONS & MONITORING

- Routine inspection of high-risk sags, inlets, and culverts.
- Enhanced vegetation management and inlet cleaning.

- Selective water quality monitoring at key outlets.
- Improved asset record-keeping and linkages to renewal planning.
- Manhole-to-catch-basin lid replacements in surcharge-prone areas.

POLICY & PROGRAMMING

- The planned rechannelization of Glaser/King Creek as a planned new development upgrade that conflicts with setback requirements outlined in the Official Community Plan. Resolve this by pursuing a design alternative (in collaboration with the development community) or amending the OCP.
- Establish a dedicated stormwater reserve to support renewal and leverage grants.
- Encourage lot-level controls (e.g., rain-barrel rebate pilot, roof-leader redirection), including incentive programs where feasible.
- Integrate green infrastructure options into future design stages where feasible.

CAPITAL COSTS & IMPLEMENTATION TIMELINE

The Stormwater Management Master Plan establishes a phased capital program to address flood risk, system deficiencies, and future climate impacts in a financially manageable manner. Cost estimates are provided at a **Class D (conceptual)** level, reflecting system-wide planning rather than detailed design, and are intended to support long-term budgeting, prioritization, and grant applications.

The **total estimated capital program is approximately $18.1 million**, including a 30% contingency. This total represents the full infrastructure replacement value of recommended upgrades; the Town's net contribution will vary by project depending on grant funding and Development Cost Charge (DCC) recovery.

Implementation is structured across three horizons. **Short-term (0–5 years)** investments focus on immediate risk reduction through localized overland drainage improvements, select manhole lid conversions in surcharge-prone areas, and priority culvert upgrades where roadway overtopping is a risk. The short-term program is estimated at **$3.24 million**, equating to an average annual investment of approximately **$0.65 million**.

The **medium-term (5–10 years)** program addresses conveyance deficiencies along Dodd's Creek and introduces targeted downtown system enhancements, including green infrastructure opportunities where feasible. This phase is estimated at **$9.35 million**, or approximately **$1.87 million per year**, and is intended to be coordinated with downtown revitalization, transportation upgrades, and potential grant funding for nature-based solutions.

Long-term (10+ years) investments include culvert upgrades Shikurski Park and development-driven stormwater works within the King/Glaser Creek corridor, delivered as growth proceeds under the DCC program. These works are estimated at **$5.54 million** and are expected to be implemented over an extended horizon (~ 30 years).

In addition to capital upgrades, the Plan recommends strengthening **annual operations, maintenance, and system renewal funding**, including a **$0.78 million per year** allocation for opportunistic pipe renewal coordinated with road and utility projects.

Table ES-1: Summary of Capital Program by Phase

Implementation Phase	Primary Focus	Estimated Cost (incl. 30% contingency)
Short-Term (0–5 years)	Overland drainage fixes, priority culverts, manhole lid conversions	$3.24 M
Medium-Term (5–10 years)	Major culvert upgrades, downtown system enhancements	$9.35 M
Long-Term (10+ years)	DCC-driven upgrades and remaining culvert works	$5.54 M
Total Capital Program	**All recommended upgrades**	**$18.13 M**

SUMMARY

Overall, the SMMP provides the Town of Creston with a clear, implementable roadmap to reduce flood risk, adapt to future climate conditions, and manage stormwater infrastructure in a cost-effective manner. By focusing on targeted upgrades, operational improvements, and coordinated implementation with First Nations and agency partners, the Plan supports resilient infrastructure investment while strengthening environmental stewardship and long-term municipal decision-making.

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D ASSUMED MANHOLE INFORMATION

E PUBLIC WORKS ENGAGEMENT AND SITE WALK MEMO

F PROJECTS OPC

G FUTURE UPGRADES PIPE SIZING TABLE

1 BACKGROUND

1.1 INTRODUCTION

The Stormwater Management Master Plan (SMMP) for the Town of Creston (Town) will serve as a long-term strategy for stormwater infrastructure planning, flood risk mitigation, and environmental protection. The Town's existing Master Drainage Plan (Dayton and Knight 1982) was developed in 1982 and it does not account for modern hydrologic conditions, recent urban expansion, or climate change impacts. Creston has grown considerably in the ensuing years, and it has also been subject to increasingly intense storm events, leading to storm sewer capacity limitations, overland flooding, and erosion issues. The 2014 flooding along Erickson Road highlighted vulnerabilities in the drainage system, and recent studies have identified further risks due to sedimentation, erosion, and peak flow surges. Additionally, climate change is driving more frequent and intense rain-on-frozen-ground events, which limit infiltration and exacerbate runoff-related challenges.

Development of the SMMP includes a comprehensive assessment of the existing stormwater system to develop strategies that enhance flood resilience, protect watersheds, and support sustainable urban growth. The plan is being developed to align with Creston's climate action and community sustainability goals, ensuring that future stormwater management practices are adaptive, efficient, and environmentally responsible.

1.1.1 PROJECT SCOPE

The Stormwater Management Master Plan (SMMP) will provide a structured approach to managing stormwater challenges in the Town. The study will:

- **Assess Existing Infrastructure –** Identify system deficiencies, capacity limitations, and flood-prone areas.
- **Develop a Stormwater Model –** Use hydrologic and hydraulic modeling to analyze existing and future conditions, incorporating RCP 8.5 climate projections.
- **Identify Improvement Strategies –** Recommend infrastructure upgrades and Low Impact Development (LID) measures to enhance flood mitigation and stormwater management.
- **Review Policies & Regulations –** Evaluate municipal policies and propose amendments to align with best practices.
- **Develop a 20-Year Capital Plan –** Prioritize stormwater investments with phased implementation and cost estimates.
- **Engage Stakeholders & the Community –** Facilitate collaboration to inform decision-making and promote sustainable stormwater management.

The key objectives of the SMMP are summarized below:

OBJECTIVE	PURPOSE
Flood Risk Reduction	Minimize overland flooding and drainage issues.
Infrastructure Resilience	Ensure stormwater assets can withstand future climate conditions.
Water Quality Protection	Improve stormwater treatment to minimize impacts on local water bodies.
Sustainable Growth	Integrate stormwater best practices into urban planning.
Cost-Effective Planning	Balance infrastructure upgrades with nature-based solutions.
Regulatory Compliance	Align with provincial and federal stormwater regulations.
Community Engagement	Increase public awareness and stakeholder participation.

1.2 STUDY AREA

The Town is located in southeastern British Columbia, within the Regional District of Central Kootenay (RDCK). It is situated in the Kootenay River Valley, bordered by the Purcell Mountains and the Town of Erickson to the east, the Selkirk Mountains to the west, Kootenay Lake to the north, and the U.S. border (Idaho) to the south. Creston is within the unceded traditional territory of the Yaqan Nukiy, a member community of the Ktunaxa Nation. With a population of approximately 5,900 residents (as of 2023), it serves as a regional hub for agriculture, tourism, and small-scale manufacturing. The Town's landscape is characterized by urban, suburban, and rural areas, encompassing residential neighborhoods, commercial districts, industrial zones, and expansive agricultural lands.

The study area for the SMMP encompasses the entire Town, including residential, commercial, industrial, and agricultural zones. The Town's stormwater drainage system discharges into key natural watercourses, including Dodd's Creek, Goat River, and the Kootenay River floodplain. **Figure 1** showcases the study area.

Key features of the study area include:

- **Urban Areas:** The downtown and surrounding neighborhoods have a mix of impervious and pervious surfaces, with stormwater primarily managed through an existing storm sewer network, ditches, and culverts.
- **Agricultural and Rural Areas:** These regions usually contribute overland flow and the associated sediment load may influence water quality in downstream receiving bodies.
- **Major Watercourses:**
    - **Dodd's Creek:** A primary drainage channel within Creston, which has experienced capacity exceedances and erosion issues.

- **King Creek:** A secondary drainage channel located within Creston. It originates near 16th Avenue, flows northwest, and ultimately discharges into Glaser Creek at Devon Road.
- **Glaser Creek:** Another secondary drainage channel within Creston that begins at the confluence with King Creek at Devon Road. It continues northwest along the southwestern base of Arrow Mountain.

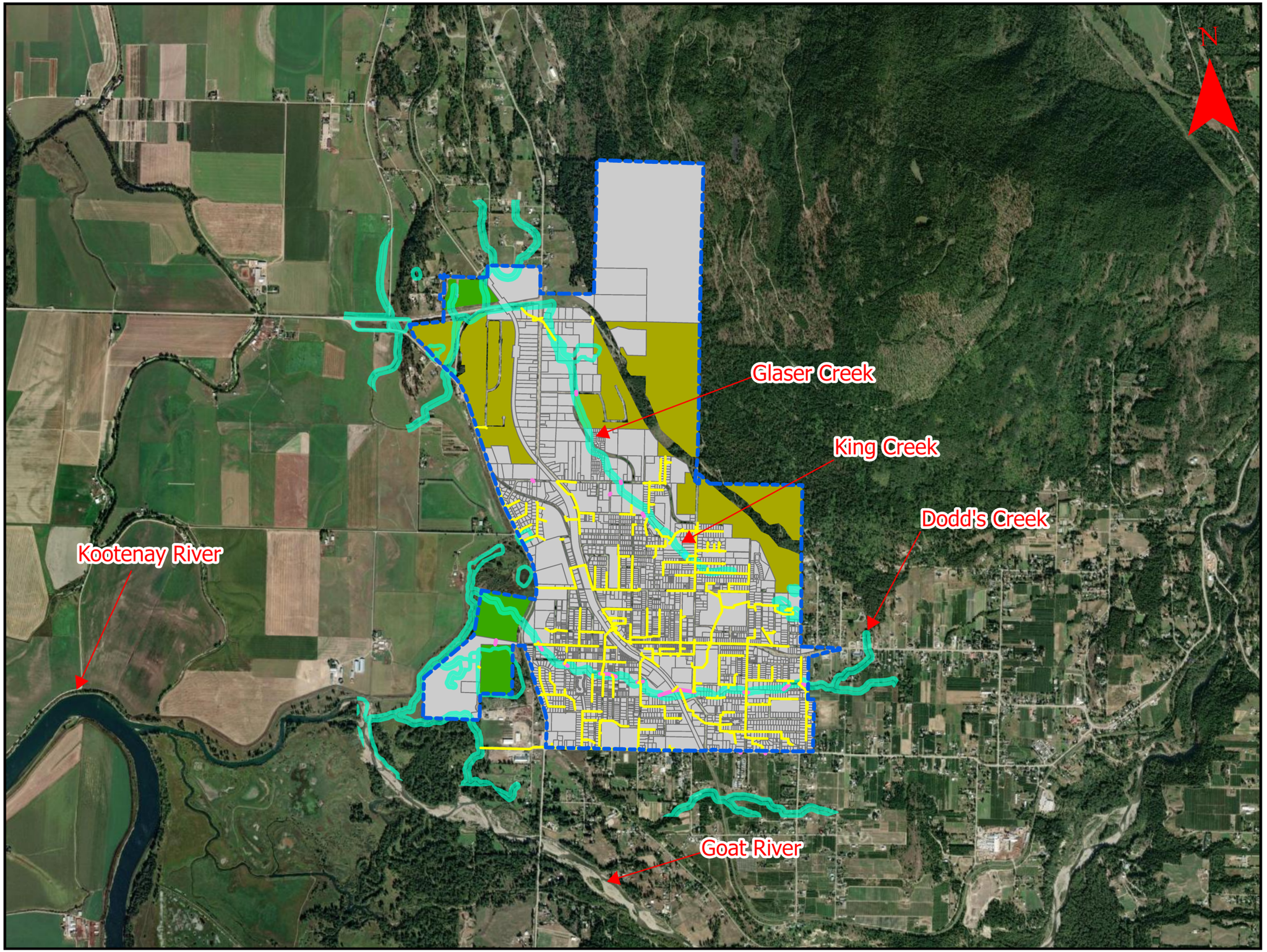
1.2.1 TOPOGRAPHY AND DRAINAGE PATTERNS

Creston's topography (**Figure 2**) plays a crucial role in shaping its stormwater management challenges. Located within the Kootenay River Valley, the Town is bounded by the Purcell Mountains to the east and the Selkirk Mountains to the west, with an elevation ranging from approximately 530 meters above sea level (masl) in low-lying areas near Dodd's Creek to over 1100 masl in the surrounding hills close to Arrow Mountain. The terrain features a gradual slope towards the low-lying Kootenay River floodplain, with some local depressions and concentrated overland flow paths.

The Town's stormwater network consists of a mix of gravity-driven storm sewers, culverts, roadside ditches, and natural channels, including the following:

- 30.6 km of storm pipes
- 400 storm manholes
- 106 catch basins (with gaps in cataloging)
- 921 m of culverts
- 5.3 km of roadside ditches
- 6.9 km of drainage channels (natural and constructed)
- Two stormwater ponds (detention areas) along Glaser/King Creek (private facility at 1608 Northwest Blvd and Town facility at Schikurski Park (703-12 Ave N.)

Stormwater from Creston discharges into several receiving waterbodies including Dodd's Creek (which discharges west to Goat River), Glaser & King Creek (flowing north) and surrounding wetlands. While these watercourses are susceptible to seasonal fluctuations, sedimentation, and erosion, it is some natural flood attenuation and water quality enhancement is likely provided by riparian buffer areas and the wetland complex.



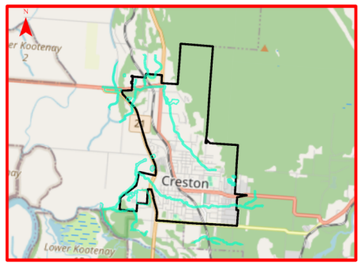
CRESTON VALLEY
TOWN of CRESTON

PROJECT

TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE

FIGURE 1
STUDY AREA



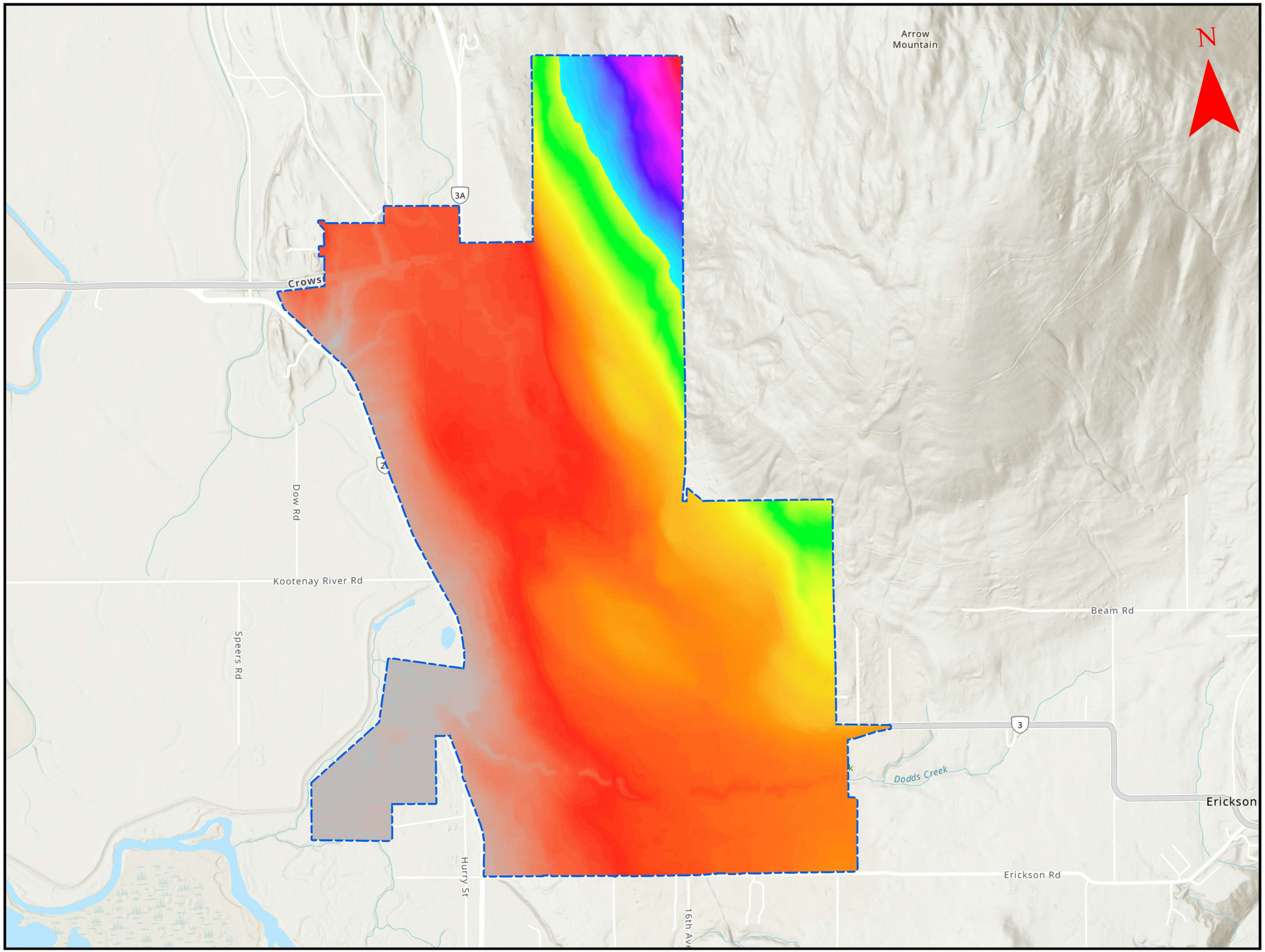
Legend

- MunicipalBoundary
- Watercourse
- Culverts
- Storm Pipes
- Agricultural
- Rural
- Urban Areas

0 0.33 0.65 1.3 km

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August 2025			
NAD 1983 UTM Zone 12N			
1:27,858			

wsp



CRESTON VALLEY

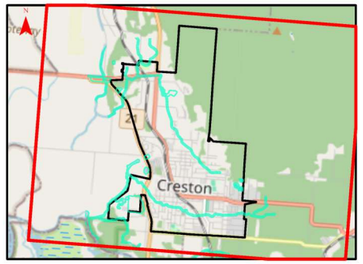
TOWN of CRESTON

PROJECT

TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE

FIGURE 2
DIGITAL ELEVATION MODEL OF CRESTON REGION (LIDAR-DERIVED)



Legend

MunicipalBoundary_Exp

Creston_LiDAR_Cr

Value

1108.77

531.951

NOTE:
- WOODLAND CARIBOU (SOUTHERN MOUNTAIN POPULATION) CRITICAL HABITAT COVERS WHOLE MAP.
- AMERICAN BADGER JEFFERSONII SUB-SPECIES CRITICAL HABITAT COVERS WHOLE MAP.

0 0.23 0.45 0.9 km

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August 2025	
NAD 1983 UTM Zone 12N	
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2 DATA COLLECTION AND REVIEW

A robust data collection process was undertaken to support the development of the Stormwater Management Master Plan (SMMP) for the Town. This process involved gathering existing planning documents, spatial data, as-built records, design criteria, and identifying data gaps to facilitate a comprehensive evaluation of the stormwater system. This data provides a foundation for hydrologic and hydraulic modeling, infrastructure assessment, and policy recommendations.

2.1 BACKGROUND REPORTS

DRAINAGE STUDY – TOWN OF CRESTON (1982)

Creston's first comprehensive master drainage plan, completed in December 1982, provided the foundation for stormwater management within the municipality. It aimed to guide system design, infrastructure upgrades, and drainage policy development.

Key technical elements included the following:

- Identification of alluvial, glacio-lacustrine, and deltaic soils, along with shallow bedrock, as critical to design affecting infiltration, erosion control, and construction methods.
- Introduction of a minor/major drainage system approach, recommending a 5-year return period design standard for the minor system and a 100-year standard for the major system (e.g. roadways, overland flow, and culverts).
- Guidance for calculation of stormwater flows (Rational Method), selection of rainfall intensities, culvert design and management of stream velocities.
- Lot-level drainage guidance including the connection of foundation drains to storm sewers, discharge of roof leaders to splash pads or storm sewers and the use of gravity vs. pumped service connections.

DEVELOPMENT OF IDF CURVES UNDER A CHANGING CLIMATE (2015)

The *Development of IDF Curves Under a Changing Climate* report was commissioned by the Town of Creston, in collaboration with Columbia Basin Trust, to update the Intensity-Duration-Frequency (IDF) curves used for stormwater infrastructure design. Traditional IDF curves are based on historical climate data, assuming steady rainfall patterns over time. However, climate change is causing more intense and frequent extreme rainfall events, increasing the risks of infrastructure failure and increased flooding. This study provides future IDF projections for Creston to ensure stormwater management systems remain effective in the coming decades.

The study utilized the IDF_CC Tool, a web-based platform that integrates historical climate data with outputs from global climate models (GCMs) to project future rainfall intensities. Three future time horizons were assessed: the 2020s (2010–2039), the 2050s (2040–2069), and the 2080s (2070–2099). Climate projections were analyzed using three Representative Concentration Pathways (RCPs) low (2.6), medium (4.5), and high (8.5). However, given that global emissions trends are tracking above even the worst-case RCP 8.5 scenario, all stormwater infrastructure analyses were based on the RCP 8.5 projections.

Results indicated significant increases in rainfall intensity compared to historical IDF curves. The average increases in rainfall intensity under RCP 8.5 were estimated at 16% by the 2020s, 26% by the 2050s, and 42% by the 2080s across all durations and return periods. To evaluate the impact of these changes, the study assessed a test case: a culvert on Dodd's Creek at 5th Avenue. Under the projected IDF curves, the flow from a 5-year storm in the 2080s would be only 13% lower than the flow from a 100-year storm in 1983, demonstrating how climate change will increase flood frequency and magnitude. The projected 5-year flow rates increased by 15% to 36%, while 100-year flow rates increased by 16% to 29% between the current IDF values and future projections.

Study findings highlight the need for updated stormwater infrastructure design standards in Creston, recommending that future drainage infrastructure be designed based on the IDF curve corresponding to the infrastructure's expected lifespan. For instance, culverts with a 25-year design life should use 2050s IDF curves, while major infrastructure like bridges (75–100 years) should consider 2080s IDF projections. Other key recommendations included the exploration of alternative stormwater management approaches, such as detention ponds, infiltration systems, and green infrastructure, to help mitigate the impacts of climate change on stormwater systems.

Overall, this study provides a critical decision-making tool for Creston, ensuring that future stormwater infrastructure and flood management policies consider increasing rainfall intensities and help the Town adapt to a changing climate.

SOUTHEAST DRAINAGE BASIN STUDY (2017)

The Southeast Drainage Basin Study was commissioned by the Town of Creston to assess the capacity, performance, and future resilience of the storm drainage system within the Erickson Road area, which drains into Dodd's Creek (Dead Horse Creek). This study was initiated due to increasing concerns over climate change-induced extreme rainfall events and recent overland flooding issues, notably impacting residential properties in the spring of 2014. The objective was to evaluate the existing stormwater infrastructure, assess potential flood risks under future climate conditions, and recommend cost-effective flood mitigation solutions to inform future stormwater management improvements and policy decisions.

The study, conducted by WSP Canada Group Ltd., involved a hydrologic and hydraulic assessment using EPA-SWMM modeling to evaluate system performance under 5-year, 10-year, and 100-year storm events. Climate change impacts were analyzed using updated IDF curves from the 2015 Town of Creston IDF study, specifically following RCP 8.5 projections, which predict increasing rainfall intensities over time. Additionally, Rain-on-Frozen-Ground (ROFG) simulations were conducted to assess runoff behavior during early spring thaws when infiltration is reduced due to frozen soil conditions. The study also included a comprehensive review of stormwater infrastructure, analyzing storm sewer networks, culvert crossings, and overland flow routes (OFRs) to identify capacity limitations and vulnerabilities. Based on these assessments, conceptual servicing alternatives were developed and evaluated, focusing on on-site detention, system diversions, and off-site detention basins.

The study identified several system deficiencies, including under-capacity storm sewers, flow restrictions in Dodd's Creek at key culvert crossings (25th Avenue, 20th Avenue, and the CPR rail corridor), and obstructions in overland flow routes originally identified in the 1982 Creston Drainage Study due to urban development. Climate change modeling results indicated that rainfall intensity increases under RCP 8.5 projections could result in a 30–60% increase in flood volumes by the 2050s, further stressing the existing stormwater system. The Rain-on-Frozen-Ground (ROFG) scenarios also highlighted additional flood risks, as melting snow combined with heavy rainfall reduces infiltration and increases runoff, exacerbating urban flooding potential.

To mitigate these risks, the study proposed several flood mitigation alternatives. These included on-site detention and pipe capacity upgrades to manage peak flows within the existing system, diversion of stormwater to alternative discharge points to alleviate pressure on Dodd's Creek, and construction of off-site detention facilities to capture excess runoff before it enters the urban drainage network. These alternatives were assessed based on feasibility, cost, and effectiveness in reducing flood risks.

The study concluded that a comprehensive, multi-faceted approach is required for sustainable stormwater management. Key recommendations included capacity upgrades for critical drainage infrastructure, implementation of on-site detention requirements for new developments, preservation and restoration of overland flow routes to prevent urban drainage bottlenecks, and the development of stormwater management policies integrating climate resilience into future infrastructure planning. These findings provide a foundation for long-term flood mitigation planning, supporting the Town of Creston's efforts to adapt to climate change impacts while ensuring sustainable stormwater infrastructure development.

GOAT RIVER – RDCK FLOODPLAIN AND STEEP CREEK STUDY (2020)

The Goat River Floodplain and Steep Creek Study (2020), commissioned by the Regional District of Central Kootenay (RDCK), assessed flood risks along an 11 km stretch of the Goat River near Creston, British Columbia. The study aimed to update historical floodplain mapping, evaluate flood hazards, and support land use planning, policy development, and emergency response strategies. The assessment was prioritized due to the high flood risk associated with the Goat River, which has a history of damaging flood events impacting infrastructure and properties.

The study used hydrological and hydraulic modeling to characterize flood hazards under different return periods (20, 50, 100, 200, and 500-year events), utilizing a two-dimensional (2D) hydraulic model to estimate flood extents, depths, and velocities. Climate change projections were incorporated using Representative Concentration Pathway (RCP) 8.5, which represents a high-emission scenario developed by the Intergovernmental Panel on Climate Change (IPCC). RCP 8.5 assumes unmitigated greenhouse gas (GHG) emissions, leading to significant global temperature increases, altered precipitation patterns, and more frequent extreme weather events. In the context of the Goat River, these changes are projected to result in higher flood volumes, earlier snowmelt, and increased peak flows, amplifying flood risks for the region.

Historical aerial imagery and channel change mapping from 1958 to 2019 revealed ongoing bank erosion, channel migration, and sediment deposition, further contributing to flood hazards. The study identified that certain dike structures near Highway 21 may be overtopped during a 200-year flood event, highlighting vulnerabilities in the existing flood protection infrastructure. Additionally, sediment accumulation in key areas increases the risk of localized flooding and reduced channel conveyance capacity over time.

To mitigate these risks, the study recommended dike upgrades, erosion protection measures, and improved floodplain management policies. It emphasized the need for ongoing flood hazard monitoring and periodic assessment updates to address the dynamic nature of the Goat River and evolving climate conditions. The findings serve as a critical resource for the RDCK and local authorities in developing long-term flood mitigation strategies and enhancing community resilience against future flood events.

2.2 PLANNING DOCUMENTS

The following planning documents were reviewed to evaluate how existing policies, sustainability goals, and regulatory framework may influence stormwater management in Creston:

- **Integrated Community Sustainability Plan (2013):** The Cultivating Creston ICSP advances stormwater resilience by promoting compact growth, protecting natural areas, and limiting new impervious surfaces. It encourages water-conserving development, low-impact landscaping, and site designs that reduce runoff and improve infiltration. By emphasizing resource efficiency, ecological protection, and coordinated land-use and transportation planning, the plan establishes a strong foundation for LID, green infrastructure, and watershed-sensitive urban development.
- **Official Community Plan (2017):** The OCP outlines long-term land use, development, and environmental stewardship objectives. Key guidance relating to stormwater management includes the following:
    - It prioritizes low-impact, watershed-based stormwater management, emphasizing infiltration, retention, and natural asset protection.
    - DPA 2 (Dodd's & Glaser-King Creeks) imposes the strongest stormwater controls, requiring QEP-prepared plans, no increase in post-development flows, water-quality treatment, and a 15 m riparian setback along open and culverted channels.
    - Form-and-character DPAs (3–8) require on-site stormwater retention/infiltration, no net increase in overland runoff, and use of LID practices such as rain gardens, permeable surfaces, and vegetated buffers.
    - OCP infrastructure policies direct the Town to integrate green infrastructure (e.g., rain gardens, cisterns, dry wells) and use parks, greenways, and creek corridors as functional stormwater assets.
    - Growth management policies focus development within the Residential Growth Containment Area, limiting expansion of stormwater infrastructure and reducing downstream impacts.
    - Development on steep slopes, flood-prone lands, and environmentally sensitive areas is discouraged to minimize runoff, erosion, and flood risk.
- **Multi-Modal Transportation Plan (2022):** The plan outlines a 30-year vision for an integrated, sustainable network that reduces emissions, improves safety, and enhances community livability through active transportation and regional partnerships. It supports stormwater resilience by by narrowing paved areas, adding vegetated boulevards and buffers, and creating new green space through curb and street redesigns. Expanded walking and cycling corridors can incorporate absorbent surfaces, while reduced vehicle use lowers pollutant buildup and makes the street network more compatible with LID and future stormwater retrofits.
- **Downtown Revitalization Plan (2023):** The plan envisions a vibrant, walkable downtown by transforming Canyon Street into a complete street, enhancing public spaces, and reducing car-centric design. Guided by community input and local policy, it aims to improve accessibility, support mixed-use development, and strengthen the long-term vitality of Downtown Creston. Key elements relating to stormwater include:
    - Promotion of green infrastructure/LID (rain gardens, swales, permeable paving, absorbent landscaping) in both public and private realm.
    - Streetscape concepts that incorporate landscaped curb extensions, boulevard rain gardens, and street trees to enhance infiltration and manage runoff.
    - Expansion of the urban forest with canopy targets, minimum soil volumes, and climate-adaptive species to improve interception and cooling.

    - Minimization of impervious surfaces and use permeable surfaces or soil cells where hardscape dominates.
    - Winter-effective design, including snow-storage accommodation and landscape features that maintain stormwater performance year-round.
- **Climate Action Plan (2023):** The Town's Climate Action Plan focuses on reducing greenhouse gas emissions and adapting to climate change. It directs Creston to develop and implement a stormwater plan, flood management plan, and extreme-weather response plan; incorporate green infrastructure (rain gardens, permeable surfaces, green roofs); use native, water-efficient landscaping; reduce water use and system leakage; and prepare infrastructure for more intense rainfall and flooding driven by climate change.
- **By-laws:** Key bylaws pertaining to stormwater management include the following:
    - **Drainage Bylaw No. 1417** – Establishes stormwater connection standards, overland drainage regulations, and development requirements.
    - **Zoning Bylaw No. 1958** – Defines land use designations, impervious surface limitations, and development restrictions in flood-prone areas.
    - **Works and Services Bylaw No. 1170** – Specifies infrastructure requirements for new developments, including stormwater system standards and conveyance regulations.
    - **Fees and Charges Bylaw No. 1763** – Outlines financial provisions related fees and development cost charges including stormwater connection fees.

2.3 SPATIAL DATA

GIS-based spatial datasets were provided by the Town of Creston to facilitate infrastructure mapping and hydrologic analysis. The key datasets include:

- **Shapefiles for buildings, roads, and stormwater infrastructure**, including storm pipes, manholes, culverts, ditches, and drainage channels.
- **Contours and Digital Elevation Model (DEM)** to assess topography, drainage divides, and flow paths.
- **2025 Cadastral and Zoning Information** to analyze land use, impervious surface distribution, and potential development impacts.
- **Ortho Imagery** to validate land cover, identify unrecorded drainage features, and assess vegetative buffers along waterways.

2.4 DRAWINGS

As-built files for select developments (**Figure 3**) provide details on installed stormwater infrastructure, including pipe sizes, invert elevations, and design specifications:

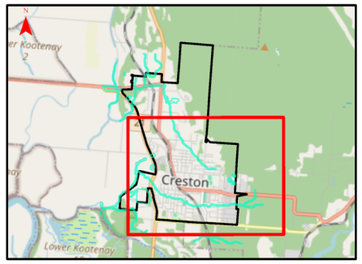
- Hawkview Ph 1 2007
- Hawkview Ph 2 2008
- McLaren Ph 1 2007-10

- McLaren Ph 2 (2020)
- Wigen (12th Ave N) – 2014
- 1710 Murdoch (K. Naef June 2019) Signed IFC
- McLaren Ph 3 (2023)

CRESTON VALLEY
TOWN of CRESTON

PROJECT
TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE
FIGURE 3
AS-BUILT LOCATIONS



Hawkview
Wigen
McLaren
1710 Murdoch St.
Beam Rd
Crowsnest Hwy
Creston
Schikurski Park
Creston Valley Hospital & Health Centre
Rotary Mini-Park
Canyon Street Walkthrough Park
Millennium Park
Burns Park
Kinsmen Park
Centennial Park & Spray Park
Dodds Creek
Glaser Creek
Devon St
Valleyview Dr
Highway 21
Cavell St
Scott St
Ibbitson St
Regina St
Dale St
Alder St
Hurl St
Hillside St
Pine St
Canyon St
Cook St
Birch St
Ash St
Erickson Rd
Arrowsmith St
Davis Rd
Hurry St
Northwest Blvd
6th Ave N
9th Ave N
10th Ave N
4th Ave N
5th Ave N
11th Ave N
20th Ave N
22nd Ave N
26th Ave N
27th Ave N
5th Ave S
8th Ave S
9th Ave S
20th Ave S
N

Legend

- Storm Pipes
- MunicipalBoundary

0 0.13 0.25 0.5 km

DRAWN BY	AM	CHECKED BY	KU
August 2025			
NAD 1983 UTM Zone 12N			
1:11,411			

2.5 DESIGN CRITERIA BASIS

System design will be guided by Creston's design guidelines from the previous MDP (Dayton and Knight 1982), supplemented by British Columbia's provincial standards (BC 2002) and best practices in Low Impact Development (LID) (MOECP 2022). Additional guidance may be drawn from established resources including Low Impact Development Stormwater Management Planning and Design Guide (CVC 2010), and Stormwater Source Control Design Guidelines (Metro Vancouver 2023) to support sustainable stormwater management. Climate change impacts will be considered by integrating the Town's 2015 IDF curves under RCP 8.5 projections. This approach aligns with Creston's objectives for resilient and sustainable water management.

Additionally, key considerations include:

- **Level of service**: Modeling 5-year and 100-year design storms to identify flood risks and system bottlenecks
- **Growth projections**: Incorporating a 20-year scenario based on designated growth areas in the Official Community Plan (OCP)

2.6 IDENTIFIED DATA GAPS AND PROPOSED STRATEGY

The development of the Stormwater Management Master Plan (SMMP) revealed several data gaps that need to be addressed to improve Creston's stormwater management framework. These gaps were identified through the review of existing infrastructure data and historical reports.

2.6.1 DATA GAPS

A comprehensive stormwater management strategy requires accurate and complete datasets to evaluate system performance, predict flood risks, and plan for future infrastructure improvements. Through our initial data review, the following key data gaps have been identified:

- **Incomplete GIS Data:** Existing GIS records lack complete information on invert elevations, which limits the ability to conduct a detailed system capacity assessment.
- **Limited Overland Flow Analysis:** Previous studies do not fully model extreme storm events and their impact on overland flow paths, requiring additional hydrologic and hydraulic assessments.
- **Absence of Water Quality Monitoring Data:** There are no water quality monitoring programs to assess pollutant loads at stormwater outfalls and potential effects of stormwater discharges on Dodd's Creek, Goat River, and other receiving water bodies.
- **Lack of Integrated Stormwater Asset Management Data:** There is no centralized stormwater asset management system, making it difficult to track infrastructure condition, schedule maintenance, and prioritize long-term investments.
- **Gaps in Sediment Transport and Erosion Analysis:** There is limited information on sediment transport and erosion trends, particularly where natural drainage channels intersect with urban development, impacting long-term channel stability.

2.6.2 STRATEGY TO ADDRESS DATA GAPS

To support development of Creston's SMMP, a targeted strategy was undertaken to address key data gaps:

1. **GIS Data Enhancement**
    - **Engineering judgment** was applied to estimate missing invert elevations using:
        - Interpolation between known upstream and downstream inverts
        - Minimum pipe slopes
        - Minimum depth of cover
    - The **stormwater GIS database** was updated to reflect both surveyed and assumed data, resulting in a more complete and accurate infrastructure inventory.
2. **Hydrologic & Hydraulic Modeling**
    - **Updated LiDAR and topographic data** were incorporated to simulate overland flow paths.
    - **PCSWMM modeling** was used to assess extreme rainfall scenarios and identify high-risk flood zones.

3 ENVIRONMENTAL REVIEW

A desktop review of environmental features in and around the Town of Creston was completed so the SMMP can consider these features and provide general avoidance and mitigation strategies for stormwater management activities. Included in the environmental review were environmental policies relevant to stormwater management activities for the Town to consider when updating and developing municipal policies.

The environmental review was conducted by reviewing publicly available databases and data provided by the Town of Creston. Databases reviewed included:

- BC Conservation Data Center (including BC iMap layers and BC Ecosystem Explorer [BCSEE])
- BC Freshwater Atlas
- BC Habitat Wizard
- Central Kootenay Regional District Web Map (RDCK Web Map)

The focus of the environmental review was to identify sensitive environmental features in and around the Town that may be directly or indirectly impacted by stormwater management activities. Sensitive environmental features, for the purpose of this document include:

- Species and ecological communities at risk (provincial and federal)
- Designated Critical Habitat for federally listed Species at Risk (SAR)
- Watercourses and wetlands and associated riparian areas
- Wildlife and high-value wildlife habitat

A 500 m Local Study Area (LSA) buffer was applied to the Town boundary for the environmental review (**Figure 4**). The LSA allowed for consideration of sensitive environmental features that may occur near to the Town and still be subject to direct or indirect impacts from stormwater management activities (e.g. changes in infiltration, available surface water, habitat fragmentation, etc.).

In this report, the term species at risk refers to any organism, including animals, plants (vascular and non-vascular), lichens, and fungi that are designated under Schedule 1 of the federal *Species at Risk Act* (SARA), those reviewed and designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as something other than Not at Risk, and/ or species assigned to the BC Blue or Red List. Ecological communities at risk are communities that are on the BC Blue or Red List. Species on the BC Blue List are native species or ecological communities to be of Special Concern. These are species that are particularly sensitive or vulnerable to human activities or natural events. Species on the BC Red List are native species or ecological communities that have or are candidates for Extirpated, Endangered, or Threatened status in British Columbia.

The BCSEE was queried for species with ranges that overlap the Town of Creston and those that are known to occur in the Town of Creston, BC. The results of the BCSEE query were further screened based on the ecological characteristics of the Town and the LSA and cross referenced with the species at risk lists compiled for the CVWMA Habitat Management Plan (Wilson et al. 2004). The BCSEE screening included assigning species and ecological communities having a likelihood of occurrence in the Town or the LSA based one of the following classes:

- **Not Expected**: Habitat or habitat characteristics attributed to the species or ecological community are not present in or Town, the LSA.

- **Potential**: Habitat or habitat characteristics attributed to the species or ecological community are present in the Town, the LSA. This class may also include species where little is known about the habitat or habitat characteristics of a species which can be common for cryptic species or complex species groups like mosses and lichens.
- **Known**: Species or ecological community has been observed in the Town or the LSA.

HABITAT MAPPING

Habitat mapping was undertaken to identify areas that are considered most likely to support wildlife, wildlife habitat, plant and animal species at risk, or ecological communities at risk or other environmental sensitivities that may be subject to existing regulations. As this was a desktop exercise, a conservative approach was taken to include features that may not be clearly present or functioning as a habitat feature. For example, a feature that may appear saturated but occurred only in a slight depression, was included in the mapping out of caution that the feature may be a wetland and therefore may require consideration as a regulated feature or be a feature that supports species at risk. Ground verification can be used to determine whether these features should be retained in the mapping.

Four broad categories of habitats were identified as important within the context of the Town of Creston: Forest, Wetland, Riparian, and Floodplain. These habitat types are known to occur in the Town and/or the LSA, and are considered the most likely to support wildlife, species at risk, and ecosystems at risk. Open field and grassland habitat were not included because the majority of open field habitat in and around the Town appears to be actively used for agriculture or recreation.

Wetlands were mapped at 1:1,500 due to their complex edges and association with subtle elevation changes, while all other features were mapped at 1:3,000. Data inputs included aerial imagery, hillshade (Government of BC 2025), B.C. Freshwater atlas, and Google Earth Street view (Google Earth Pro 2020).

The habitat mapping is intended to serve as a starting point for planning stormwater management activities, it is not considered a comprehensive map of ecosystems in the Town. As activities are proposed, it is recommended the Town or its contractors review the mapping to identify if the area under consideration is located where habitat has been mapped. If an area is not included in the mapping, the area should be reviewed by a qualified biologist or ecologist to determine if the area truly does not possess habitat, or if it was simply omitted from the mapping. Other resources should also be reviewed during the planning process including Habitat Wizard, BC Conservation Data Center, BC Freshwater atlas SARA, and COSEWIC, as occurrence data, critical habitat mapping, and species list status are subject to change over time.

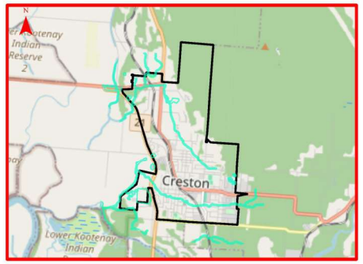
CRESTON VALLEY
TOWN of CRESTON

PROJECT

TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE

FIGURE 4
ENVIRONMENTAL SITE LOCATION OVERVIEW



Legend

- PROJECT AREA
- STUDY AREA

0 0.5 1 2 km

DRAWN BY	AM	CHECKED BY	EW
April 2025			
NAD 1983 UTM ZONE 12N			
1:40,235			

wsp

3.1 ENVIRONMENTAL REVIEW FINDINGS

ECOLOGICAL CONTEXT

The Town of Creston is located in an ecologically rich area, situated in the Southern Interior Mountains (SIM) Ecoprovince, in the Southern Columbia Mountains Ecosection (Demarchi 2011). It sits in the valley between the Purcell and Selkirk Mountain ranges, which are east and west of the Town, respectively. The Town is subject to a strong rain shadow effect, leading to relatively dry conditions (Demarchi 2011). It is located on the east side of the Kootenay River floodplain, at the base of Arrow Mountain, at an elevation of approximately 597 m.

The Town is primarily located in the Interior Cedar Hemlock - very dry warm (ICHxw) Biogeoclimatic (BEC) subzone. A small portion of the LSA is in Interior Cedar Hemlock dry warm (ICHdw) subzone. The ICHxw zone is the smallest and driest ICH subzone. The ICHdw is similarly warm and dry and in the Creston Valley exists at higher elevations than ICHxw. The ICH has an interior, continental climate with cool wet winters with light snowfall and warm dry summers, which is produced by easterly moving air masses (Braumandl and Curran 2002; Meidinger and Pojar 1991).

Prior to European settlement, the Creston Valley was a series of marshes and floodplains. European settlers began attempting to control water levels in the 1880's by installing dikes. In 1968, the Creston Valley Wildlife Act was passed, delegating a Management Authority to manage the designated Creston Valley Wildlife Management Area (CVWMA), which occurs north and west of the Town with a portion of overlap on the west side of the municipal boundary (CVWMA 2020).

The Creston Valley is noted for its importance as a migration corridor for bird species at risk and an overwintering habitat for birds of prey in the interior of the province. Historically, it provided extensive wetland and floodplain habitat in the valley bottom, before being largely converted for agriculture. In 1947, Dr. James Munro, of the Canadian Wildlife Services, stated "*Kootenay Flats constitutes the largest and most important resting and feeding ground for waterfowl in the interior of British Columbia,*" (CVWMA 2020). In 1994 the Creston Valley was added to the Convention of Wetlands' *List of Wetlands of Internation Importance*, an international treaty supporting the conservation of wetlands, underscoring the ecological significance of the wetlands in the valley and its recognition on an international scale.

3.1.1 ECOLOGICAL COMMUNITIES AND VEGETATION

Generally, ecosystems in the ICH are subject to moisture limitations due to hot dry summers and winters with light snowfall. Wildfires and fires intentionally set by European settlers in the 1890's have resulted in limited late seral forest sites, shaping the ecosystems observed in the Town and LSA today (Braumandl and Curran 2002). The following subsections provide a description of terrestrial, riparian, floodplain, and wetland habitats present in the Town and LSA.

TERRESTRIAL HABITAT

The eastern portion of the Town and the LSA is comprised of forested areas on the mid- and lower slopes of Arrow Mountain (**Figure 5**). The higher elevation portions of the Town and LSA that overlap with Arrow Mountain include forest harvest areas that were harvested as early as 1979 and areas with harvest records as recent as 2024 (Ministry of Forests 2025). Mature forests in the ICHxw are typically dominated by Douglas-fir (*Pseudotsuga menziesii*), with lesser amounts of Western redcedar (*Thuja plicata*), Western hemlock (*Tsuga heterophylla*), and Grand fir (*Abies grandis*). Mature forests in the

ICHdw typically have more Western redcedar and black huckleberry (*Vaccinium membraceum*) than forests in the ICHxw (Braumandl and Curran 2002). The actual composition of forests around the Town are subject to the unique site conditions, including slope, aspect, soil moisture and soil nutrient regimes, micro-climate, and disturbance history.

In the Town, forested areas are primarily confined to riparian habitats, with the exception of the east side of the Town, at the base of Arrow Mountain, where there is contiguous forest habitat that extends north and east. Many private parcels in Town contain one to several trees on their property.

RIPARIAN HABITAT

Riparian areas are the transitional areas above the highwater mark of an aquatic feature[1] that are influenced by the water and conversely exert influence on the aquatic feature. Intact riparian habitats are important buffers between the aquatic feature and upland habitat, providing structural diversity, forage, and cover opportunities for wildlife, including birds, mammals, amphibians, and invertebrates. Forested riparian habitats provide important functions for fish habitat by providing shade, nutrient and woody debris inputs, bank stability, stormwater infiltration, and providing cover for fish (Braumandl and Curran 2002). Riparian habitats occur throughout the Town, around wetland features and along Dodd's Creek and Glaser/King Creek (**Figure 5**).

WETLANDS AND FLOODPLAINS

Wetlands and floodplains are dynamic ecosystems that occur as transitions between upland and aquatic environments. Wetlands form when a site is saturated with water long enough that soils possess hydric indicators and hydrophytic vegetation becomes dominant. While wetlands are considered infrequent in the ICH due to the geomorphology of the region, extensive wetland habitat is noted to occur in the Creston Valley, south of Kootenay Lake, on and adjacent to the Kootenay River floodplain (Meidinger and Pojar 1991; Demarchi 2011). Floodplains are regularly flooded riparian areas that occur on well-drained, non-wetland soils (MacKenzie and Moran 2004). They are prominent ecological features in the Creston Valley.

Both wetlands and floodplains represent unique features that only form in the presence of water and in specific landscape positions. As a result, both are sensitive to disturbances that result in changes to hydrology and ground disturbance which can lead to changes in water level, flow rate, sediment deposition and erosion, soil saturation duration and frequency, and vegetation composition.

Based on a review of aerial imagery and hillshade (elevation) data, wetlands and floodplains primarily occur on the west side of the Town of Creston, toward the Kootenay River (**Figure 5**). Many areas on the west side of the LSA were mapped as aggregated wetland/floodplain features due to the scale and scope of the mapping.

VEGETATION AND ECOLOGICAL COMMUNITIES AT RISK

Based on the BCSEE screening, three bryophytes at risk, one lichen at risk, 11 vascular plants at risk, and two ecological communities at risk are considered to have potential to occur in the Town or the LSA (**Table 3-1**). One species, common downingia (*Downingia elegans*) was added to the list as potential based on the CVWMA Habitat Management Plan but is thought to be extirpated from BC. The only plant species at risk ranked as known to occur in the Town or LSA is alkali marsh butterweed (*Senecio*

[1] An aquatic feature may include a stream, river, lake, pond, or wetland.

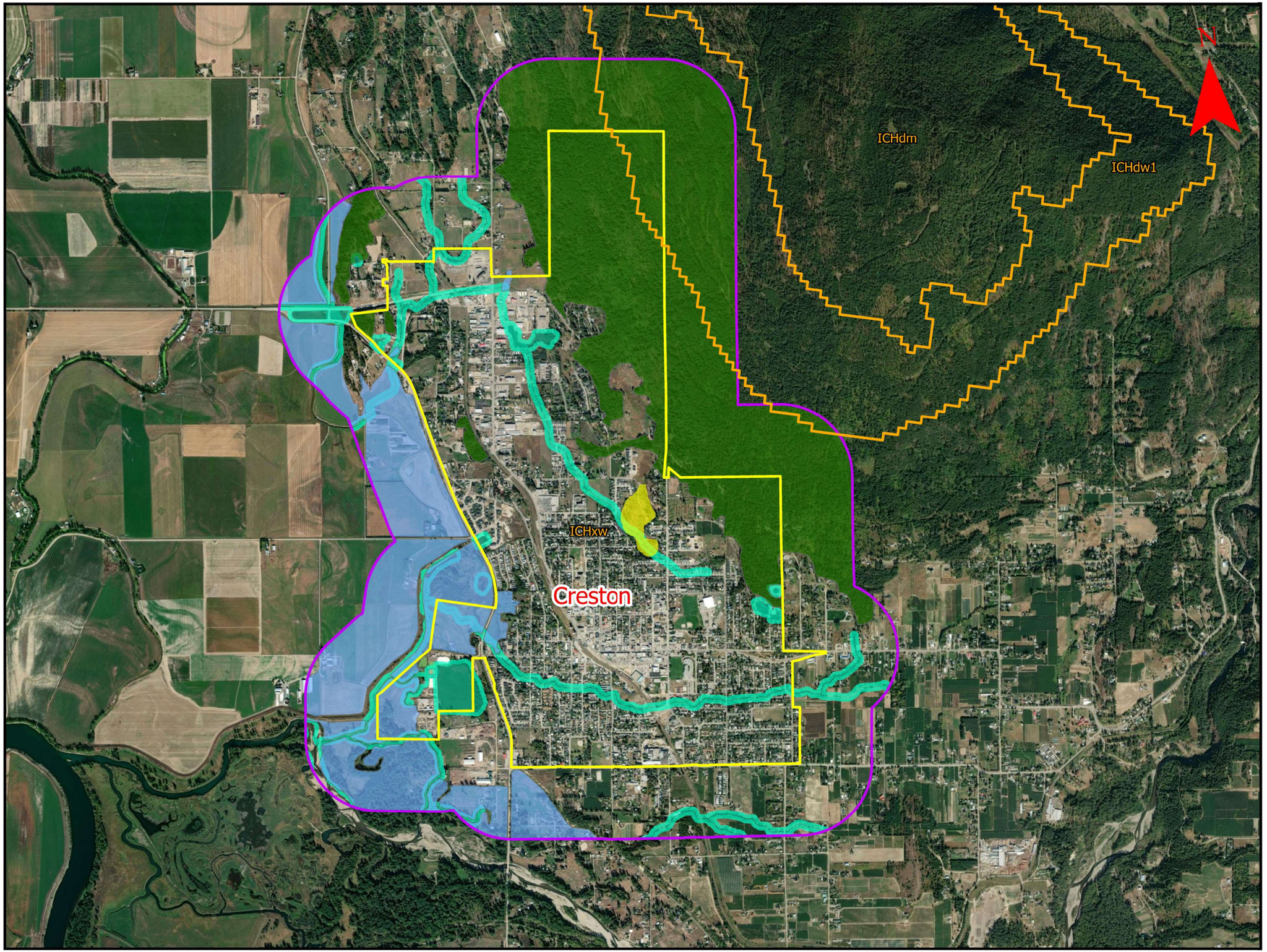
hydrophilus) which is mapped as having an occurrence on the east side of the Town/LSA (**Figure 5**). Alkali marsh butterweed occurs in marsh and swamp habitats.

Plant and lichen species at risk, and ecological communities at risk are considered most likely to occur in areas of intact habitat (e.g. habitat that has not been recently disturbed) or areas that are re-naturalizing following disturbance, these include forests, floodplains, riparian habitats, and wetlands.

Table 3-1 Plant, Lichen, and Ecological Communities at Risk BCSEE Screening Results

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
Bryophyte	*Entosthodon fascicularis*	banded cord-moss	Yellow	SC	1-SC	Potential
	Microbryum vlassovii	nugget moss	Blue	E	1-E	Potential
	Scouleria marginata	margined streamside moss	Red	E	1-E	Potential
Lichen	*Arctoparmelia subcentrifuga*	abrading ring	Blue	-	-	Potential
Ecological Communities	*Festuca idahoensis - Pseudoroegneria spicata - Lupinus sericeus - Koeleria macrantha*	Idaho fescue - bluebunch wheatgrass - silky lupine - junegrass	Red	-	-	Potential
	Pseudotsuga menziesii / Mahonia aquifolium / Cryptogramma acrostichoides	Douglas-fir / tall Oregon-grape / parsley fern	Red	-	-	Potential
Vascular Plant	*Botrychium michiganense*	Michigan moonwort	Blue	-	-	Potential
	Botrychium montanum	Mountain moonwort	Blue	-	-	Potential
	Claytonia cordifolia	heart-leaved springbeauty	Blue	-	-	Potential
	Downingia elegans	common downingia	Red	-	-	Potential
	Pyrola aphylla	leafless wintergreen	Blue	-	-	Potential
	Scrophularia lanceolata	lance-leaved figwort	Blue	-	-	Potential
	Senecio hydrophiloides	sweet-marsh butterweed	Blue	-	-	Potential
	Senecio hydrophilus	alkali-marsh butterweed	Red	-	-	Known

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
	Solidago gigantea var. *shinnersii*	smooth goldenrod	Blue	-	-	Potential
	Thalictrum dasycarpum	purple meadowrue	Blue	-	-	Potential
	Veronica catenata	pink water speedwell	Blue	-	-	Potential
	Acorus americanus	American sweet-flag	Blue	-	-	Potential



CRESTON VALLEY

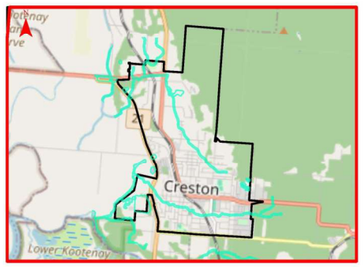
TOWN of CRESTON

PROJECT

TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE

FIGURE 5
VEGETATION AND WETLANDS



Legend

- Populated Place
- Highway
- Existing Road
- Railway
- River
- Wetland
- WATERCOURSE
- Bay and Channel

Biogeoclimatic Zone

- ICHdm
- ICHdw1
- ICHxw
- PROJECT AREA
- STUDY AREA
- Waterbody

WSP HABITAT FEATURE

- Floodplain
- Floodplain / Wetland
- Forest
- Shrub/Forest
- Wetland
- Riparian Areas

NOTE:

- CDC PLANT SPECIES ALKALI-MARSH BUTTERWEED COVERS

0 0.3 0.6 1.2 km

DRAWN BY AM	CHECKED BY EW
April 2025	
NAD 1983 UTM ZONE 12N	
1:25,750	

3.1.2 WILDLIFE

As previously discussed, the Town occurs in an ecologically significant area. In an otherwise warm, dry landscape, the Creston Valley has historically provided extensive wetland and floodplain habitat for wildlife. A total of 354 vertebrate species use the habitats found in the CVWMA, approximately 60% of all terrestrial vertebrate species in British Columbia. In the context of European settlement, areas in the valley not managed for agriculture have been managed for waterfowl (Wilson et al. 2004). Intact upland habitats in the Town and LSA are considered limited to riparian corridors and portions of Arrow Mountain that overlap the Town and LSA.

Organizations like the Columbia Basin Trust's Ecosystem Enhancement Program, CVWMA, the Nature Conservancy of Canada, Ducks Unlimited, and both the federal and provincial government have invested in enhancing and restoring wetlands in the Creston Valley (CVWAM 2024; Yates 2022).

Wildlife enhancement and restoration activities that have taken place in the Creston Valley include:

- Recontouring drainage channels and constructing new channels and wetlands (CVWMA 2024; Yates, 2022)
- Cattle exclusion fencing around riparian habitats (CVWMA 2024)
- Fencing wildlife habitat from cattle during important reproductive life history phases (CVWMA 2024)

WILDLIFE SPECIES AT RISK

Based on the BSEE there are 67 wildlife species at risk that were ranked as having potential to occur in the Town or the LSA and eight that are known to occur in the Town or LSA (**Table 3-2**). The screened BCSEE list is provided as **Appendix A**.

Table 3-2 Results of BCSEE Screening by Animal Group

Type	Known	Potential
Amphibians	-	5
Birds	6	20
Insects	1	27
Mammals	1	12
Reptiles	-	3
Grand Total	**8**	**67**

WILDLIFE OCCURRENCES AND CRITICAL HABITAT

There are three publicly available documented occurrences of wildlife species at risk: Monarch butterfly (*Danaus plexippus*, occurrence ID: 18412), red-tailed chipmunk (*Neotamias ruficaudus simulans*, occurrence ID: 3406), and great blue heron (*Ardea herodias herodias*, occurrence ID: 6483) (BC CDC 2014a; BC CDC 2014b; BC CDC 2014c). The monarch butterfly occurrence covers the western portion of the Town, the red-tailed chipmunk occurrence covers the floodplain portion of the LSA, and the great blue heron occurrence is located on the southwest corner of the LSA near the Kootenay River (**Figure 6**).

A critical habitat polygon for American badger (*Taxidea taxus jeffersonii*, eastern population, critical habitat ID: 138412, 138432, 139704) covers the south and east portions of the Town and LSA (BC CDC 2023). A draft critical habitat polygon for woodland caribou (*Rangifer tarandus*, southern Mountain population, critical habitat ID: 20927) overlaps the entire Town and LSA (BC CDC 2022) (**Figure 6**).

Users are directed to contact Environment and Climate Change Canada for more information about the draft critical habitat post for woodland caribou.

The CVWMA is a provincial wildlife management area that covers the northern and western portions of the valley. The Creston Valley Important Bird Area (IBA) covers the entirety of the valley, including the CVWMA and the Town. The IBA program is an international conservation initiative coordinated by BirdLife International with co-partners in Canada that include Birds Canada and Nature Canada. IBA's are conservation tools used to design reserve networks and prioritize lands for acquisitions. The Creston Valley IBA was designated for Tundra Swans, American Coot and waterbirds (IBA Canada n.d.).

MASKED WILDLIFE OCCURRENCES

There is a masked wildlife occurrence (Masked Sensitive Area ID: 581372) that overlaps the Town and LSA (BC CDC n.d.). A request was submitted to the BC Ministry of Water, Land and Resource Stewardship on Mar. 28, 2025, for information on the occurrence and its potential interaction with stormwater management activities but data has not yet been received.

3.1.3 AQUATIC RESOURCES

The recent land management history of the Creston Valley has led to fish populations being negatively impacted by flood control and dike constructions, including the construction of the Libby Dam on the Kootenay River in Montana, which changed downstream flow (Wilson et al. 2004). The following subsections describe the aquatic resources known to occur in the Town and the LSA, as well as a description of the Kootenay River and Goat River which are outside of the LSA but is considered a significant ecological feature in the valley.

Dodd's Creek and Glaser/King Creek are both in the Town's Environmentally Sensitive Development Permit Area (DPA 2). The DPA 2 was designed to protect the natural environment from development activities and protect development from hazardous conditions. Construction, repair and maintenance of municipal works and services by the Town and its authorized agents and contractors are exempt from DPA 2 (Town of Creston 2017).

KOOTENAY RIVER

The Kootenay River originates on the east side of the Purcell Mountains, north of Canal Flats, B.C. The river flows south into the United States where it is dammed east of Libby, Montana and then continues on to flow north through Idaho, and back to Canada where it flows into Kootenay Lake, north of the Town. The Kootenay River delta forms extensive wetland habitat in the Creston Valley.

There are 49 species of fish that have been documented in the Kootenay River (Ministry of Environment n.d.). For brevity, the list has been included as **Appendix B**.

GOAT RIVER

Goat River (Wastershed Code: 340-445900) is a tributary of Kootenay River, occurring south of the Town. While Goat River does not intersect with the Town, Dodd's Creek which flows through the Town connects to it. This connection means that impacts occurring to streams and ditches upstream, can impact Goat River. Fish stocking and collection data is available for the Goat River, which is a fish bearing river. There are at least 12 species known to occur in the Goat River, including an unidentified trout (**Table 3-3**).

Table 3-3: Goat River Fish Occurrence Data (Ministry of Environment 2025)

Scientific Name	English Name	BC List
Salvelinus fontinalis	Brook trout	Exotic
Salvelinus confluentus	Bull trout	Blue
Lota lota pop. 1	Burbot (Lower Kootenay Population)	Red
Oncorhynchus clarkii	Cutthroat trout	*
Oncorhynchus nerka	Kokanee	Not reviewed
Prosopium williamsoni	Mountain whitefish	Yellow
Oncorhynchus mykiss	Rainbow trout	Yellow
Various	Sculpin	-
Cottus cognatus	Slimy sculpin	Yellow
NA	unidentifiable trout	-
Oncorhynchus clarkii ssp. *lewisi*	Westslope (yellowstone) cutthroat trout	Blue
Catostomus commersonii	White sucker	Yellow

*Potential to be lewisi subspecies, which is on the BC Blue List, COWESIC Special Concern, and Schedule 1 - Special Concern under SARA.

DODD'S CREEK

Dodd's Creek (Watershed Code: 340-445900-2300-25400) intersects the southern portion of the Town, flowing east to west. Fish collection data has not been documented on the provincial database; however, it flows into the Goat River southwest of the Town, which is a fish bearing river. The presence of obstructions to fish passage from the Goat River to Dodd's Creek is unknown. Provincial mapping indicates the headwaters of Dodd's Creek occurs on the east side of the Town, toward the base of Arrow Mountain.

UNNAMED TRIBUTARY

There is an unnamed tributary (340-445900-02300) in the southern portion of the LSA that flows west to the Goat River. Fish collection data has not been documented on the provincial database for this tributary.

GLASER/KING CREEK

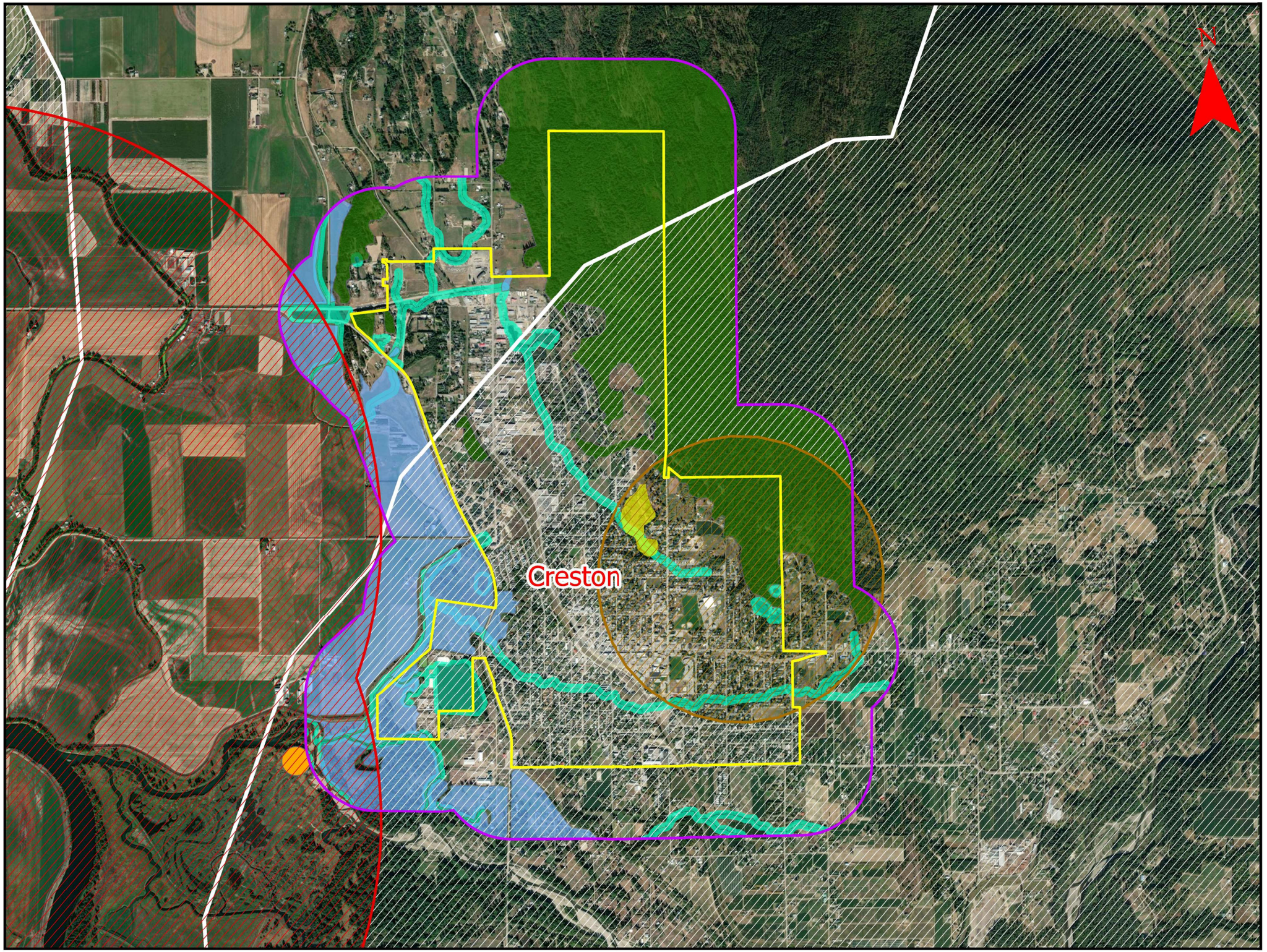
Glaser/King Creek (Watershed Code: 340-424100-24100) is mapped as occurring in the central portion of the Town of Creston and flows into a fish-bearing, unnamed tributary (Watershed Code: 340-424100) of the Kootenay River, west of Town. The presence of obstructions to fish passage from the Kootenay River to Glaser Creek is unknown.

FISH SPECIES AT RISK

There are at least eight fish species at risk that have been documented in the Goat River and Kootenay River (**Table 3-4**). Notable impacts to fish, including burbot (*Lota lota*), sturgeon (*Acipenser transmontanus*), and kokanee (*Oncorhynchus nerka*), have been attributed to the Libby Dam in Montana which changed the flow of the Kootenay River into the Creston Valley, as well as diking which has eliminated or cutoff access to habitat (Wilson et al. 2004).

Table 3-4 Fish Species at Risk Documented in the Goat and Kootenay Rivers

Scientific Name	English Name	BC List	COSEWIC	SARA
Acipenser transmontanus pop. 1	White sturgeon	Red	E	1-E (2003)
Cottus confusus	Shorthead sculpin	Blue	SC	1-SC
Cottus hubbsi	Columbia sculpin	Blue	SC	1-SC
Lota lota pop. 1	Burbot	Red	-	-
Oncorhynchus clarkii ssp. *lewisi*	Westslope (yellowstone) cutthroat trout	Blue	SC	1 - SC
Oncorhynchys clarkii ssp. *clarkii*	Coastal cutthroat trout*	Blue	-	-
Rhinichthys umatilla	Umatilla dace	Red	T	3
Salvelinus confluentus	Bull trout	Blue	SC	-



CRESTON VALLEY

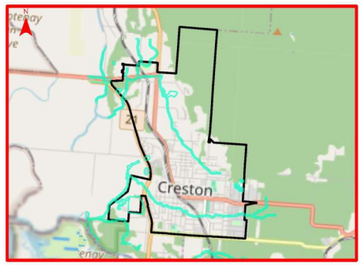
TOWN of CRESTON

PROJECT

TOWN OF CRESTON - STORMWATER MANAGEMENT MASTER PLAN

TITLE

FIGURE 6
WILDLIFE, FISH AND AQUATIC FEATURES



Legend

- Populated Place
- Highway
- Existing Road
- Railway
- PROJECT AREA
- STUDY AREA

CDC ANIMAL SPECIES OF CONSERVATION CONCERN

- Great Blue Heron, herodias subspecies
- Monarch
- Red-tailed Chipmunk, simulans
- Sensitive_Mask_Elem

WSP HABITAT FEATURE

- Floodplain
- Floodplain / Wetland
- Forest
- Shrub/Forest
- Wetland
- Riparian Areas

NOTE:
- WOODLAND CARIBOU (SOUTHERN MOUNTAIN POPULATION) CRITICAL HABITAT COVERS WHOLE MAP.
- AMERICAN BADGER JEFFERSONII SUB-SPECIES CRITICAL HABITAT COVERS WHOLE MAP.

0 0.3 0.6 1.2 km

DRAWN BY	AM	CHECKED BY	EW
April 2025			
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3.2 ENVIRONMENTAL ASSESSMENT AND POLICY REVIEW

Based on the environmental review completed in Section 3.1, it is understood there is potential for SMMP activities to impact various environmental components, including but not limited to aquatic, wetland, and terrestrial ecosystems, wildlife and plant SAR, lichen at risk, and ecosystems at risk. Activities that cause a physical impact or disturb the existing conditions of an area, such as soil disturbance, vegetation removal, or use of heavy equipment, have potential to impact the environment and may be regulated under the law. To determine how environmental regulations interact with proposed SMMP activities, a stepwise approach to reviewing the proposed activities and their potential impact on the environment can be used:

1. Describe and consider the following details:
    a. Type of activity: describe the activities that will result in the impact. Details should include the type of equipment and materials that will be used to complete the activity.
    b. Project footprint: the area where the SMMP activities will take place. The Project footprint will determine the spatial extent of impacts.
    c. Schedule: provide the timing and duration of the activities. The timing and duration of the activities can impact environmental components differently based on seasonality, life history, migratory patterns, and other factors.
    d. Strategies to avoid and/or mitigate impacts: determine if there are planning and design considerations that can be implemented to avoid or reduce the impact of the SMMP activities on the environment.
2. Describe the environmental condition of the area where the SMMP activities will take place:
    a. Establish a Local Study Area (LSA): the LSA is a buffer established around the Project footprint to account for indirect impacts that may occur as a result of SMMP activities. Typically, the size of the LSA will be based on the location of the SMMP activities, proximity to sensitive environmental features, likelihood to support environmental features, connectivity to sensitive environmental features, and known sampling intensity in the area[2]. The purpose of the LSA is to account for indirect impacts from SMMP activities.
    b. Complete a desktop environmental review and summarize findings: review available data for the Project footprint and LSA to characterize the environmental conditions. Environmental features to consider during the desktop review include watercourses, aquatic ecosystems, fish habitat, wetlands, riparian habitat, wildlife SAR, plant SAR, lichen at risk, and ecosystems at risk, as well as nest trees protected under Section 34b of the B.C. Wildlife Act and pileated woodpecker nest holes as defined by the Migratory Birds Regulation.
    c. Identify environmental laws, regulations, and bylaws that may be triggered by the environmental features and proposed activities: this will help guide the permitting process, environmental avoidance and mitigation, and focus the field assessment.

[2] Areas where sampling intensity is known to be low, a larger LSA may be selected to account for sampling bias in hard to reach areas.

d. Field assessment: for areas where environmental features may occur in the Project footprint, a field assessment to confirm the presence or likelihood of those features should be completed. In addition to describing the existing condition of the Project footprint and LSA, the field assessment should focus on areas and features that will be subject to the permitting process (see Section 3.3).

    i. In addition to reviewing the Project footprint, features in the LSA may require a field assessment, if those features require setbacks or protective buffers under the law. For instance, streams/lakes supporting fish and bird nest trees outside of the Project footprint may have setbacks associated with them that overlap with the Project footprint.

3. Identify potential impacts:

    a. Describe the potential impacts of the SMMP activities in the context of the various spatial and temporal scales they may occur at:

        - **Direct Impacts:** occur within the Project footprint, resulting from explicit interaction with SMMP activities.
        - **Indirect Impacts:** occur outside the Project footprint, where there is inexplicit interaction with project activities. Typically, the LSA is used to account for and characterize indirect impacts.
        - **Temporary Impacts**: are anticipated to end when construction is complete, and the impacts have been restored to pre-disturbance conditions (WDFW 2009).
        - **Permanent Impacts:** are anticipated to persist and cannot be restored within the life of the project to pre-disturbance conditions (WDFW 2009) and are typically associated with the footprint of the project.

    b. Provide avoidance and mitigations strategies to reduce the likelihood and area of impacts to the environment from the SMMP activities.

    c. Quantify the area (square meters or square hectares): once avoidance and mitigation strategies have been considered and implemented, calculate the area of temporary and permanent impacts, and the area of direct and indirect impacts.

    d. Address residual impacts that cannot be mitigated and propose offsetting strategies where required.

4. Regulatory review and submission process: Once the environmental conditions in the Project footprint and LSA have been described and avoidance and mitigation measures have been incorporated into the design and implementation plans, determine the regulatory and environmental review processes that are relevant to the SMMP activities. The environmental regulatory review and permitting process will vary based on the type of SMMP activities proposed and the environmental conditions of the Project footprint and LSA.

ACTS AND REGULATIONS

It is understood that SMMP activities may fall under federal, provincial, and municipal jurisdiction. The type of environmental regulatory review and permitting process will depend on the SMMP activities proposed and the environmental features the activities may impact. The following section provides a description of Acts and Regulations that may be applicable to SMMP activities that can require environmental review and/ or approval to proceed with the activities. Additional Acts and Regulations may be applicable to SMMP activities and each SMMP activity should be reviewed by a Qualified

Environmental Profession (QEP) for potential to trigger environmental Acts and Regulations. See **Appendix C** for other Acts and Regulations that may be of consideration for SMMP activities.

The regulatory review and permitting process can lead to delays in project timelines if not properly considered during the planning phase of SMMP activities. It is recommended that avoidance and mitigation strategies, where feasible, be incorporated into the planning process as early as possible to avoid review and permitting delays. Often regulators can be engaged early in the planning process which can provide clarity on permitting and review requirements and avoid delays later in the project.

FEDERAL ACTS AND REGULATIONS

FISHERIES ACT

The *Fisheries Act*, R.S.C, 1985, is administered by Fisheries and Oceans Canada (DFO). There are two key prohibitions that came into effect following the 2019 amendment of the *Fisheries Act*:

- Subsection 34.4 (1): prohibits carrying out a work, undertaking, or activity, other than fishing that results in the death of fish, and
- Subsection 35(1): prohibits the carrying out a work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat (HADD).

A Project Request for Review (RFR) is an opportunity for a project to be reviewed by the Fish and Fish Habitat Protection Program. The FFHP will review project plans and identify risks to fish and fish habitat associated with a project and assist in identifying strategies to reduce those risks. If project risks can be mitigated to an acceptable level, the FFHP will provide a Letter of Advice explaining their findings and the mitigations they expect to be implemented. If the FFHP finds that HADD is likely, the submission may be elevated to a *Fisheries Act* Authorization and require further review and often an offsetting plan should impacts be significant. An RFR is not required if DFO's measures to protect fish and fish habitat are followed which includes:

- Prevent the death of fish
- Maintain riparian vegetation
- Carry out works, undertakings and activities on land
- Maintain fish passage
- Ensure proper sediment control
- Prevent entry of deleterious substances in water

An Authorization may be issued by the Minister of Fisheries and Oceans with terms and conditions in relation to a proposed work, undertaking or activity, that may result in HADD. Typically, Authorizations are issued when a project is still expected to result in HADD or death of fish after avoidance and mitigation strategies are implemented (DFO 2024).

RFR's and Authorizations are submitted electronically to the regional office (ReferralsPacific@dfo-mpo.gc.ca). For the Town, the nearest DFO regional office is Salmon Arm, BC. DFO is required by regulation to notify the applicant within 60 days of receiving an application for an Authorization if the application is complete, incomplete or inadequate. Once the application is complete and adequate, DFO is required to complete their review and issue their decision within 90 days, not including time required for consultation and engagement.

MIGRATORY BIRDS CONVENTION ACT / MIGRATORY BIRDS REGULATIONS

The *Migratory Birds Convention Act* (MBCA), 1994, which is administered by Environment and Climate Change Canada (ECCC), provides protection for migratory birds and their nests on all lands in Canada through the Migratory Birds Regulations, 2022, and the Migratory Birds Sanctuary Regulations. MBCA and MBR sections relevant to the SMMP activities include:

- MBCA Section 5.1(1): Prohibits the willful deposition of harmful substances into waters frequented by migratory birds
- MBR Section 5(1): Prohibits the capture, killing, taking, or harassing of a migratory bird, its nest, or its eggs
- Schedule 1: MBR, 2022 provides year-round nest protection for 18 species including pileated woodpecker

Nests of migratory birds are protected while active. If a nest threatens public health and safety, a Damage or Danger (DoD) permit can be applied for to scare migratory birds, destroy eggs or nests, relocate birds or their nests, or kill birds. Birds and their nests listed under Schedule 1 of the MBR are afforded year-round protection. Pileated woodpecker nesting cavities are afforded protection for 36-months after the cavity is deemed inactive and only then can a DoD permit be applied for. The application process takes approximately 35 days. Permit applications should be submitted to the nearest Canadian Wildlife Service (CWS) office: scfpacpermitscwspacpermits@ec.gc.ca.

SPECIES AT RISK ACT

The *Species at Risk Act* (SARA), S.C. 2002, is intended to prevent wildlife species in Canada from going extinct or being extirpated from their current range, provide for the recovery of species that are extirpated, endangered, or threatened, and manage species of special concern to prevent them from becoming endangered or threatened (ECC 2016). The definition of wildlife under the Act includes animals, plants or other organisms, other than a bacterium or virus. SARA protections also extend to areas that have been designated as critical habitat for wildlife SAR. SARA applies specifically to federal land, and to aquatic species and migratory birds, regardless of location.

Permits are required if activities on federal land have the potential to affect species listed on Schedule 1 of SARA as extirpated, endangered, or threatened or designated critical habitat. As SMMP activities are not expected to occur on federal land, SARA is most likely to apply to aquatic species or migratory birds potentially impacted by SMMP activities. SARA permit applications for impacts to aquatic species should be directed to DFO. SARA permit applications for impacts to migratory birds should be submitted to CWS.

PROVINCIAL ACTS AND REGULATIONS

RIPARIAN AREAS PROTECTION ACT / RIPARIAN AREAS PROTECTION REGULATION

The Riparian Areas Protection Regulation (RAPR) was enacted under Section 12 of the *Fish Protection Act* later re-titled the *Riparian Areas Protection Act* (RAPA), SBC 1997. The RAPR is intended to protect the features, functions, and conditions of riparian areas that are critical for maintaining stream health and productivity for fish. The legislative reach of RAPR applies specifically to residential, commercial, and industrial developments in municipalities listed in the Regulation.

Town is regionally not under the jurisdiction of the RAPR and municipal works completed by the Town are typically considered institutional activities; however, technical manuals established under Section 13

of RAPA are recommended for use when establishing fish habitat setbacks and calculating impacts to fish habitat. The methodologies provided in the manuals are repeatable means of determining the physical extent of impacts to fish habitat, which is required information when submitting an RFR or Authorization to DFO.

WATER SUSTAINABILITY ACT / WATER SUSTAINABILITY REGULATION

The provincial *Water Sustainability Act* (WSA), SBC 2014, which is administered by the Ministry of Water, Land and Resource Stewardship (WLRS) vests the property and right to the use and flow of water in streams, as defined by the WSA, in the government of British Columbia. Under WSA, streams are defined as including wetlands, and other watercourses, whether or not they have been previously modified. This is taken to mean even constructed features, if they interact with the historic flow of water at a site, are under the jurisdiction of WSA.

If SMMP activities propose a change to the use or flow of water, in and about a stream, an Approval under Section 11 of WSA may be required; however, if the activity is listed under Section 39 of the Water Sustainability Regulation of authorized changes to streams or is listed as an exemption for a local government, the submission of a Notification to WLRS is expected to be sufficient to complete the work.

Notifications and Approvals are submitted electronically through FrontCounter BC. Approvals can take six months to one year to process and depend on the backlog at the province, while Notifications are processed in 45 days as they are approved activities. Both submissions are typically accompanied by Project designs, environmental assessments, and environmental mitigation plan(s).

WILDLIFE ACT / WILDLIFE REGULATION

The BC *Wildlife Act* is intended to conserve and manage wildlife and wildlife habitat in BC. Through Section 2 of the *Wildlife Act*, the ownership of all wildlife[3] is vested in the government of BC. The *Wildlife Act* prohibits wildlife harassment, capture, relocation, and habitat destruction, unless the activity is permitted under the Act (see Sections 29, 33, and 34 of the BC *Wildlife Act*). To capture and relocate wildlife a *Wildlife Act* General Wildlife Permit is required.

Wildlife Act General Wildlife Permits are submitted electronically through FrontCounter BC. The target review and issuance time is 30 days but can take up to four months, depending on provincial backlog or if consultation is required. Once issued, the permit is typically valid for one calendar year and can be renewed as needed. If the Project description, method of construction, or location changes, the applicability of the *Wildlife Act* will need to be reviewed.

MUNICIPAL BYLAWS

Based on a review of municipal bylaws in June 2025, it is understood SMMP activities would not require permitting or environmental review under existing bylaws. There are several bylaws that may impact the planning and execution of work, including the Drainage Bylaw (No. 1417), Fire Prevention and Hazard Control Bylaw (No. 1931), and Noise Control Bylaw (No. 1389).

[3] Under the Wildlife Act wildlife means: raptors, threatened species, endangered species, game and other species of vertebrates prescribed by regulation, and fish but does not include controlled alien species.

3.3 BC'S MITIGATION HIERARCHY APPROACH

B.C. has an existing Environmental Mitigation Policy, which provides a process intended to support decisions about how to use or develop B.C.'s natural resources. The policy was developed to provide flexibility in methodology rather than a "one-size fits all" approach to mitigation. It also emphasizes the importance of understanding and considering environmental values, and mitigating negative impacts to the environment and communities (Government of BC 2025e).

The policy proposes a four-tier mitigation hierarchy to support the development and application of measures to mitigate impacts to the environment. The hierarchy is intended to be used such that mitigations at one level are considered before moving onto the next and that rationale is provided as to why the next level of mitigation is needed (MoE 2014). The levels of the hierarchy are:

Level 1: *Avoid* – the first step in mitigating impacts to the environment is to avoid impacts in the Project footprint and surrounding environment. Avoidance can be particularly important for environmental components that are rare on the landscape or are sensitive to disturbance (MoE 2014). Typically, in the environmental review process, regulators will look for where projects have incorporated avoidance strategies into the design and implementation of the Project. Avoidance can consider the following:

1. Location – consider if the SMMP activities can be moved to a different area to avoid impacts to sensitive environmental features.
2. Means – consider alternate methods of completing the SMMP activities.
3. Timing – consider if conducting SMMP activities at a different time of day or in the year will avoid impacts to sensitive environmental features (e.g. migration timing, nesting windows, spawning, etc.).
4. Not proceeding with a specific activity – consider if SMMP activities are necessary.

Level 2: *Minimize* – the second highest priority that is intended to partially avoid impacts. It should only be considered when measures to avoid impacts on the environment have been exhausted or avoidance is not practicable. Measures to minimize should consider the scope, scale, and duration of the impacts and apply to the same components as avoidance: Location, Means, and Timing (MoE 2014).

Level 3: *Restore On-Site* – should only been considered when avoidance and minimization have been exhausted or are not practicable. Restoration is intended to establish composition, structure, pattern, and ecological processes necessary for terrestrial and aquatic ecosystems to be sustainable, resilient, and healthy under current and future conditions. Restoration exists on a continuum (e.g. restoration, rehabilitation, remediation, reclamation) and should be defined during the planning stage of SMMP activities. Restoration goals and objectives with which to measure "success" or determine when an area can be considered "restored" must be clearly defined during the planning stage. Monitoring and adaptive management are key components of tracking restoration activities and addressing deficiencies (MoE 2014).

Level 4: *Offset* – should only be considered if impacts to the environment remain after mitigation measures to avoid, minimize, and restore on-site have been exhausted or are not practicable for the site. Offsetting requires a detailed understanding of the residual impacts that remain after the first three levels have been implemented and what future condition and area of land would be needed to account for those residual impacts. Typically, offsetting is completed when works propose permanent impacts to fish or wildlife habitat within a project footprint. Monitoring and adaptive management are key components of tracking restoration activities and addressing deficiencies (MoE 2014).

3.4 RECOMMENDATIONS FOR AVOIDANCE AND MINIMIZATION OF IMPACTS

Avoidance and minimization of impacts will generally be specific to the SMMP activities that are proposed. The following are recommended actions to take to avoid and minimize impacts to the environment from SMMP activities:

Engage a QEP early: When proposing SMMP activities that may result in disturbance or impacts to the environment, the activities should be reviewed by a QEP to determine if a fulsome environmental review is necessary.

Develop Environmental Management Plans: Environmental management plans are intended to provide the Town and anyone working on an SMMP project, including contractors, subcontractors, and regulators, a clear blueprint of roles and responsibilities relating to the environment. Environmental management plans may include Construction Environmental Management Plans (CEMP) and Environmental Protection Plans (EPP). CEMPs are typically high-level plans developed by a QEP on behalf the of the project owner, outlining the environmental requirements for a project, expectations for environmental mitigation measures, and the roles of anyone working on the project. EPP's are typically developed by contractors or subcontractors and contain specific methods and measures for avoidance and mitigation of impacts. All environmental management plans should be considered living documents that are updated as needed to effectively avoid and mitigate impacts to the environment.

Reduce the area: Where feasible, reduce the amount of area that will be impacted by the work to the smallest area possible to safely and effectively complete the SMMP activities.

Follow least risk timing windows: Least timing windows exist for fish and wildlife and are intended to avoid times of the year or life history stages in which fish and wildlife are particularly sensitive or at risk of being impacted by project works.

Follow established and recommended mitigation measures: Mitigation measures should follow industry best practices and be tailored to the SMMP activities proposed. They should be evaluated by a QEP at the time of implementation and throughout the SMMP activities and updated as needed based on performance.

3.5 POTENTIAL HABITAT ENHANCEMENT AND IMPROVEMENT OPPORTUNITIES

Activities relating to stormwater infrastructure development and upgrades, are considered opportunities to evaluate baseline conditions and improve fish and wildlife habitat features within the Town. Stormwater features like detention ponds, ditches, and wetlands, already provide a measure of fish and wildlife habitat value; however, these can be degraded if the riparian area is not sufficiently large enough or has been altered, flow has been modified, or there is a pollution source. Where viable, stormwater management planning should include nature based solutions that increase habitat and enhance water quality. This may include:

- Increasing urban tree canopy;
- Implementing bioretention facilities (e.g. rain gardens, bioswales, bioretention beds); ;

- Preserving and enhancing existing natural spaces and riparian areas (e.g. weed control, buffer zones, structural features, native plantings, human use restrictions);
- Developing constructed wetland facilities; and/or
- Implementing landscaping practices that consider wildlife corridors and incorporate native species to support pollinators and other local species.

To optimize the habitat value of stormwater infrastructure, a QEP with experience in the field of stormwater management should be involved in designing the features, setting success criteria, and providing adaptive management techniques.

4 HERITAGE RESOURCES REVIEW

A desktop review was conducted to provide contextual information regarding the presence of registered heritage resources within the project study area. An initial high-level evaluation of the potential for yet to be discovered archaeological resources within the project study area is also provided. This information is intended to support the SMMP's plans for avoidance and mitigation to minimize impacts to cultural resources that may be impacted by the project's activities.

For the purposes of this report, heritage resources include both archaeological and historical sites. Archaeological sites are defined as locations containing physical remains of past human activity which are studied through the methods and techniques employed in the discipline of archaeology. Archaeological sites can be associated with pre-contact or post-contact periods; that is, the time before and after the first arrival of non-Indigenous people in the region. Historical sites are defined as any structure, site, or thing that is of historical or architectural significance. Historical sites and locations in B.C. are primarily attributable to post-contact Euro-Canadian settlement and land use but also include habitations and other evidence left by Indigenous peoples. These heritage resources include structures, engineering works, architectural features, and artifacts. For this study, "archaeological" refers to sites that predate AD 1846, which are automatically protected under the *Heritage Conservation Act* (HCA; Government of British Columbia 1996) and "historical" refers to sites that postdate AD 1846.

The review was conducted through reviewing publicly available and industry available databases including:

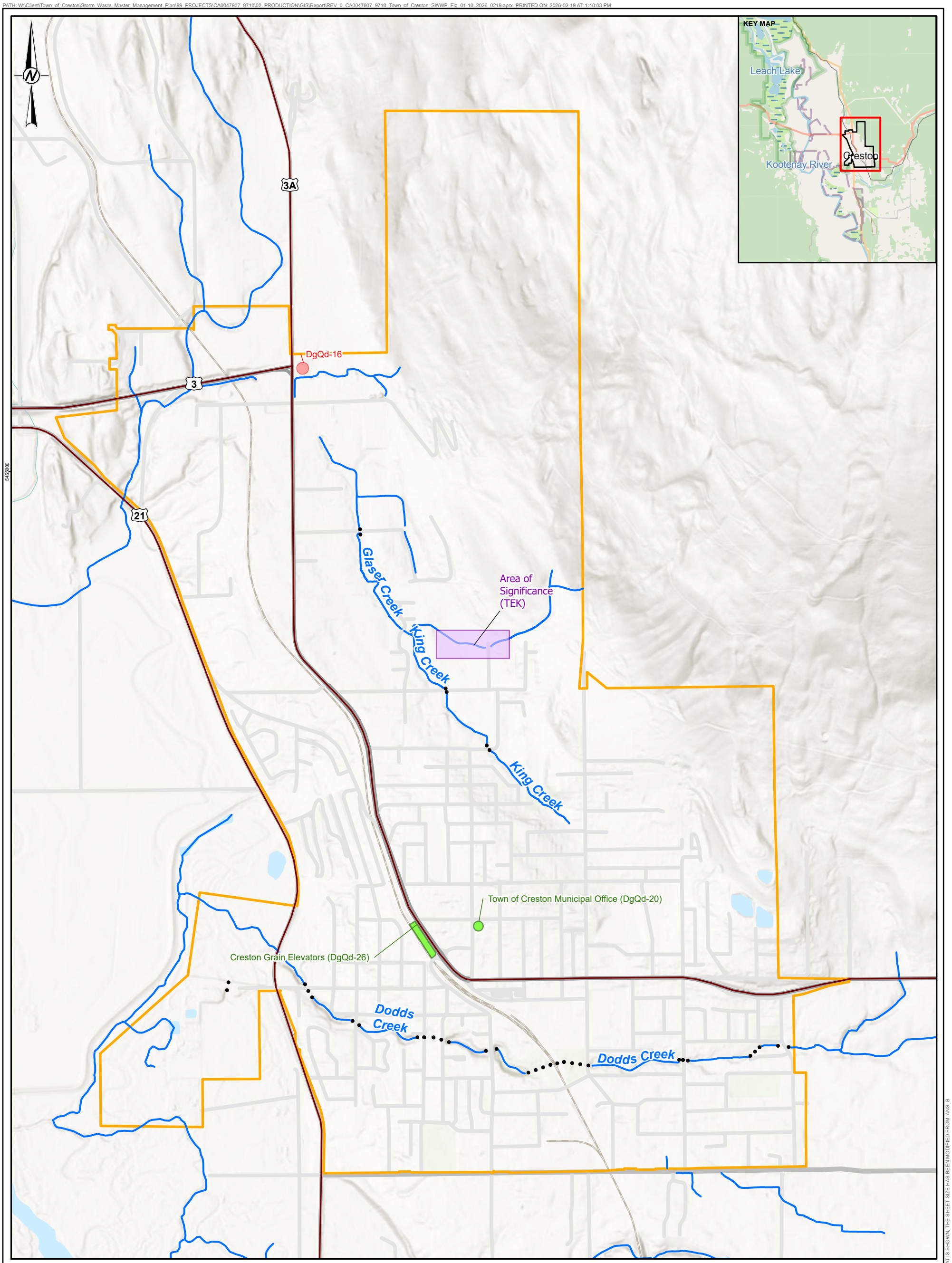
- Remote Access to Archaeological Data (RAAD)
- Provincial Archaeological Report Library (PARL)
- iMAPBC
- BC Register of Historic Places
- LidarBC
- Google Earth™ Imagery

A 5 km Local Study Area (LSA) buffer was applied to the project study area for this review (**Figure 7**) to capture heritage sites in proximity to the project study area. This buffer was applied to allow for a better understanding of the nature of registered heritage resources within the surrounding landscapes and assist in predicting areas where the project may impact heritage resources that have are to be discovered.

4.1 HERITAGE RESOURCES REVIEW FINDINGS

Three known heritage sites are located within the project study area, including one registered archaeological site and two recognized historic sites (**Figure 7**). An additional 10 known heritage sites (all registered archaeological sites) are located outside of the study area but within the 5 km LSA.

There are no previous archaeological studies recorded as being conducted within the project study area. Numerous archaeological studies, including some under HCA Permit, have been conducted with the LSA outside of the project study area (Government of British Columbia 2025a, 2025b).



LEGEND

- CULVERT
- HIGHWAY
- WATERCOURSE
- STUDY AREA
- PREVIOUSLY RECORDED ARCHAEOLOGICAL SITE
- PREVIOUSLY RECORDED HERITAGE SITE
- AREA OF SIGNIFICANCE (TEK)

0 0.5 1

1:15,000 KILOMETRES

CRESTON VALLEY
TOWN of CRESTON

REFERENCE(S)

1. BASE DATA FROM TOPOGRAPHIC MAP © ESRI AND ITS LICENSORS. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. BASE DATA CONTAINS INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA AND TOWN OF CRESTON PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
HERITAGE REVIEW

CONSULTANT
wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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4.1.1 ARCHAEOLOGICAL RESOURCES

REGISTERED ARCHAEOLOGICAL SITES

One registered archaeological site (DgQd-16) is located within the project study area. The full extent of DgQd-16 is unknown as the site is comprised of a single stone (lithic) artifact recovered by a landowner during farming activities (i.e., field cultivation). No archaeological inspection has been conducted at this site to delineate the size or nature of the site, and spatial inaccuracies, including site location and full boundaries, are likely (Government of British Columbia 2025a).

Ten additional registered archaeological sites, some of which also contain a historic component, are located outside of the project study area but within the LSA. **Table 4-1** provides additional details on each of the registered archaeological sites located within the project study area or LSA.

Table 4-1: Registered Archaeological Sites within 5 km of the project study area

Borden Number	Distance and Direction from Study Area	Site Type	Permit # of Previous Visits
DgQc-6	4.5 km east	Subsurface lithics (Fire altered rock)	1974-0001
DgQc-8	1.9 km east	Surface lithics	1981 (No permit), 1982 (No permit); 1982-0017
DgQd-1	3.8 km north	Stone cairn; subsurface lithics; cultural depression (cache pit)	1957 (No permit); 1972 (No permit)
DgQd-3	4.8 km southwest	Surface lithics	1974-0001
DgQd-4	4.6 km west	Subsurface lithics; historic refuse	1974-0017; 1979 (No permit); 1983-0037
DgQd-5	2.5 km south	Cultural depression (housepit); post-contact burial	1974-0001
DgQd-6	4.9 km southwest	Rock shelter	1974-0001
DgQd-11	2.2 km north	Surface lithics	1974-0001
DgQd-16	0 km (overlap)	Surface lithics	2003 (No permit)
DgQd-18	4.3 km west	Surface lithics, subsurface faunal	1981 (No permit)
DgQd-24	2.9 km south	Subsurface lithics	2017 (No permit)

These registered archaeological sites represent a wide variety of archaeological site types including cultural depressions (house pits and cache pits), a rock shelter, a stone cairn, and surface and subsurface lithic and faunal scatters, in addition to a post-contact burial site. Typically, these sites have been identified in proximity to extant or existing watercourses and on larger terraces overlooking river valleys.

PREVIOUS ARCHAEOLOGICAL STUDIES

No previous archaeological studies were identified through this review as having occurred within the project study area. Several recorded archaeological studies have been conducted outside of the project study area but within the LSA, including under HCA Permits 1974-0001, 1974-0017, 1982-0017, and 1983-0037, during which archaeological sites were identified or revisited (see **Table 4-1** above).

Additional archaeological studies were conducted within the LSA but outside of the project study area, including archaeological impact assessments under HCA Permits 2015-0133, 2016-0344, 2017-0140 (Government of British Columbia 2025a). In addition to the archaeological studies completed under HCA permits, several unpermitted large-scale surveys were completed in the 1970s and 1980s within the LSA, during which archaeological sites were also identified (see **Table 4-1** above).

POTENTIAL TO IMPACT ARCHAEOLOGICAL SITES

The sparsity of registered archaeological sites within the project study area may be attributed to the lack of archaeological studies conducted within the project study area, as opposed to an absence of archaeological sites themselves. The project study area is typically located on a large terrace at the base of Arrow Mountain overlooking the Goat River valley to the south and east and the wider Kootenay River valley to the west. Several smaller watercourses cross through the project study area, the most notable being Dodd's Creek (Google Earth™; Government of British Columbia 2025c). Based on the project study area topographic and environmental setting, which is consistent with settings on which archaeological sites have been identified in the broader LSA, the project study area is considered to contain archaeological potential. This archaeological potential assessment can be further refined once the specific project footprint has been defined, at which time a field visit to confirm archaeological potential within the project footprint should be conducted.

4.1.2 HISTORICAL RESOURCES

PREVIOUSLY REGISTERED HISTORIC SITES

Two known historic sites are located within the project study area. The Creston Grain Elevators (DgQd-26) represent a rare historic agricultural building type and are located adjacent Highway 3 northwest of 9th Avenue. These two, six-storey, standing grain elevators were constructed in 1935-1936 and were used in the region's agricultural industry until 1971 and 1982 before being formally recognized as a heritage site in 2020 (Government of British Columbia 2025b). Due to safety concerns and the infeasibility of the building's restoration, one of the grain elevators was dismantled in 2024/2025 (Columbia Basin Trust 2025). The Town Municipal Office (DgQd-20) is also recognized as a historic building by both the Central Kootenay Regional District in 2020 and the Town in 1989 and 2001. DgQd-20 is located on the southeast corner of Vancouver Street and 10th Avenue in the Town's urban centre.

TRADITIONAL ECOLOGICAL KNOWLEDGE

During a presentation on January 16, 2025, Yaqan Nukiq representatives identified a reach of Glaser/King Creek that hosts easily accessible dogwood and cattails. These resources are noted to be of value for their contemporary and historical significance. They are valued for their application to traditional culture, tools, and crafts. This area is highlighted on Figure 7.

4.2 HERITAGE POLICY REVIEW

4.2.1 LEGISLATION

HERITAGE CONSERVATION ACT

In British Columbia, all archaeological sites on Provincial Crown land or private land that predate AD 1846 are automatically protected under the HCA (Government of British Columbia 1996). Certain sites, including burials and rock art sites that have historical or archaeological value, are protected regardless of age. Heritage wrecks, consisting of the remains of vessels and aircraft, are also protected under the HCA after two or more years have passed since they sank, crashed, or were abandoned (including being placed in a landfill environment). Protection of these sites applies whether they are recorded, unrecorded, intact, or disturbed. The Archaeology Branch of the Ministry of Forests and the BC Energy Regulator are the agencies responsible for administering the HCA, issuing permits, and handling referrals from various development agencies. The Archaeology Branch maintains a register of recorded archaeological sites accessible through the Remote Access to Archaeological Data application (RAAD; Government of British Columbia 2025a).

Archaeology sites, whether registered or unregistered, may not be altered, damage, moved, excavated, or disturbed without a permit issued under the HCA. Subsurface inspection and investigation of an archaeological site, or inspection with the intent to locate a site, require a permit under Section 12.2 of the HCA.

Apart from impacts occurring under a Section 12.2 permit, any alteration to known archaeological sites must be conducted under an Alteration Permit, issued under Section 12.4 of the HCA. An Alteration Permit is held by the individual responsible for site alterations and is usually co-signed by a professional archaeologist. These permits may allow for actions including, but not limited to, systematic data recovery in the form of archaeological excavations or archaeological monitoring concurrent with development within an archaeological site. The Archaeology Branch forwards all applications for Section 12.2 and 12.4 HCA permits to First Nations identified as having Aboriginal interests in the permit area, for their review and comment.

LOCAL GOVERNMENT BY-LAWS

Historic sites that are not protected by the HCA may be protected by municipal by-law under the authority of the BC *Local Government Act* (Government of British Columbia 2015). These sites are usually documented on Community Heritage Registers administered by municipalities or regional districts, the BC Register of Historic Places, and/or the Canadian Register of Historic Places. For example, historical sites DgQd-26 and DgQd-20 are included in the Regional District of Central Kootenay (RDCK) Community Heritage Register (Section 4.1.2). A Community Heritage Register entry generates a degree of recognition for these sites; however, without a site-specific protection mechanism in place such as a heritage designation by-law, heritage revitalization agreement by-law, or heritage restrictive covenant, inclusion on any of these three registers does not provide automatic protection for these sites.

4.2.2 FIRST NATIONS' HERITAGE POLICY AND PERMITTING SYSTEMS

Many BC First Nations have developed their own heritage policies and permitting systems. Consistent with the code of conduct and by-laws of the BC Association of Professional Archaeologists, as well as the Canadian Archaeological Association Statement of Principals for Ethical Conduct Pertaining to Aboriginal Peoples, WSP and the professional archaeological community respect these requirements and systems.

The scope of these policies reflects Indigenous sovereignty over their cultural heritage and ensures a measure of oversite during archaeological research. First Nations heritage policies and permitting systems aim to protect cultural heritage on unceded traditional lands and treaty lands, track archaeological assessments, protect Aboriginal Rights, and confirm cultural protocols are being observed, particularly as they relate to Ancestral Remains and spiritual locations.

First Nations heritage polices and permitting systems are comparable to the HCA, however, consistent with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP; United Nations 2007), their definition of "heritage resources" is often much broader in scope than the HCA's (Mason 2013).

Indigenous groups that do not have formally developed heritage policies may have heritage protocols or procedures that are communicated via the HCA permit referral process or during archaeological projects. For example, the Ktunaxa Nation Council has issued the *Guidelines for Archaeological Assessment and Engagement in Ktunaxa Territory* (Ktunaxa Nation Council 2019). At the time of this memo and to WSP's knowledge, no Indigenous communities within the project study area have an independent permitting process in place.

4.3 HERITAGE RECOMMENDATIONS

The study area has potential for unrecorded archaeological sites (Sections 4.1 and 4.2). The following management options are recommended for avoiding or mitigating possible impacts to protected archaeological sites, if present:

- A project-specific Archaeological Overview Assessment (AOA) be conducted, including a preliminary field reconnaissance (PFR), to refine our understanding of archaeological potential within the study area and to identify high potential areas (HPAs) where additional archaeological work in the form of an archaeological impact assessment (AIA) would be recommended. The AOA could be restricted to specific project footprints should they be available. An AOA/PFR does not require an HCA permit, however, advanced notification to First Nations is required, following similar timelines as to what is required during the permit referral process (typically a 30-day notice).
- An AIA be conducted within HPAs identified during the AOA, should they be located within the proposed project footprint. The purpose of the AIA would be to identify archaeological sites that may be present and to provide management recommendations for those sites. In areas where the ability to conduct manual subsurface inspection is constrained by the presence of built surfaces, machine assisted testing may be recommended. In areas where preliminary testing is not possible, the AIA may be able to be conducted concurrent with project-related construction (i.e., archaeological monitoring). The acquisition of a heritage inspection permit pursuant to Section 12.2 of the HCA will be required prior to conducting an AIA. The current timeline for permit issuance is approximately 10-12 months from the time of permit application submission. Given

this timeline, it is recommended that the Section 12.2 inspection permit application be submitted to the Archaeology Branch as soon as possible, including prior to completion of the AOA/PFR. Note that while completion of an AOA/PFR ahead of the AIA is not a requirement, it would allow for a more efficient and timelier AIA following permit issuance.

- The Ktunaxa Nation Council's Chance Find Procedures (Ktunaxa Nation Council 2025) be implemented should any unexpected archaeological materials be encountered during project construction. It is strongly recommended that implementation of chance find procedures be preceded by an AOA (and AIA if recommended during the AOA) in order to reduce the likelihood of unintentional alterations to sites protected under the HCA and resulting project delays due to permitting requirements and work stoppage.
- Impacts to archaeological site DgQd-16 be avoided through project redesign. Should avoidance of DgQd-16 not be possible, an Alteration Permit pursuant to Section 12.4 of the HCA will be required prior to any ground disturbance within the site boundaries following AIA within the site (see next bullet). The current timeline for site alteration permit issuance is also approximately 10-12 months from the time of permit application submission.
- Due to the noted spatial inaccuracies of the registered site boundaries, an AIA is recommended in those areas where project-related ground disturbance is expected within 50 m of the recorded DgQd-16 site boundary to confirm both the location and extent of the site.
- For the two recorded historic sites within the study area, the Town should follow its heritage regulations and policies, in consultation with the Columbia Basin Trust and the RDCK, for recommendations regarding potential impacts to these sites.

5 SYSTEM OVERVIEW

5.1 STORMWATER SYSTEM

The stormwater system in Creston features a dual drainage network designed to manage both local urban runoff and external flows from surrounding upland areas. Located at the base of Arrow Mountain, the Town receives substantial inflows from adjacent higher terrain in addition to its own stormwater. The system is fully separated and incorporates both minor (storm sewer) and major (overland) components.

The original design philosophy, as outlined in the Town's 1982 Master Drainage Plan (Dayton and Knight 1982), was to convey runoff from the 5-year return period storm within the minor system, with flows from more intense events routed through the major system using road rights-of-way, swales, and ditches. These overland pathways ultimately discharge to one of two receiving creeks: Dodd's Creek or Glaser/King Creek. The system is comprised of small, separate drainage basins that reflect the community's varied topography and staged development history.

5.1.1 STORM SEWER NETWORK

The minor drainage system includes approximately 29,900 metres of storm sewers and 770 metres of culverts, based on GIS data provided by the Town. The network is most developed in the central and southern portions of the community, while coverage is sparse in the north, where runoff is more frequently conveyed via overland routes.

Pipe diameters range from 150 mm to 1200 mm with the majority between 200 mm and 300 mm. **Figure 8** illustrates the pipe network sizing. The system is composed of various pipe materials, including PVC (predominant), concrete, asbestos cement, corrugated steel, ductile iron, galvanized steel, HDPE, and vitrified clay tile reflecting the incremental development of the network over several decades.

5.1.2 OVERLAND DRAINAGE

Overland drainage plays a critical role in the Town's dual drainage strategy, particularly during storm events that exceed the 5-year design capacity of the minor system. Major system flows are conveyed primarily along road rights-of-way, which act as controlled overland flow corridors. Ditches, vegetated swales, and occasional informal flow paths supplement overland conveyance in less developed or topographically constrained areas.

Runoff is routed to natural watercourses, with most overland flow directed toward Dodd's Creek, which ultimately discharges to the Kootenay River. This overland routing is generally consistent with the community's sloped topography, which facilitates westerly flow by gravity.

While much of the major system functions as intended, several areas have experienced drainage problems[4], likely related to insufficient overland capacity, grading constraints, or aging infrastructure. Notable locations include:

- Valleyview Road and Highway 21

[4] Personal communication, Colin Farynowski (August 13, 2025).

- King Creek area north of Cavell Street
- Storm drain crossing at Highway 3 and Regina Street
- Erickson Road
- Highway 3 and Regina Street
- Dodd's Creek (culverts and southeast basin areas)

5.1.3 RECEIVING SYSTEM

Stormwater runoff from Creston ultimately drains into a network of natural watercourses, primarily Dodd's Creek and Glaser/King Creek. This Runoff is conveyed via storm sewers or routed overland through roadways, ditches, and swales before entering the creeks through stormwater outfalls or surface discharge points. These watercourses traverse the Town's urban and peri-urban areas before discharging into the Goat River, a major tributary of the Kootenay River. This sequence forms part of a larger regional watershed extending beyond the Town's jurisdiction.

As illustrated in **Figure 9**, the study area includes four major sub-basins:

- **Dodd's Creek Upper Sub-basin:** The majority of Creston's developed lands and the upstream lands near Arrow Mountain (871 ha) drain directly into the upper reaches of Dodd's Creek, which flows east to west through the Town.
- **Dodd's Creek Lower Sub-basin:** Areas of west and south Creston drain westward into the lower reaches of Dodd's Creek.
- **Glaser/King Creek Upper Sub-basin:** Northeast Creston and the upstream lands near Arrow Mountain drain into Glaser/King Creek
- **Glaser/King Creek Lower Sub-basin:** Northwest Creston drains the lower reaches of Glaser/King Creek.

Dodd's Creek and Glaser/King Creek serve an important stormwater function and two stormwater detention facilities are located along Glaser/King Creek as shown in Figure 8. One is a privately maintained facility at the rear of the Home Hardware (1608 Northwest Blvd) and the other is a natural depression in Schikurski Park (703-12th Avenue North). Both Dodd's Creek and Glaser/King Creek should be viewed as natural infrastructure for the Town. While no chronic issues have been reported at stormwater outfalls (or within the channels), information on condition is limited as no formal monitoring program is in place.

5.1.4 STORMWATER TREATMENT

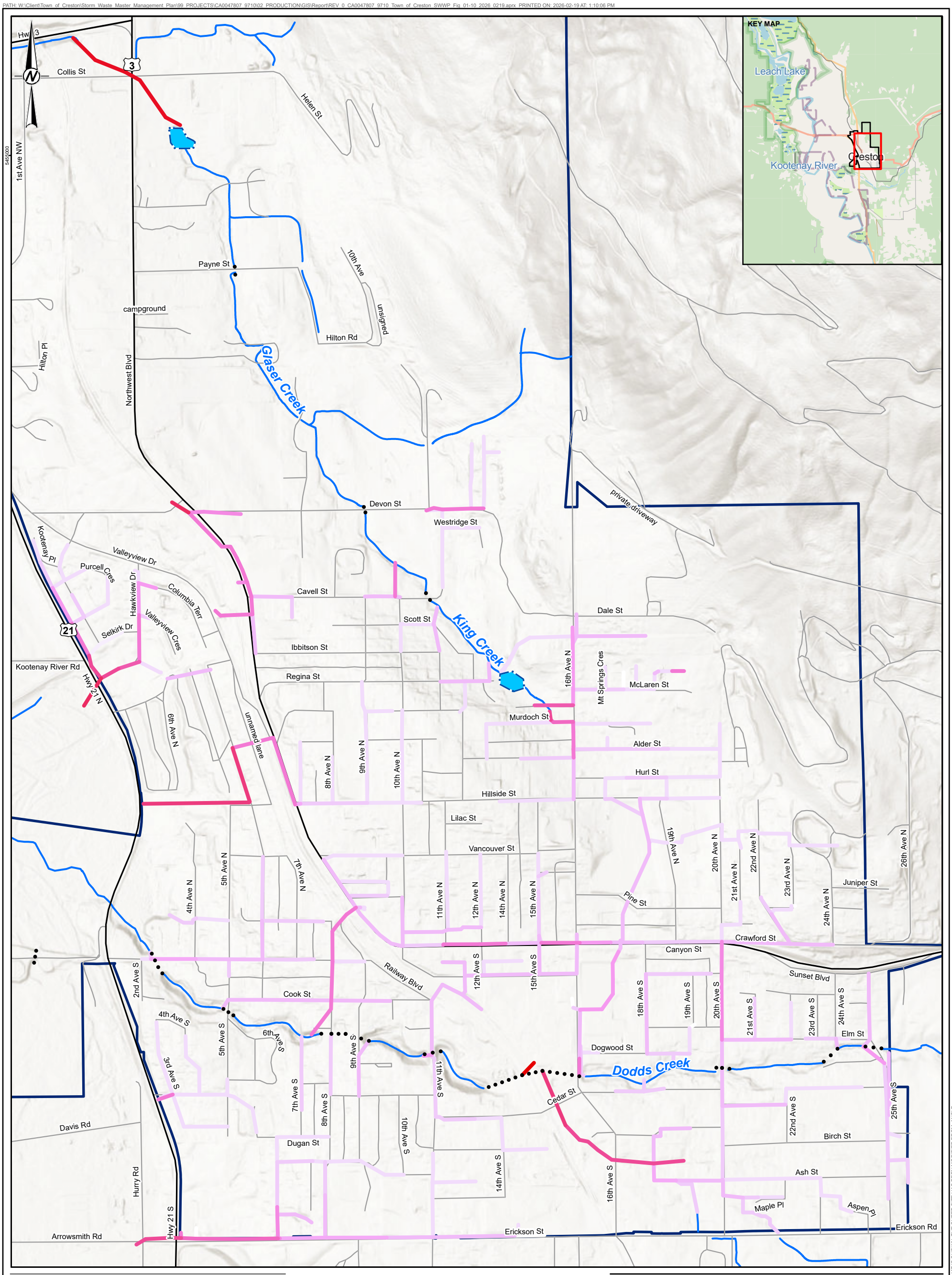
The Town of Creston currently lacks any formal stormwater treatment infrastructure. No Low Impact Development (LID) features, of LID practices such as swales, rain gardens, and other surface-based features have been implemented and there are no municipal stormwater management facilities (SWMFs) or oil-grit separators in existing or newly developed areas.

While the Town's Official Community Plan (OCP) encourages the future implementation of LID practices, none have been constructed to date. There are several privately-owned ponds that may provide incidental treatment, but their design intent and performance are unknown.

Any stormwater treatment that does occur is informal and incidental, typically through basic settlement or filtration within roadside drainage swales. Additionally, natural wetlands located downstream on the west side of the Town, toward the Kootenay River, may provide some water quality benefits, although their treatment capacity has not been formally assessed.

At present, the Town does not have a formalized water quality treatment strategy, and the stormwater model reflects existing conditions without any stormwater treatment. Stormwater management practices in Creston are expected to align with provincial environmental guidelines, as no specific local by-laws or standards define treatment parameters. Future development should align with best practices outlined in British Columbia's Stormwater Planning Guidebook (BC 2002) which states to capture 0 to 50% of the MAR[5] (90% of the rainfall volume in a typical year) at the source (building lots and streets) and infiltrate, evaporate, or reuse it.

[5] MAR is Mean Annual Rainfall Event (i.e., approximately a 2.33-year, 24-hour storm event – refer to Guidebook).



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY
- STORMWATER DETENTION FACILITY

PIPE SIZE

- 0.15
- 0.175
- 0.2
- 0.25
- 0.3
- 0.35
- 0.375
- 0.4
- 0.45
- 0.5
- 0.525
- 0.6
- 0.65
- 0.75
- 1
- 1.2
- 1.5

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER INFRASTRUCTURE

CONSULTANT
wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
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KEY MAP

Leach Lake

Kootenay River

Creston

3A

3

21

Glaser Creek

King Creek

Dodds Creek

LEGEND

- HIGHWAY
- WATERCOURSE
- MUNICIPAL BOUNDARY

MAJOR SUB-BASIN

- DODD'S CREEK LOWER SUB-BASIN
- DODD'S CREEK UPPER SUB-BASIN
- GLASER/KING CREEK LOWER SUB-BASIN
- GLASER/KING CREEK UPPER SUB-BASIN

0 0.5 1 1.5

1:25,000 KILOMETRES

CRESTON VALLEY

TOWN of CRESTON

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CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
CRESTON - MAJOR SUB-BASINS

CONSULTANT

wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
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6 MODEL DEVELOPMENT

6.1 SELECTED SOFTWARE

PCSWMM (Personal Computer Stormwater Management Model) was used to carry out single event analyses. Developed by Computational Hydraulics International, PCSWMM is an adaptation and enhancement of the widely used US EPA SWMM computer model. It features a GIS-based interface and provides a front-end pre- and post-processor for the US EPA SWMM computational engine.

The model simulates four key hydrologic and hydraulic processes, representing the primary components of the land surface hydrologic cycle:

- Precipitation;
- Rainfall losses;
- Runoff transformation; and
- Channel and reservoir routing.

The drainage system used was modeled using discrete elements that reflect its physical components, including catchment areas, conduits, junctions (manholes), and outfalls.

6.2 MODEL SET-UP

A detailed model was created with PCSWMM to assess Creston's stormwater management system. The Town's drainage network was represented as a dual drainage 1D model. Dual drainage 1D models are a practical simplification of complex 2D urban hydrodynamic systems. They aim to represent both surface and subsurface (sewer) flows using one-dimensional equations, which significantly reduces computational demands while still capturing key hydraulic behaviors.

6.2.1 MODEL CONFIGURATION

Key components of the model include subcatchments, conduits, and nodes:

- Subcatchments are the foundational units for simulating how rainfall becomes runoff. As shown in **Figure 9**, they represent small, relatively homogeneous areas within the watershed. The model generates runoff hydrographs for each subcatchment based on geometry, slope, surface roughness and other factors.
- Conduits are used to represent sewers and overland flow routes:
    - Circular conduits are used for sewers.
    - Open conduits with custom cross-sections represent the overland road network and ditches. For roads, a standard 15-meter road right-of-way (ROW) with crown and gutter was used.
- All conduits are connected via nodes. Within the sewer system, nodes may represent a catchbasin (CB), manhole (MH) or an outlet. Within the surface system, nodes may represent an intersection of flow paths, a change in flow direction, change in conduit shape, or an outlet.

The model includes all contributing subcatchments located upslope of the Town and extends downstream to capture reaches of Dodd's Creek and Glaser/King Creek. Free outlet conditions are assumed at the downstream model boundaries.

6.2.2 PARAMETER SELECTION

The PCSWMM model developed for the Town is intended to provide a reliable representation of runoff behavior and system drainage under various rainfall conditions. As with any conceptual model, several assumptions and simplifications were applied to develop the model network:

- Junction invert elevations in the major system correspond to the base of the roadway or drainage path.
- Rim elevations in the major system network were selected at a typical depth of 0.30 m above the base elevation to capture the depth of flow and allow routing between surface nodes.
- Only mapped infrastructure was included in the model; unrecorded connections, small private systems, or informal ditches may exist but were not explicitly modeled.

6.2.2.1 HYDROLOGIC PARAMETERS

This section outlines the hydrologic parameters applied to subcatchments within the PCSWMM model to simulate rainfall-runoff processes across the Town. These parameters govern how rainfall is transformed into surface runoff and include subcatchment specific values such as percent imperviousness, infiltration characteristics, surface roughness, and depression storage. The values applied were selected to reflect the physical conditions within the Town and consider industry best practices for master planning.

IMPERVIOUSNESS

Imperviousness is a key factor influencing surface runoff generation, as it directly impacts the volume and rate of rainfall that becomes runoff rather than infiltrating into the ground. In the PCSWMM model, imperviousness was assigned to each subcatchment based on existing and future land use types identified in the Town's Official Community Plan (OCP). Spatial land use data were overlaid onto the delineated subcatchments using GIS to determine the proportion of each land use type within each drainage area.

Each land use category is based on the OCP zoning and assigned a representative imperviousness value, reflecting expected impervious cover (rooftops, paved surfaces, driveways, and other hardscapes). These values were selected based on typical values published municipal guidelines, and consider values implemented in drainage studies for comparable municipalities.

The assigned imperviousness values for each land use category are summarized in **Table 6-1**.

Table 6-1: Imperviousness of Catchments

LAND USE	IMPERVIOUSNESS
Residential – Low Density	55
Residential - Rural	35
Commercial	95
Industrial	85
Institutional	85
Agricultural	0

LAND USE	IMPERVIOUSNESS
Municipal Forest	0
Natural	0
Large Land Holdings	35
Roadways (Right-of-Way)	70
Railway Corridor	25

INFILTRATION

The Town is primarily underlain by silt loam soils, which typically fall under Hydrologic Soil Group B classification per TR-55 (USDA NRCS). These soils have moderate infiltration potential and lower runoff generation. A uniform infiltration approach was applied across all modeled subcatchments using the Horton infiltration method

Infiltration was modeled using the Horton equation, which defines a time-dependent exponential decay in infiltration capacity during a rainfall event:

$$f(t) = f_c + (f_0 - f_c) \cdot e^{-kt}$$

Where:

- $f(t)$ = infiltration rate at time t (mm/hr)
- f_0 = initial (maximum) infiltration rate (mm/hr)
- f_c = minimum (final) infiltration rate (mm/hr)
- k = decay coefficient (1/hr)

To ensure consistency with past modelling in the Town and to reflect local soil conditions, the Horton parameters were adopted from the Southeast Drainage Basin Study (WSP 2017), which derived values based on local soil mapping and literature guidance from Akan (1993). These parameters align well with typical ranges for silt loam soils described in USDA NRCS TR-55 and infiltration capacity estimates from Rawls et al. (1983).

These values are summarized below:

Table 6-2: Horton Infiltration Parameters

Parameter	Value	Units	Justification
f_0	254.0	mm/hr	Adopted from Southeast Drainage Basin Study (2017); reflects dry soil infiltration potential based on Akan (1993)
f_c	9.5	mm/hr	Southeast Drainage Basin Study (2017); aligns with TR-55 Group B soils and Rawls et al. (1983)
k	4.14	hr^{-1}	Southeast Drainage Basin Study (2017); consistent with typical ranges for silt loam soils

RUNOFF SURFACE PARAMETERS

In addition to infiltration parameters, key runoff surface parameters were applied across subcatchments to simulate surface roughness, depression storage, and runoff timing. These were selected based on standard practice for small urban and semi-rural municipalities, informed by EPA SWMM, CHI PCSWMM guidance, and municipal modeling standards.

Table 6-3: Surface Runoff Parameters

Parameter	Value	Units	Description
N-Imperv	0.012	-	Manning's n for impervious surfaces (e.g., asphalt, rooftops)
N-Perv	0.250	-	Manning's n for pervious areas (e.g., lawns, fields, forests)
Dstore-Imperv	1.5	mm	Depression storage on impervious areas (e.g., roads, driveways)
Dstore-Perv	3.0	mm	Depression storage on pervious surfaces (e.g., vegetation, soil)
Zero-Imperv	20	%	Portion of impervious area directly connected to drainage with no abstraction

These values reflect typical surface and soil conditions within the Town, balancing urbanized areas, low-density residential developments, agricultural lands, and naturalized landscapes.

6.2.2.2 *HYDRAULIC PARAMETERS*

Hydraulic parameters were assigned in the PCSWMM model to reflect the physical characteristics of conduits, overland flow paths, and other stormwater infrastructure within the Town. These parameters govern how water is conveyed through both the minor and major system under varying flow conditions.

Manning's roughness coefficients were selected based on standard values for typical construction materials and surface conditions. These values directly influence behavior within the stormwater network.

The following roughness coefficients were applied:

- **Pipes:** A Manning's n value of **0.011** was assigned to all storm sewer conduits. This value is consistent with smooth concrete or PVC pipe materials commonly used in municipal drainage systems and reflects minimal internal friction and sediment buildup.
- **Streets:** A Manning's n value of **0.013** was used to represent overland flow along road surfaces within the 15-meter right-of-way (ROW). This value captures typical urban roadway surface texture and was applied to simulate gutter or crown-line flow in dual drainage conditions.
- **Ditches and Overland Flow Paths:** Manning's n was set to **0.03** for vegetated swales, roadside ditches, and undeveloped overland routes within the Town, 0.1 for Dodds Creek within Town, and 0.06 for overland flow routes outside the Town. This reflects the higher surface resistance associated with grassed channels and natural channels, and shallow natural depressions that may convey flow during major storm events.

6.2.3 *SUBCATCHMENT DELINEATION*

The overall contributing area draining through the Town extends from the slopes of Arrow Mountain to the northeast and includes portions of the Town of Erickson to the east. Creston is situated at the base of Arrow Mountain and receives surface runoff from both adjacent upland and internal drainage sources. Subcatchment boundaries were delineated using a high-resolution Digital Elevation Model (DEM) processed within the PCSWMM modeling environment. DEM-based delineation allows for automated identification of flow direction, flow accumulation, and drainage divides, which were used to define discrete hydrologic subcatchments across the study area.

These subcatchments form the basis of the surface runoff modeling and are aligned to match natural topography and constructed drainage infrastructure such as roads, ditches, and culverts. Each subcatchment was reviewed and refined to ensure that it accurately represents observed drainage patterns, flow paths, and outlet locations.

To characterize each subcatchment, land use information from the OCP was used in conjunction with typical land cover composition to assign representative hydrologic parameters (see **Section 6.2.2.1**). For subcatchments comprised of more than one land use, subcatchment parameters were calculated based on weighted imperviousness.

6.2.4 HYDRAULIC NETWORK

The hydraulic network for the Town was developed using existing stormwater infrastructure data provided by the Town. This included the available storm pipe inventory, surveyed pipe inverts, and manhole rim elevations. The resultant model reflects existing pipe alignments, diameters, materials, and connectivity wherever data were available.

Where surveyed information was incomplete or unavailable, engineering judgment was applied to estimate missing pipe and manhole inverts. These estimates were guided by local ground elevation, subcatchment slope, and topographic context, ensuring continuous and hydraulically realistic flow paths throughout the network. Rim elevations for manholes were likewise interpolated (See **Appendix D** for detailed information) or confirmed using available survey points, LiDAR, or digital elevation model (DEM) data to maintain vertical accuracy and surface continuity across the system.

The model facilitates continuity between the minor and major systems by linking surface overflow nodes to downstream storm sewer inlets or overland outlets, allowing for an evaluation of both pipe conveyance capacity and surface flooding.

To represent the major system, surface junction nodes were incorporated to simulate roadway flow routing and surface ponding. Subcatchments were initially connected to the major system via catch basins (CBs), which directed runoff hydrographs to the minor system under normal conditions. For junction nodes representing the major system, the invert elevation corresponds to the base of the roadway (transect invert or spill elevation at the edge of pavement), while the rim elevation was set to reflect the maximum allowable surface water depth above the node, enabling simulation of ponded water and overland flow.

Additional rim elevation depth was included to facilitate routing between surface junction nodes, allowing overflow volumes to travel along the roadway network. In alignment with a conservative modeling approach, the volume attributed to each road catch basin reflects only the dynamic ponded depth above the junction node, excluding the static structural volume of the catch basin. When surface storage exceeds the available catch basin capacity, flows spill at the downstream highpoint and continue routing through adjacent surface nodes until they either re-enter the minor system or discharge westward toward the Goat River and ultimately to the Kootenay River. This approach ensures that the major system was constructed based on roadway geometry, surface flow paths, and elevation data, allowing for realistic simulation of overland flow and surface flooding.

6.2.5 BOUNDARY CONDITIONS

Upstream boundaries were defined by including all upstream subcatchments within the study area to estimate contributing inflow. Downstream boundaries extended to natural watercourses. All downstream boundaries were modeled with free outlet conditions, assuming unrestricted hydraulic discharge at outlet locations.

6.2.6 DESIGN EVENTS

Design storm events for this study were selected based on the dual-drainage philosophy adopted by Town under their current Master Drainage Plan (Dayton and Knight 1982) and updated climate-informed rainfall data developed for the Town (WSP 2015).

The dual-drainage philosophy provides a framework for system analysis and design:

- **Minor system:** Designed for the 5-year return period event.
- **Major system:** Manages flows exceeding the 5-year event, including up to the 100-year return period.

This approach recognizes that underground conveyance of all storm events is impractical and cost-prohibitive, instead relies on overland flow routes (e.g., roads, ditches, swales) for managing extreme events.

6.2.6.1 IDF CURVE DEVELOPMENT AND CLIMATE HORIZONS

Rainfall intensities were derived from updated IDF curves established in *Development of IDF Curves Under a Changing Climate* (WSP 2015). These curves were generated using the IDF_CC Tool[6] (Schardong et al. 2015). This tool applies statistical modeling and bias-corrected global climate model (GCM) data to develop localized rainfall projections for the following time horizons:

- 2020s (2010–2039)
- 2050s (2040–2069)
- 2080s (2070–2099)

The high (RCP 8.5) scenario was adopted exclusively for this study. This scenario captures worst-case rainfall intensities, particularly for short-duration, high-intensity storms that are critical to stormwater infrastructure design. Use of RCP 8.5 is consistent with guidance from previous work (WSP 2015), recognizing that the current global emissions trajectory is tracking at or above this worst-case scenario.

6.2.6.2 RAINFALL DISTRIBUTION

Rainfall depths from the IDF analysis were converted into design storm hyetographs using the AES Type 2 distribution for the BC Interior region, as recommended by the Hydrology of Floods in Canada (NRC 1989) and supported by current design guidelines (MMCD, 2019). This distribution was selected because:

- It is calibrated for interior BC rainfall;
- The Town does not mandate a specific storm distribution method; and
- AES is widely used across BC in the absence of municipal protocols.

The AES distribution was applied to each return period to generate synthetic design storms. A 1-hour storm duration was used to assess local capacity (minor system) and surface flooding (major system).

6.2.6.3 DESIGN STORM CONSTRUCTION

Design storms were created using the *PCSWMM Design Storm Creator,* based on the IDF Curve Report for the RCP 8.5 scenario (WSP 2015). For the 1-hour duration, average rainfall intensities (mm/hour)

[6] The IDF_CC Tool provides updated intensity-duration-frequency curves that account for climate change projections and can be accessed online at http://www.idf-cc-uwo.ca/.

were multiplied by one hour to obtain total rainfall depths. **Table 6-4** summarizes the rainfall intensities used for the historical baseline and projected future horizon for the 5-year, and 100-year return periods.

Table 6-4: RCP 8.5 Rainfall Intensities (1-hour Storm Duration)

RCP 8.5 Scenarios	Average Rainfall Intensity (mm/hour)	
	5-year	100-year
Historical Data (Appendix G, Table 3)	16.11	33.63
2080s (Appendix G, Table A9a)	24.52	45.05

These rainfall depths were transformed into temporal rainfall distributions using the AES Type 2 (BC Interior) hyetograph, as shown in **Figure 10 and Figure 11**. These rainfall events reflect both historical data and future climate projections, supporting a robust assessment of system performance and resilience.

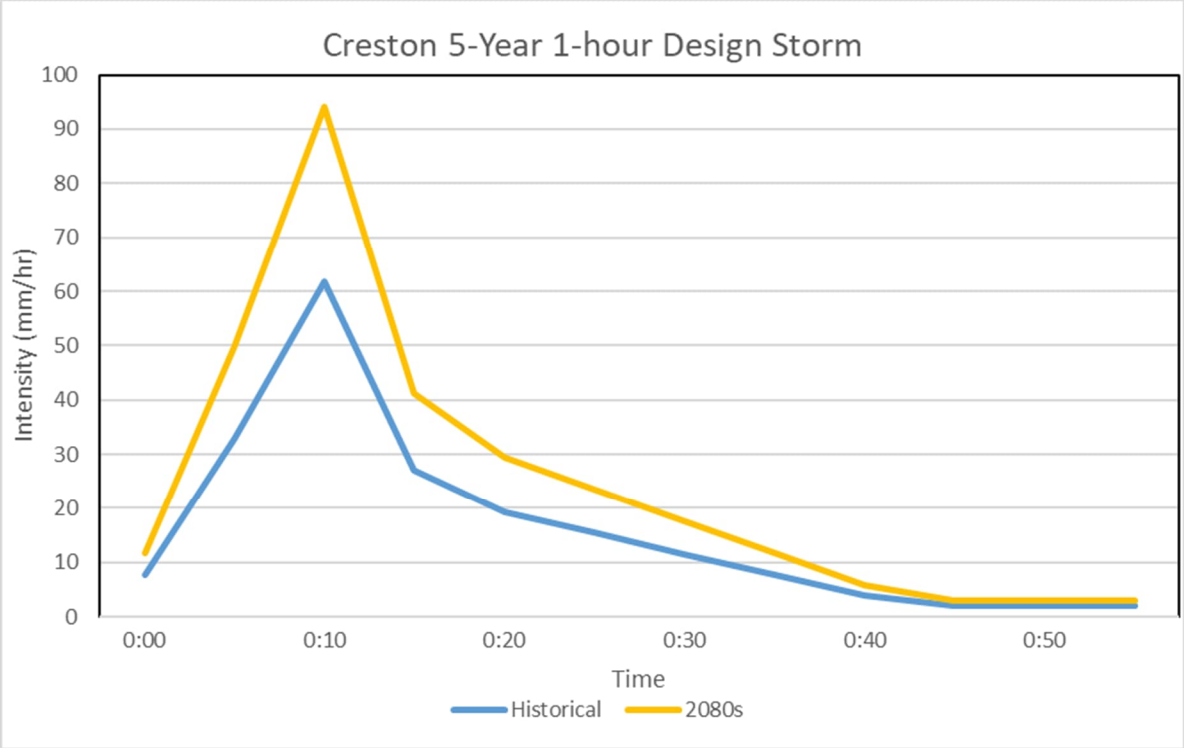


Figure 10: 5-Year 1-hour Design Storms

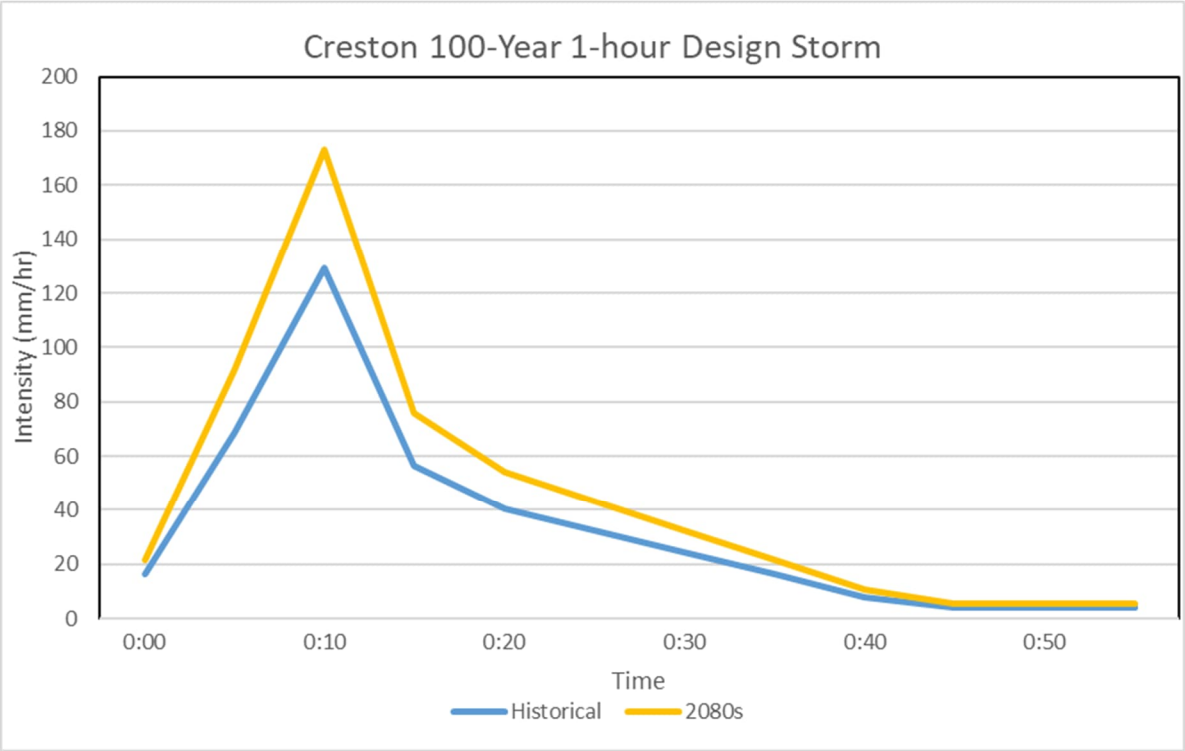


Figure 11: 100-Year 1-hour Design Storms

6.2.7 MODEL VALIDATION

To validate the hydrologic modelling of contributions from upstream rural catchments, a regional flood frequency analysis was completed. This analysis used long-term hydrometric data from three nearby Water Survey of Canada gauges located on small streams within the same physiographic region:

- SULLIVAN CREEK NEAR CANYON (08NH115)
- ARROW CREEK NEAR ERICKSON (08NH084)
- DUCK CREEK NEAR WYNNDEL (08NH016)

These gauges were selected for their long record periods and catchments The contributing catchments are comparable (in size and composition) to the rural watersheds draining toward Creston, including Arrow Mountain and upstream basins discharging to Dodd's Creek and Glaser/King Creek.

The analysis used annual peak flow data extracted for standard return periods (2-, 5-, 10-, 20-, 50-, and 100-year events). Observed peak flows from all three gauges were plotted against drainage area on a log–log scale, and best-fit regression curves were generated for each return period. This resulted in empirical equations of the form:

$$Q = C \times A^{B}$$

Where:

- Q = estimated instantaneous peak flow (m^3/s)
- A = drainage area (km^2)

- C, B = regression coefficients

The derived regression equations are shown on the graph (see Figure 12Figure 12). For example, the 100-year best-fit equation was:

$$Q_{100} = 0.16 \times A^{1.26}$$

These equations were then used to estimate peak flows entering Creston from upstream rural catchments. The resulting flow aligns reasonably well with modeled discharge (e.g. 2.37 m^3/s vs 2.88 m^3/s at Dodd's Creek) , strengthening model credibility and ensuring that external inflows reflect reasonable magnitudes for planning and design purposes.

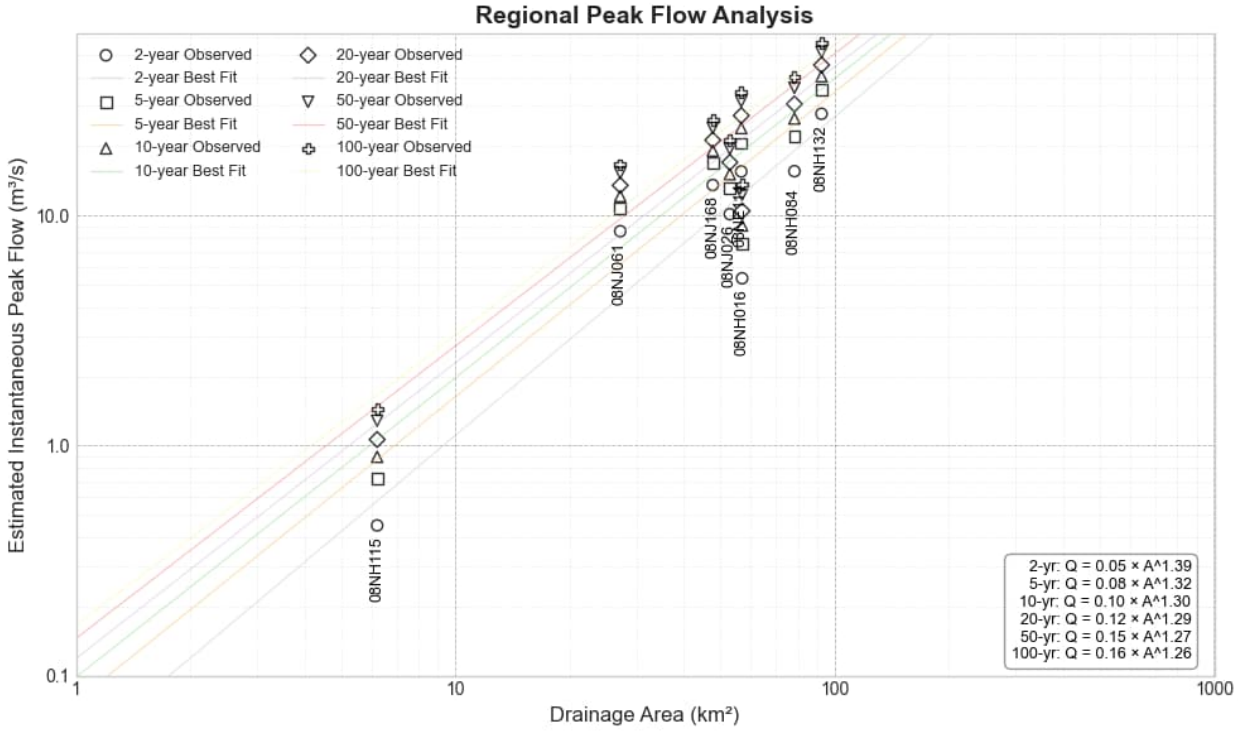


Figure 12: Regional Peak Flow Analysis

7 EXISTING SYSTEM

7.1 SYSTEM PERFORMANCE

The performance of the existing stormwater system was evaluated under two design storm scenarios reflecting the Town's dual-drainage strategy:

- The 5-year return period storm, representing the minor system design event for storm sewers and inlets; and
- The 100-year return period storm, representing major system design event where runoff is conveyed primarily via roads, overland flow paths, and open channels.

7.1.1 MINOR SYSTEM PERFORMANCE (5-YEAR 1-HR DESIGN STORM)

The capacity and performance of the Town's minor stormwater system were evaluated under the 5-year 1-hour return period design storm. This analysis focused on the ability of the piped network, catch basins, and inlets to collect and convey runoff during the target design event.

Model results showed that, under this design scenario, much of the minor system performs adequately. However, localized capacity constraints were identified in several areas. These include select older neighbourhoods and the downtown core, where storm pipes are predominantly small-diameter (200–300 mm) and where land use intensification over time has increased imperviousness beyond the original design intent. Gradual pipe slopes further reduce capacity, contributing to surcharging during severe events.

Table 7-1 provides a snapshot of system performance during the design event, summarizing the proportion of surcharged junctions (manholes) and conduits (storm pipes) within the system.

Table 7-1: Summary of Surcharged Manholes and Storm Pipes – 5-year Design Storm

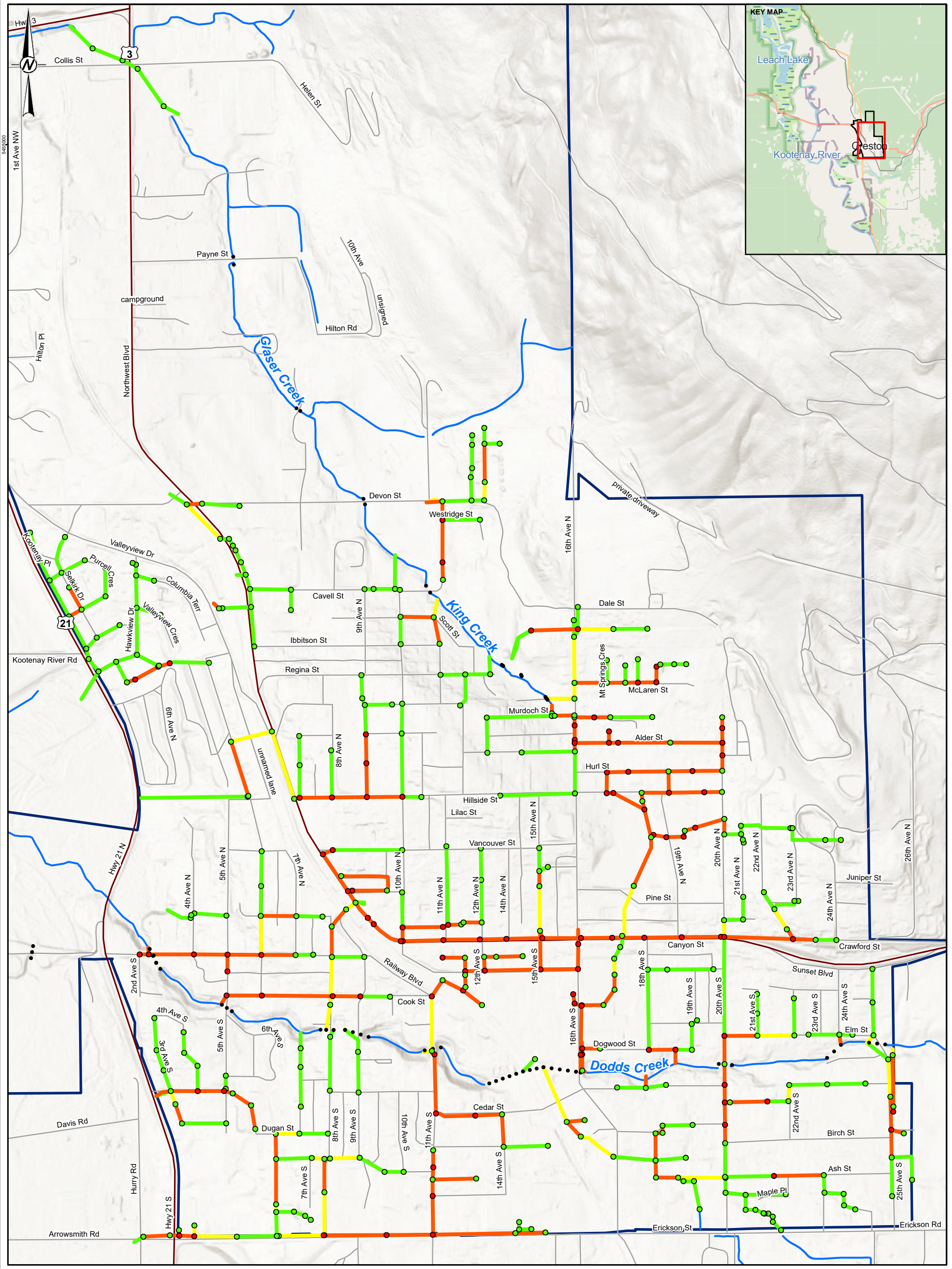
Item	Count / Length	% of Total	Note
Number of junctions surcharged to grade	108	25%	Junctions with HGL above manhole rim elevation
Number of surcharged conduits	192	42%	Pipes exceeding full pipe flow conditions
Total length of surcharged conduits (m)	11,686	39%	Includes pipes with flow at or above capacity

Model results indicate that the most frequently surcharged segments were concentrated in the downtown core, with additional occurrences in older residential neighborhoods and in areas where the system transitions from piped conveyance to overland flow. While surcharging does not necessarily correspond to surface flooding, the identified hydraulic constraints highlight infrastructure vulnerabilities that could impact homes and businesses, particularly as land use continues to evolve. **Figure 13** and **Figure 14** depict modeling results for the 5-year design storm event. **Figure 13** shows the extent of pipe surcharge

within the minor system, whereas **Figure 14** illustrates major system flow paths and associated depths of flow.

In this analysis, surcharge within the minor system is defined as any condition where the hydraulic grade line (HGL) rises above the pipe obvert elevation, indicating pressurized flow within the conduit. This does not imply that flow has reached the surface, but it does signal that the pipe is operating under constrained conditions that may reduce conveyance efficiency or increase the risk of surface emergence at connected structures.

Figure 13 uses the ratio Q_{max}/Q_{cap} to illustrate pipe capacity utilization. Q_{max} represents the peak flow rate simulated in each pipe segment during the storm event, while Q_{cap} denotes the theoretical maximum flow capacity based on pipe geometry and hydraulic properties. The figure legend categorizes this ratio into three performance bands: ≤0.70 (adequate capacity), 0.70–0.90 (approaching capacity), and >0.90 (potentially undersized or surcharged). These thresholds help identify segments that may be vulnerable to surcharge or require further investigation for capacity upgrades.



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM HGL RELATIVE TO MANHOLE RIM

- MANHOLE SURCHAGE
- NO MANHOLE SURCHARGE

PIPE CAPACITY

- QMAX/QCAP ≤ 0.70
- 0.70 < QMAX/QCAP ≤ 0.90
- QMAX/QCAP > 0.90

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER SYSTEM - MINOR SYSTEM
5-YEAR 1-HOUR STORM EVENT

CONSULTANT

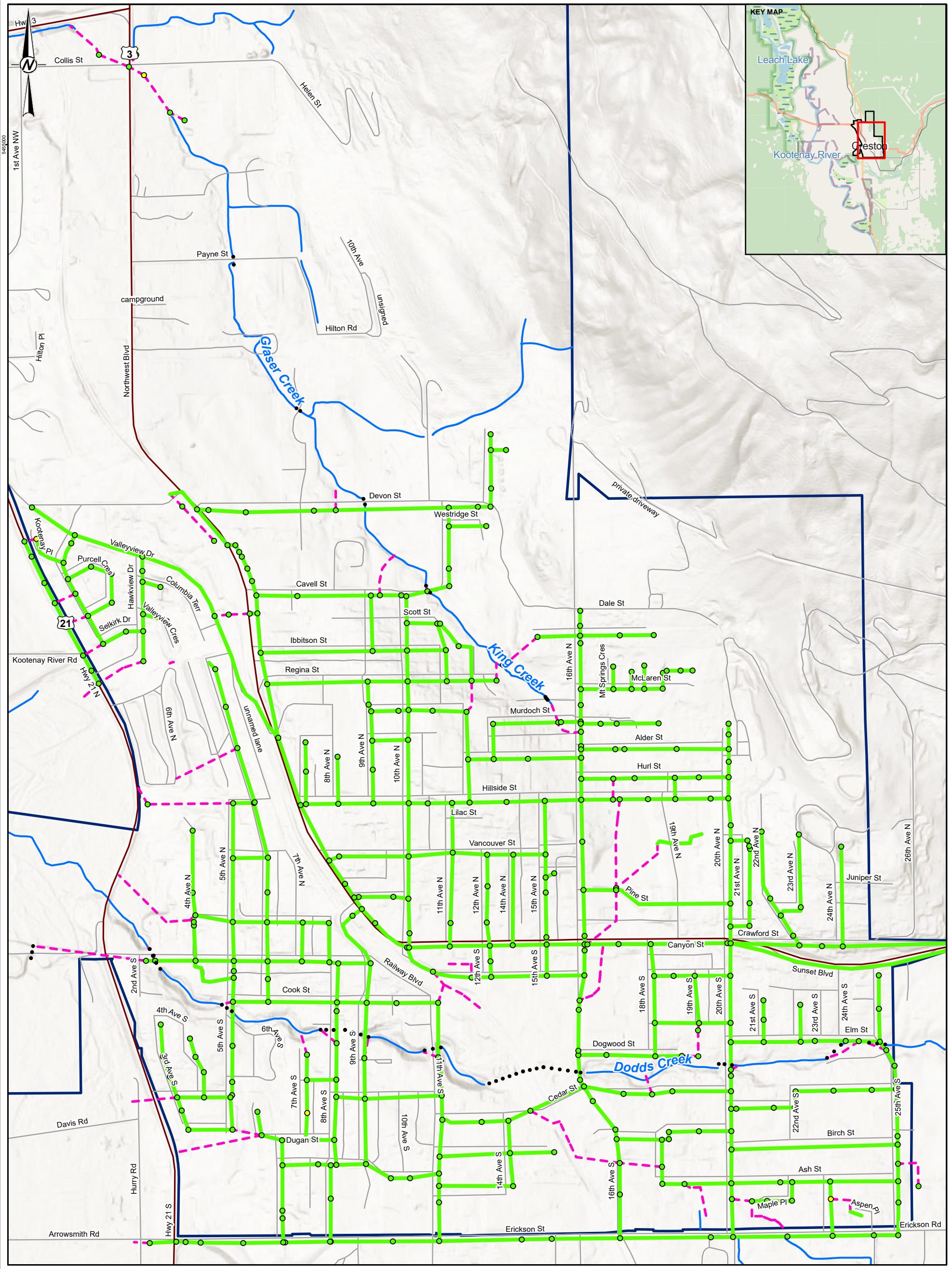
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YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0047807.9710		0	13

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- OVERLAND MAJOR SYSTEM CHANNELS
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM DEPTH (MAJOR SYSTEM)

- ≤ 0.15
- 0.15 - 0.30
- > 0.30

MAJOR FLOW PATH DEPTH

- MAX/FULL DEPTH ≤ 0.15
- MAX/FULL DEPTH > 0.15

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

REFERENCE(S)

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER SYSTEM - MAJOR SYSTEM
5-YEAR 1-HOUR STORM EVENT

CONSULTANT

wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
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The assessment of the Town's storm sewer network under the 5-year design storm revealed localized capacity exceedances at various junctions and conduits. Model results (**Table 7-1**) indicate that approximately 25% of all modeled manholes experience surcharge conditions, with hydraulic grade lines (HGL) rising above pipe crowns, suggesting capacity limitations during minor storm events. Surcharging was particularly notable along older segments of the network where pipe diameters are inconsistent, or grades are relatively flat resulting in reduced conveyance efficiency. As per **Table 7-2**, key streets such as Canyon Street, Cook Street, and 20th Avenue South exhibit peak surcharge depths of up to 0.27 m, highlighting areas where operational performance may be compromised. These findings support the need for targeted capacity upgrades. **Figure 15** presents the locations prone to frequent surcharging mentioned in **Table 7-2**.

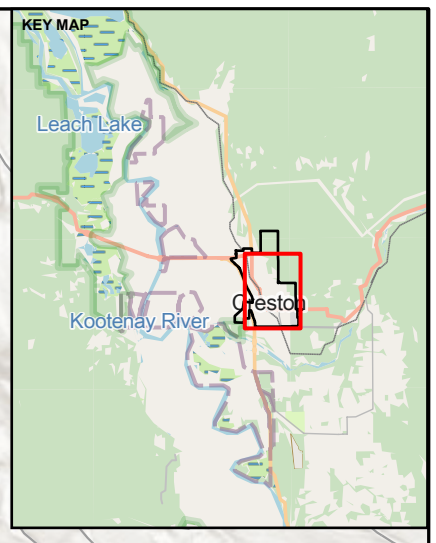
Table 7-2: Key Locations with Frequent or Prolonged Surcharge – 5-year Event

No.	Location / Street	Location Description	Max Surcharge Depth* (m)	Max. Pipe Dia. (mm)	Notes (e.g., old network, flat grade)
1	11th Ave N	Cavell to Devon St	2.0	200	Small-diameter pipe in aging system; limited hydraulic capacity.
2	11th Ave S	Birch St to Erickson Road	2.2	200	Small-diameter pipe; limited hydraulic capacity.
3	16th Ave N	Cook to Dogwood Street	2.1	300	Small-diameter pipe; limited hydraulic capacity.
4	20th Ave N	Hurl to Alder Street	2.6	200	Small-diameter pipe; limited hydraulic capacity.
5	Alder Street	16th to 20th Ave N	2.8	250	Small-diameter pipe; limited hydraulic capacity.
6	Canyon Street	7th Ave N to Highway 21	3.2	300	Small-diameter pipe; limited hydraulic capacity.
7	Cedar Street	3rd to 5th Ave S	1.9	200	Small-diameter pipe; limited hydraulic capacity.
8	Cook Street	10th to 16th Ave N	2.6	300	Small-diameter pipe; limited hydraulic capacity.
9	Cook Street	5th to 9th Ave S	2.0	300	Small-diameter pipe; limited hydraulic capacity.
10	Erickson Road	11th to 16th Ave S	1.4	300	Small-diameter pipe; limited hydraulic capacity.
11	Hillside Street	10th Ave N to Northwest Boulevard	1.7	250	Small-diameter pipe; limited hydraulic capacity.
12	Hillside Street	16th to 20th Ave N	2.5	250	Small-diameter pipe; limited hydraulic capacity.

No.	Location / Street	Location Description	Max Surcharge Depth* (m)	Max. Pipe Dia. (mm)	Notes (e.g., old network, flat grade)
13	16th Ave N	Murdoch Street to Alder Street	1.4	450	Medium pipe with surcharge; limited hydraulic capacity.
14	20th Ave S	Elm Street to Canyon Street	1.6	400	400 mm pipe positioned between 250 (d/s) / 300 (u/s) mm pipes. Pipe sizing inconsistency observed.
15	Canyon Street	11th to 14th Ave N	1.7	450	450 mm pipe positioned between 250 (d/s) /300 (u/s) mm pipes. Pipe sizing inconsistency observed.
16	Hurl Street	16th to 20th Ave N	2.1	250	250 mm pipe between 200 mm pipes on both u/s and d/s ends. Pipe sizing inconsistency observed.
17	McLaren St	East of 16th Ave N	1.9	250	Low surcharge may reflect newer design standards.
18	Northwest Boulevard	Vancouver Street to 10th Ave N	1.4	300	Small-diameter pipe; limited hydraulic capacity.

*Surcharge depth is an approximation that is based on estimated catchbasin spacing and capacity

KEY MAP



Hwy 3
Collis St
Helen St
1st Ave NW
5455000
Payne St
campground
10th Ave
unsigned
Hilton Rd
Hilton Pl
Northwest Blvd
Glaser Creek
Devon St
12th Ave N
Westridge St
Location 1
private driveway
16th Ave N
Kootenay Pl
Valleyview Dr
Purcell Cres
Selkirk Dr
Columbia Terr
Valleyview Cres
Hawkview Dr
Cavell St
9th Ave N
Scott St
King Creek
Dale St
Location 17
Ibbitson St
10th Ave N
Mt Springs Cres
McLaren St
Location 5
Kootenay River Rd
Regina St
Murdoch St
Alder St
Location 4
6th Ave N
8th Ave N
11th Ave N
Location 13
Hurl St
unnamed lane
Location 16
Hillside St
Lilac St
Location 6
Location 11
Location 18
15th Ave N
Location 12
Vancouver St
19th Ave N
20th Ave N
22nd Ave N
23rd Ave N
26th Ave N
Juniper St
Hwy 21 N
4th Ave N
5th Ave N
Location 15
21st Ave N
24th Ave N
Pine St
7th Ave N
Crawford St
Canyon St
Sunset Blvd
2nd Ave S
5th Ave S
Railway Blvd
12th Ave S
Location 8
18th Ave S
Location 14
Cook St
19th Ave S
20th Ave S
4th Ave S
Location 3
21st Ave S
23rd Ave S
24th Ave S
Elm St
3rd Ave S
6th Ave S
Location 9
Dogwood St
Dodds Creek
Davis Rd
Dugan St
8th Ave S
9th Ave S
10th Ave S
11th Ave S
Cedar St
22nd Ave S
Birch St
Location 7
7th Ave S
14th Ave S
16th Ave S
Ash St
Hurry Rd
Maple Pl
25th Ave S
Location 2
Hwy 21 S
Erickson St
Erickson Rd
Arrowsmith Rd
Location 10

LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY

PIPE CAPACITY

- QMAX/QCAP ≤ 0.70
- 0.70 < QMAX/QCAP ≤ 0.90
- QMAX/QCAP > 0.90

MAXIMUM HGL RELATIVE TO MANHOLE RIM

- MANHOLE SURCHAGE
- NO MANHOLE SURCHARGE

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

REFERENCE(S)

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
KEY LOCATIONS WITH FREQUENT SURCHARGE

CONSULTANT
wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0047807.9710		0	15

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7.1.2 MAJOR SYSTEM PERFORMANCE (100-YEAR 1-HR DESIGN STORM)

To assess the Town's ability to safely manage extreme rainfall events, the major system was evaluated under the 100-year 1-hour return period design storm. This scenario represents an exceedance event well beyond the design condition for the minor (piped) system, where excess runoff is intentionally conveyed overland through streets, rights-of-way, ditches, and natural drainage channels.

Model simulations show that, during the 100-year event, the major system generally functions as intended, providing an overland flow route for runoff volumes exceeding the capacity of the minor system. Key overland flow corridors including Erickson Road, Canyon Street, Northwest Boulevard, Valleyview Drive, and Hillside Street act as primary conveyance pathways, directing surface flows toward downstream receiving creeks (Dodd's Creek and Glaser/King Creek), which ultimately discharge into the Kootenay River.

Table 7-3 provides a summary of system performance during the design event, summarizing the proportion of flooding locations within the system.

Table 7-3: Major System Performance (100-year event)

Item	Value / Count	% of Total	Notes
Number of Flooded Junctions	151	34%	Junctions where depth exceeds 0.15m (assumed curb height)

The PCSWMM modeling results for the 100-year design storm revealed several key overland flow corridors where surface water depth and topography create conditions for ponding and potential flooding of private lands. In multiple locations, particularly where sag conditions exist, model simulations indicate that stormwater leaves the public right-of-way and enter adjacent private properties. Streets such as Erickson Road, Cook Street, and 24th Avenue South exhibit surface ponding and runoff diversion due to inadequate grading and/or lack of curb and gutter systems. These areas warrant further investigation to identify potential drainage upgrades or property-level flood protection measures. **Table 7-4** summarizes key locations, modeled flood depths, velocities, and notes on observed or likely ponding behavior.

Table 7-4: Key Overland Flow Corridors and Observed Flooding – 100-year Event

No.	Street	Max Depth * (m)	Max Flow Velocity (m/s)	Ponding Observed	Note
1	Pine St and 4th Ave N	0.07	3.2	Yes	Flow is directed west toward the Pine St & 4th Ave N intersection. A sag near 123 4 Ave N results in bypass flow through private residential properties.
2	Erickson Road	0.19	1.7	Yes	Water depths exceed typical curb height. In areas lacking curb and gutter, stormwater may enter adjacent private parcels. rather than being conveyed along the street.

No.	Street	Max Depth * (m)	Max Flow Velocity (m/s)	Ponding Observed	Note
3	Cook Street	0.1	2.7	Yes	A topographic low leads to local ponding. Surrounded by downtown commercial land uses; risk of business disruption during major events.
4	20th Ave S and Elm Street	0.23	0.8	Yes	Low spot near Elm St results in overtopping flow towards Dodd's Creek. Adjacent residential and commercial areas are vulnerable.
5	7th Ave S	0.23	0.1	Yes	A sag between Dugan St and Cedar St leads to ponding and redirection of runoff into nearby private property. Regrading may be required.
6	24th Ave S	0.32	0	Yes	Low point between Ash St and Erickson Rd allows runoff to drain directly into private properties. Long-term drainage concern.
7	Murdoch Street	0.19	0.6	Yes	Between 14th Ave N and 16th Ave N, a local depression causes surface flow into private lots northward. Property protection should be considered.
8	Ibbitson Street	0.12	0.7	Yes	Sag at Ibbitson St and 11th Ave N causes surface flow northeast through residential backyards. Flooding risk is recurrent.
9	5th Ave S	0.17	2.5	Yes	Sag at 5th Avenue near Canyon Street causes surface flow into the residential property (124 5th Avenue S)
10	16th Ave S	0.11	1.0	Yes	Residential property (518 16th Ave S) is in a depression and is primarily dependent upon a heavily vegetated inlet.
11	20th Ave S	0.08	0.8	Yes	Residential property (610 20th Ave S) has a sag in the front near roadway resulting in no major overland route for the stormwater.

*Max flow / ponding depth is an approximation that is based on estimated catchbasin spacing and capacity

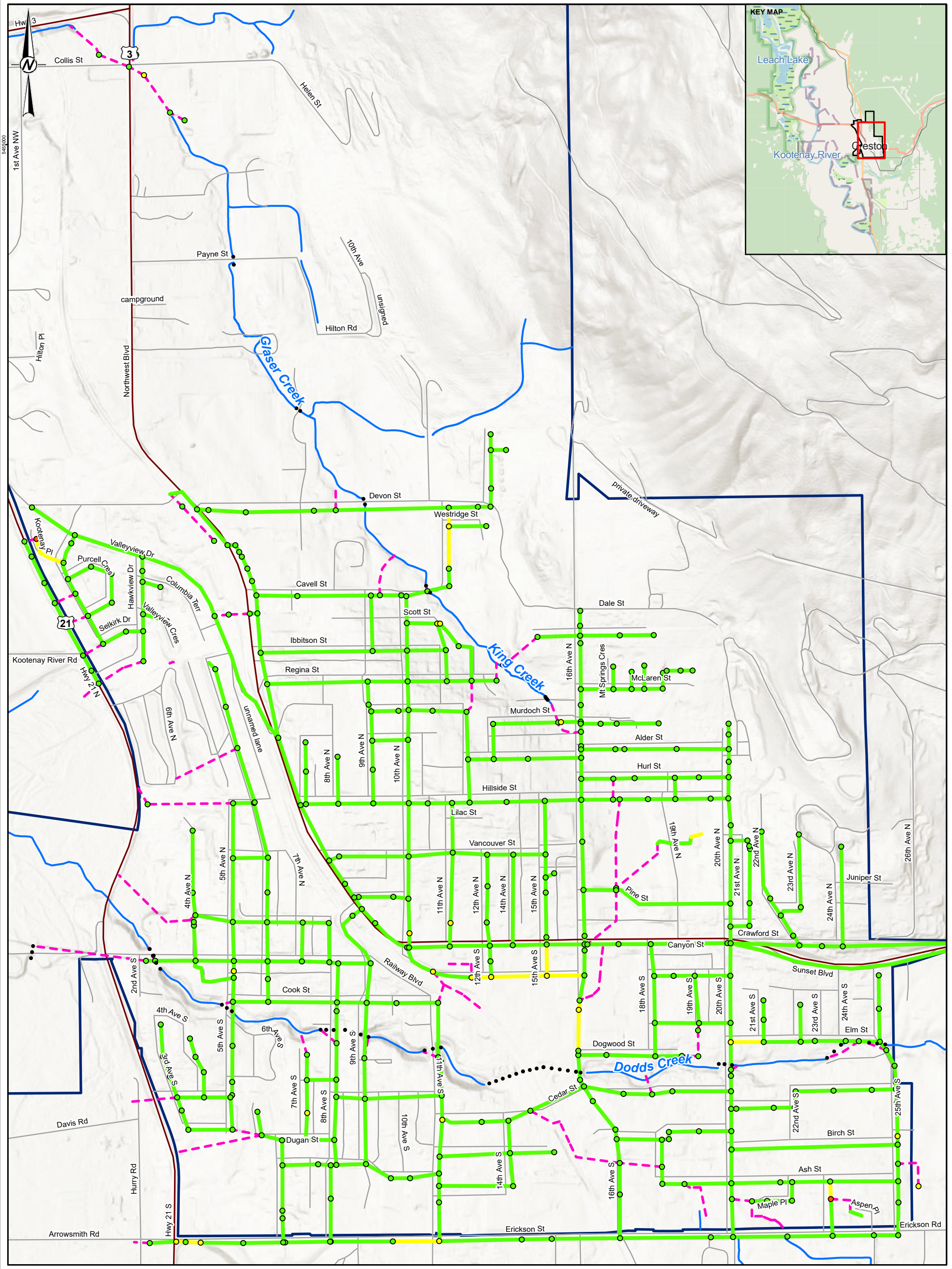
Figure 16 and Figure 17 depict hydraulic modeling results for the 100-year design storm event. **Figure 16** illustrates major system flow paths and associated depths of flow, whereas **Figure 17** shows the extent of pipe surcharge (ratio of maximum flow to pipe-full flow) within the minor system.

The model outputs include maximum surface water depths, extents of flooding, and flow velocities along major routes, which help identify areas where flooding may pose safety risks, impede access, or damage property.

Overall, the results show that, while the major system is largely effective at routing excess flows toward the Town's natural drainage outlets, there remain localized vulnerabilities that could lead to property or infrastructure impacts during extreme rainfall events.

Figure 18 depicts the key flooding locations mentioned in **Table 7-4**.

On August 13, Joshua Maxwell (WSP) and Colin Farynowski (Town of Creston) conducted interviews with Public Works staff and carried out a field inspection of selected sites within the Town of Creston's stormwater system as mentioned in **Table 7-4**. The attached memorandum (**Appendix E**) provides a concise summary of the discussions and observations from the inspection.



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- OVERLAND MAJOR SYSTEM CHANNELS
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM DEPTH (MAJOR SYSTEM)

- ≤ 0.15
- 0.15 - 0.30
- > 0.30
- <ALL OTHER VALUES>

MAJOR FLOW PATH DEPTH

- MAX/FULL DEPTH ≤ 0.15
- 0.15 < MAX/FULL DEPTH ≤ 0.30
- MAX/FULL DEPTH > 0.30

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

REFERENCE(S)

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER SYSTEM - MAJOR SYSTEM
100-YEAR 1-HOUR STORM EVENT

CONSULTANT

wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0047807.9710		0	16

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KEY MAP

Leach Lake
Kootenay River
Creston

Hwy 3
Collis St
3
Helen St
1st Ave NW
5455000
Payne St
campground
10th Ave
unsigned
Hilton Rd
Hilton Pl
Northwest Blvd
Glaser Creek
Devon St
Westridge St
private driveway
Kootenay Pl
Valleyview Dr
Purcell Cres
Hawkview Dr
Columbia Terr
ValleyView Cres
Cavell St
Scott St
21
Selkirk Dr
Ibbitson St
King Creek
Kootenay River Rd
Hwy 21 N
Regina St
16th Ave N
Mt Springs Cres
McLaren St
Dale St
6th Ave N
unnamed lane
8th Ave N
9th Ave N
10th Ave N
Murdoch St
Alder St
Hurl St
Hillside St
Lilac St
Vancouver St
4th Ave N
5th Ave N
7th Ave N
11th Ave N
12th Ave N
14th Ave N
15th Ave N
19th Ave N
20th Ave N
21st Ave N
22nd Ave N
23rd Ave N
24th Ave N
26th Ave N
Juniper St
Pine St
Crawford St
Canyon St
Railway Blvd
Sunset Blvd
2nd Ave S
4th Ave S
3rd Ave S
5th Ave S
6th Ave S
7th Ave S
8th Ave S
9th Ave S
10th Ave S
11th Ave S
12th Ave S
15th Ave S
18th Ave S
19th Ave S
20th Ave S
21st Ave S
22nd Ave S
23rd Ave S
24th Ave S
25th Ave S
Elm St
Dogwood St
Dodds Creek
Cook St
Cedar St
Davis Rd
Dugan St
Birch St
Hurry Rd
Hwy 21 S
14th Ave S
16th Ave S
Ash St
Maple Pl
Aspen Pl
Arrowsmith Rd
Erickson St
Erickson Rd

LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM HGL RELATIVE TO MANHOLE RIM

- ABOVE RIM
- BELOW RIM

PIPE CAPACITY

- 0.70 < QMAX/QCAP ≤ 0.90
- QMAX/QCAP > 0.90
- QMAX/QCAP ≤ 0.70

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

REFERENCE(S)

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CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER SYSTEM - MINOR SYSTEM
100-YEAR 1-HOUR STORM EVENT

CONSULTANT

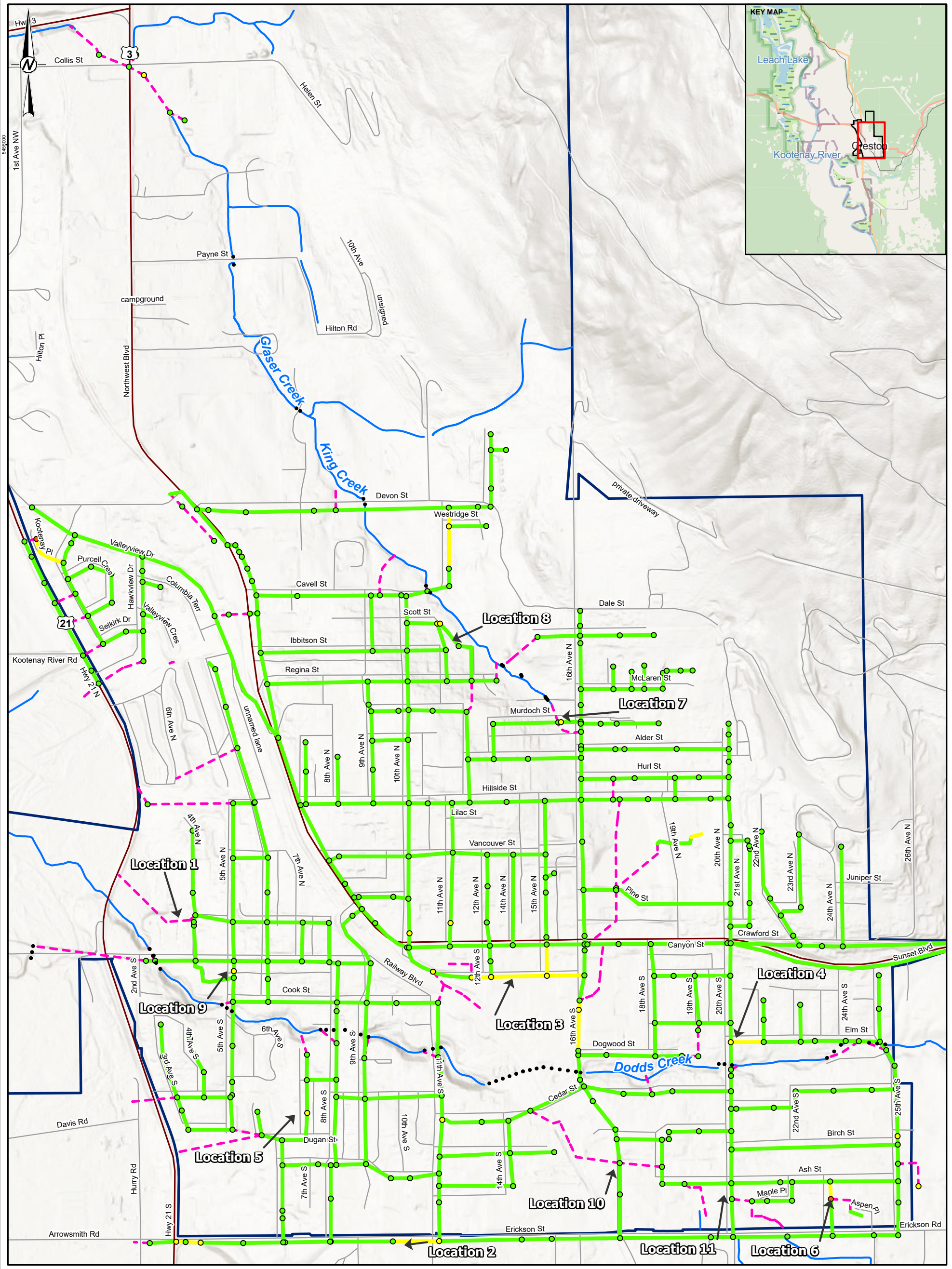
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PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0047807.9710		0	17

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0 25mm



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- OVERLAND MAJOR SYSTEM CHANNELS
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM DEPTH (MAJOR SYSTEM)

- ≤ 0.15
- 0.15 - 0.30
- > 0.30

MAJOR FLOW PATH DEPTH

- MAX/FULL DEPTH ≤ 0.15
- 0.15 < MAX/FULL DEPTH ≤ 0.30

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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PROJECTED COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING STORMWATER SYSTEM
KEY FLOODING LOCATIONS

CONSULTANT

wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0047807.9710		0	18

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7.1.3 HISTORICAL VS. FUTURE CLIMATE COMPARISON

To evaluate the potential impacts of climate change on stormwater system performance, the model was used to assess how the Town's drainage network would respond to projected rainfall intensities in the 2080s, based on the RCP 8.5 high-emissions scenario.

This included a comparative analysis to assess how the existing system might perform under the increased rainfall intensity projected under the scenario.

Compared to the historical condition, model results indicate:

- Increased runoff volumes and flow rates entering both minor and major systems.
- More frequent and severe surcharging of junctions and conduits.
- Increased depth and aerial extent of surface flooding along major overland routes, particularly in areas with noted capacity limitations.

A summary of the comparative performance for the minor system and major system design events are presented in **Table 7-5** and **Table 7-6** respectively.

Table 7-5: Comparative Performance – Historical vs. 2080s (RCP 8.5) – Minor System 5-Year Design Storm

Item	Historical	2080s (Future)	% Change	Note
Number of surcharged storm junctions	108	166	+53%	Junctions with surcharging above rim elevation during 5-year event
% of surcharged junctions	25%	38%	+53%	
Number of surcharged storm pipes	192	259	+35%	Flow exceeds full pipe capacity
% of surcharged storm pipes	42%	57%	+35%	
Length of surcharged storm pipes (m)	11,686	15627	+35%	Flow exceeds full pipe capacity

Table 7-6: Comparative Performance – Historical vs. 2080s (RCP 8.5) – Major System 100-Year Design Storm

Item	Historical	2080s (Future)	% Change	Notes
Number of Flooded Junctions	151	195	+29%	Depths exceed 150 mm curb height
Flooded Junctions (%)	35%	45%	+29%	Depths exceed 150 mm curb height

The comparative analysis between historical and projected future (2080s, RCP 8.5) design storm conditions reveals a marked decline in the performance of both the minor and major stormwater systems in the Town. Under the 5-year design storm, the number of surcharged junctions increased from 108 to 166 (a 53% rise), while the number of surcharged storm sewers grew from 192 to 259 (+35% rise), indicating growing strain on the network. This trend is a result of a 52.2% increase in peak rainfall intensity for the 5-year event under the simulated climate change scenario.

For the 100-year design storm that governs the major system design, the number of flooded junctions increased from 151 to 195. This result demonstrates a significant increase in flood risk due to future intensification of rainfall, underscoring the need for targeted system upgrades, improved overland flow routing, and resilient design strategies to accommodate future climate scenarios.

Model results also show that while the major overland flow routes continue to convey runoff toward the downstream receiving creeks, additional flow volumes under the future climate scenario increase ponding at known low points, potentially creating new flood-prone areas not previously identified.

7.1.4 INTERPRETATION & KEY OBSERVATION

The system performance analysis under historical and future design conditions reveals key insights into how the Town's stormwater network currently operates and where it is most vulnerable. Under the historical scenario, both the minor and major system generally function as intended. However, there some areas of concern including pipe capacity in select neighbourhoods and low points within the overland flow network at risk of surface flooding.

When comparing historical conditions to future projections for the 2080s, the analysis indicates a meaningful increase to the severity and duration of surcharging as well as increased surface flooding (in terms of depth, duration and areal extent). The future climate scenario increases flooding in areas already prone to surcharge and highlights new risk areas where flooding has not historically been reported.

7.2 SYSTEM DEFICIENCIES AND POTENTIAL SOLUTIONS

7.2.1 IDENTIFIED DEFICIENCIES

Analysis of the Town's existing stormwater infrastructure under the 5-year and 100-year design storm events reveals localised and systemic deficiencies. These are primarily linked to:

- **Major System Deficiencies**

    - Lack of curb and gutter systems, especially near residential areas, limiting controlled overland flow.
    - Sag conditions in roadways, leading to runoff bypassing public rights-of-way and entering private properties.

- **Minor System Deficiencies**
    - Undersized pipes (200–250 mm) in older neighborhoods, unable to handle current runoff volumes.
    - Inconsistent pipe sizing, causing backwater effects and surcharging.
    - Flat or reversed slopes, reducing flow velocity and capacity.

Approximately 40% of the network experiences surcharge under the 5-year event, with surface ponding at low points and limited capacity for water to drain away efficiently. The major overland system, aided by natural topography, helps mitigate flood risk by directing excess runoff to receiving water bodies like Dodd's Creek and Glaser/King Creek.

CULVERT OVERTOPPING RISK ASSESSMENT – EXISTING CONDITIONS

An assessment of the historical 100-year design storm event was conducted to evaluate the performance of existing culverts along Dodd's Creek and Glaser/King Creek. The analysis revealed that seven crossings are significantly undersized, resulting in overtopping at roadways during peak flow conditions. This poses a substantial risk to public safety and infrastructure, including roadway washouts and localized flooding. Table 7-7 summarizes peak flows at seven critical locations:

These results highlight the severity of capacity limitations in the current system. At Cavell Street overtopping flows are expected to reach 3.7 m^3/s, creating localized flooding hazards.

Without upgrades, these vulnerabilities will persist and likely worsen under future climate conditions, increasing the frequency and magnitude of overtopping events. This reinforces the need for culvert upsizing and complementary overland improvements to maintain safe conveyance and protect public assets.

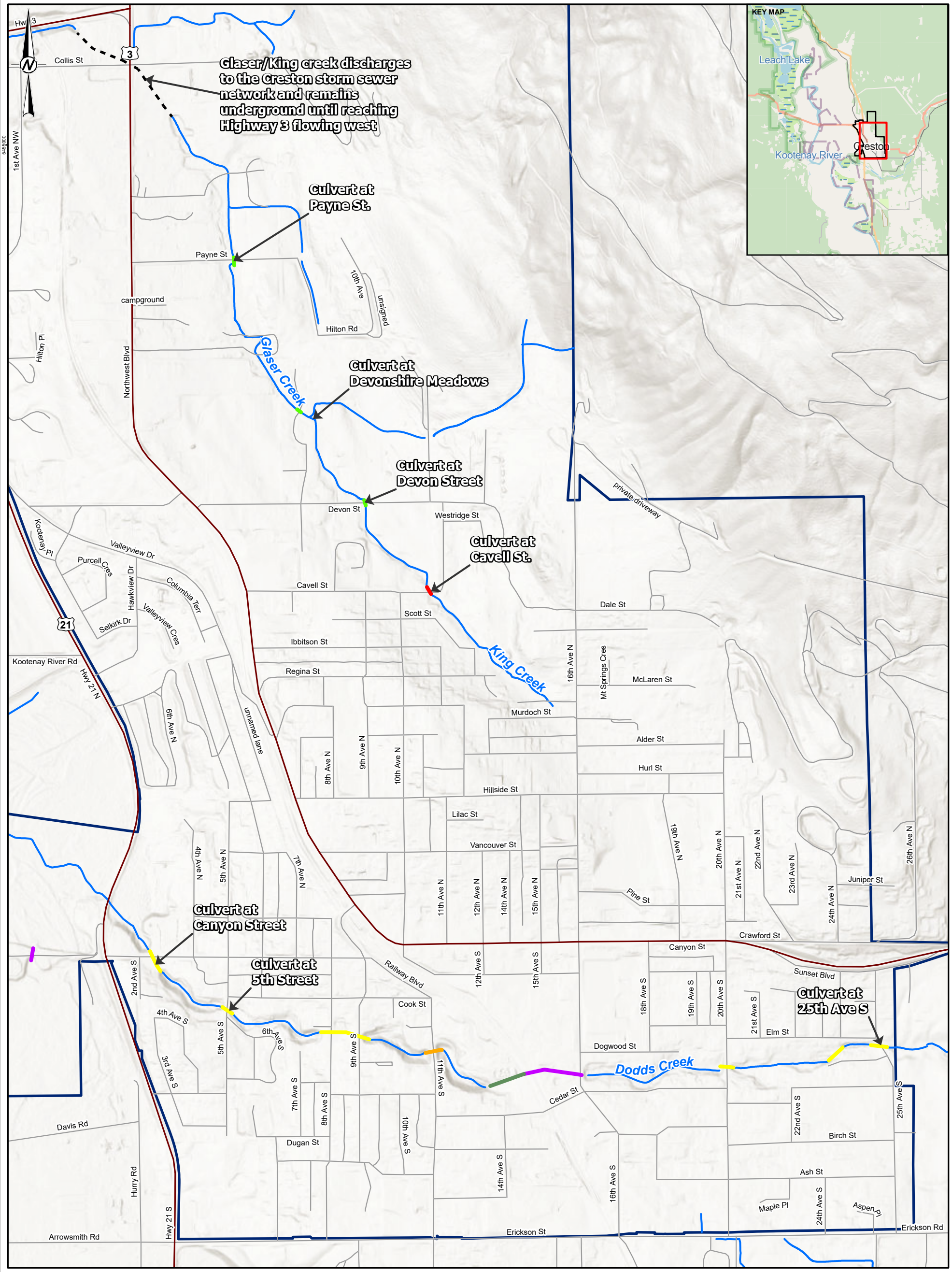
Figure 19 illustrates the existing culvert sizing and highlights the above mentioned critical culvert locations.

Table 7-7: Peak Flows at Critical Culvert Locations – Existing Conditions (100-Year Design Storm)

ID	Location	Existing Culvert Size	Full Flow Capacity[1] (m3/s)	Peak Overtopping Flow[2] (m^3/s)	Peak Culvert Flow[3] (m3/s)	Peak Total Flow[4] (m3/s)
C42	Dodd's Creek at 25 Ave S	900 mm	0.9	1.5	1.9	3.4
C24_3	Dodd's Creek at 5 Ave S	900 mm	0.9	0.5	2.7	3.2
c C23_2 C23_5	Dodd's Creek at Canyon St	1200 mm	1.7	1.4	2.2	3.6
C204_1	Glaser/King Creek at Cavell St.	450 mm	0.2	3.7	0.5	4.2
C175_1	Glaser/King Creek – at Devon St.	600 mm	0.3	1.0	0.7	1.7
C123_1	Glaser/King Creek – at Devon St. (Devonshire)	600 mm	0.3	1.4	0.6	2.0
C115_4	Glaser/King Creek – Payne St.	600 mm	0.3	1.1	0.4	1.5

[1]*Based on headwater elevation at pipe obvert.*
[2]*Refers to the peak flow overtopping the roadway.*
[3]*Refers to the peak flow passing through the culvert.*
[4]*Sum of peak culvert flow and peak overtopping flow..*
Note: flows at Glaser Creek culverts within Schikurski Park are excluded from table.

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LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- STORM PIPES
- MUNICIPAL BOUNDARY

EXISTING CULVERT DIAMETER

- 0.45
- 0.6
- 0.8
- 0.9
- 1.2
- 1.5

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
EXISTING CULVERT NETWORK AND CRITICAL CULVERT LOCATIONS

CONSULTANT

wsp

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PREPARED	MY
REVIEWED	KU
APPROVED	JM

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8 FUTURE SYSTEM

This section presents the future system analysis including recommended infrastructure upgrades, a description of the modeled system, and an assessment of anticipated system performance under climate-adjusted conditions. The evaluation builds on the Town's current network and applies projected 2080s (RCP 8.5) rainfall intensities to test infrastructure capacity under a long-term planning horizon.

8.1 OVERVIEW OF FUTURE SYSTEM LAYOUT AND ASSUMPTIONS

8.1.1 OPPORTUNISTIC MINOR SYSTEM UPGRADES

Analysis of the current storm sewer network (Section 7) indicates that most sewers within the Town do not meet the target level of service, defined as conveyance capacity for the 5-year design storm. However, upgrading the entire system to meet this standard would be cost-prohibitive and offer limited benefit, as the major drainage system generally performs well. Roadways and ditches effectively convey overland flow in most areas, reducing flood risk to municipal infrastructure and private property.

It is recommended that the Town pursue incremental improvements to the minor system by upsizing pipes during scheduled replacements (due to age or structural condition) or in coordination with other capital works (e.g., roadway reconstruction). A summary table of recommended pipe sizes provided with the submission (Appendix G). These proposed upgrades are not incorporated into the future hydraulic model and are therefore excluded from the assessment of projected system performance.

8.1.2 MODELED FUTURE SYSTEM

The future system layout builds on the existing storm sewer and overland network, incorporating targeted upgrades to improve service levels and support growth. The proposed improvements aim to (1) reduce the flood risk to infrastructure and private property and (2) increase system resilience under future climate conditions.

Key upgrades modeled in the future system include the following:

- **Major System Performance Enhancements:**
    - **Culvert Upsizing**: Culverts have been upsized based on the 100-year 2080s RCP 8.5 1-hour intensity to ensure the depth of flow remains below the pipe obvert. Sizing is based on an assumed single barrel configuration.
    - **Overland Improvements:** Key improvements to address overland flood risk in areas of concern (Section 7) are incorporated.
- **Targeted Improvements in Canyon and Cook Street Corridors:** Improvements are proposed to improve level of service in the downtown area. Upgrades incorporate green infrastructure philosophies and are assumed to be completed in conjunction with other initiatives in the downtown core include planned transportation upgrades and downtown revitalization:

    - Canyon Street green street improvements.
    - Cook St/16 Ave bioswale.
- **New Development:** Key upgrades to support new development are incorporated into the future system model. These upgrades will be supported by Development Cost Charges (DCCs).

A detailed inventory of these upgrades is included in Section 8.2.

MODELING ASSUMPTIONS

Key assumptions for the future system modeling include:

- **Rainfall Inputs**: Design storms were based on 2080s RCP 8.5 1-hour (for analysing overall minor/major conveyance network) & 6-hour (for analysing pond storage capacity) intensities, representing the Town's planning horizon for climate-adjusted stormwater infrastructure.
- **Boundary Conditions**: Upstream catchments remain unchanged from the existing system model. Downstream outfalls were assumed to discharge under free-outlet conditions to receiving systems (natural channels, ditches, or Kootenay River).

This modeling approach provides a realistic basis for evaluating how infrastructure upgrades will perform under projected future rainfall conditions.

8.2 INVENTORY OF RECOMMENDED INFRASTRUCTURE UPGRADES

8.2.1 MAJOR SYSTEM PERFORMANCE ENHANCEMENTS

The PCSWMM modeling and field information identified several locations throughout the Town where the existing stormwater system is undersized, has insufficient overland flow capacity, or lacks adequate protection for adjacent properties. This section provides an inventory of recommended upgrades to address these deficiencies and improve system performance under both current and future climate conditions.

Details of overland drainage improvements and recommended culvert upgrades are presented in **Table 8-1** and **In addition** to the upgrades noted above, Glaser/King Creek discharges to the storm sewer system network near the north end of town and it remains underground as the watercourse traverses the industrial park until reaching the Highway 3 ditch (shown on Figure 20). Upstream of this, the creek valley provides a natural basin and means of stormwater attenuation. This part of the system performs well under existing conditions but simulations of the future condition indicate that retained water at this depression may overtop the banks during the 100-year event, introducing a flood risk to the downstream industrial area at flood risk. This is not deemed an immediate risk but is flagged as an area of concern. While pipe upsizing could address this risk, the associated attenuation benefits would be diminished. In lieu of this, it is suggested that this site be inspected to identify potential lot level improvements (e.g. lot grading, berms) to mitigate the risk to private property.

Table 8-2, respectively. **Figure 20** illustrates the locations of these improvements.

The recommended improvements focus on addressing critical deficiencies in the stormwater system to improve overall performance and reduce risk to public and private properties. The identified overland flow enhancements are proposed to resolve sag points and low spots that currently direct runoff into private properties or create bypass flows. High-priority locations, such as Pine Street and 4th Avenue North and 24th Avenue South, require immediate attention due to the elevated risk to private property. Recommended measures include regrading roadway sags and establishing well-defined conveyance routes within the right-of-way. Other areas, including 20th Avenue South at Elm Street, Murdoch Street, and Ibbitson Street, present medium-priority concerns where localized grading improvements can significantly reduce vulnerability. For sites like 16th Avenue South, where vegetation obstructs inlets, maintenance actions such as clearing and improving inlet conditions are suggested as initial steps before considering structural upgrades.

Table 8-1: Inventory of Recommended Overland Drainage Upgrades

ID	Location / Street	Key Deficiency	Recommended Upgrade	Notes / Priority
O.1	**Pine St & 4th Ave N**	Sag causes bypass flow through private property.	Regrade roadway sag and have well defined conveyance channel through the ROW (to be confirmed by the Town) near the property.	High priority due to private property risk.
O.2	**20th Ave S & Elm Street**	Low spot overtops flow toward Dodd's Creek; vulnerability to nearby properties.	Regrade surface	Medium priority
O.3	**7th Ave S**	Sag directs runoff into private property.	Implement localized grading improvements	Medium priority
O.4	**24th Ave S**	Low point drains directly into private properties.	Regrade to redirect flow; consider local property protection measures.	High priority
O.5	**Murdoch Street**	Local depression causes flow into private lots.	Regrade to redirect flow	Medium priority
O.6	**Ibbitson Street**	Sag at intersection causes flow through residential backyards.	Regrade to redirect flow	Medium priority.

ID	Location / Street	Key Deficiency	Recommended Upgrade	Notes / Priority
O.7	**5th Ave S**	Sag near Canyon Street results in flow into residential property.	Regrade to redirect flow	Medium priority.
O.8	**20th Ave S**	Sag at residential property frontage with no overland route.	Regrade to redirect flow	Medium priority.
O.9	**16th Ave S**	Residential property at depression with heavily vegetated inlet.	Improve inlet maintenance/vegetation clearing.	Low-medium priority; start with maintenance actions.

Proposed culvert upgrades (**In addition** to the upgrades noted above, Glaser/King Creek discharges to the storm sewer system network near the north end of town and it remains underground as the watercourse traverses the industrial park until reaching the Highway 3 ditch (shown on Figure 20). Upstream of this, the creek valley provides a natural basin and means of stormwater attenuation. This part of the system performs well under existing conditions but simulations of the future condition indicate that retained water at this depression may overtop the banks during the 100-year event, introducing a flood risk to the downstream industrial area at flood risk. This is not deemed an immediate risk but is flagged as an area of concern. While pipe upsizing could address this risk, the associated attenuation benefits would be diminished. In lieu of this, it is suggested that this site be inspected to identify potential lot level improvements (e.g. lot grading, berms) to mitigate the risk to private property.

Table 8-2) are needed across the system to enhance conveyance capacity and mitigate the risk of localized flooding. Those upgrades listed as high priority should be implemented as soon as possible. It is recommended that Creston implement a phased approach for the remaining upgrades and coordinate efforts with road reconstruction to optimize costs and minimize disruption.

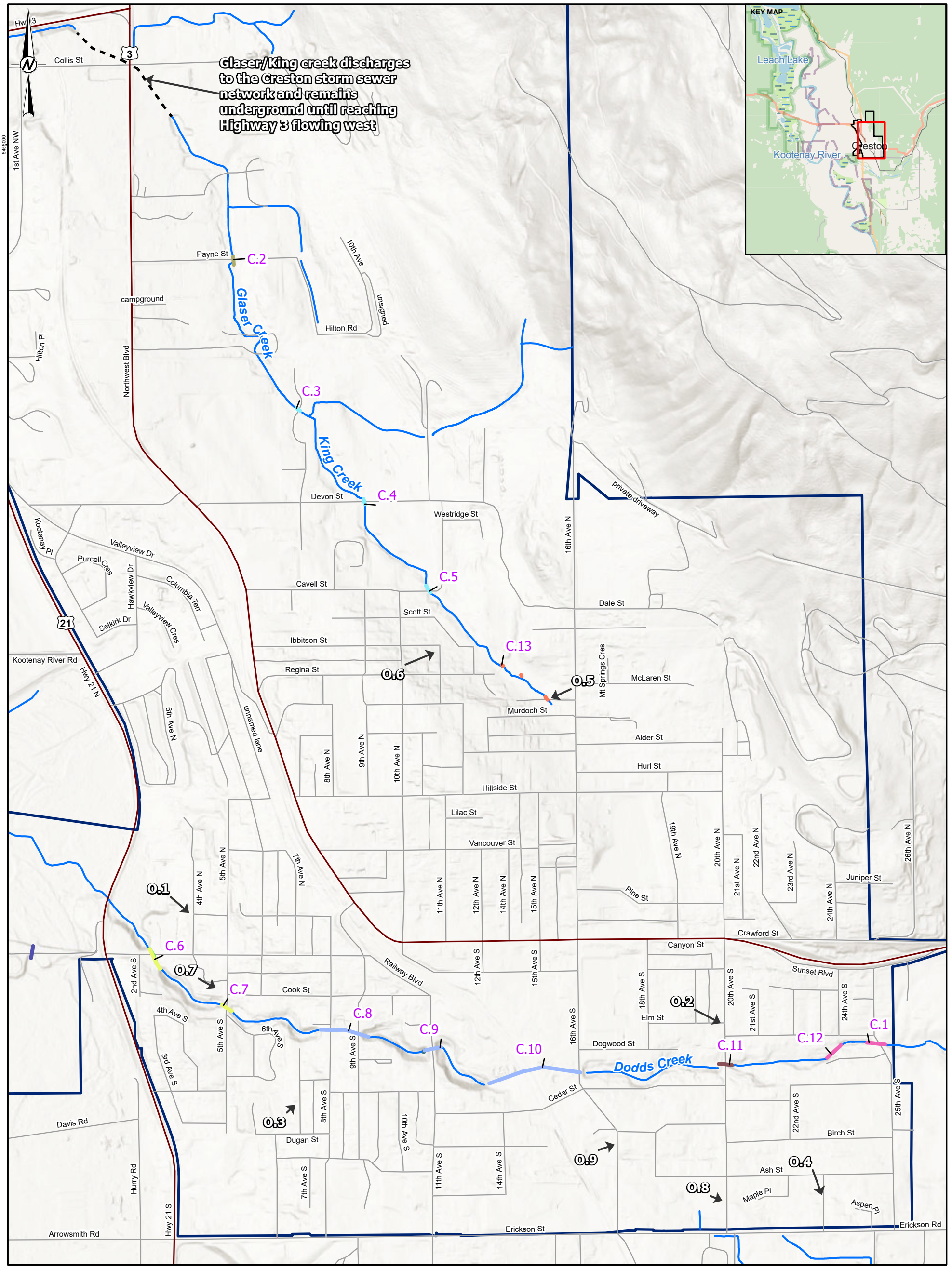
In addition to the upgrades noted above, Glaser/King Creek discharges to the storm sewer system network near the north end of town and it remains underground as the watercourse traverses the industrial park until reaching the Highway 3 ditch (shown on Figure 20). Upstream of this, the creek valley provides a natural basin and means of stormwater attenuation. This part of the system performs well under existing conditions but simulations of the future condition indicate that retained water at this depression may overtop the banks during the 100-year event, introducing a flood risk to the downstream industrial area at flood risk. This is not deemed an immediate risk but is flagged as an area of concern. While pipe upsizing could address this risk, the associated attenuation benefits would be diminished. In lieu of this, it is suggested that this site be inspected to identify potential lot level improvements (e.g. lot grading, berms) to mitigate the risk to private property.

Table 8-2: Future Culvert Sizing Upgrades

Project ID	Location	Size (mm)	Material	Existing Full Flow Capacity (m^3/s)	Existing 100-Yr Discharge (m^3/s)	Recommended Upsizing(mm)	Future Full Flow Capacity (m^3/s)	Length (m)	Priority
Dodd's Creek (downstream to upstream)									
n/a	Tributary	1200	CSP	1.5	0.00	N/A	1.5	34	N/A
C.6	Canyon St.	900	CSP	1.7	1.7	2700	16	62	High
		1200	CSP		2.2	2700			
		525	CSP		0.5	N/A		42	
C.7	5th Ave S	900	CSP	0.9	2.7	2700	14.0	33	High
C.8	8th/9th Ave S	900	Conc	0.9	4.3	2400	18.5	135	Medium
		900	Conc		3.3	2400			
		900	Conc		3.3	2400			
		900	Conc		3.3	2400			
C.9	11th Ave S	800	Conc	0.7	2.1	2400	10.6	45	Medium
C.10	Railway ROW and 16th Ave S	1500	Conc	1.0	3.8	2400	9.5	259	Medium
		1200	PVC		5.1	2400			
		1200	PVC		2.4	2400			
		900	CSP		2.3	2400			
C.11	20th Ave S	900	CSP	1.0	1.8	2200	8.1	37	Medium
		900	CSP		1.6	2200			
C.12	24th Ave S	900	CSP	0.9	1.9	1800	10.8	54	Medium
C.1	25th Ave S	900	CSP	0.9	1.5	1800	4.8	45	High

Table 8-2: Future Culvert Sizing Upgrades (continued)

Project ID	Location	Size (mm)	Material	Existing Full Flow Capacity (m^3/s)	Existing 100-Yr Discharge (m^3/s)	Recommended Upsizing(mm)	Future Full Flow Capacity (m^3/s)	Length (m)	Priority
C.2	Payne St.	600	CSP	0.3	0.4	1600	3.9	22	High
C.3	Devonshire Meadows	600	CSP	0.3	0.6	1400	2.7	13	High
C.4	Devon St.	600	CSP	0.3	0.7	1400	2.5	22	High
C.5	Cavell St. near 10th Ave N	450	CSP	0.2	0.5	1400	2.7	22	High
C.13	Schikurski Park	450	CSP	0.3	0.6	1200	4.0	14	Low
		Open channel	n/a	n/a	Unknown	1200	2.0		
		750	PVC	0.6	1	1200	2.0		
		525	PVC	0.2	0.3	1200	1.8		



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- STORM PIPES
- MUNICIPAL BOUNDARY

FUTURE CULVERT DIAMETER

- 0.45
- 0.525
- 1.2
- 1.4
- 1.6
- 1.8
- 2
- 2.1
- 2.4
- 2.7

NOTES:
"O.#" REFERS TO AN OVERLAND DRAINAGE UPGRADE
"C.#" REFERS TO A CULVERT UPGRADE"

0 100 200 300 400 500
1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
FUTURE OVERLAND DRAINAGE AND CULVERT UPGRADES

CONSULTANT
wsp

YYYY-MM-DD	2026-02-19
DESIGNED	AM
PREPARED	MY
REVIEWED	KU
APPROVED	JM

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8.2.2 TARGETED IMPROVEMENTS IN THE CANYON AND COOK STREET CORRIDORS

Targeted improvements are proposed to improve system performance along Cook Street and Canyon Street. These key corridors are located in a low area where surface runoff accumulates quickly due to flow convergence (from upstream catchments) and steep gradients. This condition is particularly notable along Cook Street but both corridors exhibit shallow but continuous overland flow during larger design events. To address these issues, both green and grey infrastructure approaches were assessed to identify opportunities that enhance hydraulic performance while supporting broader Town objectives.

GREEN INFRASTRUCTURE OPTION (PREFERRED)

The integration of green infrastructure in the downtown core presents a unique opportunity to reduce flood risk while also increasing climate resiliency and enhancing the public spaces.

Canyon Street

Canyon Street is the Town's primary commercial corridor and also forms part of the Crowsnest Highway (Highway 3). Existing planning documents (Watt 2022, Barefoot 2023) reenvision Canyon Street as a "complete street," repurposing its 18 m cross-section to calm traffic and increase walkability (see Figure 21). In keeping with this vision, it is recommended that this thoroughfare be converted to a green street from 10th Avenue to 16th Avenue. Green streets integrate green infrastructure including trees, permeable pavements, and bioretention systems. These features support stormwater management and environmental function and it is recommended that the following improvements along Canyon Street be considered:

- Infiltration trenches along curb lines to capture first-flush runoff.
- Tree-box filters to provide stormwater filtration and expanded canopy coverage.
- Incorporation of pervious pavement zones to reduce effective imperviousness, and
- Bioretention areas to provide retention and infiltration capacity.

Together, these features will reduce peak overland flow rates, improve water quality prior to discharge to Dodd's Creek, and create a more attractive, walkable corridor that aligns with future plans.

Cook Street and 16th Avenue Improvements

To alleviate overland flood risk along Cook Street, a linear bioswale running parallel to 16 Avenue South is recommended. This feature, with a bottom width of approximately 0.5 meters and gentle 3:1 side slopes, would run from Cook Street to Dodds Creek, promoting infiltration and providing conveyance connectivity to the creek via two new 450 mm culvert crossings near Dogwood Street. Elevated crosswalks (~200 mm) at 16th Avenue, Cook Street, and Canyon Street would complement these measures by intercepting flow and directing runoff toward the bioswale. While there is limited space within the road right of way to accommodate this feature, a bioswale could be located within the boulevard as shown in Figure 22. However, implementation here would necessitate removal of the sidewalk and would need to consider potential impacts to existing utilities (e.g. overhead power) and mature boulevard trees. Another option could be to utilize space within the adjacent sports fields at Kootenay River Secondary School. Should space be available, simulations showed that a larger bioswale paired with dry pond storage at this location would further enhance performance.

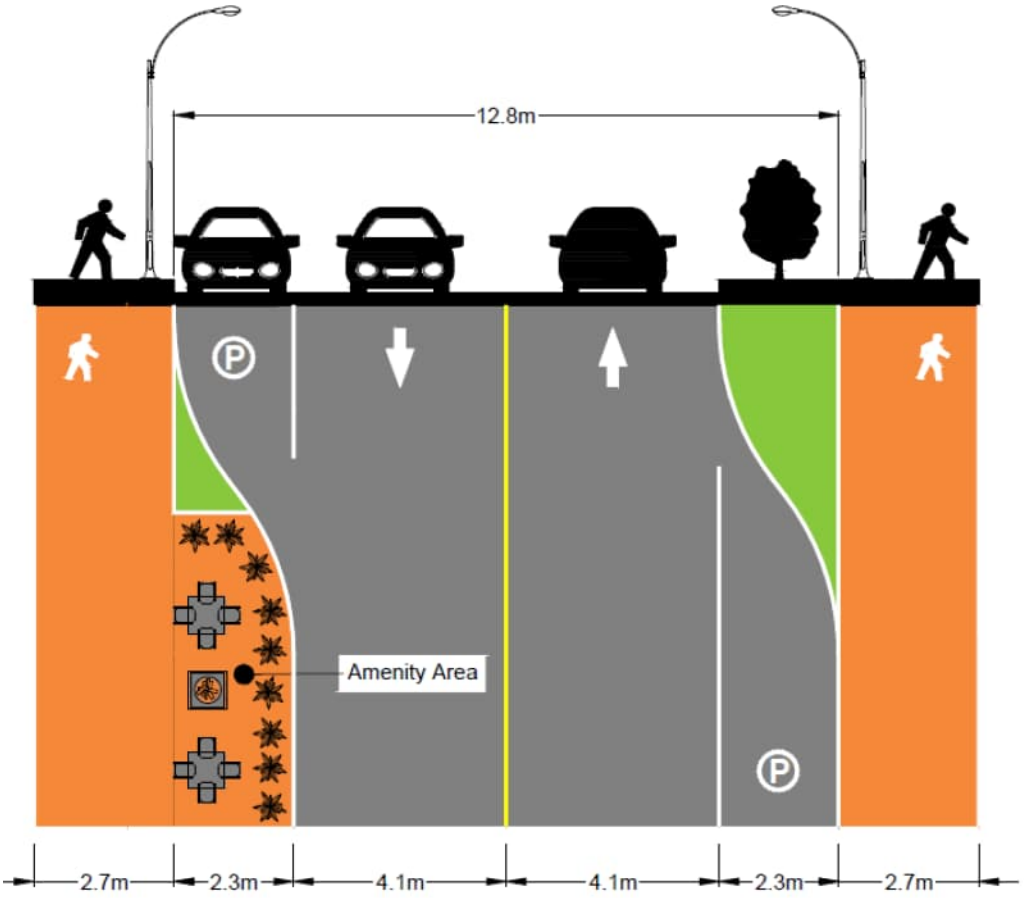


Figure 21: Proposed cross-section at Canyon Street between 10th Ave and 16th Ave (Watt 2022)

An earlier Master Drainage Plan (Dayton and Knight 1982) identified the Recreation Centre property as a potential location for stormwater detention within the Cook Street catchment,. The intent of that concept was to attenuate peak flows upstream and reduce reliance on extensive downstream storm sewer upgrades. While that option is not advanced as part of the current plan, it illustrates the broader benefit of detaining stormwater within the catchment. From a performance perspective, the Kootenay River Secondary School property is located lower within the catchment and is better positioned to intercept and attenuate peak flows before they propagate downstream. Should land acquisition or partnership opportunities arise in the future, additional on-site or near-source detention within the Cook Street basin could further reduce pressure on the minor system and complement the recommended improvements.

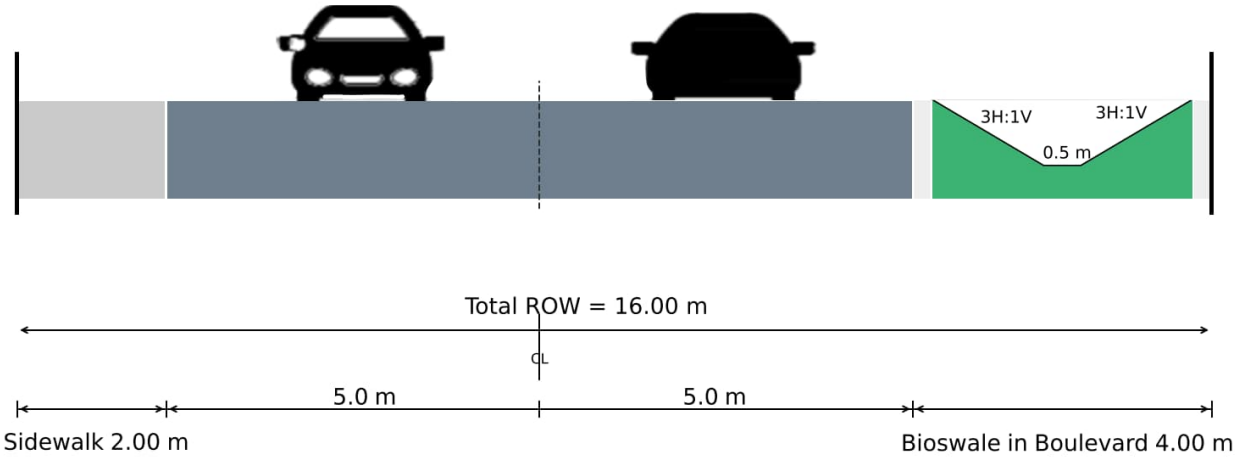


Figure 22: Prospective cross-section of 16th Avenue with bioswale.

The proposed improvements are summarized in Table 8-3. Improvements in the downtown core are recommended to enhance infiltration, storage, and water quality while improving urban character and climate resiliency. Figure 23illustrates the locations of the downtown system enhancements.

Table 8-3: Inventory of Recommended Upgrades – Cook St. and Canyon St. System Enhancements

ID	Location / Street	Key Deficiency	Recommended Upgrade	Notes / Priority
DOWNTOWN SYSTEM ENHANCEMENTS				
D.1	**Cook Street**	Topographic low in downtown core; risk to businesses during major events.	Construction of a bioswale along 16 Ave from Cook Street to Dodd's Creek.	Medium priority; likely to be phased in with other improvements.
D.2	**Canyon Street**	Highly impervious commercial street	Conversion to green street from 10th Avenue to 16th Avenue including installation of infiltration trenches, tree-box filters, pervious pavements	Medium priority; likely to be phased in with other improvements.

ALTERNATIVE: STORM SEWER UPSIZING THROUGHOUT DOWNTOWN CORE (GREY SOLUTION)

To achieve comparable performance with traditional (grey) infrastructure, it would be necessary to upsize storm mains along Cook Street (300 mm to ~1,050 mm) and route flows to Dodd's Creek. While hydraulically effective, this requires deep excavation within roadways, railway crossing approvals, and significant construction in a built-up commercial area. This results in high capital cost (see Section 9), complex staging, and no water quality benefits.

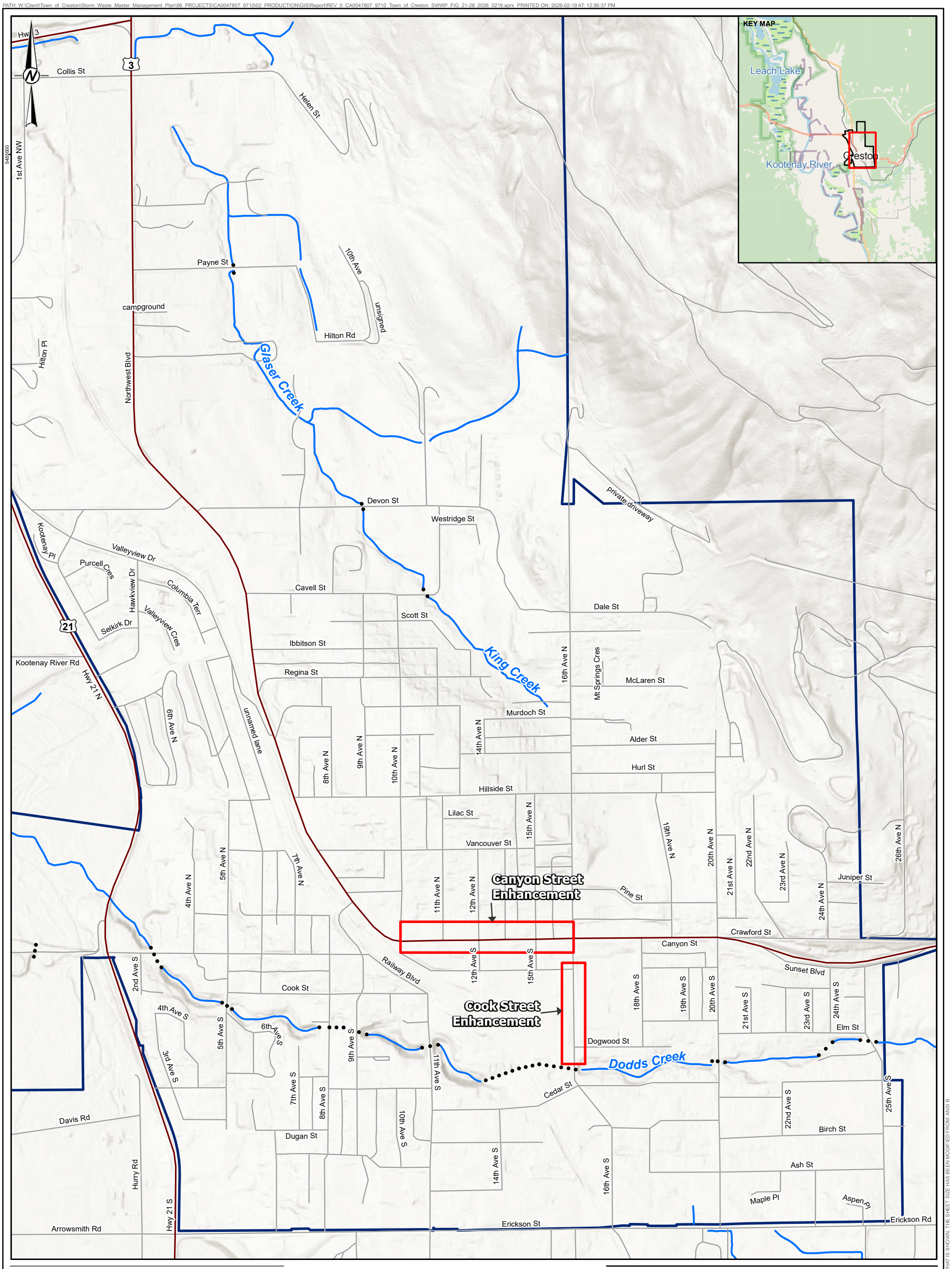
CONSIDERATIONS

The implementation of retrofit improvements within established areas is a challenging undertaking and this is doubly so for green infrastructure projects. While projects such as these offer significant value, they also face challenges associated with design and delivery. At the Master Plan level, improvements in the downtown core were modeled simplistically, focusing on increasing perviousness within the catchment (D.1) and providing an improved conveyance link via the 16th Avenue bioswale (Improvement D.2). However, there a multitude of green infrastructure permutations that can be considered and these enhancements warrant optimization. The downtown area of Creston would benefit from a more detailed assessment to develop a comprehensive conceptual design that considers the following:

1. How and where storage and conveyance can be provided most effectively within the downtown core. Consideration should be given to dry pond storage, bioretention/bioswales, and on-site retention (e.g. rain barrels, roofs, storage tanks). Analysis should incorporate multiple alternatives that consider the most viable options and examine whether and where hybrid approaches may make sense (i.e. a combination of green infrastructure with conventional pipe upgrades).
2. Land availability in the near and medium term.
3. Known constraints associated with existing infrastructure.
4. Coordination with other projects (i.e. transportation upgrades, downtown revitalization) and identification of potential cost-sharing opportunities.
5. Opportunities to phased implementation
6. Cost benefit analysis including consideration of co-benefits and comparison with grey infrastructure alternatives.

SUMMARY

The proposed green infrastructure approach reduces flooding risk, improves water quality, and delivers co-benefits such as enhanced urban character, climate resiliency through shading, and lower lifecycle costs compared to traditional conveyance upgrades. It also avoids major railway crossing works and allows for flexible staging. In addition, grants for green infrastructure are becoming more widely available in recognition of its co benefits. However, effective implementation will require further evaluation. It is recommended that these improvements be pursued in coordination with other initiatives and that a conceptual design and cost benefit analysis be completed to develop a plan that meets the Town's objectives and further develop this the project such that it is "shovel ready" if and when grant opportunities become available.



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY
- ENHANCEMENT AREA

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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STORMWATER MANAGEMENT MASTER PLAN

TITLE
FUTURE UPGRADES - DOWNTOWN SYSTEM ENHANCEMENTS

CONSULTANT
wsp

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PREPARED	MY
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APPROVED	JM

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8.2.3 NEW DEVELOPMENT

The Town's Development Cost Charge (DCC) program outlines several long-term stormwater improvements that support future development, including upgrades within the King Creek and Glaser Creek corridors. These improvements are defined in two phases:

- Phase 1 focuses on re-establishing and rechanneling the existing drainage pathways; and
- Phase 2 introduces select storm sewers to service build-out conditions in the surrounding growth areas.

For this Stormwater Management Master Plan, these concepts have been incorporated under the assumption that the drainage corridors will remain key conveyance routes. The Future System model includes the Phase 1 and Phase 2 upgrades to reflect anticipated build-out and ensure adequate hydraulic performance under design storm events.

Future development areas within the Town require strategic upgrades to the minor stormwater system to provide sufficient conveyance capacity and integration with the overall drainage network. These improvements are designed to meet hydraulic requirements for a 5-year (minor system) and 100-year (major system) event as well as mitigate localized flooding risks. PCSWMM modeling was used to reassess the existing sizing upgrades within DCC, and the sizing has been updated to account for future design storm events, ensuring alignment with long-term system performance objectives.

DETAILED UPGRADES

Table 8-4 outlines the detailed minor system upgrades proposed for Devon Street (N.1), Cavell Street to Devon Street (N.2), and Glaser Drive (N.3), as well as the re-channelization and sizing of Glaser/King Creek (N.4), as part of the DCC program upgrades.

Table 8-4: Inventory of Recommended Upgrades – New Development

ID	Location / Street	Key Deficiency	Recommended Upgrade	Notes / Priority	PCSWMM Model Reference
NEW DEVELOPMENT (DCC UPGRADES)					
N.1	**Devon Street**	No existing minor system	Installation of 750mm pipe from Highway 3 (NW Blvd) to Highway 21	Medium priority; project triggered once development begins in the area	Pipe C123: D – 750mm, L – 34m Pipe C206: D – 750mm, L – 217m Pipe C323: D – 750mm, L – 159m Pipe C326: D – 750mm, L – 184m
N.2	**8th Avenue North (between Cavell St and**	No existing minor system	Installation of 300/450mm pipes; discharging into Glaser/King Creek	Medium priority; project triggered once development begins in the area	Pipe C328: D – 300mm, L – 120m Pipe C334: D – 300mm, L – 112m Pipe C335: D – 450mm, L – 45m

ID	Location / Street	Key Deficiency	Recommended Upgrade	Notes / Priority	PCSWMM Model Reference
	Devon St)				
N.3	**Glaser Drive – Minor System Improvements**	No existing minor system	Installation of 300-750mm pipes across the proposed Glaser Drive; discharging into Glaser/King Creek	Medium priority; project triggered once development begins in the area	Pipe C36: D – 300mm, L – 95m Pipe C336: D – 300mm, L – 102m Pipe C364: D – 300mm, L – 27m Pipe C337: D – 300mm, L – 149m Pipe C338: D – 450mm, L – 139m Pipe C339: D – 450mm, L – 175m Pipe C342: D – 450mm, L – 115m Pipe C343: D – 525mm, L – 101m Pipe C345: D – 750mm, L – 74m
N.4	**Glaser Drive – Re channelization of Glaser/King Creeks**	Re-channelization of the creek to accommodate a future roadway	Assumed a 1m flat bottom with 3:1 side slopes and depth varying between 0.5m (U/S) to 1.2m (D/S)	Medium priority; project triggered once development begins in the area	Channel C370: D – 0.5m, L – 75m Channel C143: D – 0.5m, L – 75m Channel C371: D – 0.5m, L – 136m Channel C133_2: D – 1.0m, L – 35m Channel C123_3: D – 1.0m, L – 92m Channel C372: D – 1.0m, L – 88m Channel C378: D – 1.0m, L – 88m Channel C379: D – 1.0m, L – 83m Channel C380: D – 1.2m, L – 91m

REASSESSMENT OF KINSMEN PARK STORM POND RECOMMENDATION

The Southeast Drainage Basin Study (2017) identified a stormwater detention pond at Kinsmen Park as a potential measure to alleviate capacity constraints along Cedar Street and 20th Avenue South. As part of the current Master Drainage Plan, this concept was re-evaluated using updated hydraulic modelling and future climate-adjusted design flows.

Model testing that included the addition of localized storage within the southeast basin showed that the hydraulic benefits of a storm pond at Kinsmen Park would be limited in extent and largely confined to the immediate upstream area. While some short-term attenuation was observed, the storage did not provide sufficient downstream relief to justify the capital footprint of a new detention facility, particularly under future (2080s) 5-year design storm conditions.

Since completion of the 2017 study, a portion of the Cedar Street storm sewer (between 20th Avenue South and 22nd Avenue South) was upsized to approximately 300 mm based on earlier recommendations. Under future system modelling, this segment is again shown to be under-capacity, with required pipe sizes increasing to approximately 450–525 mm based on modelled future system data. This reflects the cumulative effect of increased upstream conveyance, climate-adjusted runoff volumes, and system-wide pipe upgrades assumed in the future condition.

The GIS future system dataset (attached as Appendix with the report) assumes that minor system conveyance is addressed primarily through strategic pipe upsizing rather than the introduction of new centralized storage facilities. No additional future storm ponds were assumed in the model. This represents an idealized planning scenario intended to guide opportunistic upgrades and ensure that replacement or upsizing works are aligned with long-term system requirements rather than short-term relief measures.

Based on this reassessment, stormwater management within the southeast drainage basin is recommended to proceed through targeted pipe capacity upgrades, rather than the construction of a new storm pond at Kinsmen Park. The analysis confirms that pipe upgrades provide broader and more reliable system benefits, whereas detention-based solutions offer localized relief that does not materially resolve downstream capacity constraints.

CONSIDERATIONS FOR RECHANNELIZATION OF GLASER/KING CREEK (N.4)

While the proposed rechannelization of Glaser/King Creek (N.4) has been retained as a future storm system upgrade, exploring alternatives to this upgrade may be warranted to align with policies in the OCP (see section 0).

8.3 SYSTEM PERFORMANCE

The future system model under 2080s RCP 8.5 conditions shows a marked improvement in system performance relative to the existing configuration, particularly at known high-risk locations. Pipe sizing (DCC locations) and overland flow routing measures collectively reduce the extent of surcharge and surface ponding at locations of concern during both the 5-year and 100-year design storms.

The performance of the existing stormwater system was evaluated under two design storm scenarios reflecting the Town's dual-drainage strategy:

- The 5-year return period storm, representing the minor system design event for storm sewers and inlets; and
- The 100-year return period storm, representing major system design event where runoff is conveyed primarily via roads, overland flow paths, and open channels.

8.3.1 FUTURE MINOR SYSTEM PERFORMANCE (5-YEAR 1-HR DESIGN STORM)

The Town's minor stormwater system was re-evaluated under the 5-year, 1-hour design storm, incorporating future upgrades. These upgrades include DCC-identified improvements, targeted enhancements along Canyon and Cook Streets, culvert upsizing, and key overland conveyance upgrades. Importantly, the scenario does not assume full replacement of the existing minor pipe network; upgrades focus on critical bottlenecks and corridors with planned development or known deficiencies.

Modeling results (**Figure 24 and Figure 25**) show localized capacity gains where culverts were upsized, new conveyance routes added, or pipes enlarged. These improvements reduce surcharge frequency in

select trunk segments and enhance conveyance to Dodd's Creek and King/Glaser Creek. Downtown corridors, particularly Canyon and Cook Streets, also benefit from added green infrastructure and improved surface routing.

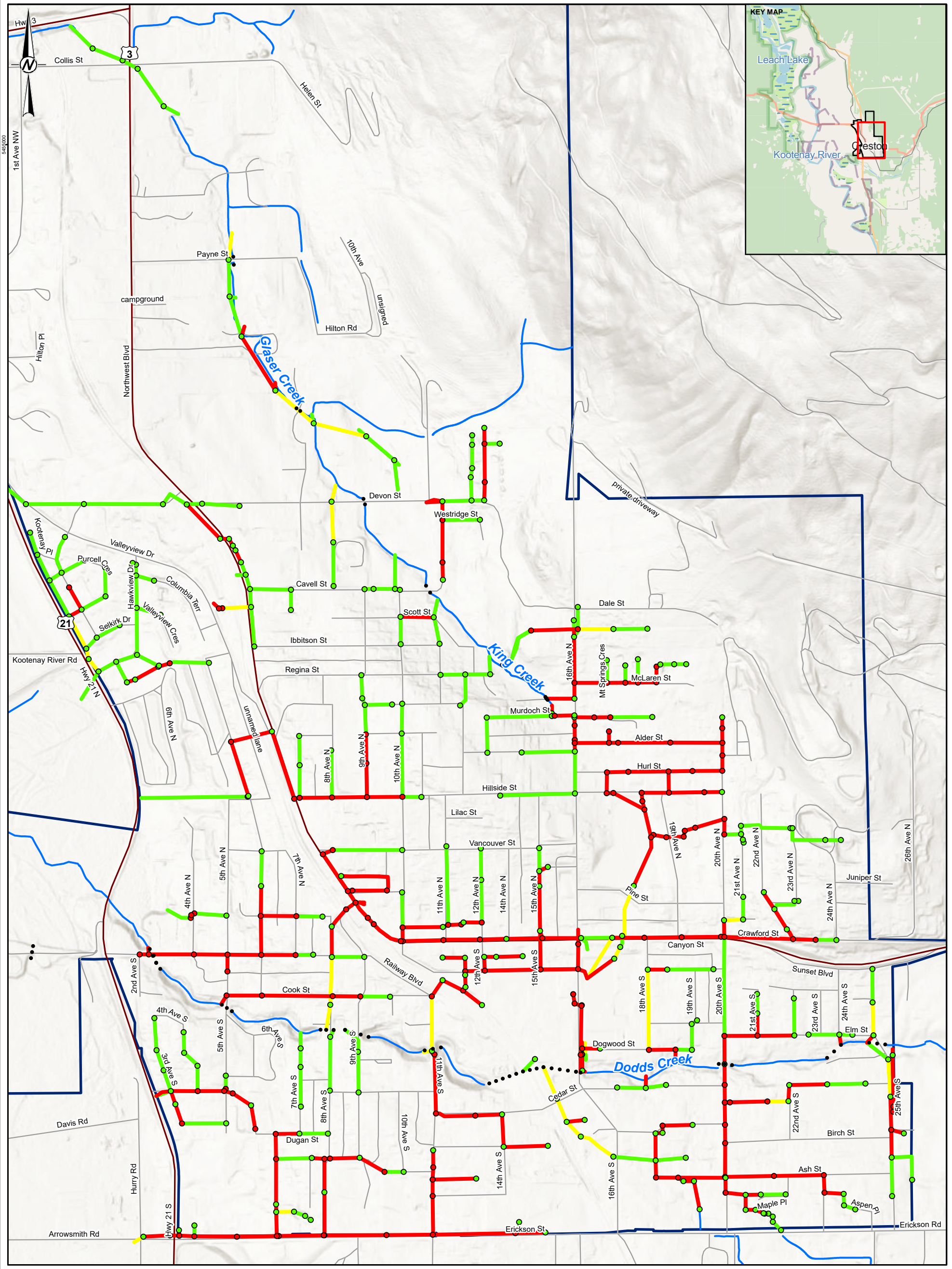
Despite these targeted upgrades, the broader minor system remains largely unchanged. Legacy 200–300 mm pipes and flat grades continue to limit hydraulic efficiency, resulting in widespread surcharging under future rainfall intensities.

Table 8-5 summarizes system performance, showing increases in surcharged junctions, conduits, and pipe lengths compared to existing conditions.

Table 8-5: Summary of Surcharged Manholes and Storm Pipes – 5-year Future Design Storm

Item	Count / Length	% of Total	Note
Number of junctions surcharged to grade	155	35%	Junctions with HGL above manhole rim elevation
Number of surcharged conduits	253	53%	Pipes exceeding full pipe flow conditions
Total length of surcharged conduits (m)	15,267	48%	Includes pipes with flow at or above capacity

Overall, the future system continues to experience widespread surcharge due to higher rainfall intensities under the 2080s RCP 8.5 climate horizon. While targeted upgrades improve performance in key corridors, the legacy network remains constrained. These results highlight the need for phased renewal, expanded overland flow protection, and coordinated green infrastructure to strengthen long-term system resilience.



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM HGL RELATIVE TO MANHOLE RIM

- MANHOLE SURCHAGE
- NO MANHOLE SURCHARGE

PIPE CAPACITY

- QMAX/QCAP ≤ 0.70
- 0.70 < QMAX/QCAP ≤ 0.90
- QMAX/QCAP > 0.90

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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CLIENT
TOWN OF CRESTON

PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
FUTURE STORMWATER SYSTEM - MINOR SYSTEM
5-YEAR 1-HOUR STORM EVENT

CONSULTANT

wsp

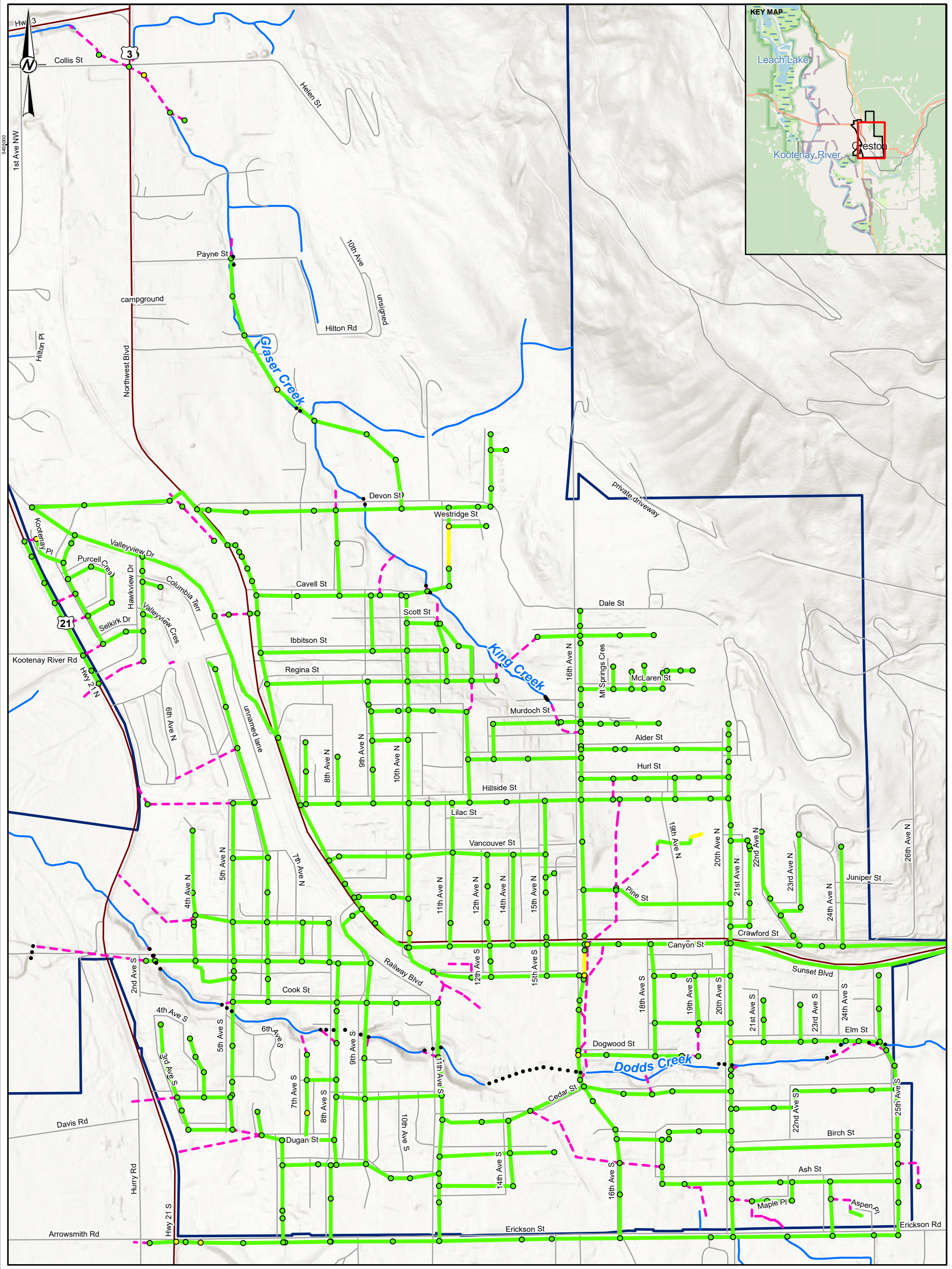
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REVIEWED	KU
APPROVED	JM

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LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- OVERLAND MAJOR SYSTEM CHANNELS
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM DEPTH (MAJOR SYSTEM)

- ≤ 0.15
- 0.15 - 0.30
- > 0.30

MAJOR FLOW PATH DEPTH

- MAX/FULL DEPTH ≤ 0.15
- MAX/FULL DEPTH > 0.15

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
TOWN of CRESTON

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PROJECT
STORMWATER MANAGEMENT MASTER PLAN

TITLE
FUTURE STORMWATER SYSTEM - MAJOR SYSTEM
5-YEAR 1-HOUR STORM EVENT

CONSULTANT

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APPROVED	JM

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8.3.2 MAJOR SYSTEM PERFORMANCE (100-YEAR 1-HR DESIGN STORM)

To evaluate the resiliency of the Town's drainage network under future climate conditions, the major system was assessed using the 100-year, 1-hour design storm derived from the 2080s RCP 8.5 IDF projections. As with the existing-condition analysis, this scenario represents a storm well beyond the design capacity of the minor (piped) system, making the performance of the overland flow network streets, rights-of-way, drainage channels, and natural pathways critical to safely conveying excess runoff.

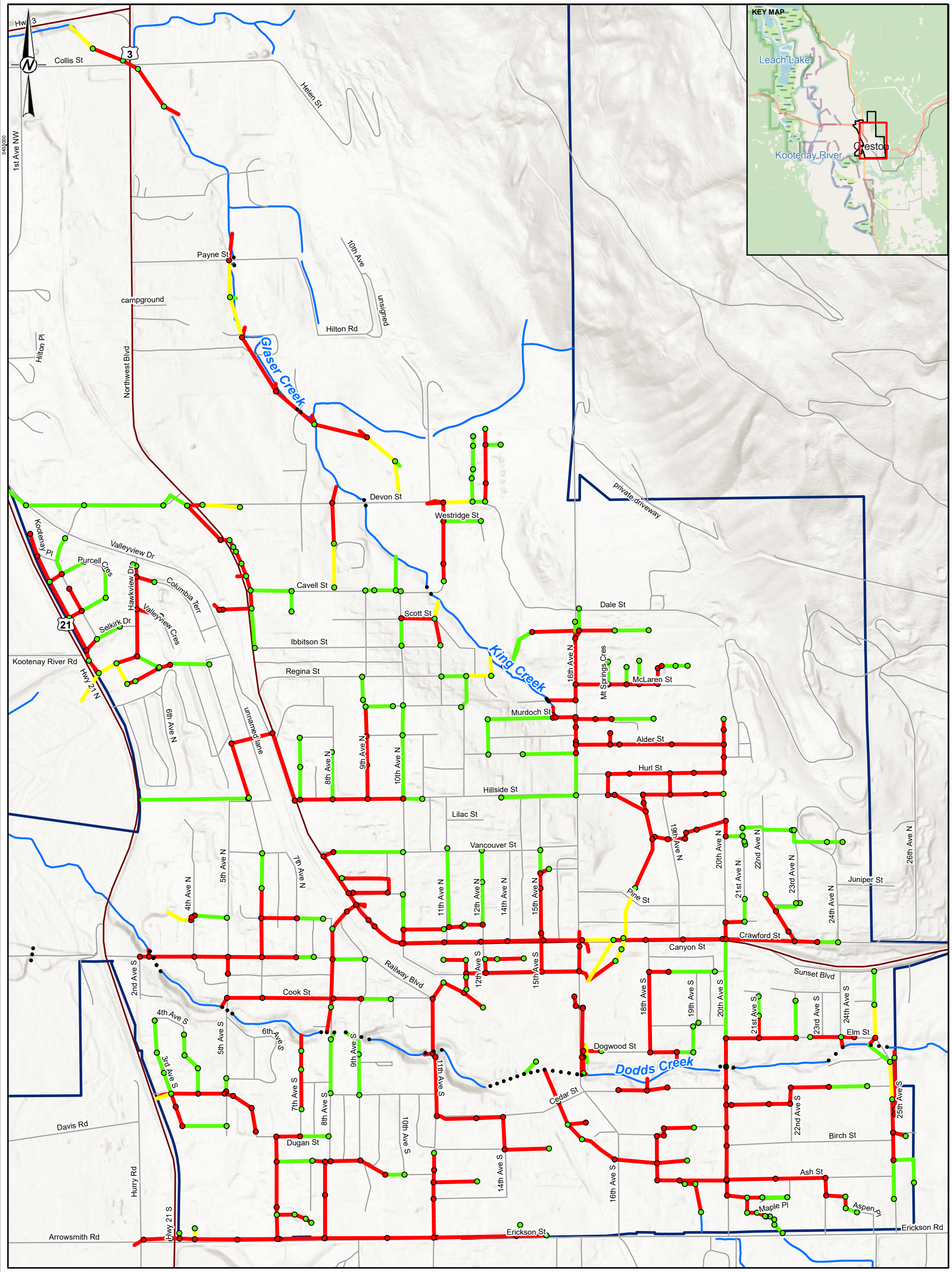
Targeted upgrades incorporated into the future scenario, including downtown drainage enhancements, culvert improvements, and development-driven DCC projects, strengthen the Town's ability to manage extreme rainfall. While peak intensities in the 2080s are significantly higher than historical conditions, the upgraded system is designed to route flows overland in a controlled manner, reducing risks to private property and maintaining safe conveyance through key corridors.

Table 8-6 summarizes major-system performance metrics for the future system. Under the 100-year event, the number of roadway junctions experiencing flooding greater than 0.15 m is 67, which is a significant improvement from the existing conditions.

Table 8-6: Future Major System Performance (100-year event)

Item	Value / Count	% of Total	Notes
Number of flooded junctions	67	15%	Junctions where depth exceeds 0.15m (assumed curb height)

System performance during the 100-year 1-hour design storm is presented in Figure 26 and Figure 27. Localized benefits are evident: upgraded culvert crossings mitigate overtopping, and enhancements along Canyon and Cook Streets improve hydraulic conveyance and surface flow routing. Although surcharging continues to occur under the magnitude of the 100-year event, most modeled flood depths remain relatively shallow (<0.20 m), and the system improvements ensure flows are directed along public rights-of-way rather than impacting private properties. Overall, the future-conditions assessment demonstrates that while extreme rainfall will continue to challenge the network, the proposed upgrades provide meaningful resilience. By safely conveying flows overland, limiting ponding depths, and directing runoff away from private property, the Town's drainage system is better positioned to withstand climate-adjusted conditions. Beyond the modeled improvements such as culvert upgrades, downtown drainage enhancements, and DCC projects - further resilience can be achieved through opportunistic measures not explicitly included in this scenario. These include distributed green infrastructure (e.g., rain gardens), property-level programs (e.g., rain barrels), and surface grading refinements, which are discussed in the recommended strategies section. Together, these initiatives reinforce the importance of a phased renewal approach and complementary interventions to strengthen long-term system performance.



LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM HGL RELATIVE TO MANHOLE RIM

- ABOVE RIM
- BELOW RIM

PIPE CAPACITY

- QMAX/QCAP > 0.90
- 0.70 < QMAX/QCAP ≤ 0.90
- QMAX/QCAP ≤ 0.70

0 100 200 300 400 500

1:10,000 METRES

CRESTON VALLEY
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TOWN OF CRESTON

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STORMWATER MANAGEMENT MASTER PLAN

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FUTURE STORMWATER SYSTEM - MINOR SYSTEM 100-YEAR-1-HOUR STORM EVENT

CONSULTANT

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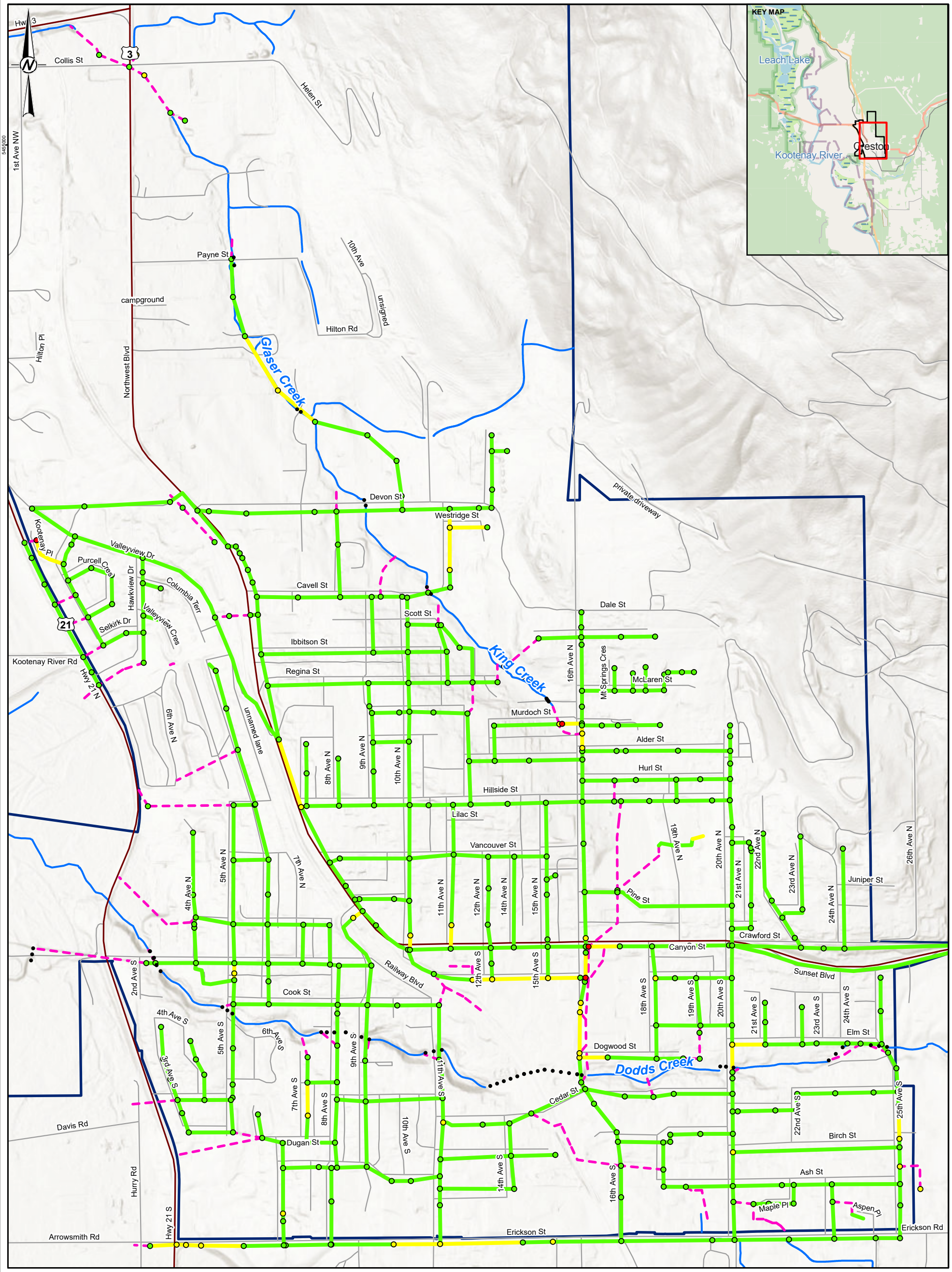
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LEGEND

- HIGHWAY
- EXISTING ROAD
- WATERCOURSE
- OVERLAND MAJOR SYSTEM CHANNELS
- CULVERT
- MUNICIPAL BOUNDARY

MAXIMUM DEPTH (MAJOR SYSTEM)

- ≤ 0.15
- 0.15 - 0.30
- > 0.30

MAJOR FLOW PATH DEPTH

- MAX/FULL DEPTH ≤ 0.15
- 0.15 < MAX/FULL DEPTH ≤ 0.30
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REVIEWED	KU
APPROVED	JM

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8.4 ALIGNMENT OF PROPOSED UPGRADES WITH EXISTING POLICIES AND PLANS

OVERVIEW

The new Stormwater Management Master Plan (SMMP) is strongly aligned with Creston's existing policy documents. It advances the Official Community Plan (OCP) by supporting long-term objectives for sustainable growth, environmental stewardship, and flood-risk reduction, and by reinforcing Development Permit Area guidelines for watershed protection and responsible infrastructure planning. The SMMP also upholds the Integrated Community Sustainability Plan (ICSP) through its emphasis on climate-adaptive design, enhanced infiltration, water-quality protection, and resilient natural-systems management—key pillars of the Town's sustainability vision

The plan directly supports the Climate Action Plan (CCAP) by incorporating climate-resilient stormwater infrastructure, promoting nature-based solutions, and preparing the community for more intense rainfall and overland-flow conditions, all of which are highlighted as municipal climate-action priorities. Its focus on green infrastructure and multimodal streetscape enhancements complements the Multi-Modal Transportation Plan (MMTP), which encourages the integration of stormwater features—such as vegetated boulevards and absorbent surfaces—into street redesigns to improve safety, walkability, and environmental performance.

Finally, the SMMP aligns with the Downtown Revitalization Plan, which promotes streetscape greening, pedestrian-focused design, and the use of green infrastructure to enhance downtown vibrancy and environmental function. By recommending bioswales, rain gardens, and other low-impact development measures in the downtown core, the SMMP directly implements the Revitalization Plan's direction to transform Canyon Street and adjacent corridors into greener, more climate-resilient public spaces.

OCP: AREAS OF ALIGNMENT AND POTENTIAL CONFLICTS

The OCP emphasizes protection of natural watercourses, management of flood hazards, and integration of environmentally responsible infrastructure. The proposed drainage upgrades support these objectives by prioritizing:

- Conveyance improvements in known flood-prone corridors to reduce risk to public safety and private property;
- Protection of receiving watercourses (King/Glaser Creek, Dodd's Creek) through controlled discharge, overland flow management, and targeted culvert upgrades; and
- Incremental introduction of green infrastructure measures, particularly within the downtown core, to improve runoff attenuation, water quality, and streetscape function.

The phased capital approach also aligns with OCP objectives related to fiscal responsibility and coordinated infrastructure investment.

However, Development Permit Area 2 – Environmentally Sensitive Areas (DPA 2) may present a conflict. The OCP sets strict standards for works near streams, riparian corridors, and drainage features, aiming to minimize disturbance, preserve hydrologic function, and protect riparian ecosystems by maintaining natural flow and minimizing channel impacts. The proposed rechannelization of King/Glaser Creek (Improvement N.4) conflicts with this guidance, and the OCP does not address this rechannelization or similar improvements. This results in a gap within current policy and introduces a potential compliance risk.

RECOMMENDED POLICY REFINEMENTS

To strengthen alignment between infrastructure planning and policy implementation, it is recommended that the Town address the conflict between the proposed rechannelization of Glaser/King Creek and the OCP. This may require engagement with the development community to collaborate on alternative solutions along this reach. Alternatively, consider amending the OCP to include more flexibility in the implementation of infrastructure upgrades. Potential amendments may include:

- modifications to the DPA 2 overlay;
- relaxation of the setback for culverted segments of watercourses; and/or
- the inclusion of specific direction for the planned rechannelization.

Should the Town prefer to proceed with the planned rechannelization, a design approach that incorporates naturalized elements (e.g. bioretention, native planting, etc.) would be more in keeping with the spirit of the OCP recommendations.

9 CAPITAL PLAN

9.1 UPGRADE COSTS

Cost estimation for the recommended upgrades provides the Town of Creston with a preliminary capital planning framework to prioritize investments in the stormwater system. Because this Master Drainage Plan focuses on system-wide performance rather than detailed design, cost estimates (Table 9-2) are provided at a conceptual (Class D) level to support budget planning and grant applications.

Table 9-1: Projects Total Costing

Capital Upgrade	Amount	Contingency (30%)	Total
Culvert Upsizing	$8,074,900	$2,422,470	$10,497,370
Overland Improvements	$172,500	$51,750	$224,250
Downtown System Enhancements	$1,400,000	$420,000	$1,820,000
New Development (DCC) Upgrades	$4,245,000	$1,273,500	$5,518,500
General	$50,000	$15,000	$65,000
Total	**$13,892,400**	**$4,182,720**	**$18,125,120**

In addition to the above capital projects, it is also recommended that Creston review their annual budgeting for stormwater operations, maintenance infrastructure renewal as described in section 9.2.2.

Individual project costs are outlined in Table 9-2 to Table 9-5 and further specifics can be found in Appendix F.

Table 9-2: Culvert Upgrade Costs

ID	Description	Amount
C.1	Upsize existing culvert to 1800 mm (25th Ave and Dodd's Creek)	$405,000
C.2	Upsize existing culvert to 1600 mm (Payne Street and Glaser/King Creek)	$217,800
C.3	Upsize existing culvert to 1400 mm (Devonshire Meadows and Glaser/King Creek)	$159,900
C.4	Upsize existing culvert to 1400 mm (Devon St. and Glaser/King Creek)	$209,000
C.5	Upsize existing culvert to 1400 mm (Cavell St. and Glaser/King Creek)	$209,000
C.6	Upsize existing culvert to 2700 mm (Canyon St. and Dodd's Creek)	$657,200
C.7	Upsize existing culvert to 2700 mm (5th Ave. and Dodd's Creek)	$412,500
C.8	Upsize existing culvert to 2400 mm (8th/9th Ave. and Dodd's Creek)	$2,025,000
C.9	Upsize existing culvert to 2400 mm (11th Ave. and Dodd's Creek)	$540,000
C.10	Upsize existing culvert to 2400 mm (Railway ROW/16th Ave. and Dodd's Creek)	$2,331,000
C.11	Upsize existing culvert to 2200 mm (20th Ave. and Dodd's Creek)	$407,000
C.12	Upsize existing culvert to 1800 mm (24th Ave. and Dodd's Creek)	$486,000
C.13	Upsize existing culverts to 1200 mm (Schikurski Park and Glaser/King Creek)	$15,500
	Sub-Total:	$8,074,900
	Contingency (30%):	$2,422,470
	Projects Total Cost:	**$10,497,370**

It is noted that large diameter culvert costs are highly variable, depending on depth, length, restoration needs and environmental/regulatory requirements. Additional evaluation of flood risk and exploration of potential construction methods (e.g. trenchless vs. open cut) is recommended to refine costing and implementation timing of these upgrades.

Table 9-3: Overland Drainage Upgrade Costs

ID	Description	Amount
O.1	Pine St & 4th Ave N	$6,000
O.2	20th Ave S & Elm Street	$53,000
O.3	7th Ave S	$5,000
O.4	24th Ave S	$49,500
O.5	Murdoch Street	$10,000
O.6	Ibbitson Street	$5,000
O.7	5th Ave S (near Canyon St)	$34,000
O.8	20th Ave S (610 20th Ave S)	$5,000
O.9	16th Ave S (518 16th Ave S)	$5,000
	Sub-Total:	$172,500
	Contingency (30%):	$51,750
	Projects Total Cost:	**$224,250**

Table 9-4: Downtown System Enhancement Costs

ID	Description	Amount
D.1	Cook Street (Not incl surface disturbance costs)	$500,000
D.2	Canyon Street - LID & Streetscape Upgrade (Optional)	$900,000
	Sub-Total:	$1,400,000
	Contingency (30%):	$420,000
	Projects Total Cost:	**$1,820,000**

Table 9-5: New Development (DCC) Upgrades

ID	Description	Amount
N.1	Devon Street	$646,000
N.2	8th Avenue North (between Cavell St and Devon St)	$242,000
N.3	Glaser Drive – Minor System Improvements	$3,173,500
N.4	Glaser Drive – Re channelization of Glaser/King Creeks	$183,500
	Sub-Total:	$4,245,000
	Contingency (30%):	$1,273,500
	Projects Total Cost:	**$5,518,500**

9.2 PHASED IMPLEMENTATION

A phased implementation strategy provides the Town with a structured, adaptable pathway for delivering stormwater upgrades in a financially sustainable manner. Because many improvements are tied to system age, road rehabilitation cycles, asset condition, and development pressures, this plan emphasizes both timing and flexibility, ensuring that capital decisions remain responsive to future monitoring results and evolving community needs. The recommended approach divides upgrades into short-term, medium-term, and long-term priorities, supported by clear triggers and an understanding that this Master Plan is a living document that should be revisited regularly.

9.2.1 RECOMMENDED TIMELINE OF UPGRADES

SHORT-TERM (0-5 YEARS)

Short-term efforts focus on projects that address known problem areas, improve public safety, and support ongoing maintenance efficiency.

Key priorities:

- Localized overland drainage improvements at high-risk sag locations.
- Replacement of standard manhole lids with CB-style lids in areas with recurring surcharge pressures. (Assumed 20 lids to be replaced in the high priority areas within the horizon)
- Replacement/upsizing of priority culverts where roadway overtopping occurs during the 100-year event under existing conditions.

Table 9-6 summarizes the estimated costs associated with the planned short-term upgrades, providing a clear view of the investment required over the 0 to 5-year horizon.

Table 9-6: Estimated Costs of Short-Term (0–5 Year) Upgrades

ID	Description	Amount
Overland Drainage Upgrades		
O.1	Pine St & 4th Ave N	$ 6,000
O.2	20th Ave S & Elm Street	$ 53,000
O.3	7th Ave S	$ 5,000
O.4	24th Ave S	$ 49,500
O.5	Murdoch Street	$ 10,000
O.6	Ibbitson Street	$ 5,000
O.7	5th Ave S (near Canyon St)	$ 34,000
O.8	20th Ave S (610 20th Ave S)	$ 5,000
O.9	16th Ave S (518 16th Ave S)	$ 5,000
Culvert Upgrades		
C.1	Upsize existing culvert to 1800 mm (25th Ave and Dodd's Creek)	$ 405,000
C.2	Upsize existing culvert to 1600 mm (Payne Street and Glaser/King Creek)	$ 217,800
C.3	Upsize existing culvert to 1400 mm (Devonshire Meadows and Glaser/King Creek)	$ 159,900
C.4	Upsize existing culvert to 1400 mm (Devon St. and Glaser/King Creek)	$ 209,000
C.5	Upsize existing culvert to 1400 mm (Cavell St. and Glaser/King Creek)	$ 209,000
C.6	Upsize existing culvert to 2700 mm (Canyon St. and Dodd's Creek)	$ 657,200
C.7	Upsize existing culvert to 2700 mm (5th Ave. and Dodd's Creek)	$ 412,500
General Upgrades		
G.1	Convert existing manhole lids to catch basin-style lids (CB lids) to relieve pressure	$ 50,000
	Sub-total	$ 2,492,900
	Contingency	$ 747,870
	Total	$ 3,240,770

The short-term program focuses on localized overland improvements at high-risk sag locations, with nine targeted projects addressing property risk and public safety as well upgrades priority culverts. The total estimated cost of these upgrades is **$3.2 million** with the majority of this going to culvert costs. Spread across the five-year horizon, this equates to an average annual spend of approximately **$650,000**.

Should there be insufficient resources to complete the recommended near term projects within the proposed timeframe, it is recommended that the Town undertake a comprehensive evaluation of culvert performance and flood risk of all infrastructure along Dodd's Creek and Glaser/King Creek to further

prioritize and cost the recommended projects. This should include consideration of trenchless and open cut installations at all locations.

MEDIUM-TERM (5–10 YEARS)

Medium-term projects include additional culvert upgrades along Dodd's Creek and Glaser/King Creek as well as targeted upgrades to improve the level of service within the downtown core.

Key priorities:

- Five major culvert upgrades along Dodd's Creek.
- Incremental introduction of green infrastructure (LID) within urban streetscapes particularly along Canyon Street in the downtown core to increase climate resiliency, improve water quality, enhance aesthetics, and reduce peak flow contributions.

Error! Reference source not found. summarizes the estimated costs associated with the planned medium-term upgrades, providing a clear view of the investment required over the 5 to 10-year horizon.

Table 9-7: Estimated Costs of Medium-Term (5-10 Year) Upgrades

ID	Description	Amount
Culvert Upgrades		
C.8	Upsize existing culvert to 2400 mm (8th/9th Ave. and Dodd's Creek)	$ 2,025,000
C.9	Upsize existing culvert to 2400 mm (11th Ave. and Dodd's Creek)	$ 540,000
C.10	Upsize existing culvert to 2400 mm (Railway ROW/16th Ave. and Dodd's Creek)	$ 2,331,000
C.11	Upsize existing culvert to 2200 mm (20th Ave. and Dodd's Creek)	$ 407,000
C.12	Upsize existing culvert to 1800 mm (24th Ave. and Dodd's Creek)	$ 486,000
Downtown Enhancement Upgrades		
D.1	Cook Street (Not incl surface disturbance costs)	$ 500,000
D.2	Canyon Street - LID & Streetscape Upgrade (Optional)	$ 900,000
	Sub-total	$ 7,189,000
	Contingency	$ 2,156,700
	Total	$ 9,345,700

The combined cost of medium-term upgrades is **$9.3 million**. This represents the total infrastructure replacement cost, inclusive of any developer and grant contributions; the actual town share will vary by project. Distributed across the five-year horizon, this equates to an average annual spend of approximately **$1.87 million**.

The downtown enhancements require further development to optimize performance. It is recommended that these upgrades be completed in conjunction with downtown revitalization and that a conceptual design of all associated improvements be completed to develop an integrated design that considers stormwater performance as well implications to transportation, commercial areas and park spaces. As funding for natural infrastructure is becoming increasingly available, it is recommended that the Town monitor opportunities and seek grant opportunities to support implementation.

LONG-TERM (10+ YEARS)

Long term upgrades include those improvements that are either less urgent in terms of flood risk and/or upgrades that will not be needed until future developments proceed within the priority growth area.

Key priorities:

- Future upgrades within the King/Glaser Creek corridors identified in the DCC program. These are anticipated to be driven by the pace of development and therefore may extend beyond the conventional 20-year planning scope.
- Culvert upgrades within Schikurski Park.

Table 9-8 summarizes the estimated costs associated with the planned long-term upgrades, providing a clear view of the investment required over 10+ year horizon.

Table 9-8: Estimated Costs of Long-Term (10+ Year) Upgrades

ID	Description	Amount
Culvert Upgrades		
C.13	Upsize existing culvert to 1200 mm (Schikurski Park and Glaser/King Creek)	$ 15,500
New Development Upgrades		
N.1	Devon Street	$ 646,000
N.2	8th Avenue North (between Cavell St and Devon St)	$ 242,000
N.3	Glaser Drive – Minor System Improvements	$ 3,173,500
N.4	Glaser Drive – Re channelization of Glaser/King Creeks	$ 183,500
	Sub-total	$ 4,260,500
	Contingency	$ 1,278,150
	Total	$ 5,538,650

The combined cost of long-term upgrades including development driven DCC projects and culvert upgrades in Schikurski Park is estimated to be 5.54 million. When distributed across a 30-year horizon, this equates to an average annual spend of about **$185,000**.

9.2.2 ANNUAL OPERATIONS, MAINTENANCE AND SYSTEM RENEWAL

In addition to the capital projects outlined above, it is also recommended that the Town of Creston evaluate their annual budget for stormwater operation, maintenance and system renewal:

- It is recommended that Creston implement an infrastructure renewal program to replace aging/undersized storm sewers. For cost efficiency, it is proposed that this be completed opportunistically in conjunction with planned roadway and/or utility upgrades. Based on an estimated system replacement cost of ~$39,000,000 (excluding restoration) and an assumed 50 year timeline for replacement, an annual allocation of **~$780,000** (2026 dollars) is recommended for system renewal. This allocation can and should be linked to the Town's asset inventory and refined/revisited annually based on the most recent forecasting.

- Gradually increase capacity for operations and maintenance to include increased inspection and maintenance of built and natural infrastructure and water quality monitoring (section 10.2). Examine opportunities to capitalize on seasonal staff and community supported reporting.
- Allocate funding to support a pilot rebate program for rain barrels, with potential expansion to on-site storage, rain gardens and tree planting.

9.2.3 ADAPTIVE AND "LIVING" NATURE OF THE PLAN

This Master Drainage Plan is intended to be dynamic, adjusting as conditions evolve. Monitoring results, updated rainfall projections, future modelling exercises, and observed system performance should guide future refinements.

A living plan ensures:

- High-risk areas are addressed promptly based on ongoing field verification.
- Long-term upgrades are not constructed prematurely.
- Lot-level improvements and routine maintenance may effectively delay or reduce the need for major capital interventions.

Potential Delay of Capital Upgrades

In some neighbourhoods, improvements in lot grading, private drainage maintenance, and proactive catch basin cleaning may substantially reduce flood risk. Where these measures prove consistently effective, the Town may choose to defer or scale down larger upgrades.

Continued monitoring with a focus on areas with predicted flooding but limited historical reports is essential to determine when capital upgrades are genuinely required.

9.2.3.1 KEY TRIGGERS FOR IMPLEMENTATION

Given the variability in storm frequency, development pacing, and funding constraints, the plan assigns upgrades to short-, medium-, and long-term horizons for guidance; however, a flexible approach is essential, as the triggers outlined below may necessitate shifts in project timing:

System-Driven Triggers

- Repeated surcharging or flooding reported through monitoring (especially at high-risk private property locations).
- Structural deterioration identified through CCTV or culvert inspections.
- Major blockages or sedimentation requiring repeated maintenance.

Development-Driven Triggers

- Upgrades required under the Town's DCC program (e.g., Glaser Creek, King Creek) should proceed when any new development in the contributing areas advances.
- OCP-required environmental assessments including habitat compensation, erosion risk reviews, and water quality checks may also trigger drainage improvement needs.

Infrastructure Coordination Triggers

- Planned road rehabilitation projects providing opportunities to replace or upsize storm pipes.
- Utility replacement projects where trenching is already anticipated.

Funding/Grant Triggers

- Availability of provincial/federal grants for flood resilience, green infrastructure, or watershed restoration.
- Potential partnerships with First Nations or local stewardship groups.

9.3 FUNDING SOURCES AND KEY ASSUMPTIONS

Delivering the recommended stormwater upgrades will require a combination of external funding sources and ongoing operational resources. This section summarizes grant programs and funding instruments that the Town can pursue, outlines municipal financing options, describes policy and incentive approaches for on-lot control measures.

9.3.1 MUNICIPAL REVENUE

Municipal revenue remains the Town's most flexible and reliable funding source for stormwater capital upgrades, particularly for renewal-driven projects that are not tied to growth. Given the age of much of the system and the prevalence of undersized or inconsistent pipe segments, a stable annual allocation to a dedicated stormwater reserve is recommended to support proactive asset reinvestment. Historically, stormwater works have been bundled with road rehabilitation budgets, but segregating these reserves will improve transparency, support long-term planning, and allow the Town to strategically coordinate storm upgrades with roadway projects. A consistent annual contribution will also position the Town to leverage external grants by ensuring that municipal matching funds are readily available when opportunities arise.

9.3.2 DEVELOPMENT COST CHARGES (DCCS) AND DEVELOPMENT LEVIES

The Town of Creston's Development Cost Charges (DCC) program is a key financial mechanism to ensure that growth pays for growth. Under the proposed 2025 update, stormwater management is explicitly recognized as a major infrastructure category, alongside water, sanitary sewer, roads, and parks. This update reflects the growing importance of drainage systems in mitigating runoff impacts from new development and maintaining community resilience.

Under updated DCC framework, rates have been recalculated based on current construction costs, extended growth projections to 2039, and updated infrastructure priorities. Stormwater projects identified in the Master Drainage Plan and related assessments form the basis for these charges. The program applies the "benefit to future development" principle, ensuring that only the portion of project costs attributable to new growth is recovered through DCCs, while costs benefiting existing users are funded through municipal sources such as grants or taxation.

This report presents revised cost estimates for the associated DCC upgrade projects. Consequently, the planned DCC valuation may need to be reassessed to reflect the updated project costs.

For single-family residential development, the proposed stormwater DCC component is approximately $3,552 per unit, contributing to an overall DCC of $10,603 when combined with other infrastructure categories. This represents a substantial increase from the previous bylaw, where stormwater costs were bundled and less transparent. The update also incorporates oversizing principles, allowing developers to recover costs for trunk stormwater infrastructure that serves multiple developments, while local works remain their responsibility.

In addition to traditional drainage improvements, the updated policy supports integrated stormwater solutions, including culvert upgrades, re-channelization projects, and stormwater retention facilities. These investments are critical for managing peak flows, reducing flood risk, and supporting sustainable land development practices. By aligning stormwater DCCs with updated engineering standards and community planning objectives, the Town ensures equitable cost-sharing and long-term system performance.

9.3.3 GRANT FUNDING

Implementing the SMMP will require significant investment in infrastructure upgrades and innovative approaches such as nature-based solutions (NbS). To offset costs and accelerate delivery, external funding sources should be leveraged. This section identifies potential grant programs and funding opportunities at federal, provincial, and regional levels, with a focus on programs that support NbS and climate adaptation.

FEDERAL FUNDING PROGRAMS

- **Federation of Canadian Municipalities (FCM) - Green Municipal Fund & Municipalities for Climate Innovation Program (MCIP)**
  FCM provides funding, loans and capacity-building support for municipal climate and sustainability projects. The Green Municipal Fund and MCIP have supported planning and implementation projects related to climate adaptation and stormwater management. Grants/loans may support planning, pilot projects and certain retrofit / implementation works.
- **Disaster Mitigation and Adaptation Fund (DMAF) - Government of Canada**
  A national program that provides capital contributions for large infrastructure projects that reduce disaster risk and adapt to climate change (e.g., major culvert replacements, natural infrastructure for flood mitigation). Funding levels and eligibility are project-specific; past rounds have funded large-scale conveyance and natural infrastructure.
- **Environment and Climate Change Canada (ECCC) /Other - Targeted Resilience Grants**
  ECCC periodically issues funding calls for localized climate adaptation and resilience-building projects. These grants are ideal for initiatives that incorporate NbS, such as wetland restoration or green corridors. ECCC and Infrastructure Canada announcements should be monitored to capitalize on targeted funding intakes.

PROVINCIAL FUNDING PROGRAMS

- **Union of BC Municipalities (UBCM) - Community Emergency Preparedness Fund (CEPF)**
  Province-funded streams administered by UBCM include Flood Risk Assessment, Flood Mapping and Flood Mitigation Planning, and other disaster risk reduction streams. These streams fund planning, mapping, and smaller mitigation works and are well-suited to obtaining funding for the technical studies, mapping, and targeted mitigation measures recommended in this Plan. Intake windows and maximum award sizes vary by stream.
- **Provincial/Regional Programs and Partnerships**
  Provincial ministries and regional agencies periodically offer targeted funds (e.g., watershed restoration, storm mitigation). Also explore opportunities with provincial watershed stewardship programs and First Nations partnership funding for joint projects. See UBCM and provincial announcements.

NATURE BASED SOLUTIONS AND CLIMATE RESILIENCE

- **Nature Smart Climate Solutions Fund (ECCC)**
  With a commitment of $1.4 billion over 10 years, this fund supports projects that restore or enhance ecosystems such as wetlands, forests, and grasslands. These projects deliver climate mitigation and resilience benefits while improving biodiversity.
- **Intact Financial Corporation - Municipal Climate Resiliency Grants**
  Intact runs a national Municipal Climate Resiliency Grants program that provides modest grants to support pilot projects and community-scale resilience measures (e.g., small-scale flood protection, green infrastructure pilots). Good for pilot LID implementations or demonstration projects (e.g., Canyon Street pilot).
- **WWF-Canada Nature and Climate Grant Program**
  This program funds restoration projects that improve habitat and capture carbon, with a strong emphasis on Indigenous-led initiatives. It is well-suited for projects that combine ecological restoration with community engagement.
- **Nature Conservancy of Canada – Nature + Climate Accelerator**
  This initiative mobilizes private capital to complement public funding for conservation and NbS projects. It offers opportunities for municipalities to partner with conservation organizations to achieve shared climate goals.

9.3.4 FINANCIAL ASSUMPTIONS & SENSITIVITY

Key assumptions related to the capital plan include the following:

- **Grant Assumption:** This Master Plan's financial framework assumes an average grant funding contribution of ~30% across eligible projects. Some high-priority projects (large DMAF-style works or FCM implementation projects) may secure higher contributions (up to 40–60% for small-to-medium pilot or natural infrastructure projects under specific programs), while others (purely local upgrades) may receive none. The 30% figure is considered an average planning assumption.
    - **Matching / Reserve Requirement:** The Town should plan for at least a 20–40% municipal match for larger grant applications and keep a contingency allowance (15–30%).
- **Assumed Maintenance:** Costs include lifetime maintenance for LID features and additional O&M for storm system in budget forecasts; grant programs often do not fund long-term maintenance.
- **Opportunistic Capitalizing During Road Rehabilitation:** The Town will coordinate pipe upgrades and LID installation with roadworks to reduce total cost (single mobilization, reduced traffic control costs). Costs estimates only include the incremental cost of storm sewer installation (e.g. roadway rehab costs excluded).

10 STORMWATER OPERATIONS, MANAGEMENT AND PROGRAMMING

10.1 CURRENT ASSET MANAGEMENT APPROACH

Stormwater infrastructure in the Town of Creston is overseen collaboratively by Engineering and Public Works, with maintenance activities guided by operational experience and system knowledge accumulated over time. Work is typically prioritized based on observed issues in the field such as blocked inlets, localized drainage concerns, or condition-related repairs along with general awareness of higher-use or high-visibility areas.

Asset inventory information from the Town's 2019 Asset Management Plan supports ongoing tracking of storm pipes, manholes, and culverts. Documentation is more developed for piped systems within road corridors, while information for natural drainage channels and overland flow routes continues to grow as field observations and capital planning projects provide new detail. Formal condition assessments or routine inspection programs have not yet been fully established, but operational staff regularly monitor drainage features during site visits and seasonal maintenance activities.

Stormwater servicing for new development is reviewed on a case-by-case basis through the development permitting process. As-built drawings, design submissions, and servicing reviews contribute to the Town's understanding of infrastructure performance, though long-term system capacity is not currently tracked through a structured monitoring program.

Overall, the current approach remains practical and responsive to community needs, and this Master Drainage Plan provides a foundation to continue strengthening asset information, operational insight, and long-term planning over time.

10.1.1 OPERATIONAL RISK MANAGEMENT AND SYSTEM OVERSIGHT

The Town's current operational approach to stormwater management involves system oversight driven primarily by visible issues, resident reports, or seasonal maintenance requirements. Routine activities such as catch basin cleaning, culvert inspections, and debris removal at key inlets are performed when blockages are observed or when staff anticipate issues during major rainfall events. Similarly, monitoring of culverts along Dodd's Creek and other key conveyance corridors generally occurs during or immediately after storm events.

Formal risk-based processes are currently limited, and the Town does not maintain an asset condition inventory or a systematic method for prioritizing maintenance activities. Water quality monitoring programs are not in place, and there is no established framework for tracking erosion, sedimentation, or performance of natural drainage channels. Oversight of new development is supported by existing permitting requirements, but there is no standardized mechanism to verify downstream capacity or track cumulative impacts on the stormwater network.

Overall, the existing operational model relies heavily on staff experience, observations during storms, and responses to public concerns. While this approach enables the Town to address immediate issues efficiently, it limits the ability to anticipate emerging risks, compare system performance over time, or align maintenance activities with long-term asset management objectives.

10.2 MONITORING, OPERATIONS AND MAINTENANCE

A proactive Monitoring, Operations, and Maintenance (MOM) program is an important component in sustaining reliable stormwater performance over time. While the system generally functions well, particularly the major overland routes, structured monitoring of key locations will help the Town manage risk, support decision-making, and identify opportunities for future upgrades.

HYDRAULIC PERFORMANCE MONITORING

PCSWMM modeling identified several sag points, inlet restrictions, and localized depressions where ponding and private-property drainage can occur during major storm events. To address these emerging pressures, these locations should be incorporated into the Town's routine inspection routing. Locations identified in **Table 7-2** & **Table 7-4**.

A practical approach would include:

- Seasonal inspections twice per year
    - Spring, prior to snowmelt and wet-weather events
    - Fall, prior to freeze-up
- Event-driven follow-ups following significant rainfall (>25 mm in 24 hr)
- Checks for debris accumulation, inlet blockages, and bypass flow routes
- Spot-checks of known low points where runoff may leave the right-of-way

This approach builds on existing practices, while gradually shifting toward a more structured and risk-informed inspection system.

NATURAL CHANNEL MONITORING

Although no erosion issues have been formally reported in natural receiving channels (Glaser/King Creek and Dodd's Creek), selective monitoring is recommended to confirm long-term channel stability as conveyance upgrades occur.

Monitoring may remain streamlined, focusing on:

- Bank stability at culvert crossings;
- Evidence of localized scour at outfalls;
- Blockages from woody debris;
- Overall channel condition after high-flow events;

It is important to note that erosion may become a growing concern as culverts are upgraded and conveyance capacity increases. Higher velocities can accelerate channel instability, particularly near crossings and outfalls. This may necessitate future erosion protection works such as riprap armoring, energy dissipation structures, or vegetated stabilization measures to maintain channel integrity and prevent downstream impacts.

This proactive approach helps ensure that any changes in hydrologic response are identified early and mitigated before they evolve into significant maintenance or safety issues.

To balance risk management with available resources, inspections should occur twice per year - once in spring before snowmelt and once in fall before freeze-up along with event-driven checks following major storms (e.g., >25 mm rainfall in 24 hours). Opportunistic inspections during routine maintenance can further streamline efforts.

COMMUNITY SUPPORTED REPORTING

To optimize limited operational resources, resident observations can be incorporated into the Town's regular monitoring process. A simple enhancement to existing communication channels such as a centralized reporting form or 311-style service would allow the public to report visible drainage concerns, including:

- Blocked or damaged inlets
- Unexpected surface ponding
- Channel debris or erosion

These reports can be integrated into staff workflows by flagging locations for follow-up inspection during the next scheduled visit, or by triggering event-based checks when multiple notifications are received for the same area. This community supported approach supplements existing field programs, improves system awareness, and helps prioritize maintenance based on real-time observations.

MANHOLE AND CATCH BASIN LID MANAGEMENT

Hydraulic surcharge during major storm events can increase internal pressure within manholes, creating a risk of lid displacement. In high-risk locations, replacement of solid manhole lids with grated catch basin lids is recommended to:

- Relieve pressure safely during large events
- Maintain surface drainage continuity
- Reduce risks to road users

These replacements can be coordinated with capital projects and routine surface works.

RECORD-KEEPING AND ASSET TRACKING

As inspections and maintenance activities expand, maintaining consistent digital records will support future asset management decisions. Stored information should include:

- Inspection results and observed deficiencies
- Maintenance actions and schedules
- Culvert and outfall photos / condition ratings
- Locations of recurring drainage issues

Over time, these records can inform:

- Renewal prioritization
- Performance tracking

- Cost forecasting
- Updates to the hydraulic model

10.2.1 WATER QUALITY MONITORING RECOMMENDATIONS

The Town does not currently operate a formal water quality monitoring program. While no immediate concerns have been identified, a general approach to water quality monitoring would support compliance with the OCP, reinforce environmental stewardship, and provide baseline data for future planning.

An initial phase could focus on one or two key outfalls along King/Glaser Creek and Dodd's Creek. Opportunistic sampling during routine inspections and occasional grab samples for basic parameters, such as turbidity, pH, temperature, and key nutrients (e.g., nitrogen and phosphorus), following rainfall events may be considered. Visual checks for erosion, sediment-laden runoff, or unusual discharges could be incorporated into existing fieldwork to minimize additional costs.

Program development may benefit from partnerships with local universities, watershed groups, First Nations, and citizen science initiatives. These collaborations can offer technical expertise, volunteer support, and shared resources, while creating opportunities for joint funding and grant applications.

Over time, the pilot could evolve into a more comprehensive monitoring program with expanded coverage, automated sensors, and integrated data management to inform long-term planning and stormwater infrastructure upgrades.

10.3 MUNICIPAL PROGRAMMING & POLICY OPTIONS

A combination of policy tools, financial mechanisms, and operational practices will be required to support long-term stormwater management in the Town of Creston. The following subsections outline feasible municipal programming options that build on current practices while positioning the Town for future system renewal needs, climate resiliency, and sustainable service delivery.

10.3.1 MUNICIPAL REVENUE MANAGEMENT AND OPTIMIZATION

Currently, stormwater renewal and maintenance are funded primarily through the general municipal tax levy, with stormwater work often bundled into road rehabilitation budgets. While this approach has met short-term needs, it limits the Town's ability to plan and fund upgrades on a lifecycle basis. To ensure future requirements, particularly those identified in the Master Drainage Plan, are adequately resourced, a more structured and transparent funding model is recommended.

The following strategies could support this.

DEDICATED STORMWATER RESERVE (RECOMMENDED)

Establishing a dedicated stormwater reserve would provide a predictable funding pathway for renewal projects, system upgrades, monitoring programs, and emergency works. Annual allocations should reflect system age and condition as well as planned capital works identified in the MDP. This reserve would allow stormwater funding to be separated from road budgets, improving transparency and long-term financial planning.

OPTIMIZING USE OF EXISTING MUNICIPAL REVENUE (SHORT-TERM)

Short-term optimization opportunities include:

- Using "bundling" strategies (e.g., curb renewal + CB replacement + local pipe upsizing + MH lid replacement) to reduce the frequency of localised disturbance.
- Implement an annual stormwater renewal allowance tied to asset age and risk. Continuing to integrate stormwater renewal with road rehabilitation projects to reduce costs.
- Update capital planning regularly as models and data evolve to to keep priorities current and risk based.

STORMWATER UTILITY / USER FEE (OPTIONAL, LONG-TERM)

A stormwater utility fee structured by impervious area, meter size, or property class could provide a stable revenue stream that directly reflects stormwater service demand. While implementation requires significant administrative setup, benefits include:

- Predictable funding for renewal and O&M;
- Fairness across residential, commercial, and institutional properties; and
- Incentives for on-site stormwater controls (e.g., storage, rain gardens, infiltration).

Given the Town's size, a utility should be considered as a long-term strategy, implemented gradually and when administrative capacity allows.

10.3.2 ON-LOT STORMWATER CONTROLS

Managing stormwater at its source is an effective way to reduce runoff, improve water quality, and ease pressure on municipal systems. Simple on-lot measures, such as rain barrels, rain gardens, infiltration features, and tree planting, can provide meaningful benefits while engaging residents in sustainable practices. These approaches are low-cost, practical, and can complement larger system upgrades.

POTENTIAL APPROACH: INCENTIVE PROGRAM FOR ON-LOT CONTROLS

The Town can encourage adoption through a rebate program that supports homeowners installing stormwater controls. A practical starting point is a **pilot focused on rain barrels**, offering 50% reimbursement up to a set cap (e.g., $250–$500 per household). This mirrors existing Town rebate programs and can be administered through a simple online application with receipt and photo upload. A one-year pilot for up to 20 households would allow the Town to gauge interest and estimate runoff reduction benefits.

Over time, the program could expand to include other measures such as rain gardens or tree planting, with technical guidance provided through fact sheets on siting, maintenance, and winter considerations. Promotion can occur through utility bill inserts, community events, and partnerships with local stewardship groups.

On-lot measures (rain barrels, rain gardens, infiltration boxes) reduce runoff volumes, improve water quality, engage residents and may defer larger capital upgrades.

POLICY INTEGRATION: ROOF LEADER REDIRECTION

To further reduce unnecessary loads on the storm system, the Town should promote roof leader redirection to on-lot infiltration or rain barrels wherever feasible, rather than direct discharge to the storm network. This simple measure can significantly reduce peak flows and improve water quality. Where discharge to streets is unavoidable, encourage routing across vegetated strips or curb-side features to minimize concentrated flows.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSIONS

The Master Drainage Plan provides an updated assessment of Creston's stormwater system under current and future climate conditions. The analysis shows that the Town's minor storm sewer network is significantly overloaded and does not achieve the intended level of service. Many older areas rely on small-diameter pipes that frequently surcharge, leading to localized flooding and property intrusion. These deficiencies are expected to worsen under projected 2080s rainfall intensities, which will place additional stress on the system.

At the same time, upgrading the entire minor system is not considered cost-effective. While the underground network struggles during heavy rainfall, the major overland drainage system, supported by Creston's natural slopes toward Dodd's Creek and the Kootenay River, continues to function effectively during large storm events. This means that wholesale pipe upsizing would provide limited benefit relative to its cost and disruption.

The recommended strategy therefore focuses on enhancing major system drainage to reduce flood risk and improve climate resiliency, while addressing localized issues through targeted interventions, operational improvements, and policy refinements. This approach balances technical performance with financial sustainability and leverages opportunities to integrate green infrastructure and distributed retention where feasible.

11.2 RECOMMENDATIONS

The following recommendations outline a clear, implementable path for improving Creston's stormwater resilience.

INFRASTRUCTURE UPGRADES

The recommended upgrades focus on resolving localized flooding risks, enhancing conveyance capacity, and improving drainage resilience through a combination of targeted works and planned renewal. Key components include:

- **Culvert Upsizing:** Replacement of undersized crossings along major drainage routes (IDs C.1 - C.13) to safely convey large storm events and improve downstream flow continuity.
- **Localized Overland Drainage Improvements:** Nine small-scale projects (IDs O.1 - O.9) to correct sag conditions, restore overland flow routing, and reduce runoff onto adjacent private properties.
- **Downtown System Enhancements:**
    - Cook Street upgrades (D.1) to improve hydraulic capacity and operational reliability, and
    - Green-street treatment on Canyon Street (D.2), where feasible, to incorporate LID, improve water quality, and enhance streetscape function.

- **Development-Driven Servicing Upgrades:** Key improvements identified in the DCC program (IDs N.1 -N.4), including upgrades within the Glaser/King Creek corridor, to be delivered as growth occurs.

In addition to these defined capital works, opportunistic renewal is recommended implementing stormwater infrastructure upgrades concurrently with roadway rehabilitation supported by an annual system renewal allocation based on a 50-year asset replacement timeline. This approach ensures ongoing risk reduction and smooths capital spending year-to-year, while preserving flexibility as development progresses and system needs evolve.

To implement the above improvements responsibly, a phased delivery approach is recommended that focuses on mitigating flood risk in the near term and strengthening system performance and supporting capacity growth in the medium and long term.

FUTURE STUDY

Several key infrastructure upgrades would benefit from further evaluation to optimize design, costs and implementation timing:

- Culvert costs are highly variable, depending on depth, length, restoration needs and environmental/regulatory requirements. Additional hydraulic evaluation of watercourse flows (Dodd's Creek and King/Glaser Creek) is recommended to examine flood risk and explore of potential construction methods (e.g. trenchless vs. open cut) to finetune implementation prioritization.
- Conceptual design of downtown (green infrastructure) upgrades in conjunction with downtown revitalization plans is recommended to optimize stormwater performance and further develop a project that is "shovel ready" if and when grant opportunities become available.

LOT-LEVEL AND DISTRIBUTED SOLUTIONS

As described in section 8.2.1, Glaser/King Creek discharges to the storm sewer system network near the north end of town and it remains underground as the watercourse traverses the industrial park until reaching the Highway 3 ditch. The system performs adequately under existing conditions but the adjacent industrial area represents a potential future flood risk during the 100 year event. In lieu of pipe upgrades, it is suggested that this site be inspected to identify whether local improvements can be implemented mitigate the risk to private property.

Because there is little opportunity for traditional detention ponds within the developed townsite, the promotion of lot-level retention throughout Creston is an important component of the strategy. A pilot rebate program for rain barrels is recommended as a starting point, with potential expansion to on-site storage, rain gardens and tree planting. New development should be required to integrate retention-based measures to match pre-development rate and volume targets.

MONITORING, OPERATIONS, AND MAINTENANCE

Recommendations for improving operations and monitoring include:

- **Structured Inspection Program**
  Establish a formal inspection schedule for culverts, catch basins, and roadway drainage features, with priority given to locations that have historically experienced issues. Inspection data should be linked to the Town's asset management system to support lifecycle planning, risk assessment, and renewal forecasting.
- **Erosion and Water Quality Monitoring**
  Introduce monitoring protocols that can be triggered by development activity or following major

storm events to track system performance and environmental impacts. Sampling can be focused on sensitive receiving streams and areas near construction sites.

- **Public Reporting Integration**
  Leverage resident reports and complaints as an additional source of information to augment formal inspections. A simple reporting mechanism such as an online form or mobile app can help identify emerging issues quickly and direct maintenance crews to problem areas. Tracking these reports over time also supports trend analysis and prioritization.
- **Safety Enhancements**
  Replace select manhole lids with catch basin-style lids in high-pressure zones to reduce the risk of lids dislodging during surcharged conditions and improve public safety.

POLICY AND PLANNING

Review of the OCP revealed a potential conflict between the planned rechannelization of Glaser/King Creek and the DPA2 setback restrictions. It is recommended that the Town either engage with the development community to develop an acceptable alternative to the rechannelization or amend the OCP to bring both plans into alignment.

In addition, it is noted that the Development Cost Charge (DCC) program currently identifies conventional piped solutions for King and Glaser Creek. Future design stages should consider integrating nature-based features where space and site conditions allow. These refinements could enhance conveyance while delivering additional benefits such as improved water quality and climate resiliency.

Promoting roof leader redirection to landscaped areas or rain barrels, rather than direct connections to the storm sewer, is recommended as a practical way to reduce unnecessary system loading and encourage on-lot stormwater management. Incorporating green infrastructure (requirements or incentives) into subdivision servicing standards provides an opportunity to embed sustainable practices into new development and redevelopment projects.

FUNDING AND FINANCIAL STRATEGY

A proactive and diversified funding approach is recommended to support implementation of stormwater improvements. Opportunities exist to pursue provincial and federal funding streams, including programs such as the Disaster Mitigation and Adaptation Fund (DMAF), the Federation of Canadian Municipalities' Green Municipal Fund (FCM GMF), and UBCM grants. Based on industry experience, an assumption of approximately 30% external grant funding across project categories provides a reasonable planning basis.

Establishing a dedicated stormwater reserve is recommended to create a predictable source of funding for renewal projects, system upgrades, monitoring programs, and emergency works. This approach reduces reliance on combined road–storm budgets and supports long-term financial planning.

Growth-related improvements can be addressed through Development Cost Charges (DCCs), ensuring that new development contributes to the infrastructure required to support it. In addition, development approvals can incorporate provisions for on-site retention and green infrastructure measures, reducing future system demand and aligning with broader sustainability objectives.

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APPENDIX

A

BCSEE WILDLIFE SCREENING, SPECIES

WITH POTENTIAL OR KNOWN TO OCCUR IN THE TOWN OF CRESTON OR LSA

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
Amphibians	*Ascaphus montanus*	Rocky Mountain Tailed Frog	Blue	T	1-T	Potential
Amphibians	*Anaxyrus boreas*	Western Toad	Yellow	SC	1-SC	Potential
Amphibians	*Lithobates pipiens*	Northern Leopard Frog	Red	E	1-E	Potential
Amphibians	*Plethodon idahoensis*	Coeur d'Alene Salamander	Blue	SC	1-SC	Potential
Amphibians	*Plestiodon skiltonianus*	Western Skink	Blue	SC	1-SC	Potential
Birds	*Accipiter atricapillus atricapillus*	American Goshawk, atricapillus subspecies	Blue	NAR	-	Potential
Birds	*Aeronautes saxatalis*	White-throated Swift	Blue	-	-	Potential
Birds	*Ardea herodias herodias*	Great Blue Heron, *herodias* subspecies	Blue	-	-	Known
Birds	*Asio flammeus*	Short-eared Owl	Blue	T	1-SC	Potential
Birds	*Buteo lagopus*	Rough-legged Hawk	Blue	NAR	-	Known
Birds	*Chordeiles minor*	Common Nighthawk	Blue	SC	1-SC	Potential
Birds	*Coccothraustes vespertinus*	Evening Grosbeak	Yellow	SC	1-SC	Potential
Birds	*Contopus cooperi*	Olive-sided Flycatcher	Yellow	SC	1-SC	Potential
Birds	*Cygnus columbianus*	Tundra Swan	Blue	-	-	Known
Birds	*Cypseloides niger*	Black Swift	Blue	E	1-E (2019)	Potential
Birds	*Dolichonyx oryzivorus*	Bobolink	Red	SC	1-T (2017)	Known
Birds	*Eremophila alpestris merrilli*	Horned Lark, *merrilli* subspecies	Red	-	-	Potential
Birds	*Euphagus carolinus*	Rusty Blackbird	Blue	SC	1-SC (2009)	Potential
Birds	*Falco peregrinus anatum*	Peregrine Falcon, *anatum* subspecies	Red	NAR	-	Potential
Birds	*Hirundo rustica*	Barn Swallow	Yellow	SC	1-T (2017)	Potential

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
Birds	*Icteria virens*	Yellow-breasted Chat	Red	E	1-E	Potential
Birds	*Larus californicus*	California Gull	Red	-	-	Potential
Birds	*Megascops kennicottii macfarlanei*	Western Screech-Owl, *macfarlanei* subspecies	Blue	T	1-T	Potential
Birds	*Melanerpes lewis*	Lewis's Woodpecker	Blue	T	1-T	Potential
Birds	*Nannopterum auritum*	Double-crested Cormorant	Blue	NAR	-	Known
Birds	*Numenius americanus*	Long-billed Curlew	Yellow	T	1-SC	Potential
Birds	*Pelecanus erythrorhynchos*	American White Pelican	Red	NAR	-	Potential
Birds	*Podiceps nigricollis*	Eared Grebe	Blue	-	-	Potential
Birds	*Recurvirostra americana*	American Avocet	Blue	-	-	Known
Birds	*Sterna forsteri*	Forster's Tern	Red	DD	-	Potential
Birds	*Tyto alba*	Barn Owl	Blue	T	1-T	Potential
Insects	*Anguispira kochi*	Banded Tigersnail	Blue	NAR	-	Potential
Insects	*Argia vivida*	Vivid Dancer	Blue	SC	1-SC	Potential
Insects	*Callophrys affinis*	Immaculate Green Hairstreak	Blue	-	-	Potential
Insects	*Cicindela hirticollis*	Hairy-necked Tiger Beetle	Blue	-	-	Potential
Insects	*Cryptomastix mullani*	Coeur d'Alene Oregonian	Blue	-	-	Potential
Insects	*Cupido comyntas*	Eastern Tailed Blue	Blue	-	-	Potential
Insects	*Danaus plexippus*	Monarch	Red	E	1-E	Known
Insects	*Epargyreus clarus*	Silver-spotted Skipper	No Status	-	-	Potential
Insects	*Epargyreus clarus clarus*	Silver-spotted Skipper, *clarus* subspecies	Blue	-	-	Potential

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
Insects	*Euptoieta claudia*	Variegated Fritillary	Blue	-	-	Potential
Insects	*Galba dalli*	Dusky Fossaria	Blue	-	-	Potential
Insects	*Galba obrussa*	Golden Fossaria	Blue	-	-	Potential
Insects	*Galba truncatula*	Attenuate Fossaria	Blue	-	-	Potential
Insects	*Gyraulus crista*	Star Gyro	Blue	-	-	Potential
Insects	*Hemphillia camelus*	Pale Jumping-slug	Blue	-	-	Potential
Insects	*Kootenaia burkei*	Pygmy Slug	Blue	SC	1-SC	Potential
Insects	*Limenitis archippus*	Viceroy	Red	-	-	Potential
Insects	*Lycaena nivalis*	Lilac-bordered Copper	Blue	-	-	Potential
Insects	*Magnipelta mycophaga*	Magnum Mantleslug	Blue	SC	1-SC	Potential
Insects	*Musculium partumeium*	Swamp Fingernailclam	Blue	-	-	Potential
Insects	*Oreohelix subrudis*	Subalpine Mountainsnail	Blue	-	-	Potential
Insects	*Physella columbiana*	Rotund Physa	Red	-	-	Potential
Insects	*Polites themistocles themistocles*	Tawny-edged Skipper, *themistocles* subspecies	Blue	-	-	Potential
Insects	*Pyrgus communis*	Checkered Skipper	Blue	-	-	Potential
Insects	*Speyeria mormonia erinna*	Mormon Fritillary, *erinna* subspecies	Red	-	-	Potential
Insects	*Sphaerium occidentale*	Herrington Fingernailclam	Blue	-	-	Potential
Insects	*Valvata tricarinata*	Threeridge Valvata	Red	-	-	Potential
Insects	*Zacoleus idahoensis*	Sheathed Slug	Red	SC	1-SC	Potential
Mammals	*Corynorhinus townsendii*	Townsend's Big-eared Bat	Blue		-	Potential

Type	Scientific Name	English Name	BC List	COSEWIC	SARA	Potential to occur
Mammals	*Lasionycteris noctivagans*	Silver-haired Bat	Yellow	E	-	Potential
Mammals	*Lasiurus cinereus*	Hoary Bat	Blue	E	-	Potential
Mammals	*Myotis ciliolabrum*	Western Small-footed Myotis	Blue	-	-	Potential
Mammals	*Myotis lucifugus*	Little Brown Myotis	Blue	E	1-E	Potential
Mammals	*Myotis thysanodes*	Fringed Myotis	Blue	DD	3	Potential
Mammals	*Myotis yumanensis*	Yuma Myotis	Blue	-	-	Potential
Mammals	*Neotamias minimus selkirki*	Least Chipmunk, *selkirki* subspecies	Red	-	-	Potential
Mammals	*Neotamias ruficaudus simulans*	Red-tailed Chipmunk, *simulans* subspecies	Blue	-	-	Known
Mammals	*Rangifer tarandus* pop. 1	Caribou (Southern Mountain Population)	Red	E	1-T	Potential
Mammals	*Taxidea taxus*	American Badger	Red	E	1-E	Potential
Mammals	*Thomomys talpoides segregatus*	Northern Pocket Gopher, *segregatus* subspecies	Red	-	-	Potential
Mammals	*Ursus arctos*	Grizzly Bear	Blue	SC	1-SC	Potential
Reptiles	*Charina bottae*	Northern Rubber Boa	Yellow	SC	1-SC	Potential
Reptiles	*Chrysemys picta* pop. 2	Painted Turtle - Intermountain - Rocky Mountain Population	Blue	SC	1-SC	Potential
Reptiles	*Coluber constrictor*	North American Racer	Blue	T	1-T	Potential

APPENDIX

B

KOOTENAY RIVER FISH

Scientific Name	English Name	BC List	COSEWIC	SARA
Ameiurus melaas	Black catfish	Exotic		
Hybognathus hankinsoni	Brassy minnow	No status		
Catostomus columbianus	Bridgelip sucker	Yellow		
Salvelinus fontinalis	Brook trout	Exotic		
Salmo trutta	Brown trout	Exotic		
Salvelinus confluentus	Bull trout	Blue	SC	
Lota lota pop. 1	Burbot	Red		
Various	Carp			
Various	Carp (general)			
*Oncorhynchys clarki*i ssp. *clarkii*	Coastal cutthroat trout*	Blue		
Cottus hubbsi	Columbia sculpin	Blue	SC	1-SC (2003)
Oncorhynchus clarkii	Cutthroat trout	No Status		
Various	Dace (general)			
Salvelinus malma	Dolly varden	Yellow		
	Fish - unidentifable species			
Oncorhynchus nerka	Kokanee	Not reviewed		
Coregonus clupeaformis	Lake whitefish	Yellow		
Micropterus salmoides	Largemouth bass	Exotic		
Catostomus macrocheilus	Largescale sucker	Yellow		
Rhinichthys falcatus	Leopard dace	Yellow	NAR	
Rhinichthys cataractae	Longnose dace	Yellow		
Catostomus catostomus	Longnose sucker	Yellow		
Cottus hubbsi	Mottled sculpin	Blue	SC	1-SC (2003)
Prosopium williamsoni	Mountain whitefish	Yellow		
Esox lucius	Northern pike	Yellow		
Ptychocheilus oregonensis	Northern pikeminnow	Yellow		
Mylocheilus caurinus	Peamouth chub	Yellow		
Cottus asper	Prickly sculpin	Yellow		
Lepomis gibbosus	Pumpkinseed	Exotic		
Prosopium coulterii	Pygmy whitefish	Yellow	NAR	
Oncorhynchus mykiss	Rainbow trout	Yellow		
Richardsonius balteatus	Redside shiner	Yellow		
Various	Sculpin (general)			
Cottus confusus	Shorthead sculpin	Blue	SC	1-SC
Micropterus dolomieu	Smallmouth bass	Exotic		
Various	Sucker (general)			
Tinca tinca	Tench	Exotic		
Gasterosteus aculeatus	Threespine stickleback	Yellow		
Cottus rhotheus	Torrent sculpin	Yellow		
Rhinichthys umatilla	Umatilla dace	Red	T	3 (2003)

Scientific Name	English Name	BC List	COSEWIC	SARA
Various	Unidentifiable trout			
Sander vitreus	Walleye	Yellow		
Oncorhynchus clarkii ssp. *lewisi*	Westslope (yellowstone) cutthroat trout	Blue	SC	1 - SC
Acipenser transmontanus pop. 1	White sturgeon	Red	E	1-E (2003)
Various	Whitefish (general)			
Anodonta californiensis/nuttalliana clade	Winged floater mussel	Yellow		
Perca flavescens	Yellow perch	Unknown		

APPENDIX

C

ACTS AND REGULATIONS FOR SMMP ACTIVITIES

ACT	DESCRIPTION	ADMINISTERING AGENCY
Federal		
Fisheries Act	Prohibits activities that may result in the death of fish or the harmful alteration, disruption or destruction of fish habitat unless authorized by DFO.	Oceans and Fisheries Cananda
Migratory Birds Convention Act (MBCA)	The Act protects the majority of Canada's migratory bird species. Pursuant to Section 6 of the Regulation, no person shall disturb, destroy or take a nest, egg, nest, shelter of a migratory bird; or be in possession of a migratory bird, dead, alive, a nest or eggs of a migratory bird except under a permit.	Environment and Climate Change Canada
Seed Act	Prohibits to the selling, importing or exporting of seeds that present a risk of harm to human, animal or plant health or the environment	Environment and Climate Change Canada
Species at Risk Act (SARA)	Intended to prevent the loss of wildlife in Canada, provide for the recovery of species that are extirpated, endangered, or threatened as a result of human activities, and to manage species of special concern. Administered on federal lands for the protection of threatened, endangered, and extirpated native species. Activities that may impact a SARA listed species or its habitat requires an approval under the Act.	Environment and Climate Change Canada; Canadian Wildlife Service Fisheries and Oceans Canada
Transportation of Dangerous Goods Act	The Act and associated regulations specify the prohibitions and necessary means of complying with the safe and legal handling, transporting, and containment of goods classified as dangerous under the Act.	Transport Canada
Provincial		
Environmental Management Act	Regulates industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation. Permits, regulations, and codes of practice are mechanisms under the Act for authorizing the discharge of waste into the environment. The Act provides enforcement options that encourage compliance.	Ministry of Water, Land, and Resource Stewardship
Heritage Conservation Act	The Act provides protection to archaeological sites in BC. Protected archaeological sites may not be altered or changed in any manner without a permit.	Ministry of Water, Land, and Resource Stewardship
Integrated Pest Management Act	Establishes requirements for the use and sale of pesticides in BC.	Ministry of Water, Land, and Resource Stewardship
Riparian Area Protection Act	The act and associated regulations provide for the protection of fish and fish habitat through the implementation of watercourse setbacks.	Ministry of Water, Land, and Resource Stewardship

ACT	DESCRIPTION	ADMINISTERING AGENCY
Water Sustainability Act	The Act manages the diversion and use of water resources in BC. Changes made in and about a feature regulated under the Act must be reviewed and an appropriate permit obtained.	Ministry of Water, Land, and Resource Stewardship
Weed Control Act	Requires the occupier of a property to control noxious weeds listed under the Act. Under the Weed Control Regulation no person shall move machinery or vehicles containing a noxious weed or knapweed.	Ministry of Water, Land, and Resource Stewardship
Wildfire Act	Contains prohibitions on activities that may lead to or exacerbate a wildfire.	Ministry of Water, Land, and Resource Stewardship
Wildlife Act	The Act affords protection and conservation of wildlife listed under the Act in BC.	Ministry of Water, Land, and Resource Stewardship
Municipal		
Drainage Bylaw No. 1417	Projects must comply with Section 6.0 of the bylaw, which includes restrictions on activities that alter or divert natural water courses.	Town of Creston
Fire Prevention and Hazard Control Bylaw No. 1931	Restricts activities that may contribute to a fire, including the disposal of flammable or explosive material, garbage and refuse containers, and combustible materials. Projects must also comply with the access / egress requirements of the bylaw.	Town of Creston
Noise Control Bylaw No. 1389	Restricts any noise that may disturb the quiet, peace, rest, enjoyment, comfort or convenience of the neighborhood or of persons in the vicinity to the hours of 7:00 am to 10:00 pm. For Sundays and statutory holidays, noise of that sort is restricted to 9:00 am and 5:00 pm.	Town of Creston

APPENDIX

D ASSUMED MANHOLE INFORMATION

Manhole ID	Invert Elev. (m)	Rim Elev. (m)	Depth (m)
2.0171E+13	631.00	633.05	2.05
2.01803E+13	668.30	669.95	1.65
2.01803E+13	667.00	668.90	1.90
2.01803E+13	660.50	662.10	1.60
2.01803E+13	659.80	661.40	1.60
2.01803E+13	611.50	614.30	2.80
2.02003E+13	630.00	633.00	3.00
2.02102E+13	646.00	648.55	2.55
2.02102E+13	613.55	616.00	2.45
2.02102E+13	614.55	616.00	1.45
2.02102E+13	615.55	617.00	1.45
2.02102E+13	616.55	618.00	1.45
2.02102E+13	617.55	619.00	1.45
2.02202E+13	549.70	551.12	1.42
2.02202E+13	549.00	551.14	2.14
2.02202E+13	559.70	561.18	1.48
2.02301E+13	635.00	637.36	2.36
J12	679.00	683.60	4.60
J13	679.50	684.07	4.57
J14	680.00	681.45	1.45
J15	686.00	688.38	2.38
J16	613.70	615.00	1.30
J18	616.00	617.20	1.20
J22	620.50	621.70	1.20
J23	559.00	560.70	1.70
J25	540.00	544.49	4.49
J26	592.50	594.63	2.13
J27	611.40	613.90	2.50
J3	555.00	558.70	3.70
J32	656.00	657.70	1.70

Manhole ID	Invert Elev. (m)	Rim Elev. (m)	Depth (m)
J35	541.00	543.00	2.00
J36	594.00	596.45	2.45
J38	654.80	656.92	2.12
J39	626.90	628.50	1.60
J41	609.00	611.95	2.95
STM-10034	622.00	624.50	2.50
STM-10045	598.00	602.00	4.00
STM-10056	629.00	631.30	2.30
STM-10057	626.00	628.20	2.20
STM-10058	611.00	613.30	2.30
STM-10059	611.20	613.50	2.30
STM-10060	612.00	614.30	2.30
STM-10061	612.30	614.60	2.30
STM-10062	613.50	615.70	2.20
STM-10088	592.40	594.95	2.55
STM-10095	593.50	595.30	1.80
STM-10099	586.30	587.69	1.39
STM-10100	586.20	587.38	1.18
STM-10206	563.85	567.00	3.15
STM-10214	556.66	565.20	8.55
STM-10225	557.00	559.29	2.29
STM-10230	561.00	563.17	2.17
STM-10253	620.00	621.60	1.60
STM-10266	550.00	552.00	2.00
STM-10354	627.80	628.50	0.70
STM-10357	627.70	629.93	2.23
STM-10391	607.00	609.46	2.46
STM-10397	615.00	617.10	2.10
STM-10404	615.80	617.60	1.80
STM-10405	615.00	616.60	1.60

Manhole ID	Invert Elev. (m)	Rim Elev. (m)	Depth (m)
STM-10434	595.00	598.00	3.00
STM-10496	624.00	626.35	2.35
STM-10497	625.00	628.98	3.98
STM-10498	626.00	629.59	3.59
STM-10499	633.00	636.10	3.10
STM-10511	638.00	640.00	2.00
STM-10513	653.20	654.77	1.57
STM-10514	658.20	659.95	1.75
STM-10515	660.00	661.68	1.68
STM-10516	611.00	613.00	2.00
STM-10556	549.50	551.12	1.62
STM-10625	653.70	655.97	2.27
STM-10626	654.45	656.75	2.30
STM-10643	610.50	613.50	3.00
STM-10663	618.00	620.67	2.67
STM-10664	612.58	613.84	1.26
STM-10670	609.00	610.25	1.25
STM-10671	609.41	610.33	0.92
STM-10680	624.80	625.74	0.94
STM-10681	619.30	620.25	0.95
STM-10682	618.30	619.24	0.94
STM-10683	615.00	615.98	0.98
STM-10684	612.20	613.00	0.80
STM-10685	613.90	614.78	0.88
STM-10686	617.70	618.72	1.02
STM-10687	617.90	618.90	1.00
STM-10704	613.00	615.00	2.00
STM-10705	627.00	629.20	2.20
STM-10707	613.50	615.00	1.50
STM-10708	612.80	614.90	2.10

Manhole ID	Invert Elev. (m)	Rim Elev. (m)	Depth (m)
STM-10726	581.50	585.40	3.90
STM-10727	583.11	584.50	1.39
STM-10728	583.01	584.40	1.39
STM-10744	583.21	584.80	1.59
STM-10750	630.00	631.70	1.70
STM-10751	631.00	632.60	1.60
STM-10752	638.00	640.50	2.50
STM-10761	630.20	631.37	1.17
STM-10763	609.80	611.53	1.73
STM-10764	609.50	611.77	2.27
STM-10765	609.80	611.78	1.98
STM-10771	609.90	611.72	1.82
STM-10778	621.00	623.40	2.40
STM-10779	620.75	621.70	0.95
STM-10780	620.70	622.00	1.30
STM-10781	620.30	621.00	0.70
STM-10782	620.20	620.90	0.70
STM-10790	600.00	603.00	3.00
STM-10793	606.00	607.50	1.50
STM-10805A	627.00	629.90	2.90
STM-10810A	633.80	635.40	1.60
STM-10811A	623.30	625.80	2.50
STM-10812A	625.30	627.80	2.50
STM-10813A	630.90	633.90	3.00
STM-10824	633.50	636.19	2.69
STM-10825	632.80	635.78	2.98
STM-10827	632.50	635.28	2.78

APPENDIX

E

PUBLIC WORKS ENGAGEMENT AND SITE WALK MEMO

Memo

To: Colin Farynowski, Town of Creston

From: Joshua Maxwell, WSP Canada Inc.

Cc: Kristel Unterschultz, Ashmeet Singh Muker

Ref: Creston Stormwater Management Master Plan

Date: 2025-08-15

Subject: August 13th Site Walk Notes

On Aug 13th, Joshua Maxwell (WSP) and Colin Farynowski (Town of Creston) interviewed Public Works staff from the Town of Creston and completed a field inspection of various identified locations of the Town of Creston's Stormwater System. This is a brief memo summarizing the interview and inspection.

Public Works Interview

Staff in attendance:

- Joshua Maxwell, WSP
- Colin Farynowksi, Town of Creston
- Bob Bergman, Town of Creston
- Lee Spetifore, Town of Creston
- Tyler Grant, Town of Creston
- Andy, Town of Creston
- Mark Will, Town of Creston
- Mike Hillerman, Town of Creston
- Jesse Collins, Town of Creston
- Brent Vader, Town of Creston

Issues identified by Public Works Staff:

- Erosion along Valleyview Drive.

- Flooding on Highway 3 and Regina Street
- Multiple locations where CB pop off during storm events. Staff shared anecdotal stories about parking trucks or standing on top of manhole covers trying to keep them in place.
- Multiple issues with freeze/thaw flooding along Canyon Street in the downtown area.
- Historically a house was flooded at 5th Ave and Canyon (Location 9) a barrier curb was installed to alleviate this.
- Josh to verify how the 4-way piping works in the intersection of 20th Ave N and Crawford Street.
- Historical issues with blockages of culverts along Dodd's Creek, they've installed Grizzlies to cope with this. Josh and Colin later visited a culvert on Dodd's Creek and Colin showed how surrounding branches from trees were falling off in storms and blocking culvert inlets.
- Pond previously recommended at Kinsmen Park → Refer to Elise's study.
- Past issues with hill side runoff entering properties along 25th Ave S near Erikson.

Location 1. Pine and 4th Avenue

- There maybe an easement between 119 and 123 – 4th Ave. Draining out through this easement is the most straight forward solution. However, on the downhill side is a mobile home park, routing through this maybe difficult.
- Colin to confirm the existence of an easement here and whether drainage can route through here.
- The other option is regrading of the Avenue to the north, but the cuts will be substantial.



Figure 1.0. Looking between 123 (right) and 119 (left)

Location 2. Erickson Road

Site visit confirmed that there was poor containment of major drainage on the south side of the road. However, we now understand that the Town is not responsible for this roadway, it is the responsibility of the province. Our report can note the issue here but won't recommend upgrades.

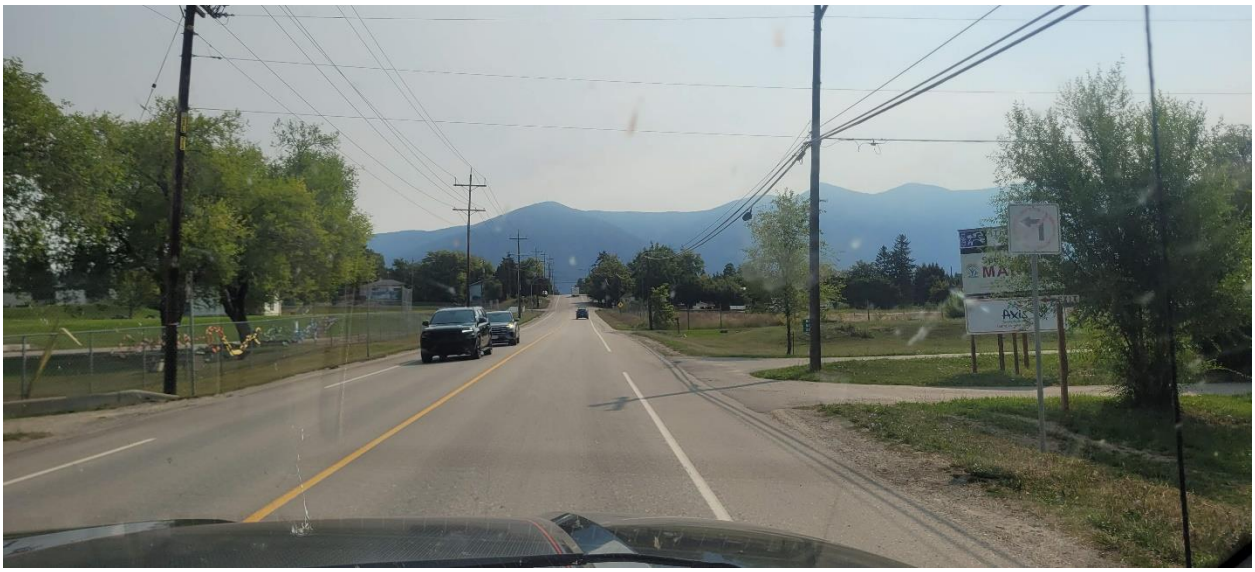


Figure 2.0. View driving east on Erickson Road at Centennial Park.

Location 3. Cook Street

-Conditions in the field matched those identified on the desktop.

-Canyon Street is managed by the Ministry, Creston still owns/manages the piping.

-Stormwater storage, or significant increases in capacity are necessary to resolve this problem (the entire area currently drains to a 300mm pipe.

-A project is in the planning stages which will provide an opportunity to resolve these issues the details are confidential at this time and can't appear in the public document.

-No culverts were noted under the railway. The railway was shallow graded and major flows probably briefly overtops it.



Figure 3.0. View looking east on Cook Street. The flows are expected to the overtopped the road in this location and drain to the south (right) in this location.

Location 4. 20th Ave S and Elm Street

- The flows currently pool in this intersection and will flood to the south into lots.

-There is a sidewalk which is poorly graded and in poor condition. Recommend to reconstruct the sidewalk with a probably curb to route flow the creek.



Figure 4.0. View looking south along 20th Avenue S, towards Dodd Street. The sideway shown in the photo is flat and flush with the roadway, there is no existing curb.

Location 5. 7th Avenue – Duggan to Cedar Street

-Grading at 407 7 Ave S appears to permit runoff to escape the right of way and drains through this lot. There does not appear to be structures blocking this drainage at this however, this is a private property, and it would be preferred to keep drainage in the right of way to avoid potential future property damage.

-Regrade road right of way (about 2m into lots), matching the grades at the driveways. This should contain major drainage sufficiently to route flows downstream.

-Regrading the curbline did not seem feasible here.



Figure 5.0. View looking south along 7th Ave. The grade break can be seen at the driveway in the photo (the drive drains into the street, the grassed/gravel area slopes away from the street.

Location 6. 24th Ave S and Ash Street

-There is a deep sag in the street at this location.

-WSP will review and offer both options in the report, regrade street or over size piping.



Figure 6.0 Drainage currently overflows the right of way and sheets into the lots shown in the picture.

Location 7. Murdoch Street, 14th Ave to 16th Ave

-A pipe drains this area, it is assumed that there is an easement in this location.

-Suggested improvement is to regrade easement, this may comprise the cover on the pipe in the easement. Alternatively, a 2nd pipe and catch basin could be added here.



Figure 7.0. Murdoch Street between 1510 and Willow Place, showing the assumed right of way and pipe which drains under the gravelled area.

Location 8. Ibbitson Street at 11th Ave

-It appears that there is already a drainage way here. The pathway is swaled and looks reasonably capable of conveying flows.

-No improvements required here, we would prefer the swale was more defined, but this generally appears to function.

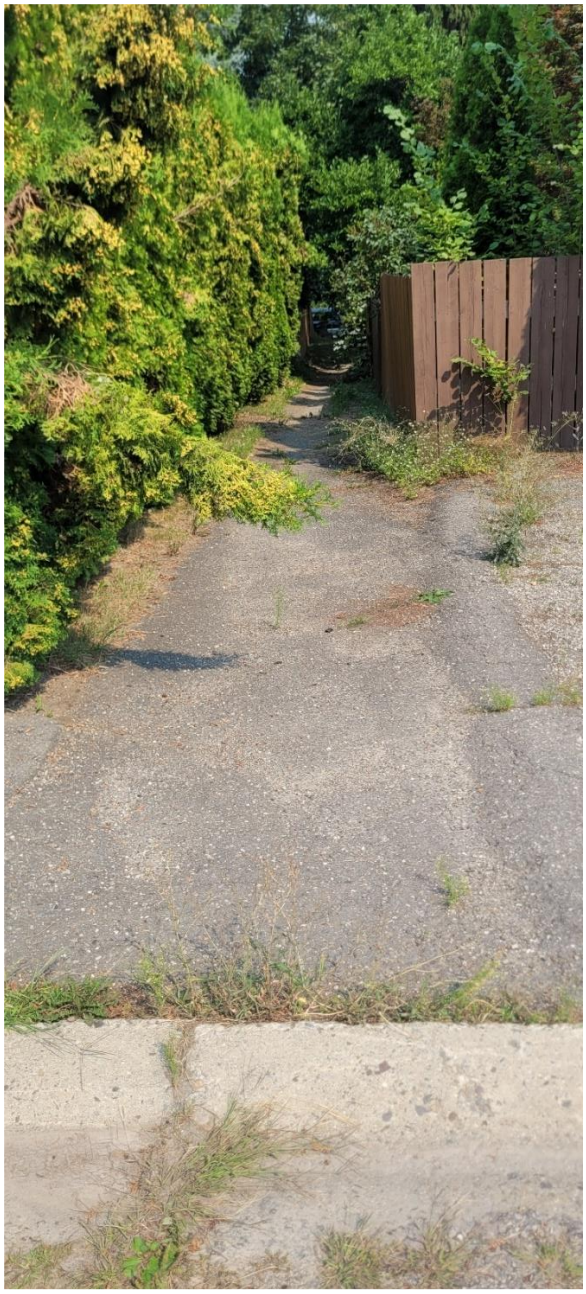


Figure 8. Drainage way on the east side of 1110 Ibbitson Street.

Location 9 (new). 5th Avenue and Canyon

-Colin identified issues with poor drainage in this location. The curb line in front of 124 5th Avenue S does properly conveys drainage.

-It appears to be possible to regrade the curbline and improve drainage here.

-I'm using a streetview picture in this location because my personal photos don't show it as well.



Figure 9.0. Poor drainage in front of 124 5th Avenue S. Curb ends as shown in the photo. The curb should regraded/installed.

Location 10 (new). 518 – 16th Ave S

This property is essentially in a depression and is dependent upon a heavily vegetated inlet. The Town can't likely solve the major drainage issue here, but we will recommend the outlet is maintained.



Figure 10.0. 518 – 16th Ave S is significantly below the street level and is dependent upon an inlet in the bottom left of this photo.

Location 11 (new). 20th Ave and Ash Street

Drainage concerns were noted here in a similar manner to others identified, no major overland route. There maybe an easement adjacent 610 20 Ave S.

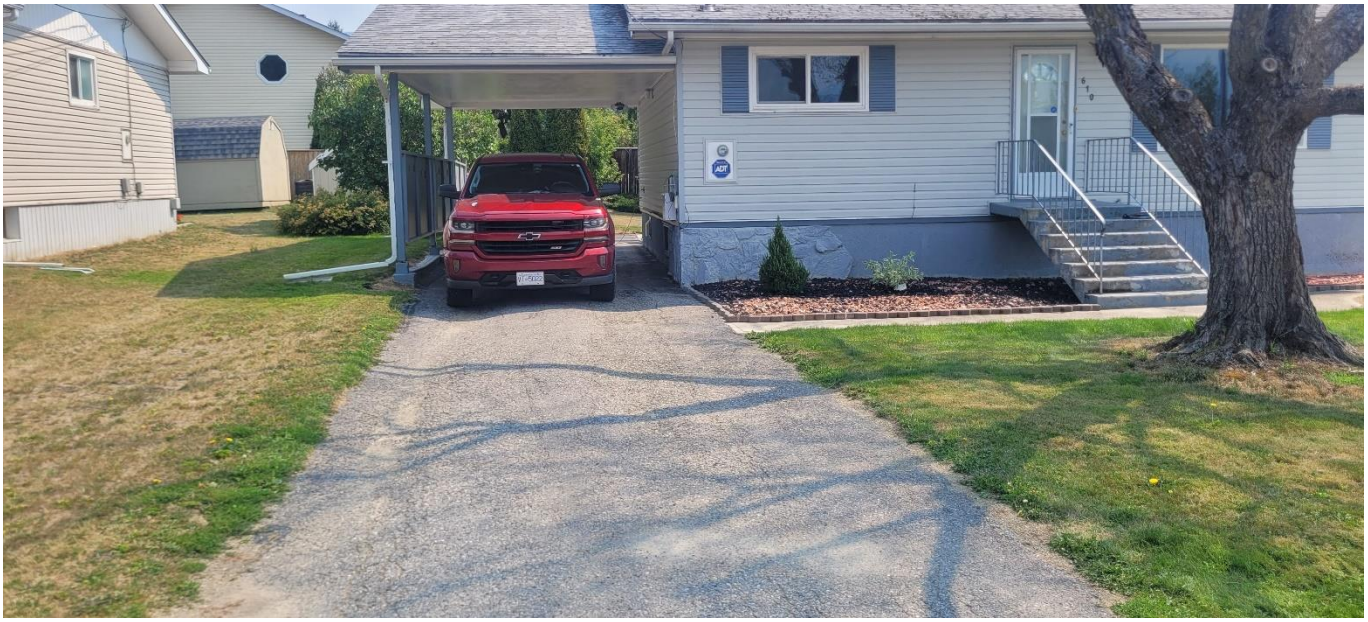


Figure 11.0. Possible drainage easement under carport at 610 – 20 Ave S.

Location 12. Possible Pond at Schikurski Park

Colin identified this site as a potential location for a pond. WSP will review the grading in the area and make a recommendation.



Figure 12.0 There is a low lying area here which could be further expanded to improve retention/detention of runoff.

APPENDIX

F

PROJECTS OPC

Town of Creston - Stormwater Management Master Plan
Opinion of Probable Costs

Date: 2026-01-28

ID	Description	Units	Quantity	Unit Price	Amount
	CULVERT UPSIZING				
C.1	Upsize existing culvert to 1800 mm (25th Ave and Dodd's Creek)	m	45	$9,000.00	$405,000.00
C.2	Upsize existing culvert to 1600 mm (Payne Street and Glaser/King Creek)	m	22	$9,900.00	$217,800.00
C.3	Upsize existing culvert to 1400 mm (Devonshire Meadows and Glaser/King Creek)	m	13	$12,300.00	$159,900.00
C.4	Upsize existing culvert to 1400 mm (Devon St. and Glaser/King Creek)	m	22	$9,500.00	$209,000.00
C.5	Upsize existing culvert to 1400 mm (Cavell St. and Glaser/King Creek)	m	22	$9,500.00	$209,000.00
C.6	Upsize existing culvert to 2700 mm (Canyon St. and Dodd's Creek)	m	62	$10,600.00	$657,200.00
C.7	Upsize existing culvert to 2700 mm (5th Ave. and Dodd's Creek)	m	33	$12,500.00	$412,500.00
C.8	Upsize existing culvert to 2400 mm (8th/9th Ave. and Dodd's Creek)	m	135	$15,000.00	$2,025,000.00
C.9	Upsize existing culvert to 2400 mm (11th Ave. and Dodd's Creek)	m	45	$12,000.00	$540,000.00
C.10	Upsize existing culvert to 2400 mm (Railway ROW/16th Ave. and Dodd's Creek)	m	259	$9,000.00	$2,331,000.00
C.11	Upsize existing culvert to 2200 mm (20th Ave. and Dodd's Creek)	m	37	$11,000.00	$407,000.00
C.12	Upsize existing culvert to 1800 mm (24th Ave. and Dodd's Creek)	m	54	$9,000.00	$486,000.00
C.13	Upsize existing culvert to 1200 mm (Schikurski Park and Glaser/King Creek)	m	14	$1,100.00	$15,500.00
			CULVERT UPSIZING	**Sub-Total:**	**$8,074,900.00**
	OVERLAND IMPROVEMENTS				
O.1	Pine St & 4th Ave N				
O.1.1	Maintaining/Regrading the existing conveyance channel in the easement	m^2	240	$25.00	$6,000.00
			Pine St & 4th Ave N	**Sub-Total:**	**$6,000.00**
O.2	20th Ave S & Elm Street				
O.2.1	Localized surface regrading	m^2	350	$25.00	$9,000.00
O.2.2	Install concrete swale	m	60	$450.00	$27,000.00
O.2.3	Surface removals (cuts)	m^3	420	$40.00	$17,000.00
			20th Ave S & Elm Street	**Sub-Total:**	**$53,000.00**
O.3	7th Ave S				
O.3.1	Localized surface regrading	m^2	200	$25.00	$5,000.00
			7th Ave S	**Sub-Total:**	**$5,000.00**
O.4	24th Ave S				
O.4.1	Localized surface regrading	m^2	540	$25.00	$13,500.00
O.4.2	Surface removals (cuts)	m^3	648	$40.00	$26,000.00
O.4.3	Property-level drainage protection (allowance)	l.s.	1	$10,000.00	$10,000.00
			24th Ave S	**Sub-Total:**	**$49,500.00**
O.5	Murdoch Street				
O.5.1	Localized surface regrading	m^2	400	$25.00	$10,000.00
			Murdoch Street	**Sub-Total:**	**$10,000.00**
O.6	Ibbitson Street				
O.6.1	Regrading/Maintenance of existing conveyance channel next to property	ea.	1	$5,000.00	$5,000.00
			Ibbitson Street	**Sub-Total:**	**$5,000.00**
O.7	5th Ave S (near Canyon St)				
O.7.1	Localized surface regrading	m^2	450	$25.00	$11,500.00
O.7.2	Install standard curb and gutter	m	17	$250.00	$4,500.00
O.7.3	Surface removals (cuts)	m^3	450	$40.00	$18,000.00
			5th Ave S (near Canyon St)	**Sub-Total:**	**$34,000.00**
O.8	20th Ave S (610 20th Ave S)				
O.8.1	Regrading/Maintenance of existing conveyance channel next to property	ea.	1	$5,000.00	$5,000.00
			20th Ave S (610 20th Ave S)	**Sub-Total:**	**$5,000.00**
O.9	16th Ave S (518 16th Ave S)				
O.9.1	Improve inlet maintenance / vegetation clearing (annual)	ea.	1	$5,000.00	$5,000.00
			16th Ave S (518 16th Ave S)	**Sub-Total:**	**$5,000.00**

Town of Creston - Stormwater Management Master Plan
Opinion of Probable Costs

Date: 2026-01-28

ID	Description	Units	Quantity	Unit Price	Amount
	DOWNTOWN SYSTEM ENHANCEMENTS				
D.1	**Cook Street**				
D.1.1	Linear bioswale / bioretention swale (excavate, media, underdrain, planting, rock inlet)	m	325	$1,000.00	$325,000.00
D.1.2	450mm Culvert	m	40	$600.00	$24,000.00
D.1.3	Overland and piped connections to Cook and Canyon Street System	L.S.	1	$100,000.00	$100,000.00
D.1.4	Design/permits/environmental assessment	l.s.	1	$50,000.00	$50,000.00
			Cook Street	**Sub-Total:**	**$500,000.00**
D.2	**Canyon Street — LID & Streetscape Upgrade (Optional)**				
D.2.1	Linear bioswale / bioretention swale (excavate, media, underdrain, planting, rock inlet)	m	350	$1,000.00	$350,000.00
D.2.2	Bioretention cell / rain garden (intersection-scale, 20–40 m^2)	ea.	4	$18,000.00	$72,000.00
D.2.3	Permeable paving (parking bays / path) incl. base & edge	m^2	700	$150.00	$105,000.00
D.2.4	Tree pits / structural soil cells (incl. tree supply & planting)	ea.	50	$3,500.00	$175,000.00
D.2.6	Soil media (supply & placement) allowance	m^3	500	$65.00	$32,500.00
D.2.7	Plant establishment & 3-year maintenance allowance	l.s.	1	$45,000.00	$45,000.00
D.2.8	Design/permits/environmental assessment	l.s.	1	$100,000.00	$100,000.00
D.2.9	Mobilization, traffic control, planting season premiums	l.s.	1	$15,000.00	$15,000.00
			Canyon Street — LID & Streetscape Upgrade (Optional)	**Sub-Total:**	**$900,000.00**
	NEW DEVELOPMENT (DCC UPGRADES)				
N.1	**Devon Street**				
N.1.1	New 750 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	340	$1,900.00	$646,000.00
			Devon Street	**Sub-Total:**	**$646,000.00**
N.2	**Cavell St to Devon St**				
N.2.1	New 300 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	235	$820.00	$193,000.00
N.2.2	New 450 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	45	$1,080.00	$49,000.00
			Cavell St to Devon St	**Sub-Total:**	**$242,000.00**
N.3	**Glaser Drive**				
N.3.1	New 300 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	370	$820.00	$303,500.00
N.3.2	New 450 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	520	$1,080.00	$562,000.00
N.3.3	New 525 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	100	$1,270.00	$127,000.00
N.3.4	New 750 mm storm pipe (open cut, incl. bedding, backfill, restoration)	m	75	$1,900.00	$142,500.00
N.3.5	Subgrade Prep (300mm deep)	m^2	11125	9.2	$102,500.00
N.3.6	300mm of 80mm Crushed Granular Sub-Base, Roadway	m^2	11125	30	$334,000.00
N.3.7	100mm of 25mm Crushed Granular Base, Roadway	m^2	11125	24	$267,000.00
N.3.8	100mm of Asphalt Mix	m^2	11125	80	$890,000.00
N.3.9	Install standard curb and gutter	m	1780	$250.00	$445,000.00
			Glaser Drive	**Sub-Total:**	**$3,173,500.00**
N.4	**Glaser/King Creek Re-channelization**				
N.4.1	Re-channelization of existing creek	m^3	2670	$50.00	$133,500.00
N.4.2	Design/permits/environmental assessment	l.s.	1	$50,000.00	$50,000.00
			Glaser/King Creek Re-channelization	**Sub-Total:**	**$183,500.00**
	GENERAL IMPROVEMENTS				
G.1	**Convert existing manhole lids to catch basin-style lids (CB lids) to relieve pressure**	l.s.	1	$50,000.00	$50,000.00
				Sub-Total:	**$50,000.00**
				All Tasks Sub-Total:	**$13,942,500.00**
				Contingency (30%)	**$4,183,000.00**

APPENDIX

G

FUTURE UPGRADES PIPE SIZING TABLE

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
20170315110633	119.64	200	0.035	300	0.104
20171005095423	32.84	200	0.104	300	0.306
20171011131710	68.49	300	0.195	300	0.195
20171012105043	48.88	300	0.263	300	0.263
20180306100528	31.79	300	0.340	375	0.616
20180306102507	10.75	150	0.063	300	0.399
20180306103107	72.48	200	0.122	300	0.361
20180306105955	55.35	250	0.079	300	0.129
20180306110131	65.14	300	0.276	300	0.276
20180306134245	32.99	200	0.064	300	0.189
20180306134551	72.69	200	0.014	300	0.042
20200302100804	42.41	450	0.751	375	0.462
20200302101509	45.28	450	0.707	450	0.707
20200302112118	76.40	525	1.065	600	1.521
20200302135250_1	24.61	375	0.741	300	0.409
20200302135250_2	19.03	375	0.361	300	0.199
20200306114306	115.26	200	0.092	300	0.272
20210208095106	34.84	200	0.099	375	0.527
20210208095328	50.62	200	0.112	300	0.330
20210208095424	64.33	200	0.106	300	0.314
20210208095540	47.57	150	0.042	300	0.267
20210218091634	14.06	300	0.175	525	0.779
20210218091834	103.04	300	0.193	450	0.568
20210218092034	57.75	300	0.195	300	0.195
20210218113955	29.71	200	0.115	300	0.340
20210225101106	59.51	375	0.199	1050	3.102
20210225111616	51.99	375	0.287	1050	4.476
20210225111647	41.15	375	0.323	1050	5.032
20210225111711	44.02	375	0.312	1050	4.864
20210225111736	35.89	375	0.346	1050	5.387
20210225111819	32.00	300	0.205	1050	5.791
20220228112100	4.22	250	0.108	300	0.176
20220228112614	48.78	450	0.348	1050	3.329
20220228115142	88.28	200	0.131	300	0.386
20230127115300	74.93	200	0.122	300	0.359
20240206160242	60.82	300	0.285	300	0.285
20240206160644	101.15	200	0.150	300	0.444
20240327151353ds	1.67	375	0.720	1050	11.208
C1_1	10.84	200	0.096	450	0.832
C1_2	117.52	200	0.082	600	1.539
C10	131.19	450	0.688	1500	17.065
C11	89.57	750	3.633	750	3.633

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
C12	105.88	200	0.096	300	0.284
C13	69.88	250	0.072	375	0.213
C14	97.15	300	0.536	300	0.536
C2	32.97	450	1.124	300	0.381
C204	43.46	200	0.085	450	0.742
C205	43.88	200	0.083	600	1.546
C23	38.53	1000	5.196	300	0.210
C27	32.74	250	0.247	300	0.401
C3	38.10	200	0.129	300	0.381
C314	72.68	250	0.234	375	0.689
C315	23.76	250	0.172	450	0.826
C320	64.00	375	0.399	450	0.648
C4	12.02	300	0.382	300	0.382
C5	43.12	200	0.078	300	0.231
C6	110.44	250	0.088	450	0.424
C7	122.67	200	0.025	300	0.073
C8	77.94	300	0.497	300	0.497
C9	53.98	750	1.266	1050	3.105
STM-10000	194.83	450	0.642	750	2.505
STM-10001	8.23	300	0.218	375	0.396
STM-10002	115.87	450	1.091	750	4.260
STM-10003	14.99	350	0.263	750	2.010
STM-10004	63.60	200	0.035	300	0.104
STM-10005	80.76	200	0.056	300	0.164
STM-10006	19.67	200	0.033	300	0.096
STM-10007	79.50	200	0.026	450	0.223
STM-10008	92.74	200	0.039	450	0.343
STM-10009	81.88	200	0.049	300	0.145
STM-10010	173.90	200	0.084	300	0.248
STM-10011	215.91	200	0.102	300	0.300
STM-10012	50.11	300	0.177	375	0.321
STM-10013	36.01	300	0.170	450	0.502
STM-10014	15.56	300	0.130	525	0.576
STM-10015	110.83	300	0.137	750	1.576
STM-10016	156.30	650	0.618	900	1.471
STM-10018	292.18	650	3.616	900	8.613
STM-10019	129.41	200	0.084	300	0.247
STM-10020	89.67	200	0.070	300	0.207
STM-10021	80.32	200	0.111	300	0.327
STM-10022	88.89	250	0.231	600	2.387
STM-10023	96.09	250	0.219	450	1.051
STM-10024	97.39	200	0.080	375	0.427

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10025	52.23	200	0.104	300	0.307
STM-10026	46.91	200	0.057	300	0.167
STM-10029	2.64	650	1.106	900	2.635
STM-10030_1	33.58	200	0.051	300	0.151
STM-10030_2	45.24	200	0.096	375	0.511
STM-10031	106.88	200	0.123	525	1.617
STM-10032	86.69	200	0.110	300	0.325
STM-10033	116.86	200	0.105	300	0.309
STM-10067	49.39	450	0.381	375	0.234
STM-10068	102.87	400	0.287	375	0.242
STM-10069	42.07	400	0.120	825	0.828
STM-10071	9.29	450	0.350	525	0.527
STM-10072	78.97	450	1.149	450	1.149
STM-10073	131.39	450	0.294	750	1.148
STM-10074	24.37	450	0.380	525	0.573
STM-10075	21.49	450	0.436	525	0.658
STM-10076	14.67	450	0.341	450	0.341
STM-10077	36.05	450	0.401	450	0.401
STM-10078	36.62	450	0.310	375	0.191
STM-10079	25.11	400	0.273	375	0.230
STM-10080	40.97	450	0.447	375	0.275
STM-10081	112.59	300	0.247	300	0.247
STM-10082	55.85	250	0.071	300	0.115
STM-10083	108.77	300	0.231	300	0.231
STM-10087	20.00	450	0.301	525	0.455
STM-10105	79.63	200	0.080	300	0.237
STM-10106_1	75.02	200	0.134	300	0.394
STM-10106_2	39.29	250	0.177	450	0.851
STM-10107	72.10	200	0.152	300	0.448
STM-10108	39.16	200	0.114	300	0.337
STM-10109	64.17	200	0.041	300	0.122
STM-10110	77.96	250	0.056	300	0.091
STM-10111	100.21	450	0.395	525	0.596
STM-10112	43.71	600	0.636	750	1.154
STM-10113	29.27	600	0.629	675	0.861
STM-10114	41.74	175	0.088	300	0.372
STM-10115	71.42	175	0.068	300	0.287
STM-10116	55.45	600	1.829	600	1.829
STM-10117	67.35	200	0.129	300	0.380
STM-10118	68.23	250	0.060	300	0.098
STM-10119	10.37	200	0.071	300	0.210
STM-10120	51.29	375	0.199	300	0.110

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10123	51.35	200	0.035	750	1.204
STM-10124	102.81	200	0.104	300	0.306
STM-10125	116.17	200	0.024	675	0.612
STM-10126	47.96	200	0.055	300	0.163
STM-10127	24.47	200	0.107	300	0.315
STM-10128_1	16.30	250	0.190	525	1.375
STM-10128_2	44.56	250	0.122	825	2.943
STM-10129	49.27	200	0.056	300	0.164
STM-10130	61.28	250	0.048	525	0.344
STM-10131	65.64	200	0.041	300	0.120
STM-10132	60.39	200	0.072	300	0.214
STM-10133	72.43	200	0.094	375	0.502
STM-10134	56.81	200	0.077	300	0.227
STM-10135	52.62	200	0.069	300	0.205
STM-10136	69.52	200	0.021	300	0.061
STM-10137	73.84	200	0.123	375	0.655
STM-10138	88.32	200	0.096	300	0.284
STM-10139	58.54	200	0.085	300	0.250
STM-10140	60.39	200	0.084	300	0.247
STM-10143	38.15	200	0.055	375	0.293
STM-10144	55.93	200	0.019	375	0.100
STM-10145	121.34	200	0.099	300	0.292
STM-10146	27.03	250	0.047	300	0.076
STM-10147	41.17	250	0.095	300	0.155
STM-10148	68.36	200	0.046	300	0.135
STM-10149	82.38	150	0.019	300	0.123
STM-10150	52.60	200	0.128	300	0.378
STM-10151	78.53	200	0.061	300	0.180
STM-10152	81.60	200	0.100	300	0.294
STM-10153	15.34	200	0.074	375	0.396
STM-10154	91.70	250	0.087	375	0.255
STM-10155	14.38	300	0.495	300	0.495
STM-10156	226.80	300	0.325	525	1.444
STM-10157	25.75	600	1.011	1200	6.421
STM-10158	29.30	600	1.153	1200	7.323
STM-10159	72.88	600	0.601	1200	3.816
STM-10160	41.31	500	0.529	975	3.138
STM-10161	116.89	500	1.386	825	5.268
STM-10162	5.35	400	1.525	825	10.514
STM-10163	123.25	350	0.564	825	5.555
STM-10164	170.57	350	0.339	825	3.341
STM-10165	127.20	300	0.101	825	1.496

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10166	33.66	300	0.197	300	0.197
STM-10167	20.28	200	0.086	300	0.254
STM-10169	92.64	250	0.083	375	0.245
STM-10170	55.32	300	0.130	300	0.130
STM-10171	41.72	250	0.110	300	0.180
STM-10172	50.46	250	0.048	450	0.232
STM-10174	15.13	450	0.751	300	0.255
STM-10175	7.51	200	0.045	300	0.132
STM-10176	29.83	150	0.039	300	0.249
STM-10177	17.63	250	0.120	450	0.573
STM-10182	1.89	350	0.519	825	5.105
STM-10187	36.12	200	0.119	300	0.351
STM-10188	112.46	375	0.143	300	0.079
STM-10189	60.27	525	1.204	450	0.798
STM-10190_2	129.23	450	0.869	450	0.869
STM-10190_3	29.78	200	0.050	300	0.148
STM-10190_4	88.87	375	0.596	300	0.329
STM-10192	118.08	300	0.203	450	0.597
STM-10193	109.81	500	1.368	825	5.202
STM-10194	41.08	300	0.130	300	0.130
STM-10195	7.62	250	0.125	1200	8.181
STM-10272	84.57	250	0.082	300	0.134
STM-10273	97.71	300	0.310	375	0.561
STM-10274	8.78	450	0.301	750	1.175
STM-10275	99.77	200	0.152	600	2.847
STM-10276	178.94	200	0.096	300	0.284
STM-10277	96.71	200	0.053	300	0.156
STM-10278	126.37	375	0.569	300	0.314
STM-10279_2	19.00	300	0.311	300	0.311
STM-10280_1	43.39	375	0.551	450	0.896
STM-10281	54.23	500	0.514	1200	5.310
STM-10282	22.39	450	0.363	1050	3.477
STM-10283	44.16	200	0.110	375	0.590
STM-10284	9.96	500	0.245	1800	7.453
STM-10285	39.51	450	0.379	750	1.480
STM-10286	23.06	450	0.566	525	0.853
STM-10287	163.17	650	0.222	1050	0.797
STM-10288	78.75	250	0.035	300	0.058
STM-10289	28.93	250	0.117	300	0.190
STM-10290	17.38	250	0.160	3053	126.549
STM-10291	146.12	250	0.168	300	0.274
STM-10292	115.38	300	0.181	300	0.181

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10293	205.26	200	0.101	300	0.299
STM-10294	101.93	200	0.048	300	0.141
STM-10295	90.65	300	0.194	450	0.571
STM-10296	101.44	300	0.175	300	0.175
STM-10299	104.22	200	0.050	300	0.149
STM-10300	105.05	200	0.045	300	0.133
STM-10301	28.42	300	0.155	1500	11.356
STM-10302	82.52	300	0.109	300	0.109
STM-10304	136.88	200	0.069	375	0.370
STM-10305	129.95	300	0.193	375	0.351
STM-10306	60.85	350	0.221	525	0.652
STM-10307	74.48	300	0.139	450	0.409
STM-10308	83.08	600	0.876	300	0.138
STM-10309	46.83	350	0.163	600	0.687
STM-10310	116.57	600	1.168	600	1.168
STM-10311	98.03	250	0.275	300	0.447
STM-10312	66.11	400	0.408	450	0.559
STM-10313	48.96	300	0.106	300	0.106
STM-10314	32.58	300	0.142	300	0.142
STM-10315	18.96	300	0.083	300	0.083
STM-10316	34.65	200	0.057	300	0.168
STM-10317	68.90	200	0.084	300	0.249
STM-10318	65.07	200	0.124	300	0.366
STM-10319	78.39	200	0.106	300	0.313
STM-10320	107.00	600	1.071	750	1.942
STM-10321	19.29	300	0.156	450	0.460
STM-10322	19.75	300	0.109	450	0.322
STM-10323	35.99	200	0.051	600	0.960
STM-10325	48.29	300	0.172	675	1.493
STM-10326	61.14	250	0.096	300	0.157
STM-10327	53.48	250	0.165	300	0.269
STM-10329	93.31	300	0.324	300	0.324
STM-10331	55.97	600	0.400	1050	1.779
STM-10332	20.98	400	0.228	450	0.312
STM-10333_1	7.14	200	0.138	1050	11.505
STM-10333_2	22.01	600	0.489	2100	13.807
STM-10334	54.51	200	0.038	750	1.297
STM-10335	5.21	450	0.330	1200	4.514
STM-10336	77.77	300	0.177	600	1.125
STM-10339	44.31	200	0.025	300	0.075
STM-10340	134.44	200	0.044	375	0.235
STM-10341	124.49	250	0.101	375	0.297

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10342	2.70	300	1.004	375	1.820
STM-10344	56.96	300	0.128	675	1.109
STM-10345_1	268.25	400	0.604	300	0.281
STM-10414_1	31.68	450	1.480	1500	36.691
STM-10414_2	61.69	450	0.961	1500	23.822
STM-10415	111.53	300	0.244	300	0.244
STM-10416	76.07	300	0.236	375	0.428
STM-10417	81.69	300	0.262	300	0.262
STM-10418	89.02	200	0.097	300	0.286
STM-10419	96.98	300	0.285	375	0.517
STM-10420	147.73	250	0.126	300	0.205
STM-10421	42.55	250	0.277	375	0.816
STM-10422	51.13	250	0.119	300	0.194
STM-10423	108.93	250	0.072	300	0.116
STM-10424	48.26	200	0.051	300	0.150
STM-10425	52.82	200	0.065	300	0.193
STM-10426	31.56	200	0.060	300	0.177
STM-10427	83.66	450	0.667	1500	16.548
STM-10428	194.36	300	0.355	375	0.645
STM-10429	27.90	300	0.562	450	1.658
STM-10430	20.98	250	0.492	300	0.801
STM-10431	69.76	450	1.705	1500	42.284
STM-10454	48.78	300	0.200	450	0.589
STM-10455	75.45	300	0.167	300	0.167
STM-10456	188.90	300	0.365	525	1.625
STM-10457	52.31	200	0.137	300	0.404
STM-10458	91.24	200	0.057	300	0.169
STM-10459	75.28	200	0.128	300	0.376
STM-10460	67.95	300	0.238	300	0.238
STM-10461	62.33	200	0.118	300	0.348
STM-10462	62.12	300	0.325	450	0.957
STM-10463	57.04	300	0.203	300	0.203
STM-10464	108.24	250	0.171	600	1.770
STM-10465	102.36	250	0.156	675	2.203
STM-10466	88.29	300	0.193	750	2.223
STM-10467	63.17	200	0.138	300	0.408
STM-10468	26.22	250	0.137	300	0.223
STM-10469	41.39	200	0.060	300	0.178
STM-10470	122.78	250	0.183	300	0.297
STM-10471	85.58	375	0.346	750	2.199
STM-10472	20.81	250	0.130	375	0.383
STM-10473	72.78	450	0.407	975	3.197

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10474	100.81	450	0.428	1050	4.104
STM-10475	56.21	250	0.073	300	0.118
STM-10476	73.50	200	0.069	450	0.602
STM-10477	78.63	250	0.082	300	0.134
STM-10478	111.85	250	0.078	1050	3.598
STM-10480	32.20	250	0.050	450	0.240
STM-10481	8.84	250	0.164	600	1.692
STM-10482	45.93	200	0.115	375	0.614
STM-10483	106.41	450	0.478	825	2.406
STM-10484	105.98	300	0.217	525	0.966
STM-10485	98.47	300	0.142	900	2.650
STM-10486	110.26	250	0.124	525	0.897
STM-10487	91.26	200	0.146	300	0.431
STM-10524	68.92	250	0.212	450	1.018
STM-10525_1	9.74	250	0.101	450	0.483
STM-10525_2	8.09	250	0.175	450	0.839
STM-10528	95.56	250	0.098	300	0.160
STM-10529	81.93	250	0.091	300	0.148
STM-10530	71.82	250	0.184	300	0.299
STM-10531	97.72	250	0.195	300	0.316
STM-10532	107.22	300	0.350	300	0.350
STM-10533	91.95	300	0.288	300	0.288
STM-10534	90.54	300	0.323	375	0.585
STM-10535	26.88	300	0.096	600	0.610
STM-10536	74.17	375	0.368	825	3.014
STM-10537	16.48	300	0.123	525	0.546
STM-10538	102.66	250	0.065	675	0.920
STM-10539	90.92	250	0.074	675	1.042
STM-10540	75.86	250	0.063	450	0.302
STM-10541	106.23	250	0.132	300	0.214
STM-10542	93.99	250	0.262	375	0.772
STM-10543	48.48	250	0.199	300	0.324
STM-10544	92.82	300	0.433	375	0.785
STM-10545	92.21	300	0.294	450	0.867
STM-10546	46.19	250	0.092	300	0.150
STM-10547	18.54	250	0.162	600	1.674
STM-10548	25.06	200	0.082	600	1.542
STM-10552	141.13	300	0.135	450	0.399
STM-10553	123.98	350	0.391	525	1.154
STM-10554	14.14	300	0.820	300	0.820
STM-10555	119.36	250	0.154	300	0.250
STM-10580	22.86	200	0.034	300	0.101

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10581	78.40	300	0.050	1050	1.410
STM-10582	9.00	200	0.152	450	1.317
STM-10584	40.28	200	0.063	450	0.549
STM-10585	81.92	200	0.080	375	0.430
STM-10586	65.86	200	0.072	375	0.387
STM-10587	96.52	250	0.064	675	0.904
STM-10588	97.06	200	0.081	450	0.703
STM-10589	74.99	250	0.141	450	0.675
STM-10590	23.48	300	0.153	675	1.329
STM-10591	23.25	300	0.226	450	0.667
STM-10592	42.61	200	0.115	300	0.340
STM-10593	46.30	200	0.138	300	0.406
STM-10594	83.43	200	0.127	300	0.374
STM-10595	48.66	200	0.054	300	0.158
STM-10596	58.49	200	0.056	450	0.485
STM-10597	58.75	200	0.023	450	0.196
STM-10598	15.98	200	0.017	300	0.050
STM-10599	8.24	200	0.080	300	0.236
STM-10600	34.64	200	0.061	300	0.180
STM-10601	42.30	200	0.047	375	0.251
STM-10602	57.30	200	0.054	450	0.473
STM-10603	18.39	250	0.079	525	0.568
STM-10604	139.38	200	0.167	300	0.491
STM-10605	5.62	200	0.116	300	0.342
STM-10631	102.96	300	0.169	600	1.075
STM-10632	153.07	300	0.130	675	1.127
STM-10633	10.40	300	0.133	750	1.526
STM-10634	53.82	300	0.213	750	2.453
STM-10635	37.92	200	0.049	300	0.144
STM-10636	36.93	300	0.126	375	0.229
STM-10637	61.42	300	0.100	300	0.100
STM-10638	68.61	300	0.195	525	0.868
STM-10639	39.69	300	0.222	300	0.222
STM-10649	38.00	300	0.194	750	2.239
STM-10650_1	77.39	300	0.092	525	0.408
STM-10650_2	45.07	300	0.170	525	0.757
STM-10651	12.16	250	0.123	600	1.266
STM-10652	96.45	300	0.193	300	0.193
STM-10653	190.83	200	0.078	300	0.230
STM-10654	29.45	200	0.093	450	0.810
STM-10655	95.17	250	0.007	600	0.076
STM-10656_1	89.91	300	0.137	1350	7.585

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10656_2	23.77	300	0.130	1500	9.539
STM-10657	53.89	300	0.085	1500	6.235
STM-10659	37.79	300	0.146	750	1.685
STM-10660	5.30	300	0.524	1050	14.795
STM-10672	126.83	250	0.146	300	0.238
STM-10673	53.45	250	0.096	300	0.156
STM-10674	220.53	300	0.140	300	0.140
STM-10675	37.18	250	0.080	450	0.384
STM-10676	72.98	250	0.138	375	0.406
STM-10677	45.10	250	0.136	300	0.222
STM-10678	71.20	200	0.090	300	0.264
STM-10679	17.81	150	0.019	300	0.121
STM-10688	53.53	300	0.241	750	2.770
STM-10689	63.02	300	0.204	750	2.344
STM-10691	20.00	250	0.132	525	0.951
STM-10692	162.24	250	0.100	600	1.029
STM-10693	22.72	375	1.538	750	9.766
STM-10694	65.55	300	0.181	300	0.181
STM-10695	11.50	300	0.259	750	2.982
STM-10696	33.09	300	0.306	750	3.526
STM-10697	89.06	200	0.032	450	0.281
STM-10698	121.76	200	0.045	300	0.132
STM-10699	25.99	150	0.016	300	0.100
STM-10700	149.78	300	0.220	750	2.531
STM-10701	13.52	250	0.130	525	0.938
STM-10702	146.78	300	0.258	1050	7.275
STM-10703_1	115.76	300	0.101	1050	2.846
STM-10703_2	28.31	300	0.057	1050	1.604
STM-10721	125.16	1200	4.474	1350	6.125
STM-10722	86.15	1200	3.506	1650	8.196
STM-10723	88.65	1200	3.858	1650	9.018
STM-10725	47.34	1200	4.390	1350	6.010
STM-10731	47.30	1500	21.617	300	0.296
STM-10732	134.64	300	0.108	1050	3.046
STM-10737	42.80	200	0.146	300	0.430
STM-10745	45.34	1200	6.383	1050	4.470
STM-10748	89.51	250	0.120	450	0.574
STM-10749	62.12	200	0.103	300	0.302
STM-10753	94.15	250	0.087	675	1.224
STM-10754	25.10	250	0.140	450	0.673
STM-10755	143.21	250	0.155	450	0.745
STM-10756	143.09	200	0.067	450	0.579

		Existing		Future	
Pipe ID	Length	Pipe Diameter	Pipe Full Capacity	Pipe Diameter	Pipe Full Capacity
	(m)	(mm)	(m^3/s)	(mm)	(m^3/s)
STM-10759	49.99	250	0.177	450	0.850
STM-10760	31.50	200	0.031	300	0.091
STM-10766	24.71	300	0.073	300	0.073
STM-10767	58.92	300	0.082	300	0.082
STM-10768	13.73	300	0.169	300	0.169
STM-10770	93.15	450	0.897	300	0.304
STM-10771	11.90	200	0.079	300	0.234
STM-10772	12.59	200	0.077	300	0.228
STM-10772A	24.07	250	0.064	300	0.104
STM-10773A	10.52	250	0.097	300	0.158
STM-10774A	14.69	250	0.082	300	0.133
STM-10775A	14.27	250	0.042	300	0.068
STM-10776A	32.11	250	0.062	300	0.101
STM-10777A	2.93	250	0.130	300	0.211
STM-10783A	80.19	450	1.227	375	0.755
STM-10784A	34.60	450	0.994	300	0.337
STM-10785A	50.04	200	0.130	300	0.384
STM-10786A	105.35	200	0.104	300	0.307
STM-10787	12.03	300	0.233	450	0.687
STM-10787A	43.55	200	0.100	300	0.295
STM-10788A	41.78	200	0.112	300	0.331
STM-10800	64.00	200	0.125	300	0.368
STM-10801	25.13	200	0.110	300	0.323
STM-10802	64.18	200	0.115	300	0.338
STM-10803	26.13	200	0.130	300	0.382
STM-10804	35.96	200	0.034	525	0.449
STM-10816	104.49	200	0.032	300	0.094
STM-10828	30.04	200	0.047	375	0.251
STM-10829	16.62	200	0.080	300	0.235
STM-10830	47.68	200	0.031	375	0.164
STM-10831	36.17	200	0.088	450	0.762
STM-10832	61.82	200	0.035	300	0.103
STM-10834	7.92	200	0.097	300	0.287